A CRITICAL ANALYSIS OF ASPECTS PERTAINING TO THE TEACHING OF THE ECOLOGY SECTION OF THE STANDARD EIGHT BIOLOGY SYLLABUS

BY

RAZEENA WAGIET

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PROMOTER: PROFESSOR B. MC KENZIE
CO-PROMOTER: PROFESSOR H. HERMAN

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ABSTRACT

In this study an attempt has been made to investigate how the **Ecology section** (suitable for fostering awareness and concern for the environment) of the standard eight Biology syllabus is taught. Since fieldwork and related exercises are integral components of ecology, teachers are strongly advised to venture into such activities.

It was ascertained that the restraints which inhibited teachers from undertaking meaningful endeavours such as fieldwork include: an inadequate pre-service training in ecology, with limited or no experience of fieldwork techniques; lack of time and, syllabus constraints. It is therefore recommended that there should be a restructuring of the content and approach followed by the tertiary institutions involved in teacher training.
Additionally, it should be noted that in the absence of in-service teaching programmes, and, with the weaknesses identified in the textbooks, difficult sections experienced by the teachers (for example, nutrient cycling), will continue to be problematic, and unsuitable methods of ecology teaching will be perpetuated.

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Lastly I would like to thank my husband Fadli, for the support and encouragement given during this project.

I declare that **A CRITICAL ANALYSIS OF ASPECTS PERTAINING TO THE TEACHING OF THE ECOLOGY SECTION OF THE STANDARD EIGHT BIOLOGY SYLLABUS** is my own work, and that all the sources I have cited or used have been acknowledged and indicated by means of complete references.

K. Naguet

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CHAPTER ONE: INTRODUCTION

1.1 AIMS AND SCOPE

The area of assessment is related to the content and methodology of teaching the **Ecology Section** of the standard **Eight Biology Syllabus**. Central to this theme is the teacher, who has to impart the syllabus content to the pupil. The manner [teaching style] in which the teacher, disseminates the content is affected by numerous factors, three of which are discussed in this survey:

-the pre-service training which the teacher received;

-the amount of time available for the teaching of the content,and

-the resources used by the teacher.

The reasons for having chosen the **Ecology section** of the Biology syllabus are twofold:

-Firstly, it is fundamental for future generations to have an **adequate understanding** on the functioning of the Biosphere and the careful management of it's resources to safeguard the survival of Man;

-Secondly, to **instill** certain **values** in pupils that will foster a love for the environment, and to make them **environmentally aware.**

The ecology section of the biology syllabus is, in these respects, an ideal vehicle to accomplish the above. With regards to the first point, Watson [1990] effectively describes how the major problems experienced in South Africa are of a Biological/ ecological nature. He writes *"Whichever political party rules*

the country in the next century will be faced with enormous problems, all fundamentally of a biological nature...they are problems which relate to population numbers and the ability of the land to support it's population".

Ecology can thus be regarded as a very important aspect of the school curriculum, as Watson [1990] points out: *"...biology teachers are going to have to set about addressing these problems in the classroom...as education is going to be the key to the resolution of these problems".* It is therefore clear that biology teachers are partly responsible for ensuring that their pupils understand the ecological processes on which our survival depends. The decision makers of today who are frequently criticised for poor management and handling of environmental issues are products of an educational system that did not prepare them adequately for the task. It is up to the teachers of today, as well as the designers of the curriculum to ensure that pupils will not make the same errors when they are the decision makers of tomorrow. Nightingale [1977] comments:

"Education must be seen as a key to gaining public support for measures aimed at the wise frugal use of scarce resources."

With regard to the content in the syllabuses, Hurry, [1977] commented on the syllabuses for biology, and the standard eight document is considered in chapter four . Generally, the syllabus has been criticised for presenting confined, somewhat inward-looking perspectives on ecology.This argument still holds today. In this regard Evans [1988], mentions *"Structures of communities*

and circumscribed habitats are essential, but they must be complimented by considerations of the global environment. It is important for pupils to realise that there are interactions between ecosystems on a world scale, and that interference with one system can have far reaching, and sometimes disastrous effects on others". He proceeds by mentioning the chain effects of, for example, pesticides, which are used to regulate pests of crops on the land, but may find their way into food chains in the oceans, destruct coral reefs, erode and pollute estuaries, ultimately affecting sea fisheries, a source of food to mankind, thus threatening our survival.

The narrow perspective of the ecology syllabus links up with the methodology facet. Is the content disseminated to the pupils in a functional manner, so that they can use it to interact positively with the environment, assisting in it's health and vitality?

The customary approach to the teaching of ecology is to build applied facets of the subject into a sound framework and understanding of the basic concepts [Evans, 1988]. Most syllabi, and textbooks first deal with the fundamental ecological processes, and later inquire into the influence of human activity on the environment, instead of interrelating the two.

Hurry, [1977] supports the view held by many ecologists and educationists, believing that there has been limited success in changing attitudes and patterns of behaviour via the curricula, since it makes no room for individuals seeing themselves as

organisms interacting with the environment. The outcome of an ecology course should ideally be one where the learner appreciates the interaction between man and his total environment, fully understanding the nature and implications of human impact [Linke, 1976 in Nightingale, 1977]. Nevertheless, the current approach to the teaching of ecology may have its advantages, (being academically sound) but it certainly has its drawbacks, since it does not accentuate the **interaction** of man with his environment.

This approach is a typical ***"Western world-view"*** [Opie, 1989], where man is seen as being separate from his environment, instead of being interrelated with the natural world. Opie [1989] stresses the importance of the methodology facet of teaching, as he writes: *"...we need an educational method that looks outwards at the reality of our dying land and promotes **CONCERN, CARING AND COMMITMENT**"*. In essence, this is the second motivation for tackling the ecology section of the standard eight biology syllabus, since, values education, an important component of environmental education, can be fostered via this component of the school curriculum. The ecology section of the standard eight syllabus being an ideal vehicle for environmental education.

At this point a review of what *environmental education* entails will follow. Defining environmental education is rather difficult for various reasons. The objectives of environmental education vary according to the values and interest, as the aims of ecologists and educationists do not always coincide. However,

an appropriate definition for this survey is one that needs to satisfy the needs of both the ecologist and educationist. Such a definition is contained in the U.S. Environmental Education Act 1970 [Linke, 1976 in Nightingale, 1977]

> "Environmental education is an integral process which deals with man's interrelationship with his natural and man-made surroundings, including the relation of population growth, resource allocation and depletion, conservation, technology, urban and rural planning to the total human environment.
> Environmental education is a study of the factors influencing ecosystems, mental and physical health, living and working conditions, decaying cities and population pressures.
> Environmental education is intended to promote among citizens, the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to ensure our survival and to improve the quality of life".

To attain the goals of environmental education via the ecology section of the biology syllabus, the methodology applied by the teacher is of utmost importance. Activities which will foster the development of environmental-friendly values has to be pursued. Many educators both locally [Nightingale, 1987; Watson, 1990; Moodie, 1987; Opie; 1989] and internationally [Bouskila, 1987; Millet, 1988] are in agreement that the educational objectives of environmental education cannot effectively be accomplished unless pupils are exposed to suitable outdoor educational encounters. In this respect fieldwork and environmentally based projects are invaluable. The nature of these activities can contribute towards the development of values and attitudes that should make our future decision-makers suitably environmentally aware.

It becomes necessary to define what is meant by the term fieldwork. Some of the terms used as synonyms to the term

fieldwork include field studies, field teaching, outdoor education excursions and field research. The term means different things to different people. In this survey it invariably follows the definition of Nightingale [1977], which is **a formal study outside the classroom, undertaken by pupils as part of their academic studies in biology.**

Opie [1989] indicates that values education comprises activities which are essentially right brain activities, and are often neglected in our schools today, in favour of left brain activities (cognitive development and related skills). He is of the opinion that an equilibrium should be reached in the provision of learning activities in the school curricula. Unless this is so *"there will continue to be an unbalanced view, due to unbalanced education, inevitably resulting in unbalanced people"* [Opie, 1989]. Right brain activities (spiritual awareness, insight, imagination, emotional sensitivity, creative thinking, and the like) may not truly be achievable in our heavy loaded, academic biology syllabus.

The importance of fieldwork is shared by other educationists, for example Watson [1990]: *"the environmentally based projects, fieldtrips and conservation course...all contribute to the development of attitudes and values..."*; Nightingale [1977]: *"it can provide a training in the methodology in the natural sciences, and indeed the scientific method. Field studies are important means of developing the critical faculty of pupils..."*; Millet, [1988]:

"Can teachers continue to risk the trade-off of measuring unnecessary facts in exchange for good thinking and problem-solving skills? Every time I see student's positive reactions to field techniques and participatory activities, my belief in the value of these activities is reaffirmed".

The preceding paragraphs portray that the ecology section of the standard eight Biology syllabus is a distinct vehicle for the facilitation of environmental education. Notwithstanding this, it is the teacher who is the facilitator thereof. The mode of teaching employed by the teacher, [vital for the facilitation of environmental education] as mentioned earlier on, will depend upon:

-his knowledge of ecology, which is based on the pre-service teacher training programme which he was exposed to;
-the nature of the content as contained in the syllabus;
-time available to teach the matter;
-the resources used to facilitate the teaching process.

Clearly, the teaching of ecology can only succeed if the teachers are capable of teaching it. Teachers with a limited knowledge of ecology cannot transfer the information with confidence and insight. Ecology is a global phenomenon and a holistic view in this regard should be transferred to the pupil. The Council for the Environment [1987] reiterated the importance of pre- and in-service training for teachers. In this document it is stated that the Belgrade Charter proposes that a foundation should be laid for an environmental education programme. This implies that it

is the task of the teacher, *who are at the corner stones of any educational endeavour* to develop this. The Council for the Environment [1987] furthermore appeals to Colleges of Education and to Faculties at Universities to cater for a proper in- and pre-service training of teachers in this regard.

When training teachers for education within the ecology framework, they must be shown the way in which the structure and function of the whole ecosystem can be demonstrated [Randall in Albrecht and Seeley, 1986]. Another vital prerequisite for pre-service teacher training, is to increase the desire for, and abilities in fieldwork, since ecology is a field-based science. In this survey, data has been gathered pertaining to these facets of the respondents' pre-service training, and analysis of this is given in CHAPTER THREE.

Examples where a functioning environmental elective has been implemented during pre-service training, include a few universities in Southern Africa, and a few colleges of education (those functioning with a degree of autonomy), including:

-Johannesburg College of Education (Johannesburg) [Nightingale, 1987];

-five Colleges of Education in Bophuthatswana [Irwin, 1987];

-Edgewood College of Education (Durban), [Nightingale, 1987]-to be discussed in CHAPTER THREE;

-Mowbray College of Education, and at certain universities, such as Bophuthatswana and Rhodes. It may very well be that there are other tertiary institutions where such a course has been

implemented but are not listed here.

Nevertheless,it is beyond the scope of this survey to investigate all the existing situations prevalent at the various colleges of education, and the various faculties at universities involved with the pre-service training of teachers in ecology. Thus no recommendations wil be made in this regard, thereby leaving this area open for future research.

In addition to the teacher training aspect, the other factors influencing teacher-methodology under consideration in this survey are resources. Since the textbook is probably the main teaching resource of most teachers, this aspect will be reviewed in CHAPTER SIX. Lastly, however, it can be stated that **what** is taught, and **how** it will be taught, ultimately depends on the time available to the teacher, an aspect to be examined in CHAPTER FIVE.

1.2 RESEARCH METHODOLOGY.

In this research investigation, a cross-sectional survey has been conducted. Pertaining to the collection of data, a self-administered method of questioning, instead of an interview technique was employed. The latter technique had been decided against, since it is rather time-consuming (this study had been carried out on a part-time basis), and unsuitable where a large number of respondents are involved, (52 in this survey) who are, furthermore, geographically scattered (throughout the Republic of South Africa).

The mailed questionnaire was selected since:

-it enabled simultaneous distribution and application;

-the large number of respondents were geographically scattered;

-time available was limited;

-the structured nature of the technique facilitates comparisons and analysis of the data which was collected.

However, in an attempt to:

-yield more detailed and reliable information;

-elicit certain verbal responses, and to

-facilitate a certain degree of in-depth probing, a first draft of the questions had been verbally discussed/ pre-tested with a group of 15 biology teachers. To eliminate further ambiguities, a pilot study had been subsequently conducted with 25 teachers, teaching biology at standard eight level.

The draft of questions was re-evaluated and refined. A copy of the final questionnaire is included as Appendix 1.

The questionnaire was then mailed to eighty Biology teachers (teaching at standard eight level) throughout the country. Some of the respondents were sub-examiners for the 1989 Senior Certificate Examination in Biology [Department of Education and Culture- House of Representatives]. After having obtained permission from the chief-examiner to communicate with the teachers at the centre where they had been evaluating, the names, addresses and telephone numbers of those who had expressed their willingness to participate in this survey had been recorded. Some of these teachers had passed on a few questionnaires to their

colleagues at other schools within their respective regions. From the eighty questionnaires that were mailed, only fifty-two were completed and returned.

1.3 ANALYSIS OF DATA

The data, was then processed, and arranged into five sections:

-Chapter two deals with the **background information** about the respondents in terms of:

*their school location;

*institutions where their pre-service training [professionally and academic] qualifications had been obtained;

*their number of years of teaching experience.

-Chapter three examines certain aspects of the **content** of the pre-service training programme which these teachers were exposed to, pertaining to **ecology**, with special reference to **fieldwork** and **practicals**.

-Chapter four investigates the actual **teaching practice** (in and out of the classroom). In this regard the **syllabus** on the ecology section is firstly reviewed, as to ascertain which are the difficult, and on the other hand, interesting sections, and an attempt has been made to determine why this is so.
Other aspects of the actual teaching being examined at this point relates to **fieldwork** and **practical work**. The constraints as indicated by the teachers involved in this sample have been isolated, and certain suggestions have been put forward in this regard.

-Chapter five, on the other hand explores the time factor, which, as already mentioned, has an influence upon the methodology applied by the teacher. The penultimate chapter,- chapter six, examines the textbook [most important teaching resource]. This aspect is reviewed in terms of:

*popularity;

*content pertaining to the various subsections on ecology.

The most frequently used textbook is reviewed in terms of readability on certain of the ecology subsections.

The data on the various sections is statistically analyzed by means of frequency tables. Data is visually represented by different graphs, for example histograms, pie graphs and bar graphs [Mulder, 1982].

CHAPTER TWO: INFORMATION ON SAMPLE

2.1 INTRODUCTION

In this chapter an investigation in the regions and areas where the subjects involved in this project were teaching at the time of the survey is explored. Furthermore, two aspects pertaining to the pre-service training of the sample are examined:

-institutions where their professional and academic qualifications had been obtained,

-their teaching experience.

These two variables have been included into the questionnaire, in order to ascertain first of all whether there are any differences in the teaching style/ methodology between the experienced, and the inexperienced teachers. Secondly, to establish whether there are any differences in the way information is disseminated between the individuals who qualified from the various tertiary institutions. This information will be linked to chapter three where other aspects of pre-service teacher training is examined, and to chapter four, where the actual teaching in [or out of] the classroom is reviewed.

2.2 LOCATION OF VARIOUS SCHOOLS.

The sample of fifty two teachers was drawn from forty Senior Secondary Schools throughout the country. All schools involved in the survey fell under the auspices of The Department of Education and Culture, House of Representatives.

The geographical distribution of the various schools where these

teachers were employed at the time of the survey, is summarised in *Table One.*

Table One: Distribution of Schools involved in the survey.

PROVINCE	REGION
Western Cape	Athlone
Western Cape	Wynberg
Western Cape	Bellville
Western Cape	Mitchells Plain
Eastern Cape	George
Boland	Paarl
Boland	Worcester
Transvaal	Johannesburg
Transvaal	Pretoria
Natal	Durban
Northern Cape	Kimberley

2.2 INSTITUTIONS INVOLVED IN THE PRE-SERVICE TRAINING

The institutions where the respondents received their pre-service teacher training included both universities and colleges of education. From the sample of fifty two teachers, twenty eight **[54%]** were graduates, with the majority of them, twenty- **[71%]** receiving their academic tuition at the **University of the Western Cape**. The other eight graduates were academically trained at the University of Cape Town,[3]; the University of South Africa, [2]; and the University of Fort Hare, [3], respectively.

The majority of these graduates- twenty three **[82%]** held a BSc degree, while three of them held BSc Honours degrees, and one held an MSc degree.The other graduate held a B.A. degree.

The other twenty four teachers involved in this survey held various diplomas in Education, from seven respective Colleges of Education. The majority of the diplomate teachers -(fourteen,/ **58%)** qualified from the Hewat College of Education in Athlone-Cape Town. Furthermore, four teachers received their teacher training at the Rand College of Education in Johannesburg; two from the Perseverance College of Education in Kimberley; and one teacher qualified from each of the Colleges of Education of Wesley in Cape Town; Sohnge in Worcester; Athlone in Paarl, and Bechet in Durban.

It is interesting to note that eighteen **[75%]** of the college trained teachers were actually trained as Senior Primary [standards 2 to 4] specialists, but, at the time of this survey, [1990] were teaching at standard eight level. The other six college trained teachers obtained the Higher Diploma in Education which enables them to teach between standards 5 to 7 [Junior Secondary], and not at standard eight level where they were operating at. Implied in the above analysis is a situation of concern, since teachers who qualified from the colleges are not adequately prepared to teach at standard eight level which they were operating at.

Since the sample involved in this survey was rather small, one cannot generalise that the situation is the norm throughout the country. A broad based research project in this regard is recommended to establish what the situation pertaining to suitably qualified teachers throughout the country [at Secondary

School level] is like.

