

THE EFFECT OF READING PERFORMANCE ON HIGH SCHOOL  
SCIENCE ACHIEVEMENT

by

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## ABSTRACT

This study was undertaken to investigate the relationship between student reading performance and achievement in science. Many students have difficulties comprehending written materials presented to them in science and many tests used to measure achievement in science rely heavily on reading ability. Students may have trouble demonstrating their science knowledge due to their lack of reading skills.

In this study, the reading ages and science achievement scores of students were calculated. Twenty activity cards used to teach the science topic Plants and Animals were modified to reduce the language difficulty level. All students in two Year 8 science classes used the modified activity cards and modified science achievement measures. Five students were selected to form a sub-sample of the class group for in-depth observations, interviews, and analysis. These students were low performance readers who achieved poorly on science topic tests even though they had excellent work habits. The student reading ages in the class groups ranged from 8 years 1 month to above 16 years 10 months.

The reading performance data were found to correlate significantly with science achievement as measured on topic tests. Class 1 produced a correlation coefficient of 0.46, while

Class 2 produced a correlation coefficient of 0.75. In this study it appears that science achievement is related to reading performance.

Qualitative analysis of data from the five students in the sub-sample showed that the modified activity cards were relatively easy to use. Students could work on the cards independently. This study demonstrated that textual material needs to be presented at an appropriate reading level for independent learning to occur.

All of the students in the sub-sample demonstrated improved science achievement on the modified Plants and Animals topic test. In addition, most other students in the study improved their performance on the modified science test. Thus, the modifications appeared to make it easier for most students to demonstrate their science achievement.

A positive correlation was found between student reading age and science achievement. Reading performance may be a critical factor in achievement on science tests. If this is the case, learning strategies must be developed that focus on helping students to utilize textual materials effectively.

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## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	viii
CHAPTER 1 INTRODUCTION	1
Background to the Study	5
Overview of the Study	8
Significance of the Study	9
Research Questions	10
Overview of the Remainder of the Thesis	11
CHAPTER 2 LITERATURE REVIEW	12
Introduction	12
Overview of This Chapter	14
Ethnographic Research	15
Measuring Student Reading Ages	17
What Factors Affect Reading Difficulties?	19
Cognitive Processes Involved in Constructing Meaning	23
How Do You Modify Text to Reduce Reading Difficulty?	27
A Review of Research Involving Reading Performance and Science Achievement	28
Summary	33

CHAPTER 3	METHODOLOGY	35
	Overview	35
	Whole Class Study	35
	Case Study on the Use of Modified Materials	47
	Summary	53
CHAPTER 4	RESULTS AND DISCUSSION	55
	Introduction	55
	Whole Class Study	55
	Case Study on the Use of Modified Materials	60
	Summary	77
CHAPTER 5	SUMMARY, CONCLUSION AND IMPLICATIONS	79
	Introduction	79
	Summary	79
	Results of the Study	81
	Limitations of the Study	83
	Implications of the Study	86
	Recommendations for Future Research	89
	Conclusions	91
	LIST OF REFERENCES	93
APPENDIX A	ORIGINAL TEXTUAL MATERIALS	96
APPENDIX B	MODIFIED TEXTUAL MATERIALS	130
APPENDIX C	LANGUAGE RATING SCALE	164
APPENDIX D	SCIENCE RATING SCALE	167
APPENDIX E	INTERVIEW MATERIALS	170
APPENDIX F	PLANTS AND ANIMALS PRETEST	172

APPENDIX G	A COMPARISON OF STUDENTS' CLASS, READING	174
	AGES, CHRONOLOGICAL AGES, SCIENCE	
	ACHIEVEMENT, AND GENDER	

## LIST OF TABLES

Table		Page
1	Science Rating Scale Results	41
2	Language Rating Scale Results	42
3	Reliability Coefficients for all Science Achievement Measures	46
4	Internal Consistency Reliability Coefficients for the Test Data	49
5	A Comparison of Reading Ages, Chronological Ages, and Science Achievement by Class and Gender	56
6	Correlational Data on Reading Age and Science Achievement	57
7	Data on the Selected Students	61
8	Student Survey Showing Number of Circled Words	71
9	Student's Graded Responses of Passage Explanations	72
10	Student's Science Test Results	75
11	Student's Test Results	76



## LIST OF FIGURES

Figure		Page
1	List of logical connectives	21
2	Burr diagrams	24
3	Original and modified text samples	38
4	Original and modified text samples	39
5	Original text sample	39
6	Modified text sample	40

## CHAPTER 1

### INTRODUCTION

The learning process involves the interaction of many factors. In Science, students are expected to read information, carry out experiments, record results, and demonstrate knowledge on achievement measures. A critical component of the learning process underlying these factors requires utilization of reading skills. Student reading performance therefore may affect the ability to learn, perform activities, or demonstrate science achievement.

The relationship between reading performance, the learning process, and science achievement needs to be understood by science teachers, science educators, and researchers. Reading is an important variable for educational attainment. For example, in science education students are required to engage in many tasks which require reading. Students need to read and comprehend information during the learning process to be able to complete activity cards, experiments, and tests. Two critical areas of instruction involve the effect of reading performance on the completion of learning activities, and the effect of reading performance on achievement measures.

Reading a variety of print materials is one of the main methods of instruction in schools. Many subject areas use printed materials as a standard resource and so students must be able to read and comprehend the information provided. Student activity cards or workbooks should emphasize science knowledge, skills or

values without depending heavily on students' reading and comprehension abilities. There appears to be little advantage in designing innovative instructional techniques based on self-paced activity cards if students have trouble reading and understanding the cards. If students have difficulties in reading resource materials such as activity cards and textbooks then the learning process will be hampered by an inability to fully comprehend the written materials. An important component of this research is to examine the effects of modifying science materials.

This study aims to examine the development and implementation of alternative reading materials to accommodate students with a low reading performance. These modified materials will be analyzed to determine their effectiveness for low ability readers. The results of research in readability of instructional materials may have broad implications for teachers in all subjects since reading plays an important part in each specific subject.

The second area of concern examined in this study involves the effect of reading performance on science achievement measures. Whenever students are given pencil and paper achievement tests they must first be able to read and understand the question before they consider an appropriate answer. Students may understand the scientific material being tested but be unable to exhibit their knowledge because of their inability to read and comprehend the test items (Finkelstein & Hammill, 1969). Sometimes students with low reading performance score very poorly

on topic tests even though their school work and class participation indicate they have acquired appropriate science knowledge. In these situations, students are being denied the chance to demonstrate acquisition of the science knowledge. Thus, the effect of reading performance on science assessment activities is critical.

This study aims to investigate the link between reading performance and results on science achievement measures. Test items will be modified to simplify the language difficulty level, while student performance on the modified items will be measured. The results of this research will have implications for science teachers and teacher educators.

Many studies have been conducted on the readability of text. Yore and Shymansky (1985) summarised the main findings: textbooks tend to be written at a reading level above the intended reader's ability; science texts show variation in the presentation of material, the use of vocabulary, and the structure of the language within a set book or chapter; everyday vocabulary has been found to have as much influence as scientific terminology on the readability of science materials. All of these points have been found to influence the readability of textual materials. Since most science texts have no systematic chapter structure or vocabulary the students have no pattern to follow in order to work out the meaning of unknown terms. Many textbooks are written with a readability level above that of the intended reader. The reader is then liable to become frustrated trying to comprehend

this material.

Many measures have been developed to analyze the readability of materials. Early research on the readability of textual materials concentrated on variables that were easily identified and measurable. Variables such as sentence length, vocabulary, number of syllables in a word, and number of words not found on a standard word list were used to produce an indication of the readability of a passage or text. A number of readability formulae have been produced and used to assess the reading difficulty of textual material. However, doubts have been expressed over the validity of the readability formulae. The formulae were not consistent and often were measuring different factors. Each formula appears to measure different attributes and consequently agreement across instruments is not usually obtained.

During the 1970's attention focussed on the ways that meaning is constructed. Research conducted on how the reader interacts with new material found the existing cognitive structure of the reader played an important part in the comprehension of new information (Ausubel, Novak and Hanesian, 1978).

Many practical studies have been conducted to modify textual materials and thereby make it easier for students to comprehend the information. Some studies have been based on the use of readability formulae to modify text and others on the theories of meaning construction. Johnstone and Cassels (1978, 1984) modified

science test items and found that minor modifications in the language used in test questions could produce a significant increase in the number of students who answered a question correctly. Macinnis (1979) produced a set of rules which could be used as a basis for the modification of textual material and found that applying these rules did in fact produce a modified language difficulty level. Gardner (1980) studied phrases which could cause comprehension problems for students. A group of logical connectives were found to cause problems in the comprehension of science materials.

In this study three research strategies were chosen on the basis of previous research methodologies and findings. Textual material was modified, the modified material was presented to the students in science lessons, and then the students were observed as they interacted with this material. The aim of this study was to determine the effect of students' reading performances on science achievement.

#### BACKGROUND TO THE STUDY

At the metropolitan government senior high school used to undertake this study, science is taught using an activity based approach. During most lessons students are required to manipulate equipment, make observations, and record data. Over the last few years the activities included in each of the science topics in the Year 8 course have been typed onto activity cards. This was done to minimise the amount of copying from texts, or from the

blackboard, students engaged in before they could start an experiment. The use of activity cards has become the major method of instruction for the 4 - 5 week science topics in the Year 8 course.

Approximately 18 cards have been developed for each topic. Teachers utilize activity based learning cards in a variety of ways. Some teachers control the pace of the topic by using one activity card each lesson. Other teachers provide the students with the cards according to the student's individual rate of work. Some teachers allow the class to work on a group of four or five cards.

Whichever instructional strategy is used, students are expected to read information on the card, conduct any suggested activity, record results, and answer questions on the basis of these results. They are expected to be actively involved in learning science. A heavy reliance is placed on each student's ability to read and comprehend the activity cards. However, some of the activity cards have been written at a language difficulty level above that of the intended students. As approximately 40% of students at this school are low performance readers there is a need for texts, references, and testing instruments to be written at a language level that the students can read and understand.

The problem with language difficulty level of science materials became apparent when many students were observed simply copying other students' work. They were not sure of what activity

had to be done apart from the fact they knew the questions had to be answered. Other students were asking many questions of the teachers. The questions related to understanding the content of the cards, the directions, the activity to be completed, and were not necessarily to do with the science concepts. Once the activity cards were explained in simpler language the students understood the work required and were able to complete the set tasks.

During 1985 the writer conducted a preliminary study on the effects of student reading performance on science achievement. It was found that many activity cards were written at a language difficulty level above the intended reader. The activity cards appeared to be a very useful teaching strategy. In general, the students enjoyed working from them. Motivation to complete the cards was high and the self-paced aspect of the cards provided a successful instructional strategy for large classes. The activity cards allowed the teacher to move around the room assisting students who needed extra help as well as questioning students as they engaged in the learning process. The concept of activity based learning through the use of activity cards was successful; however, modifications were needed to enable the cards to be used independently by all students.

There are two terms which need to be defined for this study. Science achievement refers to the student's results on written tests of science concepts. In the school situation, science achievement is usually measured in this manner. In this study



science achievement refers to major topic tests taken every 4-5 weeks and does not refer to daily achievement of classroom activities or small section tests.

The second term that needs defining is reading performance. This is the student's demonstrated reading level. Reading age is used as a measure of the variable reading performance in this study.

#### OVERVIEW OF THE STUDY

This study involves measuring student reading performance, analyzing the language difficulty of materials used in two science classes, and modifying these materials in order to make them easier to comprehend. By so doing it will be possible to gain insights into the range of reading performance in science classes and examine how successfully student learning is facilitated by the use of modified activity cards. By modifying the activity cards to simplify their language difficulty level the students should have a better chance of being able to read and comprehend the information given. Although the student needs help in constructing meaning, one of the simplest aids that a teacher can provide is to modify the reading materials. Thus, although the science content remains unchanged, the vocabulary and syntax are modified. The student is not being given easier science concepts but the work given is at a more appropriate reading level. By discussing the activity cards with selected students, observing activity work, and monitoring written work it

should be possible to gain further insight into student's comprehension of textual information on the activity cards. Students will be interviewed to ascertain the major difficulties in understanding. Finally, a comparison will be made between the student's science achievement as measured on a standard topic test and on a topic test modified to place less reliance on reading performance. These test results will be analyzed with reference to student reading performance.

#### SIGNIFICANCE OF THE STUDY

Students who have reading deficiencies are often penalized in content areas (Finkelstein & Hammill, 1969). For example, students may have acquired the objectives of the science course but be unable to adequately demonstrate their mastery of the material. If the language difficulty of the topic test is high, then those students with a poor reading performance may be disadvantaged.

Many texts, references, and tests used to promote or assess achievement in school subjects place a high premium on reading performance. Failure to answer a question correctly on a test may be a result of a comprehension problem rather than a lack of scientific knowledge. The inability of a test to distinguish between failure due to lack of critical scientific knowledge and failure due to lack of reading skills greatly restricts the use of pencil and paper tests to assess educational gain (Royer & Cunningham, 1981).

Similarly, when students have had reading difficulties associated with comprehending textual material or activity cards it is difficult to determine the extent of their scientific achievement. All students must have a reasonable chance of success in all content areas. Students with differing reading comprehension levels must be accommodated in science classes. These science classes may or may not be grouped in ability and often contain upward of 30 students.

#### RESEARCH QUESTIONS

The following research questions indicate the scope of the study. Each question required the collection and subsequent analysis of data.

1. Is student achievement on a science topic test related to the reading performance of the student?
2. Do linguistically modified science materials enable students with low reading performance to more easily comprehend the science materials?
3. Do linguistically modified tests enable students with low reading performance to more successfully demonstrate their science achievement?

Each of these questions is discussed in more detail in Chapter 3 and the results and discussion are presented in Chapter 4.

#### OVERVIEW OF THE REMAINDER OF THE THESIS

The remainder of the thesis includes four chapters. Chapter 2 contains a review of literature to provide a rationale for the research hypotheses. Chapter 3 describes the methodology used in this study. Tests are described, modifications to activity cards are explained and justified, and the data analysis techniques are outlined. Chapter 4 presents the results of the study and accompanying discussion. The chapter provides answers to each of the research questions posed in Chapter 1. Chapter 5 provides a summary of the study and presents implications for teaching and research, describes limitations of the research, and offers recommendations for teaching, teacher education, and further research.

## CHAPTER 2

### LITERATURE REVIEW

#### INTRODUCTION

##### Purpose

The literature review provides information relating to the purpose of this study. The study examined the effect of reading performance on high school science achievement.

##### Method

The literature used in this review was identified as a result of manual searches of journals, use of the citation indices, and also a computer search utilising the ERIC system. The key words used in the computer search were reading difficulty, reading ability, secondary school science, and achievement.

##### Overview

Readability is the term used to describe the ease with which textual material can be read and understood. The application of readability measures is primarily concerned with a basic problem familiar to most people who choose books for others to use. This is a problem of matching. On the one hand there is a range of books and other reading materials, differing widely in content, style, and complexity. On the other hand there are student

variables such as interest and reading ability. The extent to which reading materials can be comprehended is determined by the relationship of these two factors.

In order to choose textual material for others to read it is important to consider four factors. Firstly, the reading ability of the intended reader. They must be able to read and comprehend the material. Secondly, the fluency of the readers must be considered. They must be able to easily recognize letters and words in order to understand them. Thirdly, the interest of the reader must be taken into account. A person interested in gardening will be more likely to read a book on plants than a person who is not interested in gardening. Finally, the content knowledge that the reader brings to the task is important. Background concepts are required before further concepts can be understood. These four aspects of the reading process must be taken into account when choosing textual materials.

People with limited reading ability soon become discouraged if they are given texts which are beyond their comprehension. For this reason, it is useful if teachers have an understanding of readability, since this provides a systematic basis on which to judge the appropriateness of materials for students of various abilities. This allows the teacher to select and organize material suitable for particular students.

Tests of science achievement used in schools are generally composed mainly of multiple choice items. If a student is to

perform well on these tests, then adequate reading skills are essential. A student could have knowledge of the material being tested but be unable to read the test items. Teachers have long recognised that the schoolwork and class participation of some poor readers indicate a greater knowledge of science than would be expected from their test scores. Students are often able to demonstrate considerably greater knowledge of science when the test questions are read aloud. Sometimes students think that by being able to read a passage it follows automatically that they can comprehend its meaning. This can become a problem in science. Students can often use scientific terms in appropriate ways but cannot explain their meaning. If this occurs, teachers must then spend time assisting students to understand the concept underlying the specific scientific terminology.

#### OVERVIEW OF THIS CHAPTER

The review of the literature that follows is divided into six sections. The first section deals with the use of ethnographic research. A discussion of the methodologies used and the advantages and disadvantages of this type of research are given.

The second section deals with the measurement of students' reading ages. The tests currently available to measure reading ages and their advantages and disadvantages are discussed, and the reasons for choosing the GAPADOL instrument are also provided.

The third section describes the factors that have been found to alter the reading difficulty level of materials. A discussion of how these factors can be modified to alter reading difficulty levels is included.

The fourth section details the current knowledge on how students construct meaning from textual materials. The cognitive processes involved in comprehending textual material are outlined. This is useful background information since students must actually process the material that they are reading in order to extract meaning from the words and sentences of achievement measures and work cards.

The fifth section sets out suggestions for modifying textual material in order to lower the reading difficulty level. Examples of how this may be achieved are included.

The final section of the literature review discusses the results of previous research findings that examined reading ability and achievement on written tests. The effect of student reading ability on test performance is compared across many studies.

#### ETHNOGRAPHIC RESEARCH

My study follows on from a preliminary study undertaken in 1985 (Ireland, 1985). This study focussed on modifications to textual material, how the students used these materials, and the



effects of reading performance on science achievement.

As well as utilising appropriate statistical procedures, this study involved ethnographic research. This allowed text-related learning and teaching to be the main focus of my study. Walker (1981) recommended ethnographic research as a valuable approach to use in analysing textual materials.

Ethnographic research involves detailed observation in a setting. Qualitative data are collected and analyzed for trends. In education, ethnographers work in the classroom and observe interactions between the classroom participants and the setting. Field notes are written to record these observations and other documentary evidence such as book work and test results are collected. These data are analysed for trends and detailed descriptions, direct quotes from interviews, and narrative vignettes are used to report the results.

Erickson (1986) described the role of the ethnographer and the teacher in classroom research. He suggested that it would not be long before the classroom teacher was the ethnographer. In my study this was the case. There were many advantages in conducting observational research in my own classroom. Ethnographic research requires little initial training other than skills of observation and reflection. Classroom teachers utilise both these skills in their everyday life.

## MEASURING STUDENT READING AGES

Reading age is a term used to describe the chronological age of a reader who could read and comprehend a specific piece of textual material. A student has a reading age of 12 years if he or she can understand a piece of material that the average 12 year old can read. A similar term is applied to the text itself; a text with a reading difficulty of 14 years is one that could be understood by a 14-year old student having average reading ability.

Methods used to assess reading age must satisfy four criteria: accuracy; ease of application; ease of marking; and ease of calculation. Very often the accuracy of a measure decreases with its ease of application. Teachers usually require a procedure that does not take a substantial amount of time to apply, mark, and calculate results. For this reason, the most commonly used type of reading age assessment procedure is sentence completion (Gilliland, 1972). Sentences are taken from a passage and certain words are omitted. The degree of comprehension is the extent to which a person who has read the passage can replace the omissions correctly. The words to be replaced have usually been chosen to reflect only the content of the passage and not the linguistic complexity. The name of this type of assessment procedure is cloze and it comes from the Gestalt Psychology term closure. Closure is used to describe the tendency for a person to mentally complete or make whole an incomplete pattern. Humans are able to fill in gaps in spoken or

written sentences and tend to do so. Taylor (In Gilliland, 1972) defined a cloze unit as :

"... any single occurrence of a successful attempt to reproduce accurately a part deleted from a 'message' by deciding from the context that remains what the missing part should be."  
(p.102)

The cloze procedure deals with specific word meanings and also the ability of the readers to respond to their own language patterns. Responses on a cloze test reflect the total language capabilities of the reader.

The principle of the cloze procedure was used to develop a standard reading comprehension test by McLeod (1965). He devised a simple test, titled the GAP test, made up of two passages in which approximately every tenth word was deleted. The two passages comprise alternative forms of the test. If greater precision is required the two forms of the test may be combined to form an aggregate score. The GAP test is easy to administer and quick to score. Tables for converting scores into reading ages are provided for each form of the test.

This form of comprehension test enables the teacher to measure the student's response to the different elements of language. The GAP test reading ages may be a better index of a student's ability to apply their reading skills than traditional word recognition or some comprehension tests since they rely on the student being able to comprehend the materials instead of only recognising patterns (McLeod, 1965).

The GAPADOL test (McLeod & Anderson, 1972) was based on the GAP test and was designed to identify the reading ages of adolescent children. It used the same strategies as the GAP test and was designed specifically to discriminate reading ages at many age levels. The GAP test had an effective ceiling at a reading age of 10 and discriminated reading retardation accurately only in children 12 or younger. However, the GAPADOL test was designed to discriminate at high abilities and age levels as well as low.

There are many other tests of reading and comprehension available. However, in terms of ease of application and scoring in educational research, the GAPADOL tests were judged to provide the most reliable estimates of reading ability within the constraints of the classroom. Therefore in this study I have chosen to use the GAPADOL test as a measure of student reading ability.

#### WHAT FACTORS AFFECT READING DIFFICULTIES?

Many factors affect the readability of textual materials and the reading difficulties shown by students. Macinnis (1979) outlined some important areas that affect the reading level and the students' comprehension and understanding of textual material. The following factors tend to make textual material more difficult to read and understand.

- . Long words
- . Unfamiliar words
- . Long sentences
- . Prepositional phrases
- . Impersonal words and sentences
- . Passive voice

The factors mentioned above are applicable to reading performance in general, however, when two or more factors are present some overlapping occurs. For example, despite its length the word 'temperature' because of the reader's previous knowledge, will be more readable than 'par' for the average reader. However, in terms of word length and pronunciability, 'par' would appear to be easier. Similarly, at the sentence level, a short sentence of unusual structure may be more difficult to read than a longer, more familiar structure. Whenever two or more factors occur together a compromise solution must be reached.

Johnstone and Cassels (1978) confirmed the six factors above and found that questions using a negative statement were more difficult to comprehend than those using a positive form. It was also found that test items or written passages were more difficult to read and comprehend if the use of connectives in the sentences was not appropriate to the reading level of the student (Gardner, 1978). Logical connectives are used to connect together propositions. In Gardner's study, the following list of connectives presented severe difficulties to students.

as shown by	indeed
as to	it follows that
by way of	moreover
clearly	namely
consequently	on the basis of
conversely	only if
e.g.	respectively
essentially	say
for instance	similarly
further	simultaneously
hence	so also
here	so to speak
in addition	the fact that
in contrast	vis.
in general	where
in practice	whereas
in that	whereby
including	

Figure 1. List of logical connectives (Gardner, 1978)

The logical connectives listed in Figure 1 often confuse students. Textual material that is written containing many logical connectives may be too difficult for many students to read and understand. However it has been shown in other studies that texts written without connectives tend to be confusing. The readability of a text will be appreciably affected by the complexity of the relationships that these connectives develop.

Another factor influencing reading comprehension is the frequency with which words occur in print. When opportunities for encountering frequent words are increased, there is a better chance of them being recognized. However, many of the most frequently used words are function words and they are difficult to comprehend. By altering function words, frequencies are manipulated to facilitate learning to read. Ruddell (1965) found that students' comprehension scores were significantly greater when the textual material used contained oral language patterns. He concluded that reading comprehension is a function of the similarity of language patterns used in speech and those encountered in reading material. Therefore, the relationship between oral and written language structures needs to be considered when designing workcards and tests.

Knowing the factors that affect reading difficulty in textual material it is possible to attempt modifications or restructuring of materials to enable them to meet the requirements of a particular student population. In this study an attempt was made to restructure textual material on science activity cards and in a topic test. The language difficulty level of the textual materials was altered by implementing the strategies discussed in this section.

## COGNITIVE PROCESSES INVOLVED IN CONSTRUCTING MEANING

The processes involved in constructing meaning from written material are complex. It is not enough for proficient readers to simply recognise the graphic display of a word. Proficient readers need to know how a particular word is being used within the context of the story. They need to be able to reduce uncertainty about unfamiliar words they read. Word recognition does not necessarily imply understanding but the recognition or production of written descriptions is at least a pre-requisite for understanding.

Meaning is constructed by the reader from his/her knowledge store and the sensory input just received. Reading involves the interaction of the information the reader receives through the visual system and the information that the reader already has available in the long-term memory. This enables the reader to recognise and organise the incoming information and to make sense of it. Bell (1983) outlines key elements in the process by which learners construct meaning.

- "1. The existing knowledge of the learner is viewed as the beginning point for the construction of meaning from any experience, not the experience itself. Existing knowledge influences what will be selected and attended to in the environment.
2. The sensory input selected and attended to by the learner, of itself, has no meaning.
3. In the construction of meaning from sensory input, links are generated by the learner between the stimuli attended to and what is perceived as relevant existing knowledge.



4. The initial or tentative construction is evaluated against the existing knowledge and against the sensory input.
5. The learner is active in constructing a meaning in terms of attending to selected stimuli, generating links to existing knowledge and evaluating the construction."

(p.83)

From the processes above, unfamiliar words for which the learner makes no connections to existing knowledge are, by definition, meaningless. Sutton (1980) has developed the idea of burr diagrams (Figure 2) to illustrate how new words and concepts may be assimilated with previously known information.

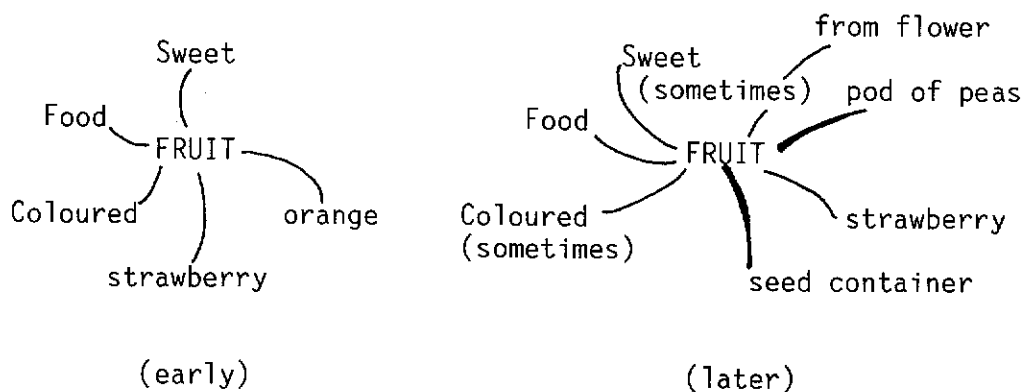


Figure 2. Burr diagrams (Sutton, 1980)

These burr diagrams become more complex as our knowledge and understanding of the concept increases. The capacity to retrieve and use a concept depends on the richness of other connections in the stored version of the concept. The larger the number of connections, the easier it will be to retrieve that information. As the brain can only process a limited amount of visual information at any given time, proficient readers organise a

store of information in their memories. The meaning of a sentence is derived from the original string of words by an active interpretive process. When readers are confronted with an unknown word they can find a group of words with similar patterns and so guess at the meaning. In generating meaning, readers are constructing a representation or explanation of what is decoded, and organising this incoming information so that it makes sense.

According to Lipscombe (1981) the store of information is known as our long-term memory. The short-term memory of the learner has definite limits. Only a few pieces of information can be processed at one time. Many concepts in traditional science and mathematics lessons can easily exceed these limits, short-term memory is overloaded, and understanding collapses. The processing and retrieval of information is enhanced if the learners can transform the science concept into their own language so that it can relate to other knowledge already in their cognitive structure.

Investigations into concept learning (Pines and West, 1986) have shown that knowledge that is reformulated by the learners is more easily recalled; linked to other knowledge; is more accessible; and more easily applied in novel situations. According to Sutton (1980) it is the connectedness of one's knowledge that makes it meaningful and accessible.

In the Overview for Lower Secondary Science (Education Department of Western Australia, 1981) greater attention has been

devoted to students using their previous experience, clarifying ideas, reviewing and demonstrating understanding. Emphasis has been placed on the student as an active learner. The acquisition of knowledge may take place in one of three ways. Knowledge can be memorised by rote, replace an existing concept or be reconciled with existing concepts. A greater level of understanding occurs in the last stage of concept learning. Our current science courses need to promote learning that involves active participation by the student in acquiring concepts.

The idea that meaning varies from person to person, and grows and changes with time, is unfamiliar in the world of science instruction. The meaning of terms is thought to be fixed and determined, so does not play a part in teaching methods. If meaning was seen as something which has to grow, students would be encouraged to locate more and more connections by saying "This is an example of so-and-so", or "it makes me think of such-and-such", and these procedures would be a standard part of science lessons (Sutton, 1980). Small group discussion, writing which requires comparisons and contrasts, and re-expression in one's own words would be a top priority among science lesson activities. These approaches should be taken in order to encourage students to construct linkages with their previous concept knowledge.

## HOW DO YOU MODIFY TEXT TO REDUCE READING DIFFICULTY?

According to Cassels and Johnstone (1984), presenting information in a clear, organised fashion or in simple sentences rather than larger, complex sentences with embedded clauses can bring about improvement in performance. Information in a clear, organized fashion reflects the language change influencing thinking necessary to answer questions. Teacher modification of complex expressions can bring about an improvement in reading performance on textual materials.

To modify textual material in order to simplify the reading level required and comprehend the information given, the following points must be considered. These points have been proposed earlier in the literature review by Macinnis (1979), Johnstone & Cassels (1978), and Gardner (1978).

- . Shorter words are better than long words.
- . Familiar words are better than unfamiliar words.
- . Short sentences are better than long sentences.
- . Prepositional phrases should be avoided.
- . Personal words and sentences are preferred over the impersonal.
- . The active voice is preferred to the passive one.
- . Negative item forms should be avoided.
- . Connective words such as therefore, hence, and consequently should be avoided.

Writing should not be any more difficult to read and understand than is necessary. Some writing is hard to understand because the ideas are abstract and complicated. The following sentence is an example of a difficult concept that occurs during a science topic. "All fungi have many fine thread-like filaments called hyphae which grow out to collect the food." It may be impossible to simplify this type of writing (Shymansky and Yore, 1986). On the other hand, a good deal of writing is difficult to read because the words used are unnecessarily abstract, and the sentence and paragraph structure are needlessly complex. Many students experience some difficulty with language that connects premise and conclusion or observation and inference. By modifying textual information it is possible to reduce the reading difficulty levels. Once this has been done the student has a better chance of being able to read and comprehend the information provided. In this study the textual material for a science topic was modified to reflect a lower language difficulty level.

#### A REVIEW OF RESEARCH INVOLVING READING PERFORMANCE AND SCIENCE ACHIEVEMENT

Most students have language difficulties at some stage of their lives and teachers must be aware of the relationship of language difficulty levels of materials and student reading ability. If a textbook or test paper is written with a high language difficulty level, students' comprehension may suffer and they may confuse concepts. The language of science is very

precise, and teachers must avoid taxing student understanding to a level beyond their linguistic capabilities. If science concepts and their interrelationships are to be understood, then students need to learn the appropriate vocabulary and syntax. Teachers need to ensure that textual materials are at an appropriate level.

Gardner (1980) outlined two instructional procedures to be followed if a word is difficult due to its unfamiliarity. Teachers can either avoid using the term, replacing it by a more frequently used and easily understood synonym or they can deliberately teach the term.

In an attempt to reduce the influence of general reading ability upon performance on a science content test, Finklestein & Hammill (1969) developed the Pictorial-Aural Inventory of Science Knowledge. The inventory consists of a series of multiple-choice items using pictures instead of words for both item stems and distractors. Students are required to listen to the question presented on tape, and choose an appropriate answer from items shown on the picture screen. In this type of presentation reading is eliminated. The study found that all students improved their test score using this pictorial format, and the poor readers demonstrated greatest improvement. This suggests achievement on written test items depends on reading performance as well as knowledge of science and the interaction between these factors.

Another line of research has concentrated on modifying test item vocabulary, order of distractors and negative items (Johnstone & Cassels, 1978). The positive results obtained on test items can also be applied to the modification of larger passages of textual material. Johnstone and Cassels (1978) rewrote some test items in one of four ways to determine if this made a difference to the student's score. In some items they altered only one word; in others they reduced the length to diminish 'linguistic noise'; some were changed from negative to positive forms and others were simplified by the removal of subordinate clauses. Improved test scores were found in most of the altered items indicating the changes allowed the students to comprehend what was being asked.

Lynch (1978, 1980) investigated the use of process and concept words in science. Science concept words and relevant associations in a written passage make the meaning of the textual material highly precise and the interpretation is more exacting for the students. Concept words and associations are key factors in the communication of scientific knowledge. Students must be helped to understand the meaning of these terms in order to understand the scientific material. It is not sufficient to memorise the concept words so that a knowledge/recall type examination can be passed. Memorization does not lead to depth of understanding.

Research has demonstrated students have trouble with connective words like consequently, hence, and therefore

(Gardner, 1978). A logical connective is a term which serves to link a phrase, clause or sentence to another clause or sentence. The Logical Connectives in Science project (Gardner, 1972) set out to compile a comprehensive list of those logical connectives found with moderate to high frequency in school science textbooks, and to measure students' difficulties with these terms. Scientific writing deals with causes, effects, and inferences, so these connectives occur relatively more frequently in scientific contexts. A student's interpretation of a question or textual passage may be incorrect if the question is phrased using terms that s/he does not understand. Many of the words utilised by teachers of secondary science are not accessible to their students (Gardner, 1972). Thus, there is a need to improve student's comprehension and to explain new terms and meanings with a great deal of explanation.

Holcz (1980) demonstrated that students' reading performance and not just their intelligence had an effect on achievement in science. Gardner (1980) suggests that reading and intelligence are related. Scientists generate scientific concepts through intellectual processes such as stimulus discrimination, description, classification, correlation, and explanation in order to deal with observable aspects of the world. If students do not have the appropriate language level to deal with these operations they will be unlikely to grasp the correct scientific meanings of the concepts presented.



A third line of research examines factors that affect student science achievement. Some of the factors that have been researched include student background (Schibeci & Riley, 1986), attitudes to science (Cannon & Simpson, 1985), reading abilities (Gilliland, 1972), classroom environment (Fraser, 1986), and learner characteristics such as formal reasoning ability and locus of control (Tobin & Capie, 1982).

Previous research in science on student reading performance has attempted to describe the way students construct meaning from words. Yore and Shymansky (1985) suggest that a poor reader is unable to predict or anticipate the next section of the text. Thus, poor readers have no strategies to uncover uncertainties in what they read. These students need to be helped to discover these strategies so that they can be used in their content area reading to determine some of the unknown concepts.

Previous studies have modified textual material in order to simplify the reading level required from students. Corey (1977) found that the modifications did improve the reading rate of students and also their comprehension of the text. Wright (1982) conducted a similar study and found that although comprehension scores were improved, science achievement was not altered. My study seeks to compare the student's reading performance and science achievement on particular science topics.

This literature review has focussed on three issues: the difficulty of reading textual material; methods used to alleviate

problems due to language difficulty level in textual material; and the results of studies investigating relationships between reading performance and science achievement.

Problems of language difficulty levels exist in tests, textbooks, worksheets, and in the oral communication between teachers and students. In oral communication an immediate remedy can be applied if the teacher is sensitive to student verbal and non-verbal responses. However, in the other cases, problems can persist without anyone, including the students, being aware of them. It is therefore very important to ensure that teachers and others associated with the education process are aware of the potential problems and methods for dealing with them.

#### SUMMARY

Research has been conducted into the appropriateness of tests that purport to assess science achievement but are in fact also measures of reading ability. Caution must be used in interpreting test scores derived from traditional measures of achievement, especially when these tests are used with students suspected of underachievement in reading. A large proportion of students with reading deficiencies may be penalized whenever they are subjected to achievement tests or textual materials that require reading. The tests may underestimate their knowledge in a specific academic subject.

This literature review has covered many aspects concerned with reading and science. The chapter discussed the instruments used to determine reading ages and relevant research findings on reading and science. In each of these sections, an effort was made to relate this research to the student. There are a large number of students in our schools today who need to be helped towards a better understanding of what they see and read. This study has been conducted with these students in mind. This study focussed on the research hypothesis that there is a significant positive relationship between student reading performance and science achievement.

## CHAPTER 3

### METHODOLOGY

#### OVERVIEW

This chapter describes the research methodology used in this study. The sample characteristics are given and the design of the study is detailed. The main focus of this study was on the effect of modifications to textual material on low performance readers. In order to achieve this, data were collected from large class groups and also from a small group of selected students.

#### WHOLE CLASS STUDY

##### Sample

The sample included two Year 8 science classes containing 52 students (23 female, 29 male) from the same metropolitan government high school. The students were the writer's own science classes. This ensured that all students were subject to similar conditions and teaching strategies. The students were randomly assigned to classes at the beginning of the year. The two classes selected were representative of the Year 8 student population at a metropolitan government senior high school in Western Australia.

### Design

The design for the whole class study is represented in standard notation below.

