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APPENDICES

APPENDIX A - ACTUAL PRELIMINARY STUDY WORKSHEETS

QUESTION 4.1 - SHEET 1

COMPLETE QUESTION 4.1 - SHEET 1
BRAINSTORM THE ENVIRONMENTAL ISSUES IN YOUR AREA. WHAT ARE THE ROOT CAUSES OF THESE ISSUES?

LIST YOUR EXAMPLES IN TWO COLUMNS:

RESOURCE ISSUES	WASTE ISSUES

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Are you, yourselves environmentally literate and environmentally active?

Definition of Environmental Literacy: the ability to observe and interpret the relative healthiness of environmental systems and to take the appropriate action to maintain the state of these systems.

QUESTION 4.2A - SHEET 2A

COMPLETE QUESTION 4.2A - SHEET 2A
Have you ever had any experience in solving a local community environmental problem?
If yes state the problem and explain in detail how you went about tackling it.

If no explain how you would solve the following issue: You live in an area where you do not have access to basic water services. How would you go about making sure that each person has access to 25 litres per day?

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QUESTION 4.2B - SHEET 2B

COMPLETE FIGURE 4.2B – SHEET 2B
You live in an area where not everyone has access to basic water services. How would you go about making sure that each person has access to 25 litres per day?

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How is your school encouraging environmental education?

QUESTION 4.3 - SHEET 3

COMPLETE QUESTION 4.3 - SHEET 3
How is your school encouraging environmental education? List all the ways you can think of

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Many educators have promoted the idea that citizens need to play an active part in decision-making processes about social issues. Today more than ever it appears that the issues that citizens are asked to consider, fall into the category of science related social issues. It appears however that students are not being trained to deal with Science-Technology-Society issues and that existing science courses are not giving the students the knowledge and experience they need to become active citizens.

Science education should produce informed citizens prepared to deal responsibly with science related societal issues. Science must instill in students a sense of responsibility, an appreciation of the potential of science to solve or alleviate societal problems and a sense of custodianship to protect and preserve that natural world with which science concerns itself.

Because environmental issues can be considered within the realm of Science-Technology-Society issues, the goal areas that need to be covered include:

- science foundations
- issue awareness
- issue investigation
- issue resolution

This technique can be looked at as one of several instructional “means” for biology.

Let us look at an issue very close to home, namely your **SCHOOL GARDEN.**

QUESTION 4.4 - SHEET 4

COMPLETE QUESTION 4.4 - SHEET 4
DRAW A MAP OF YOUR SCHOOL GROUNDS SHOWING THE BUILDINGS AND THE PLANTED UP AREAS

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Teachers have identified that pupils find the teaching of plants, as presented in the current biology curriculum, difficult, boring and irrelevant. Biology is seen today by many pupils as the memorization of many unrelated facts, which have very little or no bearing on their lives. The emphasis in biology should not be on memorizing facts but on the understanding, interpretation and application of biological information.

Unfortunately many teachers teach as they were taught. These educators are generally a product of a science education system, which did not emphasize self-exploration and a critical outlook, both of which are essential in providing ways and means of solving everyday problems. It is noted that teachers usually resort to teaching about plants by lecturing and demonstration while pupils take down notes. This tends to generate a negative attitude towards plants. Teachers need to have the necessary knowledge of plants, the skills to handle them and a positive attitude towards them, to teach about plants with enthusiasm. With this in mind it is necessary to formulate a biology curriculum that is enlightening, interesting and relevant.

Biology is the study of living organisms and the relationship between them with the abiotic environment. Biology teachers mainly teach IN or ABOUT the environment. The environment is the world around us and includes both the living and non-living. It also includes the social and personal aspects. Thus biology can be seen as the study of the environment without the social and personal aspects. Plants form an integral part of the environment. The usual teaching of facts can be regarded as teaching ABOUT the environment and sometimes takes place IN the environment. Biology teachers may, therefore be criticized for not teaching FOR the environment. Topics in biology can be extended to include teaching FOR the environment. Although the knowledge base (teach ABOUT the environment) will always remain important for biology teachers, they should find ways to teach FOR the environment. By teaching FOR the environment, biology teaching can be made more relevant to everyday life.

With all the above in mind let us develop a "package for teachers that will utilize plants to impart to them, the knowledge, skills and attitudes necessary to identify and tackle, as environmentally literate citizens, a local problem, namely the school garden."

Using the diagram on problem solving, the following needs to be identified:

- What is the problem? – issue awareness - lack of well developed school grounds
- What do we need to know to solve the problem? - issue investigation – how do we go about developing the school grounds?
- Knowing how to go about developing the school grounds, how do we actually develop the school grounds? - issue resolution – which plants should be included in the garden and why? - who is going to do what?
- What do we need to know about the plants for them to grow well? – science foundations

QUESTION 4.5 - SHEET 5

COMPLETE QUESTION 4.5 - SHEET 5
PROBLEM: HOW CAN SCHOOL GARDENS BE IMPROVED?
List the garden/nature areas that you think should be included in your ideal school garden.

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QUESTION 4.6 - SHEET 6

COMPLETE QUESTION 4.6 - SHEET 6
Taking the SEIDET garden as the sample, brainstorm how you would improve it.

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PROBLEM: CAN PLANTS IN THE SCHOOL GARDEN BE USED IN THE LEARNING SITUATION?

QUESTION 4.7 - SHEET 7

COMPLETE QUESTION 4.7 - SHEET 7

Are your school grounds being used as a learning resource? If so, state for which topic in the syllabus they are being used. If not, state why not.

RESOURCES USED	TOPIC IN SYLLABUS

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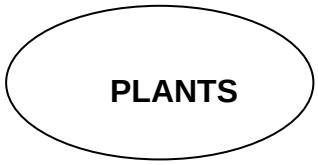
QUESTION 4.8 - SHEET 8

COMPLETE QUESTION 4.8 - SHEET 8

Brainstorm what you think pupils in your particular learning phase should know about plants remembering that learning should be relevant.

Write down the grade/s that you are teaching at the moment. GRADE: _____

Brainstorm what you think pupils in your particular learning phase should know about plants remembering that this learning should be relevant to them.



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Having completed Question 4.8 - Sheet 8, what KNOWLEDGE do you want your pupils to have regarding plants? Try to make a list linking a particular plant as a resource for enabling that knowledge to be imparted?

QUESTION 4.9 - SHEET 9

COMPLETE QUESTION 4.9 - SHEET 9

What KNOWLEDGE do you want your pupils to have regarding plants? Make a list linking a particular plant as a resource for enabling that knowledge to be imparted?

KNOWLEDGE	PLANT

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QUESTION 4.10 - SHEET 10

COMPLETE QUESTION 4.10 - SHEET 10

Having completed Question 4.9 - Sheet 9, what SKILLS do you want your pupils to have regarding plants? Make a list linking a particular plant as a resource for enabling those skills to be imparted?

SKILL	PLANT

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QUESTION 4.11 - SHEET 11

COMPLETE QUESTION 4.11 - SHEET 11

Having completed Question 4.10 - Sheet 10, what ATTITUDES do you want your pupils to have regarding plants? Try to make a list linking a particular plant as a resource for enabling those attitudes to be imparted?

ATTITUDE	PLANT

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APPENDIX B - GAUTENG BIOLOGY SYLLABUS SHEETS FOR EACH GRADE 1 – 7

GRADE 1 – 3

General information p1 & 2 Grades Syllabus

PLANTS

Beauty of God's creation - sense of wonder

Instil an interest and love of plants in pupils:
Be guided towards discovering interesting facts by his own efforts pursuing the steps of: critical observation, recording, discussion, drawing of conclusions, exploring, classifying, comparing, reasoning, predicting, acquire good working habits, problem solving, recording, speech, reading, writing, drawing, critical thought, classifying their world

Express themselves through the medium of their own:
Drawings, dramatization, singing, games, making of models

Learn to care for plants (respect them):
Sustaining natural resources (grade 2)
Seasons – the effects on plants (grade 2)
Awareness of the wonderful things created by man
Continuous observations e.g. day / night, weather (grade 3)

Evaluation:
Listening
Speaking
Doing – creative activities using plants:
- Painting
- Drawing
- Cutting
- Stenciling
- Printing
- Modeling

School grounds:
Need to know the composition e.g. draw playing fields, garden etc. (grade 3)

Need to know care of the grounds (appreciate plants – do not damage) (all)
Need to know safety

GRADE 4

PLANTS

Beauty of God's creation - sense of wonder

Instill an interest and love of plants in pupils:
Be guided towards discovering interesting facts by his own efforts pursuing the steps of: critical observation, recording, discussion, drawing of conclusions, exploring, classifying, comparing, reasoning, predicting, acquire good working habits, problem solving, recording, speech, reading, writing, drawing, critical thought, classifying their world

Express themselves through the medium of their own:
Drawings, dramatization, singing, games, making of models