2.4 TEACHING EXPERIENCE

As far as teaching experience of the teachers involved in this survey is concerned, the number of years of teaching experience varied between one to thirty four years, with the majority of teachers having ten or less years of teaching experience. This information is visually illustrated in *figure one.*

Upon analysis of the data received from the respondents, it was found that fourteen [50%] of the twenty eight graduates had between one to ten years of teaching experience. From these fourteen recently qualified graduates, eleven [79%] received their academic tuition at the **University of the Western Cape**, and the other three qualified from the University of Cape Town. The situation pertaining to the other 50% of the graduates [fourteen in total], is that from the eight who were classified into the 11 to 15 years experience class interval, seven [88%] received their Academic degrees from the University of the Western Cape while the other teacher had qualified from the University of South Africa. In the 16 to 20 year class interval,there were three teachers, one qualifying from each of the universities of the Western Cape, South Africa and Fort Hare respectively. Those teachers with the most years of teaching experience, were placed into the 21 to 35 years class interval. There were three teachers

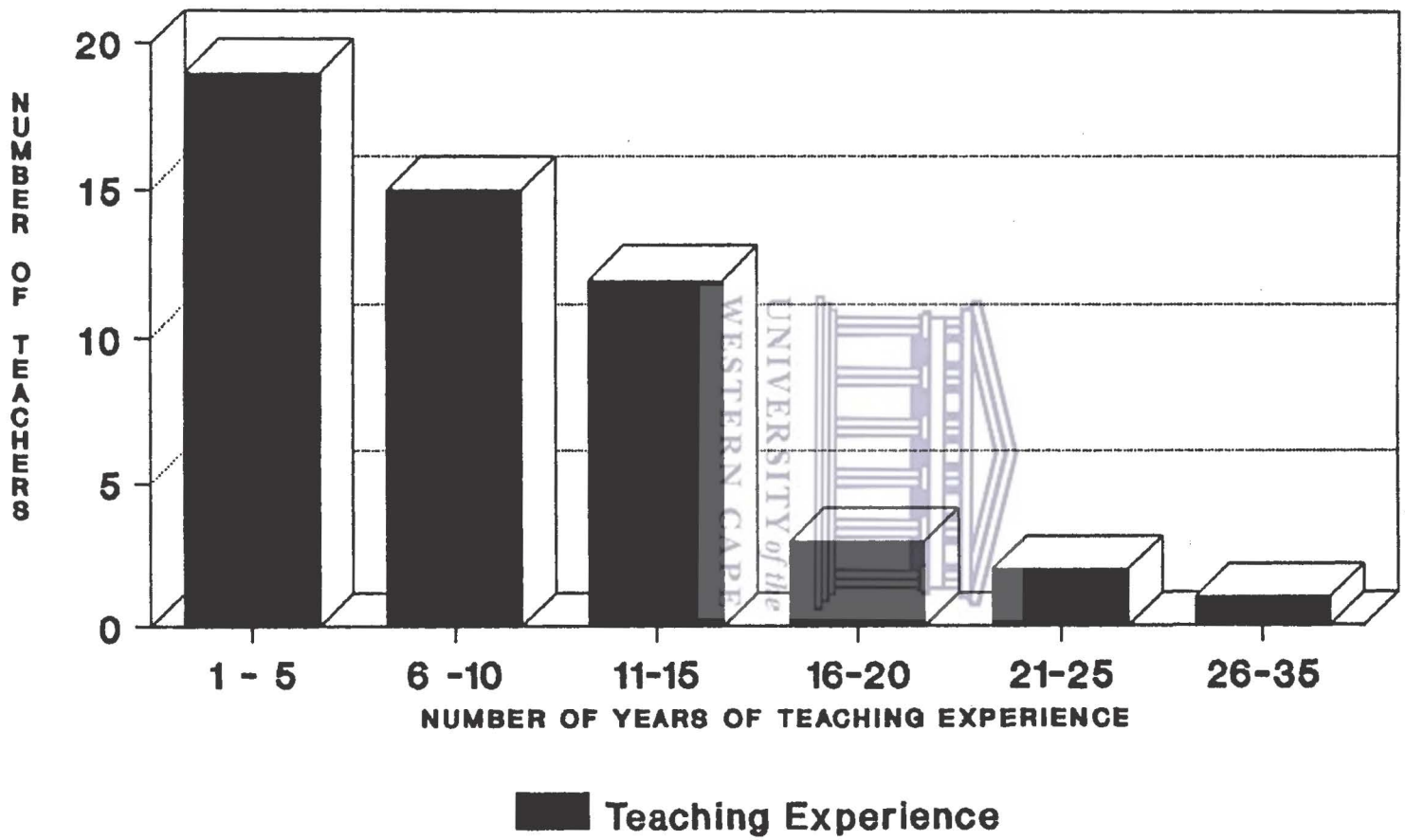


FIGURE ONE
NUMBER OF YEARS OF TEACHING EXPERIENCE

who were listed into this category, two of them qualifying from the University of Fort Hare, while the last teacher in this category graduated from the University of the Western Cape.

The foregoing discussion points to the fact that 50% of the graduates involved in this survey were academically trained [and in most cases professionally as well] at the University of the Western Cape. The majority of these graduates were rather inexperienced, since 79% of these teachers had ten, or fewer years of teaching experience. After an examination into the shortcomings experienced by the teachers during their pre-service training [chapter three], and problems experienced while teaching [chapter four], certain recommendations will be suggested in terms of a more meaningful pre-service teacher training programme.

2.5 CONCLUSION

A possibility for a future project could be an in-depth examination of the syllabuses followed in the different faculties at this university pertaining to the training of biology teachers, and extrapolate on the ecology section in this regard. Specific recommendations could be made on the shortcomings identified by teachers in the field, pertaining to the pre-service teacher training programme in ecology, so that future biology teachers will receive an adequate preparation before they enter into the teaching profession.

Upon examination of the situation pertaining to College trained

teachers in this survey, twenty [83%] of the total of twenty four had qualified between one and ten years ago, eleven of these twenty [55%] , from the **Hewat College of Education**. Furthermore, three from the Rand College; two from the Perseverance College, and one from each of the Colleges of Bechet, Sohnge, Wesley and Athlone (Paarl), respectively. As for the last four teachers, all fell into the 11 to 15 year class interval, with three having qualified from Hewat, and one from Rand College of Education.

Since the Colleges of Education mentioned in the foregoing discussion are not autonomous, they all are subjected to prescribed syllabuses determined by the Department of Education and Culture, House of Representatives. The final year examination papers for teachers [third and fourth year] are also set by the above-mentioned Education Department, leaving out the flexibility in terms of altering the syllabus content. This, however, should not rule out the possibility for examining the constraints experienced by the teachers in the following two chapters, and making recommendations pertaining to the pre-service training in ecology for future teachers of biology.

Nevertheless, the situation in the case of College-trained teachers is not as straightforward as it might appear, since these teachers are not being trained to operate at standard eight level, but mainly at primary school level.

CHAPTER THREE: TEACHER TRAINING IN ECOLOGY

3.1 INTRODUCTION

The purpose of this chapter is to examine whether the teachers in this survey received any **tuition** in ecology during their pre-service training, and whether this training was of a **suitable nature** to prepare them adequately for their task. These two facets of their training [nature and content] ultimately determine whether the teacher is adequately prepared to teach ecology with confidence, and in a meaningful way. It is the teacher who has to impart to the pupil, a thorough knowledge of the functioning of the Biosphere, so that he/ she may understand the delicate balance in nature, and the impact that man has upon it.

The teacher, via the method of teaching has to instill apt values in the pupils, so that they, as future custodians of the planet, can foster a love and respect for their environment. Randall, quotes from Broad [1969, in Albrecht and Seeley 1987]: *"in education lies our only hope of solving this vast problem of ensuring that the natural (biological) resources of the earth are used with wisdom and restraint, so that it will continue to provide a suitable habitat for man".*

It becomes quite clear that teacher training is an area of utmost importance if the aims of environmental education are to be realised. The White Paper on Environmental Education [Dept.

Environment, 1989] comments on teacher training, and reinforces the need for:

-all student teachers to be made aware of the aims, principles and methodology of environmental education;

-specialised programmes on environmental education to be included in teacher training courses; and

-skills and techniques necessary for environmental education outside the classroom to be stressed in the training of teachers.

The definition adopted for the purpose of this survey [U.S. Environmental Education Act 1970], on environmental education, indicates that the ecology section of the standard eight biology syllabus could be an ideal vehicle for the implementation of environmental education. This can only succeed if the teachers are capable of teaching it. The importance of specialised teacher training in environmental education (with ecology as a vehicle) has been widely recognised [Hurry, 1979; The Council for the Environment, 1986, in Ballantyne and Oelofse, 1988; O'Donoghue and McNaught, 1990]. As Sterling [1987, in Ballantyne and Oelofse 1988] writes: *"the key to school commitment to environmental education lies with the teachers, and this highlights the vital role of teacher education..."*

3.2 PRE-SERVICE TUITION IN ECOLOGY

Upon analysis of the data obtained from the teachers involved in this survey, it was found that thirty seven **[71%]** had indeed

received some form of tuition in ecology, while fifteen [29%] responded negatively. When linked to their respective tertiary institutions where they had been trained to become teachers of Biology, it was found that, of the twenty who graduated from the University of the Western Cape, all but one had indeed received some form of tuition in ecology. The graduates from the Universities of Fort Hare and South Africa, respectively, indicated that they had been exposed to a certain percentage of ecology. Two of the three University of Cape Town graduates were subjected to tuition in ecology, the third teacher obtained a B.A degree where no life sciences [or geography] courses had been followed. In total, of the twenty eight graduates, 26 [93%] were subjected to a degree of tuition in ecology during pre-service teacher training.

With regards to the remaining twenty four teachers involved in this survey, who were trained at the various Colleges of Education, eleven [46%] disclosed that tuition in ecology was part of their pre-service training, while the majority [54%] received none. From the eleven who responded positively, eight [73%] were trained at the Hewat College of Education. Of the two teachers who were trained at Perseverance College, one had been subjected to ecological tuition, while the other one was not [this could be attributed to the teacher's subject choice, during training]. One teacher from each of the Colleges of Education of Bechet and Wesley replied positively in this regard. However, not one teacher from the Colleges of the Rand [4]; Sohnge [1] and Athlone [1] received any tuition in ecology during pre-service

training.

The situation can thus be summarised by stating that from the fifteen teachers **[29%]** who received no tuition in ecology, 13 **[87%]** were trained at Colleges of Education. This is a serious matter of concern, especially in view of the fact that these teachers are teaching at standard eight level, which they are not adequately prepared for. Nevertheless, it may be that this extremely negative state of affairs is an exception to the rule, since the sample is small. However, unless research is initiated in this regard, the real situation will not become known.

The question pertaining to tuition in ecology was pursued a bit further in that the respondents who indicated that they had received some form of tuition, were requested to indicate whether that tuition had prepared them adequately to teach ecology without any difficulties. A majority of twenty eight **[76%]** of the thirty seven stated that the tuition which they received during pre-service training, did not equip them adequately to teach the ecology section without experiencing any difficulties.

The overall situation pertaining to the tuition [content] on ecology in the sample involved in this survey is rather unsatisfactory. Fifteen with no tuition at all, and twenty eight with an inadequate tuition, brings the total to 43-**[83%]** having an unsatisfactory training with regards to the content on the subject. An inadequately trained teacher will find it difficult to develop certain skills and to instill values in the pupils,

two vital elements for fostering environmental awareness. This view is reiterated by Albrecht and Rands [in Albrecht and Seeley, 1987]: *"The most important factor in any teaching process is the teacher who can literally make or break a subject for the students".* Suitable pre-service training is therefore generally very strongly recommended for teachers, from a variety of sources.

3.3 EXPOSURE TO FIELDWORK DURING PRE-SERVICE TRAINING.

If it is accepted that the teaching of ecology could be a vehicle to inculcate environmental awareness in the pupil, then inevitably, the method of transfer to the pupils is of great importance. According to Ballantyne and Oelofse [1988]

" As environmental education is characterised by the nature of it's teaching practice rather than it's content, it is suggested that an alternative approach to the subject content is necessary".

This **alternative approach** is related to *how*, and, also *where* the dissemination of information takes place, inevitably linked to **fieldwork**. The need for fieldwork to be an integral part of the teaching of ecology has been expressed by many educationists, for example, Nightingale, [1987]; Millet, [1988] and Opie, [1986]. However, this can only be realised if the teacher is conversant with the technique, implying that he/ she has been exposed to this aspect of ecology during pre-service training.

In this section, an investigation into the aspect of fieldwork,

to which the sample had been subjected during their pre-service training is established. Slightly more than half, twenty seven **[52%]** divulged that they had been exposed to some form of fieldwork during their teacher training course, some inevitably, on a more frequent basis than others, as indicated in *table two.*

Table Two: Exposure to fieldwork during pre-service training

Frequency of Exposure to fieldwork	No.of individuals
Once every 3 weeks	6 [22%]
Once every 6 weeks	3 [11%]
Once every 12 weeks	6 [22%]
Once every 24 weeks	6 [22%]
Once every 52 weeks	6 [22%]

From the twenty seven who were exposed to fieldwork, sixteen **[59%]** qualified at the University of the Western Cape, implying that only four teachers who graduated from this institution had not been exposed to any form of fieldwork. Regarding the three University of Cape Town graduates in this sample, only one had received no training pertaining to fieldwork, as was the situation relating to the three teachers who qualified from the University of Fort Hare. As to be expected, those teachers who qualified from the University of South Africa, did so on a part-time basis/ correspondence course, where exposure to fieldwork is unlikely.

Considering the situation at the various Colleges of Education, once again, the responses received from the teachers who had trained at these institutions is rather disturbing. Only seven **[29%]** of the twenty four college diplomates were exposed to some form of fieldwork or related techniques.From the seven, six **[86%]** received their training from the Hewat College of Education, while the seventh qualified from Bechet College. As the data reveals, no other college trained teacher was subjected to any form of fieldwork during the pre-service period. Once again, due to the limited number of teachers involved in this survey, generalisations in this regard cannot be made.

3.4 **CONCLUSION.**

As for recommendations, it would be appropriate for the various faculties at universities to review the course content and fieldwork component pertaining to pre-service teacher training. Universities, on the one hand, have greater freedom as far as curricula are concerned. Colleges of Education on the other hand, fall under the auspices of the Department of Education and Culture- House of Representatives, and have to follow prescribed syllabi. The same recommendations, nevertheless apply to them as well, and planners of the syllabuses should pay attention to these aspects.

Hurry, [1977] makes the following suggestions in this regard:

-Colleges of Education should re-examine their basic approach to teaching;

-departments within colleges should co-operate more in

discussions involving common ground topics (eg. biology and geography);

-if Colleges accept that conservation awareness is one of the basic long-term aims of education, then they should ensure that all subjects are used, in varying degrees, as vehicles for creating this awareness;

At this point it is worthwhile to explore the successful implementation of an environmental elective, which is practised at the Edgewood College of Education in Durban [Nightingale, 1987]. The Geography Department at this college offers an environmental elective to fourth year senior primary [standard 2 to 4] student teachers. Nightingale [1987] discusses the rationale for the course, and it's relationship to environmental education and fieldwork are considered. Appropriate teaching strategies are also examined. A major objective of the course is to equip students with the particular skills required by teachers if they are to conduct fieldtrips successfully.

As fieldwork is an indispensable part of environmental education, the practical and theoretical components complement each other [Nightingale, 1987]. This is applied in the environmental elective at the Colleges of Education in Bophuthatswana, as mentioned by Irwin [1987]: *"Practical and project work, which accounts for about 25% of the course, over three years, is integrated at all times with the theory".*

Even though all students are involved in practice teaching during

their pre-service training at all Colleges of Education, few of these colleges offer practice teaching in fieldwork- as is the situation at Edgewood College. The reason for this is to prepare students adequately with the necessary skills which are required if they are to venture into successful fieldtrips. Furthermore, these student teachers are exposed to fieldwork as it would take place in the school, since it is their task to make all the necessary arrangements- be it academic or administration, and then lead the fieldtrip, accompanied by the pupils from the surrounding schools. They deal with both the pre- and post-excursion components.

Since these are working models on environmental education, it would be advisable for the various Colleges of Education to obtain first hand information from colleges like the Edgewood College, and then investigate the feasibility of the implementation of such an elective at their specific college. If environmental education is to be successfully implemented in the classroom, with ecology as a vehicle to facilitate this, then teachers, adequately trained in both content and fieldwork are imperative.. This is an aspect which needs the attention of the colleges, and the planners involved in syllabus construction.

CHAPTER FOUR: THE PRACTICE OF ECOLOGY TEACHING

4.1 INTRODUCTION

Since the objectives which are set for the teaching of ecology involves both cognitive and affective development, both the content which is taught to the pupils, as well as the method of presentation are equally important. In this chapter these two facets, viz.

what [syllabus] is taught, and **how** [method of presentation] it is taught to the pupils, specifically pertaining to fieldwork and practicals will be examined.

4.2 THE SYLLABUS

In South Africa, one is bound by syllabuses which are generally highly academic. Due to the centralised nature of our educational system, biology, like all other subjects, follows a core syllabus determined by the Joint Matriculation Board. Although the national core syllabus makes suggestions regarding the content on biology taught at standard eight level, it is left up to the seven individual Departments [in the case of this survey- House of Representatives] to make certain final decisions. An investigation initiated by Hurry, [1977] revealed that the Education Departments of Cape, House of Representatives, Orange Free State and Transvaal have similar syllabuses [in biology] from standards one to matric. In the case of the Natal Education Department, it has been found that the biology syllabus is different, as was the case of the Department of Education and

ECOLOGY TEACHING PRACTICE 30

Training, from standards one to seven.

The syllabuses at Senior Secondary level, standards eight to ten, are essentially the same for all seven departments. A copy of the standard eight biology syllabus for the House of Representatives is included as Appendix two [H.G] and three [S.G], respectively. Syllabuses, therefore, serve to **define** and **constrain** the content taught at our schools [Ballantyne and Oelofse, 1988].

The ecology section of the standard 8 biology syllabus is summarised in *table three.*

Table Three: Summary of the standard eight ecology syllabus.

	Sub-section of Ecology Syllabus
A	Practical study of ecosystem, with emphasis on the relationship between it's components
B	Abiotic components: [physical;edaphic;physiographic]
C	Biotic components: Producers; Consumers- herbi-, carni-, omnivores; Decomposers
D	Biological Rhythms
E	Symbiotic Relationships
F	Trophic Levels
G	Nutrient Cycling
H	Biosphere
I	Ecosystems: Aquatic and Terrestrial
J	Man and Ecosystem: Pollution
K	Conservation of indigenous flora & fauna

4.3 INTERESTING AND DIFFICULT ASPECTS OF THE SYLLABUS

The teachers involved in this survey were issued with an extract of the ecology section of the Biology syllabus, as contained in Appendices 2 and 3. It was requested of the respondents to indicate which areas they found to be particularly interesting, and then, which areas they found to be rather difficult to teach. The data obtained from the sample has been statistically analyzed, and it is visually represented in *figure two*.

The data revealed that the section on **Conservation** has been regarded by twenty one **[40%]** as being the most interesting aspect of the syllabus.No teacher had indicated that they experienced difficulties pertaining to the teaching of this aspect either. The sub-section on the impact of man has been indicated as interesting by 18 **[35%]**. Once again, no-one found this sub-section difficult to teach. With regards to the most difficult sub-sections, **Nutrient Cycling** was by far (twenty nine-**[56%]**) considered as the most **difficult** sub-section, followed by the aspect on **Ecosystems**, regarded as difficult by **[39%]**.

At this point the question **"why is conservation regarded as the most interesting area, and nutrient cycling the most difficult aspect to teach"** may be posed. Starting with conservation, one has to remember that the idea of conservation is not new. In the past two decades, this topic has become increasingly more public, dominating many items in the news, and receiving extensive media coverage.

