



Teacher Education Workbook

for Environment and Sustainability Education

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Notes on adaptation:

The resource is written in the first instance for users in South Africa, and in addition, for users elsewhere in Southern Africa. Section 2 is based on the South African curriculum, but educators and materials developers should be able to adapt the concepts, ideas and examples to most other curricula. Those who would like to adapt these materials for use in other countries, should strongly consider using examples from those countries and a variety of contexts within them.



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The Concept: A Two-in-One Resource

This is

a 'workbook' that teachers can work through in their own time, or as part of an environmental education course or programme (such as Eco-Schools),

and

a 'resource for a course' which a course developer or lecturer can use to design and support a short or long course for student - or in-service teachers.

Rationale

Environmental education is an integral part of South Africa's National Curriculum Statements. Yet few teachers, teacher educators or government officials have a background in environmental education. This resource was motivated by the need to strengthen our professional capacity for curriculum-based environmental education.

There is no shortage of school materials on environmental topics and environmental education. This resource aims to pull these resources together, and point you in their direction. (See Section 5.) At the same time it provides you with orientation and key connecting ideas, to help you choose and better use available resources. If you work systematically through the workbook, and follow up the leads to other materials, you will gain a coherent overview of environmental education theories and practices.

If time is short, though, simply dip in and extract what you need at the time. A flexible resource, it fits a variety of circumstances and needs you might have, as a lecturer or a curriculum advisor; or as a teacher at a primary school or a high school; in a well-resourced school or a no-fee school; teaching languages, sciences or other subjects.

Format

The core resource is a workbook which is available in a printed format and on CD (order from sharen@wessa.co.za, tel. 033-3303930, P.O. Box 394, Howick, 3290) and electronically (download from www.tessafrica.net; www.ru.ac.za or www.capection.org). The workbook consists of five sections or 'layers'. Each section is marked with a different colour or tab. The sections contain a varying number of topics, of which there are 26 in total.

The topics are dealt with in a concise manner and are not comprehensive. Most topics are presented in units of two to six single pages or screen lengths. Each unit provides links to other resources (journal articles, classroom activities, directories, or other topic pages). This 'octopus', consisting of a core of units in the workbook, leading to additional sources and resources, can be used by course developers to offer a variety of training options, at different levels.

Individual teachers can also use the expansions to suit their needs, interests and time constraints. If you come across an idea you like in the workbook, follow the references to journal articles, where you will find more detail. If you come across a practical suggestion that you'd like to try, follow the references to a classroom resource. If you read about a topic like biodiversity, and you need further references for yourself or your students, follow the links to accessible web or printed materials.



Most units contain school stories to provide context and connecting points. The units also include 'work it out' questions – hence the term 'workbook'. If you work through the book on your own, use these for reflection and planning. If you are presenting a course, use and adapt them for group activities and work-away tasks.

Origins and Partners

The workbook was commissioned by the Environmental Education and Sustainability Unit at Rhodes University. It was developed through the C.A.P.E. Conservation Education Programme which is coordinated by the Unit and funded by the United Nations Development Programme (UNDP).

The Rhodes Unit asked Dr Eureka Rosenberg, an environmental education professional of twenty years, to serve as author. They invited a number of partners including teacher education institutions, to help plan and review the resource.

The members of this review team are:

University of Stellenbosch: Prof Chris Reddy; University of Fort Hare: Mary Ann Hood; Tswane University of Technology: Prof Pentecost Nkhoma; University of the Western Cape: Keith Langenhoven; Wits University: Dr Paul Goldschagg; Rhodes University: Prof Heila Sisitka, Associate Prof Rob O'Donoghue, Ingrid Schudel; University of Cape Town: Sue Nepgen; Wildlife and Environment Society of South Africa (WESSA): Dr Jim Taylor, Laura Conde; South African National Biodiversity Institute (SANBI): Donovan Fullard; Eastern Cape Department of Education: Sindiswa Yoyo; and TESSA, the Teacher Education in Sub-Saharan Programme at Fort Hare University: Jayshree Thakrar.

CONNECTING STORIES: Different Ways of using this Resource

- An environmental NGO and a university Faculty of Education team up for a new short course in environmental education. The NGO has no knowledge of teacher education. The faculty staff lack an environmental background. By systematically reviewing the workbook topics and the linked readings, they design a content-based course for teachers to improve their ability to teach the new curriculum.
- Rob O'Donoghue teaches a one-week module in environmental education in the Post-Graduate Certificate in Education (PGCE) at Rhodes. He wants to use the workbook, specifically Section 2, on the curriculum, and Section 4, on methods. He hands these out to students to help them investigate 'environment' in their various subject areas. Students then develop a set of posters of environmental education across the curriculum. Rob uses these to customise his course notes.
- Avril Peters teaches Geography and Life Orientation. She becomes interested in environmental education when her Grade 9's participate in a sponsored project on sustainable development. Realising that she needs new knowledge, she starts to use the workbook to come to grips with environment and sustainability in relation to her subjects.