0	0	0	X	0	0	0
1	2	3		4	5	6

Where,

- 0<sub>1</sub> is previous science topic tests,
- 0<sub>2</sub> is reading age test,
- 0<sub>3</sub> is a Plants and Animals pretest,
- 0<sub>4</sub> is the modified Plants and Animals topic test,
- 0<sub>5</sub> is the original Plants and Animals topic test,
- 0<sub>6</sub> is a Plants and Animals posttest,
- X is the modified Plants and Animals activity cards.

Class 1 followed the design above while Class 2 reversed the order of 0<sub>4</sub> and 0<sub>5</sub> to counteract the practice effects of the tests.

Firstly, the students' previous science topic test results were collected. These topic tests are pencil and paper tests given to the students at the end of each 4-5 week topic. They represent the student's achievement on that topic. All of the previous topic test results were averaged and the average score was used as an estimate of the student's overall science achievement. The students' reading ages were measured using the GAPADOL instrument. These results were used to assess student reading performance.

A pretest on the topic Plants and Animals was administered to obtain baseline data for each of the students so that changes in achievement could be measured. A posttest (an exact copy of the pretest) was administered at the conclusion of the topic, approximately five weeks after the pretest. These tests were used to ensure that there was some change in achievement on the Plants and Animals topic. At the conclusion of the topic, two additional achievement tests were administered to the student sample. One of these was the original topic test for Plants and Animals, administered to all Year 8 students at this school. The second test was a modified version of the topic test. The modifications were designed to make the test easier to read and comprehend.

Each of the steps outlined above are described in detail later in this chapter.

### Modifying Textual Material

Chapter 2 provided a summary of the main findings from the relevant literature on modifying textual material. The research indicated that reading difficulty could be reduced by: using shorter words and sentences where possible; using familiar words; avoiding the use of negative terms; and avoiding difficulty clauses and connective words. By applying these findings it was possible to reduce the language difficulty level of textual material in the activity cards and the tests.

In this study, the 20 activity cards associated with the Year 8 topic Plants and Animals were modified. The two revision sheets included in the topic and the topic test were also modified. The language and grammatical structure of the textual material were altered in order to reduce the language difficulty level. Each of the activity cards, revision sheets, and test were modified using the guidelines below, as appropriate.

- . Shorter words
- . Shorter sentences
- . Familiar words
- . No negative items
- . Avoid connective words

The figures below show examples of the original text and the modified material.

<u>Original</u>	<u>Modified</u>
PLANTS	PLANTS
1. Plants remain fixed in one place, expend little energy and move only slowly by growth.	1. Plants stay in one place, use little energy and move slowly by growth.
2. Most plants are green and make their own food using the process photosynthesis.	2. Most plants are green and make their own food by photosynthesis.
3. Plant cells are box-shaped, have a hard cell wall and contain green chlorophyll.	3. Plant cells have a box shape, a hard cell wall and green chlorophyll.

Figure 3. Original and modified text samples

<u>Original</u>	<u>Modified</u>
ANIMALS	ANIMALS
1. Animals move from place to place in search of food and to escape enemies.	1. Animals move a lot looking for food and to escape their enemies.
2. Animals obtain their food ready made from plants or other animals.	2. Animals get their food by eating plants or other animals.
3. Animal cells may be any shape, have no hard cell wall or chlorophyll.	3. Animal cells can be any shape and they don't have a hard cell wall or chlorophyll.

Figure 4. Original and modified text samples

Original

1. Label your petri dishes as I, II and III. Write your group name on each one.
2. Place a piece of dry bread into Dish I, wet it and expose it to the air for 20 minutes. Replace the cover on the petri dish. Tape the two halves of the dish together.
3. Place a piece of dry bread into Dish II. Expose it to the air for 20 minutes and replace the cover. Tape the two halves of the dish together.
4. Smear one side of the microscope slide with petroleum jelly.
5. Place the microscope slide (petroleum jelly side up) into Dish III. Expose it to the air for 20 minutes. Replace the cover on the dish.
6. Examine these petri dishes regularly over the next three days.
7. Your teacher will tell you where to leave your petri dishes.

Figure 5. Original text sample



### Modified

1. Collect three petri dishes and write your name on them. Label the dishes 1, 2 and 3.
2. In dish 1, put a piece of wet bread.  
In dish 2, put a piece of dry bread.  
In dish 3, put a microscope slide with vaseline on it.
3. Leave the three petri dishes open to the air for 20 minutes.  
After this time put the covers on the dishes and tape them up.
4. Put the dishes at the side of the room and look at them for the next three days.

Figure 6. Modified text sample

Figures 3 and 4 illustrate the way that the activity cards were altered in order to reduce the language difficulty level. This modification was achieved by concentrating on changing the vocabulary to shorter and more familiar words. The example shown in Figures 5 and 6 focusses on changing the sentence length and vocabulary of the text.

The complete set of original and modified materials are contained in Appendices A and B.

Two panels of experts, each containing different members, were established to ensure that the modifications carried out altered only the language of the cards and not the science content or processes. The first panel included three teachers involved in language instruction who considered the language used in both the modified and unmodified cards. The panel were asked to independently complete a rating scale on the cards to indicate whether the modified card had changed in vocabulary, syntax or

task difficulty level. A copy of this rating scale is contained in Appendix C. The second panel included three science educators who considered the science concepts covered in both the modified and unmodified cards. The panel were asked to independently complete a rating scale on the cards to indicate whether the modified card had changed the scientific objective, concepts, skills or terminology. A copy of this rating scale is contained in Appendix D.

Science panel. The results of the ratings given by the science panel are contained in Table 1.

TABLE 1

## Science Rating Scale Results

	Is the Modified Card the Same :-		
	Always	Sometimes	Never
Objective	100%	0%	0%
Concepts	93%	7%	0%
Skills	78%	22%	0%
Scientific Terminology	96%	4%	0%
Average	92%	8%	0%

As can be seen from this table the panel agreed that the modified activity cards covered the same scientific objectives as the original card. The concepts presented and scientific terminology used on the cards were also highly matched. The skills presented on the modified cards are the same as those on the original cards in the majority of cases. Thus, for more than 90% of the time, the modified cards cover the same scientific objectives, concepts, skills, and terminology as the original cards.

Language panel. The results of the ratings given by the language panel are contained in Table 2.

TABLE 2

## Language Rating Scale Results

	What change has occurred in the modified card?		
	Easier	No change	Harder
Vocabulary	76%	24%	0%
Syntax	67%	33%	0%
Task Difficulty Level	69%	34%	0%
Average	71%	29%	0%

As can be seen from the table above the panel assessed the vocabulary on the modified cards as generally easier. The syntax was also given as easier by the majority of the panel. As a result of these first two measures the task difficulty level of the modified activity cards was also judged as easier. Thus, the modified cards were altered such that the overall language difficulty level was simplified. The panel suggested that the modified cards were easier than the original cards in approximately 70% of the cases. In the remaining cases the panel judged that there was no change in the vocabulary, syntax, and task difficulty level.

#### Assessment of Student Reading Performance

Reading age can be used as a measure of student reading performance. In order to assess the reading ages of students involved in this study the GAPADOL test was chosen (McLeod and Anderson, 1972). This is a sentence completion exercise which has a number of advantages over other tests that are available.

Firstly, this test can be administered to a large group of students at one time. It is a pencil and paper test which requires only that the students are supervised sufficiently to prevent any co-operation and copying between them.

The second advantage relates to the time taken to administer and score the test. The time taken to administer the test is 40 minutes and it is possible to score the students' responses

quickly because there is only one correct response for each answer. The student's score is then compared with a standard reference table to find the appropriate reading age.

With these points in mind, the GAPADOL test suited the aims of this study. Other tests available such as PAT (Australian Council for Educational Research, 1973) or TORCH (Australian Council for Educational Research, in publication) provide good estimates of reading age, however, they have disadvantages in administering and/or scoring. These are important considerations for a classroom teacher. Thus, the GAPADOL test was chosen as the most efficient method of obtaining reliable measures of reading age. In this study the measures obtained for the two classes of students had reliability coefficients of 0.94 and 0.93 respectively using the Kuder-Richardson 21 formula.

In order to obtain estimates of the students' reading ages, Form G of the GAPADOL test was chosen to be administered. This test was given to both Year 8 science classes containing students of mixed ability in science. The test instructions were given orally and the first sample test item was worked through as a class group. Students completed the test in 30 minutes.

#### Science Achievement Tests

Two science achievement tests were used in this study. The first involved a pretest and posttest on the Plants and Animals topic, the starting point for data collection in this study. The

questions required short written answers. The pretest enabled the writer to gauge the prior knowledge of the students on this topic. The posttest was an exact copy of the pretest and it was given to all of the students after they had completed the topic and the standard topic test. The pretest and posttest results were used to determine if the students had made progress. A copy of the pretest is contained in Appendix F.

The second achievement test was the topic test. At the end of every topic in Science students completed a 40 minute pencil and paper test on the material included in the topic. This test was composed of multiple choice questions and a written section where extended answers were required. In this study the language difficulty level of the topic test was also modified. Therefore, both classes of students answered the original topic test and, a week later, the modified topic test. These tests are contained in Appendix A and Appendix B. To negate the effect of seeing similar test questions previously, the classes completed the tests in alternate order. Class 1 was given the modified test first and then the original test, while Class 2 was given the original test first and then the modified test. This was done to counteract the practice effect that may have occurred as a result of seeing the first test. The two tests were given in alternate order so that the internal validity of the study was not threatened. Table 3 shows the internal consistency reliability coefficients for the original Plants and Animals topic test and the modified test. It also includes the sample reliabilities for the pretest and posttest. The reliabilities were estimated using the Kuder-

Richardson 21 formula.

TABLE 3  
Reliability Coefficients for All Science Achievement Measures

Class	Original Test	Modified Test	Pretest	Posttest
1	0.85	0.87	0.87	0.94
2	0.91	0.92	0.90	0.91

#### Data Analysis Procedures

Of the original 52 students in this study, 48 sets of results were used in the statistical data analysis. A loss of data occurred because four students did not complete one or more of the science achievement tests on the Plants and Animals topic. An a-priori decision was made to delete students from the study if they missed any of the achievement tests.

By comparing the results on the original topic test and the modified topic test for Plants and Animals it should be possible to state whether the students with low reading performance benefited from the modifications. A within-class correlation procedure was run utilising the SAS statistical package (SAS, 1985) to obtain correlations between the results on the topic tests and reading performance.

T-tests were conducted using the SAS statistical package in order to determine the significance of the differences observed in test results. Differences were noted between the original Plants and Animals topic test and the modified Plants and Animals topic test as well as between the pretest and the posttest. T-tests were performed on both of these differences.

#### CASE STUDY ON THE USE OF MODIFIED MATERIALS

A sample of five students was selected so that intensive classroom observations and interview data could be collected in order to answer the research hypothesis.

##### Sample

The selected student sample involved five Year 8 science students (3 female, 2 male). Two students were selected from Class 1, and three from Class 2. The selected students were representative of the low performance readers in these classes.

##### Procedures

The procedures followed in the case study were identical to the whole class study except for two additions. The science achievement and reading age data were used as a basis for identifying five students for intensive observation during the study. These were low performance readers who showed below average science test results even though they worked well in the



classroom.

During classwork on the modified Plants and Animals activity cards the five selected students were closely observed and their participation in class, written work, and working partnerships were noted.

The final stage of the study involved interviewing the five selected students to examine their comprehension of the science activity cards. They were asked to identify difficult words on a sample of cards and asked to discuss how easy or difficult the cards were to understand. The students explained some sections of the cards and described how they worked out difficult passages and from whom they sought help.

#### Identification of Selected Students

Student reading ages were used, along with other data, to choose five students for intensive observation in this study. The students' results on their first five science topic tests were collected as background information on the students. These results were used to compute an average science achievement score. The age and gender of students were also recorded. Table 4 shows the reliability coefficients for the science topic tests used throughout the year. The internal consistency reliability coefficients were estimated using the Kuder-Richardson 21 formula.

TABLE 4  
Internal Consistency Reliability Coefficients for the Test Data

Test	Class 1	Class 2
1	0.92	0.88
2	0.90	0.88
3	0.87	0.85
4	0.89	0.85
5	0.85	0.84
6	0.83	0.81
7	0.85	0.91

The student's reading ages were determined and were compared with the chronological age of each student. This produced an age difference which was calculated in months. This age difference and the science test average were used to identify possible students for closer observations. These were students with a greater chronological age than reading age and a low average science achievement score.

The number of students on the total class list was reduced by considering the classroom attitude and behaviour of each student. The final five selected students were chosen because they were willing workers with a co-operative attitude in class. This was done because such students were likely to co-operate in class and use the written materials as directed.

As a final check on the suitability of the five students the remedial reading teacher was consulted. All five students chosen were under her care for 2 hours each week, and it was agreed that they were ideal students for intensive observation.

### Classroom Observations

The five students selected for intensive observation were observed during the topic Plants and Animals. The purpose of the observation was to gain an insight into how they went about using the activity cards. Each student was observed by the teacher at least once or twice each week for a 5 minute period. The five students were also observed less intensively during each lesson. The observations were recorded during the lesson and analysed at a later date. These observation periods were used to focus on five points.

- (i) Whether the student worked alone or with others.
- (ii) Who the student asked for help.
- (iii) The student's willingness to use the equipment.
- (iv) The student's rate of progress.
- (v) How the student worked out what to do from the card.

During class time all students were expected to show the completed activity cards to the teacher. A record of how many cards had been completed was obtained for each of the five students. The students' standard of written work was gauged at this time and at a later time when the students' books were

examined in detail. The data that were obtained allowed the writer to analyze how the students used the activity cards.

### Interview Procedures

An interview was conducted with each of the five selected students in this study. The interview was used to determine the ease with which the students could utilize the modified activity cards. Questions were asked about the procedures and the vocabulary on the cards.

All five selected students were interviewed using a semi-structured interview format. This ensured uniformity between the interviews and also allowed the interviewer to be flexible in following up the responses given. Each student was interviewed separately, and the interview was recorded on tape for detailed analysis. The student was told of the background to the study and a series of general questions were asked in order to establish rapport.

Once this had been done the student was given photocopies of two activity cards. The student was asked to read the information given on the sheets and to circle any words for which the meaning was not known or that s/he could not explain on request. Once this was done the student was asked to explain the meaning of several words and sentences from the activity cards. Appendix E shows the cards used and the sections queried. The students were given time to amplify or expand on the meanings of these

sentences or words as well as the chance to use examples in clarifying the ideas. The students' understandings were assessed on a three point scale of 1 - fully understood; 2 - partly understood; and 3 - not understood at all. Some students were not asked to explain all passages since they had already circled the word as unknown and the interviewer left out the question. When this occurred the grade was shown as 4.

The second part of the interview focussed on how the students used the activity cards. They were asked to respond to questions on how easy or difficult it was to follow the cards, who they went to for help, how they worked out what to do, and where they found the answers to the questions on the activity cards. They were also asked for suggestions on making the cards easier to read. At the end of this time the students were asked some general questions in order to emphasize the informal nature of the interview and were thanked for their voluntary participation.

The results obtained in these interviews were used to indicate the depth of understanding obtained from activity cards. By asking students to circle difficult words, an idea of the difficulty they had in reading these cards was gained. The students' responses were used to indicate the amount of understanding that the students had of specific terminology. During the second part of the interview classroom observations made during the topic were complemented. Students described the processes they engaged in while working on the activity cards.

### Data Analysis Procedures

The quantitative data analysis has been described in the whole class study. In addition to these analyses the selected student study involved analysis of qualitative data.

The five selected students were observed as they worked on activity cards in the classroom, and at the end of the topic they were interviewed. These two techniques were used to examine the effectiveness of modifications to the Plants and Animals activity cards. The writer observed students as they worked on the activity cards and then the students explained how they used the cards and where they had difficulties. Trends were observed in the responses given by the students and the observations made by the writer. An interpretation of these data enabled the effectiveness of the modifications to be ascertained.

### SUMMARY

This section of the report outlined the methodologies used to investigate the relationships between reading performance and science achievement. The chapter contained descriptions of the data collection and data analysis techniques. The modification of the activity cards was also discussed along with procedures used to ascertain whether the science concepts, skills, processes, and terminology were equivalent.

A detailed account of the assessment of student reading ages, background information, and identification of students for intensive observation was compiled. The need for classroom observations of selected students along with the interview procedure were discussed.

Finally, the need for assessment of students' science achievement and the procedures used were also discussed. A section on the analysis of the data explained how the data would be processed in order to obtain answers to the research questions.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### INTRODUCTION

This chapter presents the results and interpretations of the study using the research questions as an organizing framework. The results are reported first for the whole class study and then for the case study.

#### WHOLE CLASS STUDY

##### Research Question One

Research question one asked "Is student achievement on a science topic test related to the reading performance of the student?". It refers to the relationship between student reading performance and achievement on science topic tests. In order to answer this question data were collected on the student's reading age and performance on seven science topic tests.

Two classes of students were given the standard GAPADOL reading test in order to determine the reading age of each student. The science topic test results of each student were also recorded and an average score was calculated. This average test score was used as a measure of each student's science achievement. Table 5 shows a summary of the results by class and gender. The full set of student results is contained in Appendix G.



TABLE 5

A Comparison of Reading Ages, Chronological Ages, and Science Achievement by Class and Gender

Class	N	Gender	Reading		Chronological		Science	
			Age		Age		Achievement	
			$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.
1	11	F	12.4	1.11	13.2	0.4	47.8	8.2
1	14	M	11.8	2.2	13.1	0.4	53.6	12.5
1	25	All	12.0	2.0	13.1	0.4	51.0	11.0
2	12	F	13.4	1.11	13.2	0.6	45.0	10.7
2	11	M	10.7	3.4	13.2	0.4	41.1	8.9
2	23	All	12.5	1.8	13.2	0.5	43.1	9.9

Both Year 8 classes contained a mixture of students studying at all levels. The course taught throughout the year was a general science course. In both classes the average chronological age was 13 years and 2 months. The average reading age in Class 1 was 12 years while in Class 2 it was 12 years and 5 months. This difference between classes was not statistically significant at the 0.05 level. However, in both classes many students had a reading age below that of their chronological age. In fact, only nine students in each class had a reading age above their chronological age.

The average science achievement in Class 1 was 51%, while the average in Class 2 was 43%. There is a statistically significant difference in these two figures ( $p < 0.05$ ). Although students were randomly assigned to the two classes at the beginning of the school year they showed a significant difference in science achievement throughout the year.

When the results of the science achievement measure were compared with the reading ages in each class the following correlational data were obtained.

TABLE 6  
Correlational Data on Reading Age and Science Achievement

Class	N	Reading Age		Science Achievement		Correlation
		$\bar{x}$	s.d.	$\bar{x}$	s.d.	
1	25	12.0	2.0	51%	11.0	0.46
2	23	12.5	1.1	43%	9.8	0.75

Each of these correlations was significant at the 0.05 level. Thus, student achievement on science topic tests is significantly related to the reading performance of the student. A higher correlation was found in Class 2. This result is supported by the independent observations of the writer. Students in Class 2 with a low reading level seemed to have trouble handling the classroom activities. However, some of the students in Class 1 with low

reading levels were excellent workers and were always willing to try set tasks. Thus, it is not possible to use reading performance as an absolute predictor of achievement since not all of the students fit this pattern. There was a general trend for students with a relatively high reading performance to score higher marks on science achievement tests.

### Research Question Two

Research question two asked "Do linguistically modified science materials enable students with low reading performance to more easily comprehend the science materials?". It concerned the comprehension of modified science materials by low performance readers. This question was answered using selected students in observational work and interview situations. The results are reported in the selected student study later in this chapter.

### Research Question Three

Research question three asked "Do linguistically modified tests enable students with low reading performance to more successfully demonstrate their science achievement?". It seeks to determine if a modified science topic test would enable students with low reading performances to more successfully demonstrate their science achievement. The regular science topic test and a modified science topic test were utilised in order to obtain data to answer this question.

In Class 1, the average gain on the modified test was 4%. The results of the t-tests indicated that the gain was statistically significant ( $p < 0.05$ ). In Class 2, the average gain on the modified test was 6%. The t-test indicated that this gain also was significant ( $p < 0.05$ ).

The reading performances of students were compared with the results on the original and modified topic tests using the Pearson correlation formula. Both tests were significantly related to reading age ( $p < 0.05$ ). The original test produced a correlation coefficient of 0.43 while the modified test produced a correlation coefficient of 0.33. Thus, the modified test reduced the reliance on reading performance but did not eliminate it completely.

A small number of students in each class did not benefit by the test modifications undertaken in this study, however, changes in the class mean scores demonstrated an improvement in the science achievement. The study therefore demonstrates that not only do students with a low reading performance benefit from a test written in simpler language but so do other students in the class.

Both science classes showed gains over the pretest and posttest period. The average gain for Class 1 was 20% while the average gain for Class 2 was 17%. Both of these gains were statistically significant ( $p < 0.05$ ). Most students from both classes showed a substantial gain on the posttest when compared

to their pretest result.

In conclusion, it appears that students do benefit by having a science topic test which has been modified in order to reduce the language difficulty level. Not only do the low performance readers show an improvement in their science achievement but so do most other students. This probably occurs because the questions are no longer written using complex language structures and so are easier to understand. Thus, the students are no longer confused during the reading of the questions and were able to demonstrate their science knowledge.

#### CASE STUDY ON THE USE OF MODIFIED MATERIALS

##### Research Question One

Research question one refers to the relationship between a student's reading performance and science achievement. The same procedure was followed as in the whole class study and similar results were obtained. Table 7 shows the data for the selected students.

TABLE 7  
Data on the Selected Students

Student	Class	Reading Age	Chronological Age	Science Achievement	Gender
Fiona	1	10.7	13.2	35%	F
James	1	11.6	13.2	43%	M
Annette	2	10.6	12.9	33%	F
George	2	10.11	13.4	37%	M
Jane	2	11.7	14.5	31%	F

Fiona, James, Annette, and George all support the trend that as reading performance increases so does science achievement. Jane is the only selected student who does not appear to follow this trend.

#### Research Question Two

Research question two seeks to identify whether students with a low reading performance find it easier to comprehend the modified science materials. In order to answer this question observational data were collected and analyzed. The following observations were obtained from two main sources of data. These were the observations that were made in the classroom situation and the interviews conducted with the selected students.

The selected students were numbers 7, 9, 29, 31, and 35 from Appendix G. The following summaries illustrate the way that each of the selected students went about the set tasks in the science classroom, and also the responses given during informal interviews. Each observation focussed on how the students comprehended the modified activity cards.

Fiona. Fiona was a quiet and co-operative student in class. She usually worked with a group of females although she did not participate in setting up equipment for activity work. Her written work was usually done on her own and she completed the work quietly and steadily. Fiona was willing to ask me for help during the lesson as long as there were other students asking for help. She may have used other workmates to get the answers to questions.

Fiona asked fewer questions of me during the Plants and Animals topic. She spent more time working with other students in a co-operative manner than she did in previous topics. She sat with students who achieved good results in class, and learned to work with them. Fiona was not seen copying other student's work. She produced complete answers to questions for the Plants and Animals topic.

From the observations of Fiona during the Plants and Animals topic it appears that she found it easier to work on these modified materials. During previous science topics Fiona had not completed all set work.

The interview data produced some useful insights into the methods used by Fiona to work from the activity cards. First of all she had no trouble explaining the chosen section from Card A. However, she did have problems explaining the terms from Card B. The sections that gave Fiona trouble involved scientific terminology. The terms photosynthesis and spores were not explained correctly even though Fiona had not circled them as unknown. The terms decomposers and parasites had been circled as unknown and so these terms were not queried. Fiona was able to explain the term fibre but not in a scientific context.

Fiona was confident that she could use Card A independently. During the interview she also indicated understanding of the processes involved in completing interview Card B. Fiona explained that the textual material contained information to be used in completing the notes on the cards.

Fiona suggested explaining some of the scientific terminology in detail in order to make card B easier to understand. She suggested "Put like a definition of it". Fiona stated that definitions of the major scientific terms would enable her to understand them. If Fiona was having trouble understanding a card she asked the teacher or other students for help. The students mentioned were the brighter students in the class. Thus, Fiona was confident enough to walk around the room and ask anyone for help. This may be the teacher or students in the class who have shown ability in science.



Fiona developed a number of strategies to help her understand the science activity cards. She was willing to ask other students or the teacher for help and watched other students as they worked on the cards. She showed a greater level of work during the modified Plants and Animals activity cards than in previous science topics. Thus, Fiona showed that she found the modified activity cards easier to understand and complete.

James. In the earlier topics James was a demanding student. If he was not sure of what to do or the answer to a question then he asked me to tell him. He tended to ask for answers even though he could work them out. Thus, he needed to be guided through the work. He asked fewer lower level questions during the Plants and Animals topic than he did in earlier science topics. James still asked about more difficult aspects of the activity cards but he spent a greater proportion of time working on the cards on his own. He did not work with other students and usually came straight to me for help. Thus, his lack of questions during this topic indicated that he genuinely was able to do more of the work on his own. His rate of progress throughout the topic was on a par with most of the students in the class. James was very keen to use any equipment involved in the activity cards. He confidently handled the use of a microscope after initial instruction in its functioning and was keen to look at the maximum of six slides rather than the minimum of two which were required.

The interview data highlighted some strategies used by James to work from the activity cards. Firstly, he had no trouble explaining the sections chosen from Card A. James also managed to attempt explanations for most of the terms on Card B. He partly explained the terms photosynthesis and fibre, although he could not explain spores. However, the scientific terms decomposers and parasites were circled as unknown.

James was confident that he could use Card A independently. He also indicated understanding of the processes involved in completing Card B. James explained that the textual material contained information to be used in completing the notes on the card.

James suggested simplifying the scientific terms on Card B in order to make them easier to understand. He wanted to replace the scientific terms with words that were easier to comprehend. If James was having trouble understanding a card he asked the teacher or other students for help. The students named were the brighter students in the class. Thus, James was confident enough to ask anyone in the room for help.

James has developed a number of strategies to help him understand the science activity cards. He showed a lower level of uncertainty during the modified Plants and Animals topic than in previous science topics. Thus, James showed that he found the modified activity cards easier to understand and complete.

Annette. Annette was a quiet student who tended to work with other females during the lesson. She watched what other students were doing and often copied their work into her book. Annette did not participate well in experimental work. She was not inclined to manipulate the equipment and tended to watch what others were doing. Annette was willing to ask questions of me but only after she had tried to get the information from other students. She worked very slowly and meticulously. Annette sat with students of her own ability and tended to socialise as well as complete work. I did not notice a change in Annette's work pattern during the modified Plants and Animals activity cards.

The interview data produced some useful information about the methods used by Annette to work from the activity cards. First of all, she had no trouble explaining the chosen sections from Card A. However, she did have problems explaining the terms from Card B. The sections that gave Annette trouble involved scientific terminology. The terms photosynthesis and fibre were not explained correctly even though Annette had not circled them as unknown. The terms spores, decomposers, and parasites had been circled as unknown and so these terms were not queried.

Annette was confident that she could use Card A independently. She also indicated understanding of the processes involved in completing card B. Annette explained how to find the information to complete the cloze exercise by stating "From the bits you've read".

Annette suggested explaining some of the scientific terminology in detail in order to make card B easier to understand. She suggested writing explanations of the scientific terms on the activity cards. If Annette was having trouble with a card she stated that she would go straight to the teacher and not ask any students for help.

Annette did not develop a large number of strategies to help her use the activity cards. She worked steadily and consistently to produce a suitable rate of work during the modified Plants and Animals activity cards.

George. George was a quiet student who spent most of the time in class working on his own. He was a slow and consistent worker. George rarely asked questions about the activity cards but when he did they were directed to me or to a bright student who sat next to him. George was interested in conducting minor experiments in science but left the setting up of microscopes and chemical reactions to his partner. Since George rarely sought answers to questions from me the only guide to his ability to utilise the cards was in the amount of written work he produced. As he worked on his own this gave an idea of how well he understood the cards. George completed the majority of cards in the Plants and Animals topic. This compared very favourably to other topics where George had completed less than half of the activity cards.

From the observations of George made during the Plants and Animals topic it appeared that he found it easier to work on these modified materials. During previous science topics George had not completed all set work but he did complete the work during the Plants and Animals topic.

The interview data produced some useful insights into the methods used by George to work from the activity cards. Firstly, he had no trouble explaining the chosen sections from Card A. However, he circled many words on Card B as difficult. This meant that none of the terms on Card B were available for George to explain. The sections that gave George trouble involved scientific terminology. The terms photosynthesis, spores, decomposers, and parasites were all circled as unknown.

George was confident that he could use Card A independently. He also indicated understanding of the processes involved in completing Card B. George pointed to the textual information on the activity card when asked where he found the words to complete the notes on the cards.

George suggested replacing the difficult scientific terminology with simpler words in order to make Card B easier to understand. If George was having trouble understanding a card he asked a bright student who sat next to him. He rarely asked the teacher or other students for assistance.

George developed a number of strategies to help him understand the science activity cards. He showed a greater level of work during the modified Plants and Animals activity cards than in previous science topics. Thus, George showed that he found the modified activity cards easier to understand and complete.

Jane. Jane was a quiet and co-operative student in class. She sat with other females but always worked on her own. She relied on reading the cards and following the instructions. Her approach was steady and purposeful. Jane came to me to ask questions when she had tried to work out an instruction or answer but had not been able to achieve this. She made every effort to learn. During the Plants and Animals topic Jane had asked very few questions. She methodically worked her way through the activity cards. Jane showed skills at using the microscope but rarely attempted the use of equipment without encouragement from her partners.

From the observations of Jane made during the Plants and Animals topic it appeared that she found it easier to work on these modified materials. During previous science topics Jane had not completed all set work but she did most of the work during the Plants and Animals topic.

The interview data produced some useful insights into the methods used by Jane to work from the activity cards. First of all, she had no trouble explaining the chosen sections from Card

A. However, she did have some problems explaining the terms taken from Card B. The sections that gave Jane trouble involved scientific terminology. The terms photosynthesis, fibre, and spores were not explained correctly even though Jane had not circled them as unknown. The terms decomposers and parasites had been circled as unknown and so these terms were not queried.

Jane was confident that she could use Card A independently. She also indicated understanding of the processes involved in completing Card B. Jane explained that the textual material contained information to be used in completing the notes on the card.

Jane suggested replacing some of the scientific terminology in order to make card B easier to understand. She suggested "Just use a more simpler word and I can do as it says". When Jane was working on the activity cards she had a philosophy of attempting the cards by herself first. "I try to do the cards on my own first and then if I can't I just ask." Jane asked the teacher or other students for help with the cards.

Jane developed a number of strategies to help her understand the science activity cards. She showed a steady level of work during the modified Plants and Animals activity cards.

General trends. The observations recorded on each student outlined the strategies that they used to work in the science classroom. This section emphasises points made during the

observations and interviews.

The first stage of the interview procedure involved the students being given two modified activity cards. They were asked to read the cards and to circle any words that they did not understand or for which they could not explain the meaning. Table 8 shows the number of words that were circled by the students.

TABLE 8  
Student Survey Showing Number of Circled Words

Student	Card A	Card B
Fiona	1	6
James	3	8
Annette	1	7
George	1	7
Jane	1	9

It was interesting to note that most of the words circled on the cards by each student were the same. On Card A, every student circled the word stimulus as unknown. On Card B, every student circled the words chlorophyll, photosynthesis, hyphae, decomposers, parasites, and antibiotic. Thus, it was the scientific terms that students found difficult to explain. In a previous study (Ireland, 1985) students circled many common English words as difficult. However, on the Plants and Animals



activity cards these words were replaced and students seem to have found the replacements easier to comprehend.

When the students were asked to explain some words or sentences on the activity cards trends were observed in the responses given. Table 9 shows the students' graded responses.

- 1 - fully understood
- 2 - partly understood
- 3 - not understood at all
- 4 - question not asked

TABLE 9  
Students' Graded Responses of Passage Explanations

Card	Passage	Student				
		Fiona	James	Annette	George	Jane
A	A	1	1	1	1	1
A	B	1	1	1	1	1
B	C	1	1	1	4	1
B	D	3	2	3	4	3
B	E	2	2	3	4	3
B	F	3	3	4	4	3
B	G	4	4	4	4	4
B	H	4	4	4	4	4

As can be seen from this table each student gave varying explanations of the chosen textual words or passages. James could explain most of the passages to a greater extent than the other students. Fiona, Annette, and Jane tried to explain the passages but were not very successful. George circled many of the passage words as unknown.

From these results and the number of words circled as unknown it can be stated that Card A was easier to comprehend than Card B. Card B presented a few problems for students even in its modified form. A number of scientific terms were circled as unknown and students had difficulty explaining the meanings of the given passages even though the words were presented to them in context. The students may have been able to read most of the words using a phonetic approach but they still could not explain the terms and did not appear to fully understand them. The fact that the students did not circle many of the words seems to indicate that they thought they could explain the words. Thus, these students saw reading and understanding as highly linked events, whereas comprehension does not necessarily follow from the ability to read. When the students were asked to explain passages there was a definite gap in their comprehension of terms compared with their perception of the difficulty of the same terms.

The comments made by the students during the interview indicate that they were quite willing to work independently on the activity cards and that they were capable of following

instructions from the cards and completing any cloze notes. The students could work from these cards at a self-paced rate. The only time the students had trouble comprehending the cards was with the circled scientific words. This supported the observations made previously in the classroom. Students worked on the modified activity cards during the lesson and were seen to complete the relevant written work.

Most students said they would approach the teacher with any problems or ask some of the brighter students for help with the activity cards. The classroom observations showed that during the Plants and Animals topic the selected students did not ask as many questions of the teacher and they were not seen asking brighter students for help. Thus, it can be concluded that the selected students found it easier to comprehend and work on the modified activity cards in an independent manner.

### Research Question Three

Research question three concerns the effect of modifying science topic tests in order to reduce the language difficulty level. Data were collected to determine if low performance readers more successfully demonstrated their science achievement on the modified topic test. Table 10 shows the test scores for the selected students together with their class.

TABLE 10  
Students' Science Test Results

Student	Class	Original Test	Modified Test	Difference	%Difference
Fiona	1	42	54	12	29
James	1	45	51	6	13
Annette	2	26	32	6	23
George	2	44	45	1	2
Jane	2	26	33	7	27

All of the selected students showed an increase in science achievement as measured by the modified test. The increases range from 12% to 1%.

The average gain on the modified test for Class 1 was 4%. Class 1 did the modified test and then the original test. However, Fiona gained 12% and James gained 6%. Thus, the modified test allowed these two students to demonstrate their science achievement more successfully than the original test. The average gain on the modified test for Class 2 was 6%. Class 2 did the original test and then the modified test. Jane gained 7%, Annette gained 6%, and George gained 1% in Class 2. Thus, the modified test allowed Jane and Annette to demonstrate their science achievement more successfully than the class average. However, the modified test did not seem to help George demonstrate his science achievement more successfully. The selected students

demonstrated a gain in science achievement when the Plants and Animals topic test was modified to reduce the language difficulty level.

A pretest and a posttest were administered to the selected students as part of the whole class study. Table 11 shows gains over the duration of the Plants and Animals topic.

TABLE 11  
Students' Test Results

Student	Class	Pretest	Posttest	Difference	%Difference
Fiona	1	17	41	24	58
James	1	13	13	0	0
Annette	2	8	13	5	38
George	2	3	28	25	89
Jane	2	0	21	21	100

The average gain in Class 1 was 20% so Fiona showed a larger than average gain on her posttest. However, James simply maintained his pretest score. The average gain in Class 2 was 17%. This indicates that George and Jane have shown a larger than average gain on the posttest while Annette achieved a slightly lower than average gain.

The selected students test results show that gains in science achievement were made during the Plants and Animals topic. The modified topic test made it easier for the selected students to demonstrate their science achievement. However, a relatively low level of posttest achievement occurred despite the use of the modified materials. This may indicate the cumulative nature of the learning process. These trends were also observed in the whole class study.

#### SUMMARY

This chapter focussed on presenting the results of the study and discussing the possible explanations of classroom observations. The three points below represent the main findings of this study.

The reading performance data were found to correlate significantly with science achievement as measured on topic tests. Class 1 produced a correlation coefficient of 0.46 while Class 2 produced a correlation coefficient of 0.75. Thus, it appears that a student's science achievement is related to reading performance. Those students with a high reading performance tend to score better on science achievement measures than those students with a low reading performance. This finding is consistent with an interpretation that poor reading skills inhibit science learning as the topic is studied in class and also when achievement is assessed.

The selected students found the modified activity cards relatively easy to use and they could work on them independently. Thus, textual material needs to be presented at an appropriate reading level for independent learning to occur.

All of the selected students showed improved science achievement on the modified Plants and Animals topic test. However, the rest of the students in the class also benefited from the modified test. Thus, the modifications made it easier for most students to demonstrate their science achievement.

The results stated above indicate that reading performance is related to science achievement. However, it also seems that other student- or class-based factors may influence science achievement. Thus, there is a need for further research in the area of factors affecting student science achievement.

## CHAPTER 5

### SUMMARY, CONCLUSION AND IMPLICATIONS

#### INTRODUCTION

This chapter presents a summary of the study and the findings. An outline of the aims, research findings, and methodologies are provided followed by an examination of the limitations of the study and a discussion of the results and conclusions. A discussion of the implications for science teaching are also presented along with recommendations for future research.