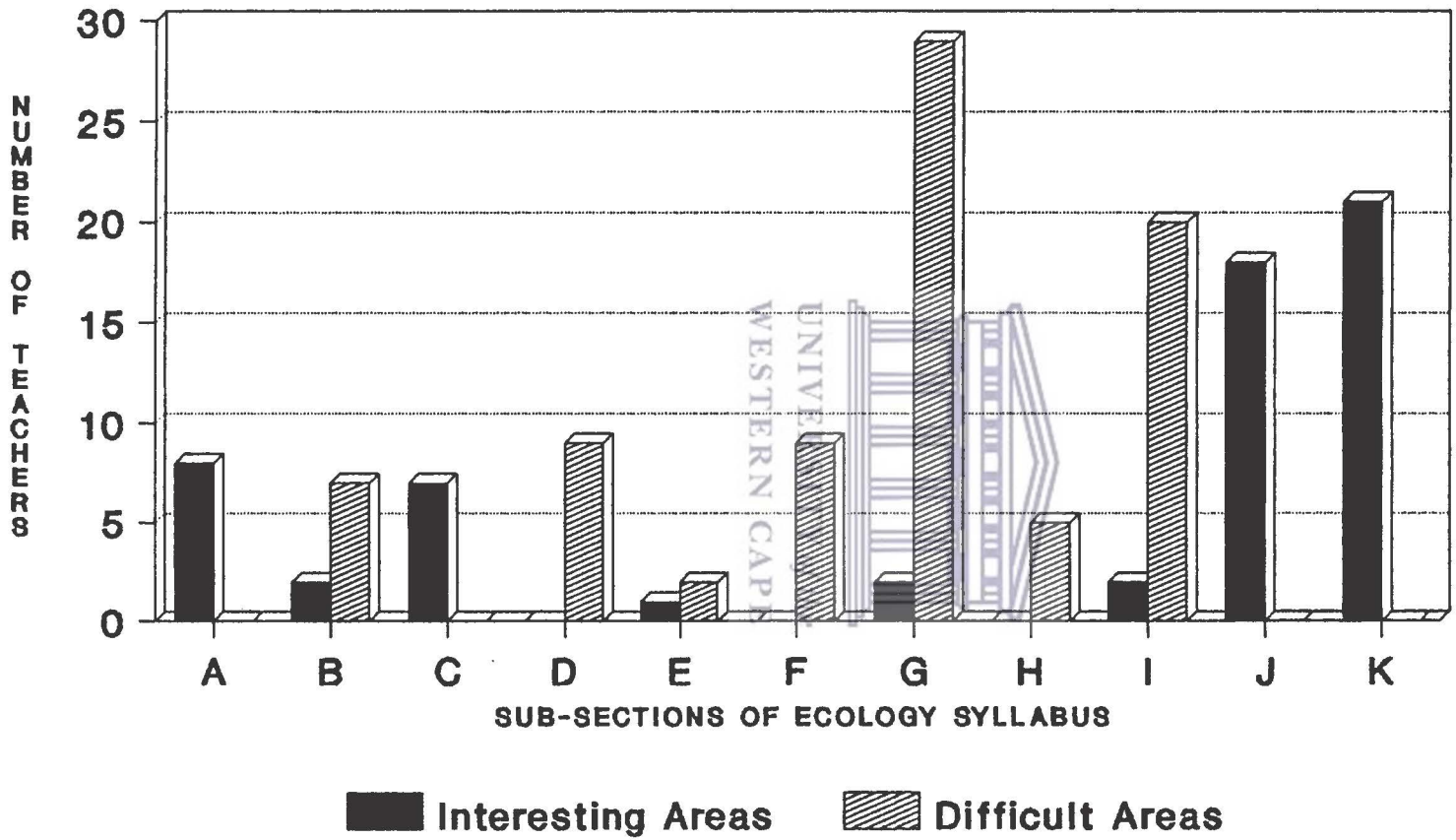


FIGURE TWO
COMPARISON BETWEEN INTERESTING AND DIFFICULT SUB-SECTIONS OF ECOLOGY.

The publicity surrounding Earth day, River day, Arbour day and the like, cannot, but capture the interest of teachers and pupils. The Department of Nature and Environmental Conservation normally issues charts, posters and literature to commemorate these days, free of charge to many schools, which plays a facilitating role in the teaching of this aspect. Another factor which influences the ease of teaching, is the way the information is covered in the all important teaching resource, namely the textbook, which will be reviewed in **chapter six.**

The reasons why **nutrient cycling** was found to be difficult, may also be varied. As opposed to a topical aspect such as conservation, nutrient cycling is rather abstract and chemical in nature, and Chemistry has never been one of the easier subjects to many teachers. Nutrient cycling, furthermore, cannot be taught in isolation. One of the favourite examples used by teachers to illustrate the concept of an ecosystem, is the pond. However, one cannot view the cycling of nutrients in the pond alone- it has to be taken out into the Biosphere, for example [oxygen; carbon dioxide]. This is where the "holistic" approach to the teaching of ecology comes in. This "holistic" approach develops in the individual the ability to view situations as "wholes", and in particular, to see the interrelationships within situations [Hurry, 1977]. Ecology, as mentioned earlier on, is a holistic affair, and should be taught as such.

A further investigation into the difficult aspects of the ecology syllabus was subsequently pursued, in order to ascertain whether

a correlation existed between those individuals who received some form of tuition in ecology, and those teachers who received no tuition in ecology. Secondly the respondents were divided into class intervals, based on their teaching experience to determine whether there were any discrepancies between the experienced and inexperienced teachers, pertaining to the type of pre-service training they had been exposed to. This exercise was conducted to determine whether there had been a drastic change in the content taught to the teachers, over the years.

No teacher found the following sub-sections difficult to teach:

-A [Practical study of a selected ecosystem- relationship between it's components];

-C [Biotic components];

-J [Interaction of Man on the ecosystem- Pollution]; and

-K [Conservation of indigenous Flora and Fauna].

Abiotic Components [sub-section B] was found difficult by seven teachers, of which five had no tuition in ecology. The two teachers who had some form of tuition in ecology, fell into the six to ten and twenty one to twenty five years of experience categories respectively, both finding the sub-section difficult to teach. This reveals that no difference has been found between earlier and recently qualified teachers, or between those with some form of tuition and those without any tuition in ecology, since they all still experienced difficulties in the teaching of this aspect.

Biological rhythms [D] was found difficult by nine teachers, four

of them without any tuition in ecology. From the five with some tuition, four qualified recently (less than 10 years ago), and one qualified 16 to 20 years ago.

Symbiotic relationships [E] was found difficult by two teachers, one qualified 11 to 15 years ago, with no ecology tuition, and one qualified 16 to 20 years ago, with some form of ecology training.

Trophic levels [F] was found difficult by nine respondents, with six of them having received tuition in ecology, but still experiencing problems in this regard. Three of these teachers qualified recently (less than 10 years ago), while three were more experienced, since they had qualified more than 10 years ago. The other three teachers received no ecological tuition.

Nutrient Cycling [G] was found difficult by the majority [29]. What is interesting here is that twenty four **[83%]** had indeed received tuition in ecology, thirteen of them qualified recently (1 to 10 years ago), while 11 qualified more than 10 years ago. This suggests that the situation pertaining to the pre-service content in ecology did not alter drastically over the years.

An analysis of the data pertaining to each of the difficult sub-sections indicates that it did not matter whether the teacher qualified recently or earlier on, or whether they received tuition in ecology or not, difficulties were still experienced, pointing to an inadequate pre-service training in this regard, that did not change much over the years.

This situation is clearly summarised in *Table 4.*

Table 4: Teachers experiencing difficulties with Nutrient cycling

Years of teaching experience	Teachers with tuition in ecology	Teachers having problems [with tuition]	Teachers with no tuition in ecology	Teachers having problems [with no tuition]
1-5 [19] years	[14]	10 71%	[5]	1 20%
6-10 15] years	[8]	3 38%	[7]	3 43%
11-15 [12] years	[9]	6 67%	[3]	1 33%
16-20 [3] years	[3]	3 100%	0	-
21-25 [2] years	[2]	2 100%	0	-
26-35 [1] years	[1]	0	0	-

Of the thirty seven teachers who had received tuition in ecology during their pre-service training, twenty four [65%] still experienced difficulties in teaching nutrient cycling. In summary it can be expressed that all the teachers who qualified more than 15 years ago experienced difficulties in the teaching of this aspect. However, the 71% who qualified recently, and still experienced difficulties cannot be disregarded. Surely, their training was as inadequate? Consequently it can be stated that the content taught at the various tertiary institutions over the past years did not change drastically- pertaining specifically to the content received by the sample under consideration.

4.4 TEACHING STRATEGIES

In general, it can be stated that teachers in this country tend to stress the learning of factual information, rather than developing attitudes, values and skills [Ballantyne and Tooth-Aston, 1989]. Teaching is therefore teacher-centred, this being reinforced by the strict departmental control, combined with prescribed syllabuses, textbooks (which will be investigated in chapter six) and the emphasis on examinations. Traditional teaching practice is thus expected to be a stumbling block in the achievement of environmental literacy [Ballantyne and Tooth-Aston, 1989]. If, according to Nightingale [1977], environmental education is characterised more by the attitudes it seeks to develop, than by cognitive skills, much of the teaching should for example take place outside the classroom, emphasising the importance of fieldwork, a view shared by many educationists, as listed earlier on.

These researches argue that the aims and objectives of environmental education are realised to the fullest, where learning is based on first hand experience. Bird, [1966 in Nightingale, 1977] states that: *" the best way of dealing with the practical conservation problems is to study them in the field where relevant environmental factors and ecological processes can be examined at first hand"*. Furthermore, Linke [1976, in Nightingale, 1987] supports this view by stating: *"Education <u>about</u> the environment could well define the cognitive domain... of interrelationships between man and his environment...Education <u>for</u> the environment covers the affective concern for the quality of life and commitment to environmental conservation"*. However,

Nightingale [1987] takes this view a bit further by stating that: *"education in the environment refers to a particular pedagogical technique, i.e. field work".*

4.4.1 FIELDWORK AS A TEACHING TECHNIQUE

A long list to illustrate how invaluable fieldwork is to the total educational experience, is listed by Nightingale [1978, in Opie, 1989]. These include reasons such as:

-Fieldwork encourages the development of critical faculties if pupils are given the opportunity to learn at first hand. This stimulates, for example,

*development of skills, and the

*perception of the outdoors as a field laboratory;

-Fieldwork leads to a concern for the environment, since

*attitude and value formation are augmented by environmental encounters;

-Fieldwork leads to many fringe benefits, in that it may

*improve teacher-pupil relationships.

In the light of what has been stated in the foregoing discussion, it is almost impossible to deny the value of this technique in education. In order to evaluate what the prevailing situation is like at the various schools from which this sample under consideration has been drawn, an evaluation of the data received by the respondents will subsequently be examined.

From the fifty two respondents,only twenty two **[42%]** ventured into fieldtrips with their pupils, while more than half **[58%]** did not expose their pupils to first hand environmental encounters.

Table 5 discloses how often those teachers who responded positively, actually took their pupils out on fieldtrips.

Table 5: Frequency of fieldtrips.

Frequency of fieldtrips	Number of teachers
Regularly	3 [14%]
Thrice a year	2 [9%]
Twice a year	6 [27%]
Once a year	11 [50%]

Furthermore, the most common constraints specified by those teachers who did not undertake any fieldtrips, included:

-Large classes, as listed by sixteen **[53%]**;

-Financial constraints, indicated by fifteen **[50%]**;

-Time factor, eleven teachers mentioned this aspect **[37%]**

-Unmotivated pupils/ boycotts, listed by six **[20%]**

-Syllabus constraints, mentioned by five **[17%]**

-Lack of confidence, also indicated by five **[17%]**, and lastly

-Two gave no reasons **[7%]**.

Many of the above-mentioned constraints pertaining to fieldwork can be solved in various ways. Nightingale, [1977] suggests that constraints relating to **time** and **finance** can be alleviated if suitable sites near to, or on the school premises are used. If no such sites are available, it is not impossible for teachers and pupils to work together to create suitable sites in this regard. Opie, [1989] states that *"effective fieldwork is what they do...not how far they travel"*. Weekends and school holidays,

however, should not be ruled out, even if only a few enthusiastic pupils go along.

As far as restrictions such as large classes are concerned, the problem can be contained if:

-more smaller groups are taken out, on a frequent basis;

-sites suitable for large groups may be visited;

-ask a colleague or two to accompany the group, [this will also rule out discipline problems]; or

-contact certain non-government ecological bodies to assist in this regard.

As far as the syllabus, as a limiting factor is concerned it would appear to be necessary for the revision of the lengthy, academic content. However, Opie, [1989] states that *" some parts of the syllabus naturally lends itself to fieldwork, and thus fieldwork does not increase the length of the task, it only varies the method".*

Teachers, as mentioned in chapter three, will feel insecure if they had not received adequate training in this facet. However, a fieldtrip should be regarded as a learning experience where both pupil and teacher can learn. There are a number of publications and suitable literature to assist the novice in this regard. More experienced teachers who are familiar with this aspect could also be approached. The establishment of subject associations and in-service teacher training can also be of invaluable assistance.

4.4.2 THE SITUATION ON PRACTICALS.

Very closely related to fieldwork, is the situation on practicals, also very much neglected in our schools. In response to the question on whether any problems are experienced on practical work, forty seven **[90%]** experienced difficulties in this facet of teaching, while only five **[10%]** indicated that practical work was not problematic. Those who indicated that they experienced difficulties had to substantiate why, and the reasons are graphically represented in *figure 3* on page 42.

Many of the constraints experienced by the teachers as far as practicals are concerned, correspond to the constraints listed for fieldwork. The aspect on time-table constraints, however, had not been addressed. When pupils are involved in practicals or related activities, problems might arise if they impinge upon another teacher's time. This situation may be remedied if certain afternoons (after school) are used, weekends or even holidays. Furthermore certain trade-offs can also be made with the teacher losing time,in that, if the time-table permits, he could use the biology time the following week. Alternatively, he could accompany the class during his scheduled time, and also render assistance in this regard [Opie, 1989].

As far as the limitations of resources are concerned, the teachers are in the best position to help themselves, through co-operative effort, such as,for example, the *Action Ecology Project* in Natal [O'Donoghue and McNaught, 1990].

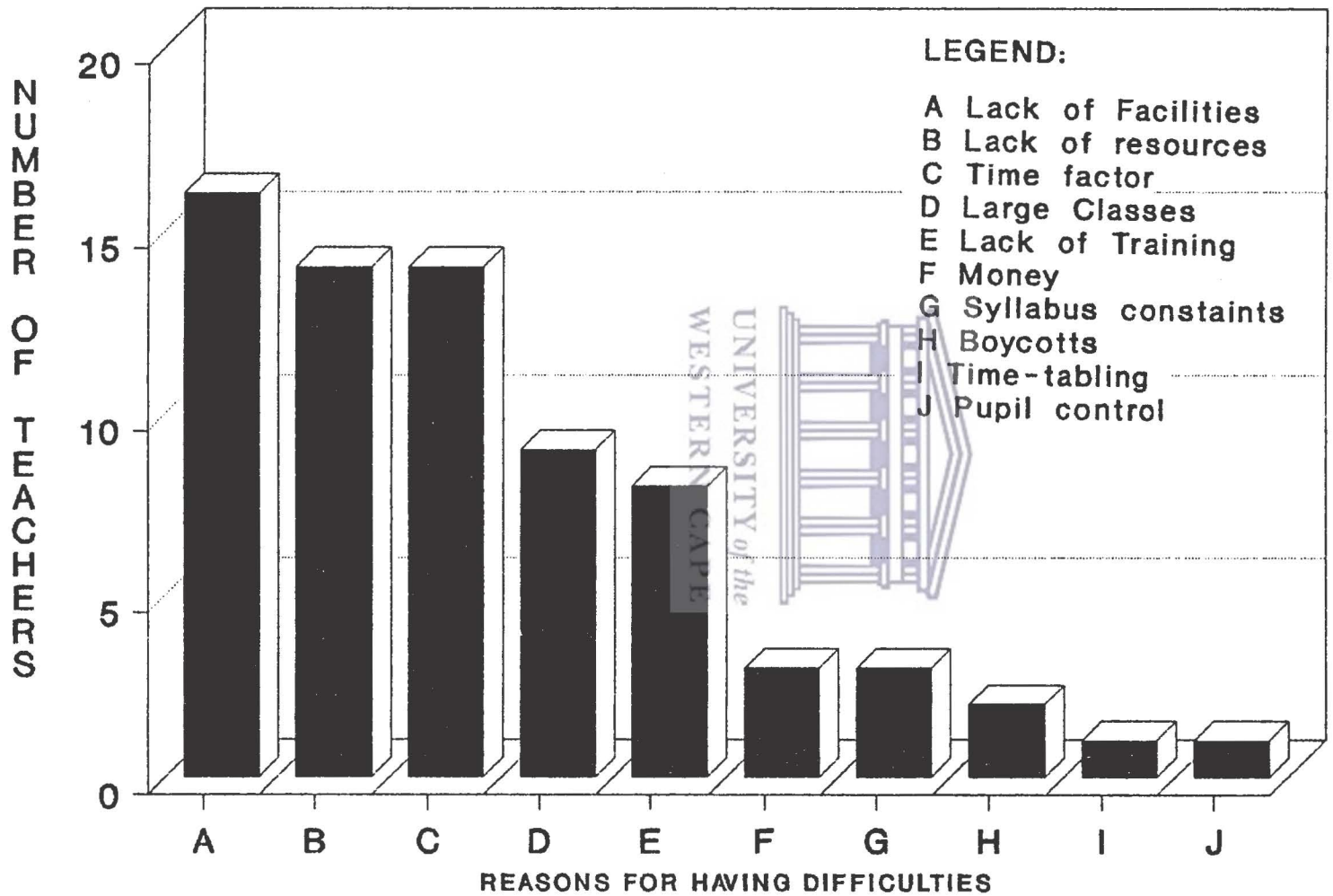


FIGURE THREE
CONSTRAINTS PERTAINING TO PRACTICALS

The reasons for the initiation of this project were twofold:

-to solve fieldwork problems by developing resource materials for an environmental education approach to ecology and fieldwork;

-to disseminate new techniques and materials to teachers so that they could undertake ecology fieldwork with greater confidence and proficiency. In this project, resource materials were collected, developed and tested by participatory teachers and conservation field staff [O'Donoghue and McNaught, 1990].

Projects of a similar nature could be undertaken by the different teachers in the various regions, and material can be adapted to suit local needs. Joint ventures such as these could save the individual a lot of time and effort. The Council For The Environment [1987] urges teachers colleges to develop support material. This view is also expressed in the White Paper on Environmental Education [Anonymous, 1989].

-with regard to serving teachers the attention of the Education Authorities is drawn to the need for

*in-service training of teachers and the possible institution of a training programme on environmental education;

*seminars and workshops on environmental education, with a view to updating the teachers's knowledge;

-In regard to teaching aids and facilities the Department of Environmental Affairs will:

*be willing to undertake research to assist the education authorities in the production of handbooks for teachers, workbooks for pupils, and audiovisual aids for use in environmental education programmes.

4.5 CONCLUSION

One fact that one cannot loose sight of, is that both fieldwork and practical activities are enquiry, and participatory based learning, vital for the fostering of positive and values in favour of the environment. Hurry, [1977] claims that the biology [and geography] syllabi are too exam-orientated. He suggests that the length of the syllabus be reduced. In doing so, he argues, and together with the encouragement of fieldwork and practicals by the Educational Authorities, greater *"conservation awareness"* could be created via the formal ecology curriculum. This argument still holds today.

Opie [1987] believes that there is still much *"missionary work"* to be done in this area, since fieldwork and practical related activities are still perceived as *"luxuries"*, which does not contribute to examination success rates. Ultimately, examinations encourage and reward the use of the conservative teaching style, and teacher-centered methods in the classroom, which is in direct conflict with the goals of environmental education.

CHAPTER FIVE: THE TIME FACTOR INVOLVED IN THE TEACHING OF ECOLOGY

5.1 INTRODUCTION

Closely associated to the teaching (content and style) is the time available to the teacher, since he/ she can only disseminate a specific "amount" of information in a particular manner if there is sufficient time at his/ her disposal. Central to this is the content as determined in the syllabus, and the whole question on examination requirements. Ledger, [1980, in Ballantyne and Oelofse, 1988] did a survey on geography at South Africa Senior Secondary schools,where he found that 93% of the teachers felt that their classroom practice was influenced by examination considerations. Rands and Albrecht [in Albrecht and Seeley 1986] supported this view, in that they mention in this regard *"the pressures of school time-table and examination syllabus is such that in the main only what is required is taught".*

In this chapter, an investigation into the time-factor is explored in the following manner, and order:

-overall time utilised by the respondents involved in this survey to teach the ecology section of the standard eight Biology syllabus, in comparison to the time recommended by the educational authorities;

-time used to teach each of the sub-sections, as compared to how much time is recommended

-examination on how the ecology section has been taught by the

respondents who utilised the least time.