Learn to care for plants (respect them):
Stimulate an eagerness to learn about natural phenomena
Introduce scientific technology
Accurate observations
Basic concepts
Factual knowledge
Effect of moving air on plants
Importance of water for plants
Plants and humankind:
useful plants – habitat, use, general appearance, fruit, seed dispersal
unwanted plants – habitat, use, general appearance, fruit, seed dispersal

GRADE 5

PLANTS

Beauty of God's creation - sense of wonder

Instill an interest and love of plants in pupils:
Be guided towards discovering interesting facts by his own efforts pursuing the steps of: critical observation, recording, discussion, drawing of conclusions, exploring, classifying,

comparing, reasoning, predicting, acquire good working habits, problem solving, recording, speech, reading, writing, drawing, critical thought, classifying their world

Express themselves through the medium of their own:
Drawings, dramatization, singing, games, making of models

Learn to care for plants (respect them):
Stimulate an eagerness to learn about natural phenomena
Introduce scientific technology
Accurate observations
Basic concepts
Factual knowledge
Germination of seeds (importance of air, water and warmth)
Monocotyledon: structure, growth, reproduction
Dicotyledon: structure, growth, reproduction
Vegetative reproduction – cuttings
Importance of soil

GRADE 6

PLANTS – subject matter should be related to everyday lives and experiences of the pupils

PLANTS

Beauty of God's creation - sense of wonder

Instill an interest and love of plants in pupils:
Be guided towards discovering interesting facts by his own efforts pursuing the steps of: critical observation, recording, discussion, drawing of conclusions, exploring, classifying, comparing, reasoning, predicting, acquire good working habits, problem solving, recording, speech, reading, writing, drawing, critical thought, classifying their world

Express themselves through the medium of their own:
Drawings, dramatization, singing, games, making of models

Learn to care for plants (respect them):
Stimulate an eagerness to learn about natural phenomena
Introduce scientific technology
Accurate observations
Basic concepts

Factual knowledge
Plants as a primary food source for:
animals
humankind

Food storage in:
leaves
stems
roots
seeds
flowers
fruits

Importance of conservation
Dangers of pollution to plants

GRADE 7

PLANTS – subject matter should be related to everyday lives and experiences of the pupils

PLANTS

Beauty of God's creation - sense of wonder

Instill an interest and love of plants in pupils:
Be guided towards discovering interesting facts by his own efforts pursuing the steps of: critical observation, recording, discussion, drawing of conclusions, exploring, classifying, comparing, reasoning, predicting, acquire good working habits, problem solving, recording, speech, reading, writing, drawing, critical thought, classifying their world

Express themselves through the medium of their own:
Drawings, dramatization, singing, games, making of models

Learn to care for plants (respect them):
Objectivity
Acquire knowledge of natural world
Know how to use apparatus
Know how to use vocabulary
Analyze data

Observe carefully

Solve problems by scientific method – reasoning and scientific procedures

Be aware of science

Role and implications of natural science for people's way of life

Study of algae – pond

Study of fungus – bread mould, mushrooms

Study of moss

Study of ferns

Study of cone-bearing plant

Study of flowering plants:

- monocotyledon (external)
- dicotyledon (external)

Sorting – using keys (life and living)

Specific conservation programme

Arbor Day

Conservation of natural resources (Earth and Beyond)

Use of soil for pH and plants growing in & peat

Use of plants in acids and bases – lemon juice, vinegar

Use of plants in dyes (beetroot)

Use of plants to talk about radiation

Use of plants to discuss energy – coal, fossil fuel

Use of plants to grasp measurement – magnifying glass

Equilibrium between plants, animals and man

APPENDIX C - ENVIRONMENTAL LITERACY QUESTIONNAIRE

APPENDIX C - QUESTIONNAIRE TO TEACHERS

INFORMATION TO TEACHERS

Please read the following carefully before you answer the questionnaire.

1. Your honest opinion is of great importance.
2. Please write your name on the answer sheet.
3. Please attempt all the items in this questionnaire.
4. Please do not write anything on the questionnaire.
5. For each item indicate your response by means of a single stroke with a HB pencil on the appropriate number on the answer sheet, for example:

1 [1] [2] [3] [4] [5] [6] [7] [8]

6. Please make sure that the answer number on the answer sheet corresponds to the question number on the questionnaire.

SECTION A - BACKGROUND INFORMATION

Indicate your response (1, 2, 3, etc) to each item (1-12). For example:

Question number on the questionnaire 3. Location of your school.

Urban = 1
Rural = 2
Semi-urban = 3

If your answer is “Semi-urban” mark on your answer sheet as follows:

3. [1] [2] [3] [4] [5] [6] [7] [8]

1.Gender:

Male = 1
Female = 2

2. In which age category do you fit?

24 Years or less	= 1
25-29 Years	= 2
30-34 Years	= 3
35-39 Years	= 4
40-44 Years	= 5
45-49 Years	= 6
50-54 Years	= 7
55 Years or older	= 8

3. Location of your school.

Urban	= 1
Rural	= 2
Semi-urban	= 3

4. Location of your home.

Urban	= 1
Rural	= 2
Semi-urban	= 3

5. Please indicate your highest academic qualifications

Standard 10	= 1
B.A.	= 2
B.Sc.	= 3
B.Com.	= 4
Other	= 5

6. In which learning area is your highest qualification?

Language, Literacy and Communication	= 1
Human & Social Sciences	= 2
Mathematics, Mathematical literacy & Mathematical sciences	= 3
Natural Sciences	= 4
Arts & Culture	= 5
Economics & Management Sciences	= 6
Life Orientation	= 7
Technology	= 8

7. Please indicate your professional qualifications

J.S.T.C.= 1
P.T.C. = 2
P.T.D. = 3
S.T.D. = 4
U.D.E. = 5
Other = 6

8. Teaching experience in years

3 Years or less	= 1
4-7 Years	= 2
8-11Years	= 3
12-15 Years	= 4
16-19Years	= 5
20-23Years	= 6
24-27 Years	= 7
28 Years or more	= 8

9. In which Phase are you teaching?

Foundation Phase (Grade 1-3)	= 1
Intermediate Phase (Grade 4-6)	= 2
Senior Phase (Grade 7-9)	= 3
Further Education & Training Phase (Grade 10-12)	= 4

10. Please indicate the learning area in which you offer tuition.

Language, Literacy and Communication	= 1
Human & Social Sciences	= 2
Mathematics, Mathematical literacy & Mathematical sciences	= 3
Natural Sciences	= 4
Arts & Culture	= 5
Economics & Management Sciences	= 6
Life Orientation	= 7
Technology	= 8

11. Have you received any training in environmental education?

Yes = 1
No = 2

12. Do you belong to any environmental education organization?

Yes = 1
No = 2

SECTION B1

Consider each statement below and indicate to what extent you agree or disagree with each one. Use the following scale for your responses.

Strongly Agree =1
Agree =2
Disagree =3
Strongly Disagree =4

Indicate your response to items 13-120 on your answer sheet.

13. The particular place living organisms live provides the resources it needs to survive.
14. Food, water, shelter and space are all necessary for the survival of life.
15. Plants and animals depend on each other in many ways.
16. The earth has a limited capacity to recycle materials naturally.
17. Burning of coal releases gases into the atmosphere which affects the survival of living organisms.
18. Intensive farming has changed air, water and land as life support systems.
19. Humans must live in harmony with nature in order to survive.
20. I am not concerned about overgrazing because it is not always harmful to the environment.
21. I do not worry about too many wild animals being killed because in the long run things will balance out.
22. I am happy to offer help to take air samples to test the level of air pollution in a nearby industrial area on a free afternoon.
23. I am willing to be involved in a project to develop a school garden.
24. I will stop using aerosols containing harmful gases.
25. The earth is like a spaceship, with only limited resources on board.
26. Indigenous trees have no advantages for human beings.
27. Wildlife is important in the cultural heritage of all regions and groups of people.

28. If a drought exists in a certain area and plants die off, predators such as lions in the area will also be in danger of extinction.
29. In an ecosystem there are producers, carnivores, herbivores, omnivores, and decomposers.
30. Ecosystems consist of people and other animals, plants and other life forms, and non-living factors interacting and interdependent in a wide variety of ways.
31. Loss of the particular place where it lives has contributed to many species of wildlife to become endangered.
32. Tree planting days will increase public awareness of the necessity of trees.
33. I think that there is too much fuss about pesticides entering the food chain.
34. I would be interested to know what kind of little creatures live in ponds.
35. I enjoy talking about the TV programmes I watched about nature.
36. I am willing to participate in recycling paper at my school.
37. When shopping, I avoid buying products made from animal furs or skin.
38. At present, most of the energy used in South Africa comes from the burning of coal and wood.
39. Energy from the sun is passed on to animals through food chains and food webs.
40. Trees in plantations cause lower water flows into rivers.
41. Only very little of the sun's energy is reaching tertiary consumers such as human beings in an ecosystem.
42. Carbon dioxide produced by burning coal causes a warmer climate.
43. Earthworms play an important role in a food chain.
44. We should save plants and animals from extinction.
45. When natural fires occur within national park boundaries it is better to have a "let it burn" policy.
46. Individual actions such as collecting cans for recycling have no effect on the environment.
47. I shall support a campaign to kill all snakes because snakebites can be fatal.
48. I am willing to be involved in a tree planting campaign.
49. I will strive to study problems in nature.
50. The energy from sunlight absorbed by plants may be utilised by animals which eat plants.
51. High concentrations of sewage in an area result in a serious depletion of dissolved oxygen in the water.
52. There is continuous environmental pollution from industry.
53. Limiting the size of the family is important to avoid overpopulation.
54. All of the following factors will contribute to the pollution of the atmosphere: veld fires, braai fires, smoke from factories, smoke from cars.
55. Abundant resources and a low death rate stimulate rapid growth in a population of organisms.
56. It is important to repair leaking taps.
57. When humans interfere with nature, it produces disastrous consequences.