Work It Out Questions

- Which parts of this resource could a school textbook writer use?
- How could *you* use this resource in your own context? Where would you start?

Ideas Underpinning Environmental Education

UNIT 1.2

SECTION 1 BACKGROUND

Why Environmental Education?

Environmental education is not that different from good general education. So why do we use labels like environmental education, conservation education, or sustainability education? Here are two reasons:

Firstly, 'environment' has been neglected; there is a gap in our curricula. Since 1994, many South African policies (National Environmental Management Act, NEMA, Act 107 of 1998, www.environment.gov.za; the National Water Act, Act 36 of 1998, www.dwaf.gov.za; the National Environmental Management: Biodiversity Act, Act 10 of 2004, www.environment.gov.za) have indicated that all sectors of society must give attention to the environment and to the sustainability of the country's development. Specialists and members of the public alike are increasingly concerned about environmental issues like water pollution, food security and climate change. The United Nations calls for schools and universities to re-orient their curricula towards sustainability (www.unesco.org/education/desd/). A special label such as environmental or sustainability education serves to draw attention to the new focus required in educational programmes.

Secondly, good education is not always common in schools and universities. Environmental education reminds educators of learning outcomes to strive for, and generates ideas, methods and resources for achieving them. Through environmental education, we expose students not only to environmental concerns and sustainability practices, but to sound general learning opportunities.

Why the Variety of Labels?

Different terms are used for educational activities that address environmental concerns. Here the term environmental education is used because Southern Africa has a 25 year history of environmental education, and the term has come to include conservation education and education for sustainability or sustainable development (see Unit 1.3). It is therefore broad enough for our purposes.

What exactly do we mean by Environment?

Environmental education as conceptualised in Southern Africa today does not narrowly focus on nature, as if people do not matter. Rather, it emphasises that people are inseparable from the environments in which they live and make their living, and that we are affected when things go wrong in these environments, as are the other beings with which we share the Earth. City slickers or farm folk, we all depend on the health and wholeness of our living, physical home. The Earth's atmosphere, cycles and ecosystems form the critical support base for all life and all productive activity. Environmental education recognises and explores the many links between society, cultural and economic activities and political decision-making, and the state of the Earth's life-support systems. (See Figure 1).



What Kind of Education?

We've noted that environmental education is 'good education'. One feature of good education is that it is not an indoctrination to make others see things our way. When we become aware of the serious threats environmental issues pose, we want to make everyone else

aware of the problem, too, and we want them to take action, change their ways. However, educators need to steer clear of indoctrination, of advocating for children to take our views on board, and do our bidding. The educator's job is to provide students with the opportunities to learn about their world, to form their values and to build the skills needed to engage well with that world. This is especially important in environmental education and education for sustainable development (see, for example, the article "Why I don't want my children to be educated for sustainable development", by Canadian professor Bob Jickling in the *Journal of Environmental Education*, 1999, 23(4), pp.5-8). Often, we don't know exactly how to tackle environment and development problems, and some of our 'solutions' create more problems! As teachers, our advocacy is best directed at ourselves, and as we make changes to our own lifestyle and practices (e.g. reducing waste at home and school), we will have less need to 'get others' to 'change their behaviour'. Through open-ended educational processes, rather than social marketing (advertising our ideas for the greater good) and social engineering (trying to get others to change) we can join our students on a journey towards sustainability

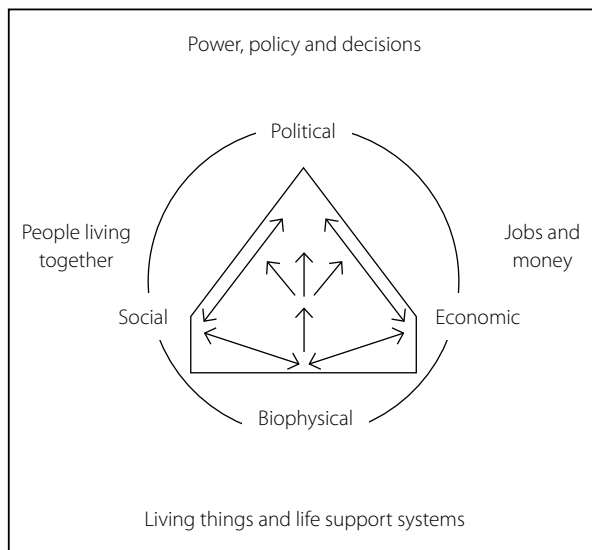


FIGURE 1: The Environment is about the interactions of Social, Political and Economic forces with the Bio-Physical world (O'Donoghue, 1994)

and respect for the Earth – a journey with destinations we can only glimpse.