#### SUMMARY

The purpose of this study was to determine the effect of reading performance on student science achievement. Many students experience reading difficulties with science materials and so an accurate measure of their science achievement is difficult to obtain using conventional pencil and paper tests. A similar problem exists when students work from self-paced activity cards during science lessons. If the student has trouble reading and understanding a workcard then very little learning can be achieved. Many texts, references, and tests used to promote or assess achievement in school subjects place a high premium on reading ability. Failure to answer a question correctly on a test may be a result of a reading difficulty, a lack of specific content knowledge, or a combination of these factors. The current



study focussed on the relationships between reading performance and science achievement.

There are many studies which seek to match the reading difficulty level of textual materials to the reading ability of the students involved. Macinnis (1979) and Johnstone and Cassels (1978, 1984) both produced a series of steps that could be used to modify textual information in order to reduce reading difficulty. Further research on words and phrases that cause difficulty was conducted by Gardner (1978, 1980) and Lynch (1978, 1980). These studies concentrated on connective words and phrases. Yore and Shymansky (1985) suggested that student reading ability is related to achievement. Poor readers have few strategies available to help them understand what they read. There are a large number of students in our schools who require a better understanding of what they read. These students should not be penalised for their poor reading and comprehension skills.

This study sought to determine methods of reducing the reading difficulty of materials and of analyzing students' science achievement scores. Both qualitative and quantitative aspects were considered.

The sample of students used in this study was taken from two mixed ability Year 8 science classes. The reading performance of each student in these classes was measured using the GAPADOL reading test. Student science achievement and reading age were used to identify five students to take part in detailed

observations throughout the study. These selected students were chosen because they had a low reading age and low science achievement even though they were willing workers in the classroom. These students were observed throughout the topic Plants and Animals in order to determine their method of utilising the science activity cards. At the conclusion of the topic the selected students were interviewed. They were asked to identify difficult words in a textual passage and explain some of the meanings of passages from the activity cards. They were also questioned on the ease with which the cards could be used.

The final data collected in this study involved the students' scores on a regular science topic test for Plants and Animals, along with results on a modified test. These results were used to determine the effectiveness of reducing the language difficulty of the test paper.

## RESULTS OF THE STUDY

The main aim of this study was to determine the effect of reading performance on student science achievement. From the results in Chapter 4, several conclusions can be drawn regarding the relationship between student science achievement and reading performance.

The correlation between reading age and science achievement indicates a significant positive relationship between the two variables. The correlation between the two variables was

significant in each class. Class 1 produced a correlation coefficient of 0.46, while Class 2 produced a correlation coefficient of 0.75. As a result of these correlations it appears that reading performance may be a factor in student science achievement. Students with higher reading performance in both classes tended to obtain higher science achievement scores. This result raises the possibility that reading performance and science achievement are related. However, it may be that these two variables are caused by a third factor. Thus, the correlations between reading performance and science achievement may be relational.

One of the strategies undertaken in this study involved collecting observational and interview data from a small group of students. These were low performance readers with low science achievement scores even though they were willing workers. These selected students found the modified activity cards easier to work on independently. Classroom observations and interview data support this proposition. Students were observed to use the activity cards in an independent manner more often than in previous topics. The amount of written work completed was higher than the amount completed in earlier science topics. During student interviews the selected students indicated a willingness to work using the activity cards at an independent rate. Thus, by altering words and phrases on the activity cards it was possible to reduce the language difficulty level of the cards and allow students to work independently.

Another trend observed during this study concerned the effect of modifications to the Plants and Animals test on the science achievement of low performance readers. All of the selected students showed improved science achievement on the modified test. However, the rest of the students in the class also benefited from the modified test. Thus, the modifications made it easier for most students to obtain higher science achievement scores. This finding underscores the possibility that estimates of science achievement based on written tests might be suppressed because of problems encountered in understanding what was required to answer written test items. When the students were given test items written in terms which they could read and comprehend easily a significant improvement was shown in the student achievement results. Thus, the variables reading performance and science achievement are significantly correlated.

Although the sample size in the observational part of this study was not large, some valuable trends were observed. Reading performance may be related to science achievement. As a student's reading performance increases so does science achievement. However, there may be other student- or class-based factors that influence science achievement.

#### LIMITATIONS OF THE STUDY

Research studies of this design are frequently limited in their representativeness because of the number of extraneous factors which may influence the generalizability of the results.

Purity of research design may sometimes be sacrificed due to practical constraints of the school situation. Several factors may have limited or confounded external validity of this study, the most important of which are discussed below.

The sample of students used in this study might not be representative of the population of Year 8 students. The class samples involved 52 students, and only five selected students were involved in the direct classroom observations and interview situation. The choice of the selected students also introduces the possibility of a non-representative sample. There may have been other students who would have been more representative. This means that it is difficult to generalize the findings of this study beyond the school in which it was conducted. However, this study was designed to obtain detailed observations of students in order to understand their methods of learning science. The study therefore was seen to be exploratory in nature.

A second factor concerns the randomness of the sample. The sample involved two Year 8 science classes from the school involved in the study. However, the heterogeneity of the groups cannot be guaranteed even though random samples were drawn. Students were initially allocated to their science classes in a non-systematic manner so that each class was heterogeneous with respect to science achievement. Consequently, violation of the assumption of random assignment to groups, which underlies the statistical tests used in this study, may not be serious.

One of the benefits in the design of this study came from the researcher being the classroom teacher. This allowed the researcher to call on valuable background observations of each student, obtain the co-operation of students in test measurements, and conduct an informal interview. During the interview it was an advantage for the researcher to be the classroom teacher. It was possible to listen to the student's answers and tell, from experience with these students, that the answers were genuine responses. However, a corresponding disadvantage occurs. The teacher is responsible for all students in the classroom and must often spend time attending to queries, helping set up equipment, and teaching the class. This means that valuable observations of the selected students may have been missed since attempting to be both researcher and teacher is time-consuming and organizationally difficult. A disadvantage of the teacher as the sole researcher is that the teacher may have been biased or overly focussed on the selected students.

The methods employed to modify the difficulty levels of the activity cards and test were comparatively new techniques for the researcher. Thus, only slight modifications were made to the activity cards and the test materials. These modifications appear to have been successful although a larger decrease in language difficulty level would have been advantageous.

One of the difficulties faced in this study concerns the interview procedure. Whenever an interview is conducted the researcher must be careful to avoid a number of pitfalls. The

interviewer must be unbiased at all times, avoid leading questions, and avoid stressing the correct answer. There is also considerable stress on the student during an interview and this must be alleviated as much as possible. This was not a serious problem during this study since the interviewer was the classroom teacher. The students appeared comfortable when answering the questions.

The limitations discussed above must be taken into account when reading the results of this study. However, none of the limitations are major enough to warrant exclusion of the results of the study.

#### IMPLICATIONS OF THE STUDY

There are five main educational implications that arise from this study.

The first involves the suitability of written materials for students. Where possible, teachers should match the learning materials chosen with the characteristics of the students. One of these characteristics is reading ability. If students with a low reading performance are given a difficult-to-read worksheet, they will be limited in their ability to use it as a learning resource. The teacher's task is to match the students with appropriate learning materials. The reading difficulty levels of worksheets and activity cards can be measured and altered. If this approach is taken then the students have written material to

work with that is appropriate to their reading performance level. This might allow students easier access to the information contained in the cards and possibly increase their performance in science. Related to the idea of making the materials more readable are the strategies involved in concept learning. The teacher needs to focus on presenting students with materials that build on science concepts as well as the reading skills and concepts already attained. Thus, the students need to be encouraged to actively interpret the materials that they read. These strategies should improve science achievement results as well as reading performance.

The second implication concerns the reading difficulty of test questions. Questions should be written at a language level appropriate for all students to understand the question. Although this is a difficult task it allows students to use a minimum amount of previous knowledge and they have a greater chance of comprehending the question. This would provide a better measurement of the student's science achievement instead of relying on reading performance in the test. Thus, by creating a test that can be read by all students, science achievement scores will not be diminished because of reading limitations of students. This can be stated in more general terms. Any items used to assess student achievement in subject areas should place low reliance on student reading performance. All students must be given a reasonable chance to demonstrate their knowledge in specific subject areas. They should not be penalised for a failure to read or understand the questions in tests. A larger



percentage of assessment time could be spent observing students during practical work or book work. These methods of assessment are as valid for achievement as written tests.

The third implication is for science teachers and teacher educators. Teachers must ensure that students are given every opportunity to participate in class work and the learning experience. Active learning implies that the students are involved in the learning process. They have access to equipment, resources, and written instructions. It is also important that students are able to demonstrate their acquisition of science knowledge. Thus, achievement measures that are difficult to understand are testing the student's reading ability as well as knowledge of science. More attention needs to be paid by all educators to the role of reading in the learning process. Teacher training institutions have a role to play in improving the strategies used by teachers to educate students. The institutions must focus attention on the relationship between reading strategies and concept learning. Teachers must be trained in the development of reading skills in students.

The fourth implication concerns low performance readers. Students who show a low reading performance need help to improve their performance. Teachers can be involved in this process by taking the time to explain difficult words and connect them to simpler concepts that may already be in the student's previous knowledge store. This involves a change in teaching strategy to place an emphasis on the background knowledge of the student.

Teachers need to alter their methods of instruction to cater for student reading performances. Emphasis needs to be placed on strategies that help students improve their understanding of and performance in cognitive areas. Students tend to work in small groups in a classroom. This situation should be encouraged since students have been found to help each other understand textual material. The teacher's task is to ensure that all students are contributing to the sharing of knowledge.

The fifth implication concerns research in education. This study involved using the classroom teacher as the sole researcher. This has limitations, which have been discussed previously, as well as advantages. The teacher is in a good position to collect qualitative data on the students. However, it may be necessary to use a second observer in the classroom to validate the data collected. The use of qualitative data in educational research is very important for analyzing the learning process. It is vital to know how students work and why they choose one strategy in preference to another. This enables teachers to focus on the problems in understanding that occur and remedy these problems. In this area qualitative as well as quantitative data are required.

#### RECOMMENDATIONS FOR FUTURE RESEARCH

Like many research studies, this investigation raised several questions in addition to those it set out to answer. Future research could extend the results of this study or could

investigate other issues which were raised. The purpose of this section is to generate recommendations for research in areas related to this study.

(i) Future research may replicate this study using a larger sample for both quantitative and qualitative data analysis.

(ii) This study sought to reduce the reading difficulty levels of some activity cards and the topic test. The language difficulty levels of these materials were modified; however, future research may wish to modify language difficulty levels of materials using a different linguistic focus.

(iii) This study used modified materials over a relatively short timespan. It would be worthwhile to conduct a study using modified materials over a longer time. The long term effects associated with low performance readers using modified materials should be examined.

(iv) Very little research has been conducted on modifying the language difficulty levels of whole tests. It is hard to get an analysis of the reading difficulty of a test item since it usually contains less than 30 words. Readability formulae have not been designed for short written passages and so future research may be conducted in this area. Alternatively, a different test

format could be considered to minimise the problems of meaning construction.

(v) This study sought to modify the language difficulty level of reading materials and future research could be directed towards the construction of meaning by the reader.

(vi) Finally, the results of this study apply to science education. Future research could be conducted in other subject areas such as mathematics and social studies, where large pieces of textual material are required to be read and understood.

## CONCLUSIONS

Reading performance and student achievement on science topic tests are related. A significant correlation was found between both of these variables. Students with high reading ages tended to score higher results on science achievement measures than students with low reading ages.

Written materials can be modified in order to alter their language difficulty levels. In this study the language difficulty levels of activity cards and tests were reduced by modifying the written material. A set of guidelines were used to achieve the modifications. These modifications alter the language difficulty level without changing the science concepts, processes, skills,

or the scientific terminology used.

Students with a low reading performance found it easier to comprehend materials modified to reduce the language difficulty level. After observing students who were low performance readers and conducting interviews with them it was noticed that these students comprehended the modified activity cards. The students participated in activity work and written work to a greater extent than they did in earlier science topics, and they spent less time asking for teacher assistance.

All students demonstrated a higher level of science achievement when tests were modified to reduce the language difficulty level. It appeared that when tests were modified to reduce their language difficulty level the questions became easier to understand for all students. Thus, the science achievement results were better for all students.

Finally, the results and conclusions drawn from this study indicate a need for further research in this area. Detailed classroom observations, together with more appropriate teacher intervention techniques, may be useful to further the results of this research.

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PLANTS and ANIMALS - OBJECTIVES

AFTER COMPLETING THIS TOPIC YOU SHOULD BE ABLE TO .....

- |   | <u>CARD NUMBER</u> |
|---|--------------------|
| * Explain the need for classification.                                  | ...1)              |
| * Make a classification key.  | (Answer Sheet 1)   |
| * Describe 3 main differences between plants and animals.               | ...2)              |
|   |                    |
| * RECALL FEATURES AND IDENTIFY EXAMPLES OF THE FOLLOWING PLANT GROUPS - |                    |
| * Algae and Mosses  | ...3)              |
| * Fungi (See also Card 5 below)   | ...4)              |
| * Lichens   | ...6)              |
| * Ferns   | ...7)              |
| * Conifers  | ...8)              |
| * Flowering Plants  | ...9)              |

- \* Recall the conditions necessary for the growth of a fungus. ...5)

- \* Identify and describe the function of the main structures of a flowering plant. (Answer Sheet 2) (Leaves, stems, flowers, roots, seeds and fruit).

- \* Use a plant classification key to identify examples of all the above plant groups. ...10)  
(Answer Sheet 3)

\* RECALL FEATURES AND IDENTIFY EXAMPLES OF THE FOLLOWING ANIMAL GROUPS -

- |  |        |
|--|--------|
| * Protozoa                             | ...11) |
| * Porifera and Coelenterates           | ...12) |
| * Annelids (See also 14 below).        | ...13) |
| * Molluscs (And Answer Sheet 4)        | ...15) |
| * Echinoderms                          | ...17) |
| * Arthropods (And Answer Sheets 5, 6). | ...18) |
| * Vertebrates                          | ...20) |

- \* Recall the effect earthworms have on garden soil. ...14)

- \* Observe and record the movement and response of snails. ...16)

- 2 -

- |  | <u>CARD NUMBER</u> |
|--|--------------------|
| * Use an arthropod classification key to identify examples of the 5 arthropod groups.                          | (Answer Sheet 5)   |
| * Recall some dangerous arthropods.  | (Answer Sheet 6)   |
| * Recall the main external features of an insect. Build a model insect.  | ...19)             |
| * Distinguish vertebrates from invertebrates.  | ...20)             |
|  |                    |
| * Distinguish between the 5 vertebrate classes on the basis of body covering.                                  | (Answer Sheet 7)   |
| * Recall that animals are classified on the basis of their level of development based on many characteristics. | ...20)             |

PLANTS AND ANIMALS

WHAT IS CLASSIFICATION?

There are many, many types of living things on the Earth. There are so many different types of plants and animals, that we need to sort them out in order to study them closely.

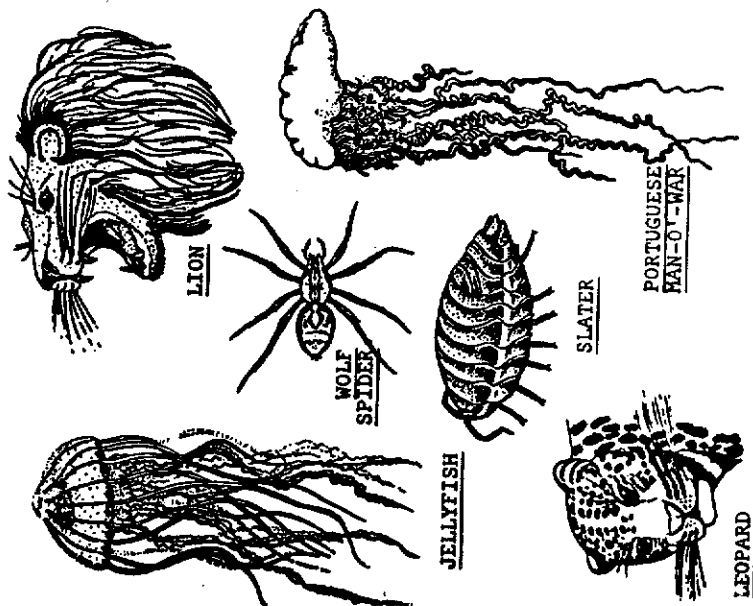
Q1. COPY THIS INFORMATION.

IN SCIENCE, SORTING THINGS INTO GROUPS IS CALLED CLASSIFICATION. WE NEED TO CLASSIFY LIVING THINGS SO WE CAN STUDY THEM EASIER.

CLASSIFYING SOME ANIMALS.

Now let's see if living things can be sorted into groups. For example, look at the animals below.

Q2. Which animals look most alike?



You probably decided that the animals which look alike are -

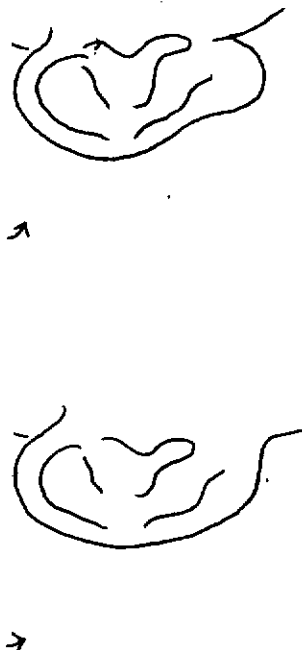
- Group 1 - Lion and Leopard.
- Group 2 - Jellyfish and Portuguese Man-O-War.
- Group 3 - Wolf Spider and Slater.

MAKING A CLASSIFICATION KEY.

Suppose you wanted to sort out your class into groups. Each group will contain people with similar features. Firstly, you might sort them into male and female groups. But each group still contains people with different features. You have to find other ways to separate them into still smaller groups which are even more alike.

Here are some other ways -

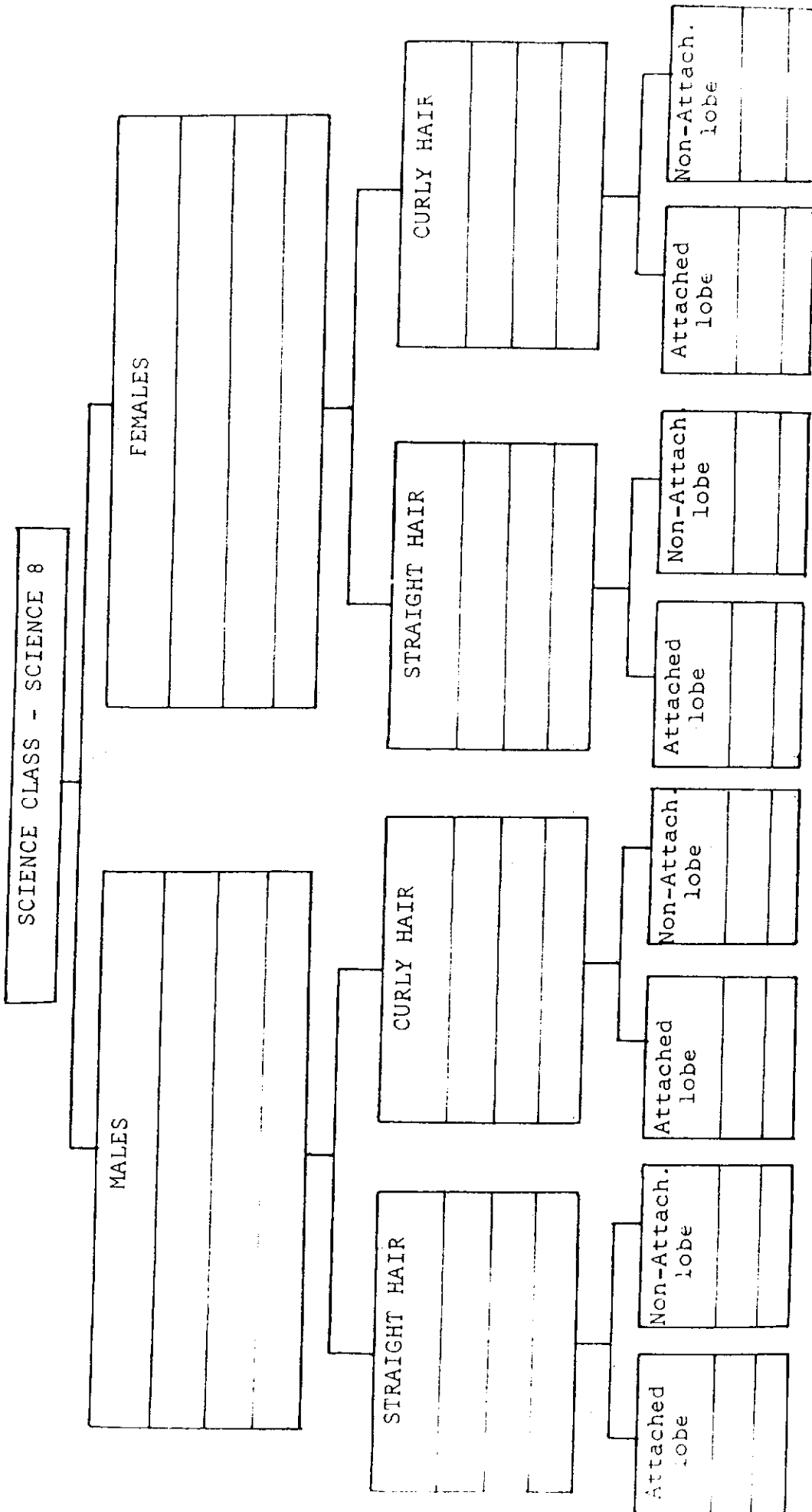
- Dark hair OR Light hair
- Straight hair OR Curly hair
- Earlobe attached OR Earlobe not attached (See diagram below).



ACTIVITY.

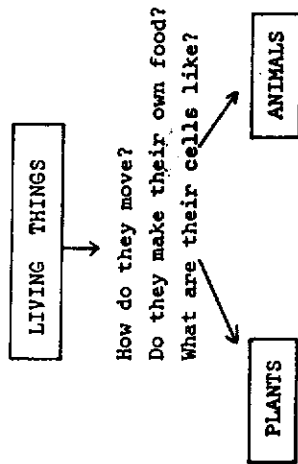
1. Ask your teacher for Answer Sheet 1 "Making a Key".
2. Fill in the names of your class members in the correct boxes, starting from the top. You will have to look at each person in your class and decide if they have the feature or not.
3. Answer these questions when you have finished making your key.
  - Q3. Did you find some people difficult to sort into a group? Why? (Scientists sometimes find it difficult classifying some plants or animals too!).
  - Q4. Can you think of other features to classify people with? Name some.

"MAKING A KEY"

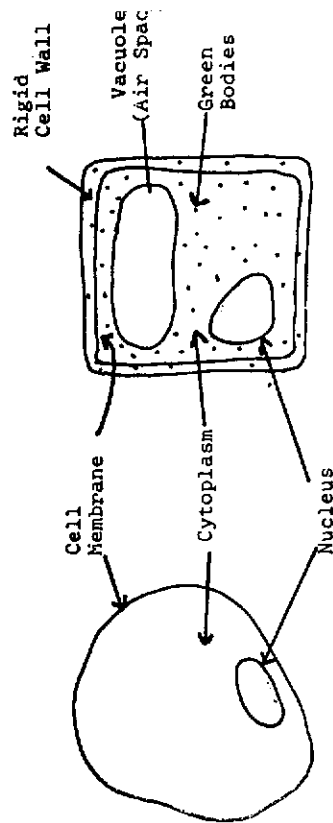


DIFFERENCES BETWEEN PLANTS AND ANIMALS

- All living things do the following -  
 they move, grow, respond to stimuli, digest food, respire, excrete waste products and reproduce. These processes help us recognise a living thing from something which is dead or non-living. But how can living things be classified into smaller groups?
- Living things are usually divided into 2 groups - plants and animals. The difference between plants and animals is based on difference in three main areas -
- \* their movement,
  - \* whether they make their own food or not, and
  - \* the structure of their cells.



- Q1. Copy the above diagram. It shows the questions to ask on deciding whether a living thing is a plant or animal.
- Q2. Look at the diagram below. It shows a plant and animal cell. Compare them and then list 3 differences between them.



ANIMAL CELL                      PLANT CELL

PLANTS and ANIMALS . . . CARD 2

- 2 -

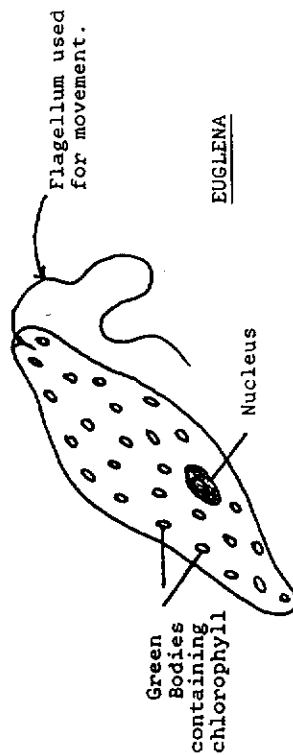
- Q3. Copy the table below. It summarises the main differences between plants and animals.

PLANTS	ANIMALS
1. Plants remain fixed in one place, expend little energy and move only slowly by growth.	1. Animals move from place to place in search of food and to escape enemies.
2. Most plants are green and make their own food using the process photosynthesis.	2. Animals obtain their food ready made from plants or other animals.
3. Plant cells are box shaped, have a hard cell wall and contain green chlorophyll.	3. Animal cells may be any shape, have no hard wall or chlorophyll.

- Q4. Refer to the BIOLOGY RESOURCE BOOK pages 4 and 5. Look at the photos on these two pages and try to decide whether they are plant or animal, giving reasons to support your answers.

It is sometimes very difficult to classify living things. Euglena is a single cell that lives in water. (See diagram below).

It is green, it produces its own food, it has no cell wall, it moves quickly by waving its flagellum like a whip.



- Q5. Do you think it is a plant or animal? Give reasons to support your answer.

SIMPLE PLANTS - ALGAE and MOSSES.

The first plant groups we will look at are very simple. Unlike plants growing in your garden, the algae and mosses have no true leaves, stems or roots.

LOOKING AT ALGAE

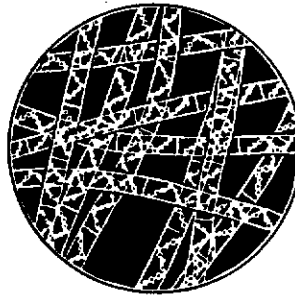
Algae vary from microscopic single cells, or small groups of cells to giant kelps which grow to lengths up to fifty metres. ALL algae live in water - either fresh or saltwater. In the upper layers of the ocean tiny algae form a major part of the plankton. The plant plankton are a major source of food for many ocean animals.

ACTIVITY

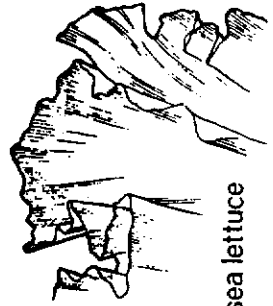
1. Your teacher will supply specimens of freshwater algae and seaweed.
2. The Freshwater Algae may look like green hair. This pond slime is made of many cells strung together to form a filament.

Observe some filaments in a Wet Mount Slide. Use low power on the Monocular Microscope to observe the cells.

3. Draw a diagram of what you can see with the microscope. (It should look like this diagram).



pond slime



sea lettuce

4. Observe specimens of Seaweed. Draw a diagram of one specimen.
5. Identify and label on your diagram the holdfast (like short roots, but all it does is to attach the plant to the reef), and the thallus. (The leafy-like part).

PLANTS and ANIMALS : CARD 3

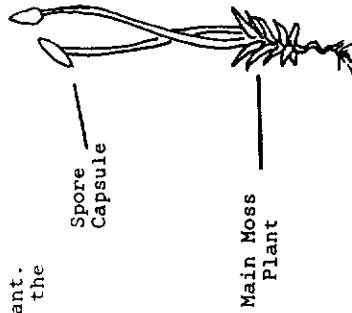
- 2 -

LOOKING AT MOSSES

Mosses live on land in damp places. They reproduce by forming resistant cells known as Spores which can survive drying out. Mosses grow usually on rocks in spreading clumps.

ACTIVITY

1. Look at some moss plants supplied by your teacher.
2. You may need a hand lens and forceps (tweezers) to separate out the individual plants.
3. Draw an individual moss plant. Label your diagram to show the spore capsule.



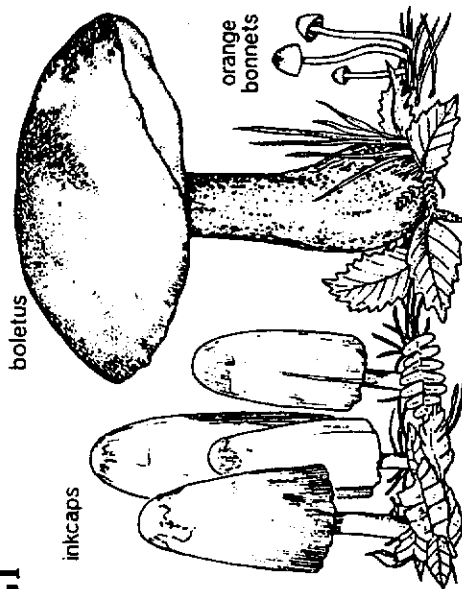
SUMMARY

Algae and Mosses are simple plants because they do not have true roots, stems or leaves. Algae live in water and vary from single cells (plankton) to large seaweeds. Mosses live on land, forming large clumps in damp places. They reproduce by spores.

- Q1. Copy the above summary.
- Q2. When large algae are lifted from the water they collapse because they have no strong stem. Why don't they need a stem?
- Q3. Another name for plant plankton is phyto plankton. Why is it called this? (hint, phyto means light).
- Q4. Where in your garden would you look to find mosses growing?

UNUSUAL PLANTS - FUNGI

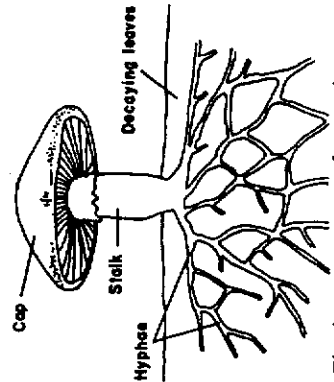
# FUNGI



Fungi are unusual because they are not green. This is because they do not contain the green pigment chlorophyll that is responsible for photosynthesis. Fungi may be brown, white or even bright orange!

Because they make their own food, Fungi need to grow on something they can use for food. Mushrooms often grow on decaying leaves or near animal manure. Moulds grow on bread, fruit or jam.

All Fungi have many fine thread-like filaments called hyphae which grow out to collect the food.



The largest parts of a mushroom plant are the hyphae which grow through the decaying matter.

The fungus may also contain a reproductive part that releases tiny spores. These float in the air and may grow into a new fungi.

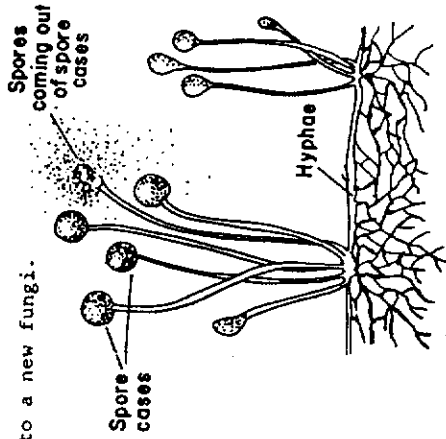
Most fungi are decomposers, but a few are parasites. Rust fungus grows on wheat. Kingworm is a fungus that grows on or just underneath the skin.

Fungi have a variety of uses. Some such as mushrooms are used as food, while yeast is used in bread and beer making. One special fungus is used to make the antibiotic Penicillin.

## SUMMARY

### Bread mould

Fungi are unusual plants because they have no chlorophyll and therefore are not green. Fungi usually live on the dead remains of other plants or animals. Fungi reproduce by spores and budding. They vary in size from microscopic yeasts to large mushrooms.



- Q1. Copy the above summary.
- Q2. Copy the diagram of the mushroom OR the bread mould. Label spores and hyphae.
- Q3. List 2 useful fungi, and 2 harmful fungi.
- Q4. Why do we still classify fungi in the plant group if they cannot photosynthesize?

## NON-GREEN PLANTS I

What conditions favour the growth of a fungus such as Bread Mould?

We will do an experiment to find out.

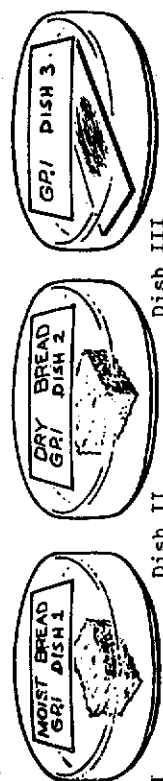
Read the following method.

### METHOD

1. Label your petri dishes as I, II and III. Write your group name on each one.
2. Place a piece of dry bread into Dish I, wet it and expose it to the air for 20 minutes. Replace the cover on the petri dish. Tape the two halves of the dish together.
3. Place a piece of dry bread into Dish II. Expose it to the air for 20 minutes and replace the cover. Tape the two halves of the dish together.
4. Smear one side of the microscope slide with petroleum jelly.
5. Place the microscope slide (petroleum jelly side up) into Dish III. Expose it to the air for 20 minutes. Replace the cover on the dish.
6. Examine these petri dishes regularly over the next three days.
7. Your teacher will tell you where to leave your petri dishes.

### NOTE :

WHEN YOU RECORD YOUR OBSERVATIONS, REMEMBER TO LEAVE YOUR PETRI DISHES TAPED UP. SOME OF THE ORGANISMS THAT MAY GROW, MAY BE DANGEROUS TO YOUR HEALTH.



Dish I

Dish II

Dish III

Scientists often will set up an experiment like this with a prediction of what will happen. This is called a hypothesis.

### COPY AND COMPLETE THE FOLLOWING -

Hypothesis : I think that bread mould will grow best in dish .....

Predict what will happen in -

Dish I

Dish II

Dish III

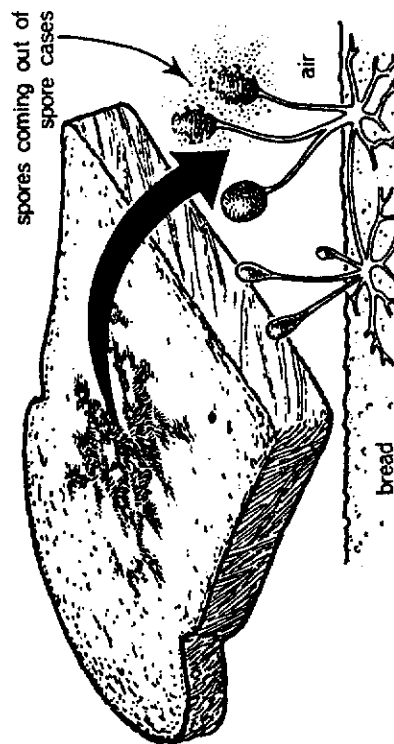
## NON-GREEN PLANTS II

### RESULTS - (After several days).

- \* Observe your petri dishes.
- \* DO NOT lift the lid of the petri dish - some fungi are harmful!

### \* ANSWER THE FOLLOWING QUESTIONS

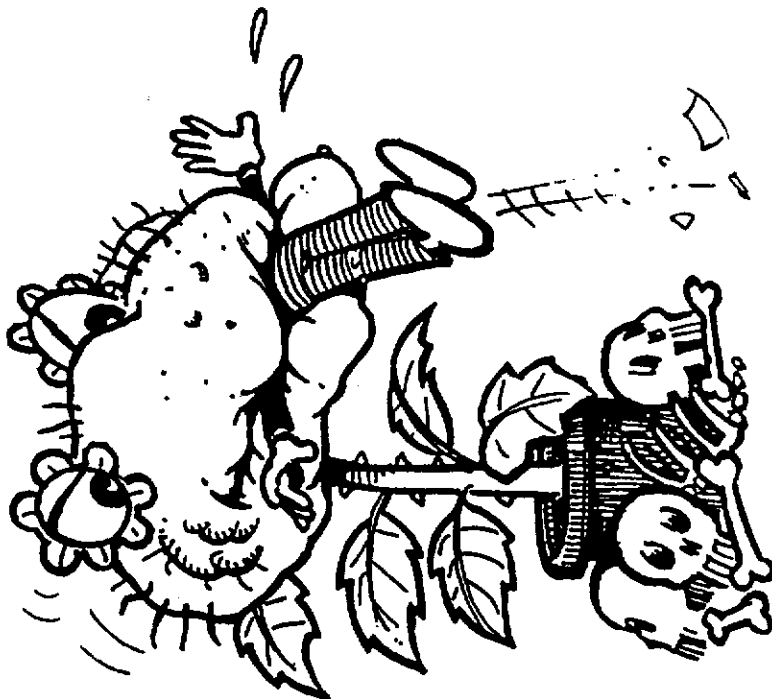
- Q1. Was your prediction for Dish I correct? If not, describe what happened.
- Q2. Was your prediction for Dish II correct? If not, describe what happened.
- Q3. What data supports your hypothesis? Explain.
- Q4. What data did not support your hypothesis? Explain.
- Q5. Do you think this experiment supports, or does not support, the hypothesis? Why?