5.2 OVERALL TIME USED FOR THE TEACHING OF ECOLOGY

Appendix 4 is a document which has been issued by biology subject advisors as a guideline to the biology course structure/ scheme of work at standard 8 level. Appendix 5 is a scheme proposed by the biology subject advisors for the setting of the final question paper. Upon analysis of these documents it is evident that the ecology section covers about 25% of the Biology syllabus at standard eight level. Likewise, Appendix 5 indicates that 25% of the final examination marks in biology (standard eight) should be allocated to ecology. If one takes this matter a bit further, Appendix 4 suggests that 35 biology teaching periods, [from a total of 142] should be utilised by the teacher to teach the ecology section. This amounts to approximately six weeks, with a normal teaching year consisting of about 32 weeks (examinations excluded). The other teaching time is allocated to revision and tests on the various sections of the syllabus.

The other content that has to be covered at standard eight level in biology, together with the proposed time allocation is summarised as follows:

-the cell and cell division, - 20 periods

-plant tissues, -12 periods;

-Angiosperm anatomy,- 35 periods;

-four broad categories of Mammalian tissues.- 10 periods;

-skeleton and associated physiology of Man,- 10 periods;

-blood-vascular system (transport and lymphatic),- 10 periods.

It is noticeable that the syllabus is lengthy and varied. The fact that 142 periods are allocated to teach the content, with a teaching period being 30 to 35 min long, is restrictive. However, following an analysis of the data received from the respondents, it was found that twenty nine **[56%]** of the teachers utilised between four to four and a half weeks to cover the ecology syllabus, which is much less than the actual suggested six weeks. Interestingly, the time used by the different respondents varied extensively between three to eight weeks, as outlined in *table 6.*

Table 6: Time used to teach the ecology section.

Time in Weeks	No. of Teachers
3 weeks	3 [6%]
3½ weeks	1 [2%]
4 weeks	17 [33%]
4½ weeks	12 [23%]
5 weeks	6 [12%]
5½ weeks	0
6 weeks	4 [8%]
6½ weeks	1 [2%]
7 weeks	2 [4%]
7½ weeks	0
8 weeks	6 [12%]

The data reflects that only five **[10%]** of the teachers were using

the correct recommended time to teach this section. Furthermore, considering the short 30 to 35 minute teaching periods, it can be deduced that the teaching style will be hampered, since it is rather restrictive in terms of practical work and outdoor activities pertaining to ecology. The matter is further compounded if one considers the fact that on average, only one double period [in a few cases, two] per week is allocated for biology teaching, the rest being single periods (a total of seven per week). These are matters which undoubtedly need to be reviewed by those who make decisions on matters in this regard.

5.3 TIME UTILISED TO TEACH THE VARIOUS SUB-SECTIONS.

Appendix 4 may serve as a guide to teachers on how much time (divided into periods) should be utilised to teach the various sub-sections of the syllabus.

This number of recommended periods is summarised in *table 7,* along with the actual number of periods used by the respondents.

Table 7: Recommended and actual time used for teaching sub-sections on ecology.

Sub-sections of Ecology	A	B	C	D	E	F	G	H	I	J	K
Number of Periods recommended	7	3	1	2	3	3	3	1	3	3	6
Average number of periods used	3	3	3	2	3	3	3	2	2	2	2

A comparison on these two tables is graphically expressed in *Figure 4* .

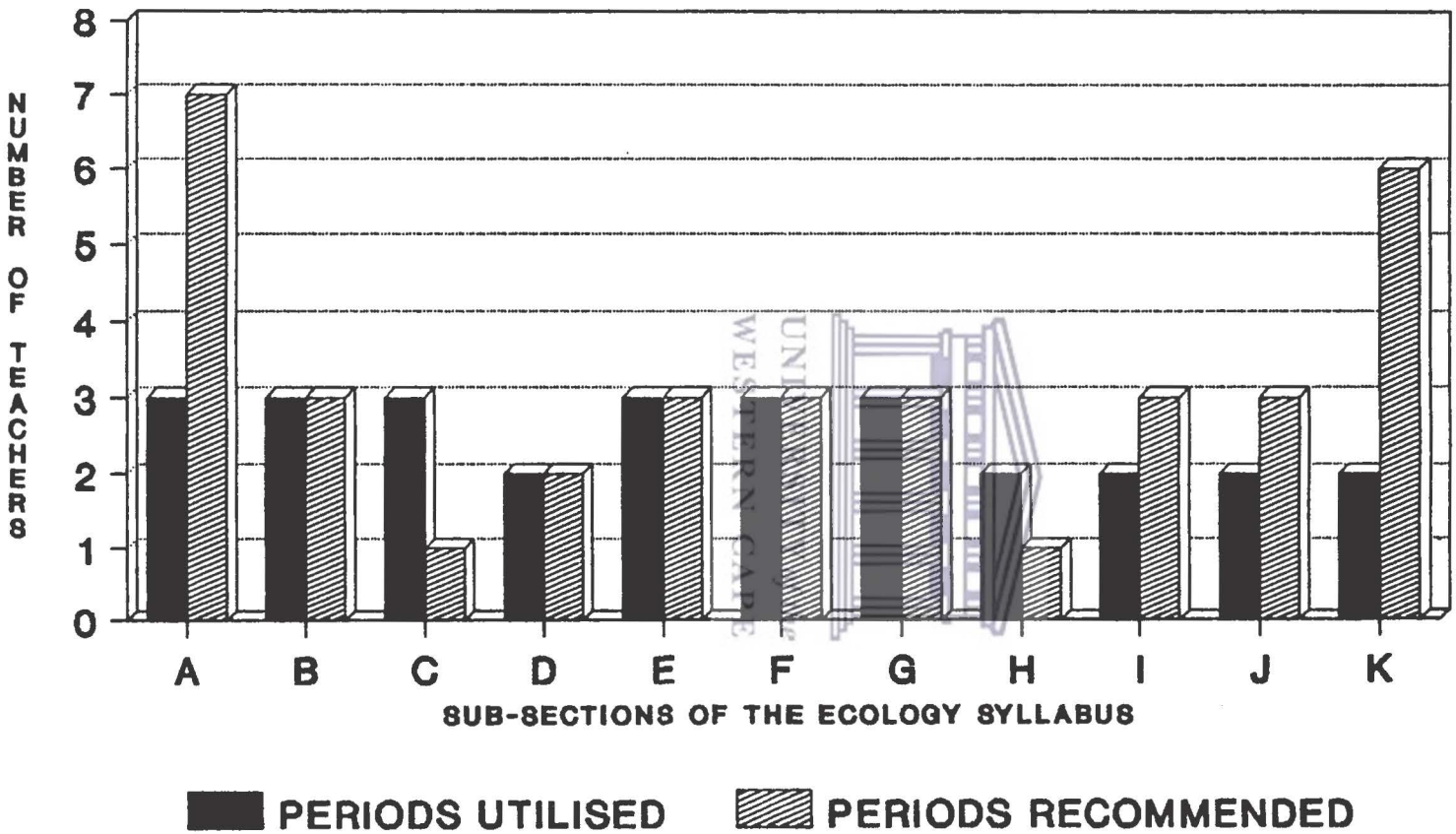


FIGURE FOUR
Periods utilised vs periods recommended for the teaching of ecology sub-sections

Since the greatest difference between the actual time used and the recommended time is centred around two aspects, namely the **Practical investigation of an ecosystem** and the **conservation** facet, it would imply that more time could be spend on practicals and fieldwork related activities, pertaining to the conservation of the environment.

Nevertheless, in response to whether they would prefer to have more time for the teaching of ecology, the majority, thirty six teachers **[69%]** responded in favour of more time, the reasons why they wanted more time is graphically illustrated in *figure 5* on page 51.

It would seem to be contradictory to want more time for the teaching of ecology on the one hand, while on the other hand, all the recommended time had not been utilised. However, it is unfair to make a statement in this regard, since the other sections of the syllabus had not been reviewed, and ecology only amounts to a quarter of the entire content. It could be that more severe demands are placed on the teacher to cover the other aspects as well, and more time is spent on in this regard at the expense of the ecology section, hence, the expressed need for more time. Once again, one can only speculate, as no investigation in this area has been made, ultimately emphasizing the need for future research.

5.4 A REVIEW OF THE TEACHERS WHO UTILISED THE LEAST TIME

Due to the fact that the respondents in this survey varied quite

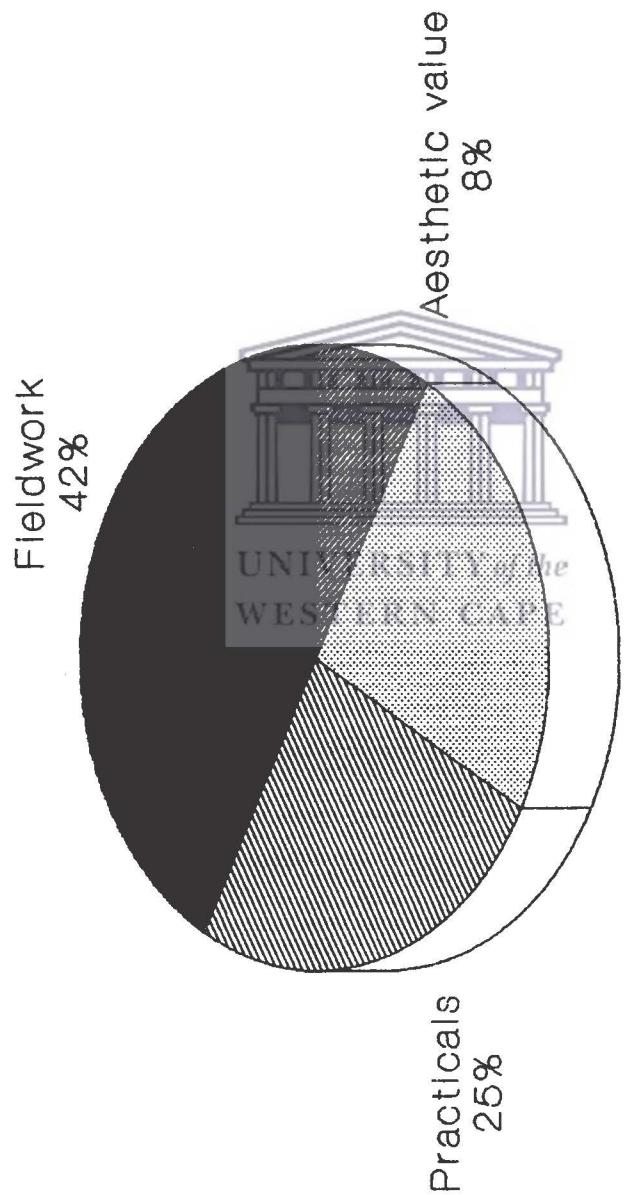


FIGURE FIVE
Why more time is required to teach Ecology

considerably with regards to the overall time used to teach the the ecology section, their method of teaching, by implication,may also be varied. An investigation in this respect is made, concentrating on those teachers who utilised less than the average four to four and a half weeks to cover the ecology section. From *table 6* it is noticeable that only four teachers were involved. These teachers were rather inexperienced, in that three of them were teaching for less than 10 years.

Three of these teachers qualified from colleges of education, while the fourth teacher was a graduate. Only two of these teachers were exposed to fieldtrips during their pre-service training, and, also, on an irregular basis [once a year]. As to be expected, not one of these respondents took their pupils out on fieldtrips, while practicals posed a problem for only two. Their reasons for not venturing into fieldtrips varied, but one factor which was common to all four participants was the fact that their pupils were unmotivated [is it not true that a teacher can make or break a subject for the pupil?].

Furthermore only two of these respondents opted for the need of wanting more time to teach ecology, while the other two felt that the time spent on the section was sufficient. Interestingly enough, the time utilised to teach the most interesting section, conservation, by these four teachers, coincided with the time used by the majority of teachers, namely 2 periods. As far as the most difficult section, nutrient cycling is concerned, two of them utilised three periods [like the majority], while the other

two only utilised two teaching periods.

Problems like these are real, but it can be remedied by more guidance and regular meetings between teachers of various schools operating at the same level in the same subject. The more experienced teachers can assist the new teachers in these aspects. This is where workshops, in-service training programmes and regular subject meetings on a regional level perhaps, can be of immense value.

5.5 CONCLUSION

In conclusion, one fact that may not be ignored is that **69%** of the teachers who participated in this survey signified that more time is needed to teach the ecology section of the standard eight biology syllabus. Despite the fact that several aims expressed in the syllabus imply that active pupil participation and outdoor activities should take place, for example:

-organisms should be observed in their natural environments;

-pupils should learn how to handle and set up experiments correctly,

no provision is made for such activities, since the content that needs to be covered is rather bulky. Furthermore, no clear instructions are given to the teacher in this regard, only vague suggestions are made.

Regardless, teachers find it necessary to confine themselves to the material laid down in the syllabus, owing to the volume of

work which they have to cover, in perhaps, the limited amount of time available. Consequently little time is devoted to activities, such as fieldwork, which will be of value to the pupil, and which will generate in him/ her a positive attitude towards the environment.

Lastly, since the sub-section on conservation has been regarded as the most interesting area of the ecology syllabus, it is still possible to understand why teachers, on average, use less than the recommended time- two as opposed to six teaching periods. However, what is rather strange, is that no teacher exceeds the recommended time (three periods) for the most difficult sub-section, nutrient cycling. These aspects will further be reviewed in terms of the textbook , in the following chapter.

CHAPTER SIX: TEXTBOOKS

6.1 INTRODUCTION

Textbooks are generally used as a means to acquaint learners with subject matter, also, as a method of instruction. It occupies an indispensable place in any educational system [Engelbrecht, 1975]. In most cases textbooks do not only prescribe what should be taught in the classroom, but also how the teaching should take place, in other words, they also prescribe, to a certain extent, on methodologies. In the latter aspect, however, it may assist the inexperienced teacher, but, on the other hand, it may create a dependency, leading eventually to a type of teaching situation where the teacher merely reads, or repeats what is stated in the textbook.

The unique value of the textbook lies therein that it offers the teacher an explanation of the syllabus. This view is supported by Diepeveen [1982 in Ballantyne and Oelofse, 1988], who established that 80% of Geography teachers in the Cape Education Department, used the textbook instead of the syllabus.
Gould, [1977 in Wegerhoff, 1981] reported that the textbook was used in more than 60% of lessons in Biology, and teachers therefore regard it as a very important teaching aid.
From the data obtained by the sample involved in this survey, forty five **[87%]** indicated that no other literature outside the prescribed textbooks had been utilised in the teaching of the ecology section, and only seven **[13%]** stated that newspaper

cuttings, magazines and other resources were utilised.

Based on the preceding discussion, it is apparent that the textbook is a focal point of teaching in our schools. Appreciating the significant role which this important learning tool plays in the teaching process, careful selection of suitable textbooks are crucial. The centralised nature of our educational system complicates matters slightly in this regard, since schools are supplied with a list of prescribed books. Nevertheless, the final selection from the recommended list lies with the school. In this concern teachers may contribute towards the selection of a particular textbook.

Nonetheless, in this survey, an attempt was made to ascertain

-which textbooks were used by the sample concerned, for the teaching of Biology at standard eight level;

-the amount of information contained in the listed textbooks, pertaining to ecology as a whole, and then to the various sub-sections thereof, the latter aspect, however, linked to the number of teaching periods utilised by the respondents;

-which criteria are involved in the assessment of readability;

-the readability of the most frequently used textbook, in terms of:

*the most difficult sub-section - nutrient cycling;

*a sub-section neither regarded as difficult, nor interesting, symbiotic relationships, and

*the most interesting sub-section- conservation.

6.2 VARIOUS TEXTBOOKS USED FOR BIOLOGY TEACHING

After an analysis of the data collected from the sample under consideration the following list of standard eight biology textbooks had been identified:

Claassens,A.J.M; Dalbock,P.R; Schroeder,W.A; and Khadaroo,G. [1985]	Biology. Standard 8. Juta & Co., Ltd. Cape Town.
DuToit, J.J; Van Rensburg,A.G; DuToit, J.H; Botha.J; Van der Merwe, W.J.J; Volschenk,B; Van der Westhuizen, H.C; de Kock,D; Niebuhr, G.A. [1985]	Senior Biology Standard 8. New Syllabus 1985. Nasou Limited. Cape Town.
Austoker,J;and Wessels,H.J. [1986]	Biology for today.Standard 8. Higher and Standard grade. Juta & Co.,Ltd. Cape Town.
Smit,A.L; Fox,H.E; Van Dijk,D.E; Hennessy,E.F; Nel,D; Vorster, P.W. [1986].	Senior Secondary Biology.8 Maskew Miller Longman. [Pty] Ltd. Cape Town.
Ayerst,P.W; Green-Thompson, A.L; Pellew,V.W; Thienel, A. *in collaboration with:* Van Rensburg,N.P.J; Roux, J.S; Van Rensburg, C,A,J. [1985]	Exploring Biology.8. Schuter and Shooter.[Pty] Ltd. Pietermaritzburg.

As far as the most frequently used textbook is concerned, *table 8* summarizes the data obtained from the sample.

Table 8 Popularity rating of textbooks under consideration

Name of textbook	Claassens et al	Du Toit et al	Austoker & Wessels	Smit et al	Ayerst et al
No. of teachers using textbooks	49 94%	17 33%	16 31%	12 23%	12 23%

6.2.1 CONTENT IN THE TEXTBOOKS USED IN ECOLOGY

Upon further investigation relating to a comparison between the

content on biology as a whole in comparison to the section on ecology, is summarised in *table 9.*

Table 9: Pages devoted to Ecology and the whole biology syllabus.

Name of Textbook	Total no. of pages	No. of pages on Ecology
A Claassens et al	289	77 26%
B Du Toit et al	246	83 33%
C Austoker & Wessels	204	44 21%
D Smit et al	293	61 20%
E Ayerst et al	296	93 31%
Totals & Ave.	1328 [265]	358 27%

Considering the situation that about a quarter, [25%] of the standard eight biology syllabus is allocated to ecology, then, ideally, an appropriate textbook would have a quarter or more of it's information allotted to content on ecology.
If numbers are the criteria to be applied, this would rule out the suitability of books C and D respectively. However it is not the quantity that is of importance here, but rather the quality.

There are several criteria that one could apply to determine just how suitable a textbook is. Engelbrecht, [1975] suggests that the following criteria be applied for the selection of school textbooks in general:
-the contents of the textbook must be in accordance with the

syllabus;

-the writer's exposition of the contents should be accurate, and in accordance with the latest scientific discoveries and theories;

-the illustrations and the quality of print must be of a high standard;

-the linguistic standards must be up to scratch.

In the latter respect, the language used in the book should match the linguistic competence of the pupil, an aspect to be examined further on in this chapter. A last, and rather important factor to consider prior to the selection of a textbook, is to remember the home-background of the pupil, since the lower the socio-economic circumstances, the more vital the instruction in the language becomes.

The textbooks under consideration were furthermore analyzed in terms of the content on ecology pertaining to the various sub-sections of the ecology syllabus. The amount of content on each sub-section of the ecology syllabus is reviewed in terms of number of pages on a particular aspect in the various textbooks. A summary on this facet is contained in *figure 6* on page 60.