Among the developments in educational thinking that have made useful contributions to environmental education is *socially critical education*, which draws on critical education (see "Towards a socially critical environmental education: Water quality studies in a coastal school", by Annette Greenall Gough and Ian Robottom in *Journal of Curriculum Studies*, 1993, 25(4), pp.301-316). Australian professor John Fien (Fien, J. 1993, 1995 *Education for the Environment. Critical Curriculum Theorising and Environmental Education*. Deakin University, Geelong) summarised it well as education *in*, *about* and *for* the environment. Teachers provide learners with experiences *in* nature, or at a rubbish dump or recycling centre. They also provide information *about* the environment, how it works, its marvels and problems. Socially critical environmental education encourages teachers to also provide learners with opportunities to do something *for* the environment, as this helps to build not only a critical understanding of these issues, but also commitment and values, as well as skills (environmental issues are ethical as well as technical issues). Borrowing a term from the work of Danish professor Bjarne Jenssen, we sometimes refer to this set of skills, values and understandings as 'action competence'.

Other educational ideas that have influenced environmental education include constructivism and socio-constructivism (see, for example, the review by Eureka Janse van Rensburg and Derick Du Toit, 'Sustainability' from constructivist and socially critical angles, pp. 25-40 in Janse van Rensburg and Lotz-Sisitka, 2000, *Monograph: Learning for Sustainability*. Ibis, Johannesburg). *Constructivism* describes meaningful learning as an active process in which the learner makes connections with what is already in her mind, as opposed to the educator stamping facts onto a blank page (passive mind). Educators mediate (help along) active learning by giving students activities in which they must think, in order to make meaning. *Socio-constructivism* emphasises that learning is not simply a one-to-one process (educator to student), but that we can learn in groups and as a social process. In fact, we learn from the moment of birth, without even knowing it, just by being part of a society.

Some of this learning has resulted in values, views and practices that we are starting to see as problematic, and environmental education is also about *becoming conscious* of how we have formed these views and values. We may need to *un-learn* practices that are harming the planet and its residents. (See “Learning on the edge: Exploring the change potential of conflict in social learning for sustainable living” by Arjen Wals and Fanny Heyman. In Wenden, AL (Ed), 2004, *Educating for a Culture of Social and Ecological Peace*, SUNY, New York, pp.123-145.)

South African professor Rob O’Donoghue points out that the younger the students, the more the teacher’s attention is on introducing them to the world and what is already known (induction into society) - see Figure 2. As students get older, we start to put more emphasis on helping them to think critically about common, deep-seated social practices, and to reflect on how we could do things differently. We could call this latter process *change-oriented learning*.

South African environmental educators Rob O’Donoghue and Heila Sisitka emphasise the role of *context* in environmental education. (See, for example, “Situated environmental learning in Southern Africa at the start of the UN Decade of Education for Sustainable Development”, in *Australian Journal of Environmental Education*, 2006, 22(1), pp.105-113.) The context in which learning takes place, influences that learning, and should influence the educator’s approach. Educators are also advised to provide a meaningful context for concepts and content being taught; case stories can play this role. (See, for example, the approach to Units 3.4 and 3.5, on Water and Energy.) This also links to ideas on *situated learning* in a community of practice (see, for example, the work of Barbara Rogoff) and *learning through doing*, interacting and reflecting (see Rob O’Donoghue, “Clarifying environmental education: Searching for CLEAR ACTION in Southern Africa”, in *Southern African Journal of Environmental Education*, 1993, pp.28-38).