58. Factory waste may be disposed in rivers because it has little effect on biological life in the rivers.
59. I encourage others to limit the size of families to avoid overpopulation.
60. I would be willing to write letters asking people to help reduce pollution.
61. I encourage people to start using electricity for cooking so that smoke pollution from home will be reduced.
62. I feel responsible to teach about environmental changes brought about by urbanisation in the normal classroom situation.
63. All animals, including human beings have basic needs.
64. Some resources once used are unavailable to future generations.
65. Coal is an inexhaustible natural resource.
66. Harmful gases in the atmosphere can be reduced if people do not use aerosols.
67. If the hole in the ozone layer gets worse more ultra-violet sunrays will reach the earth.
68. If the number of people in the world rises further at such a fast rate we will no longer be able to maintain a healthy environment.
69. Waste materials cannot be used in a positive manner by organisms in meeting their basic needs.
70. Scarcity of factors essential for the survival of organisms limits population growth.
71. Community education can counteract the effect of misuse of natural resources.
72. In order to provide food for human beings, forests must be cleared so that grains can be grown.
73. I would be willing to use public transport in order to reduce air pollution.
74. Every time I go shopping, I am willing to take a bag so that there is no need to get a plastic one from the shop.
75. When shopping, I avoid buying products known to be harmful to the environment.
76. The more people there are, the fewer resources are available per person.
77. The overuse of resources often results in environmental problems such as the destruction of the particular place where living organisms are found.
78. Conservation is the wise use of the environment to achieve sustainable environmental quality.
79. Depletion of the ozone layer causes heating of the earth.
80. Certain animal and plant species can be saved from extinction by the proclamation of nature reserves.
81. Energy, its production, use and conservation is essential in the maintenance of a sustainable society.
82. Illegal hunting is harmful to the environment.
83. It is important to make compost with biodegradable home wastes.
84. I am not interested in learning about the reasons behind the disappearance of forests.
85. It is important for all of us to reduce the consumption of material goods.
86. I always switch lights off when I don't need the light anymore.

87. I often buy products made with recycled materials.
88. I normally leave the water running when I brush my teeth.
89. Whenever possible, I take a shower instead of a bath in order to conserve water.
90. I make compost with biodegradable wastes.
91. Environmentally responsible behaviour includes personal action that benefits the environment.
92. Misuse of natural resources will not affect human beings.
93. The quantity of water on earth is constant and may be used over and over.
94. Environmental quality is the net sum of the consequences of individual and group actions.
95. Individual lifestyles such as mode of transport affect the environment directly or indirectly.
96. Many factories contribute to the formation of acid rain.
97. Green revolution is a programme focussing on the propagation of fast growing plant species to grow more food.
98. Only science teachers should know how the environment works.
99. I get upset when I see other people littering.
100. I try to behave in an environmentally responsible manner.
101. It is necessary for us to know about the environmental problems of people in other countries.
102. I will vote for or against a political candidate because of the views of the political candidate on environmental issues.
103. I encourage my students to use both sides of a paper.
104. I encourage my students to pick up litter at school.
105. Consumers need to be able to evaluate benefits as well as drawbacks for the environment when purchasing goods.
106. Recycling paper will result in fewer trees being cut down for commercial purposes.
107. Increased consumption of natural resources results in increased environmental pollution.
108. Advertising tends to ignore the drawbacks of a product to the overall health of the environment.
109. Use of unleaded petrol will reduce air pollution.
110. A reduction in the consumption of material goods will reduce the amount of wastes.
111. I do not think it is my responsibility to teach environmental issues in the normal classroom situation.
112. If I make an attempt to regulate my actions with respect to air pollution, I am sure this will have an effect on air quality.
113. When I see smoke from chimneys, I think of air pollution.
114. Even if I stop buying environmentally harmful products, it would make little difference because others are still buying these products.
115. I support the modification of the environment to provide comfort and leisure.
116. I am making personal sacrifices for the sake of slowing down pollution even though the immediate results may not be significant.

117. I am an active member in an environmentalist group.
118. I have changed some of my behaviours during the past few years to protect the environment.
119. I am infusing the study of environmental aspects into my teaching.
120. When pesticides are used to kill insects, no other animals are affected.

SECTION B2

Consider each statement below and indicate to what extent you agree or disagree with each one. Use the following scale for your responses.

Strongly Agree	=1
Agree	=2
Disagree	=3
Strongly Disagree	=4

1. Economic development often produces more environmental problems than benefits.
2. Social values and customs influence personal conservation behaviour.
3. The use of technology for disease prevention has resulted in rapid increases in the human population.
4. Ozone gas protects life on Earth from damaging effects of ultraviolet radiation.
5. The green house effect is an increase in carbon dioxide.
6. People have the right to change nature whenever they want to.
7. The benefits of modern consumer products are more important than the pollution that results from their production and use.
8. It is solely the government's responsibility to solve environmental problems.
9. A goal of my teaching is to increase the level of environmental responsibility in students.
10. I would like to discuss the influence of political decision making on the environment with my students.
11. I discuss relationships between economic development and a healthy environment with other people.
12. Human society has not developed sustainable feedback mechanism for the use and reuse of basic materials.
13. The management of natural resources to meet the needs of future generations demands long-term planning.
14. Humans tend to select short-term economic gains, which often result in long-term environmental loses.
15. In a food chain, energy is supplied by green plants.
16. Individual citizens should be stimulated to become well informed about the environment.
17. It is important to protect all useful animals.

18. The better we understand the earth, the better we can manage our resources.
19. Humans have a responsibility to develop respect for the rights of others.
20. Educators must help students' develop concern for the environment.
21. Because humans are more intelligent than other living beings, they have the greatest right to live.
22. We must set aside more land to support endangered plants.
23. I will try to persuade others to take part in environmentally responsible behaviour.
24. Because of my teaching my learners have a concern for the environment.
25. It is my conviction that I should point out to others not to smoke.
26. I discuss with my family ways to protect the environment for future generations.
27. I believe my teaching contributes to the development of environmentally literate citizens.

Thank you very much for your co-operation.

APPENDIX C.1 – VALIDITY AND RELIABILITY OF CHACKO'S ENVIRONMENTAL LITERACY QUESTIONNAIRE

It often happens that a questionnaire consists of different subsections, measuring different constructs. Chacko's questionnaire is an example of such a situation since it measures awareness, knowledge, attitude and participation with regard to the environment. In total the questionnaire measures environmental literacy. Although the test consists of different constructs, they are related to one another and to the total construct of the test because they all deal with behaviour in an environmental context. One would therefore expect to find significant positive correlations among the constructs (subsections) and between each construct (subsection) and the construct measured by the questionnaire in total (environmental literacy). If such correlations exist, one can regard the questionnaire to be construct valid. Therefore, in order to determine construct validity, Chacko calculated the correlation coefficients between the four different constructs and between each construct and the total of the test. These correlation coefficients appear in Table C.1.1.

TABLE C.1.1. INTERCORRELATIONS BETWEEN ENVIRONMENTAL LITERACY AND THE VARIABLES IN CHACKO'S (2001) "ENVIRONMENTAL LITERACY" QUESTIONNAIRE

Variables	Awareness	Knowledge	Attitude	Participation
Total (EL)	0,895*	0,882*	0,885*	0,877*
Awareness		0,799*	0,727*	0,705*
Knowledge			0,673*	0,694*
Attitude				0,701*

[see Chacko (2001) Table 15 page 200]

*Statistically significant at .01 level.

EL = Environmental Literacy

All the correlations seem to be high positive correlations, significant on the 1% level. The different constructs therefore strongly relate to one another as expected and consequently the questionnaire may be considered construct valid.

In Chacko's (2001) "Environmental literacy" questionnaire the reliability was established by calculating the alpha coefficient for each aspect of environmental literacy as well as for the questionnaire as a whole. The final reliability coefficients for each section are given in Table C.1.2.

TABLE C.1.2. RELIABILITY OF CHACKO'S (2001) "ENVIRONMENTAL LITERACY QUESTIONNAIRE

Aspect of environmental literacy	Alpha coefficient	No. of items
Awareness	0,793	26
Knowledge	0,839	32
Attitude	0,867	35
Participation	0,861	35
Total Questionnaire	0,945	128

[see Chacko (2001) Table 14 page 196]

As shown in Table C.1.2 the reliability coefficient for the questionnaire as a whole is 0,945. As this value is close to 1,0 (higher than 0,8), this questionnaire can be considered as a reliable instrument to measure environmental literacy of teachers.