Moreover, the most frequently utilised textbook, identified in *table 8* written by Claassens et al, has been analyzed in terms of the amount of information it contains on the various sub-sections on ecology.This has been linked to the number of periods

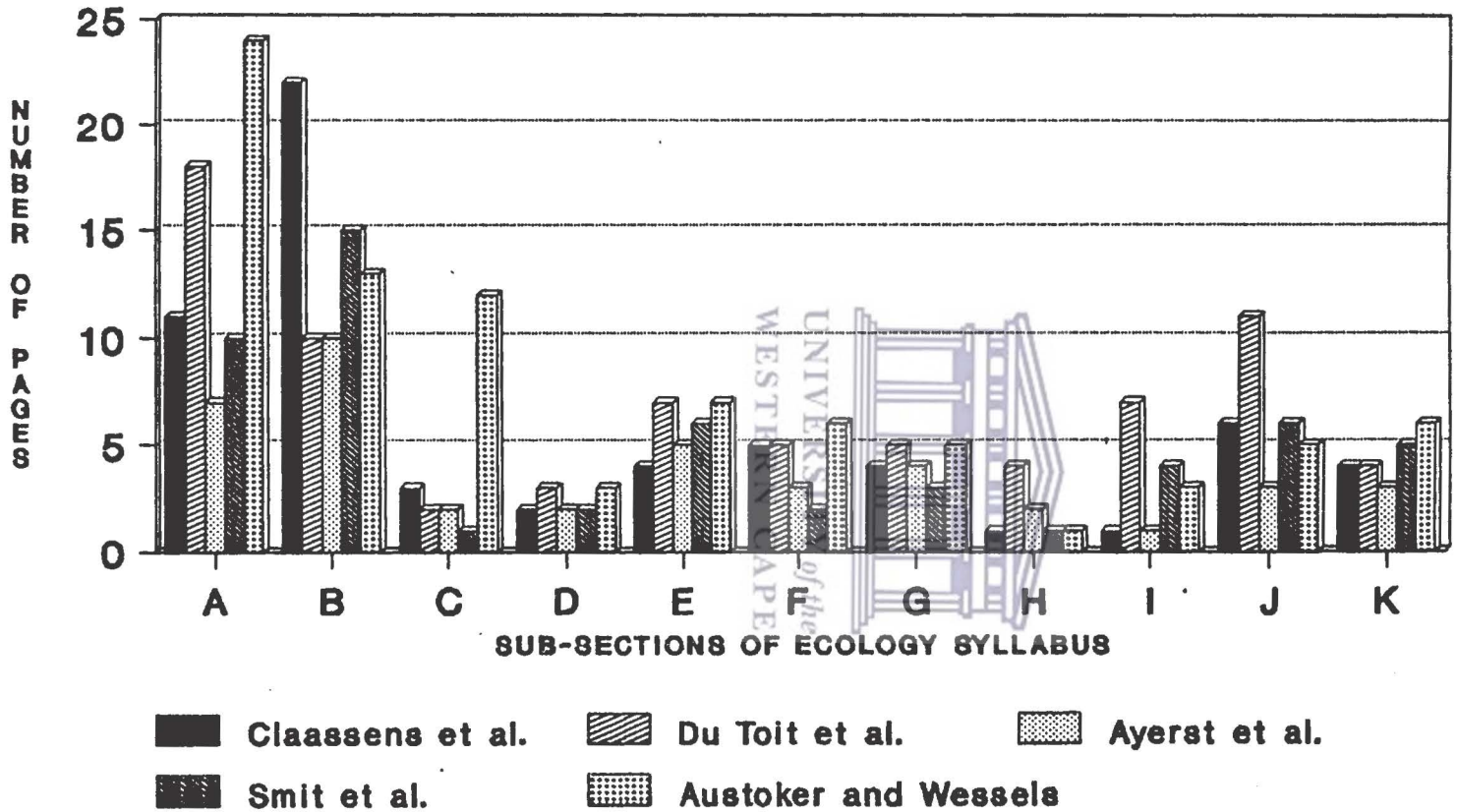


FIGURE SIX
Ecology content for different sub-sections in listed textbooks.

[as indicated by the teachers] that are used by the teachers to teach the respective sub-sections. A summary of this analysis is contained in *table 10.*

Table 10: No. of pages covered from Claassens et al. in the average no. of periods used by the teachers for each sub-section of the ecology syllabus.

pages per section	A 11	B 22	C 3	D 2	E 4	F 5	G 4	H 1	I 1	J 6	K 4
periods	3	3	3	2	3	3	3	2	2	2	2

A number of questions may result from the summary in *table 10,* for example:-

-can the specific amount of content, (as indicated by number of pages) be covered in a suitable manner within the amount of periods as indicated by the sample [bearing in mind that one period is equivalent to 35 minutes]?

-is the content of the textbook suitable to satisfy the needs of the teacher, and, does it meet up to the requirements of the pupil?

-Moreover, just how readable is the textbook in terms of:

*the most difficult sub-section, -nutrient cycling;

*the most interesting sub-section, -conservation, and

*an intermediate sub-section (neither difficult nor interesting)- symbiotic relationships. The latter three aspects will later be reviewed in terms of the most frequently used textbook.

6.3 ASPECTS OF READABILITY

Gilliland, [1976] associates the concept of readability with one of matching. He regards it as matching a reader with a text. Readability, however, is governed by:

-the ease of reading;

-the ease of understanding, and

-the ease of finding a text interesting.

These three facets are aptly summarised in a definition by Dale and Chall [1948 in Gilliland, 1972]:

"In the broadest sense, readability is the sum total (and interaction of) all those elements within a given piece of printed material, that affect the success which a group of readers have with it. The success is the extent to which they understand it, read it at optimum speed, and find it interesting"

Wegerhoff, [1981] examined Physical Science textbooks at various Cape Education Department schools in terms of readability, and suggested that the following criteria should be considered before purchasing a specific textbook:

-language simplicity;

-adequate coverage of the syllabus;

-an appropriate and interesting style of writing by the author[s], which may include, for example, the use of humour, personal and historical anecdotes;

-word density per line, and the number of syllables per word;

-line density per page, and the average sentence length;

-capitalization on the interest of learners;

-use of colour for emphasis, illustration, diagrams, etc;

-inclusion of short progressive summaries, and suitable home and

practical activities for pupils; and lastly
-the cost involved.

Implicit in the above criteria are certain methods applied for the section of appropriate textbooks, for example:
-subjective assessment [illustrations, activities, content, style of writing, format and organisation];
-readability formulae [syllables per word; words per sentence]
In the absence of quantitative methods, most assessments pertaining to the readability of a textbook is subjective in nature, which is also the most commonly used method for the selection of textbooks. Perrera, [1980] argues that *'informed judgements'* by a thoughtful teacher, may have advantages over the application of readability formulae, and other quantitative methods of assessment. Perrera [1980] claims that measures of word difficulty and sentence length used in formulae are shown to have weaknesses, since short familiar words are not easy to read in all contexts, and that long sentences are sometimes easier than short ones.

Although readability formulae can provide adequate guidelines for the selection of biology textbooks, some are rather difficult to apply at times, since tables, illustrations and specialist vocabulary may form an integral part of the text. The more suitable means of judging textbooks in biology, would then be a subjective type of analysis, which, where appropriate, can be used in conjunction with certain readability formulae. Nonetheless, the teacher will need to have some knowledge on

factors governing the selection of textbooks, if they have to make a choice in this matter.

Some of the above mentioned criteria have been applied in an attempt to evaluate the readability of certain areas in the most frequently utilised textbook, [Claassens et al, 1985].

6.4 READABILITY OF THE MOST FREQUENTLY USED TEXTBOOK

Since the textbook is regarded as an integral part of teaching, it seems logical that the manner in which the information is contained in it, will definitely have a bearing on the mode of teaching.

In chapter four it has been established that **nutrient cycling** was by far regarded as the most difficult section to teach. In addition to this, **conservation** had been signified as the most interesting area, and a sub-section which was found to be neither interesting nor difficult was the one on **symbiotic relationships**. These sub-sections will be subsequently reviewed in terms of how it is presented in the textbook, [*Biology. Standard 8; written by Claassens et al, 1985]* which is utilised by 94% of the respondents in this survey.

6.4.1 NUTRIENT CYCLING

This sub-section is covered within four pages in the textbook under consideration, and the amount of periods utilised to teach this sub-section corresponded to the amount recommended by the educational authorities, namely three periods. However, after having scrutinised the content as included in the textbook, it was found that:-

-a great deal of chemistry, which is rather abstract in nature is embraced in this sub-section, as indicated in the extract below :

> **1.2.6.2 The nitrogen cycle**
>
> The atmosphere consists of about **78 per cent** nitrogen, the main source of nitrogen required by plants and animals to build up protoplasm, muscle tissue, hair, bone, cartilage, etc. *Animals and plants cannot use atmospheric nitrogen*. Plants obtain nitrogen from nitrates. A nitrate is a NO_3 compound, e.g. $NaNO_3$ (sodium nitrate). *Plants absorb nitrates in the form of negatively charged ions (anions)*, i.e. NO_3^- ions.
>
> The process by which atmospheric nitrogen combines with oxygen to form nitrates is called *nitrogen fixation*.

-the inclusion of specialist/ technical terminology is abundant for example:

> **Ammonification**
>
> Certain bacteria change urea and uric acid into *ammonia* (NH_3), most of which occurs in the soil as *ammonium ions* (NH_4^+).
>
> **Nitrification**
>
> Nitrite bacteria change ammonia into *nitrites* (NO_2 compounds), which are not taken up by plant roots. Nitrate bacteria change nitrites into *nitrates* (NO_3 compounds). *Nitrates are absorbed by plant roots as* NO_3^- ions.

-a rather compressed form of writing is evident, as illustrated in the extract below:

> **Root nodule bacteria**
>
> These bacteria are not free-living but occur in large numbers in the *roots of leguminous plants* such as lupins, lucerne and sweet-peas. The bacteria occur in the swellings (nodules) of the roots, where they transform atmospheric nitrogen present in the soil into nitrates (Fig. 1.74).
>
> Most of the nitrogen thus fixed is taken in by the host plant which supplies the bacteria with dissolved carbohydrates manufactured in the leaves *(mutualism)*.
>
> **(2) Denitrification**
>
> *Denitrifying bacteria* present in the soil *release nitrogen from nitrates* and in doing so *restore nitrogen to the atmosphere* as nitrogen gas (N_2).

-In a few cases there are more than one idea/ process contained in one single sentence. Should these be broken up into a number of simpler sentences, it would facilitate the ease of reading and understanding of the passage, for example:

> By this process the *radiant energy* of the sun is *used to combine carbon dioxide with the hydrogen* present in water molecules *to form high-energy carbohydrates. Oxygen is released* during this process.

In this single sentence,at least four concepts are involved:

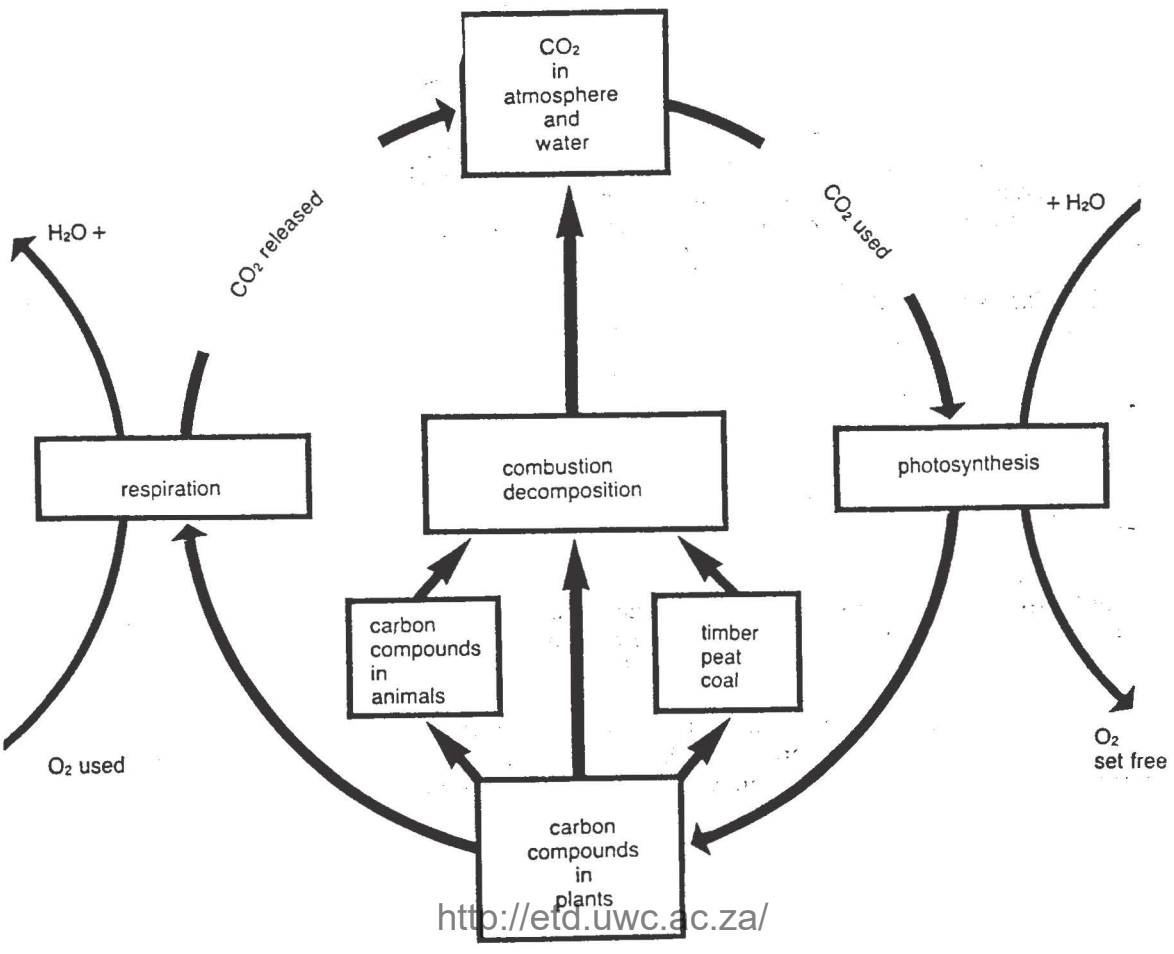
*radiant energy from the sun and it's fixation;

*CO present in the atmosphere;

*process of water uptake from the soil, and

*the production of carbohydrates by means of photosynthesis.

-intricate chemical cycles/ pathways are illustrated which require in depth explanation to the pupils, for example:



-illustrations / drawings are limited, since only one drawing is included for this entire sub-section; the one illustrated below:

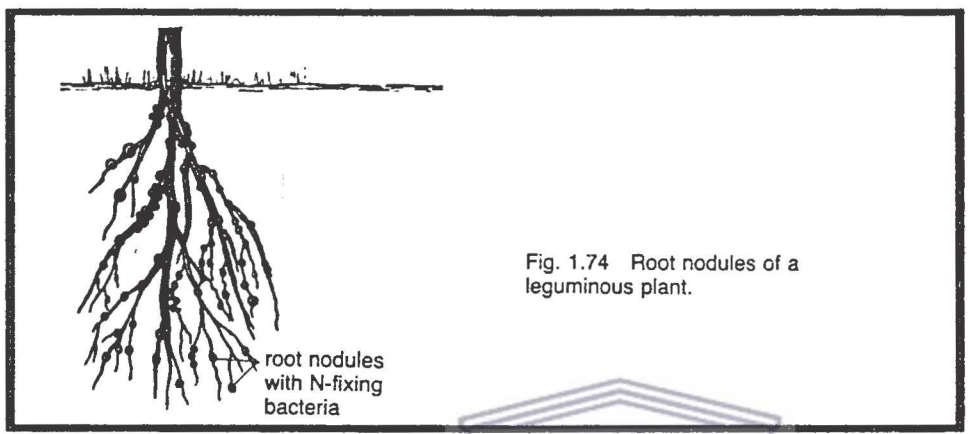


Fig. 1.74 Root nodules of a leguminous plant.

If one views this information in terms of the textbook being a self-instructional medium, or for unsupported study, surely it is not suitable in this regard?

A second matter of concern is whether it is suitable to teach a sub-section of this nature within three teaching periods? From the information in the textbook, this sub-section is further sub-divided into the following sections:

-carbon cycle;

-nitrogen cycle;

* Nitrogen fixation

  i] electrical fixation;

  ii]nitrogen fixation by bacteria;

  iii] protein synthesis

    a) de-amination,

    b) ammonification,

    c) decomposition,

    d) nitrification.

The foregoing paragraphs indicate that nutrient cycling covers a wide range of topics. Ideally, more information on each aspect is required, and not just mere paragraphs as it is presented in the textbook.

Since the role of the textbook in the teaching of biology cannot be over-stressed, there is a great possibility that the information, as contained in the textbook will be imparted as is, to the pupil. This compressed, highly technical and condensed form of writing is not suitable for the pupil, and in most cases, not for our inadequately trained teachers as well.

Furthermore it is questionable whether this type of information can be taught effectively within the three periods recommended by the authorities, and also utilised by the teachers. It is more likely that six to seven teaching periods will be needed to cover this section. Protein Synthesis on it's own is an intricate process to understand. To include it at this point, in passing, furthermore reflects the weakness in the way the syllabus is constructed, since the physiology thereof is only dealt with at standard 9 level. Yet, it is expected of the pupil in standard eight to understand the significance thereof. Surely, the planners of the syllabi should consider these facts prior to implementation?

6.4.2 SYMBIOTIC RELATIONSHIPS

This sub-section of the ecology syllabus was neither regarded as interesting, (except for one teacher) nor was it regarded as difficult (except for two teachers), hence, it is regarded as an

intermediate sub-section. The recommended time for teaching, and the amount of periods actually used by the sample was found to be the same, involving three teaching periods. This sub-section is covered within four pages in the textbook under investigation.

Relating to the content, symbiosis essentially covers three forms of relationships, i.e. parasitism, mutualism and commensalism in the textbook. Pertaining to it's presentation, the following can be stated in this regard:

-the sub-section starts off from the known, essentially linking up to the pupil's standard six knowledge:

> **1.2.4 Symbiotic relationships**
> In Standard Six you learned that there are three major forms of symbiosis and you studied examples of each kind.

Features of this nature makes the learner feel self-confident;

-the author identifies with his audience, by using user-friendly terms such:

> We shall refer to examples of each kind of symbiosis again and discuss one example of each in more detail.

-each type of symbiotic relationship is adequately described, and sufficient diagrams and illustrations are used to substantiate them. This is in direct contrast to what has been established in the case of nutrient cycling, where only one illustration has been included.

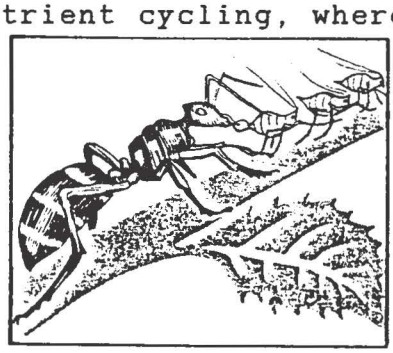


Fig. 1.62 Ants visiting aphids (mutualism).

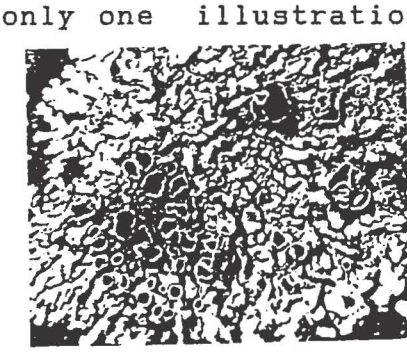


Fig. 1.60 Lichen, an example of mutualism.