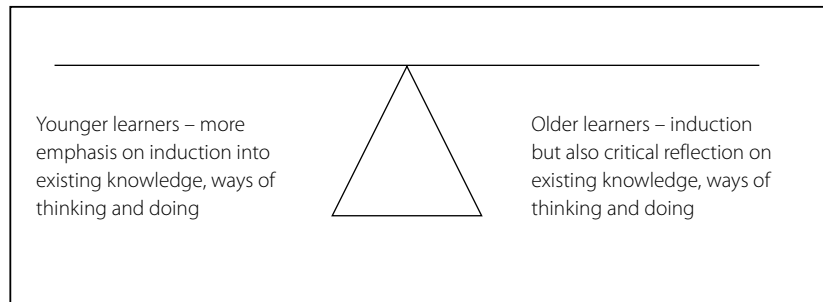


FIGURE 2: A balance between induction and reflection

The value of *social learning* theories has already been noted. Dutch professor Arjen Wals (*Social Learning Toward A Sustainable World*, 2007, Wageningen University Press, The Netherlands) describes the value of people learning in groups as they focus on a particular environmental problem or goal. He emphasises the value of the process to work through the different views and values in the group, particularly among people with diverse backgrounds, and different interests (or lack of interest) in the issue.

We cannot always learn more by simply drawing on what is already in our minds, or on others in a group. We may need new information, or practical tasks to help us generate a new understanding. This highlights the importance of *resource-based learning* (see the chapter by Angolan and South African environmental educators Vladimir Russo and Heila Sisitka, “Using learning support materials” in *Development, Adaptation and Use of Learning Support Material in Support of Environmental Education Processes*, 2003, SADC-REEP, Howick). Educators must provide learners with adequate resources to help them learn more than what they already know. These resources can vary from books and the Internet (see Unit 5.1) to materials from which to make something, or a visit from a special member of the community.



Social realism is a set of ideas informed by sociologists like Margaret Archer after the works of philosopher-scientist Baskhar. Applied to education (see *Bringing Knowledge Back In: From Social Constructivism to Social Realism in Sociology of Education*, by Michael Young,

2008, Routledge, London), social realism highlights that it is important for educators not only to think about what their learners already know, but also to work with what they don't yet know and could be supported to find out. Environmental issues are complex and emerging. We may know, for example, that we don't fully understand the difference between global warming and the greenhouse effect. Since scientists have developed these terms, someone does know the answer to this one, and we can learn it from a book (clarifying and changing understandings we've already constructed). However it is only as we work with these new ideas and develop our own ideas in day-to-day activities that we learn our way towards more sustainable lifestyles and development paths. Social realism therefore draws our attention to the importance of working with good quality knowledge resources when we are trying to understand and respond to environmental issues.

What are we working towards in Environmental Education?

Below are some of the environmental learning outcomes (values, skills and knowledge) for which we strive. Note that they have much in common with various desirable cross-cutting outcomes of schooling, as well as science, mathematics, language and other subject-specific learning outcomes:

- values like active and responsible citizenship
- an ethic of responsibility and commitment
- a sense of hope and ability to imagine new possibilities
- action competence
- technical knowledge as well as insight and understanding
- practical and conceptual skills like enquiry, reasoning, drawing conclusions
- healthy school environments.



Story for Context:

Mandla Mnisi is the science teacher at a rural school. He takes a class to a nearby river where the students observe pollution (*experiential learning*, *education in the environment*). They do some tests and find evidence of sewage in the river. Some blame the upstream farmers, others suspect an informal settlement. All are upset about the lifeless and smelly state of the river.

Mandla sees an opportunity to provide meaning to the science he has to teach (*enquiry*: planning an investigation, gathering and analysing data, forming conclusions). Back in the classroom he takes the learners through the steps of planning an investigation. He provides them with information about the tests, and about rivers, the goods and services provided by rivers, and what rivers need to remain healthy (*education about the environment*). For this he uses fact sheets which he copied for them, and a prepared lesson he based on their textbook and a River Health publication (*resource-based learning*).

When the students' investigations show that there are many sources of sewage pollution at this river, they write letters to the farmers, the municipality and a local NGO. They invite the NGO to build some composting toilets at their school, both to reduce their own impact on the river, and as a demonstration for farm workers and informal settlement dwellers (*action for the environment*).

Mandla teams up with the English teacher and organises two periods during which the municipality and the NGO visit the class. The learners ask pre-prepared questions, and discuss issues with their visitors (*deliberation*). At the end of the term, the students write up their scientific enquiry, their findings and their environmental actions, and they make recommendations on how this work can be taken further next year (*reflection*, making concluding connections, *change-oriented learning*; also more specific language and science learning outcomes).

Work It Out Questions:

- Consider the environmental learning outcomes (values, skills and knowledge) previously listed (*What Are We Working Towards?*).

Are these outcomes addressed in the subjects or learning areas you teach? Refer to the curriculum documents and explain your answer in detail.