- Q6. List some ways that can be used to prevent foods from becoming mouldy.

## CARNIVOROUS PLANTS

1. Define the term carnivorous.
2. List at least three carnivorous plants.
3. For each one -
  - a) State where it grows.
  - b) Provide a general description.
  - c) State what it 'eats'.
4. Why do carnivorous plants need to 'eat' although they usually photosynthesize?
5. Name some Western Australian examples of carnivorous plants.



## LICHENS

Lichens are composed of two plant types which live together symbiotically.

- Q1. What does symbiosis mean?
- Q2. What are the two plant types involved?
- Q3. How does each help the other?
- Q4. Where are lichens found in Western Australia?

In barren places, such as tundra regions, lichens are often eaten by animals for food.

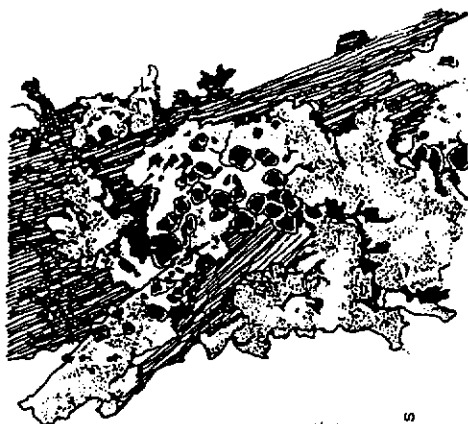
- Q5. Where are the tundra regions of the world?
- Q6. Name two animals that eat lichens.

Lichens are useful to humans as food, dyes and indicators of air and terrestrial pollution.

What food is made from Iceland Moss? (A type of lichen).

An acid-base indicator used in chemistry is also made from a lichen.

- Q7. What is the name of this indicator?
- Q8. Name some pollutants to which lichens are sensitive.





# F E R N S

Ferns are much larger than moss, fungi and most algae. They also have true roots, stems and leaves and an internal transport system to carry food and water.

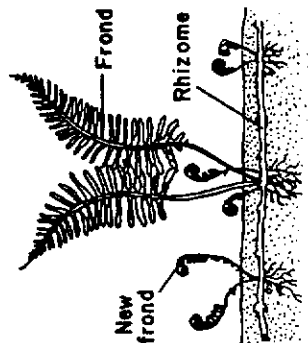
Ferns live in shady, cool places such as rainforests where there is plenty of water.

Examples of ferns



The stem of a fern plant is called a RHIZOME. In some forms this grows horizontally under the surface of the soil. The fern you can see above the ground is usually just the leaf or frond.

New fronds are curled, as they grow they uncurl. Throughout the rhizome and fronds, small tubes called veins can be seen. These carry water and food to all parts of the plant.



Fern stems or rhizomes grow horizontally under the ground.

Ferns, like mosses and fungi : reproduce by spreading spores. These are found under the mature fronds in spore cases. Thousands of tiny spores will be released when the spore case opens and some will grow into new fern plants, given the right conditions.

## ACTIVITY

1. Observe a mature fern frond provided by your teacher.
2. Draw a labelled diagram of the surface of the frond and show the veins and stem.
3. Look carefully at the underside of the frond. Identify small brown spots. These are the spore cases. Use a hand lens or binocular microscope to observe the spore cases. You may even be able to see individual spores.
4. Stick a small section of fern frond into your notes, using sticky tape. Label the spore cases.

## SUMMARY

Ferns may be small or large, but all require moisture.  
Ferns have proper leaves, stems and roots with a well developed transport system of veins.  
The veins are like small tubes which carry food and water to all parts of the plant.  
Reproduction, like in mosses and fungi is by means of spores.

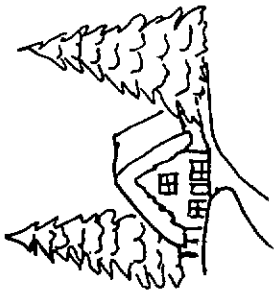
## QUESTIONS :

- Q1. Copy the above summary.
- Q2. Mosses grow close to the ground but ferns grow much taller. What enables ferns to grow much larger than mosses?
- Q3. List 2 main differences between fungi and ferns.
- Q4. Why do ferns usually have to be kept in a greenhouse?

CONIFERS

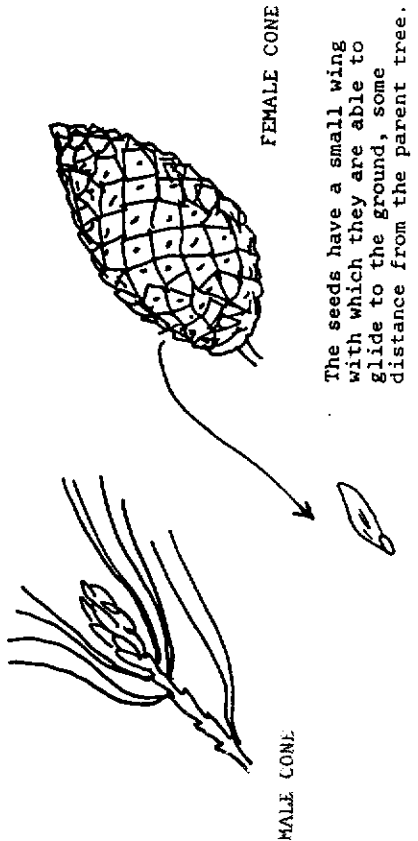
Fungi, mosses and ferns all reproduce by spores. Conifers and flowering plants reproduce by seeds.

Conifers is the name of the group of plants which includes, firs, pines, cypresses and the giant American Redwood. These plants range from small shrubs to the largest trees in the world.



Conifers are often shown covered in snow in Christmas Cards.

All conifers have cones. The male cones are small and produce the male sex cell - pollen. The female cones are larger and woody. They produce the seeds. Pollen from a male cone (from another tree) is blown onto the female cone where fertilization takes place. The seeds develop, and when ready, the female cone dries and cracks open.



ACTIVITY 1.

Your teacher may let you observe some conifers in the school grounds (near the staff carpark). Observe the bark, trunk and shape of the conifer tree.

Collect some leaves (pine-needles) and cones which may be on the ground.

ACTIVITY 2.

1. Observe some pine needles. They are modified leaves.

Q1. Why are they thin and needle-like? (Hint - think back to the Christmas Card - the pines are covered in snow).

2. Stick some pine needles into your notebook with sticky tape.

3. Observe male cones - small and papery, and female cones - large and woody.

Try and find any remaining winged seeds inside the female cone.

Q2. What is the purpose of the wing on the seed?

4. If you have found a winged seed, toss it into the air and observe how it glides.

Q3. COPY THE SUMMARY BELOW.

SUMMARY

Conifers vary from small shrubs to very large, woody trees. They all have cones, both male and female.

Male cones produce pollen. Female cones are fertilized by the male pollen and develop seeds.

The leaves of conifers are long and thin. Conifers are very useful to man because of the valuable timber they provide.

Q4. Conifers can grow very tall. How does the water get from the roots in the ground to the topmost leaves?

## FLOWERING PLANTS

The flowering plants (proper name is Angiosperms), are found in nearly all places on earth.

This large group of plants includes grasses, bushes, most trees, shrubs, weeds, flowers and even water plants like water-lilies. Like the conifers, they have roots, stems and leaves. However, flowering plants develop seeds from a flower, not a cone.

The seeds are usually carried in some kind of fruit such as an apple, pumpkin or even a gum nut.

### PARTS OF FLOWERING PLANTS.

The main parts and their functions are -

- 1) Leaves - make food using the process photosynthesis.
- 2) Flowers - produce seeds for reproduction.
- 3) Fruit - protect and disperse the seeds.
- 4) Stems - transport water and food in the veins and conducting vessels. Support the plant in an upright position.
- 5) Roots - anchor the plant in the ground and absorb water and minerals from the soil.

### ACTIVITY 1

Collect Answer Sheet 2 from your teacher. "Parts of Flowering Plants".  
Label the parts of a flowering plant and write the function of each part next to the label.

### REPRODUCTION IN FLOWERING PLANTS.

Most flowers produce both male and female sex cells. However, the female egg cell is fertilised by a pollen from another flower. This is called cross pollination. (See diagram below).

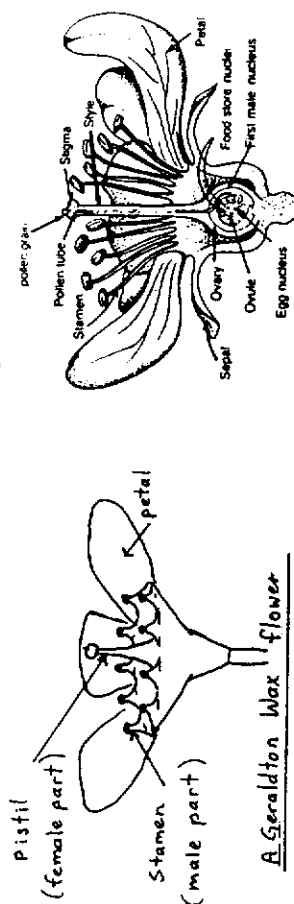


A flower on one plant has its pollen carried to the flower of another plant.

After the male and female cells unite, the flower dies off and a fruit forms. The seeds form within the fruit.

## ACTIVITY 2 - THE FLOWER

1. Collect a single flower from your teacher. (Geraldton Wax flowers are good examples).  
Also collect a hand lens and forceps.
2. Identify the parts of a flower from the diagram below. Stick the petals, pistil and stamens into your notebook with sticky tape, and label the parts.



Section of a typical flower to show fertilization

3. Collect some examples of fruit.  
These may include - peas in their pod.  
- apple or oranges.  
- gum nuts.

Observe the seeds. Remember this fruit was once a flower!

### SUMMARY

Flowering plants vary widely from grasses to large trees. They are a very successful group and they all have flowers and well developed leaves, stems, and roots.

Most flowers have male and female parts. The male sex cell (pollen) is carried to another flower by insects or the wind. Fertilisation takes place and the female sex cell becomes a seed. This is dispersed in a special structure called the fruit.

### QUESTIONS

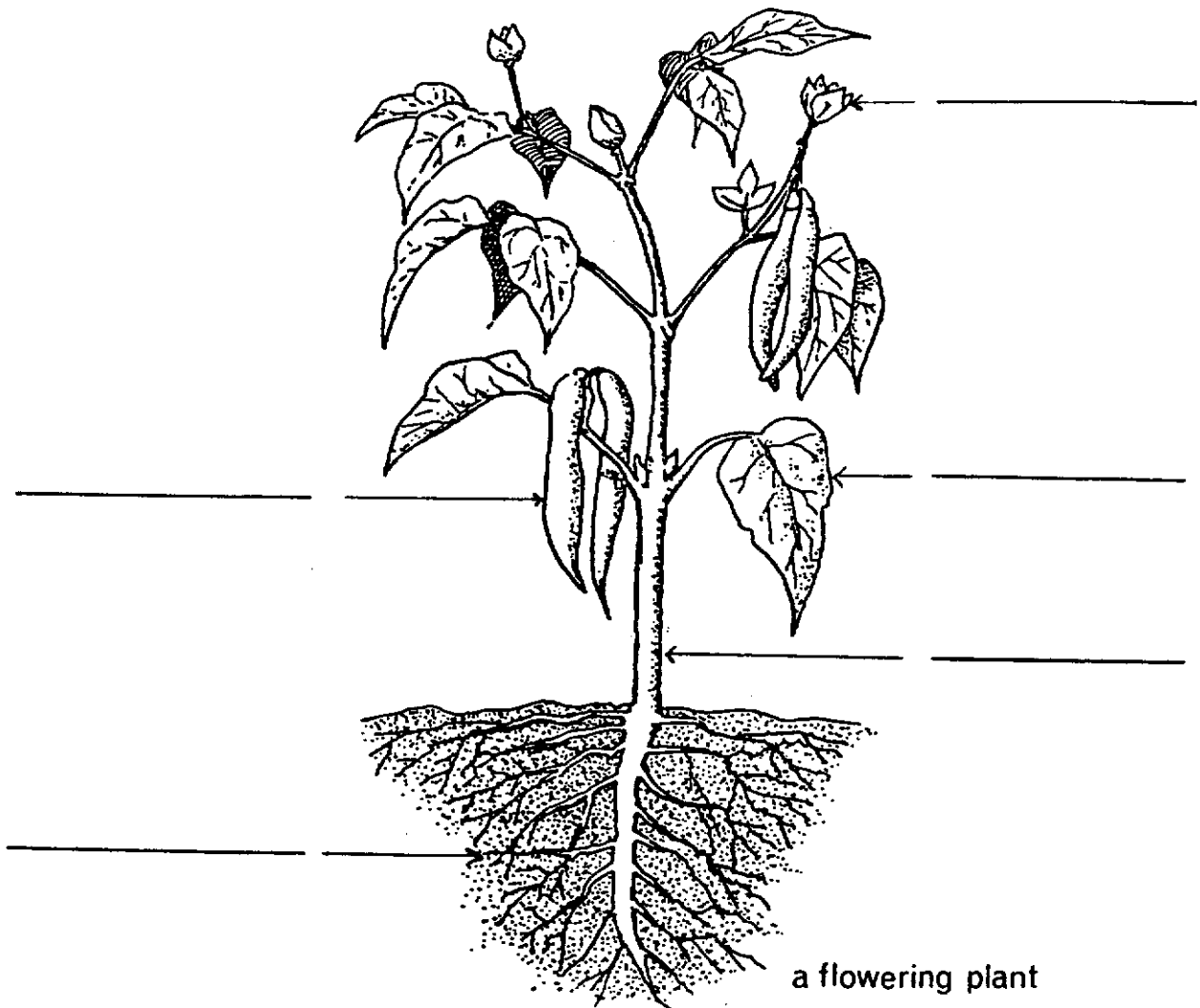
- Q1. Why are flowers brightly coloured and often sweet smelling?
- Q2. Most grasses are not brightly coloured and do not attract pollinating insects.  
How does pollination occur in these plants?
- Q3. Name 5 fruits that contain seeds.  
Why do fruits taste nice?  
If you throw away an apple core onto wet soil, what might grow later?

NAME : \_\_\_\_\_

## PARTS OF FLOWERING PLANTS

Clearly label the main structures of the plant below.

Under each label, list the functions of each structure.



CLASSIFYING PLANTS

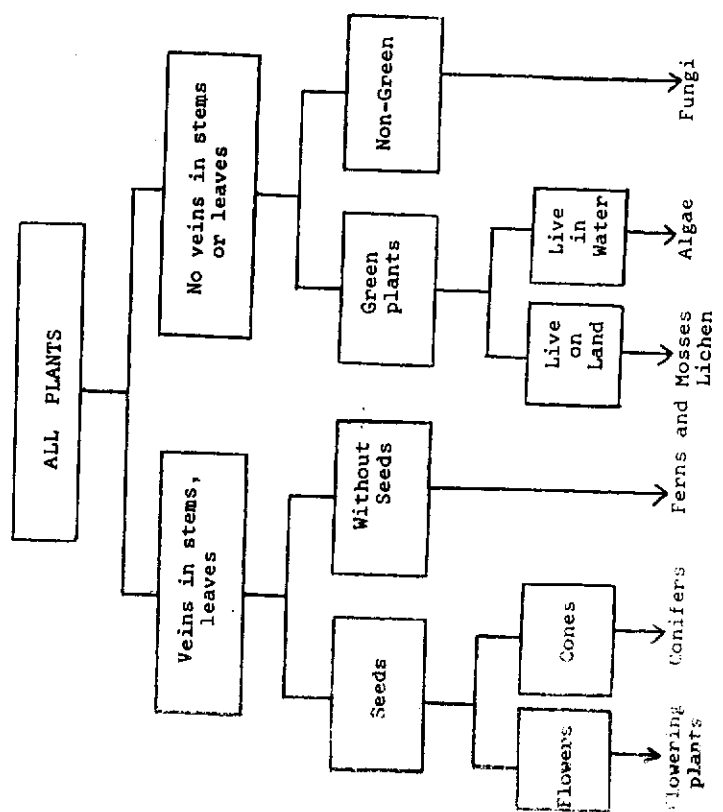
In this topic so far you have studied the following plant groups.

Algae, mosses, fungi, lichens, ferns, conifers and flowering plants.

You should realize that plants can be grouped according to whether or not they have the following features -

- veins or no veins,
- green (contain chlorophyll) or non-green,
- spores or seeds,
- flowers or cones,
- live on land or in water.

The classification key below shows how we can classify the above plant groups. Study it closely then copy it into your notes.



PLANTS and ANIMALS : CARD 10

- 2 -

ACTIVITY

You will now use the classification key to identify some plants.

1. Collect Answer Sheet 3 "Classifying Plants".
2. Your teacher will supply a variety of plant specimens such as these. They are all numbered -

1. Seaweed.
2. Mushroom.
3. Green pond slime.
4. Bread mould.
5. Gum tree.
6. Brown seaweed.
7. Fishbone fern.
8. Pine tree.
9. Geraldton Wax.
10. Moss.
11. Lichen.
12. Geranium.

3. Completely fill in the table on Answer Sheet 3 for each of the above specimens.
4. Use the classification key to help you decide on the name of the plant group to which each specimen belongs.
5. Write the name of the plant group under the heading - phylum.

NAME : \_\_\_\_\_

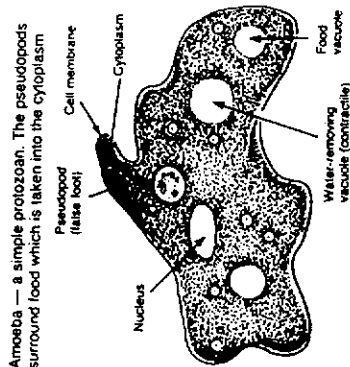
CLASSIFYING PLANTS

Plant Number	Veins or no veins	Green or Non-Green	Seeds or Spores	Flowers or Cones	Land Living or Water Living	Phylum (plant group)

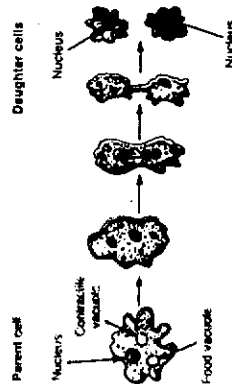
SINGLE-CELLED ANIMALS - PROTOZOA

The simplest type of animals are one-celled and live in water. Some are free-living while others are parasites, living inside the bodies of other animals.

The disease Amoebic Meningitis is caused by a type of amoeba which lives in the liquid surrounding the brain of humans. (See diagram below).



Simple fission in an amoeba. The daughter cells each have the same size as the parent cell. They soon grow to full size.



Some protozoa move freely by waving hairs called cilia, while others are fixed in one spot by a holdfast.

Protozoa reproduce asexually - by simply splitting into two as shown below, or by sexual methods.

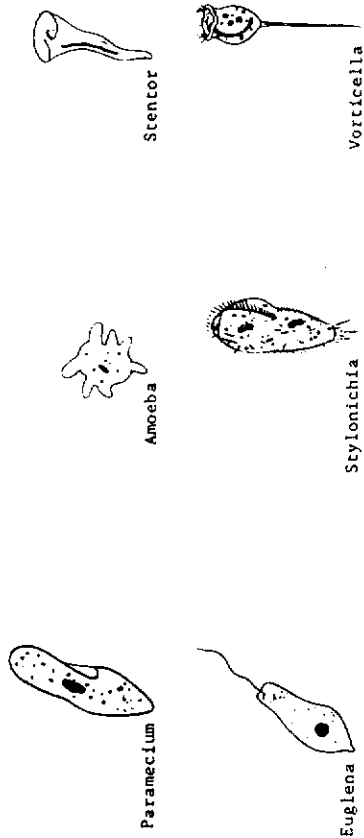
Because of the speed with which they can reproduce, a very large number of protozoa can be produced in a fairly short time. Protozoa are an important food source. They are a major part of the plankton and are a source of food for many other animals.

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SUMMARY

Protozoa are microscopic, single-celled animals which live in water. Most are free-living but some are parasitic and can cause diseases. They vary in their complexity and movement. They reproduce by themselves (ASEXUAL) or with another mate (SEXUAL).

EXAMPLES OF PROTOZOA

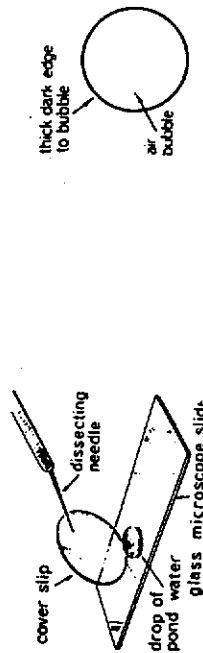


During this activity, you will prepare a wet mount slide and see some protozoa.

REMEMBER: Use low power to find them. This magnification should be sufficient to enable you to see them.

METHOD:

1. Stir up the water in the jar containing protozoa. Take a small sample of water with an eye-dropper.
2. Place one drop of water on a glass slide and add a cover slip. Be careful not to trap air bubbles when you add the cover slip.



3. When you find a protozoan, you may need to move the slide to follow it.

- Q1. Which way did you have to move the microscope slide to follow your protozoan?
4. Record the shape of the protozoan by a simple drawing.
5. Comment on its movement.
- Q2. Is it fast or slow?
- Q3. Is it random or directed?
- Q4. Did it have any structures which seemed to help it move along?
- Q5. What features do all these animals have in common?

# SIMPLE WATER ANIMALS

Animals other than Protozoans have many cells. PORIFERA - commonly called sponges and COELENTERATES - usually known as jellyfish and sea anemones have many cells. They are very simple animals because they have little development of internal structures. Both groups of animals rely upon water and cannot live without it. They are found in all the waters of the world though most are in salt water and close to the land.

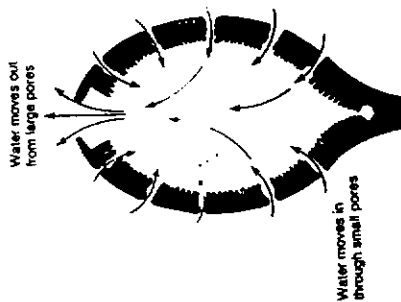
## THE SPONGES - PORIFERA.

Porifera is a name given to simple water animals with pores through their body. After they die, a type of skeleton is left behind - this is called a sponge.

Sponges are common animals attached to reefs and jetty pylons. They obtain food from sea water passing into the animal. The sea water contains plankton and other matter which is digested by cells inside the sponge.

Sponges can reproduce sexually by producing both male and female cells. Fertilization is outside the sponge, in the open water. The new sponge drifts for a while then settles down.

Reproduction can also be by regeneration. This is when a small part breaks off and regrows to form a new part.



## ACTIVITY 1

1. Observe skeletons of sponges provided by your teacher.
2. Try and find large inlet and outlet pores that allow sea water to move inside and out.
3. Draw a simple sponge skeleton. Then draw arrows on your diagram (like in the above diagram) to show the water movement.

## SUMMARY

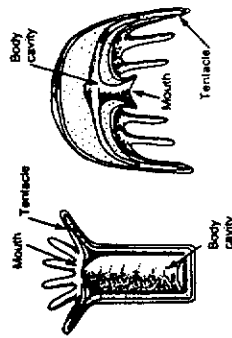
Porifera is the name given to a group of simple water animals commonly called sponges. The name porifera refers to the many pores that cover the sponge skeleton and allow the water to be filtered by the sponge. These animals can reproduce sexually or asexually.

# JELLYFISH AND SEA ANEMONES - COELENTERATES

These animals include jellyfish, coral polyps, hydra and sea anemones. They all have a hollow gut and long tentacles with which they catch food.

On the tentacles are many stinging cells which paralyse small water animals. The tentacles then bring the food to the mouth.

Some jellyfish have particularly dangerous stinging cells - Portuguese Man-of-War and the Sea Wasp are two deadly kinds.

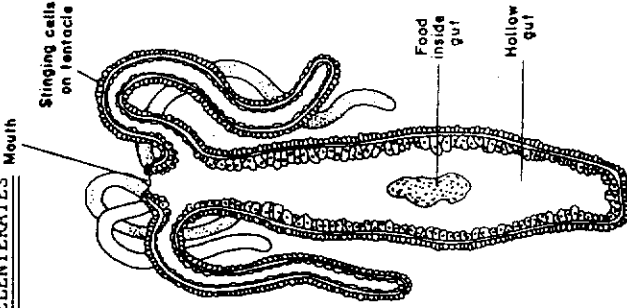


The body construction of the coral polyp and jellyfish.

Coral polyps are a kind of sea anemone that live in a colony. They secrete a hard skeleton made from salts such as calcium, found in sea water.

The skeleton called coral, protects the polyps. The polyp feeds usually at night by extending its tentacles beyond the coral skeleton. Large colonies of corals may build up entire reefs and small islands over thousands of years.

A sideways view of a hydra



## ACTIVITY 2.

1. Observe specimens of Coelenterates provided by your teacher.
2. Identify coral (the polyps have died and long since gone), jellyfish and sea anemones.
3. Draw 2 diagrams, 1 of a sea anemone, the other of a jellyfish. Label tentacles, hollow gut and stinging cells.

## SUMMARY

The Coelenterates are a group of water living, hollow bodied animals such as jellyfish, sea anemones and corals. They have tentacles with stinging cells to capture and paralyse their prey. Some are attached, others float in the water. Like the Porifera group they reproduce sexually or asexually.

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## QUESTIONS:

1. In what way do sponges and jellyfish differ?
2. Before plastics were developed, people used the sponge skeleton. What do you think they were used for?
3. A sea anemone only has 1 body opening. Describe what it must use this opening for.



WORMS - THE ANNELIDS

There are many types of worms in the Animal Kingdom. Some types are flatworms, roundworms and segmented worms. We will only look at the segmented worms, the Annelids.

Earthworms and leeches are two common examples of this group. They both have segments that look like rings around their bodies.

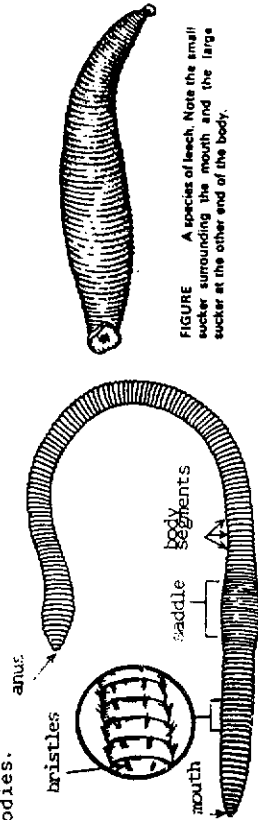


FIGURE A species of leech. Note the small sucker surrounding the mouth and the large sucker at the other end of the body.

These segments expand and contract and enable the worm to stretch out and move along.

Earthworms live in moist soil, while leeches live in water. Both need to have their skins moist because otherwise they dry out and die. A moist skin is also needed for breathing oxygen is taken in directly through the skin.

Reproduction in this animal group is unusual.

Earthworms and leeches carry both male and female sex cells. They avoid self-fertilization by swapping the sex cells by use of a saddle like structure called the clitellum.

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SUMMARY

Annelids are the segmented worms and include leeches and earthworms.

They have segments to their tubular bodies. Their skins are moist to enable them to breathe.

Reproduction involves swapping male and female sex cells, as most annelids carry both sex cells.

ACTIVITY 1. - LEECHES

If specimens are available, observe the long segmented body, and the suckers at either end.

- Q1. Sketch a leech in your notes. (Copy the diagram above if specimens are unavailable).
- Q2. What do leeches eat? How do they do this?
- Q3. Where do leeches live?

ACTIVITY 2. - EARTHWORMS

Place your live earthworm in a glass petri dish. Add a few drops of water so it does not dry out.



Examine your earthworm using the lens.

Listen to the earthworm crawling on the paper.

Run your finger first along the underside of the earthworm's body, then along its back.

Q4. What is the length of your earthworm when it is not moving? (Measure in millimetres).

Q5. Does the length change when it moves forward? Describe how it moves.

Q6. Try placing your earthworm on a piece of moist paper. Does it move easier?

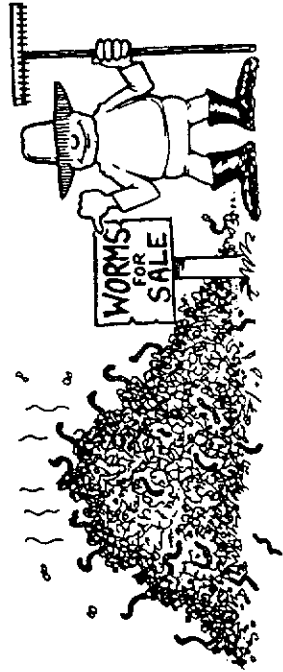
Earthworms have small bristles on their side that helps them grip the ground. Could you feel them with your fingers? You may have heard them scraping on the paper.

Q7. Does your earthworm have a saddle? Is the saddle close to the head or tail end?

Q8. Draw a diagram of your earthworm. Label the head, tail, segmented body and saddle.

Q9. What do earthworms eat?

Q10. Why are earthworms of value to farmers and gardeners?

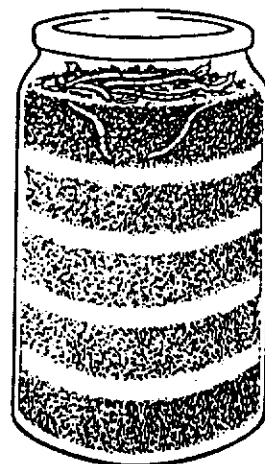


## WHAT DO WORMS DO TO THE SOIL?

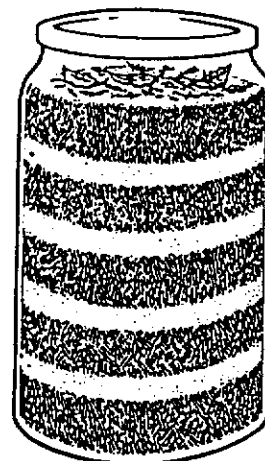
1. Moisten all soil to be used in this activity.
2. Using a spoon, put a layer of dark garden soil about 4 cm deep in the bottom of the jar. Next add a very thin layer of light sand (or powdered chalk), then another 4 cm layer of dark soil.

Repeat these alternating layers to within 5 cm of the top of the jar.

3. Press each layer down and make it level before adding the next layer.
4. Prepare a second jar repeating steps 2 and 3.
5. Add six large earthworms to one jar only.
6. Cover the sides of the jars completely with brown paper (or foil) and hold it in place with an elastic band or string.
7. Label the jars.
8. At the end of one week, remove the covers from the sides of the jars and answer the following questions:



EXPERIMENTAL

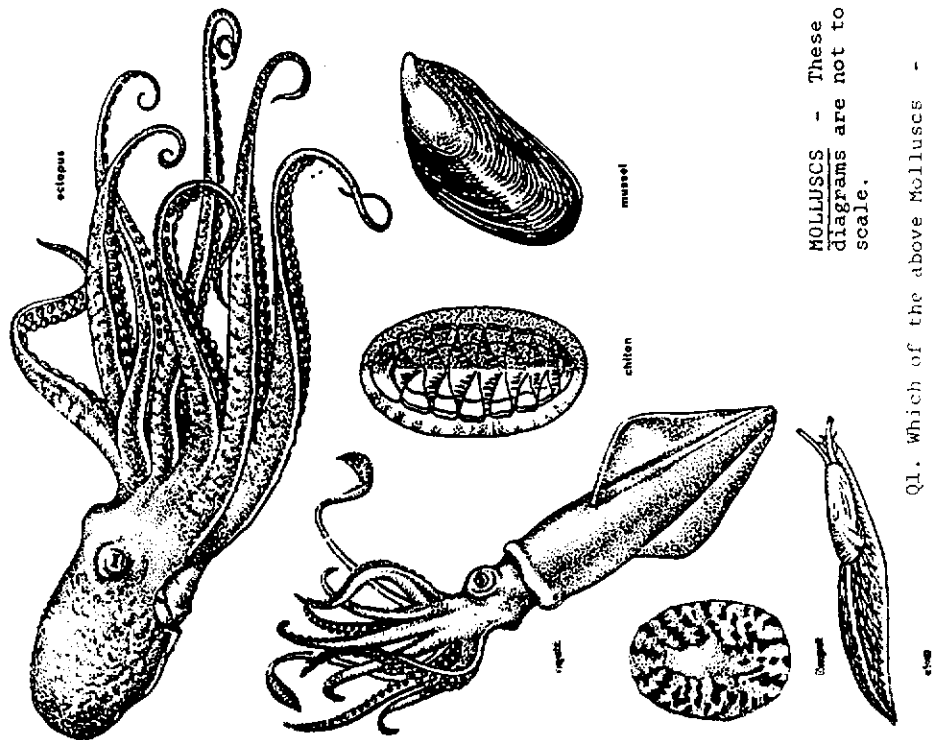


CONTROL

- Q.(a) Can you see any burrows at the side of the jar?
- Q.(b) If so, what shape are the burrows?
- Q.(c) Have the burrows gone through the layers of different coloured soils?
- Q.(d) Have the different layers of soil been mixed?
- Q.(e) What conclusions can you come to about the effect of the burrowings of earthworms?
- Q.(f) How do you think the mixing of layers has occurred?
- Q.(g) Do more worms appear to live at the bottom of the jar than the top?  
Give reasons for your answer.

SHELLFISH - THE MOLLUSCS

The Molluscs are usually known as shellfish because of the hard protective shell that most of these animals have. Some Molluscs do not have shells, while others like the cuttlefish have a hard internal structure. Of course shellfish like snails and squids look nothing like fish - See diagram below.



MOLLUSCS - These diagrams are not to scale.

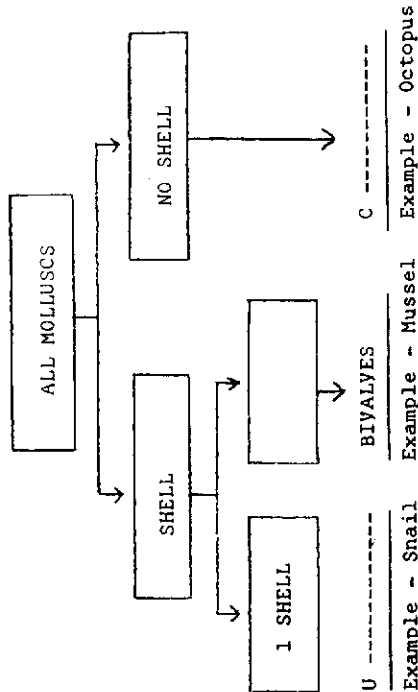
- Q1. Which of the above Molluscs -
- a) have a shell?
  - b) have tentacles with suckers?
  - c) can move quickly?

Molluscs are mainly water animals. They reproduce sexually, the females producing hundreds of eggs. Most snails reproduce like earthworms in that they have both sex organs.

\* All molluscs are classified according to the presence or absence of a shell.

If one shell - UNIVALVES or 2 shells - BIVALVES. CEPHALAPODS have no shells and include octopus, squid and cuttlefish.

Q2. Copy and complete the classification key below.



UNIVALVES - include animals such as the garden snail and slug and the marine shellfish such as the cowrie, baler shell, periwinkle and cone shell.

These molluscs all have a large muscular foot with which they move. Most univalves feed on algae or other plants.

BIVALVES

These animals have 2 shells, hinged together. They include scallops, oysters and mussels. They have a strong muscle to close the shell.

Some bivalves are attached, some are free moving. Most filter feed on plankton from the water.

CEPHALAPODS

These animals are well developed and have many special features. Squids, octopi (not octopussy!) and cuttlefish all have long tentacles with suckers, a beak like mouth and well developed eyes and brains. They can move quickly by squirting water, a form of jet propulsion. These are "intelligent" animals and they prey on fish, crabs and crayfish.

ACTIVITY

Look at the specimens provided by your teacher.  
Make sure you see at least one example from univalves, bivalves and cephalopods.

SUMMARY

Molluscs are animals which have shells.

They live in water, although some have adapted to living on land.

They reproduce sexually, producing many eggs.

Molluscs are herbivores, carnivores or filter feeders.

There are 3 main groups, UNIVALVE (single shell), BIVALVE (two shells) and CEPHALOPODS (no shell).

The Cephalopods are a highly developed group with many special features.

Q3. Copy the above summary.

Q4. What use does the shell of a mollusc serve?

Q5. What does the term filter feeder mean?

Q6. Is a filter feeder a herbivore, carnivore or omnivore?

Q7. In what ways are molluscs useful or harmful to people?

Q8. Collect Answer Sheet 4 from your teacher. Complete this for homework.

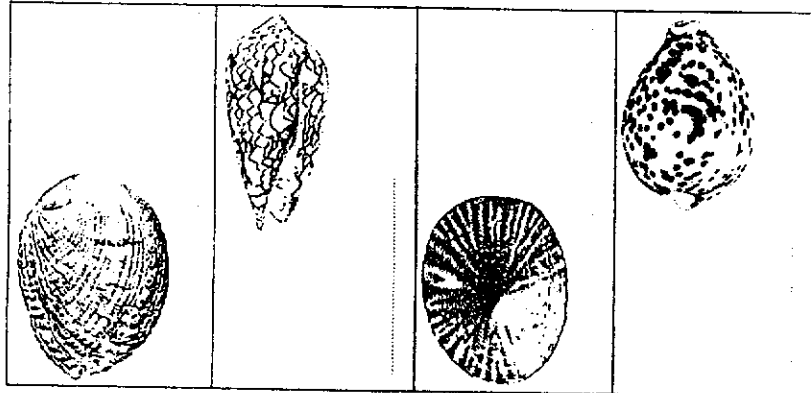
## WHAT DO YOU KNOW ABOUT MOLLUSCS?