A major concern with Chacko's questionnaire was its length which could result in a low accurate response rate mainly because of too many questions and the responding teachers losing concentration.

DESIGN OF CHACKO'S ENVIRONMENTAL LITERACY QUESTIONNAIRE

FORMAT OF THE QUESTIONNAIRE

As a point of departure, ten central concepts, each representative of particular sub-concepts related to environmental literacy, were selected for Chacko's environmental literacy test (Table C.1.3). The ten concepts related to environmental literacy were formulated from the definition of environmental literacy, the levels of environmental literacy, the characteristics of an environmentally literate person and an environmentally literate society from the concepts outlined by Munson (1994), Roth (1992) and Loubser (1992). The following were chosen:

TABLE C.1.3. THE CONCEPTS RELATED TO ENVIRONMENTAL LITERACY

NO:	CONCEPTS
1	Basic understanding of the **biosphere** (air, water, and land) as the *life support systems* on which all living organisms *depend for habitability and survival*. Knowledge of *natural and man made environment*. Knowledge of *natural laws* and *principles of nature*.
2	Understanding of an **ecological perspective** of nature and human beings: *ecological concepts and principles, concepts of ecosystems*.
3	Awareness of *human interactions* with the environment **and interrelationships in an ecosystem.** Understanding of *natural cycles* and *energy flow* in the ecosystem. Knowledge of *food chain* and *food web*.
4	Knowledge of environmental **changes** brought about by *industrialisation*, *urbanisation*. Awareness of *population growth issues* and its *influence on resources*, population growth and *control*, and *problems of human settlement*. Awareness of *pollution* and *sewage disposal*.
5	Understanding of the activities to meet **basic human needs** and *wants* and *how it affects health, the environment, and quality of life*. Knowledge of *population-resource imbalances* and taking *action to correct such imbalances*. Knowledge of the *use of resources* and *minimise the use of substances harmful to the environment*.
6	Awareness of *renewable and non- renewable* **resources.** Understanding the difference between actual and perceived risks from the *Destruction* of the environment and *exploitation of* natural resources and their *conservation*.
7	Knowledge of how to **maintain environmental quality** and *quality of life*. Knowledge of how *organizations*, and *groups of people contribute to environmental changes*.
8	An understanding about the ability to make **choices**. *Willingness to curtail individual privileges*. Awareness of *actions* that individuals can take to *protect the environment and public health*. *Personal commitment for the care and respect for the environment*.
9	Knowledge of **decision making on environmental issues** in scientific, economic, legal, social, and political contexts. Awareness of the *effect of consumer and market forces*, and reject *short-term gains*. Knowledge of the relationships between high productivity, modern technology, economic development and a healthy environment.
10	Knowledge of **environmental ethics** as a way of life. *Respect for all living things*. Knowledge of ethical issues involved in *environmental protection and management*. Management of environment and resources for *sustainable development*.

In the questionnaire presented to the teachers selected for this study, all the items for a concept were arranged in order. The arrangement of the items is shown in Table C.1.4. For each concept there are items to test awareness, knowledge, attitude and participation in the prevention and solving of environmental problems.

TABLE C.1.4. ITEMS IN SECTION "B" OF THE ENVIRONMENTAL LITERACY QUESTIONNAIRE

Concept	Items				Number of items
	Awareness	Knowledge	Attitude	Participation	
Concept 1	13-15	16-18	19-21	22-24	12
Concept 2	25-27	28-31	32-33	34-37	13
Concept 3	38-40	41-43	44-46	47-49	12
Concept 4	50-52	53-55	56-58	59-62	13
Concept 5	63-65	66-69	70-72	73-75	13
Concept 6	76-77	78-82	83-85	86-91	16
Concept 7	92-93	94-97	98-101	102-104	13
Concept 8	105-107	108-110	111-115	116-119	15
Concept 9	120- (1-2)*	(3-5)*	(6-8)*	(9-11)*	12
Concept 10	(12-13)*	(14-15)*	(16-22)*	(23-27)*	16
Total	27	34	36	38	135

* Items indicated in brackets are in Section B2 of the questionnaire.

SCORING THE QUESTIONNAIRE

The respondents had to indicate on a 4-point scale, to what extent they agree or disagree with each item by means of a single stroke indicating 1, 2, 3 or 4 in the appropriate space provided for each item. The following instruction was also given in the questionnaire: "use the following scale for your responses".

Strongly agree = 1
Agree = 2
Disagree = 3
Strongly disagree = 4

The desired response to 19 items from Section B1 (20, 21, 26, 33, 45, 46, 47, 58, 65, 72, 84, 88, 92, 93, 98, 111, 114, 115, 120) and four (4) items from Section B2 (6, 7, 8 and 21) were negative and the other (112) items were positive. This information was used during scoring

and analysis of the questionnaire. The scores for the negative items were reversed so that high scores represented a positive response.

APPENDIX D – KNOWLEDGE ON "PLANTS AND THE ENVIRONMENT" TEST

NAME:

PHASE TAUGHT:

KNOWLEDGE QUESTIONS ON "PLANTS" TEST

1. What do you understand by the word "plant?"
2. What do you understand by the term "Angiosperm?"
3. What is a flower?
4. List the different parts of the flower and give their functions.
5. What do you understand by the word "seed?"
6. What do you understand by the word "fruit?"
7. List why you think water is important for plants.
8. List 5 plants useful to man.
9. List 5 plants that are not useful to man.
10. Explain the term "vegetative reproduction"
11. List 5 methods of vegetative reproduction and give actual examples in each case.
12. List 5 plants which animals, besides man, eat.
13. List 5 plants that man eats.
14. Name a plant that stores food in its:
    - leaves
    - stems
    - roots
    - seeds
    - flowers
    - fruits.
15. Write a short paragraph on what you know about algae.
16. Write a short paragraph on what you know about fungi.
17. Write a short paragraph on what you know about ferns.
18. Write a short paragraph on what you know about cone-bearing plants.

KNOWLEDGE QUESTIONS ABOUT "PLANTS AND THE ENVIRONMENT"

19. What do you understand about the term "environment"?
20. Do you consider man to be part of the environment? Give reasons for your answer.
21. Can plants live independent of the environment?
    If yes, how? If not, why not?

22. Can plants affect the environment positively?
    If yes, list the many ways? If not, why not?
23. Can plants affect the environmentally negatively?
    If yes, list the many ways? If not, why not?
24. Does the environment affect plants?
    If yes, how? If not, why not?
25. What do plants need from the environment?
26. List what could happen to plants if the environmental conditions were not correct?
    Give reasons for your answers.
27. What is soil?
28. Why is soil important?
29. Name the three types of soil.
30. How can you test what type of soil you have?
31. What do you understand by conservation?
32. Name any conservation programmes that you know of.
33. Do you think it is important to conserve things?
    If yes, why? If not, why not?
34. What do you understand by the term “pollution”?
35. What types of pollution can affect plants?
36. How can these types of pollution affect plants?

APPENDIX E - TWELVE PRINCIPLES OF CLASS CONTROL (PLUS ONE) by Al Janulaw

California Classroom Science - March 1999

i. Be the Alpha.
ii. Project confidence.
iii. Require perfection.
iv. Remember, you are not their friend.
v. Never give an inch.
vi. Grow eyes on the back of your head.
vii. Don't do anything for them that they can do for themselves.
viii. Use natural consequences and minimal punishment.
ix. Keep them busy.
x. Be consistent.
xi. Avoid confrontations.
xii. Be aware of your stomach.
xii+i. Let your curriculum be the discipline.

§ § § § § § § § § § § §

i. Be the Alpha.

In classrooms, as in wolf packs, one member is the Alpha (dominant) and all the others are of beta status or lower. Chickens have their pecking order in which the bottom chicken may be pecked to death. If the teacher is not the dominant personality, someone else will be; the most assertive student will fill the void.

In the beginning of the year you must establish yourself as the dominant force in your class. Kids may fool you by being on their "best behavior" for the initial day or two. Until they learn if you are dangerous or not. If you have no teacher strategies up your sleeve, they will soon find out and begin stretching the limits. If they discover you are helpless to control them, their resentment will be unbridled. A weak leader makes young people insecure. Kids have no tolerance for perceived weakness, whether it is detected in a peer or in a teacher. The

following principles, when applied with kindness and firmness, will establish you as the leader of your class and open doors to successful teaching and learning.

ii. Project confidence.

This may be hard to do when you are not feeling confident, but you must do it. Know that you have the tools to teach as well as to nudge a misaligned kid into place. Walk like John Wayne, or Clint Eastwood, if you prefer. "Make my day." Wear a confident smile as you face thirty kernels of popcorn that could go off at any time. You know that popcorn is edible. No problem. It takes some practice and success at being an Alpha before fully accomplishing this, but it is a goal toward which to work.

iii. Require perfection.