- “Environmental education recognises and explores the many links between society, our cultural and economic activities and political decision-making, and the state of the Earth’s life-support systems.”

Illustrate this statement using any environmental issue. (You could refer to Section 3.)

- Sophia Vass is a primary school science teacher enrolled on an environmental education certificate course at a university. Her main assignment is to develop an environmental learning programme. Sophia chooses to develop an awareness raising session on littering for the informal traders at a taxi rank. Her lecturer is surprised that Sophia did not choose to develop environmental lessons for her science classes.

What could have been the reasons for Sophia’s choice?

- A group of learners suggest that their class goes to protest against the development of a nuclear power plant at a nearby coastal town.

How do you respond as an educator? Why?

History of Environmental Education in South Africa

UNIT 1.3



Environmental education goes back a long way. It is said that a pharaoh in Ancient Egypt sent extension workers to educate farmers along the Nile to protect the river. In the 1950s an African church leader led community education programmes to slow down soil erosion in the Transkei region. By the 1970s the Wildlife Society of South Africa was taking groups of children to wilderness areas for educational camps.

In 1984, parties who were involved in environmental education in the southern African region, mostly informally, met in Swaziland and formed the Environmental Education Association of Southern Africa (EEASA). This body was to become an important force in supporting networking between environmental educators and growing the field of environmental education. EEASA adopted a set of goals and guiding principles for environmental education that were developed at the first ever international environmental education conference, hosted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 1977 in Tbilisi (see the Tbilisi Declaration, www.gdrc.org/uem/ee/tbilisi.html for guidelines that are still useful today). In particular, the Tbilisi Declaration noted that environmental education had to be inter-disciplinary, so that learners could develop a holistic understanding of environmental problems.

During the 1970s and 1980s a popular form of conservation education focussed mostly on the need to protect Africa's dwindling wildlife and wildernesses. Over time educators became more conscious of the need to further explore the interactions between the ecological, social, economic, and cultural aspects of the environment, the need to protect the environment as the basis for human well-being and sustainable livelihoods, and the complex relations between social and economic development and the improvement of the environment. (See also Unit 1.2.)

The year 1992 saw the landmark United Nations Conference on Environment and Development (UNCED) taking place in Rio de Janeiro, Brazil. Also known as the Earth Summit, it produced principles for education for just and environmentally sustainable societies, which noted that environmental education was not value-free; it promoted a particular ethical approach to a world that was ecologically protected and socially just. UNCED also produced Agenda 21 (www.un.org/esa/sustdev/documents/agenda21) - guidelines for sustainable development that emphasised the need for education and public participation. EEASA used the opportunity to encourage both educators and politicians to look beyond the narrow view of environmental education as learning about wildlife, and to link environment, development, social justice and political transformation in environmental education. Figure 1 in Unit 1.2 is an example of the work done at this time.

The early 1990s was a time of tremendous change in South Africa – a time of transformation to a democracy. EEASA and other environmental groups joined government to formulate new environmental and educational policies. The new Constitution safeguarded a healthy environment for all, and the 1995 *White Paper on Education and Training* stated that environmental education and training was necessary for all sectors and levels of society. EEASA and the Department of Environmental Affairs and Tourism convened two initiatives, the Environmental Education Policy Initiative (EEPI) and later the Environmental Education Curriculum Initiative (EECI) which lobbied policy makers to give attention to

environmental education. (For an overview, see Part 4 of Lotz-Sisitka and Janse van Rensburg, 2000. *Contextual Profile: Learning for Sustainability Project*. Ibis, Johannesburg.)

When Education Minister Sibusiso Bengu launched Curriculum 2005 in 1995, the environment therefore featured prominently as one of six phase organisers that all teachers had to integrate into their teaching. Despite many strong intentions, Curriculum 2005 had some limitations, and when Minister Kader Asmal took over, he called for a revision, to both streamline over-complicated aspects and strengthen weaker aspects. The curriculum working groups were instructed to integrate environmental and human rights concerns across the curriculum. This process was supported by an environmental advisor to the Minister, funded by WWF (the Worldwide Fund for Nature - South Africa). When the revision of Curriculum 2005 was published in 2000 as the National Curriculum Statements (NCS) for Grades R-9 (www.education.gov.za) the environment featured across all learning areas and grades, both as the principle of a healthy environment (along with human rights, social justice and inclusivity) and as specific learning outcomes and content (see Section 2). The NCS for Grades 10-12, published in 2003, has the same strong environmental emphasis, in the form of a cross-curricular principle of environmental justice (along with social justice) and specific learning outcomes and content in most subjects (see Section 2).