-The life cycle of the Malaria parasite, however, is a bit confusing at times, since the bloodvessels seem to be a part of the skin, due to poor graphic representation:

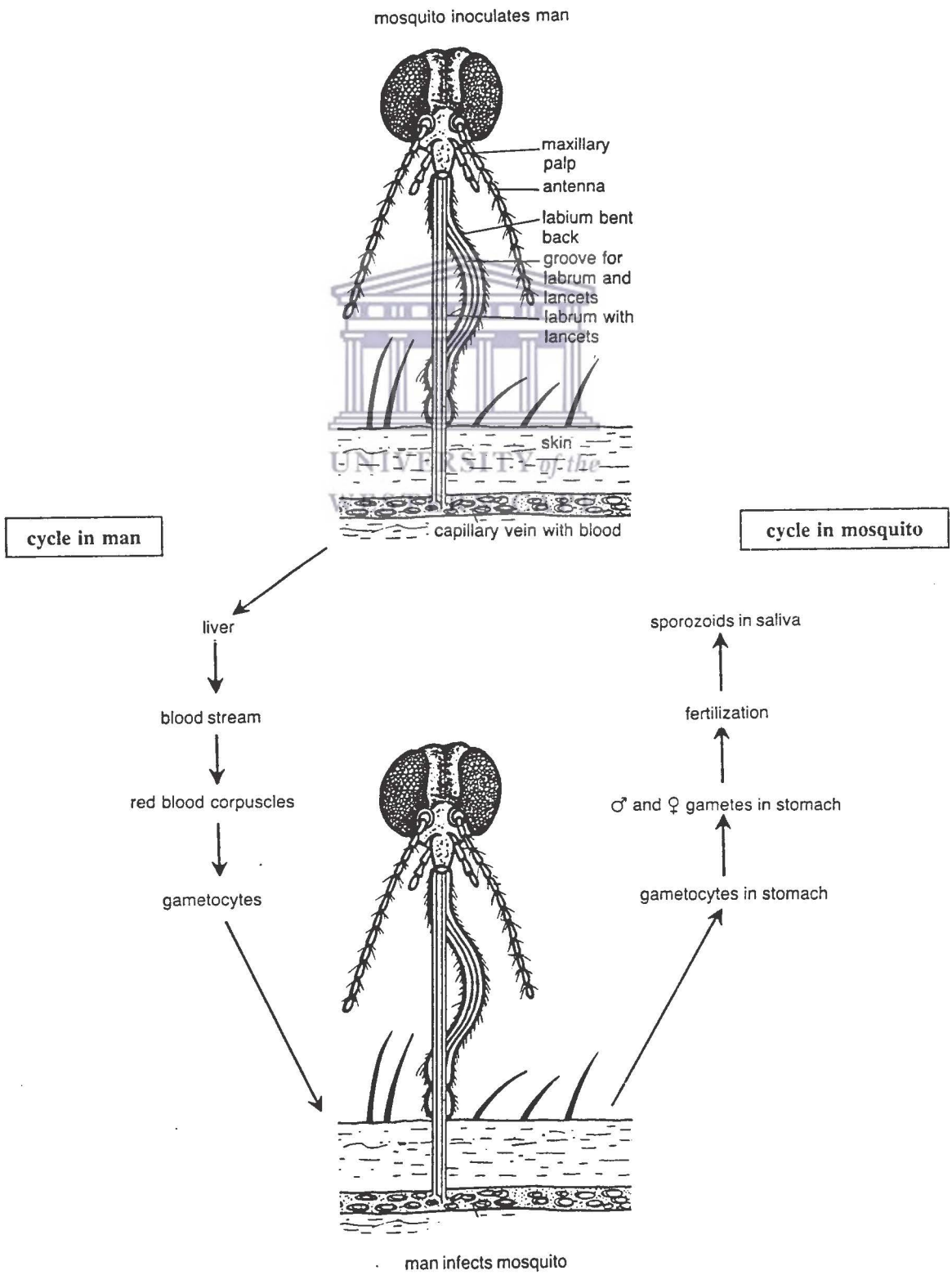


Fig. 1.59 The life cycle of the malaria parasite, *Plasmodium falciparum*.

-lastly, at certain places, the sentences seem to be lengthy, and could be broken up into simpler, smaller and more effective sentences, in order to facilitate the ease of reading and understanding, for example:

> Parasites which live on the surface of their host are called **ectoparasites** *(external parasites)*, e.g. fleas, ticks, bed bugs, lice. Parasites which live inside their host are called **endoparasites** *(internal parasites)*, e.g. the bilharzia parasite and the tapeworm (both flatworms); *Trypanosoma*, a unicellular organism transmitted by *tsetse-flies*, causes *sleeping sickness*; and *malaria* parasites, which we shall discuss in more detail.
>
> The sugar ants carry the young larvae of this butterfly from the flowers on which they feed into their nest to ensure themselves of the sweet substance secreted by these larvae. The larvae then no longer feed on the plants but on the ants' brood and at the same time are protected by the ants.

Regardless of the presentation, symbiosis, as opposed to nutrient cycling is much simpler and easier to understand, and, hence, present no real problem for the teacher to teach.

6.4.3 CONSERVATION

This sub-section of the ecology syllabus was identified as being the most interesting area of the course. It is covered within four pages in the textbook, and unlike the afore-mentioned sub-sections,there is a definite discrepancy between the time recommended to teach it [6], and the actual time utilised by the teachers in this sample [2].

Teachers should, however, bear in mind that this is one of the most important sub-sections in the entire ecology section that can be used to facilitate environmental awareness, and it is highly recommended that more time be spent on this.

Judging the readability of this sub-section, it was found beyond

all doubt, that:

-there is a more free style of writing:

> **1.4.1 Our modern society**
>
> In our modern society many people live in an almost artificial environment in which light comes from light bulbs or tubes, vegetables come out of tins, milk is manufactured in dairies and fresh air comes from an air conditioner. In such an environment one tends to forget that man is an *integral part of the natural environment* and that he is as dependent on its continuing health as were our cave-dwelling ancestors. Much more than material wealth, it *is the environment in which we live that determines the quality of our lives.*

-by the frequent usage of *'we'* and *'our'*, the authors identify with the readers:

> **1.4.2 Conservation of the environment**
>
> We have already referred to the conservation of the environment under *section 1.3*, when we discussed man's impact on the environment with special reference to *air, water and land pollution* (Fig. 1.89). We must convince ourselves and others that if the balance of the environment is so altered by man's activities that it can no longer supply us with healthy food, oxygen-containing air and clean fresh water, we ourselves will in the end suffer most from our shortsightedness and neglect (Fig. 1.90).

-the "storey-telling" style of writing increases the interest facet of readability:

> **A story of losses, gains and major concerns**
>
> In Jan van Riebeeck's time there were still *blue buck* (extinct since 1800), *Cape lions* (extinct since 1850) and *quaggas* (extinct since 1880). There were *black rhinoceros* on Table Mountain, but today they are in danger of extinction and have disappeared from their former haunts. The Transvaal lost its *elephants* in about 1902, Natal by 1916. By 1920 there were 150 *Addo elephants* in the Cape but they were later reduced, by culling, to about 20. Now some survive in the **Addo Elephant National Park** near Port Elizabeth.

-sufficient pictures are included to reinforce the facts, capitalising on the pupil's interest, and capturing their attention:

Fig. 1.93*(f)* Bride of Franschhoek *(Serruria florida).*

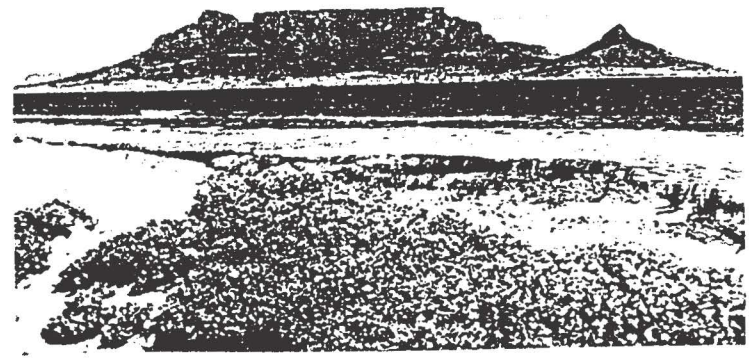


Fig. 1.92 The Table Mountain Range seen from Bloubergstrand.

Fig. 1.93*(b)* Bontebok.

Having examined the most frequently utilised book, in terms of the most **difficult** sub-section, the most **interesting** area, and an **intermediate** sub-section, it is noticeable that the level of difficulty varies substantially within the same textbook. This correlates to the Mallinson studies [1950-57, in Wegerhoff, 1981] where it had been established that the levels of reading difficulty within the same textbook may vary greatly.

A fact that ought to be considered in this regard is that there are four authors involved in the writing of the textbook, and it may well be that different authors were responsible for writing the different sections. This, nevertheless is a speculation, and cannot be stated with any degree of certainty.

6.5 CONCLUSION

Resulting from the findings in this chapter, it is clear that textbooks are of fundamental importance in our educational system, which accentuate the importance of the selection process. Teacher training institutions should take note in this regard, and incorporate the necessary skills which accompany the selection process during the pre-service teacher training.

Notwithstanding this, it must be pointed out that the section which the sample has indicated as being the most difficult [nutrient cycling], appeared to be the most difficult in terms of readability, as contained in Claassens et al, [1985] due to:

*the technical style of writing;
*limited amount of information on the various topics;
*compressed style of writing, and
*the absence of sufficient illustrations.

Ultimately, one has to remember that how readable a textbook is depends *"crucially on the personality, attitude and internal emotional state of the pupil"* [Wegerhoff, 1981].

The best textbooks can be rendered ineffective by such factors, which are beyond the control of the textbook writer.

CHAPTER SEVEN: CONCLUSION

This research set out to investigate how the ecology content, as contained in the standard eight Biology Syllabus, is taught to the pupils at various schools throughout the country by the fifty two teachers involved in this project.

The ecology section was chosen since it may be regarded as one of the more important sections in the school curriculum that can **promote environmental awareness, and instill positive attitudes towards the environment** in the pupils.

This survey has by no means been an intensive investigation due to the limitations regarding the sample size, therefore the findings of this survey should best be interpreted as preliminary. Nevertheless, interesting points pertaining to the teaching process arose, which could further be substantiated by a future full scale research project.

Of the numerous factors which may influence the actual teaching process, as carried out by the teacher, **four** factors had been assessed in this investigation:

-the **pre-service training component** which the sample of teachers were subjected to at the various tertiary institutions;

-the actual ecology content (as contained in the standard eight biology syllabus), taught in a particular manner (methodology);

-the time available to teach the subject matter, and, lastly

-the most frequently utilised resource, which was identified as

the textbook.

Firstly, the pre-service training component which encompass aspects such as the tertiary institutions where the sample involved in this survey had received their academic and professional tuition, has been outlined in *chapter two*. In this respect, it has been established that **54%** of the teachers were graduates, the majority, **[71%]** having received their academic training at the University of the Western Cape. The remaining **46%** of the teachers qualified from various Colleges of Education, with **58%** of them being trained at the Hewat College of Education.

What was rather alarming about the prevailing situation, was that all these college trained teachers were teaching at a level which they were not trained for. **Seventy five percent** of them were trained as senior primary (standards 2 to 4) specialists, while the remaining **25%** were junior secondary teachers, trained to teach standards 5 to 7. This situation is disturbing, but one cannot generalise that this is the norm prevalent at all schools, due the small sample involved, and only further in-depth research in this regard will reflect what the true situation is.

Further features on pre-service training reviewed the course work which the sample was subjected to, as contained in *chapter three*. Upon statistical analysis of the data received, it was found that **71%** of the teachers indicated that they had been exposed to some form of tuition in ecology. From the **29%** who received no tuition in ecology, **87%** were college trained teachers, once again

pointing towards the seriousness of the matter, in that these teachers were totally unprepared to operate at standard 8 level. What compounds the matter further, is that **76%** of the 71% who received some form of tuition in ecology, indicated that tuition did not prepare them adequately to teach this section without any difficulties. Hence, an overall total of **83%** indicated that their ecology training was highly unsatisfactory. The prevailing situation does not seem to be encouraging at all, but, once again, since the numbers involved were restricted, further research is recommended.

Supplementary features on pre-service training included an analysis on the status of training in fieldwork and related techniques, as outlined in *chapter three.* Despite it being a vital and integral part of any ecology course, **48%** of the sample had never been exposed to any form of fieldwork. Of the **52%** of the teachers who had been introduced to this facet, **74%** were graduates, and the other **26%** were college trained teachers, implying that the majority of college trained teachers were not even exposed to this vital element of ecology training. Yet, they were operating at a level where it is expected of them to venture into such activities. Upon further investigation of the matter, it was established that **78%** of these teachers, who had been introduced to fieldwork, were exposed on an infrequent, [mainly once a year] and unsatisfactory basis.

This negative state of affairs may generate a number of questions, for example:

-Do the constructors of the courses, or the planners of the syllabi at tertiary institutions consider which skills and information prospective teachers require before commencing into their profession?

In an attempt to answer the above question, the situation pertaining to colleges of education will first be reviewed. As mentioned in *chapter three*, colleges of education [House of Representatives] follow prescribed syllabuses in Biology and other disciplines, leaving little scope to the lecturers to employ other initiatives. The third and fourth year syllabuses for Biology are lengthy, and students are furthermore subjected to an external examination. This creates an enormous amount of pressure on the lecturers since the factual information first has to be covered before fieldwork and related activities are addressed.

This situation, nonetheless, may lead to other pertinent questions, for example, ***what is of greater importance in the training of teachers?*** From the status quo it seems to be the same as is the situation pertaining to our primary and secondary schooling, being, **a heavy emphasis on cognitive development, with very little attention paid to skills and affective development.** The latter two aspects are of absolute importance in the teaching of ecology, and are regrettably neglected, or even ignored. What is needed is a situation where the cognitive aspect is not neglected, but one where there is a balance between the cognitive, affective and skill development.

Relating to the universities, the circumstances at the University of the Western Cape will briefly be evaluated seeing that the majority of graduates in this survey qualified from this university. The situation at universities is slightly different to that prevalent at colleges, since the former have a freer hand at determining what information will be disseminated. Furthermore, not only prospective biology teachers may follow a BSc course, but pure scientists as well, which complicates the matter even further. In an attempt to remedy the situation, a BSc Education course has been introduced a few years ago, generated for science teachers, where the majority of biology teachers followed a Botany/ Zoology stream.

Have the needs of the teachers been addressed during these courses? It does not seem likely, since up to the end of the 1990 academic year, there seemed to be no difference in the content presented to the pure science BSc students, and the BSc Education students in Botany and Zoology, outside of the courses followed in education for the latter group. There was also no correlation in the content presented to these students and the biology school syllabuses which they had to teach upon completion of the course.

The first time the BSc Education students [1990 group] conversed themselves with the biology school syllabus, was during the final HDE diploma course year, also followed by BSc students who had opted for teaching. Unfortunately questions had not been included into the questionnaire to ascertain whether any tuition in ecology took place during this final year of teacher training.

Still, it seems that there should be a thorough re-thinking in this regard, with more purposeful planning towards the establishment of a link between teacher training and the actual teaching process. This BSc Education degree course has endless potential, but as far as biology, and more specifically ecology is concerned, lecturers will have to change their approach, and adjust their course content in order to equip the teachers adequately for their future profession.

The other three factors which may influence the teaching process, namely, **content and methodology** as discussed in ***chapter four***, **the time factor**, as outlined in ***chapter five***, and the **textbook**, as contained in ***chapter six***, will subsequently be discussed. Since the aims set out for education propose in-depth personal changes, not only is the content important, so too is the method of presentation. Furthermore, is it not true that no matter how well motivated a teacher is, unless there is time within the school curriculum for the teachers to mobilise their concern, all efforts can become nullified? Likewise, since time is of importance, and often restrictive, teachers are unlikely to venture into meaningful activities unless the necessary resources required are available to them. Seeing that all these factors are interrelated, they will be discussed concurrently.

In *chapter four*, the ecology content, as outlined in the standard eight biology syllabus, has been analyzed in terms of what the sample regarded as being interesting and difficult sub-sections respectively. It has been established that the sub-section on

nutrient cycling was regarded as being the most difficult, while the sub-section on **conservation** was regarded as the most interesting. Possible reasons why this was the case has been speculated upon, however, very likely possibilities have been linked to the textbook, and the manner in which the subject matter is dealt with in this all important resource.

Despite the fact that **nutrient cycling** is rather chemical in nature, there are a number of weaknesses relating to the mode in which this aspect is dealt with in the most frequently utilized textbook [Biology. Standard 8. - Claassens et. al 1985] for the purpose of this survey.

The compressed and technical style of writing, the limited amount of illustrations, and the fact that in a number of instances more than one concept has been condensed into a single sentence, contributed to the low level of readability displayed on this section. Furthermore, it was found that nutrient cycling covers a broad range of sub-components, which requires more information than the single paragraphs that have been written on it in this textbook.

It is also questionable whether this difficult section can be taught efficiently within the three teaching periods utilised by the teachers (also recommended by the educational authorities). This sub-section should at least take up six to seven teaching periods, since it embraces concepts such as protein synthesis, which, incidently, is only addressed in detail at standard 9 level, once again pointing to a weakness in the way the syllabus

is constructed.

In contrast, **conservation**, signified as the most interesting aspect of the ecology syllabus, is more topical and easy to identify with, since it receives extensive media coverage. Nevertheless, the free, story-telling mode of writing, and the fact that a number of illustrations have been included to substantiate the content, contributes to the higher level of readability. The authors of the textbook [Claassens et. al 1985], frequently include words which identify with the readers, such as *we, our* and *us*, which puts the reader at ease.

In this case, unlike the situation in nutrient cycling, a discrepancy between the number of teaching periods utilized by the sample **[2]**, and the number of periods recommended by the educational authorities **[6]** had been detected. It is recommended that more time is used to teach this section since it is one of the most important areas that can be employed to foster environmental awareness in the child. This matter, nonetheless, is not as straightforward as it seems. Since the biology syllabus at large has to be covered, and seeing that this survey only investigated the ecology section, further investigation into the whole syllabus is recommended before suggestions pertaining to time can be made.

On surface value, it appears that the standard eight biology syllabus can be interpreted as lengthy, and it might be true that the teacher needs more time to teach the other areas, at the

expense of important areas like **conservation**. Teachers, nonetheless, need guidance on these issues. According to the educational authorities, this guidance should be given by the Subject Advisors, as it is their task to keep teachers abreast with all aspects and developments relating to subject matter, and also to arrange in-service training courses. This, however, is not happening at most of our schools, since subject advisors stress the learning of factual information, rather than the development of skills, attitudes and values. The emphasis in our schools today, is on results, in that examinations play a major role in influencing what is taught, and how it is taught.

Most visits by these advisors entail an *"inspection"*, where teachers are **evaluated**. The role of the subject advisor needs to be reviewed, since they can play a very constructive role in assisting teachers to alleviate problems such as, for example, nutrient cycling. Here handouts could be made available in the form of worksheets, notes and other audiovisual material to reinforce the textbook. In this investigation these aspects have not been included in the questionnaire, and further research is recommended if the true situation is to be uncovered.

As far as the methodology facet is concerned, it was found that the teachers in this project experienced problems pertaining to fieldwork and practicals, which are essential components of ecology. Bearing in mind that the teachers have been inadequately prepared for this task during their pre-service training, the critical need for in-service training becomes more crucial.

Inadequately trained teachers impart the subject content in an incompetent manner, resulting in a pupil population who will make inept decisions pertaining to the environment in the future.

It is time for the educational authorities to work hand-in-hand with the teacher training institutions and the schools, in order to face the current problems in education. What is needed is a **holistic** approach, involving all parties dedicated to education to operate in unison. Moreover, the division of the educational system into the various departments complicates the matter even further. One single education department for all could likewise add to the solution of many of the problems currently experienced in our schools.

Due to the restriction in time, it was beyond the scope of this survey to address numerous factors, for example, a thorough evaluation on the readability of all the textbooks which had been listed by the sample. Seeing that there are weaknesses in all textbooks, it would be interesting to assess whether the same shortcomings, as detected in the textbook by Claassens et. al, [1985] are found in these books as well. In addition, a review on the other sub-sections on ecology could also be dealt with to obtain a thorough insight in this regard.