Q1. What is one feature all molluscs have in common?  
.....

Here are drawings of some molluscs.

Write each one's name from the list given at right.

LIMPET  
CONE  
CLAM  
ABALONE  
MUSSEL  
SCALLOP  
COWRIE  
OYSTER



Q2. Which of the above Molluscs are eaten by humans?

Q3. Which of the above Molluscs are dangerous?

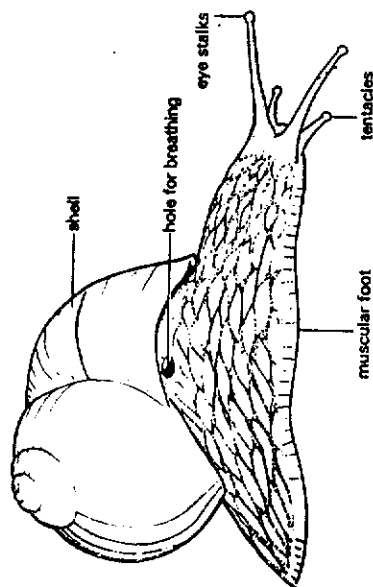
# LOOKING AT SNAILS

During the next activities take care of your snail. Do not break it's shell or let it dry out. You may want to keep your snail for later to see how it feeds.

## ACTIVITY 1. - OBSERVATIONS.

Collect your snail and observe it with a hand lens.

Q1. Copy the drawing below. Make sure you can identify all the parts on your snail.



Q2. How many coils are there in your snail's shell?

Q3. How does the snail allow for growth of it's shell?

Does it ...

- a) shed it's shell and grow a new one? or,
- b) increase the size of the shell by increasing the number of coils?

## ACTIVITY 2. - MOVEMENT.

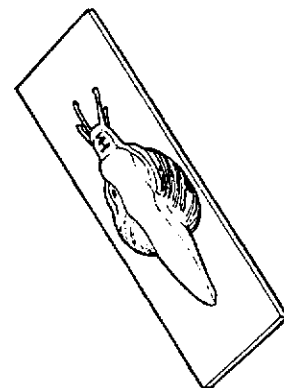
Place your snail at one end of a glass slide. When it starts to move, watch it from the side.

Now watch your snail from the underside of the slide.

Q4. Describe what you see.

Q5. You should see a slime trail left behind from the movement of the snail.

What do you think is the purpose of the slime trail?



## ACTIVITY 3. - SNAIL RESPONSES.

WHICH PART OF A SNAIL IS MOST SENSITIVE?

In this activity you will see how a snail responds when you touch it.

Q6. What is the stimulus in this activity?

Examine your snail closely. Predict which parts are the most sensitive.

Gently touch the different parts of your snail with a blunt pencil.



NOTE : If there is a response, wait until that part recovers its normal condition before touching another part of the snail.

Q7. Copy the table below, then record your observations.

PART OF THE SNAIL TOUCHED	RESPONSE
shell	
foot	
eye tentacle	
feeling tentacle	
head region	

Q8. Which part of the snail is the most delicate?

Q9. Which part of the snail would you say is the most sensitive? Why?

Q10. Are the most delicate parts of the snail the most sensitive? If so, suggest some reasons why this might be so.

## FURTHER ACTIVITIES

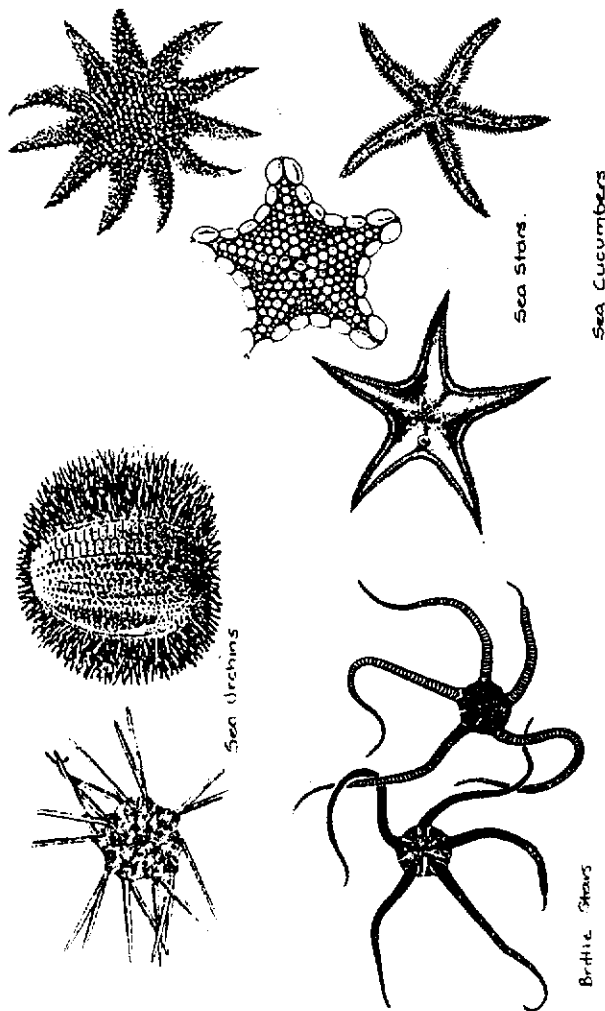
### SNAIL RACES



IS THE FASTEST SNAIL REALLY THE FASTEST? HAVE A SNAIL RACE AND FIND OUT!

# THE SPINY-SKIN

Echinoderm means spiny-skinned. If you have seen animals like sea urchins, sea stars (starfish) and sea cucumbers you will know why they are called spiny. One sea star is called the crown-of-thorns because of its large spines.



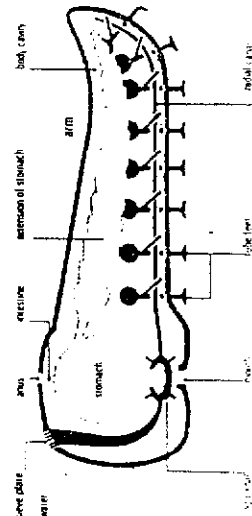
EXAMPLES OF ECHINODERMS.

All Echinoderms live in salt water, ranging from shallow tidal pools to the very deepest part of the oceans. They have a skeleton, made from a number of plates. One very distinctive feature is their RADIAL shape. This means they look from above like the spokes of a wheel. They spread out from a central area.

Another unusual feature is their well developed hydraulic system of TUBE FEET.

These small feet are operated by water pressure. Many hundreds of feet all move together to enable the sea star to move along.

Cross-section of a sea star.



Some echinoderms are carnivorous. They use their strong tube feet to pull apart bivalves like mussels and scallops. Other echinoderms such as sea urchins are herbivores, browsing on algae which they scrape off rocks.

Echinoderms reproduce sexually. The eggs and sperms are released into the open waters where fertilization takes place. The larvae float in the plankton then settle to the sea bed and grow larger. Sea stars can reproduce asexually too. If a sea star is cut so that pieces of arm and body are formed, the lost parts regrow. This is called regeneration.

## ACTIVITY

1. Observe specimens of echinoderms provided by your teacher.
2. Draw a sea star from above showing the radial shape.
3. Count the number of arms of some sea stars. Is their a common multiple?

## SUMMARY

Echinoderms are marine animals with spiny skins. They have a skeleton made of bony plates and a complex system of water filled tube feet. The tube feet help these animals to move and collect food.

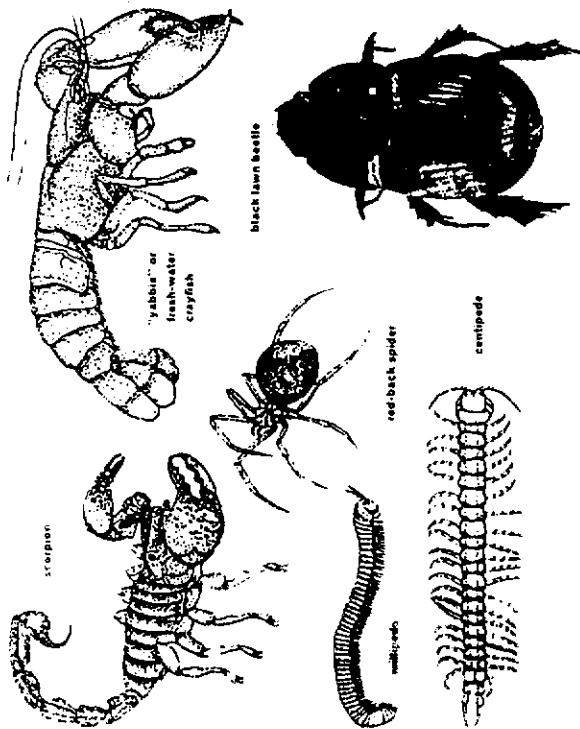
Reproduction is usually sexual, although regeneration may occur.

- Q1. Copy the above summary.
- Q2. Why are echinoderms only found in water?
- Q3. Explain why the name sea star is better than starfish.
- Q4. If you cut a sea star into two, what may happen to both halves?
- Q5. The crown-of-thorns has been seen in plague proportions feeding on coral reefs of Australia recently. Explain how they can quickly increase their numbers.

If you organised some divers to help you kill them, explain the methods you might use.

JOINTED LEGS - ARTHROPODS

The arthropods are the biggest group of all animals. Over one million different kinds of arthropods have been identified by biologists so far. Why are they such a successful group?



EXAMPLES OF ARTHROPODS  
(not to scale).

One reason for their success is their tough external skeleton, called an **EXOSKELETON**. This is like a suit of armour. They have no internal bones. Even the legs are covered in exoskeleton! To enable the legs to move, there are numerous joints that look like hinges. Observe the jointed legs in the diagrams above.

ACTIVITY - TYPES OF ARTHROPODS

There are many classes of arthropods. You will now look at a wide range of specimens and classify them into groups.

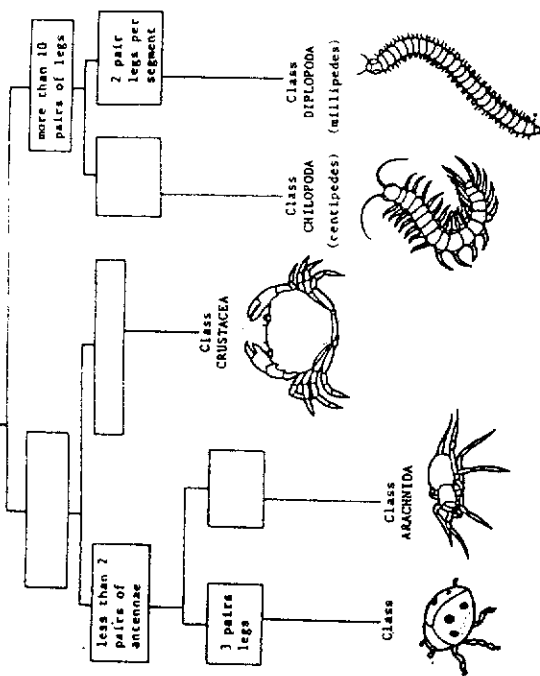
1. Collect Answer Sheet 5 "Classifying Arthropods".
2. Look at the specimens provided by your teacher and complete all columns on Sheet 5, except the one called "CLASS".
3. Answer the questions when you have finished.
4. List at least all arthropods have in common.
5. List at least three differences between the specimens in their structure.
6. Copy the following: those specimens you think are all alike in their structure.

You may already know some classes of arthropods - they are - INSECTS, ARACHNIDS, CRUSTACEA, CHILOPODA and DIPLOPODA.

THE CLASSIFICATION KEY below is an ARTHROPOD KEY.

Q4. Copy and complete this key into your notebook.

**ARTHROPODS**



Q5. Now you can complete the class column on Answer Sheet 5.

Q6. Which arthropod group has -

- a) 6 legs?
- b) 8 legs?
- c) 10 legs (including claws)?

Q7. Which arthropod group do -

- a) Scorpions belong?
- b) Millipedes belong?
- c) Butterflies belong?

Q8. Which arthropod class lives in water?

Q9. Which arthropod class is most dangerous to humans?

Q10. Which arthropod class is most numerous and is often a pest to humans?

Q11. Copy the summary below.

**SUMMARY** - Arthropods are a very successful group of animals. This is partly because of their external, jointed skeleton. They are grouped into 5 classes - INSECTS, ARACHNIDS, CRUSTACEA, CHILOPODA and DIPLOPODA, - on the basis of their body structure. All arthropods reproduce sexually and produce eggs.

Q12. There is one disadvantage in having a hard external covering - Growth! What must arthropods do when they increase in size?

Q13. Find out the life cycle of a mosquito and butterfly.

Q14. Collect Answer Sheet 6. Complete your homework.

# CLASSIFYING ARTHROPODS

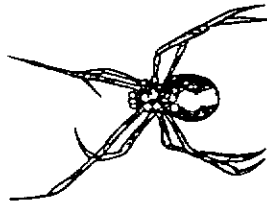
[illegible]



# DANGEROUS ARTHROPODS

\* WOULD YOU RECOGNISE A DANGEROUS ARTHROPOD?

All the arthropods shown here are found in Western Australia. Cut out each picture and stick it into your notebook.



Next to each picture write -

- \* The name of the arthropod.
- \* A brief description including colour.
- \* Why it is considered to be dangerous.
- \* Where you think it's likely to be found.

## MORE PICTURES

in the picture. and why mosquitoes may be considered to be dangerous. Why? The mosquito may be taken to get your blood.

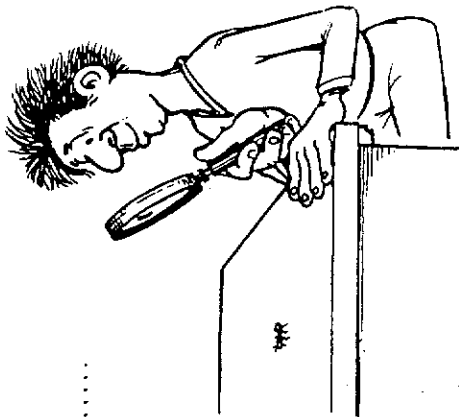
# BUILD AN INSECT

\* What insect are you making a model of?

\* Decide in your group what features it should have.

List them here.

1. Number of legs =
2. Number of body parts =
3. Wings or no wings? =
4. Number of wings =
5. Number of Antenna =
6. Special features? =



Your finished model should be NO MORE THAN 8 cm long.

## USE THESE MATERIALS

- plasticine
- cellophane or paper
- matchsticks (when bent they make good legs)
- popsticks

When you've finished construction, check that your model has all its parts.

Complete this label and place it near your model insect.

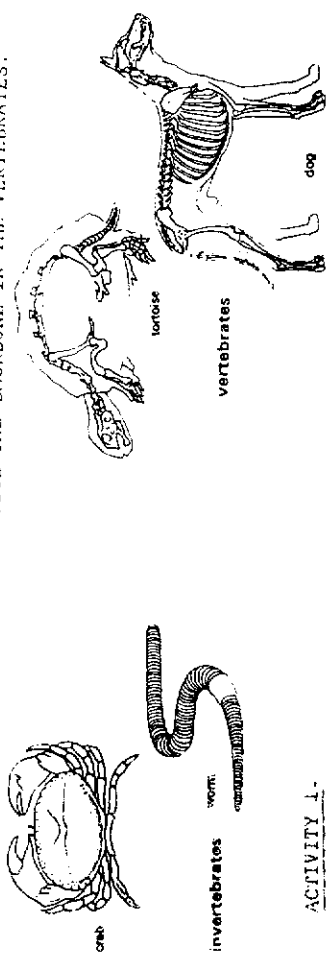
NAME OF INSECT  
DATE  
WHERE COLLECTED  
COLLECTOR'S NAME

Don't forget to fill this in.

(The collectors' name is yours!)

THE VERTEBRATES - ANIMALS WITH BACKBONE.

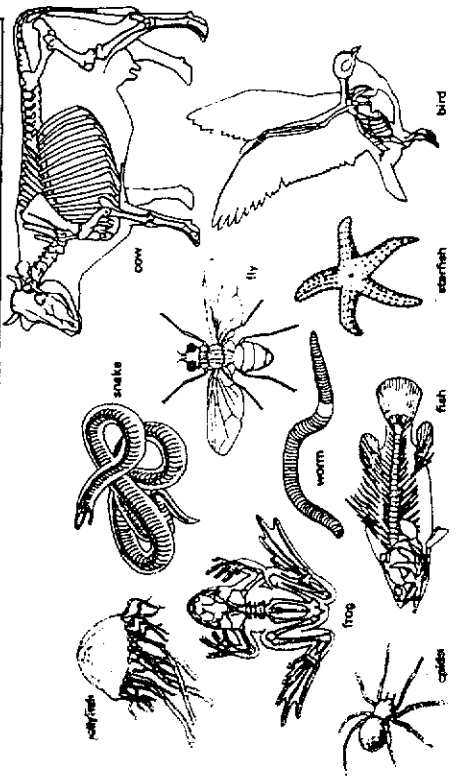
The vertebrates are a group of animals with an internal backbone. This is quite different from the Arthropods which have an exo-skeleton. The arthropods and lower animals are called invertebrates. LOOK AT THE DIAGRAMS BELOW. NOTICE THE BACKBONE IN THE VERTEBRATES.



ACTIVITY 1-

1. Observe some skeletons of vertebrates, such as fish, cat, human.
2. Identify the backbone made up of numerous vertebrae.
3. Copy this table and then complete it after looking at the diagrams of various animals below.

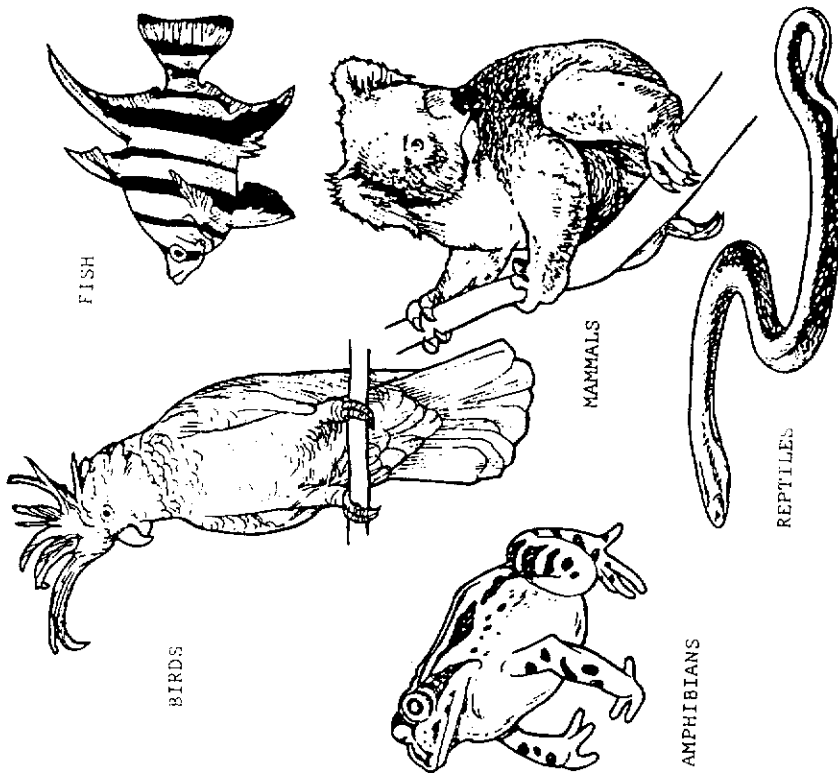
Bones inside the body VERTEBRATES	No bones inside the body INVERTEBRATES



THE VERTEBRATES.

The vertebrates are the most highly developed group of animals. They have many special features which enable them to live in most places in the world. Reproduction in all vertebrates is sexual, involving males and females, but how the young are born varies considerably.

On the basis of development and structure, 5 sub-groups have been identified. They are FISH, AMPHIBIANS, REPTILES, BIRDS and MAMMALS.



FISH - All fish live in water. They can be divided into 2 sub-groups -

1. Those with cartilage instead of bones for a skeleton (sharks and stingrays), and,
2. All other fish have a bony skeleton. Most fish have a skin covering of overlapping slimy scales. All fish are "cold blooded", meaning that the temperature of their blood is about the same as the water. Fish extract oxygen from the water using gills. They reproduce sexually, the young being born alive or hatched from eggs.

AMPHIBIANS - Amphibian means to live on land and in water. Frogs, Salamanders and Newts have a moist, naked, scaly skin. They have a life-cycle where the young live underwater and breathe by using gills. The adult stage lives on land and breathe using lungs.

Amphibians reproduce in water where many jelly-covered eggs are laid.

REPTILES - Reptiles are land animals with bodies covered in dry scales. Snakes, lizards, turtles and tortoises are all different in the way they move, their body structure and what they eat. All reptiles are "cold blooded". Most members of this class produce soft-shelled eggs.

BIRDS - Birds may have developed from reptiles as they have some reptile-like features. All birds have clawed feet and scales on their legs. Bird feathers may have developed from scales. Most birds can fly. To help them do this they have developed feathers, strong, light bones and warm blood. Birds lay hard-shelled eggs.

MAMMALS - Mammals are the most highly developed of all living things. Some of their special features include care for the young after they are born. This group of animals gets its name from special glands provided by the mother, called mammary glands. They produce milk for the young to feed on.

Other features are warm blooded, 2 pairs of limbs and hair or fur on the body. Nearly all mammals produce live young, except for 2 odd Australian mammals, the platypus and echidna which lay eggs.

#### ACTIVITY 2.

1. Collect Answer Sheet 7 "Classifying Vertebrates" from your teacher.
2. Observe a large range of vertebrate specimens. Completely fill in the table on Sheet 7 for at least 10 specimens.  
Choose 2 fish, 2 amphibians etc .....
3. You may have to consult the above information to fill in some parts of Sheet 7.
4. COPY THE SUMMARY BELOW.

SUMMARY - Vertebrates are animals with an internal skeleton and a backbone. The backbone consists of vertebrae and supports the body. Vertebrates can grow to a large size and have many special, highly developed features. They all reproduce sexually, however, they differ in how the young develop.

The 4 classes are FISH, AMPHIBIANS, REPTILES, BIRDS and MAMMALS.

The different classes can be distinguished by their body covering, blood temperature, types of limbs and methods of reproduction and obtaining oxygen.

5. Answer the questions on the next page.

Q1. What are the advantages of having an internal skeleton and a backbone?

Q2. Which vertebrate class has a skin covering of -  
a) hair?  
b) slimy scales?  
c) dry scales?  
d) moist skin?  
e) feathers?

Q3. Which classes have warm blood?  
What is the advantage of having warm blood?

Q4. Why are the platypus and echidna different from all other mammals?

Q5. Think about yourself.  
Compare yourself with a simple animal like a worm.  
Why do scientists say we are more highly developed?

Q6. Think back to all the animal groups covered on this topic.  
How does a scientist classify animals?  
Does he group them by looking at just their size, colour, shape or does he classify them according to their level of development based on many characteristics?

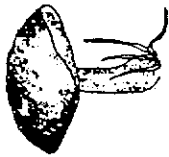
PLANTS/ANIMALS MATCHING WORKSHEET

1. The second most highly developed group of plants are the ( ).
2. The most highly developed group of plants are the ( ).
3. All fungi do not contain ( ) and therefore cannot make their own food.
4. Two common fungi that can be found growing on a human are ( ) and ( ).
5. Fungi reproduce by either ( ) or ( ).
6. The most important use of fungi is in ( ) dead material.
7. Seeds on a conifer usually have a ( ).
8. ( ) is a plant consisting of an algae and a fungi living together.
9. ( ) are an edible fungi.
10. ( ) is a fungus which attacks the roots of many trees, causing them to die.
11. Conifers have leaves shaped like ( ).
12. Conifers and flowering plants reproduce ( ) by producing seeds.
13. Conifer seeds are produced in ( ).
14. The transfer of pollen grains to the female cone is called ( ).
15. The seeds produced in a flowering plant are encased in a ( ).
16. Animals are classified according to their level of ( ) or complexity.
17. Protozoans have only ( ) cell and must be viewed through a ( ).
18. Two examples of protozoans are ( ) and ( ).
19. The common name of porifera is ( ).
20. A common feature of all sponges is that they have ( ) through which food is filtered.
21. Jellyfish group ( ).
22. Three examples of Coelenterates are ( ), ( ), and ( ).
23. An example of an annelid is the ( ).
24. A starfish belongs to the phylum ( ).
25. Starfish have the ability to regrow lost arms. This is called ( ).
26. The members of cephalopods are ( ) and ( ).

FEATURES OF PLANT GROUPS



Algae



Fungi



Mosses



Ferns



Gymnosperms  
(conifers)



Angiosperms  
(flowering plants)

SECTION A MULTI CHOICE

Select the best answer and mark it on the Answer Sheet.

1. The classification of animals is based on
1. their shape
  2. their number of legs
  3. where they live
  4. their complexity
  5. their number of body parts.
2. A large green leaf was 'destarched' and cut into a number of pieces. Some of the pieces were then soaked in water and the remainder were soaked in a glucose solution. Later, the pieces were all removed and tested with iodine solution, the pieces soaked in the glucose gave a positive result, while those soaked in water gave a negative result. This indicates that
1. too much water prevents photosynthesis
  2. iodine solution can detect the presence of glucose
  3. the presence of glucose can cause photosynthesis
  4. the glucose soaked leaves had converted some of the glucose to starch
  5. the glucose solution had absorbed enough carbon dioxide to give a positive reaction.
3. A lichen is a combination of two different plants which can assist each other by living together. The two types of plants are
1. algae and fungi
  2. algae and mosses
  3. fungi and mosses
  4. ferns and mosses
  5. algae and ferns.
4. An example of an Algae.
1. Euglena
  2. Boeckel
  3. Hydra
  4. Seaweed
  5. Mushroom.

The following table relates to questions 5 and 6.

Features	PLANT A	PLANT B	PLANT C	PLANT D
Colour	green	green	green	green
Veins/no veins?	veins	veins	no veins	no veins
Reproduction	seeds (flowers)	spores	spores	spores
Method of attachment	roots	roots	holdfast	rhizoid
Leaf Type	leaves	fronds	leaves	leaves
Habitat	land	land	water	land

SECTION A ..... Multi Choice (25 marks)

SECTION B ..... Fill in the Blank (25 marks)

3.

9. Look at the picture shown below.



The part of the plant labelled X is important for:

1. removing waste products
2. making food
3. reproduction
4. absorbing water

10. A student sets up four dishes like the ones below. He carefully lowered a glass jar over each one



In which of the dishes do you think fungi would be able to grow?

1. Dish A
2. Dish B
3. Dish C
4. Dish D
5. All of the dishes.

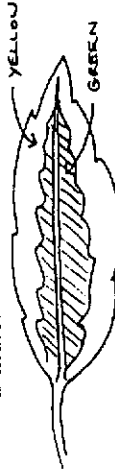
11. Green plants make their own food by photosynthesis. This equation is meant to show the things they need and the things they make.



Which of the following belongs in the blank box?

1. oxygen
2. nitrogen
3. carbon dioxide
4. starch
5. glucose

12. Look at the diagram of the variegated leaf that has been exposed to light for several hours.



Which of the following statements is true?

1. The green section contains both chlorophyll and starch
2. The green section only contains chlorophyll.
3. The yellow section contains both chlorophyll and starch
4. The yellow section only contains starch.

...4/-

2.

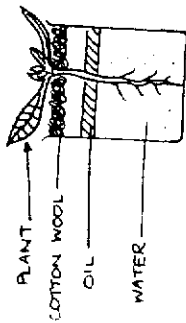
9. All these plants:

- a. produce their own food
- b. are saprophytes
- c. do not produce flowers
- d. can respire without oxygen.

10. Which of the following is most likely to be a:

- a. root
- b. flowering plant
- c. fern
- d. moss

11. A student set up the apparatus below, to see if plants absorb water through their roots.



The water level dropped overnight. He concluded that the roots of the plant had absorbed the water. His conclusion would have been more reliable if he had also set up a CONTROL tube. The control tube is exactly the same as the experimental tube, except that it has no:

- a. cotton wool
- b. soil layer
- c. plant
- d. water

12. A scientist set up the following experiment, using three identical jars and three similar sized mice. Jars A and B were kept in sunlight, while jar C was kept in the dark.



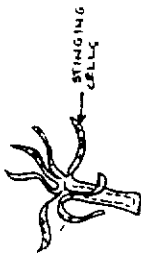
All three mice eventually died from lack of oxygen. They most probably died in the order, from first to last to die

- a. A, B, C
- b. C, B, A
- c. B, C, A
- d. C, A, B

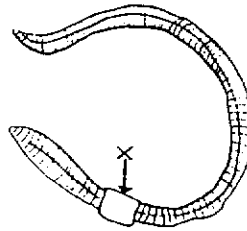
...3/-

5

17. Which of the animals shown below is most closely related to the common Snail.
1. Ant  
2. Spider  
3. Beetle  
4. Snail  
5. Centipede



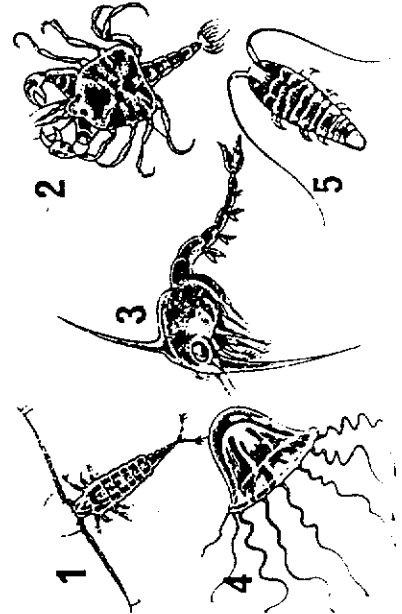
18. The diagram below shows an earthworm.



The part labelled X is called the

1. mouth  
2. foot  
3. saddle  
4. segment  
5. anus.

19. Which one of the animals shown below is most probably a coelenterate?



126

4

1. Ants are found to exist in a greater variety of conditions than mosses. The possible reason why they have been more successful in spreading is that:
2. Ants rely on photosynthesis while mosses do not  
3. Ants can produce more spores than mosses  
4. Ants have better methods of distributing their spores  
5. Ants have a better system for absorbing and conducting water.

20. The following diagram is an example of:

1. a protuberance  
2. a coelenterate  
3. a mollusc  
4. a polychaete

21. A biologist wanted to find out how ants react to changes in temperature.

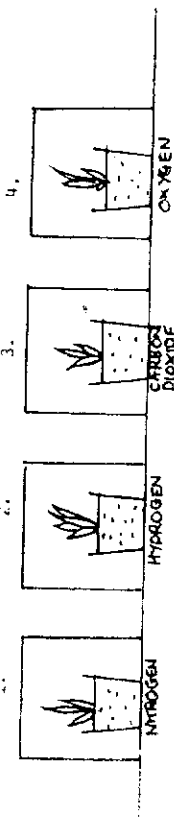
He kept a container whose temperature could be changed, and put some ants in it. He changed the temperature of the container several times and counted the number of ants moving about at each temperature. His results are shown in the table below.

Temperature	Number of Ants Moving
10°C	0
25°C	10
50°C	12
75°C	8
100°C	0

22. Which of the following temperature ranges do you think ants are most active?

1. below 10°C  
2. between 10°C and 20°C  
3. between 40°C and 60°C  
4. between 70°C and 90°C

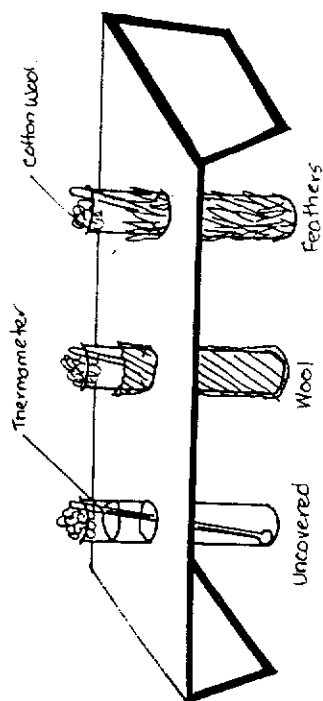
23. Four green plants were placed under separate glass jars. Each jar had a different gas in it. The gas in each jar is shown on the labels.



24. The jars were stood out in the sunlight. The only plant which would be able to make its own food is the one in jar:

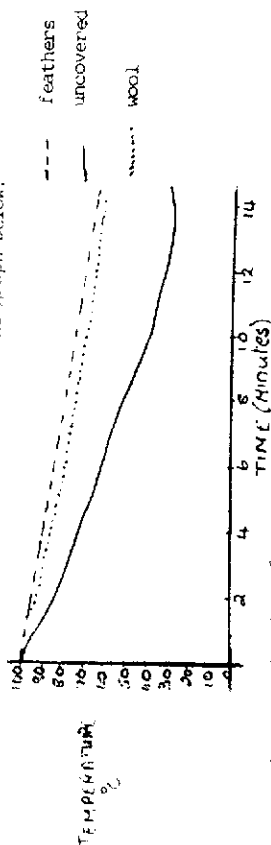
QUESTIONS 20 and 21 REFER TO THE FOLLOWING EXPERIMENT.

A group of students carried out an experiment to see how successful different types of skin coverings are at preventing heat loss. They set up three test tubes as shown.



They then added the same amount of water which had been heated to the same temperature.

They then read the temperature of the water in each tube every minute for the next 15 minutes. Their results are shown on the graph below:



20. Which of the following would NOT alter for the success of this experiment if

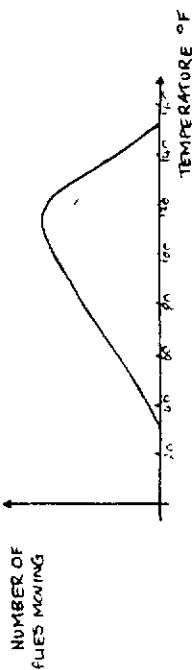
- a. they put oil into the test tubes instead of water.
- b. the water put into each test tube was not at the same temperature.
- c. there was different amounts of water in each test tube.
- d. they used different sized test tubes.
- e. the test tubes were set up in different parts of the Laboratory.

21. The results of this experiment suggest that

- a. coverings were useless in preventing heat loss since the temperature still fell.
- b. fur is useful in preventing heat loss only if the temperature is high.
- c. feathers are better at preventing heat loss from birds than from mammals.
- d. both fur and feathers raise the temperature.
- e. fur is better than feathers in preventing heat loss.

22. A scientist carried out an experiment to see how flies react to changes in temperature.

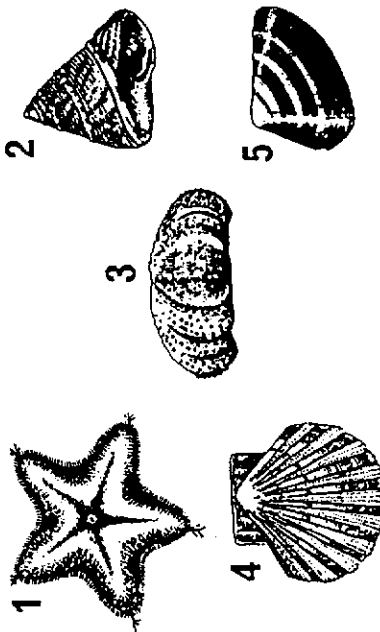
He placed a number of flies in a container the temperature of which he could vary. He changed the temperature of the container a number of times and counted the number of flies moving about at each temperature. His results are shown in the graph below.



These results indicate that:

1. flies cannot survive at temperatures below 20°F.
2. flies are most active at temperatures around 110°F.
3. flies react differently in the laboratory and in their natural state.
4. flies cannot live in desert conditions.
5. flies will soon die if they have no water.

23. Which one of the drawings below shows a mollusc which is a univalve?



24. Whenever people handle animals, there is a danger of them getting tapeworm. You can help prevent the spread of tapeworm by:

1. cooking meat that you feed to your pets.
  2. brushing your pets regularly.
  3. washing your hands after handling your pets.
  4. keeping clean the areas where animals live.
- OR
5. all of the above.

25. Scientists in Queensland are trying to control the "Crown of Thorns" starfish. Suppose they decided to cut one arm off each starfish they could catch. What do you think would happen to each starfish?

1. It would die.
2. It would live on without the arm.
3. It would grow a new arm.
4. It would die but the arm would grow into a complete starfish.
5. It would reproduce and then die.







APPENDIX B MODIFIED TEXTUAL MATERIALS

PLANTS AND ANIMALS : CARD 1

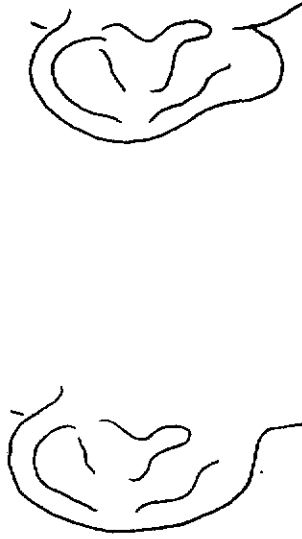
MAKING A CLASSIFICATION KEY

Let's sort the class into groups. Each group must have people who are alike.