In the current decade, the nation is at work to implement the new policies. Minister Naledi Pandor has presided over the implementation of a National Environmental Education Programme (NEEP), a Danish funded project (2000-2005) for strengthening the capacity of the provincial education departments to help teachers give expression to the environmental content of the curriculum. Today WESSA's Eco-Schools programme (www.wessaonline.co.za/education), which started in 2003, is perhaps the most prominent of a number of service-provider initiatives supporting curriculum-based environmental education in schools. Various government agencies, such as SANBI, DWAF, DEAT and its provincial agencies, SANParks and provincial conservation bodies, and even local authorities like City of Cape Town and Nelson Mandela Metro, support schools' environmental education through resource materials, learner excursions and teachers' workshops. A range of teacher education programmes (see Section 5) are addressing the challenge of helping to strengthen teachers' capacity with the new curriculum, including their ability to interpret the environmental principles and outcomes of the policy, and teach towards them.

The 2002 Johannesburg Summit on Sustainable Development gave further emphasis to the need for sustainable development. At the Johannesburg Summit, nations called for the UN to convene a Decade of Education for Sustainable Development (<http://portal.unesco.org/education>), emphasising the key role education has to play in environmental protection and social development. Environmental education programmes and approaches in South Africa are very closely aligned with (some would say, are no different from) sustainability education, and emphasise the need for environmental care and protection, along with the need to transform outdated development models that help neither poor people, nor the environment (see Unit 3.1). Even in programmes where the term conservation education is used, as in the C.A.P.E. Conservation Education Programme, the emphasis on conserving endangered plants is in the context of the role of biodiversity in economic development and livelihoods. The Handprint materials (Share-Net, Howick) are examples of resources that take environmental education from simply raising awareness about the need to conserve, to engaging in the development of better sustainability practices (See also Unit 1.2).

A useful relationship between environmental education and education for sustainable development is reflected in the Ahmedabad Declaration, drawn up at the United Nation's Fourth International Conference on Environmental Education, held in India in 2007.

Environmental Education in the Languages

UNIT 2.1



Key Ideas

Writing poems about the sea, a tree, or the devastation caused by a wild fire ... These are popular environmental education activities in primary and high schools. But there is much more to Languages, when it comes to environmental learning!

Literacy and Communication Skills

First and foremost, children must learn to read with understanding, to write for different purposes, and to speak clearly. They learn to do so in their home language, and in South Africa, they also learn to do so in one or more additional languages, to help them learn further, and to engage effectively with the world outside the home.

Active citizens must be literate if they are to find and make sense of information about environmental issues, and they must be able to communicate well in order to address such issues, whether in writing (e.g. a letter to the relevant authority about air pollution) or in speech (e.g. making a proposal about reducing office waste).

Understanding Language Use and Structure

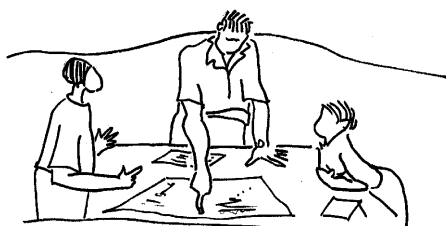
Grammar, spelling and literature studies are important. They hone the above literacy and communication skills, and they also help learners see how language may *reflect and shape* values and attitudes; how it is used to construct things like gender and the environment; and how language is used to position readers and listeners.

Thinking and Reasoning Skills

As a society facing challenging environmental issues and risks, we need to think critically and creatively as we develop better sustainability practices. *Critical thinking* is developed when children learn to use language effectively to ask questions, to probe beyond superficial answers, and to evaluate the values reflected in the language others use. *Creative thinking* is fostered when children are encouraged to think of alternatives: This piece of ground is full of rubble and litter - How could it be different? We call it a “dump” or “bushes”. How might a different word or phrase (e.g. “green open space” or “nature reserve”) change the way in which people treat it?

Learning to Read and Reading to Learn with Environmental Content

Learning to read in the first years of schooling is done in conjunction with other intended outcomes such as the life skills of keeping yourself and your surroundings clean, and exploring your environment. So Grade 1 learners might practise reading with a true story of a boy who forgot to wash his hands after going to the toilet and got a runny tummy. Or a mythical story of a boy who didn't listen to his grandma and peed in the river ... then turned into



a GIRL! The content of the reading material would in such a case not be accidental or ‘by the way’; but integral to the curriculum (Health Promotion: healthy me, healthy environment, making informed decisions). The teacher will therefore explain in appropriate terms the links between hand washing and a healthy tummy; and the importance of keeping the river clean which is home to birds and fish and the source of drinking water (even though the effects of using the river as a toilet will not *really* change boys to girls, and even though being a girl is not something to be ashamed of).