The results obtained in this survey are by no means final, and further research is required into a number of areas, of which the following are be highlighted:

- a review of the suitability of all the prescribed standard

eight biology textbooks;

- a country-wide census to ascertain whether teachers are operating at a level for which they are suitably qualified for;
- researching the existing role of the subject advisor, and what it can evolve into, in order to alleviate some of the problems experienced in education;
- an in-depth research into the entire biology syllabus, and not only the ecology section in isolation, to investigate the true extent and duration thereof, so that more viable recommendations can be made in this regard;
- an interview with the lecturers involved in the training of biology teachers at the University of the Western Cape and at Hewat College of Education, to review all aspects of ecology during pre-service training [this aspect will be addressed before publishing the findings of this survey];
- a full scale enquiry into the syllabi followed at the various tertiary institutions involved in the training of biology teachers, in order to make purposeful suggestions pertaining to course-work in ecology during pre-service training;
- devising an effective in-service programme for biology teachers currently in the profession, to acquaint with fieldwork techniques, and the development of suitable resources for the teaching of ecology.

With regards to the latter two areas, (pre- and-in-service teacher training) a committee could perhaps be established, comprising of teachers, educational authorities and specialists in the field of ecology who can devise a programme to address the

problems highlighted in this research. Such programmes are already in operation in Natal, for example the SHARE-NET programme, where teachers are actively involved in curriculum development projects.

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APPENDIX ONE: QUESTIONNARE

1

1.1 School Region:

.....

1.2 Name of School /Institution.

.....

1.3 Number of years of teaching experience.

.....

2

2.1 Academic qualifications[eg.[BSc, P.T.D, HDE Secondary Dipl]

.....

2.2 Professional qualifications [S.T.D; HDE; BEd,etc.]

.....

2.3 Institution[s] at which academic qualifications was achieved

.....

2.4 Institution[s] at which profess. qualifications was achieved

.....

3

3.1 Did you receive any tuition in ecology during your training?

.....

3.2 If yes, did this tuition equipt you adequately to teach ecology without any difficulties?

.....

3.3 During your training years, were you exposed to any fieldwork or special field techniques?

.....

3.4 If yes, how often were you exposed? [annually, once a term.]

.....

4

4.1 Which areas of the current ecology syllabus do you find particularly interesting? Why?

.....

.....

4.2 Which areas of the current ecology syllabus do you find particularly difficult to teach? List these areas in order of difficulty, and briefly explain why you have difficulties in these sections.....

.....

.....

.....

.....

APPENDIX ONE

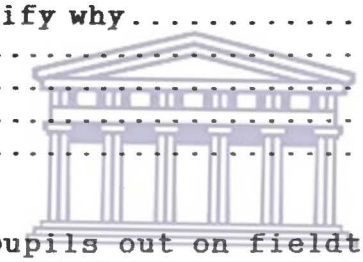
4.3 How much time do you spend with the teaching of ecology? [weeks, months, and state why.]NB:REFER TO SYLLABUS ATTACHED
.....
.....

4.4 Would you prefer having more time to teach ecology? If yes, pleasemotivatebriefly.....
.....
.....
.....
.....

4.5 Do you find it difficult to do practical work in ecology?

.....

4.6 If yes, please specify why.....
.....
.....
.....
.....



4.7 Do you take your pupils out on fieldtrips [excursions]? Y\N

.....

4.8 If yes,give a few details on these outings [frequency, venue purpose, etc]
.....
.....
.....
.....

4.9 If no, name a few reasons why it is particularly difficult for you to do so.
.....
.....
.....
.....

4.10 Which textbooks do you use to teach ecology?
.....
.....
.....
.....

4.11 Which other literature [books, journals, magazines, etc] have you personally found useful in the teaching of the ecology section of the Biology syllabus.
.....
.....
.....

APPENDIX ONE

SYLLABUS FOR STANDARD 8

SYLLABUS CONTENT	ELABORATION	TEACHING PERIODS
1. ECOLOGY	This study is intended primarily to acquaint pupils with the interrelationships among organisms and their environment	
1.1 Ecosystems		
1.1.1 The concept of an ecosystem	The naturally defined habitat in which there is a dynamic relationship between abiotic and biotic components	
1.1.2 The practical study of the structure of a selected ecosystem with emphasis on the relationships between its components	A preliminary superficial survey of the chosen ecosystem should lead to the selection of one or more abiotic and/or biotic components for further investigation These selected components should lend themselves to quantitative measurement from which tentative inferences about the distribution and interrelationships of biotic components could be made	
Abiotic components physical factors edaphic factors physiographic factors	Abiotic components which might be investigated include: light; length of day; temperature; water, including water cycle; atmospheric gases, including winds; soil characteristics such as pH (acid content), humus content, texture, water-holding capacity and air content; aspect, slope and altitude	
Biotic components producers consumers (herbivores, carnivores and omnivores) decomposers	An investigation of a selected biotic component to include a study of adaptatio to a habitat Involvement in succession and competition	
Biological rhythms	Examples of biological rhythms in the selected ecosystem caused by an abiotic factor/abiotic factors	
1.1.3 Symbiotic relationships	At least one example each of parasitism, mutualism and commensalism	
1.1.4 Trophic levels	Food chains, food webs and ecological pyramids	
1.1.5 Nutrient cycling	The significance and consequences of nutrient cycling Carbon and nitrogen cycles	
1.1.6 Biosphere	Brief outline only of the components: atmosphere, lithosphere, hydrosphere	
1.1.7 Terrestrial and aquatic ecosystem	Similarities and differences only	
1.2 Man and the ecosystem		
1.2.1 Pollution of air, water and land	At least one example of each type of pollution must be studied, and appropriate corrective measures should be considered	
1.2.2 Conservation of indigenous flora and fauna, and of other natural resources	Conservation as the wise use of natural resources A study of at least one programme of conservation that is being carried out	

APPENDIX TWO

H.G SYLLABUS FOR STANDARD 8

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1. ECOLOGY	This study is intended primarily to acquaint pupils with the interrelationships among organisms and their environment	
1.1 Ecosystems		Continuous investigation of a selected ecosystem on the school grounds or any other attainable ground; graphical representation of information, where possible (P)
1.1.1 The concept of an ecosystem	The naturally defined habitat in which there is a dynamic relationship between abiotic and biotic components	
1.1.2 The practical study of the structure of a selected ecosystem with emphasis on the relationships between its components	A preliminary superficial survey of the chosen ecosystem should lead to the selection of one or more abiotic and/or biotic components for further investigation These selected components should lend themselves to quantitative measurement from which tentative inferences about the distribution and interrelationships of biotic components could be made	
Abiotic components physical factors edaphic factors physiographic factors	Abiotic components which might be investigated include: light; length of day; temperature; water, including water cycle; atmospheric gases, including winds; soil characteristics such as pH (acid content), humus content, texture, water-holding capacity and air content; aspect, slope and altitude	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
Biotic components producers consumers (herbivores, carnivores and omnivores) decomposers	An investigation of a selected biotic component to include a study of adaptations to a habitat Involvement in succession and competition	
Biological rhythms	Examples of biological rhythms in the selected ecosystem caused by an abiotic factor/abiotic factors	
1.1.3 Symbiotic relationships	At least one example each of parasitism, mutualism and commensalism	
1.1.4 Trophic levels	Food chains, food webs and ecological pyramids	
1.1.5 Nutrient cycling	The significance and consequences of nutrient cycling Carbon and nitrogen cycles	
1.1.6 Biosphere	Brief outline only of the components: atmosphere, lithosphere, hydrosphere	
1.1.7 Terrestrial and aquatic ecosystem	Similarities and differences only	
1.2 Man and the ecosystem		
1.2.1 Pollution of air, water and land	At least one example of each type of pollution must be studied, and appropriate corrective measures should be considered	An investigation of at least one type of pollution in the environment with special reference to the effects of pollution and corrective measures (P)

APPENDIX TWO

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1.2.2 Conservation of indigenous flora and fauna, and of other natural resources	Conservation as the wise use of natural resources A study of at least one programme of conservation that is being carried out	
2. THE CELL An introductory study of certain aspects of cellular structure and organisation	The main structural features of selected components of cells as revealed by the light microscope and by electron micrographs	An investigation of the sub-cellular structure of a plant cell and an animal cell by means of e.g. electron micrographs (D)
2.1 Biological importance of protoplasm	General appearance, physical characteristics and chemical composition; relevant functions of water and proteins	
2.2 Membranes enclosing cells and forming intracellular partitions: properties, structure and functions	Structure: simple fluid mosaic model only Properties Functions	
2.3 Nucleus: composition and functions	Composition: membranous envelope with pores; nucleoplasm containing chromatin and nucleoli; chromatin network composed of many chromosomes which, during cell division, become visible as strands bearing genes; nucleoli as dense regions consisting of nucleic acids Functions: overall controller of the structure and properties of the cell in that genes regulate the synthesis within the cell of structural proteins and of enzymes; role in heredity (No study of nucleic acid composition)	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2.4 Ribosomes: Location and function	Location: in cytoplasmic matrix, often attached to membranes of E.R. Function: sites at which proteins are synthesised	
2.5 Plastids		
2.5.1 Chloroplasts: location, structure and function	Location: in cytoplasmic matrix of some cells, usually positioned to obtain adequate light Structure: variable shapes; enclosed by membranes; lamellae with grana containing chlorophyll; stroma Function: sites of photosynthesis	
2.5.2 Leucoplasts: location, mention of function		
2.5.3 Chromoplasts: location, mention of function		
2.6 Mitochondria: location, structure and mention of function	Location: in cytoplasmic matrix of most cells Structure: double membrane; cristae Function: site of final stages of respiration	

SYLLABUS CONTENT		ELABORATION	PRACTICAL WORK
2.7	Vacuoles: location, organisation and some functions	Location: in cytoplasmic matrix; often very large in cells of plants, seldom prominent in animal cells Organisation: liquid-filled cavity, bounded by membranes (tonoplast) Functions: storage of water, ions and soluble compounds; aids intra-cellular translocation; turgidity providing support for cell; mention of specialised vacuoles among others phagosomes, contractile vacuoles, lysosomes, dictyosomes	
2.8	Cell wall: location, composition, properties and functions	Location: outside cell membrane of most plant cells Composition: strand of insoluble cellulose, mostly interwoven, and impregnated with substances such as pectin and sometimes lignin; initial layers subsequently thickened Properties: rigid, comparatively non-elastic and usually permeable to water and most solutes Functions: e.g. support of cell; protection	
2.9	Other components of cells: endoplasmic reticulum Golgi body (dictyosomes) lysosomes centrioles	Recognition of these organelles as they may be seen in electron micrographs; awareness of their probable functions	

8

SYLLABUS CONTENT		ELABORATION	PRACTICAL WORK
3.	CELL DIVISION		
3.1	Only the significance of cell division for growth	It should be emphasised that additional cells are required by organisms for growth, repair, replacement, and in some cases reproduction (The process of mitosis need not be studied at this stage)	
4.	PLANT TISSUES	Differentiation of cells illustrated by a study of angiosperm tissues, emphasis being placed continuously on the relationship between the structure of a tissue and its functions	The preparation of wet mounts of plant tissues Practical investigation of structure by means of a microscope and/or micrographs and/or photo-micrographic slides or transparencies (P or D)
4.1	Meristematic tissues	Structure and functions	
4.2	Permanent tissues epidermis parenchyma chlorenchyma collenchyma sclerenchyma xylem phloem	Structure and functions of components	

APPENDIX TWO

H.G

SYLLABUS CONTENT		ELABORATION	PRACTICAL WORK
5.	ANGIOSPERM ANATOMY	Unless otherwise indicated, internal anatomical features as revealed by a light microscope should be recorded by plan diagrams as well as by drawings of small portions of tissues, representing their appearance Emphasis must be placed on the relationship between the structure of an organ and its functions	
5.1	Review of plant plan		
5.2	A young dicotyledonous root	External features; internal structure as seen in transverse section	Observation of the development of root hairs in a young seedling (P or D) Observation of a young dicotyledonous root as seen in a transverse section (P or D)
5.3	A young dicotyledonous stem and a monocotyledonous stem	External features; internal structure as seen in transverse sections Contrast between a young dicotyledonous and a young monocotyledonous stem as seen in a transverse section only	Observation of young stems of a dicotyledonous and a monocotyledonous plant as seen in a transverse section (P or D)
5.4	A dicotyledonous stem in which secondary thickening has occurred	Only a plan diagram, without cellular detail, is required Brief outline of the process of secondary thickening	Observation of annual rings (P or D)
5.5	A dorsiventral leaf	External features of a simple leaf Internal structure as seen in transverse section	Observation of a dorsiventral leaf as seen in a transverse section (P or D)

SYLLABUS CONTENT		ELABORATION	PRACTICAL WORK
5.6	A dicotyledonous flower and a monocotyledonous flower	Composition of a complete, mature dicotyledonous flower and a monocotyledonous flower (Study of tissues is not required) Diagnostic criteria of the two families studied and comparison between the two types	Analysis of a flower of each of the families studied (P)
6.	MAMMALIAN TISSUES		Use slides and/or transparencies (D)
6.1	Epithelia	Main features and functions of columnar, squamous, ciliated and glandular epithelia	
6.2	Connective tissues	Main features and functions of areolar tissue, tendons, ligaments, cartilage, bone and blood	
6.3	Muscle	Main features and functions	
6.4	Nervous tissue	Main features and functions	
7.	SOME ASPECTS OF THE ANATOMY AND PHYSIOLOGY OF MAN		
7.1	Support and locomotion		For practical work a readily availabl small mammal or an available model of a skeleton may be used for observation and identification of the components of the skeleton
7.1.1	Axial skeleton	Skull: (Names of bones of skull not required) Teeth and jaws related to functions Vertebral column and rib cage: main regions of column; atlas and axis, with their functions; structure of a thoracic vertebra; interlocking of thoracic vertebrae and articulation of ribs;	

APPENDIX TWO

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
	flexible attachment of ribs to sternum	
7.1.2 Appendicular skeleton	Girdles: components of pectoral and pelvic girdles; attachment of girdles to axial skeleton Limbs: main components (names of individual carpals and tarsals not required)	
7.1.3 Joints	Structure of joints	Observation and identification of the different types of joints (P and D)
7.1.4 Skeletal muscles	Antagonistic arrangement and attachment to bones; functioning of muscles and skeleton to bring about locomotion Levers: The three classes of levers	Observation by means of models (D) Observation of the functioning of the three classes of levers (D)
7.2 Transport		
7.2.1 Blood system		
7.2.1.1 Heart: structure and functioning	Suspension in thoracic cavity; pericardium; positions and functions of atria and ventricles, and the nature of their walls; position, attachment and functions of tricuspid, bicuspid and semi-lunar valves; main blood vessels to and from the heart Cardiac cycle: systole and diastole ; rhythm controlled by S-A node (Sino-Atrial node) and modified according	Observation and investigation of a mammalian heart (P or D) Determining of pulse rate before and after exercises; graphical representati (P)

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.2.1.2 Blood vessels: structure and functions of arteries, capillaries and veins	A comparative study, emphasising the structural suitability of each type of vessel for its particular role	
7.2.1.3 Circulation of the blood: closed, double systems; main blood vessels and their functions	Pulmonary circuit: pulmonary arteries and veins Systemic circuit: aorta supplying organs; venae cavae returning blood to heart Hepatic portal vein system Coronary circulation: coronary artery and veins	
7.2.2 Lymphatic system		
7.2.2.1 Origin and composition of lymph		
7.2.2.2 Plan of the system	Areas served by the thoracic and right lymphatic ducts; names of blood vessels into which they drain	
7.2.2.3 Functions of the system	Drainage of excess tissue fluid; return of plasma proteins to the blood; removal of bacteria and toxins; transport of absorbed fats from the villi; manufacture of lymphocytes	

APPENDIX THREE

S.G SYLLABUS FOR STANDARD 8

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
1.	ECOLOGY	This study is intended primarily to acquaint pupils with the inter-relationships among organisms and their environment	
1.1	Ecosystems		Continuous investigation of a selected ecosystem on the school grounds or any other attainable ground; graphical representation of information, where possible (P
1.1.1	The concept of an ecosystem	The naturally defined habitat in which there is a dynamic relationship between abiotic and biotic components	
1.1.2	The practical study of the structure of a selected ecosystem with emphasis on the relationships between its components	A preliminary superficial survey of the chosen ecosystem should lead to the selection of one or more abiotic and/or biotic components for further investigation These selected components should lend themselves to quantitative measurement from which tentative inferences about the distribution and inter-relationships of biotic components could be made	
	Abiotic components physical factors edaphic factors physiographic factors	Abiotic components which might be investigated include: light; length of day; temperature; water, including water cycle; atmospheric gases, including winds; soils characteristics such as pH (acid content), humus content, texture, water-holding capacity and air content; aspect, slope and altitude	
	Biotic components producers consumers (herbivores, carnivores and omnivores) decomposers	An investigation of selected biotic components to include a study of adaptations to habitat Involvement in succession and competition	

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
	Biological rhythms	Examples in the selected ecosystem caused by an abiotic factor/abiotic factors	
1.1.3	Symbiotic relationships	At least one example each of parasitism, mutualism and commensalism	
1.1.4	Trophic levels	Food chains, food webs and ecological pyramids	
1.1.5	Nutrient cycling	The significance and consequences of nutrient cycling (Details of carbon and nitrogen cycles NOT required)	
1.1.6	Biosphere	Brief outline only of the components: atmosphere, lithosphere, hydrosphere	
1.1.7	Terrestrial and aquatic ecosystems	Similarities and differences only	
1.2	Man and the ecosystem		
1.2.1	Pollution of air, water and land	At least one example of each type of pollution must be studied, and appropriate corrective measures should be considered	An investigation of at least one type of pollution in the environment with special reference to the effects of pollution and corrective measures (P)
1.2.2	Conservation of indigenous flora and fauna, and of other natural resources	Conservation as the wise use of natural resources A study of at least one programme of conservation that is being carried out	

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2. THE CELL An introductory study of certain aspects of cellular structure and organisation	The main structural features of selected components of cells as revealed by the light microscope and by electron micrographs	An investigation of the sub-cellular structure of a plant cell and an animal cell by means of e.g. electron micrographs (D)
2.1 Biological importance of protoplasm	General appearance, physical characteristics and chemical composition; relevant functions of water and proteins	
2.2 Membranes enclosing cells and forming intracellular partitions: properties, structure and functions	Structure: simple fluid mosaic model only Properties Functions	
2.3 Nucleus: location, identification and function	Functions: overall controller of cell; roll in heredity	
2.4 Ribosomes: location and function	Location: in cytoplasmic matrix, often attached to membranes of E.R. Function: sites at which proteins are synthesised	
2.5 Plastids		
2.5.1 Chloroplasts: location, identification and function	Location: in cytoplasmic matrix of some cells, usually positioned to obtain adequate light Function: sites of photosynthesis	
2.5.2 Leucoplasts: location, mention of function		
2.5.3 Chromoplasts: location, mention of function		

SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
2.6 Mitochondria: location, identification and mention of function	Location: in cytoplasmic matrix of most cells Function: site of final stages of respiration	
2.7 Vacuoles: location, identification and some functions	Location: in cytoplasmic matrix; often very large in cells of plants, seldom prominent in animal cells Function: storage of water, ions and soluble compounds; aids intracellular translocation; turgidity providing support for cell; mention of specialised vacuoles among others phagosomes, contractile vacuoles, lysosomes, dictyosomes	
2.8 Cell wall: location, properties and functions	Location: outside cell membrane of most plant cells Properties: rigid, comparatively non-elastic and usually permeable to water and most solutes Functions: e.g. support of cell; protection	
2.9 Other components of cells: endoplasmic reticulum Golgi bodies (dictyosomes) lysosomes centrioles	Recognition of these organelles as they may be seen in electron micrographs Awareness of their probable functions	
3. CELL DIVISION	It should be emphasised that additional cells are required by organisms for growth, repair, replacement, and in some cases reproduction	
3.1 Only the significance of cell division for growth	(The process of mitosis need not be studied at this stage)	