Emphasize that everything that happens in the classroom must be done exactly a particular way. The books must be on the shelf in perfect order, perfectly aligned. Students must sit with excellent posture. The papers, pencils and all other materials must be arranged perfectly and inspected by the teacher before moving on or leaving the room. The military uses this technique to control people. All socks must be rolled in a particular way in the footlocker and inspected. The method of rolling and placing the socks is arbitrary. The exact positioning of the socks doesn't matter because the goal is control of people as much as care of equipment. This method works. Later in the year, after students have bought into perfection, it is much easier to preserve both the material and emotional order in the classroom and to relax a bit.

iv. Remember, you are not their friend.

Your doctor is not your friend. Neither is your lawyer or plumber. You may be a friendly, kind teacher, but your relationship with students is professional. Keep it that way. There is nothing in this admonition that prevents discussing problems with and feeling empathy for students. In fact, everyone needs a big brother or sister or some other role model that cares about her or him. In the end, students will appreciate your strength and professionalism more than your desire to be their pal.

v. Never give an inch.

Established standards are not negotiable, nor are they bendable. Students must know you would rather die than compromise your principles. And the class is required to share your standards because you are the Alpha. Long after your standards have become the norm for the class, you may make slight adjustments for individuals who courteously approach you in

private with a strong case for mercy; "I'm so sorry to hear about the tornado that took your home last night. In this case I will allow you to turn in your project a day late with no penalty"

vi. Grow eyes on the back of your head.

Or, at least let the kids think you have them. Here's a move that will establish you as omniscient: Find a little boy, somewhere in your peripheral vision or behind you, who has an inappropriate object in his hands. Quietly walk over to him and hold out your hand. Say, "You may pick it up today after school." No discussion or explanation. If he says, "You can't do that," reply, "You may pick it up tomorrow after school." Upping the ante is something kids understand. Chances are, the little perpetrator will quickly cease his protest to avoid digging the hole deeper. After he hands you the object, put it away and return it to him, as promised. Never keep a child's things. This is a cruel act that will initiate a festering resentment for which you will pay. Perhaps he will take one of your things or ruin something, as retribution. From this simple power move, kids will gain the belief that you know what is going on and will act when necessary.

vii. Don't do anything for them that they can do for themselves.

Yes, you are hired to provide top-quality learning opportunities for students, but no, you are not hired to be their servant. What can students do?
They can keep their daily work in order, record it, collect work, tidy the room, make sure materials and equipment are in place, figure out how and when to do assignments from clear directions, ask for makeup work after an absence, and pay attention. With the exception of kindergarten teachers, we should not be teaching kids how to be students. Our role is to provide learning opportunities and to, on occasion, gently remind them of their responsibilities. Put kids in charge of tasks they can handle and expect them to perform. They will appreciate your faith in them and rise to the occasion.

viii. Use natural consequences and minimal punishment.

A student who misuses equipment doesn't get to use it for a while. A student who draws an ugly picture of the teacher on his paper copies it over (without the picture). Someone who throws doe doesn't get to do sculpting that day. A student who spits on the ground fetches a paper towel and wipes it up. The gum-chewer gets to scrape gum off the undersides of desks. Make the punishment fit the crime. Once in a while the teacher has to impose punishment on a class. For example, if the class fails to give its attention to the teacher within a reasonable amount of time, the teacher writes the number of seconds of wasted time on the board. That number of seconds is spent with the class sitting with hands folded after the bell rings. Sitting

for seventeen seconds works as motivation as well as seventeen minutes. The class will respond more quickly next time.

ix. Keep them busy.

No, we do not want to load kids up with irrelevant busy work, but we must recognize their need to be constantly doing something. If you do not provide something to do, they will think of things on their own. And you will be sorry. Here are some sub-principles that may help:

- Always" over-plan" your lessons. If, for example, you want students to read a passage and write the important information, be prepared to have them swap papers and critique each other's work or have several share their discoveries orally or mind-map the information or draw an illustration of how the information affects their lives. Note that the critique, the sharing, the mind-map and the illustration are mainly dispensable and only need to be used when there is "extra" time.

- Keep them learning. Watch their pencils. Or, during a lab, monitor their actions and conversations closely. When two-thirds of the pencils have stopped moving or when extraneous conversations begin to erupt, inform the class that it has "one more minute and then we need to move on." At the end of about a minute, hurry them on to the next assignment.

- Note: This is a frustrating situation because it is a kind act to allow kids who work slowly and carefully to have all the time they need. Unfortunately, most youngsters will not wait and the class situation will deteriorate rapidly as they finish their work. If you find that some conscientious students are suffering from the need to move rapidly, offer genuine opportunities for them to work at lunch or after school or to take the materials home.

- Have several little tricks up your sleeve. When your lesson ends ten minutes before the end of the period have them get out a piece of paper and write what they learned today, with illustrations. Some teachers use daily journals for this purpose. Or, if you are feeling clever, pose a challenging question using the principles in the lesson such as, "Should an airplane take off with the wind blowing toward its front or its tail? Use illustrations and explain your thinking."

x. Be consistent.

The world isn't always fair, but the leader of a class of youngsters must provide a stable environment and consistent expectations. The way students enter and function in a classroom

has to be the same every day. For some kids, school is the most stable situation in their lives. Provide the secure place for them. They will appreciate it and return the favor.

xi. Avoid confrontations.

It is tempting, when most of the class is following directions, to fine-tune the situation by mentioning an individual's name. "Phillip, why are you standing when I told everybody to sit down?" If Phillip is feeling feisty right then, he might respond, "I have a bad case of hemorrhoids," thus eliminating any chance of the class finding the rest of your directions of mud, interest. A much safer statement on the part of the teacher would be, "It's nice to see that almost everyone is sitting." No names, no dumb question, little chance of confrontation. This example of non-confrontation is called "addressing the ceiling," as looking up to avoid eye contact with potential teacher-tusslers can often perform it. Another strategy for non-confrontation is known as "describing the problem." For example, if there is a piece of litter on the floor and you would like to have it picked up, say, "There is a piece of litter on the floor" When students first hear this sort of declaration they will have no idea what your point is. Initially, a little explanation is always necessary; "What I mean is that we will go to lunch when the door is tidy." Strict enforcement of everyone sitting while the rest of the school rushes to lunch will make your subsequent "descriptions of the problem" much more meaningful.

xii. Be aware of your stomach.

It's that place just under your ribs that grows a knot when something is wrong in the classroom. The teacher, or Alpha, must be comfortable at all times. If the knot appears, this means you need to act. There are three ways to deal with a lesson that doesn't feel right.

- Ride out the lesson. If the lesson appears to be going sour near the end of the period you may decide to let it finish and plan overnight how to prevent reoccurrence of the discomfort.

- Make in-progress adjustments to the class or to individuals. "Please remain in your seats at all rimes unless you are actually going somewhere." Or, "Jerrod, I don't like it when you poke other kids with your pencil."

- Abandon the lesson and replace it with another. "OK. Time is up for this activity. Everybody return to your assigned seats and write three things you learned about nuclear reactors from the lesson and draw a detailed picture of one. Feel free to copy the illustration in the text." Please notice that the teacher didn't announce that the lesson was a flop, but just that it was time to move on.

One more note about protecting your stomach:
Do not allow poor behavior to become chronic. You may also get an uncomfortable feeling from the actions of a student or the conduct of the class. Don't ignore the knot. Apply Principle xii. immediately.

A thirteenth characteristic was added which the researcher believes should underpin all learning i.e.

xiii. Let your curriculum be the discipline.

If the curriculum is relevant and engages the pupils in activities that involve them in decision-making about and active participation in, the learning process then the need for discipline falls away because they enjoy the learning process.

Nearly all of the words of wisdom above are about working with students who have been trained by their culture, at school and at home, to expect an adversarial relationship between children and adults as well as among students. The most important long term goal for any teacher, one that will virtually eliminate the need for the first twelve principles, is to create an engaging curriculum with accompanying activities that involves the students in decision-making about, and active participation in, the learning process. Question everything you do. If students do not see the relevance of the curriculum, maybe it is not relevant. Let the kids teach you. Learn what motivates them by watching and listening. Then plan content-rich units that are in a style that works. Students who are given curricular opportunities that they consider interesting or, in their words, "fun" will provide the energy of twenty or thirty people pulling in the same direction. A powerful force indeed! This being the case the need for "class control" will disappear.

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APPENDIX F – PHOTOS

Photo 1: Entrance to Siyabuswa

Skills acquired at the start of the project at the Siyabuswa SEIDET Centre

Photo 2: Hebe (shrub) planted and protected by Acacia thorn branches

Photo 3: Constructing a pond using sponsored plastic

Photo 4: Planting and protecting a tree

Photographs showing plant growth after two months at the Siyabuswa SEIDET Centre

Photo 5: Hebe unaffected by roving domestic livestock

Photo 6: Planted seeds of kikuyu grass showing good growth

Photo 7: Plants protected by thorn branches

Photographs showing plant growth after four months at the Siyabuswa SEIDET Centre

Photo 8: Agapanthus (perennial – monocotyledon – indigenous) in full flower

Photo 9: Carrots ready for harvest with petunia in full bloom

Photo 10: Tree showing plenty of new growth

Photo 11: Spinach leaves ready for picking although some of them, including the onion leaves, have been eaten by rabbits.