Reading to learn is a vital part of the foundations laid in the primary school. Many South African students arrive in high school without the ability to read in the language in which they will be taught. To address this serious issue, the quality and quantity of the environmental reading materials provided to learners is an important consideration, and children need to be given adequate opportunity to strengthen their reading skills, using material that is topical and relevant to their ages and interests. Local environmental issues, such as those explored in Eco-Schools activities in the school grounds, or environmental projects in the local community, have been found to ignite an interest in learning in children who had given up hope of mastering school work, because they had struggled so much to read and write.

Practical Language Skills for Active Environmental Citizens

When young people learn to put together a good argument, to make a speech, to compose a letter to a polluter, or a poster to raise awareness, or present a report on an investigation into an issue, they are developing the skills that the citizens of a democracy need to address social and environmental issues. Language teachers can join with social or natural science teachers and other colleagues who involve the learners in practical environmental action projects, and assist the learners with the language competencies required. They can also assess the outputs as part of the Language curriculum. This requires some collaboration between staff members, something which ‘whole school’ programmes like Eco-Schools encourage.

SCHOOL STORY FOR CONTEXT: Re-Thinking Waste Action

For the students at Hector Peterson FET College the issue of waste, and particularly litter, was a starting point in environmental education. They compared their environment with others, and didn’t like what they saw. Clean-up activities started, and together with a service provider, they decided they wanted to recycle. But when they spoke about their recycling project, they often misused the term (e.g. talking about putting sweets wrappers in the bin as ‘recycling’). Like children at other schools, they also found that recycling paper, glass and particularly plastics was a quagmire. And there was no way to recycle those chips packets, which was their number one waste problem!

Schools who try hard and think critically soon realise that recycling is not the final answer for managing waste (also see *Waste reduction and creative re-use beats recycling at a Grahamstown school*, Handprint booklet, Share-Net, Howick). What are some of the other possibilities? Careful language use and understanding is needed to both understand and come up with other possibilities: from simple repair and re-use (but what about economic growth and employment if we buy less?) to completely re-designing products and packaging so that it is easier and more energy-efficient to recycle them (see Unit 3.7, Waste).

Re-Wording the World: Thinking Critically and Creatively

Languages are an important tool for achieving human rights and environmental justice. Learners should become confident bilingual or multilingual speakers, who have the critical tools to read their world and the texts spoken and written about it. They should be able to analyse these texts and 'rewrite' them in ways that expand possibilities in relation to both human rights and environmental justice. National Curriculum Statement for Grades R-9: Language, 2000, p.8.

Analysing how others use language, say in advertisements or conservation articles, as well as playing creatively with language oneself, helps to start opening up possibilities, for older learners in particular, to re-imagine the world, and possible practices for living more sustainably on the Earth.

SCHOOL STORY FOR CONTEXT: **4 x 4 through the Wetland: Language Use and Environmental Values**

Learners review two texts their teacher copied for them: (1) a full-page magazine advertisement for an off-road vehicle driving through wet terrain, and (2) an article in an environmental magazine (like *Africa Geographic*) on the ecosystem services and biodiversity of wetlands. Both texts feature photos of a muddy area, which in the advertisement is called a "swamp", and in the environmental article, a "wetland". The learners discuss the different texts, their different forms and purposes, and the language use in them. Guided questions guide the learners to note and discuss the fact that similar terrain is called by different names, by different authors, for different purposes. Different terms might shape our values and actions differently. What might one feel and think about, and want to do in a swamp? What might one feel and think about, and want to do in a wetland? What values are reflected in the terms 'swamp' and 'wetland'? What actions might spring from these terms and values? Say a developer wants to drain a muddy area to develop a golf course, and the town planner must decide whether this can be done. Would the planner think differently of the value and future use of a wetland area if it were called a swamp?

While the job of the Language teacher is not to teach scientific facts about wetlands, in the story above she is also not using the environmental text merely as comprehension material. The content is a conscious part of the learning experience. By looking at how different groups with different values and purposes (vehicle sales, or nature conservation) use language differently, and might therefore have different effects in the world (encouraging us to treat wetlands merely as rough terrain to drive over; or encouraging us to appreciate and protect them). In this language lesson the learners are guided to explore issues in a way that promotes critical thinking and reflection as well as the goals of environmental education – developing respect for the environment, and the ability and inclination to act constructively in the interest of environmental health and justice.