APPENDIX THREE

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
4.	PLANT TUSSUES	Differentiation of cells illustrated by a study of angiosperm tissues, emphasis being placed continuously on the relationship between the structure of a tissue and its functions	The preparation of wet mounts of plant tissues Practical investigation of structure by means of a microscop and/or micrographs and/or photo-micrographic slides or transparencies (P or D)
4.1	Meristematic tissues	Structure and functions	
4.2	Permanent tissues epidermis parenchyma chlorenchyma collenchyma sclerenchyma xylem phloem	Structure and functions of components	
5.	ANGIOSPERM ANATOMY	Unless otherwise indicated, internal anatomical features as revealed by a light microscope should be recorded by plan diagrams as well as by drawings of small portions of tissues, representing their cellular appearance Emphasis to be placed on the relationship between the structure of an organ and its functions	
5.1	Review of plant plan		
5.2	A young dicotyledonous root	External features; internal structure as seen in transverse section	Observation of the development of root hairs in a young seedling (P or D) Observation of a young dicotyledonous root as seen in a transverse section (P or D)

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	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
5.3	A young dicotyledonous stem and a monocotyledonous stem	External features; internal structure as seen in transverse sections contrast between a young dicotyledonous and a young monocotyledonous stem as seen	Observation of young stems of a dicotyledonous and a monocotyledonous plant as seen in a transverse section (P or D)
5.4	A dicotyledonous stem in which secondary thickening has occurred	Only a plan diagram, without cellular detail, is required Brief outline of the process of secondary thickening	Observation of annual rings (P or
5.5	A dorsiventral leaf	External features of a simple leaf Internal structure as seen in transverse section	Observation of a dorsiventral lea as seen in a transverse section (P or D)
5.6	A dicotyledonous flower and a monocotyledonous flower	Composition of a complete, mature dicotyledonous flower and a monocotyledonous flower (Study of tissues is not required) Diagnostic criteria of the two families studied and comparison between the two types	Analysis of a flower of each of t families studied (P)
6.	MAMALIAN TISSUES		Use slides and/or transparencies (
6.1	Epithelia	Main features and functions of columnar, squamous, ciliated and glandular epithelia	
6.2	Connective tissues	Main features and functions of areolar tissue, tendons, ligaments, cartilage, bone and blood	
6.3	Muscle tissue	Main features and functions	
6.4	Nervous tissue	Main features and functions	

APPENDIX THREE

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.	SOME ASPECTS OF THE ANATOMY AND PHYSIOLOGY OF MAN		
7.1	Support and locomotion		For practical work a readily available small mammal or an available model of a skeleton may be used for observation and identification of the components of the skeleton
7.1.1	Axial skeleton	Skull: (Names of bones of skull not required) Teeth and jaws related to functions Vertebral column and rib cage: main regions of column; atlas and axis, with their functions; structure of a thoracic vertebra; interlocking of thoracic vertebrae and articulation of ribs; flexible attachment of ribs to sternum	
7.1.2	Appendicular skeleton	Girdles: components of pectoral and pelvic girdles; attachment of girdles to axial skeleton Limbs: main components (names of individual carpals and tarsals not required)	
7.1.3	Joints	Structure of joints	Observation and identification of the different types of joints (P and D)
7.1.4	Skeletal muscles	Antagonistic arrangement and attachment to bones	Observation by means of models (D
7.2	Transport		
7.2.1	Blood system		

	SYLLABUS CONTENT	ELABORATION	PRACTICAL WORK
7.2.1.1	Heart: structure and functioning	Suspension in thoracic cavity; pericardium; positions and functions of atria and ventricles, and the nature of their walls; position, attachment and functions of tricuspid, bicuspid and semilunar valves; main blood vessels to and from the heart	Observation and investigation of a mammalian heart (P or D)
		Cardiac cycle: systole and diastole	Determining of pulse rate before and after exercises; graphical representation (P)
7.2.1.2	Blood vessels: structure and functions of arteries, capillaries and veins	A comparative study, emphasising the structural suitability of each type of vessel for its particular role	
7.2.1.3	Circulation of the blood: closed, double system; main blood vessels and their functions	Pulmonary circuit: pulmonary arteries and veins Systemic circuit: aorta supplying organs; venae cavae returning blood to heart; hepatic portal vein system Coronary circulation: Coronary artery and veins	
7.2.2	Lymphatic system		
7.2.2.1	Origin and composition of lymph		
7.2.2.2	Plan of the system	Areas served by the thoracic and right lymphatic ducts; names of blood vessels into which they drain	
7.2.2.3	Functions of the system	Drainage of excess tissue fluid; return of plasma proteins to the blood; removal of bacteria and toxins; transport of absorbed fats from the villi; manufacture of lymphocytes	

APPENDIX FOUR

ST. 8 BIOLOGIE (Nuwe Sillabus - 1986)

BEKNOPTE SKEMA (Kwartaalbeplanning)

EERSTE KWARTAAL	LESURE
1. Ekologie	35
1.1 Ekostelsels	
1.2 Die mens en die ekostelsel	
2. Die Sel (selstruktuur en funksies)	20
3. Seldeling	
TWEEDE KWARTAAL	
4. Plantweefsels	
4.1 Meristematiese weefsels	12
4.2 Permanente weefsels	
5. Anatomie van die Angiosperms	35
DERDE KWARTAAL	
6. Soogdierweefsels: Epiteelweefsels, bindweefsels, spierweefsel en senuweefsel.	10
7. Fisiologie en Anatomie van die mens.	10
7.1 Beweging (Skelet van die mens)	
VIERDE KWARTAAL	
7. Fisiologie en Anatomie van die mens	20
7.2 Vervoer	
Bloedstelsel	
Limfstelsel	

APPENDIX FOUR

ST. 8 BIOLOGIE - VOLLEDIGE DEURLOPENDE SKEMA.

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERKING)
		1	Ekologie	Muurplakkate / Oorhoofse projektor Transparante Nr. 1 - 10
		1.1	Ekostelsels	
1	1	1.1.1	Die konsep van 'n ekostelsel	
		1.1.2	'n Praktiese studie van die struktuur van 'n geselekteerde ekostelsel met klem op die verwantskappe tussen sy komponente	TAAK (1) : Veldstudies en die hou van rekords (bls. 6 - 8) "Ontdek Biologie " (bls. 6-8)
2	2-4	1.1.2.1	Abiotiese komponent a) Fisiografiese faktore b) Edafiese faktore c) Fisiese faktore bv. klimaat, water, atmosferiese gasse en vuur.	TAAK (2) : Ondersoek na resperasietempo van estiverende slakke. TAAK (3) : Om die hoeveelheid grondlug in die ekostelsel wat jy bestudeer het, te bepaal. TAAK (4) : Om waterhou vermoë by verskillende grondsoorte te bepaal.
3	5	1.1.2.2	Biotiese komponent a) Produseerders b) Verbruikers c) Ontbinders	PROJEK : 'n Ondersoek van 'n geselekte biotiese komponent wat 'n studie insluit van aanpassings by 'n habitat. Betrokkenheid in suksessie en kompetisie Bv. Grasveldsuksess
4	6	1.1.2.3	Biologiese ritmes	Voorbeelde in die gekose ekostelsel wat deur abeotiese faktore veroorsaak word.
	7			TOETS (1) Hersieningsvrae bls 10, 29 en
5	8-10	1.1.3	Simbiotiese verwantskappe (Voorbeelde) a) Parasitisme b) Mutualisme c) Kommensialisme	TAAK (5) : Dodder: Waarneming en optekening van gegewens.
6	11-13	1.1.4	Trofiese vlakke a) Voedselkettings b) Voedselwebbe c) Ekologiese peramiede	

APPENDIX FOUR

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERKING)
7	14-16	1.1.5	Seklisering van voedingstowwe. a) Koolstofkringloop Slegs b) Stikstofkringloop H.G	Hersieningsvrae bls. 74 (Ontdek Biologi
8	17	1.1.6	Biosfeer (Slegs eenvoudige oorsig van komponente van atmosfeer, litosfeer en hidrosfeer)	Ontdek Biologie (Bls 3)
9	18-19	1.1.7	Terrestriële en akwakatiese ooreenkomste en verskille (Slegs ooreenkomste en verskille)	Ontdek Biologie (Bls 4) TOETS (2) (1.1.3 - 1.1.7)
	20			
		1.2	Die mens en die ekostelsel	
10	21-23	1.2.1	Besoedeling van lug, water en land	Ten minste een voorbeeld van elke tipe besoedeling moet bestudeer word (korrektiewe maatreëls)
11	24-29	1.2.2	Bewaring van inheemse flora en fauna en ander natuurlike hulpbronne (Bewaring as die wyse benutting van natuurlike hulpbron)	TAAK (6) : Ondersoek na minstens een tip besoedeling in die omgewing met spesiale verwysing na die gevolge van besoedeling en korrektiewe maatreëls. TAAK (7) : Studie van minstens een bewaringsprogram wat aan die ga is. Hersieningsvrae : Bls 92 (Ontdek Biologi
	30			TOETS 3 (1.21 - 1.2.2)
	31-35		Samevatting/Prakties/ Hersiening	
12	36-37	2	Die Sel 'n Inleidende studie van sekere aspekte van selstruktuur - en - organisasie (Vernaamste strukturele kenmerke)	Muurplakkate Oorhoofse projektor Transparante Nr 11 - 20 Elektronmikrograwe Skyfieprojektor Nr. 1 - 4
13	38-40	2.1	Biologiese belangrikheid van protoplasma - die dinamiese dispersiesisteem Fisiese einskappe Chemiese samestelling	TAAK (8) : Ondersoek van die subselluêre strukture van plant - en dier selle m.b.v. elektronmikrofot en die ligmikroskoop [Beklemtoon die verskille tussen plant en dierselle.]

APPENDIX FOUR

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERKINGS)
14	41-43	2.2	Bou, kenmerke en funksies van membrane	
15	44	2.3	Selkern: SG: Plek van voorkoms, identifisering en funksies. HG: Samestelling en fuksies	
16	45	2.4	Ribosome: Plek van voorkoms en funksies.	
		2.6	Mitochondria: SG: Plek van voorkoms, identifisering en funksies. HG: Plek van voorkoms, struktuur en funksies.	
17	46-48	2.5	Plastiedes:	
		2.5.1	Chloroplaste: SG: Plek van voorkoms, identifisering en funksies. HG: Plek van voorkoms, struktuur, en funksies.	TAAK (9) : Ondersoek plastiedes (Chloroplaste) Ontdek Biologie (bls 109)
		2.5.2	Leukoplaste: Plek van voorkoms en funksie	TAAK (10): Ondersoek chromoplaste en leukoplaste Senior Biologie (bls 99)
		2.5.3	Chromoplaste: (Slegs vir HG) Plek van voorkoms en funksie	
18	49	2.7	Vakuole : Plek van voorkoms en funksies. HG: Organisasie SG: Identifisering	
19	50	2.8	Selwand: SG : Plek van voorkoms, eienskappe en funksies. HG: Plek van voorkoms plus samestelling	
20	51	2.9	Ander Selorganelle: Golgi-apparaat, lisosome en sentriole Endoplasinatiese retikulum	Doen hersieningsvrae (bls 127)
21	52	3.0	Seldeling: Slegs die belangrikheid van seldeling vir groei.	
	53-54			TOETS (4) (2 en 3)'

APPENDIX FOUR

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERKI
		4	Plantweefsels:	
22	56-57	4.1	Merisistematiese weefsels (Bou en funksies)	TAAK (11): Ondersoek voorbeelde mikroskoopskyfies van 'n lengtesnee deur 'n wortel punt of kleurskyfies var merisistematiese selle wat seldeling ondergaan.
		4.2	Permanente weefsels: (Bou en funksies)	
23	58-59	4.2.1	a) Epidermis b) Parenchiem c) Klorenchiem	TAAK (12): Ondersoek dwarssneë van jong monokotiele en/of dikotiele stingels, 'n jo wortel en 'n dorswentrale blaar.
24	60-62	4.2.2	d) Kollenchiem e) Sklerenchiem	[Kyk na die verspreiding van die per manente weefsels]
25	63-66	4.2.3	f) Xileem g) Floëem	TAAK (13) :Identifisering van weefs
				Doen hersieningsvrae (bls. 148)
	67			TOETS (5) (S.V. 4)
		5	Anatomie van Angiosperms	Elektronmikrograwe Nr. 7 - 12
26	68	5.1	Oorsig van plantplan	Mikroskooppreparate Skyfies Transparante Nr 21-30
27	69-73	5.2	'n Jong dikotielwortel: Uitwendige kenmerke; inwendige bou soos in dwarssnee gesien.	TAAK (14) :Waarneming van die ontwikkeling van wortelhare by 'n jong saailing.
				TAAK (15) : Waarneming van 'n jong dikotielwortel soos in dwarssnee gesien.
		5.3	'n Jong dikotiel- en 'n monokotielstingel:	Doen hersieningvrae bls 165
28	74-77	5.3.1	Uitwendige kenmerke; inwendige bou soos in dwarssnee gesien.	TAAK (16) : Waarneming van jong stingels van 'n dikotiele - e monokotiele plant soos i dwarssnee gesien.
29	78	5.3.2	Kontrasteer 'n dikotiel- en 'n monokrotielstingel soos in dwarssnee gesien.	Hersieningsvrae bls. 180
30	79-80	5.4	Sekondêre diktegroei van dikotiele stingels.	TAAK (17) : Waarneming van jaarringe
	81			TOETS 6 (5.1 - 5.4)
		5.5	Dorsiventrale blaar:	
31	82-83	5.5.1	Uitwendige kenmerke van enkelvoudige blaar.	TAAK (18) : Waarneming van 'n dorsive trale blaar in dwarssnee
32	84-85	5.5.2	Invendige bou soos gesien in dwarssnee.	Doen hersieningsvrae bls. 190

APPENDIX FOUR

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERKING)
		5.6	Dikotiele -- en Monokotiele blomme	
33	86	5.6.1	Algemene bou van tipiese blom	
34	87-89	5.6.2	Bou van 'n monokotiele blom Liliaceae bv. aalwyn)	TAAK (19) : Ontleding van die aalwyn
35	90-92	5.6.3	Bou van 'n dikotiele blom (Leguminoseae bv. pronkertjie)	TAAK (20) : Ontleding van die pronkertjie
36	93	5.6.4	Vergelyking van die blomkenmerke van die familie Liliaceae (aalwyn) en Leguminoseae (pronkertjie)	Doen hersieningsvrae bls. 207
	94			TOETS 7 : (5.5 - 5.6)
	95-100		Samevatting/Hersiening/Prakties	
		6	Soogdierweefsels	Maak gebruik van skyfies Nr. ..... elektronmikrograwe en transparante
37	101-102	6.1	Epiteelweefsels (Vernaamste kenmerke en funksies van kolomvormige-, plaveisel-, trilhaar-, en klierepiteel)	
38	103-106	6.2	Bindweefsels - (Vernaamste kenmerke en funksies van aerolêre weefsel, senings, ligamente, kraakbeen, been en bloed.	TAAK (21) : Identifisering van verskillende weefsels.
39	107-108	6.3	Spierweefsel: Vernaamste funksies en kenmerke	Doen hersieningsvrae bls 231
40	109-110	6.4	Senuweefsel: Vernaamste funksies en kenmerke	
		7	Anatomie en Fisiologie van die mens:	
		7.1	Beweging (Skelet)	Maak gebruik van die model van die mens se skelet.
41	111-113	7.1.1	Asskelet: Skedel, Werwelkolom en ribbekas, atlas en aksis en funksies.	
			Struktuur van 'n tipiese borswerwel.	TAAK (22) : Identifisering van verskillende dele van s
			Aaneenskakeling van werwels en arlikulasie van ribbes.	
42	114-116	7.1.2	Aanhangskelet:	
			Skouer en bekkengordel Vashegting aan asskelet Ledemate	TAAK (23) : Waarneming en identifisering van verskillende soorte gewrigte.
43	117-118	7.1.3	Struktuur van gewrigte	

APPENDIX FOUR

LES	LESURE	SILL. VERW.	INDELING VAN LEERSTOF	DIDAKTIESE BEPLANNING (OPMERK
44	119-120	7.1.4	Skeletspiere : Antagonistiese rangskikking en vashegting aan bene. Funksionering van spiere en skelet om voortbeweging te weeg te bring . Slegs HG	TAAK (24) : Waarneming van die w king van die 3 klasse hefbome. (Slegs HG)
45	121-123		Die 3 klasse van hefbome	Doen hersieningsvrae bls. 252
	124			TOETS 8: (7.1)
		7.2	Vervoer	
		7.2.1	Bloedstelsel	
46	125-132	7.2.1.1	Bou en werking van hart Voorkoms / posisie in borskasholte Uitwendige bou Inwendige bou	TAAK (25) :Ontleding en disseksie van 'n skaaphart. TAAK (26) : Werking van hartkleppe
47	133-134		Kardiale siklus	TAAK (27) : Bepaling van polsslag en na oefening - grafi voorstelling.
48	135	7.2.1.2	Bloedvate: Bou en funksies van Slagare haarvate en are.	
49	136-138	7.2.1.3	Bloedsirkulasie: Belangrikste bloedvate en hulle funksies; longbloedsomloop; Liggaamsomloop, hartomloop en lewerpoortaarstelsel.	
		7.2.2	Limfstelsel	
50	139	7.2.2.1	Oorsprong en samestelling van limf	
51	140	7.2.2.1	Plan van die stelsel Borslimfbuis en die regterlimfbuis. Name van bloedvate waarin hulle dreineer.	
52	141	7.2.2.3	Funksies van die limfsisteem	Doen hersieningsvrae 268
	142			TOETS 9 : (7.2)
	142-145		Samevatting/Hersiening/Prakties	

APPENDIX FIVE

SCHEME FOR SETTING A STANDARD 8 SG EXAMINATION PAPER

TIME: 3 hours

Total: 300

Section A: 100

Section B: 4 x 50 200

300

Factual recall 75%

Insight, Apllication 25%

THEME	Section A		Section B								
	Question 1		Question 2		Question 3		Question 4		Question 5		Total
	Marks				Marks				Marks		
	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	
Ecology ±25%											
The cell ±8%											
Cell devision ±2%											
Plant tissue ±10%											
Animal tissue ±5%											
Angiosperm anatomy ±25%											
Anatomy and Physiology of man ±25%											
Total											

Total: Recall _____ Insight _____

APPENDIX FIVE

TIME: 3 hours

Section A:		100
Section B:	3 x 80	240
Section C:	1 of 2	60
		400

SCHEME FOR SETTING A STANDARD 8 HG EXAMINATION PAPER

Total: 400

Factual recall 60%

Insight, Application 40%

THEME	Section A		Section B						Section C				
	Question 1		Question 2		Question 3		Question 4		Question 5		Question 6		Total
	Marks				Marks				Marks				
	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	Reca.	Ins.	
Ecology ±25%													
The cell ±8%													
Cell division ±2%													
Plant tissue ±10%													
Animal tissue ±5%													
Angiosperm ±25% angiosperm													
Anatomy and ±25% Physiology of man													
Total													

Total: Recall _____ Insight