Photographs showing plant growth after four months at the Siyabuswa SEIDET Centre

Photo 12: Mesembryanthemum finished its life cycle (annual) and Namaqualand daisies now in full flower

Photo 13: Teachers collecting Namaqualand daisy seeds for the following year's propagation

School 1

Photo 14: Barren areas in school ground

Photo 15: Barren areas demarcated into beds and soil turned over for planting vegetables

School 1

Photo 16: Students showing their watering cans made from recycled materials

Photo 17: Trench dug for pipe for water supply to garden

Photo 18: The schools first tap

School 2

Photo 19: Bricks used to protect plants from roving livestock

Photo 20: Brick fragments used to stop water runoff which causes soil erosion

Photo 21: Sponsored annuals planted in front of classrooms

Photo 22: Verbena (ground cover) displaying poor growth due to poor soil conditions

School 2

Photo 23: Teachers collecting Dodonea (indigenous shrub) seeds for propagation any time

Photo 24: Tree planted in school grounds before the program started – note the lack of depression for good soaking watering

School 3

Photo 25: School grounds with large barren places

Photo 26: Barren areas being cultivated for vegetable gardens

School 3

Photo 27: Patches of poorly nourished grass

Photo 28: Newly planted shrubs protected by thorn branches

Photo 29: Newly constructed pond

School 3

Photo 30: Grass patches looking much healthier after students have learnt how to water and fertilize

Photo 31: Pink verbena planted early on in programme and spreading rapidly

School 3

Photo 32: Participating teachers showing “Meadow Mix”

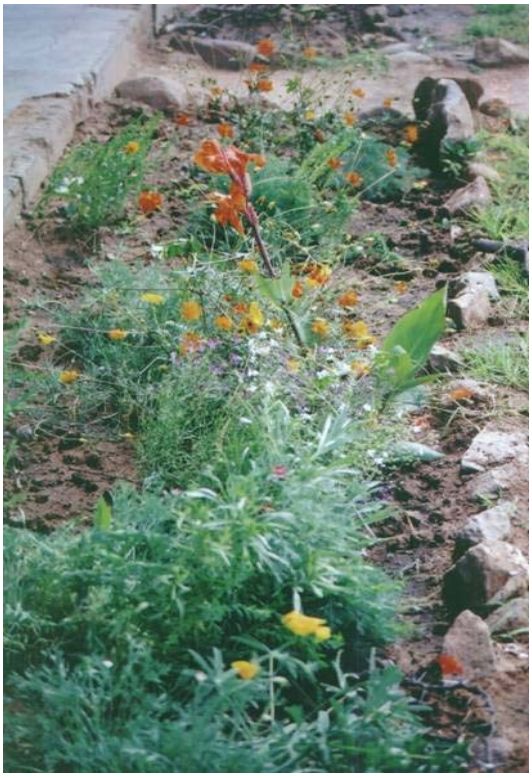


Photo 33: Full flowerbed

School 3

Photo 34: Participants collecting zinnia seeds for planting the next season

Photo 35: Petunias and geraniums planted around aloe

School 3

Photo 36: Daisy bush starting to flower and ready to take cuttings

Photo 37: Cabbage being eaten by pests

School 3

Photo 38: Flowerbed filled with annual colour planted in the middle of the project and well looked after and maintained

School 4

Photo 39: Participating teachers surrounded by bare ground

Photo 40: The home garden of a participating teacher showing well-kept lawn areas

School 5

Photo 41: Very little new growth at beginning of project.

Photo 42: Trees well positioned for shade.

School 5

Photo 43: The biggest problem cited for not developing a school garden is a lack of water but this photo shows huge water wastage due to poorly maintained pipes.

School 6

Photo 44: Barren ground before.

Photo 45: Broken fence enabling livestock to roam freely in school grounds.

School 6

Photo 46: Flower beds full of weeds at start of project.

Photo 47: Flowerbeds now planted up with annuals and protected with thorn branches.

School 6

Photo 48: Start of compost heap.

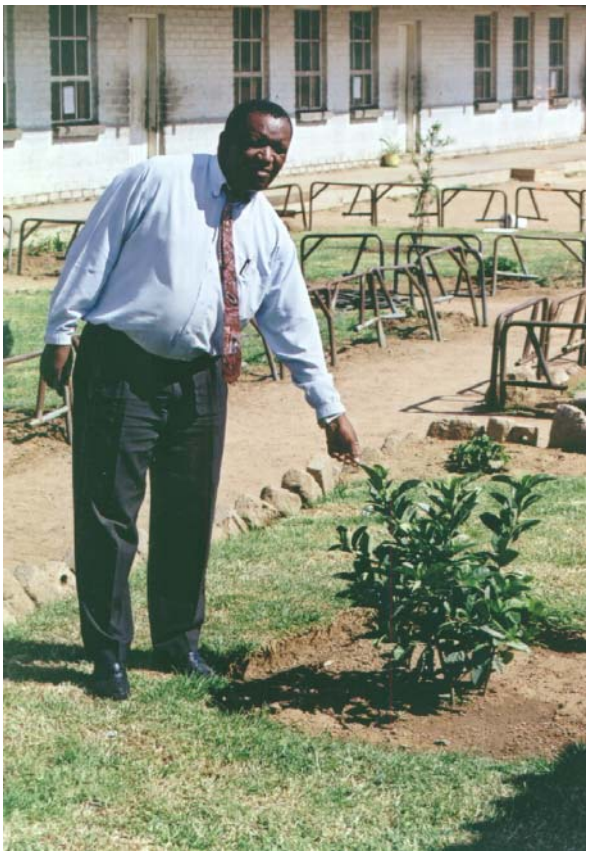


Photo 49: Viburnum shrub showing much vegetative growth.

Photo 50: Kitchen refuse brought in by students to add to compost heap.

School 6

Photo 51: Pansy in full flower at end of project.

Photo 52: Chrysanthemum paludosum in full flower at end of project.

School 6

Photo 53: Fern showing new fronds.

Photo 54: Phlox in full bloom.

Photo 55: Iris, a monocotyledon, with many new leaves.

School 7

Photo 56: Newly planted tomato seedlings.

Photo 57: Fully grown tomato plants at end of project.

School 7

Photo 58: Newly planted cabbage seedlings.

Photo 59: Cabbages ready to be harvested and then sold to the local community to raise funds for the school.

School 7

Photo 60: Students removing weeds from mealie field.

Photo 61: A water-wise idea to save water that would otherwise be wasted.

School 7

Photo 62: The pond lined with plastic.

Photo 63: A pond lined with clay collected from the local stream.

School 7

Photo 64: The pond showing water plants growing well.

Photo 65: A flowerbed of petunias in full flower at the end of the project.

School 7

Photo 66: Daylily flowering at end of project.

Photo 67: Daylily and chrysanthemum flowering at end of project

School 8

Photo 68: New hosepipe acquired with funds raised by students.

Photo 69: Marigold and dietes towards middle of project.

Photo 70: Thorn branches protecting plants from roving livestock.

School 8

School 8

Photo 71: Pond dried up due to lack of water.

Photo 72: Viburnum shrub protected by old fencing.

Photo 73: Chrysanthemum paludosum and alyssum white in full flower

School 8

Photo 74: Petunia lavender in full flower at end of project.

Photo 75: Roving cattle which cause havoc in school gardens eating all in their path.

School 9

Photo 76: A well lawned school garden with newly planted annuals close to classrooms.

Photo 77: A Frangipani tree which reproduces very easily by stem cutting.

School 9

Photo 78: “Meadow mix” interspersed with petunias and Namaqualand daisies.

Photo 79: Agapanthus growing well with a lettuce gone to seed.

School 10

Photo 80: Pipe lacking tap attachment which was stolen by a community member.

Photo 81: Initially a bare school ground with no fencing.

School 10

Photo 82: Fence erected with thorn branches and tree protected by bricks

School 10

Photo 83: Newly planted vegetable seedlings showing signs of being eaten by insects.

Photo 84: Agapanthus, lily and daisy bush growing well.

School 10

Photo 85: Marigolds in full flower.

School 11

Photo 86: Barren areas in front of classrooms at beginning of project.

Photo 87: Newly tilled ground with runners of kikuyu planted

School 11

Photo 88: Barren areas tilled and ready for planting.

Photo 89: Area planted with Kikuyu runners and annuals at the back.

School 11

Photo 90: Kikuyu runners planted in heart design surrounded by marigold seedlings.

Photo 91: Waste-water used to irrigate banana plants.

School 11

Photo 92: A well-developed vegetable garden with vegetables at different stages of growth.

Photo 93: Well established annuals growing in front of classrooms.

School 11

Photo 94: An attempt at fixing the fence.

Photo 95: Tree protected by bricks and thorn branches.

School 11

Photo 96: Young marigold seedlings protected by thorn branches.