First, put them into male and female groups. If you look at the male group there are still differences in people. We need to find a way of sorting the male and female groups into even smaller groups. We can do this by looking for other details.

Here are some other ways :-

- |                  |    |                      |
|------------------|----|----------------------|
| Dark hair        | OR | Light hair           |
| Straight hair    | OR | Curly hair           |
| Earlobe attached | OR | Earlobe not attached |



THINGS TO DO!

- A. Collect Answer Sheet 1 : "Making a Key".
- B. Write the name of every male in your class in the box with the heading "Males". Write the name of every female in your class in the box with the heading "Females".
- C. Check the people in your class for straight or curly hair. Fill in the second row of boxes.
- D. Check the earlobes of the people in your class. Fill in the last row of boxes.

Q.3 Is it hard to sort some people into groups? Why?  
(Scientists find some plants and animals difficult to classify.)

Q.4 Name three other details you could use to classify people.

PLANTS AND ANIMALS : CARD 1

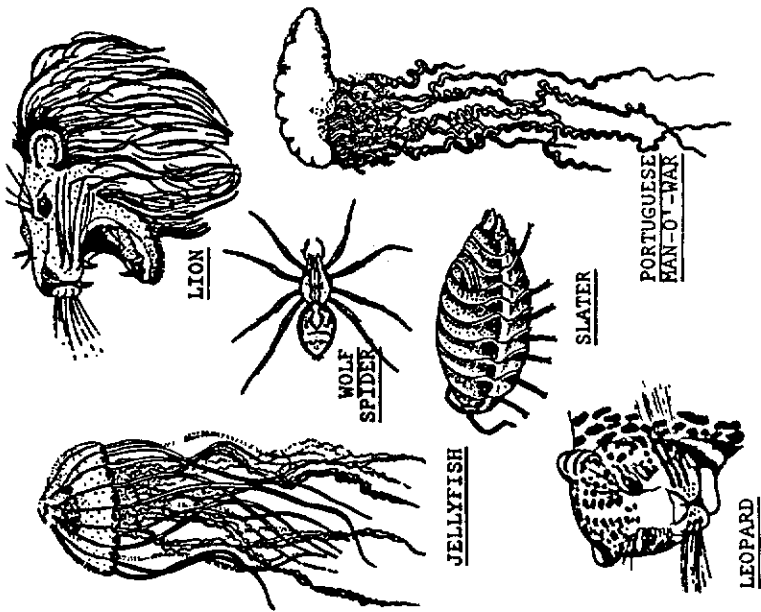
SORTING OUT ANIMALS

There are lots of living things on the Earth. Scientists need to put animals into groups so that they can learn about them easily. Animals are put into groups that look alike. Putting animals or other things into groups is called classifying.

Q.1 Copy and finish these notes.

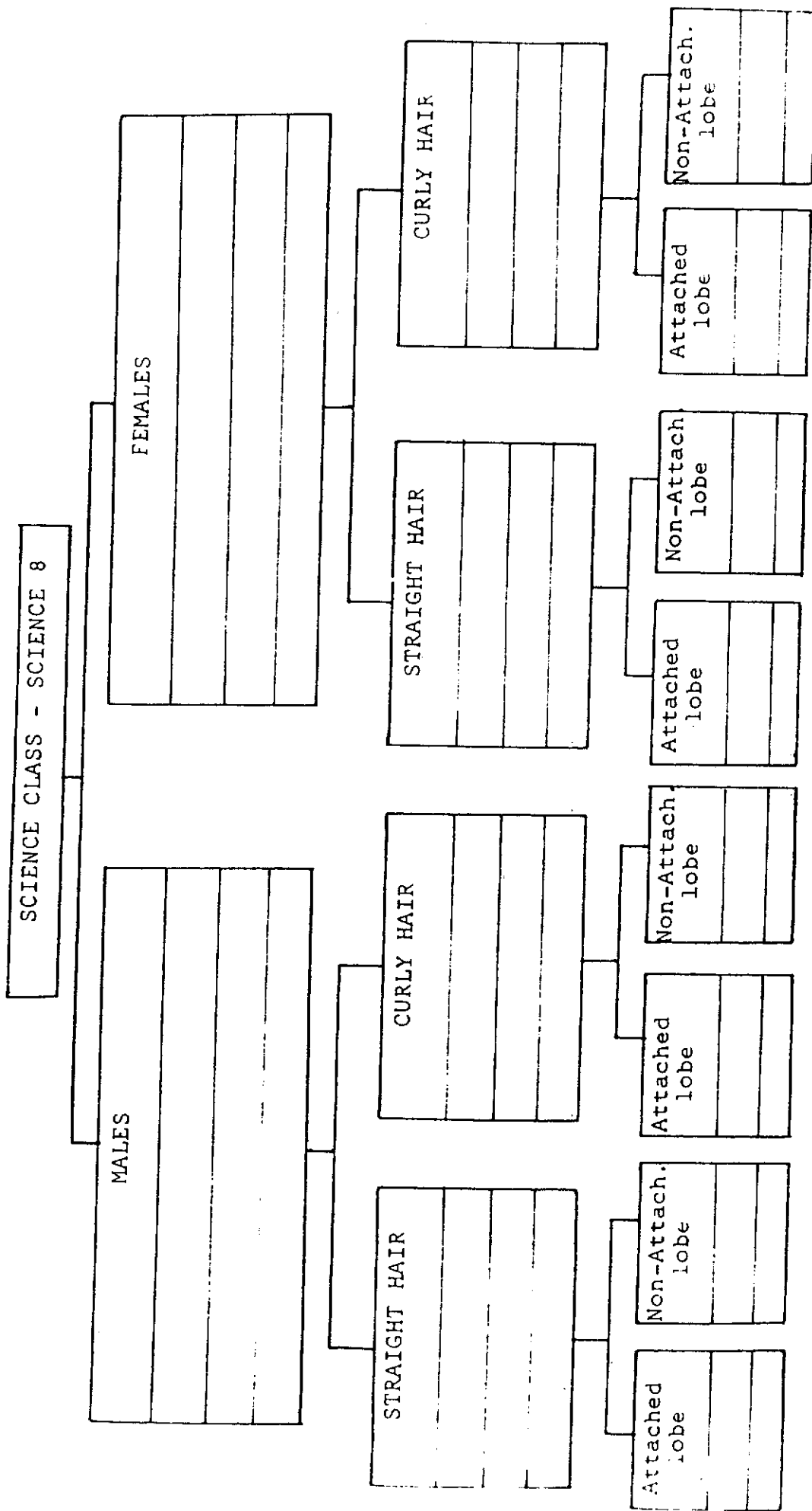
Classification means to sort animals into  
because they look ----- . We need  
to classify them into groups so that we can  
them easily.  
-----

Q.2 Look at the pictures below. Name the pairs of animals that look alike. ( Check your answers with the ones at the bottom of the page. )



[ Lion and Leopard, Jellyfish and Portuguese Man-of-War, Slater and Wolf Spider.]

"MAKING A KEY"



PLANTS AND ANIMALS : CARD 2

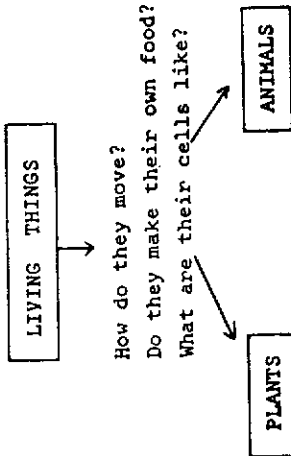
PLANTS AND ANIMALS ARE DIFFERENT

Plants and animals are living things. All living things :-

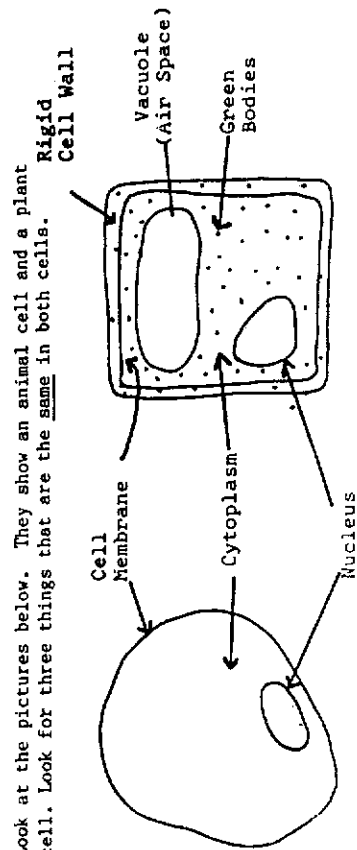
- (1) move,
- (2) grow,
- (3) respond to stimuli,
- (4) respire,
- (5) reproduce, and
- (6) excrete wastes.

If something is dead or non-living then it will not do the six things above. Only living things can do all six.

Living things are sorted into two groups by looking at three questions.



Q.1 Copy the diagram above. We can use the three questions to decide if a living thing is a plant or an animal.



ANIMAL CELL

PLANT CELL

Q.2 Name three things that are different in the plant cell.

PLANTS AND ANIMALS : CARD 2

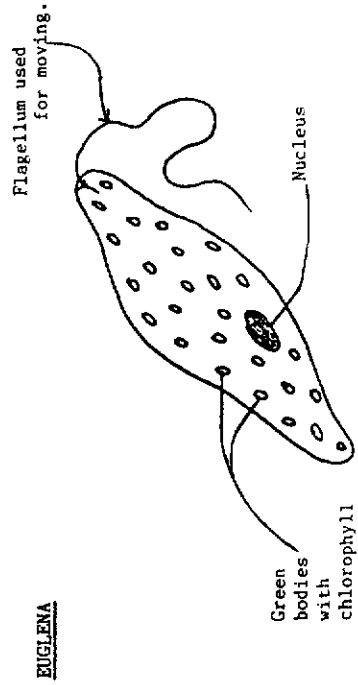
The table below shows the differences between plants and animals. Their movement, food and cells are not the same.

Q.3 Copy the table.

PLANTS	ANIMALS
A. Plants stay in one place, use little energy and move slowly by growth.	A. Animals move a lot looking for food and to escape their enemies.
B. Most plants are green and make their own food by photosynthesis.	B. Animals get their food by eating plants or other animals.
C. Plant cells have a box shape, a hard cell wall and green chlorophyll.	C. Animal cells can be any shape and they don't have a hard cell wall or chlorophyll.

Q.4 Collect the Biology Resource Book and look at p.4-5. Write down the names of the living things in the photos and then if they are a plant or an animal. Write down why you chose this.

Sometimes it is hard to classify a living thing. The picture below shows a single cell that lives in water. Euglena is green, makes it's own food, has no cell wall and moves by waving it's flagellum like a whip.



EUGLENA

Q.5 Do you think Euglena is a plant or an animal? Why is it hard to classify this living thing?

ALGAE AND MOSSES

Algae and mosses are very simple plants. They do not have leaves, stems or roots like the plants in your garden.

Algae

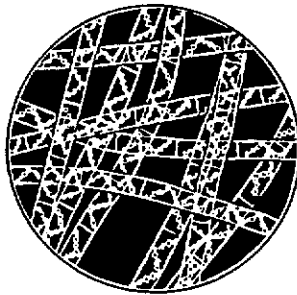
Some algae are small (single cells or groups of cells) but others like kelp grow to 50 metres. All algae live in water. In the surface layers of the ocean small algae are a large part of the plankton. Ocean animals use the plant plankton for food.

THINGS TO DO!

A. Collect some freshwater algae and seaweed.

B. The freshwater algae may look like green hair. This pond alga is made of many cells joined together to make a fibre. Put some fibres on a glass slide. Look at them under the microscope with low power.

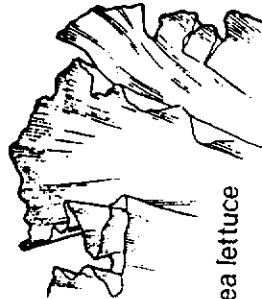
C. Draw what you see under the microscope. (It may look like this picture.)



pond slime

D. Look at the piece of seaweed and draw a picture of it.

E. Find the holdfast (like short roots, but it holds the plant to the reef) and the thallus (leafy part). Label these on your picture.



sea lettuce

Mosses

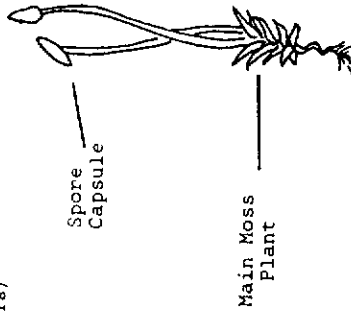
Mosses live on land in damp places. They reproduce by making spores. Spores are special cells which can survive without water. Mosses often grow on rocks.

THINGS TO DO!

A. Collect some moss plants.

B. Use a hand lens and forceps (tweezers) to separate the single plants.

C. Draw a single moss plant.



Q.1 Copy and fill in the notes below.

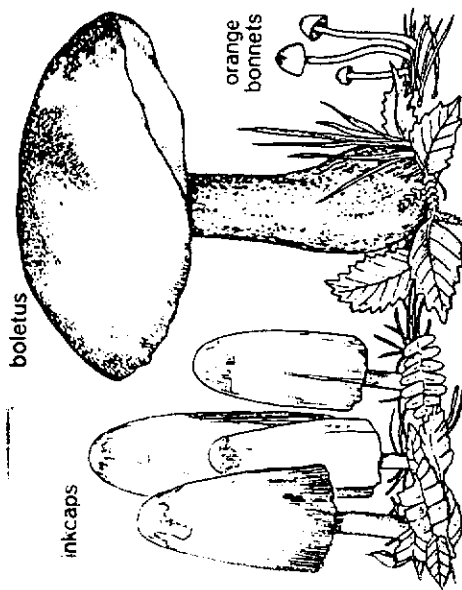
Algae and mosses are simple plants because they do not have true roots, ----- or ----- . Algae live in ----- . They may be large seaweeds or small single ----- . Mosses live on ----- in large clumps in ----- places. They reproduce by ----- .

Q.2 When seaweed is lifted from the water it collapses because it does not have a strong stem. Why don't algae need a stem?

Q.3 Plant plankton is also called phyto plankton. Why is it called this? (HINT: phyto means light.)

Q.4 If you wanted to find moss growing in your garden where would you look?

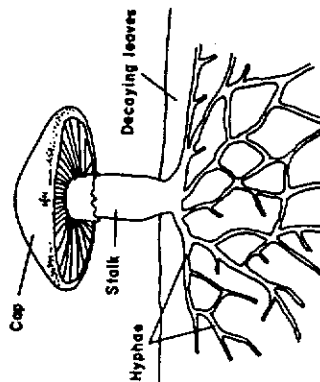
UNUSUAL PLANTS - FUNGI



Fungi are unusual because they are not green. They may be brown, white or even bright orange. Fungi do not have green chlorophyll in their cells and so they can not photosynthesise.

Fungi need to grow on something they can use for food. Mushrooms are often found on rotting leaves or near animal manure. Moulds grow on bread, fruit or jam.

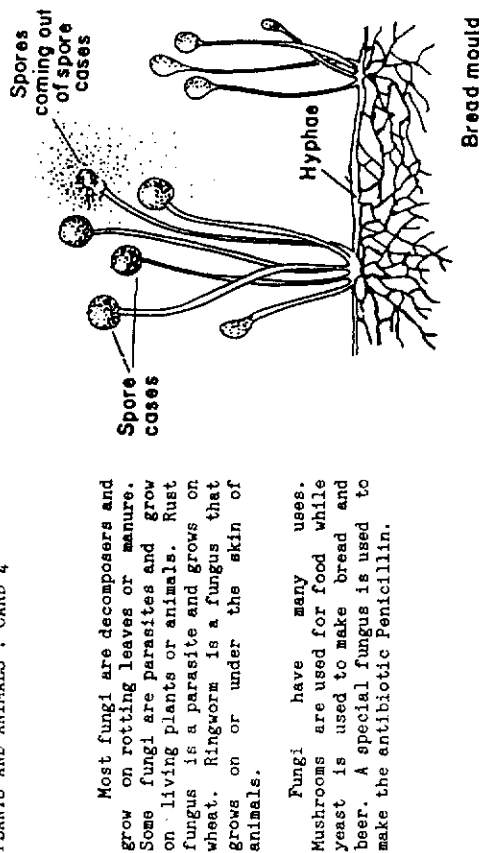
All fungi have fine, thread-like fibres called hyphae. These grow out to collect the food.



The largest parts of a mushroom plant are the hyphae. They grow through the rotting matter.

The fungus has a reproductive part that sends out tiny spores. These float in the air and may grow into a new fungi when they land.

Copy this picture of a mushroom. Label the spores and the hyphae.



Most fungi are decomposers and grow on rotting leaves or manure. Some fungi are parasites and grow on living plants or animals. Rust fungus is a parasite and grows on wheat. Ringworm is a fungus that grows on or under the skin of animals.

Fungi have many uses. Mushrooms are used for food while yeast is used to make bread and beer. A special fungus is used to make the antibiotic Penicillin.

Q.2 Copy and fill in the notes below.

Fungi are unusual plants because they have no ----- . They may be brown, ----- or ----- but not ----- . Fungi live on the remains of other plants or animals. Fungi reproduce by ----- or budding. They may be small like yeast or large like ----- .

Q.3 Name two useful fungi and two harmful fungi.

Q.4 Why do we classify fungi as a plant if it can not photosynthesise?

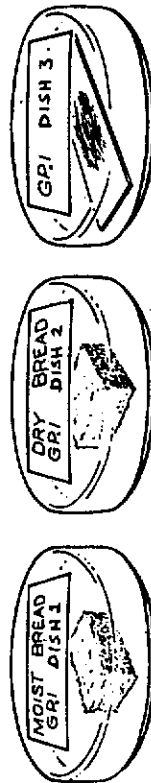
NON-GREEN PLANTS

A fungus like bread mould needs special conditions to grow. To find out what these conditions are we can set up an experiment.

THINGS TO DO :

- Collect three petri dishes and write your name on them. Label the dishes 1, 2 and 3.
- In dish 1, put a piece of wet bread.  
In dish 2, put a piece of dry bread.  
In dish 3, put a microscope slide with vaseline on it.
- Leave the three petri dishes open to the air for 20 minutes. After this time put the covers on the dishes and tape them up.
- Put the dishes at the side of the room and look at them for the next three days.

WARNING : ALWAYS LEAVE YOUR PETRI DISHES TAPED UP. LOOK AT THEM WITHOUT LIFTING THE LIDS. SOME OF THE LIVING THINGS THAT MAY GROW ARE DANGEROUS TO YOUR HEALTH.



When scientists set up experiments like this they make a prediction about what will happen. This guess is called a Hypothesis.

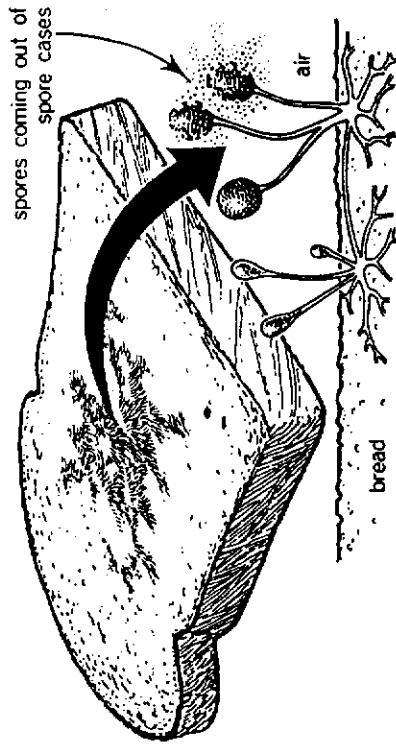
Q.1 Copy and fill in these notes.

Hypothesis :- I think that bread mould will grow best in dish ---. I think the things below will happen.

- Dish 1 -----  
Dish 2 -----  
Dish 3 -----

After a few days draw the petri dishes and answer the questions below.

- Was your guess for dish 1 right?
- Was your guess for dish 2 right?
- What data agrees with your hypothesis? How does it agree?
- What data does not agree with your hypothesis? Why doesn't it agree?



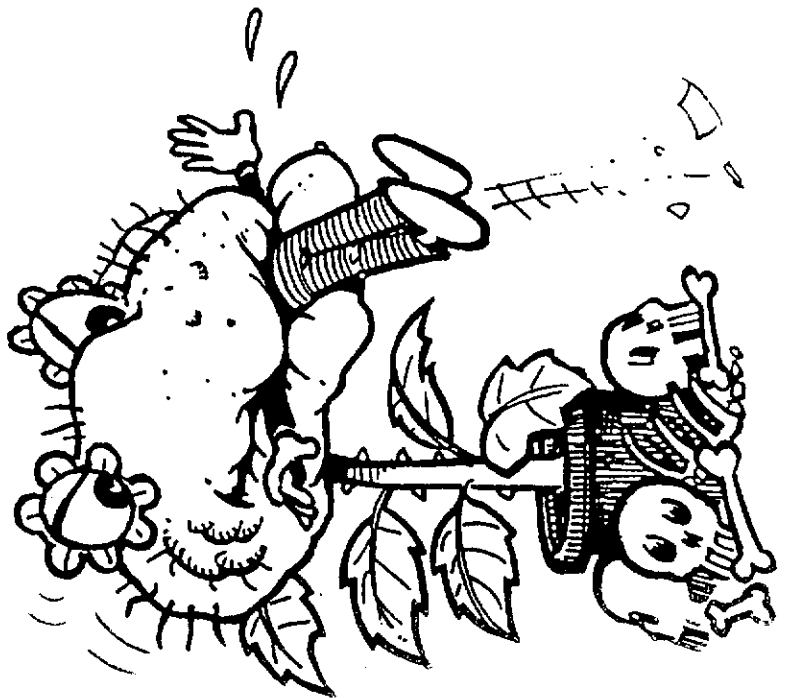
Q.6 Write down two ways you could stop food from going mouldy.



CARNIVOROUS PLANTS

Use the library reference material to answer the questions below.

- Q.1 Write the meaning of Carnivorous.
- Q.2 Write the name of a carnivorous plant. Then, find out :-  
 (a) where it grows (which state),  
 (b) what it "eats", and  
 (c) what it looks like.
- Q.3 Find out about two more carnivorous plants as in question 2.
- Q.4 Why do carnivorous plants "eat" even when they can photosynthesis?
- Q.5 Name two Western Australian carnivorous plants.



LICHENS

Lichens are made of two plants which live together symbiotically.

- Q.1 Write the meaning of symbiosis.
- Q.2 What are the two plants that make up lichen?
- Q.3 How does each plant help the other?
- Q.4 Where are lichens found in Western Australia?
- In tundra areas, lichen are eaten by animals.
- Q.5 Where are the tundra areas of the world?
- Q.6 Name two animals that eat lichen.

Humans use lichens for food, dyes and pollution indicators. An acid-base indicator in chemistry is made from a lichen.

- Q.7 Name the acid-base indicator made from a lichen?
- Q.8 What food is made from Iceland Moss?
- Q.9 Name two pollutants that lichens are sensitive to.



# FERNS

Ferns live in shady, cool places like rainforests where there is plenty of water. They are much larger than moss, fungi and most algae.

Ferns have true roots, stems and leaves like many garden plants. They also have a vein system inside to carry food and water.

Examples of ferns



Sago palm fern (Platycodon)

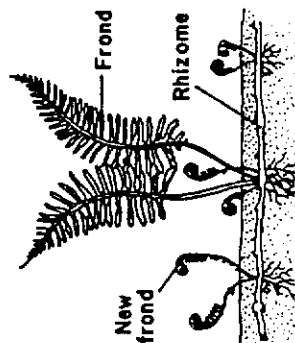
Maidenhair fern (Adiantum)

Bracken

Microsorium

The stem of a fern is called a rhizome. Sometimes this grows horizontally under the soil surface. The part of the plant that grows above the ground is the leaf or frond. New fronds are curled up and they uncurl as they grow.

Veins are found inside the rhizome and fronds. They are used to carry food and water to all parts of the fern.



Fern stems or rhizomes grow horizontally under the ground.

Ferns reproduce by spreading spores. These are found under the older fronds in spore cases. When the spore case opens, thousands of spores are blown into the air. When these spores land on the ground they will grow into new ferns if the conditions are right.

## THINGS TO DO!

- A. Collect a fern frond.
- B. Look at the frond and find the veins and stem. Draw a picture to show this.
- C. Use a hand lens to find the small brown spots on the underside of the frond. These are the spore cases. Try to find a single spore.
- D. Use sticky tape to put a small piece of the fern into your book. Label the spore cases.

Q.1 Copy and fill in these notes.

Ferns may be small or large but they all need ----- . They have true leaves, ----- and roots. Ferns have ----- to carry food and ----- to all parts of the plant. Ferns reproduce using ----- .

Q.2 Mosses grow close to the ground but ferns grow taller. What helps the fern grow taller?

Q.3 List two things that are different between fungi and ferns.

Q.4 Why do ferns grow better in a greenhouse?

# CONIFERS

Conifers is the name given to a group of plants like firs, pines, cypresses and the giant American Redwood. Some of these plants are small shrubs and some conifers are the largest trees in the world.

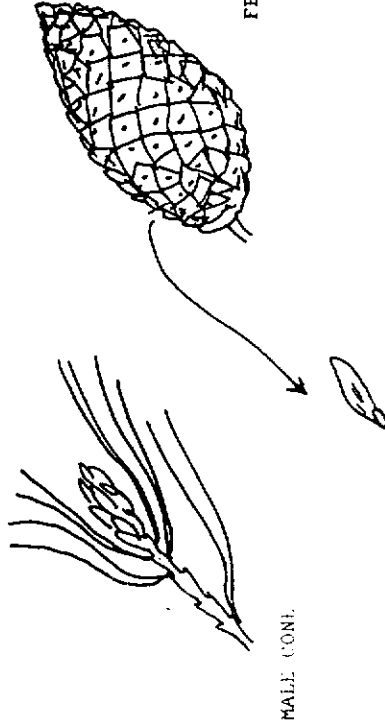


Conifers are seen on Christmas cards covered in snow.

Fungi, mosses and ferns reproduce using spores. Conifers reproduce by seeds.

All conifers have cones. The male cones are small and make pollen. Pollen is the male sex cell. The female cones are large and woody. They make the seeds.

Wind blows pollen from one tree onto a female cone on another tree. This is when fertilisation takes place. The seeds develop inside the female cone. The female cone dries up, cracks open and the seeds are thrown into the air.



The seeds have a small wing which helps them glide to the ground. They land away from the parent tree.

## THINGS TO DO

A. Take a walk to the pine trees and look at the bark, trunk and shape of the trees. Collect some leaves (pine-needles) and cones from the ground.

B. Look at the pine needles. They are types of leaves. Use sticky tape to put a pine needle into your book.

Q.1 Why are the pine needles thin? (HINT: Think back to the Christmas card, the pines are covered in snow.)

C. Look at the male and female cones. Try to find a winged seed inside the female cone. If you find a seed, toss it into the air and watch it glide.

Q.2 Why does the seed have a wing

Q.3 Copy and fill in these notes.

Conifers may be small shrubs or large  
-----, They all have -----, The cones  
may be male or female.  
Male cones make -----, Female cones  
are fertilised by the ----- and make  
-----, The leaves of conifers are long and  
-----, Humans use conifers to give them  
timber.

Q.4 Conifers can grow very tall. How does the water get from the tree's roots to it's top leaves?

### FLOWERING PLANTS

Flowering plants (Angiosperms) are found in nearly all places on earth. Plants like grasses, bushes, trees, shrubs, weeds, flowers and water-lilies are all flowering plants. They have true roots, stems and leaves. Flowering plants make seeds from a flower. These seeds are carried in fruit like apples, pumpkins and even gumnuts.

#### Parts of Flowering Plants

The main parts of a flowering plant and their uses are shown below.

- (i) Leaves - make food by photosynthesis.
- (ii) Flowers - make seeds.
- (iii) Fruit - protect and spread the seeds.
- (iv) Stems - carry water and food in the veins. Keep the plant upright.
- (v) Roots - keep the plant in the ground and soak water and minerals from the soil.

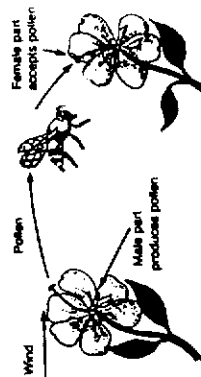
#### THINGS TO DO:

A. Collect Answer Sheet 2 "Parts of Flowering Plants".

B. Label the parts of the flowering plant and write what they are used for.

#### Reproduction in Flowering Plants

Most flowers make male and female sex cells. The female sex cell is fertilised by a male pollen cell from another flower. This is called cross-pollination.

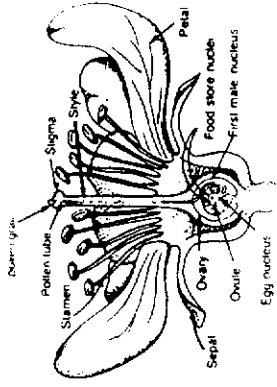
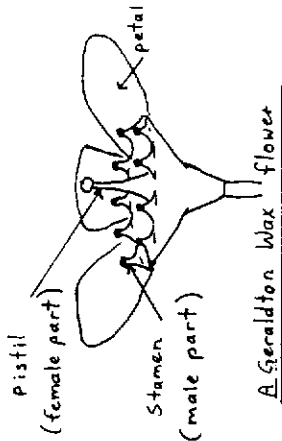


After the male and female cells join the flower dies off and a fruit forms. The seeds are made inside the fruit.

#### THINGS TO DO:

C. Collect a single flower, hand lens and forceps.

D. Look at the flower and find the parts shown below. Use sticky tape to put the petals, pistil and stamens into your book.



Section of a typical flower to show fertilization

0.1 Draw a picture of a Geraldton Wax flower. Label the main parts.

E. Collect some fruits and look for the seeds. Remember that the fruits used to be flowers.

0.2 Copy and fill in these notes.

There are many kinds of Flowering Plants. Grasses, ----- and ----- are all plants that have flowers. They have true leaves, ----- and -----.

Most flowers have male and female parts. The male sex cell (-----) is carried to another flower by insects or ----- . Fertilisation takes place and the female sex cell becomes a ----- . This seed is spread by the ----- .

0.3 Why are flowers brightly coloured and sweet smelling?

0.4 Grasses are not brightly coloured or sweet smelling. How does the pollen get to the flower in grasses?

0.5 Write down five fruits that have seeds inside them.

0.6 Can you plant an apple core and grow a tree?

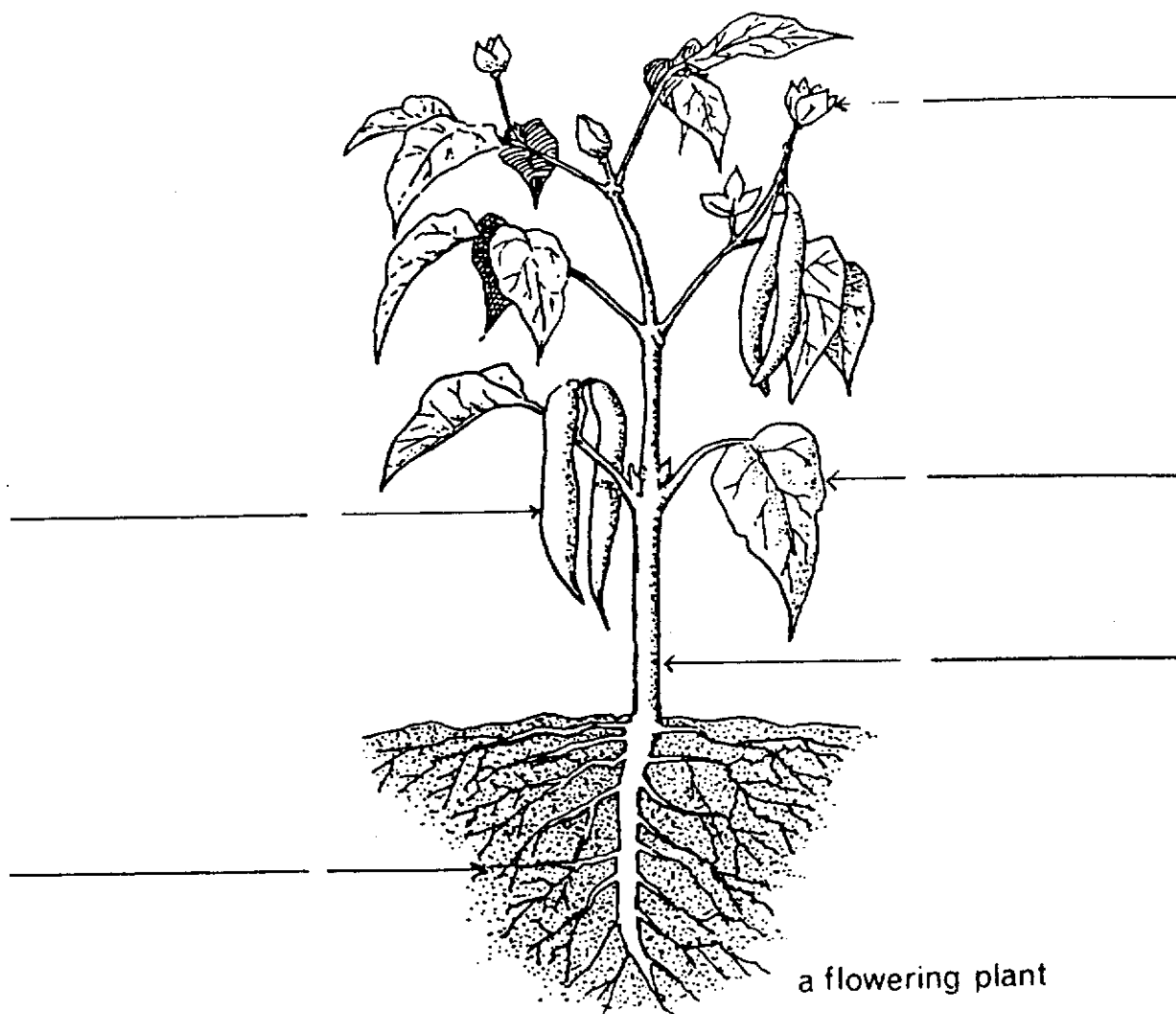
\*\*\* 0.7 Why do fruits taste sweet? \*\*\*

## PLANTS AND ANIMALS : ANSWER SHEET 2

NAME: \_\_\_\_\_

PARTS OF FLOWERING PLANTS

Label the main parts of the plant below. Under each label write down what that part is used for.



### CLASSIFYING PLANTS

In this topic you have looked at the plant and animal groups below.

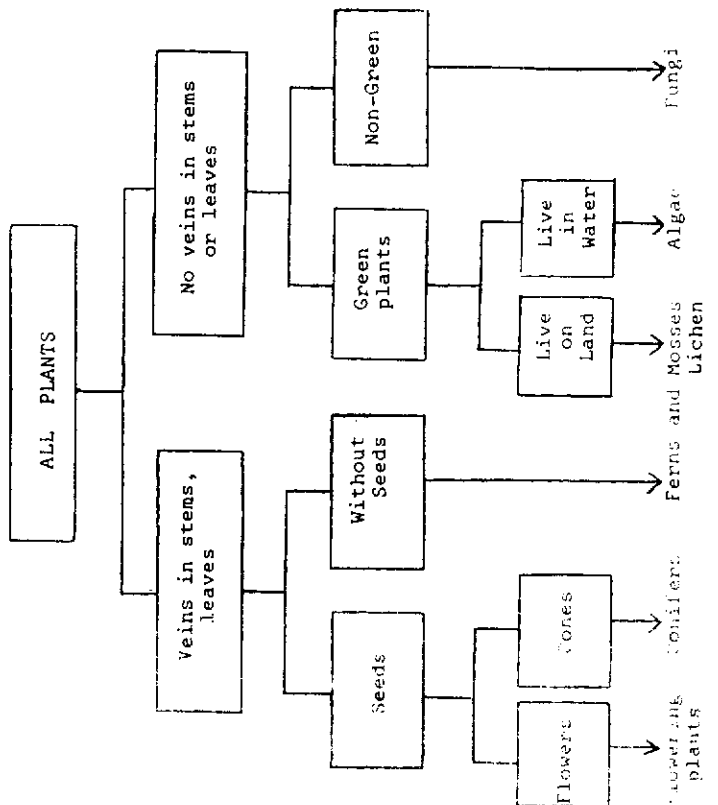
Algae	Ferns
Mosses	Conifers
Fungi	Flowering plants
Lichens	

You know that plants can be sorted into groups by looking at them in detail. You look for :-

- veins or no veins,
- green (has chlorophyll) or not green,
- spores or seeds,
- flowers or cones,
- lives on land or in water.

When you have the answers to these questions you can use a classification key to sort them into groups.

0.1 Look at the classification key below and then copy it into your book.



### THINGS TO DO!

- A. Collect Answer Sheet 3 "Classifying Plants".
- B. Look at the plants around the room. For each plant fill in the first six columns on the answer sheet.
- C. Use the classification key to help you work out which group the plant belongs in. Start at the top of the key and follow the boxes down. Write the plant group (phylum) in the last column of the table.

NAML. : \_\_\_\_\_

CLASSIFYING PLANTS

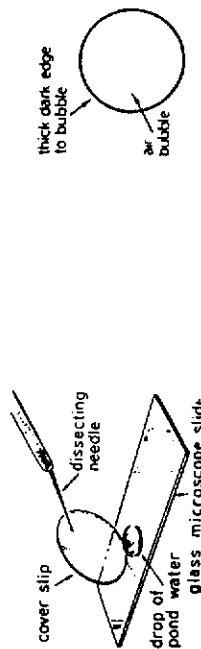
Plant Number	Veins or no veins	Green or Non-Green	Seeds or Spores	Flowers or Cones	Land Living or Water Living	Phylum (plant group)

Q.1 Copy and fill in these notes.

Protozoa are small, microscopic animals. They are made of one ----- and live in ----- . Most protozoa are found in rivers and ----- but some live in other ----- . Some protozoa move quickly using ----- . The amoeba is a ----- protozoan. Others are more complicated. Protozoans can reproduce by themselves (-----) or with a mate (sexuality).

### THINGS TO DO!

- We are going to use a microscope to find some protozoa.
- \*\* Remember : Use low power to find them. \*\*
- Stir the water in the jar of protozoa.
  - Use an eye-dropper to put one drop of water on a glass slide. Add a cover slip slowly so that you do not get air bubbles.

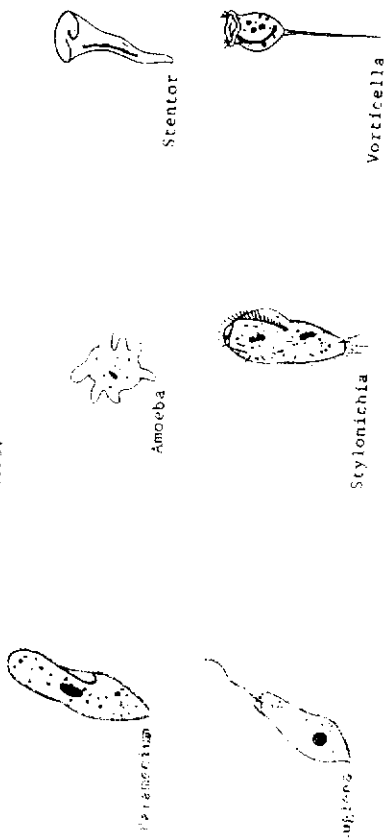


- Put the slide under the microscope. Move it around so that you can find protozoa.
- When you find a protozoa, draw it in your book.

- Q.2 How does the protozoa move? Is it fast or slow?
- Q.3 Is it going in one direction or does it keep changing?
- Q.4 Does the protozoa have anything to help it move?
- Q.5 If the protozoa moves to the right of the slide, which way do you have to move the slide to keep it in view?
- Q.6 Is there anything that all of the protozoa have?

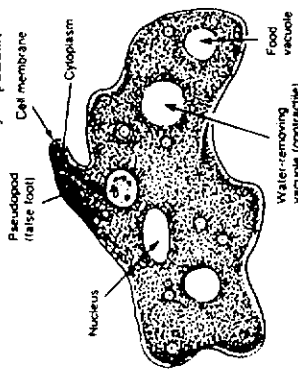
### PROTOZOA

The smallest animals are Protozoa. They are only one cell. All protozoa live in water. Some live in lakes, ponds and rivers but others live inside animals.

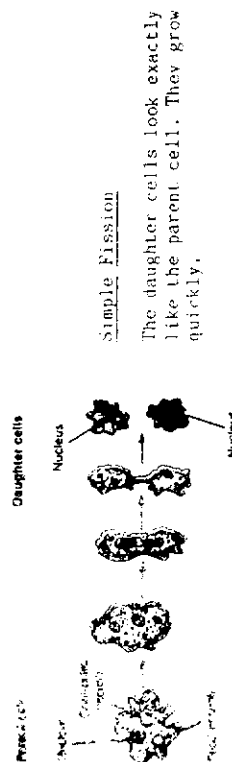


Some protozoa move quickly by waving hairs called cilia. Other protozoa are held in one spot by a holdfast.

The disease Amoebic Meningitis is caused by an amoeba. It lives in the liquid around the human brain. Amoeba - a simple protozoan. The false foot surrounds the food and then moves it into the cytoplasm.



Protozoa can reproduce asexually. They split into two parts like the pictures below.



Protozoa can also reproduce sexually. A large number of protozoa can be made in a short time. Protozoa are used as food for small animals. They are a large part of the plankton in our oceans.



## SIMPLE WATER ANIMALS

the next two groups are simple animals with many cells. They are:

- Porifera - sponges,
- Coelenterates - jellyfish and sea anemones.

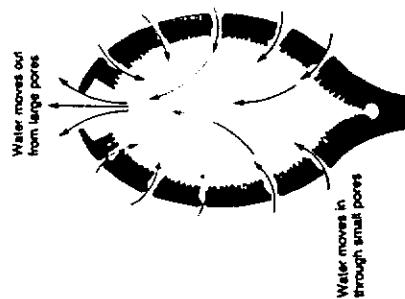
Both groups live in water. They are often found in salt water near the land. They have very little inside detail.

### Sponges (Porifera)

Simple water animals with pores through their body are called Porifera.

Sponges are found on reefs and jetty pylons. They get food by passing sea water through their body. The water has plankton in it. The sponge digests the plankton.

Sponges make male and female cells. These join together outside the sponge and drift in the water. The new sponge falls to the bottom and starts to grow. Sometimes a new sponge can be made by breaking a small part off the old sponge. This is called regeneration.



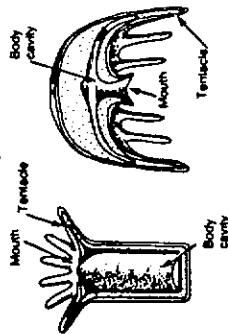
### THINGS TO DO!

- Look at the sponge skeletons.
- Try to find the large pores that let the sea water in and out.
- Draw a picture of the sponge. Use arrows to show where the water moves in and out.

Q.1 Copy and fill in these notes.

Sponges are simple water animals. They are in a group called \_\_\_\_\_. This name means the sponge has many \_\_\_\_\_. The pores let the \_\_\_\_\_ in and out. The sponge collects \_\_\_\_\_ from the water. Sponges can reproduce asexually or \_\_\_\_\_.

Jellyfish, coral polyps, hydra and sea anemones are all coelenterates. They have a hollow gut and long tentacles. These are used to trap food. There are stinging cells on the tentacles to paralyse small animals. The tentacles fold around the animal and take it to the mouth. Some jellyfish are very dangerous. The Sea Wasp and Portuguese Man-of-War are deadly.



The body parts of the coral polyp and jellyfish.

Coral polyps live in large groups. They make a hard skeleton from salts in the sea water. They are a kind of sea anemone.

The coral is the skeleton. It protects the polyp inside. At night, the polyp puts out its tentacles to trap food. Large groups of coral grow into reefs and islands. This takes thousands of years.

### THINGS TO DO!

- Look at the coelenterates in the room.
- Pick out the jellyfish, sea anemones and coral. (The polyp is inside the coral and hard to see.)
- Draw a picture of a sea anemone and a jellyfish. Label the tentacles, hollow gut and stinging cells.

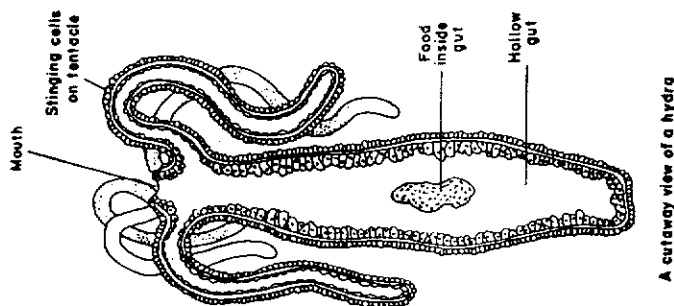
Q.2 Copy and fill in these notes.

Jellyfish, sea anemones and \_\_\_\_\_ are part of a group called coelenterates. They all live in \_\_\_\_\_ and have a hollow body. The tentacles have \_\_\_\_\_ cells. These are used to trap small \_\_\_\_\_ for food. Coelenterates can reproduce sexually or asexually.

Q.3 What is different about sponges and jellyfish?

Q.4 What can sponge skeletons be used for?

Q.5 A sea anemone only has one body opening. What does it use this for?

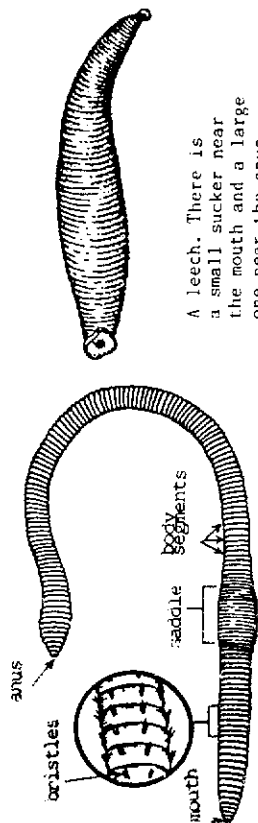


A cutaway view of a hydra

### Worms

There are lots of worms in the Animal Kingdom. Flatworms, roundworms and segmented worms are all found.

The annelids are a group of segmented worms. Earthworms and leeches are annelids. They have segments like rings on their body. The segments stretch and shrink so that the worm can move along.



A leech. There is a small sucker near the mouth and a large one near the anus.

Earthworms live in moist soil and leeches live in water. They both need to keep their skins damp so they don't dry up. Oxygen is breathed through the damp skin.

Earthworms and leeches have male and female sex cells. They swap the sex cells using the saddle or clitellum.

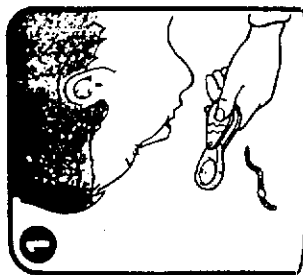
Put Copy and fill in these notes.

Annelids are ----- worms.  
Leeches and ----- are annelids.  
They have segments around their body.  
Damp skin is needed to let the worms -----.  
Reproduction uses male and female sex cells. They are swapped from one worm to another using the -----.

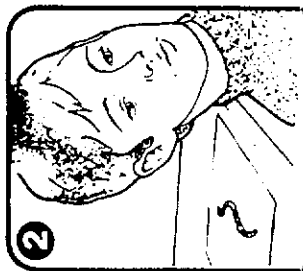
### THINGS TO DO

1. Look at the leech. Find the body segments and the suckers.
2. Draw a picture of a leech in your notebook.
3. How do leeches eat? How do they do this?
4. How do leeches live?

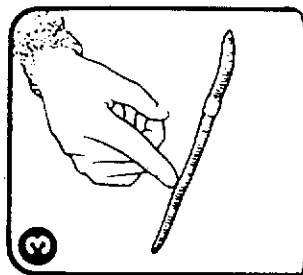
C. Put an earthworm in a petri dish. Put a few drops of water in it so it doesn't dry out.



Use a hard lens to look at your earthworm



Listen to the earthworm crawling on the paper



Run your finger underneath the earthworm's body and then along its back

Q.4 Measure your earthworm when it is not moving.

Q.5 What happens to the length when the earthworm moves forward.

D. Put your earthworm on damp paper towel.

Q.6 Does the earthworm move easier?

Earthworms have small bristles on their side. This helps them grip the ground. Can you feel them with your fingers? You may be able to hear them scraping on the paper.

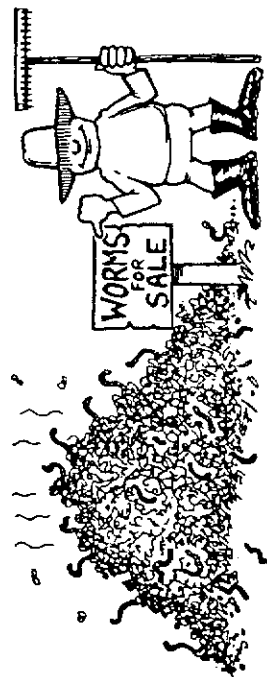
Q.7 Does your earthworm have a saddle?

Q.8 Is the saddle close to the head or tail end?

Q.9 Draw a picture of your earthworm. Label the head, tail, saddle and body segments.

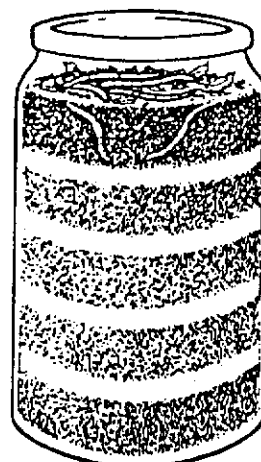
Q.10 What do earthworms eat?

Q.11 Why are earthworms useful to farmers and gardeners?



WHAT DO WORMS DO TO THE SOIL?THINGS TO DO

- A. Make sure all soil is damp for this experiment.
- B. Use a spoon to put 4 cm of dark soil in the bottom of a jar. Press it down level. Then put a thin layer of light soil.
- C. Keep putting layers of soil in the jar until you are 5 cm from the top.
- D. Fill another jar the same way.
- E. In jar 1 put six big earthworms on the top layer. In jar 2 put nothing on the top soil.
- F. Cover both jars with alfoil.
- G. Label the jars and leave them at the side of the room for one week.



EXPERIMENTAL



CONTROL

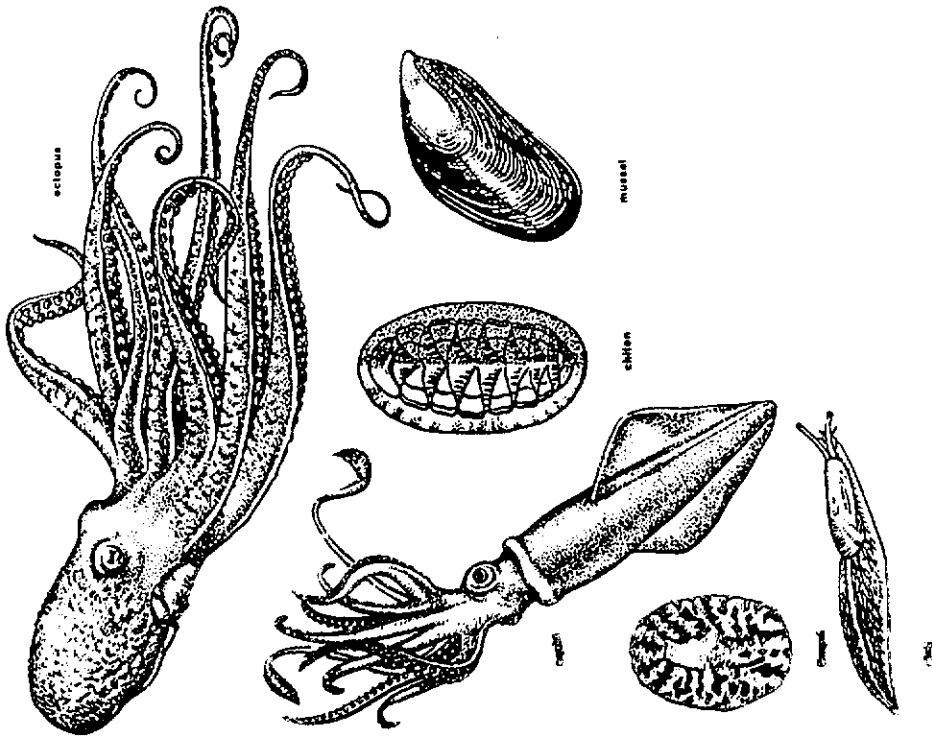
After one week, uncover the jars and answer the questions below.

- Q.1 Are there burrows on the side of the jars?
- Q.2 What shape are the burrows?
- Q.3 Do the burrows go through the soil layers?
- Q.4 Are the soil layers mixed?
- Q.5 What have the earthworms done?
- Q.6 Are the worms at the top or bottom of the jar? Why do you think they are there?

MOLLUSCS

The mollusc group is made up of shellfish because most of these animals have a hard protective shell.

The cuttlefish has a hard inside layer and the slug has not shell. They are called shellfish but none of the molluscs are fish.



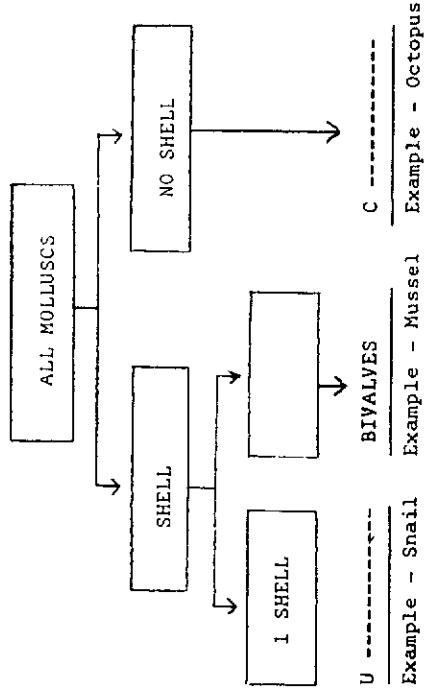
1. What do these molluscs have a hard outer shell?
  2. What do these molluscs have tentacles with suckers?
  3. What do these molluscs can move quickly?
- Answers are mainly in the water. They reproduce sexually. The female lay hundreds of eggs. These are fertilized by the male. They have male and female sex cells.

PLANTS AND ANIMALS : CARD 15

Molluscs are put into groups by looking at their shell. There are three types of molluscs.

- (a) Univalves - these have 1 shell eg. snail.
- (b) Bivalves - these have 2 shells eg. mussels.
- (c) Cephalopods - these have no shell eg. octopus.

Q.4 Copy and finish the classification key below.



UNIVALVES - These are animals like snails, slugs, cowrie, periwinkle and coneshell. They feed on algae or other plants. These molluscs use a large muscular foot to move.

BIVALVES - These are animals like scallops, oysters and mussels. They have two shells that are hinged together. The shell is closed using a strong muscle. The bivalves get their food from plankton in the water.

CEPHALAPODS - These animals include squid, octopi, and cuttlefish. They have tentacles with suckers on to help them catch their food. They eat fish, crabs and crayfish. Cephalopods move by squirting water. They can move quickly by jet propulsion.

THINGS TO DO!

4. Look at the molluscs around the room.
5. Draw a univalve, bivalve and cephalopod.
- 6.5 Copy and fill in the notes below.

Molluscs are animals that have shells.  
 They live in ----- but some of them  
 stay on the land. They reproduce  
 sexually and make many -----.  
 Molluscs can eat plants, animals or  
 plankton. There are three groups of  
 molluscs: ----- (one shell), -----  
 (two shells) and -----  
 (no shell).

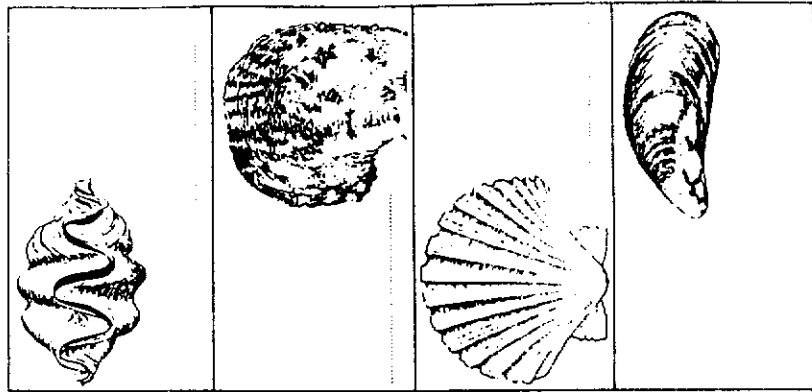
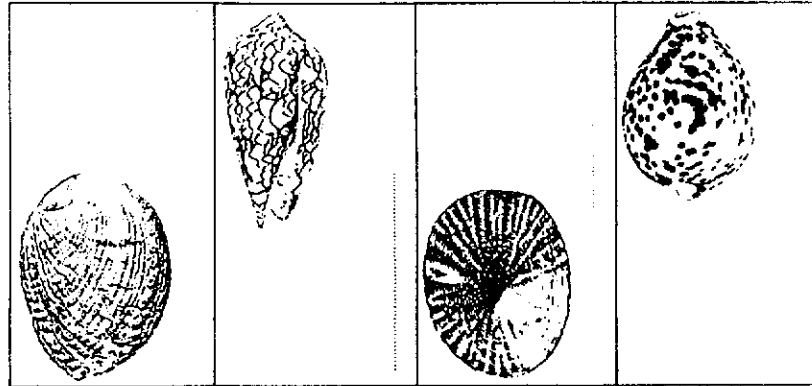
- 6.6 Why do molluscs have shells?
- 6.7 What does "filter feeder" mean?
- 6.8 How are molluscs useful to people? How are they harmful?
- 6.9 Collect Answer Sheet 4. "What do you know about Molluscs".  
 Finish this sheet for homework.

QUESTIONS TO ANSWER

Answer the questions in your notebook.

- Q.1 Give one example of each of the following.

The following molluscs are found in the sea.  
 Name the main parts of their shells.  
 Univalve:  Bivalve:   
 Cephalopod:





Q.6 Do you know which part of the snail is the most sensitive? Write down your guess.

C. Use a blunt pencil to gently touch the snail. Use the parts in the table below.

NOTE : If the snail responds, wait until it has recovered before you touch it again.

Q.7 What is the stimulus in this activity?

Q.8 Copy the table below and fill in your observations.

PART OF THE SNAIL TOUCHED	RESPONSE
shell	
foot	
eye tentacle	
feeling tentacle	
head region	

Q.9 Which part of the snail is most delicate?

Q.10 Which part of the snail is most sensitive?

Q.11 Is the most delicate part the same as the most sensitive part? Why?

EXTRA ACTIVITY

SNAIL RACES



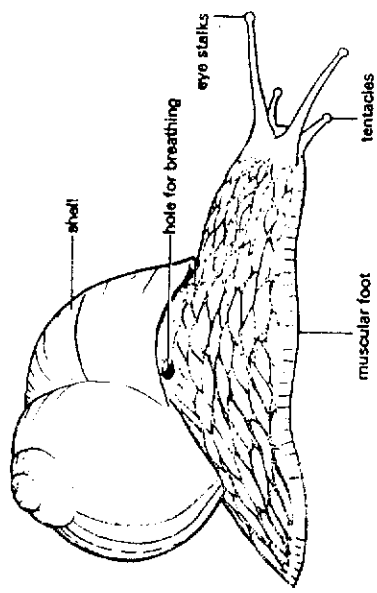
Have a snail race to find out the fastest snail.

LOOKING AT SNAILS

In this experiment you will look at snails. Take care of your snail. Keep it moist and do not break the shell.

THINGS TO DO

1. Use a hand lens to look at your snail. Try to find all of the parts in the picture below.



Q.1 Copy the picture of the snail.

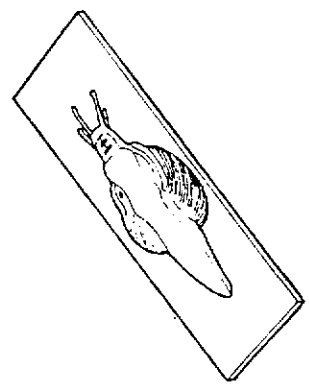
Q.2 How many coils are there in your snail's shell?

Q.3 Do you know how the snail grows? Does it get rid of it's shell and grow a new one? Does it add new coils to the shell?

Q.4 Can you put the snail on a glass slide. Watch it move.

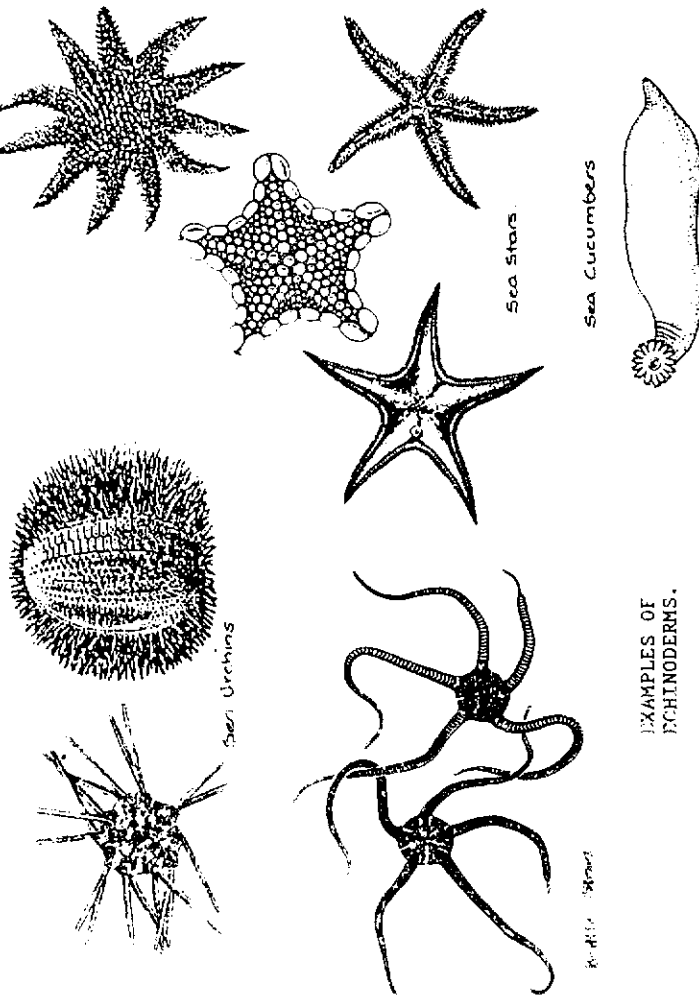
Q.5 How does the snail move?

Q.6 Snails leave slime trails when they move. What do you think the slime trail is used for?



ECHINODERMS

Echinoderms are spiny-skinned animals. Sea urchins, sea stars (starfish) and sea cucumbers have all got spiny skin. One sea star is called the crown-of-thorns because it has large spines.

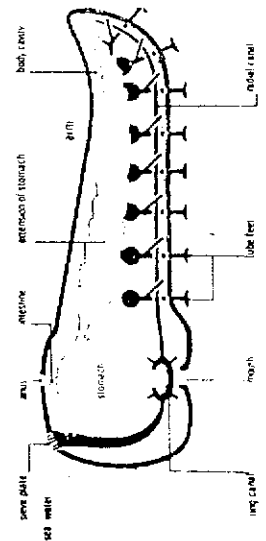


EXAMPLES OF ECHINODERMS.

All echinoderms live in salt water. Some of them live in the sea water, some live deep in the ocean.

Echinoderms have a skeleton that is made of plates. They look like the plates of a shell. They spread out from the centre.

Echinoderms have tube feet. These are used to move in the water. The tube feet are joined together so a whole animal can move along. The tube feet are part of a water vascular system.



PLANTS AND ANIMALS : CARD 17

Some echinoderms are carnivores. They use their tube feet to break up mussels and scallops. Other echinoderms are herbivores. They eat algae from the rocks.

Echinoderms reproduce sexually. The eggs and sperm are sent into the water. Fertilisation takes place and the larvae float in the ocean. They settle on the sea bed and grow larger.

Some sea stars can also reproduce asexually. If they lose part of their body or an arm they can regrow. This is called regeneration.

THINGS TO DO!

- Look at the echinoderms in the room.
- Draw a sea star from above.
- Count the number of arms of the sea stars. Is there a pattern?

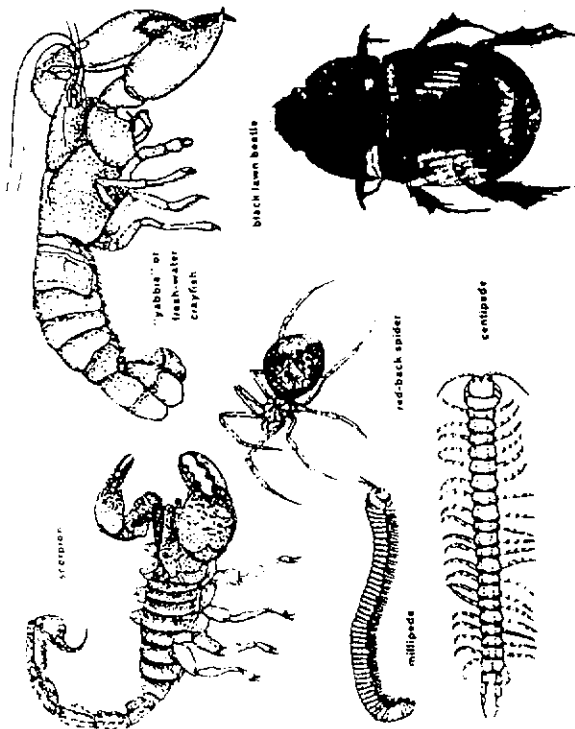
Q.1 Copy and fill in the notes below.

Echinoderms live in the ----- . They are animals with ----- skin. Echinoderms have a skeleton made from ----- . They use ----- feet to move and collect food. Reproduction is ----- but some sea stars can ----- .

- Why are echinoderms only found in water?
- Why is the name sea star better than starfish?
- If you cut a sea star in two what might happen?
- The crown-of-thorns feeds on the coral reefs in Australia. How do they multiply so quickly?
- How could a group of divers control the crown-of-thorns?

# ARTHROPODS

Arthropods are the largest group of animals. There are more than a million kinds of arthropods. They are a successful group.



The arthropods have a tough outside skeleton. This is called an exoskeleton. It protects them like a suit of armour. Arthropods have no inside bones. Their legs have joints like hinges. This helps them to move their armour.

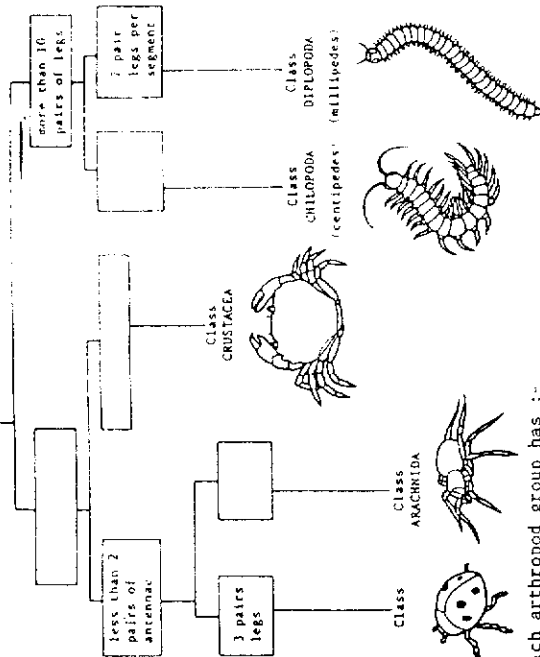
## BRING TO YOU

- Copy Answer Sheet 5 "Classifying Arthropods".
- One of the arthropods in the room. Fill in the table for each arthropod. (Leave the last column blank.)
- Write down three things that all arthropods have.
- Write down three things that are different in arthropods.
- Write down three arthropods that look alike.

There are three main classes of arthropods. They are insects, crustacea, and chelicerata. We are going to look at each of them and see how they are different from each other. We will look at the back of the class of these animals.

Q.4 Copy and fill in the classification key.

## ARTHROPODS



Q.5 Which arthropod group has :-

- 6 legs?
- 8 legs?
- 10 legs?
- 4 legs on each segment?
- 2 legs on each segment?
- 3 body parts (head, thorax and abdomen)?

Q.6 Name the arthropod class that these animals belong to.

- Scorpion
- Millipede
- Butterfly
- Spider
- Prawn
- Centipede

Q.7 Finish the last column on Answer Sheet 5 by using this key.

Q.8 Which arthropod class lives in water?

Q.9 Which arthropod class is dangerous to humans?

Q.10 Which arthropod class is a pest to humans? There are many animals in this class.

Q.11 Copy and fill in the notes below.

Arthropods are a successful group of animals. They have an outside skeleton. This has joints to allow movement. There are five classes of arthropods: insects, crustacea, chelicerata, millipedes, and centipedes. Arthropods are put into one of these groups when we look at their body. All arthropods reproduce sexually and make many eggs.





ARTHIPODS

1. Do you know a dangerous arthropod?

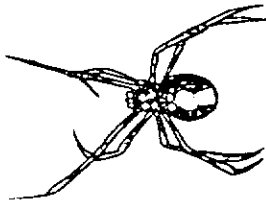
All the arthropods on this page are found in Western Australia.

THINGS TO DO!

a. Cut out the pictures and stick them in your note book.

b. Next to each picture write down

- (1) the name of the arthropod,
- (2) what it looks like (colour),
- (3) why it is dangerous,
- (4) where it is found.



BUILD AN INSECT

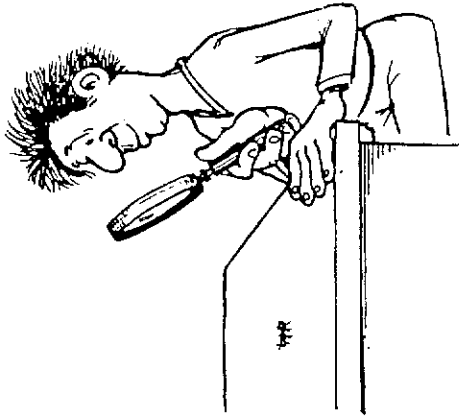
- Q.1 What insect do you want to make?
- Q.2 Your group will need to write down the details about the insect.
  - (a) Number of legs =
  - (b) Number of body parts =
  - (c) Number of wings =
  - (d) Number of antenna =
  - (e) Other special details?

THINGS TO DO!

- A. Collect plasticene, paper, matchsticks and popsticks.
- B. Use the materials to make your insect. It should be about 6cm long.
- C. Make a label like the one below for your insect.

NAME OF INSECT
DATE
WHERE COLLECTED
COLLECTOR'S NAME

- D. Put your insect on display on the side bench.



1. Mosquitoes are dangerous in tropical countries. Why?

2. What can you do to stop mosquitoes from biting you?

## PLANTS AND ANIMALS : CARD 20

AMPHIBIANS

Amphibians can live on land or in the water. Frogs, salamanders and newts are all amphibians. They have a moist, smooth skin. The young amphibians live in water and breathe using gills. The adult animals live on land and breathe using lungs. Amphibians reproduce in the water. They lay lots of jelly-covered eggs.

REPTILES

Reptiles live on the land. They are covered in dry scales. Snakes, lizards, turtles and tortoises are all reptiles. All reptiles are cold-blooded. They reproduce by laying soft-shelled eggs.

BIRDS

Birds have some things like reptiles. They have clawed feet and scales on their legs. Most birds can fly. They have feathers and strong, light bones to help them fly.

The feathers of a bird might have come from the scales of reptiles. Birds reproduce by laying hard-shelled eggs. They are warm-blooded. This means that a bird's body is always at the same temperature.

MAMMALS

Mammals are the most developed animals. They take care of the young after they are born. The mother has mammary glands that make milk for the young. This is why these animals are called mammals. All mammals are "warm-blooded" and have hair or fur on their body. They have four limbs and most make live young. The platypus and echidna lay hard-shelled eggs but they are still mammals.

THINGS TO DO

1. Complete Exercise Sheet 7 "Classifying Vertebrates".

2. Look at the vertebrates in the room. Choose two examples of each group and fill in the table. (Use the notes on this card to help you.)

## PLANTS AND ANIMALS : CARD 20

Q.2 Copy and fill in the notes below.

Vertebrates are animals with an inside skeleton and a ----- . The backbone is made of vertebrae. They support the body. Vertebrates can grow to a large size. They are well developed. All vertebrates reproduce ----- . The five classes of vertebrates are -----, -----, -----, ----- and ----- . To sort the animals into these classes we look at :- body covering, blood temperature, type of limbs, methods of reproduction and how they breathe.

Q.3 Why is it helpful to have an inside skeleton and a backbone?

Q.4 Which class of vertebrates have a skin covering of :-  
(a) hair?  
(b) slimy scales?  
(c) dry scales?  
(d) moist skin?  
(e) feathers?

Q.5 Name two classes of vertebrates that have warm blood? Why is this helpful?

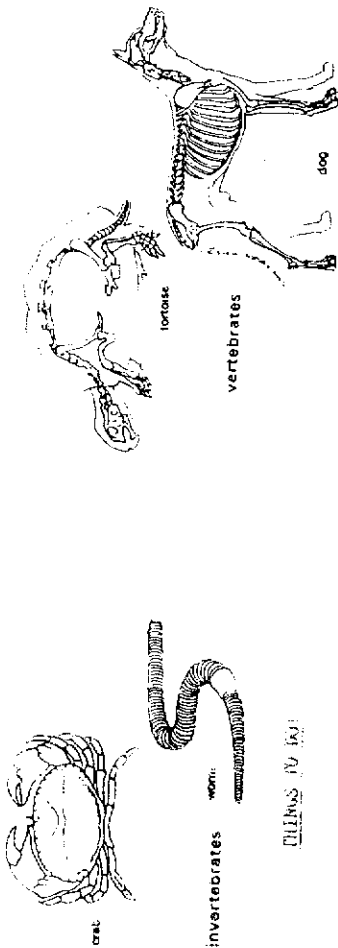
Q.6 How are the platypus and echidna different from all other mammals?

Q.7 Think about yourself and a worm. Why do scientists say we are more developed?

Q.8 How does a scientist classify animals? Does he look at size, colour and shape only or does he look at how developed they are and what details they have?