Photo 97: Teachers collecting branches to protect plants

School 11

Photo 98: Pond lined with plastic

Photo 99: Pond with well-established Cyperus plants submerged in water.

School 11

Photo100: Thank you card from teachers to class for helping to develop the school garden.

School 12

Photo 101: Pond partly destroyed by vandals.

Photo 102: Annuals protected by thorn branches.

School 14

Photo 103: Area before showing Elephant Ears and alien Canna plants.

School 14

Photo 104: Beetroot growing.

Photo 105: Spinach growing.

School 14

Photo 106: Lettuce gone to seed.

Photo 107: Tomatoes show an excellent crop.

School 14

Photo 108: Daylilies planted as examples of monocotyledons.

Photo 109: Annuals in full bloom.

School 14

Photo 110: Sesbania tree which is an alien and should be eradicated.

Photo 111: Cannas on fence were split for propagation. It appears sheep don't eat the plants.

APPENDIX G – GARDENING SKILLS

GARDENING SKILLS

For each activity the participants were supposed to:

- write down how they would do the activity
- actually do it while the researcher observed
- then receive instruction on the correct way to do it
- then do it correctly
- and then write down the correct method.

They were all given extra material to take back to their schools to plant with their students.

List in the correct order the steps you would take to prepare a bed for planting
Explain how you would water your prepared bed
List in the correct order the steps you would take to sow seeds in trays
Explain how you would water your seed in the seedling trays
List in the correct order the steps you would take to sow seeds in situ
List in the correct order the steps you would take to plant annual seedlings into the soil (petunias, dahlias, mesembryanthemums, onions and gazanias)
How to control insects and disease
List in the correct order the steps you would take to plant a groundcover (verbena)
List in the correct order the steps you would take to plant a perennial (dietes and agapanthus, cannas, montbrecias and irises)
List in the correct order the steps you would take to plant a bulb
List in the correct order the steps you would take to plant a shrub (viburnum)
List in the correct order the steps you would take to plant a tree
List in the correct order the steps you would take to plant lawn (kikuyu)

APPENDIX H – REFLECTIONS ON THE STATE OF A SCHOOL GARDEN

Name: _____

School: _____

State of garden **POOR** **AVERAGE** **GOOD**

Reason for state of Garden _____

No. of times book Activities used _____

Activity	plants used	page	grade

Actual activities used With the plants, page And grade references

No. of new plants Planted in garden _____

Names of new plants Planted in garden _____

APPENDIX I – "DESIGN A PLANT"

DESIGN A PLANT

Design a plant that is a non-woody dicotyledon or monocotyledon that lives for only one season i.e. it is an annual. The plant must be able to reproduce and live for generation after generation. This plant must be able to survive the following conditions:

SEASON	PRECIPITATION	WIND
Autumn	very little rain	windy
Winter	no rain	moderate
Spring	mostly rain	windy
Summer	heavy rain	moderate

There are flying insects and all the other usual creatures which live in a place such as this.

Draw a leaf of your plant. Annotate (explain your label) your drawing.
Draw the stem of your plant. Annotate your drawing.
Draw the root system of your plant. Annotate your drawing.
Draw the flower of your plant. Annotate your drawing and show how many of each part theris.
Draw what the ovary will become after the egg has been fertilized. Annotate your drawing.
Draw the seed of your plant. Annotate your drawing.
Define "pollination".
How will your plant be pollinated?
Define "dispersal".
How will your plant's seeds be dispersed?
Define "germination".
What are the best conditions for the seeds to germinate under?
Name four adaptations your plant has which will help it to live and compete successfully generation after generation.
Sketch the life cycle of your plant (indicate the seasons).

Choose an equivalent part from the specimens provided (if the part is available) and build up your plant. Glue the parts down on a sheet of paper in the appropriate places.

APPENDIX J – THE "GARDENING WITH FLORA" BOOKLET

"Gardening with Flora"

INTRODUCTION

WHY THESE MATERIALS WERE DEVELOPED

The researcher has always been amazed at how few schools throughout the country have developed their school grounds into areas that are aesthetically pleasing yet at the same time possess plant material that can be used in the teaching situation. Some school gardens have a great amount of the same plant material, which is not often suitable for use in teaching. This lack of variety could have arisen because the teachers do not know what to plant to help them in their teaching. Another reason their school gardens are not developed could be due to their lack of knowledge about how to plant the actual plants. This may be due to the lack of the necessary gardening skills.

The researcher has for many years been involved in running gardening workshops for children and has reached the assumption that gardening is an exciting, approachable way to teach children about plants. By integrating a good gardening programme into the curriculum, gardening can be made easy and interdisciplinary. Interdisciplinary projects enhance people's ability to make connections among isolated facts, and to find meaning among facts. It not only educates the head, the heart and the hand, but it aids in the practical application of reading, writing and arithmetic. Gardening increases and develops the power of observation. It makes a person quick to grasp ideas and put these ideas into action. These are important foundations for success in any line of business. It develops moral character. Few things, if any, develop a love of industry better than a well-kept garden. Ever changing nature lures us on to help some favourite plant to grow until we love the work.

It is with these thoughts in mind that this piece of research is being undertaken. The research looks at the topic "plants" as the biological content in the context of developing a school garden, which is an environmental system. Its development can be seen as an example of outcomes-based education. The school garden can be considered a local environmental issue that each and every teacher can relate to. In developing the school garden the teachers must see it as having the potential to be used as a resource for teaching so that their teaching methodology can be improved. It should also help them to learn more about plants in a relevant way. The choice of plant material to be included in the garden will need to be considered very carefully so that the garden can remain sustainable for as long as possible.

Teachers need to be able to critically observe the status of their school grounds and to view the lack of its development as a local problem that needs to be tackled. If the necessary

knowledge, skills and attitudes can be imparted to the teachers, and they can impart these to their pupils, who hopefully will share their knowledge with their parents, then the whole community will be encouraged to uplift their own gardens.

Thus establishing a school garden may change the entire healthiness of a neighbourhood. The school grounds, themselves, may be better planned and healthier. Each pupil may soon want a garden at home. No matter how small the yard, there is room for a garden, even if it has to be established in a tomato-box. Often space in their yards has been used for ashes, tin cans or rubbish. What was once unsightly, unsanitary and unproductive, becomes a place of beauty and utility for a whole family. It can open up a source of revenue, create a love of industry, and a respect for property. If teachers can be empowered with the knowledge, skills and attitudes that will enable them to develop their school grounds in a sustainable manner and impart these attributes to their pupils, then the research will have gone a long way to producing environmentally literate citizens. These teachers can then be said to have developed professionally and become better botany teachers who are aware of their environment.

APPENDIX K - CLASSROOM TEACHING OBSERVATION MATRIX

FORM 1 - OBSERVATION OF GROUP

Teacher: **Topic:**

School & Class: **Date:**

	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-26	17-28	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50
Verbal Activities																									
1. Asks questions requiring recall of previous learning																									
2. Asks questions requiring pupils' ideas																									
3. Asks for report/description of work																									
4. Asks questions for supervision/control (not topic)																									
5. Answers pupil's question																									
6. Answers own question																									
7. Explains meaning of words																									
8. Comments on pupils' work or answers																									
9. Asks pupils to comment on each others answers																									
10. Gives information																									
11. Gives instructions																									
12. Refers to worksheet																									
13. Other (write in)																									
Non-Verbal Activity																									
14. Uses blackboard to record pupil findings/ideas																									
15. Uses blackboard for other purpose																									
16. Organizes/distributes equipment																									
17. Demonstrates activity/what to do																									
18. Helped with use of specific equipment (not activity)																									
19. Listens to pupils																									
20. Observes pupils/not interacting																									
21. Other (write in)																									

Teacher: **Topic:**

School & Class: **Date:**

	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-26	17-28	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40	41-42	43-44	45-46	47-48	49-50
Relating to task:																									
1. Making observations																									
2. Raising questions																									
3. Suggesting hypothees (explanations)																									
4. Predicting																									
5. Finding patterms/relationships																									
6. Devising and planning investigations																									
7. Handling materials/equipment																									
8. Measuring/calculating																									
9. Recording																									
10. Other (write in)																									
Relating to teacher:																									
11. Asking about topic																									
12. Asking for help about procedure																									
13. Answering teacher's questions (fact/recall)																									
14. Answering teacher's questions (ideasl)																									
15. Reporting/explaining actions																									
16. Listening to teacher																									
17. Other (write in)																									
Relating to each other:																									
18. Organising task (co-operatively)																									
19. Organising task (argument)																									
20. Talk about topic/task																									
21. Talk about record/report																									
22. Non-tpoic/task talk																									
23. Listening/responding to others' ideas																									
24. Independent working																									
25. Number actively/purposefully working																									
26. Other (write in)																									

FORM 2 - OBSERVATIONS OF TEACHER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDIX L – QUESTIONNAIRE TO HEADS

School Garden Development Questionnaire to Heads of Participating Schools

Thank you for allowing some of your teachers to join me on the course: "How to develop your school garden".

Would you be so kind and complete the questions below so that I can assess the course before I run it again. Please circle the correct option.

Has your participating teacher started to improve your school garden? Y or N.
If yes, in what way has it been improved? If not, why has it not been improved?
Have you been asked by your participating teachers for funds to improve your school garden? Y or N. If yes, what were the funds to be used for?
Have you noticed some of your other teachers been encouraged to help develop your school garden? Y or N. If yes, what were they doing in the school garden?
Have you noticed pupils who are taught by your participating teachers being involved in developing your school garden? Y or N. If yes, what were they doing?
Have you seen a change in the teaching methods used to teach plants, to outcomes based teaching, on the part of your participating teachers? Y or N. If yes, please mention the actual changes you have seen?
Do you agree with pupils getting involved in improving their school garden?
Y or N. If yes, why? If not, why not?
Have you had any feedback from parents regarding their children working in the school garden to improve it? Y or N. If yes, please state the type of feedback.
Have you heard any comments about the course on developing your school garden? Y or N. If yes, please list them.
Are you experiencing any problems in developing your school garden? Y or N.
If yes, please list them.
Do you feel that your school garden can be used to produce things that you can sell to raise funds for your school? Y or N. If yes, list what you would like to produce.
If not, why not.

I thank you for your time and hope that your school grounds benefit from your teachers' participation on the course that was run!

NAME OF SCHOOL: _____ **NAME OF HEAD:** _____

APPENDIX M – QUESTIONNAIRE TO COLLEAGUES

School Garden Development Questionnaire to Colleagues of Participating Teachers within the Same School

Would you be so kind and complete the questions below so that I can assess the course before I run it again. Please circle the correct option.

1. Did your colleague who attended the "School Garden Development Course" give you any feedback on the course? **Y or N.** If yes, was it after every session? If it was not after every session, how often did you get feedback?
2. How was this feedback given?
3. Have you been involved in developing your school garden before this year? **Y or N.**
4. Have you been involved in developing your school garden this year? **Y or N.** If yes, why did you start to develop your school garden?
5. If you have started to develop your school garden what did you do?
6. Have you changed the way you teach any plant topics, to outcomes based teaching? **Y or N.**
7. Has the development of the school garden helped you do this? **Y or N.** If yes, please give examples of these changes.
8. If you have been using the garden as a teaching tool, is the attitude of your pupils negative or positive? **P or N.** If positive, list their reasons. If negative, list their reasons.
9. If you have started to improve your school garden, have you experienced any problems? **Y or N.** If yes, please list them.
10. How do you feel you can overcome these problems?
11. Do you have a garden at home? **Y or N.** If yes, list 10 plants that you have in it.
12. If you have used your school garden as teaching tool, have you had any feedback from parents regarding their children working in the school garden to improve it? **Y or N.** If yes, please state the type of feedback.
13. Have you heard any comments about the course on developing your school garden? **Y or N.** If yes, please list them.
14. Do you feel that your school garden can be used to produce things that you can sell to raise funds for your school? **Y or N.** If yes, list what you would like to produce. If not, why not.

I thank you for your time and hope that your school grounds benefit from your participation.

NAME OF SCHOOL: **NAME OF TEACHER:** **GRADE:**

APPENDIX N – QUESTIONNAIRE TO STUDENTS

School Garden Development Questionnaire to Students of Participating Teachers

What grade are you in? _____

1. Do you like plants? Yes or No

2. Have you got a garden with plants at home? Yes or No

3. Has your teacher taken you into the school garden to teach you about plants? Yes or No

Write down what she taught you.

What work have you done in your school garden?

4. Did you enjoy working in your school garden?

5. Did you tell your parents what you did in your school garden? Yes or No

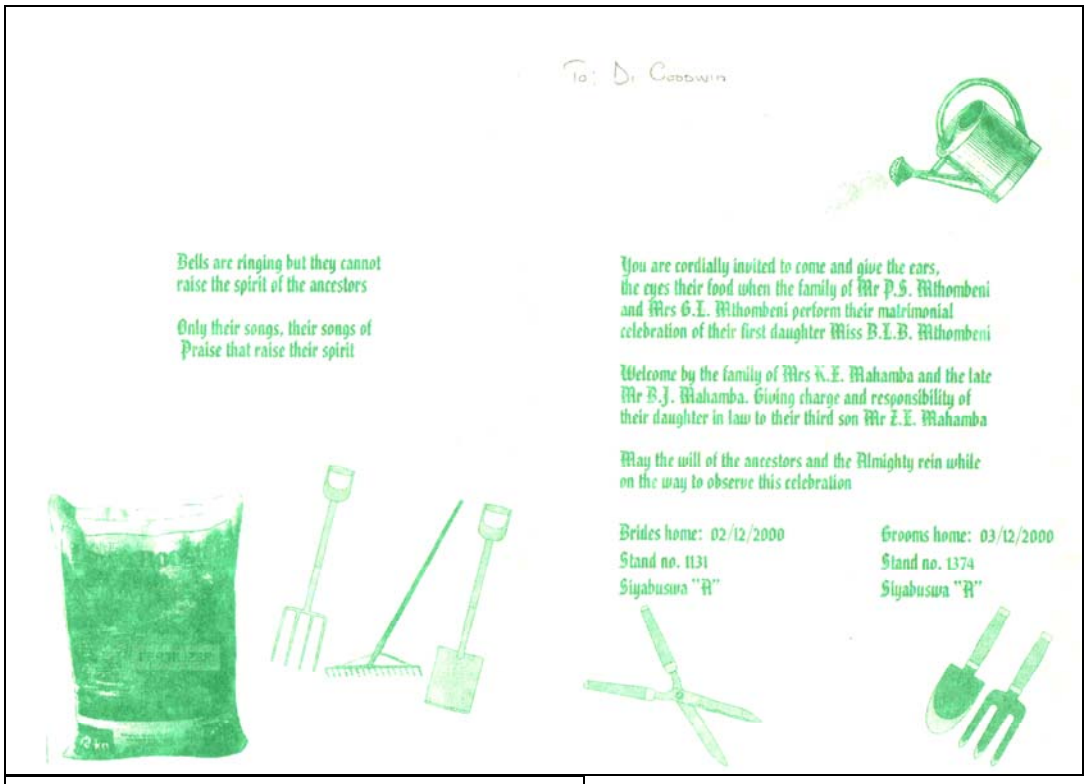
6. Do they like you working in the school garden instead of being in the classroom?

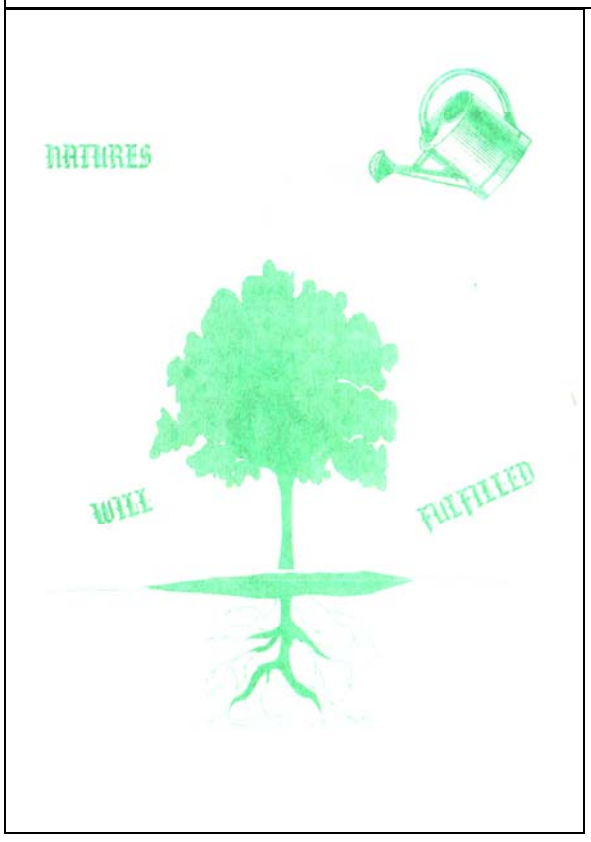
7. Draw a picture of what you like the most in your school garden.

NAME OF SCHOOL: _____ **NAME OF TEACHER:** _____

APPENDIX O – WEDDING INVITATION

TEACHER 4'S WEDDING INVITATION





To: Dr. Goodwin

Bells are ringing but they cannot
raise the spirit of the ancestors

Only their songs, their songs of
Praise that raise their spirit

You are cordially invited to come and give the ears,
the eyes their food when the family of Mr P.S. Mthombeni
and Mrs G.L. Mthombeni perform their matrimonial
celebration of their first daughter Miss B.L.B. Mthombeni

Welcome by the family of Mrs K.E. Mahamba and the late
Mr B.J. Mahamba. Giving charge and responsibility of
their daughter in law to their third son Mr Z.E. Mahamba

May the will of the ancestors and the Almighty rein while
on the way to observe this celebration

Brides home: 02/12/2000
Stand no. 1131
Siyabuswa "A"

Grooms home: 03/12/2000
Stand no. 1374
Siyabuswa "A"

NATURES

WILL

FULFILLED

INDEX