VERTEBRATES

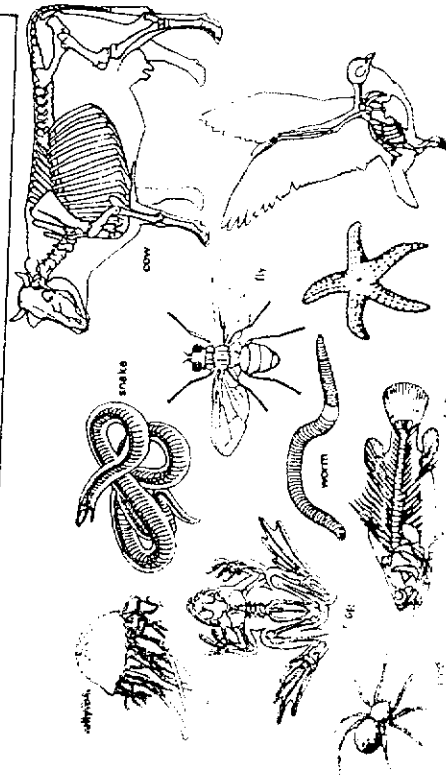
Vertebrates all have an inside backbone. The skeleton is inside the animal. Arthropods and animals without backbones are called invertebrates. The pictures below show two invertebrates (no backbone) and two vertebrates (backbone).



THEBOS IV (K)

- 4. Look at the skeletons in the room. Find the backbone in these animals.
- 5. Look at the pictures below. Try to find an inside skeleton.
- 6. Copy the table below and write in the names of the animals.

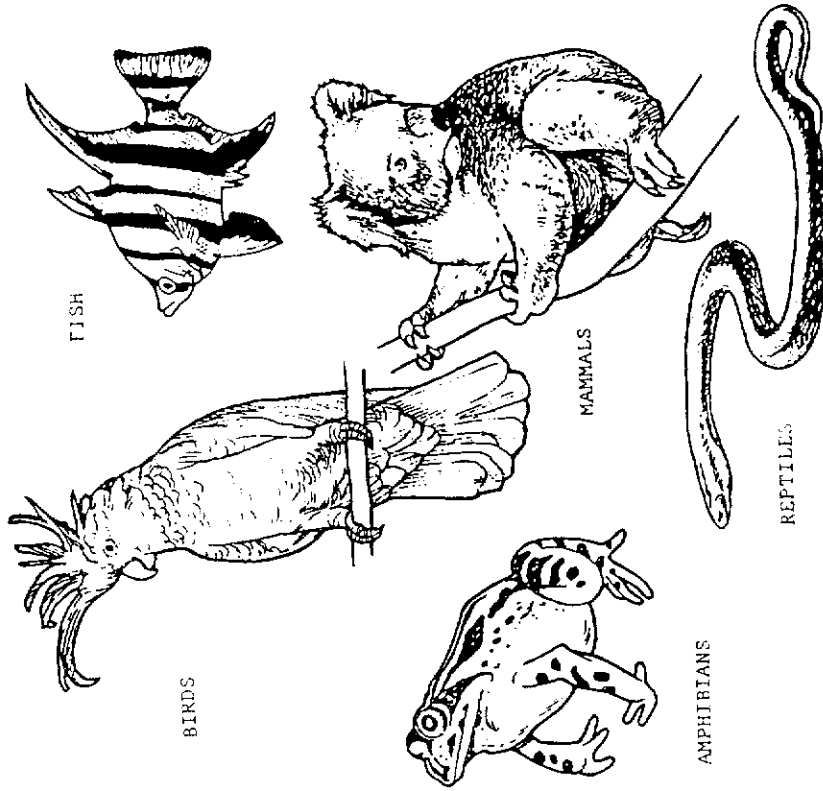
Bones inside the body VERTEBRATES	No bones inside the body INVERTEBRATES



TYPES OF VERTEBRATES

Vertebrates are the most complicated group of animals. They live in most places in the world. All vertebrates reproduce sexually. The male and female sex cells join together and make a new animal.

Vertebrates are a large group of animals. They have been sorted into animals that look alike. The five classes of vertebrates are fish, amphibians, reptiles, birds and mammals.



FISH

All fish live in water. Most fish have a bony skeleton inside them. Some fish like sharks and stingrays have a cartilage in place of bone.

Fish have slimy scales on the outside of their body. They are cold-blooded. This means that the body temperature of the fish is the same as the water.

Fish use their gills to get oxygen from the water. They reproduce sexually. Some fish hatch eggs and other fish have live young.

## CLASSIFYING VERTEBRATES

[illegible]

## PLANTS AND ANIMALS : REVISION SHEET

MATCHING WORKSHEET

In each bracket write the number of the missing word that belongs there.

1. The second highest group of plants are the (     ).  
1. Ringworm
2. The highest group of plants are the (     ).  
2. Jarrah dieback
3. All fungi do not have (     ) and so cannot make their own food.  
3. Fruit
4. Two fungi that can be found growing on a human are (     ) and (     ).  
4. Spores
5. Fungi reproduce by (     ) or (     ).  
5. Flowering plants
6. Fungi are used in (     ) dead material.  
6. Amoeba
7. Seeds on a conifer have a (     ).  
7. Sea anemone
8. (     ) is a plant made of an algae and a fungi living together.  
8. Earthworm
9. (     ) are fungi that can be eaten.  
9. Chlorophyll
10. (     ) is a fungus that attacks the roots of trees, making them die.  
10. Needles
11. Conifers have leaves that look like (     ).  
11. Tinea
12. Conifers and flowering plants reproduce (     ) by making seeds.  
12. Coral polyp
13. Conifer seeds are made in (     ).  
13. Conifers
14. The carrying of pollen to the female cone is called (     ).  
14. Paramesium
15. The seeds made in a flowering plant are in a (     ).  
15. Cones
16. Animals are classified by their level of (     ) or complexity.  
16. "Wing"
17. Protozoans have only (     ) cell and must be looked at through a (     ).  
17. One
18. Two examples of protozoans are (     ) and (     ).  
18. Breaking down
19. The common name of porifera is (     ).  
19. Octopus
20. (     ) have (     ) which filter food.  
20. Cuttlefish
21. (     ) have (     ) which filter food.  
21. Coelenterates
22. (     ) have (     ) which filter food.  
22. Sexually
23. (     ) have (     ) which filter food.  
23. Budding
24. (     ) have (     ) which filter food.  
24. Mushrooms
25. (     ) have (     ) which filter food.  
25. Development
26. (     ) have (     ) which filter food.  
26. Pollination
27. (     ) have (     ) which filter food.  
27. Regeneration

## PLANTS AND ANIMALS : REVISION SHEET

21. Jellyfish group (     ).  
28. Pores
22. Three examples of coelenterates are (     ), (     ) and (     ).  
29. Microscope
23. An example of an annelid is the (     ).  
30. Lichen
24. A starfish belongs to the (     ) group.  
31. Sponges
25. Starfish can regrow lost arms. This is called (     ).  
32. Blue bottle
26. Two examples of cephalopods are (     ) and (     ).  
33. Echinodermata

## PLANTS AND ANIMALS : REVISION SHEET

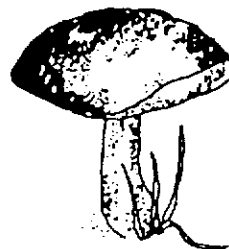
## FEATURES OF PLANT GROUPS

Under each of the pictures write down the main points for this group.

Algae



Fungi



Mosses



Ferns

Gymnosperms  
(conifers)Angiosperms  
(flowering plants)

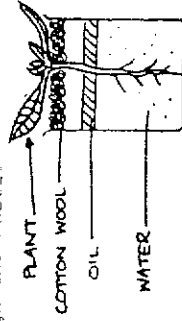
all these plants :

1. make their food.
2. are saprophytes.
3. do not make flowers.
4. can respire without roots.

Plant B is :

1. moss.
2. flowering plant.
3. lichen.
4. fern.

A student used the equipment below to find out if plants absorb water through the roots.



The water level fell overnight. He concluded that the roots had absorbed the water. The conclusion would be more reliable if a control tube was used. The control tube is the same as the experiment but it has no :

1. cotton wool.
2. oil.
3. plant.
4. water.

A scientist set up the experiment below. The jars and mice are the same size. Jar A and B were put in the light. Jar C was put in the dark.



All of the mice die from lack of oxygen. What order do they die in?

1. A, B, C.
2. C, B, A.
3. B, C, A.
4. C, A, B.

Which of the following is a true statement?

1. All plants have roots.
2. All plants have leaves.
3. All plants have flowers.
4. All plants have seeds.

A student was studying the life cycle of a plant. He found that some plants have 'detached' and can live as small pieces. Some plants were soaked in water and some in glucose. After a day all of the pieces were tested with iodine. The leaf in glucose gave a positive result and the leaf in water gave a negative result. This means that :

1. All water stops photosynthesis.
2. Iodine is a test for glucose.
3. Glucose causes photosynthesis.
4. The glucose leaves turned some glucose to starch.
5. The glucose absorbs carbon dioxide and gives a positive result.

A student made up of two plants that live together. The two plants are :

1. algae and fungi.
2. algae and moss.
3. fungi and moss.
4. ferns and moss.
5. algae and ferns.

An example of an algae is :

1. Euglena.
2. Bracken.
3. Hydra.
4. Seaweed.
5. Mushroom.

This table must be used for Q.5 and Q.6

Features	PLANT A	PLANT B	PLANT C	PLANT D
Colour	green	green	green	green
Veins/no veins?	veins	veins	no veins	no veins
Reproduction	seeds (flowers)	spores	spores	spores
Method of attachment	roots	roots	holdfast	rhizoid
Leaf Type	leaves	fronds	leaves	leaves
Habitat	land	land	water	land



1. Plants have many more places than animals to have been found.

2. Plants make their own food and animals do not.

3. Plants are made of cells and animals are made of cells.

4. Plants are better at absorbing and conducting water.



1. Chlorophyll
2. Carotenes
3. Xanthophyll
4. Anthocyanin

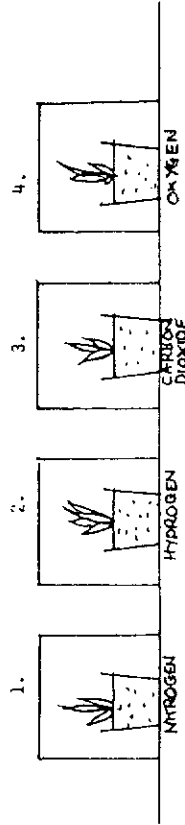
15. A scientist wanted to find out how ants moved at different temperatures. She changed the temperature a few times and counted the number of ants moving. The results are in the table below.

Temperature	Number of Ants Moving
0°C	0
25°C	0
50°C	12
75°C	8
100°C	0

When are the ants most active?

1. below 0°C
2. 10°C - 20°C
3. 40°C - 60°C
4. 70°C - 90°C

16. Four plants were put in jars with different gases.



The jars were put in the sun. Which plant could make its own food?

1. 1
2. 2
3. 3
4. 4

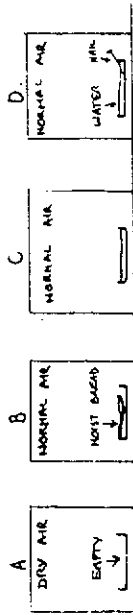
17. The diagram below



The leaf labelled X is used for:

1. releasing oxygen
2. taking food
3. reproduction
4. absorbing water

18. Four fishes were set up like the ones below.



Which dish will fungi grow in?

1. A
2. B
3. C
4. D
5. All of them.

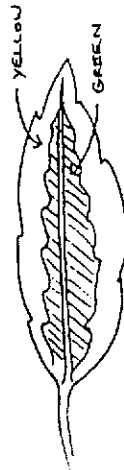
19. Green plants make food by photosynthesis. The equation below shows what happens.



What goes in the box?

1. oxygen
2. nitrogen
3. carbon dioxide
4. starch
5. glucose

20. The variegated leaf below has been put in the light for a few hours.



What is true?

1. The green part has chlorophyll and can make food.
2. The green part only has chlorophyll.
3. The yellow part has chlorophyll and can make food.
4. The yellow part only has starch.

Fig. 1. Animals from the phylum Arthropoda.

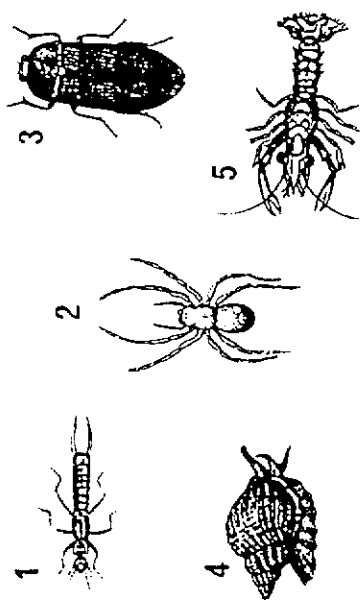
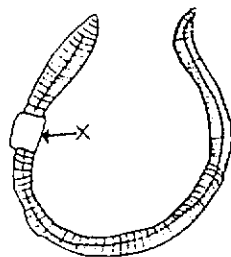


Fig. 2. The part of the body of a coelenterate.



The part labelled X is called the

1. mouth.
2. foot.
3. saddle.
4. segment.
5. legs.

The whole animal is the coelenterate.

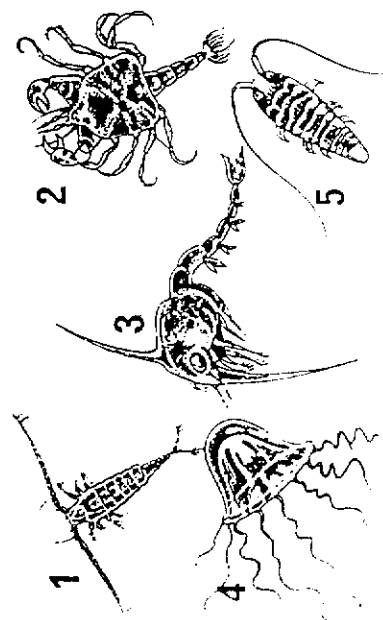
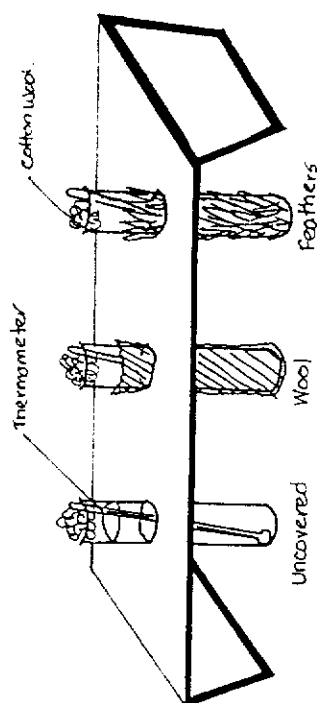
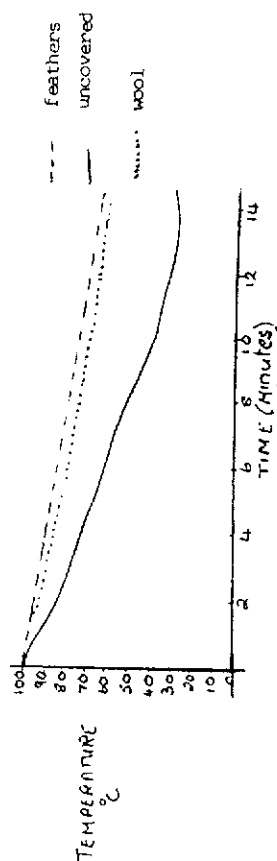


Fig. 4. The animals from the phylum Mollusca.

The animals from the phylum Mollusca are shown in the diagram below.



The animals from the phylum Mollusca are shown in the diagram below. The water temperature was measured in the test tubes. The results are shown in the graph.



Which of the things below would make no difference to the success of the experiment?

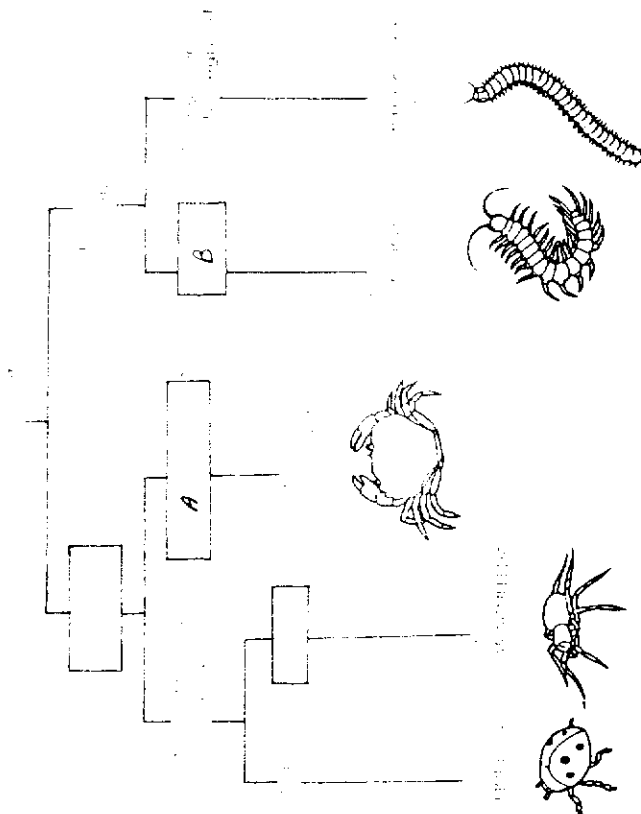
1. Replace water in the test tubes with oil.
2. Put hot water at different temperatures in the test tubes.
3. Put different amounts of water in the test tubes.
4. Use different sized test tubes.
5. Put test tubes in different parts of the room.

The results of this experiment show that:

1. coverings are not good because the temperature still fell.
2. wool is only good at stopping heat loss if the temperature is high.
3. feathers are better at stopping heat loss from birds than mammals.
4. wool and feathers keep the temperature higher.
5. wool is better than feathers at stopping heat loss.

SECTION B : Write the answers in the space provided.

Diagram showing the life cycle of a tapeworm.

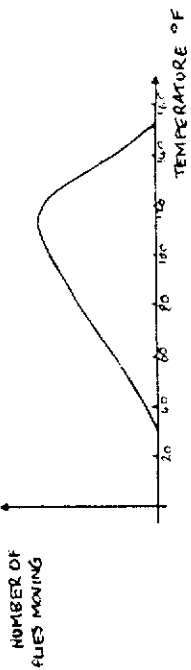
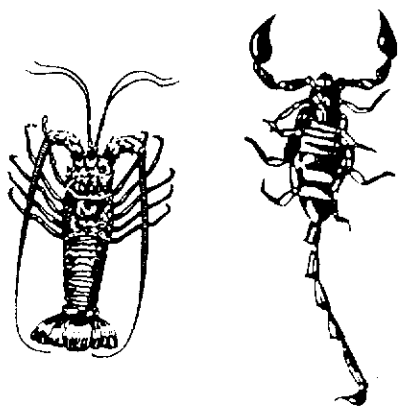


2.1 Use the key above to answer parts (a), (b) and (c).

(a) What should be written in box A?

(b) What should be written in box B?

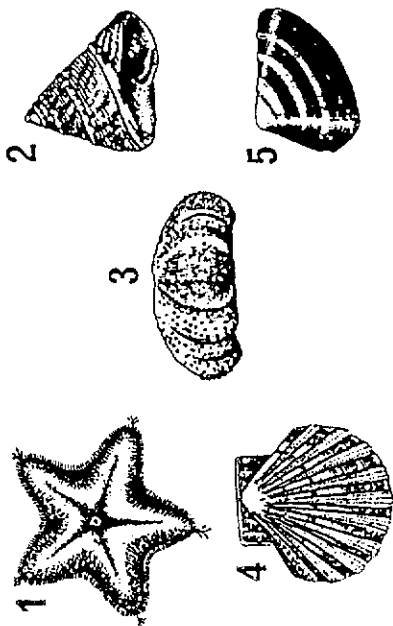
(c) Use the key to work out which of the following animals are not the life cycle of a tapeworm.



2.2 Give a name that flies like:

- (a) a cool place below 20°F.
- (b) are most active around 110°F.
- (c) react differently to their colour of skin than in the rain.
- (d) cannot live in deserts.
- (e) will die if they do not have water.

2.3 One of these pictures shows a starfish. Tick (✓) the correct one.



2.4 When people hold animals they may get tapeworm. You can stop the spread of tapeworm by:

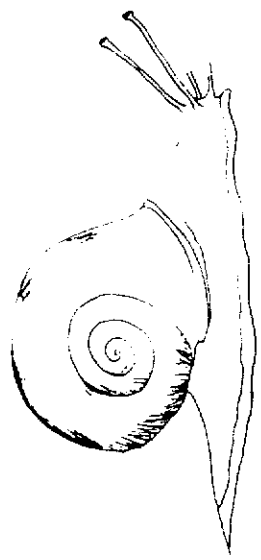
- (a) feeding pet meat.
- (b) brushing pets.
- (c) wash your hands after touching pets.
- (d) keep the pets area clean.
- (e) all of the above.

2.5 Scientists in Queensland are trying to control the crow or 'bunya' starfish. If they catch the starfish and cut one arm off, what may happen to the starfish?

- (a) it will die.
- (b) it will grow a new arm.
- (c) it will grow a new body.
- (d) it will grow a new head.

D.3 Write these labels on the picture below.

- (i) coiled shell
- (ii) head
- (iii) muscular foot
- (iv) eye tentacles
- (v) feeling tentacles
- (vi) breathing pores



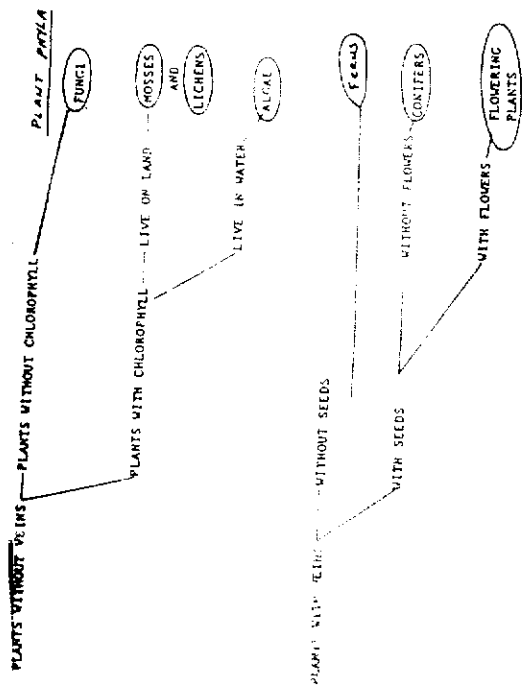
D.4 The teacher has listed some vertebrates. Write the names of the vertebrates under the correct class in the table below.

Be careful! The last four are tricky.

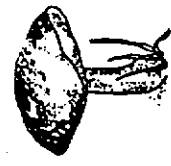
- cat, shark, frog, snake,
- hummingbird, toad, millipede,
- crocodile, peacock, crow,
- camel, elephant, giraffe,
- tuna, eagle, wallaby,
- uran, whale, turtle, bat, eel.

FISH	AMPHIBIAN	REPTILE	BIRD	MAMMAL

D.2 A classification key for the plant groups.



Using this key to work out the phyla for the plants below. Write down a reason for choosing that phylum.



## CARD 4

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 5

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 6

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 7

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 8

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 9

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## LANGUAGE RATING SCALE

Compare the original and modified cards. Then indicate the appropriate word.

## CARD 1

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 2

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Sentence length (easier, no change, harder)  
 C. Syntax (easier, no change, harder)

## CARD 3

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## CARD 3

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder)  
 B. Syntax (easier, no change, harder)  
 C. Task Difficulty Level (easier, no change, harder)

## ANSWER SHEET 2

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Sentence length (easier, no change, harder ),
- C. Syntax (easier, no change, harder ).

CARD 11

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Syntax (easier, no change, harder ),
- C. Task Difficulty Level (easier, no change, harder ).

ANSWER SHEET 3

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Sentence length (easier, no change, harder ),
- C. Syntax (easier, no change, harder ).

## LANGUAGE PAINING SCALE

Complete the "easier" and "harder" scales. Then fill in the appropriate word.

CARD 11

- A. Has the modified card changed in any of these areas?
- B. Vocabulary (easier, no change, harder ),
- C. Sentence length (easier, no change, harder ),
- D. Task Difficulty Level (easier, no change, harder ).

CARD 12

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Syntax (easier, no change, harder ),
- C. Task Difficulty Level (easier, no change, harder ).

CARD 13

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Syntax (easier, no change, harder ),
- C. Task Difficulty Level (easier, no change, harder ).

CARD 14

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Syntax (easier, no change, harder ),
- C. Task Difficulty Level (easier, no change, harder ).

CARD 15

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ),
- B. Syntax (easier, no change, harder ),
- C. Task Difficulty Level (easier, no change, harder ).

ANSWER SHEET 4

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Sentence length (easier, no change, harder ).
- C. Syntax (easier, no change, harder ).
- D. Task Difficulty Level (easier, no change, harder ).

CARD 16

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Syntax (easier, no change, harder ).
- C. Task Difficulty Level (easier, no change, harder ).

CARD 17

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Syntax (easier, no change, harder ).
- C. Task Difficulty Level (easier, no change, harder ).

CARD 18

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Syntax (easier, no change, harder ).
- C. Task Difficulty Level (easier, no change, harder ).

ANSWER SHEET 5

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Sentence length (easier, no change, harder ).
- C. Syntax (easier, no change, harder ).

ANSWER SHEET 6

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Sentence length (easier, no change, harder ).
- C. Syntax (easier, no change, harder ).

CARD 19

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Syntax (easier, no change, harder ).
- C. Task Difficulty Level (easier, no change, harder ).

CARD 20

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Syntax (easier, no change, harder ).
- C. Task Difficulty Level (easier, no change, harder ).

ANSWER SHEET 7

Has the modified card changed in any of these areas?

- A. Vocabulary (easier, no change, harder ).
- B. Sentence length (easier, no change, harder ).
- C. Syntax (easier, no change, harder ).

## SCIENCE RATING SCALE

Compare the original and the modified cards. Then circle the appropriate word in brackets.

CARD 1

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

ANSWER SHEET /

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 2

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 3

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 4

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 5

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 6

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 7

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 8

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).



## SCIENCE RATING SCALE

Compare the original and the modified cards. Then circle the appropriate word in brackets.

CARD 11

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 12

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 13

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 14

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

ANSWER SHEET 2

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

CARD 10

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

ANSWER SHEET 3

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 15**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**ANSWER SHEET 4**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 16**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 17**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 18**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**ANSWER SHEET 5**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**ANSWER SHEET 6**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 19**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**CARD 20**

Does the modified card cover the same :-

- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

**ANSWER SHEET 7**

Does the modified card cover the same :-

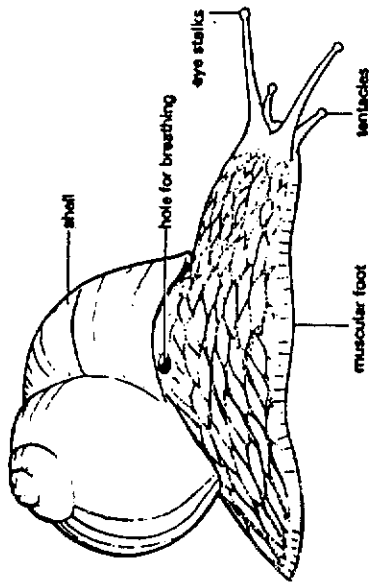
- A. Objective ( always, sometimes, never ).
- B. Concepts ( always, sometimes, never ).
- C. Skills ( always, sometimes, never ).
- D. Scientific terminology ( always, sometimes, never ).

LOOKING AT SNAILS

In this experiment you will look at snails. Take care of your snail. Keep it moist and do not break the shell.

THINGS TO DO!

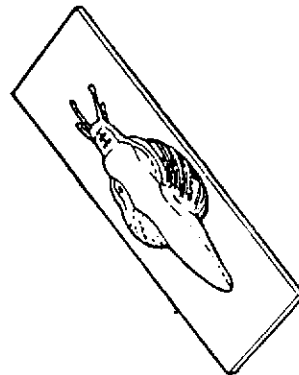
1. Use a hand lens to look at your snail. Try to find all of the parts in the picture below.



- Q.1 Copy the picture of the snail.
- Q.2 How many coils are there in your snail's shell?
- Q.3 Do you know how the snail grows? Does it get rid of it's shell and grow a new one? Does it add new coils to the shell?

1. Put your snail on a glass slide. Watch it move.

- Q.4 How does the snail move?
- Q.5 Snails leave slime trails when they move. What do you think the slime trail is used for?



- Q.6 Do you know which part of the snail is the most sensitive? Write down your guess.



C. Use a blunt pencil to gently touch the snail. Use the parts in the table below.

NOTE : If the snail responds, wait until it has recovered before you touch it again.

- Q.7 What is the stimulus in this activity?
- Q.8 Copy the table below and fill in your observations.

PART OF THE SNAIL TOUCHED	RESPONSE
shell	
foot	
eye tentacle	
feeling tentacle	
head region	

- Q.9 Which part of the snail is most delicate?
- Q.10 Which part of the snail is most sensitive?
- Q.11 Is the most delicate part the same as the most sensitive part? Why?

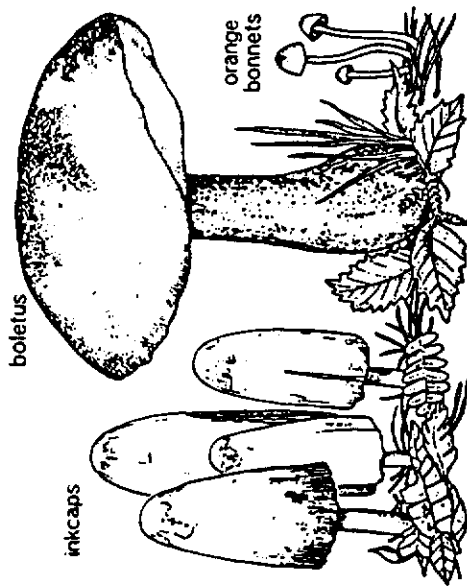
EXTRA ACTIVITY

**SNAIL RACES**



Have a snail race to find out the fastest snail.

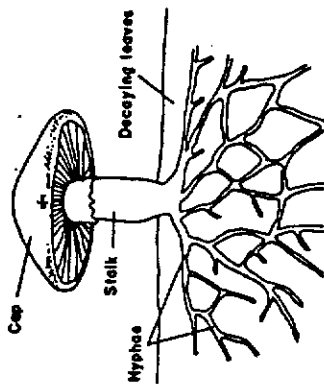
UNUSUAL PLANTS - FUNGI



Fungi are unusual because they are not green. They may be brown, white or even bright orange. Fungi do not have green chlorophyll in their cells and so they can not photosynthesise.

Fungi need to grow on something they can use for food. Mushrooms are often found on rotting leaves or near animal manure. Moulds grow on bread, fruit or jam.

All fungi have fine, thread-like fibres called hyphae. These grow out to collect the food.



The largest parts of a mushroom plant are the hyphae. They grow through the rotting matter.

The fungus has a reproductive part that sends out tiny spores. These float in the air and may grow into a new fungi when they land.

Q.1 Copy this picture of a mushroom. Label the spores and the hyphae.

Most fungi are decomposers and grow on rotting leaves or manure. Some fungi are parasites and grow on living plants or animals. Rust fungus is a parasite and grows on wheat. Ringworm is a fungus that grows on or under the skin of animals.

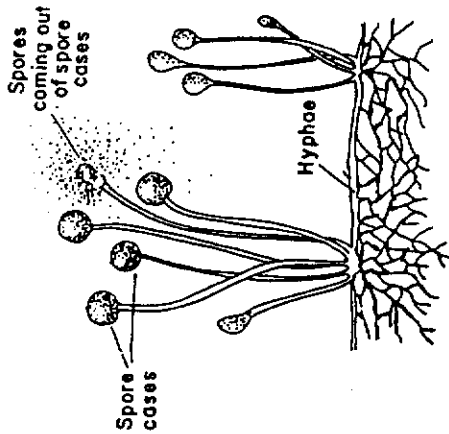
Fungi have many uses. Mushrooms are used for food while yeast is used to make bread and beer. A special fungus is used to make the antibiotic Penicillin.

Q.2 Copy and fill in the notes below.

Fungi are unusual plants because they have no \_\_\_\_\_. They may be brown, \_\_\_\_\_ or \_\_\_\_\_ but not \_\_\_\_\_. Fungi live on the remains of other plants or animals. Fungi reproduce by \_\_\_\_\_ or budding. They may be small like yeast or large like \_\_\_\_\_.

Q.3 Name two useful fungi and two harmful fungi.

Q.4 Why do we classify fungi as a plant if it can not photosynthesise?



Bread mould

## PLANTS AND ANIMALS

## PRETEST

This test is made to see how much you know about plants and animals. Write answers to the questions below. If you do not know the answer, then take a guess.

Q.1 Why do we need to sort things into groups?

Q.2 Name three differences between plants and animals.

Q.3 Name one plant that belongs in each of the groups below:

Algae -

Fungi -

Ferns -

Gymnosperms -

Flowering Plants -

Q.4 Name two things that a fungus needs to grow.

Q.5 Write down what these parts of a flowering plant are used for:

Leaves -

Stem -

Flowers -

Roots -

Seeds -

Soil -

Q.6 Name one animal that belongs in each of the groups below:

Protozoa -

Coelenterates -

Annelids -

Molluscs -

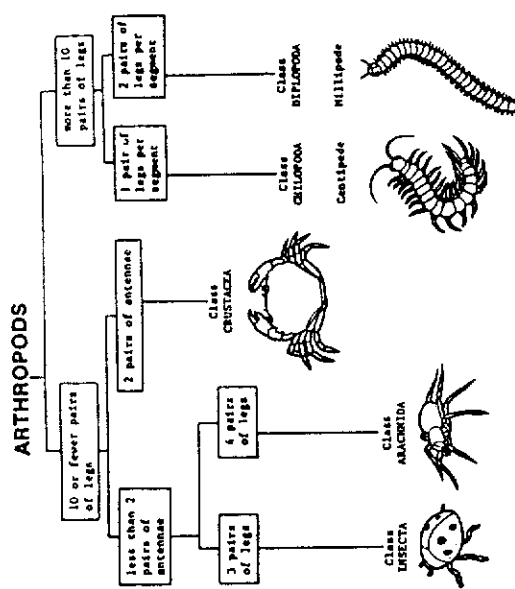
Echinoderms -

Arthropods -

Vertebrates -

Q.7 Earthworms are useful in the garden because they -----

Q.8 Use the classification key below to work out what group a spider belongs to.



Q.9 Name three dangerous arthropods.

Q.10 Insects have \_\_\_\_\_ body parts, \_\_\_\_\_ legs and an \_\_\_\_\_.

Q.11 Vertebrates have a \_\_\_\_\_ and invertebrates do not.

Q.12 Name the 5 classes of vertebrates and write down what their body is covered with.

Q.13 Animals are sorted into groups by looking at their level of \_\_\_\_\_.

## APPENDIX G

A Comparison of Students' Class, Reading Ages, Chronological  
Ages, Science Achievement, and Gender.

Student	Class	Reading Age	Chronological Age	Science Achievement	Gender
1	F	8.1	13.6	66%	M
2	F	8.2	13.3	28%	M
3	F	9.3	13.6	36%	F
4	F	9.7	12.9	35%	M
5	F	9.10	13.2	58%	M
6	F	10.6	13.5	46%	F
7	F	10.7	13.2	35%	F
8	F	10.7	13.1	48%	M
9	F	11.6	13.2	43%	M
10	F	11.6	12.10	42%	F
11	F	11.7	12.11	50%	F
12	F	11.11	13.5	47%	F
13	F	12.1	13.1	54%	M
14	F	12.2	12.9	55%	M
15	F	12.6	12.8	57%	M
16	F	12.10	13.6	69%	M
17	F	13.1	12.11	57%	F
18	F	13.1	12.8	58%	F
19	F	13.3	13.1	63%	M
20	F	13.7	13.0	45%	M
21	F	15.1	13.7	69%	M
22	F	15.1	13.4	58%	F
23	F	15.11	13.5	47%	F
24	F	15.11	13.2	51%	F
25	M	15.11	12.10	61%	M
26	M	9.7	13.6	41%	M
27	M	9.8	13.3	30%	M
28	M	10.4	13.3	34%	M
29	F	10.6	12.9	33%	F
30	F	10.9	13.4	45%	F
31	M	10.11	13.4	37%	M
32	F	11.2	13.6	32%	F
33	M	11.2	12.9	38%	M
34	M	11.4	13.1	33%	M
35	F	11.7	14.5	31%	F
36	M	11.7	13.3	43%	M
37	M	12.4	12.9	37%	M
38	M	12.6	13.1	45%	M
39	F	12.10	12.8	38%	F
40	M	12.10	12.8	56%	M
41	M	13.1	13.7	57%	M
42	F	13.5	12.10	49%	F
43	F	14.8	13.5	40%	F
44	F	14.8	12.10	48%	F
45	F	15.1	12.10	47%	F
46	F	15.6	12.9	59%	F
47	F	16.3	13.6	57%	F
48	F	16.10	13.0	62%	F