Learning to Read.

Work It Out Questions:

1. How would you select materials and plan lessons on environmental concerns (e.g. waste) and sustainability practices, in a language learning area or subject? See Section 4 for some ideas.

2. Read the newspaper extract in Unit 3.1: Fairness in a Fragile World. It describes a context in which the same people are referred to as 'pirates' and 'the volunteer coastguard'. How would you use this article with Grade 10-12 learners to help them "recognise how language and images may reflect and shape values and attitudes ... towards power relations, human rights and environmental issues"? (NCS Grades 10-12: Language, p.25).

3. Unpacking a moral tale, or turning a familiar story on its head, are both useful ways of helping students recognise the values that shape our society and our attitudes towards the environment – and the way that oral literature carries these values forward. How could a Language teacher use any of the following traditional Western and African stories to explore society's dominant environmental values, and some alternatives?
 - The water snake, whose crown is stolen by a San hunter who becomes very rich as a result, but also very miserable.
 - The three little pigs (who found that straw and wood were no good as building materials, but bricks were) and triumphed over a wolf.
 - Red Riding Hood (who also defeats a big bad wolf by having him killed, but only once a woodcutter comes to her rescue).

Environmental Education in History and Geography

UNIT 2.2

Key Ideas



Geography teachers have been at the forefront in environmental education. This is because the subject is about the physical place in which children find themselves, and the wider world, as well as the interactions between people and their environments. The physical environment determines what kinds of houses we build and clothes we wear, what kinds of food we can grow and what jobs our parents do (miners, farmers, restaurant managers). People also shape and change their environments. Societies have interacted with each other and with their environments in ways which have been to the benefit of some, but which have harmed and disadvantaged others, and sometimes degraded the environment so badly that it no longer supports people. In history, we look back in time to see how these interactions between different groups, and between people and their surroundings, have shaped the world learners encounter.

Where once there were grasslands and rivers brimming with fish, we now have cities and canals. Who benefited from these changes, and who was disadvantaged? What can we learn from the past? What is the best way to develop our world, into the future? How do we meet everyone's needs fairly, and protect the environment so that future generations can also live well? The social sciences provide key content and skills for learners to come to grips with the idea of sustainability and natural resource use, and to consider alternative practices and development paths.

The South African Social Sciences curricula include, among others, the following content:

- Places that we value and why; basic needs and resources - Grade 1
- Important places in our community; actions to improve our environment; resources like space, water, electricity, transport and their use - Grade 2
- Change in our environment; pollution; managing waste (reduce, re-use, recycle) – Grade 3
- Resources and services in a settlement (water, waste management, green open spaces) and difficulties for those without them; accessing food and water, past and present; wise use of resources – Grade 4
- SA landscape, people-environment interactions and landscape change – Grade 5
- Use and abuse of resources with a focus on water and energy in SA – Grade 5
- Environmental issues and impact of society, e.g. loss of biodiversity, disappearing wetlands, soil erosion, deforestation, extinction – Grade 6
- Development issues: causes of poverty including environmental destruction, lack of access to resources; positive case studies – Grade 6
- Natural hazards (e.g. droughts, floods) and environmental management; management and reduction of risk, e.g. managing rivers and wetlands to reduce risk to people and ecosystems – Grade 7
- Natural resources (e.g. marine life, water, soil, forests) in SA and worldwide, conservation, threats to and opportunities for conservation – Grade 8

NOTE ON ADAPTATION

The South African National Curriculum Statements (<http://education.gov.za>) feature a learning area called Social Sciences for Grades R-9, which forms the basis for History and Geography in Grades 10-12. These are the learning areas and subjects that are directly addressed in this Unit. Readers working in other contexts will find similarities with history and geography in other curricula.

- Development issues: role of science and technology, including crop modification, the Green Revolution – Grade 9
- Sustainable resource use: principles of Agenda 21, our dependence on natural resources, active participation in addressing environmental issues – Grade 9
- Social and environmental conflicts in SA – power, control and discrimination in access to resources such as land, water; case studies – Grade 9
- Global warming (in relation to weather systems and human impact) – Grade 10
- Population growth and movement, poverty, employment, inequality and conflict – Grade 10
- Organisations, solutions and management strategies for inequalities in society and the environment – Grade 10
- Coastal environments; the oceans, their exploitation and management; hazards and human responses; environmental management of hydrological systems, rivers and coastal resource management – Grade 11
- Ecosystems and related concepts, interrelationships, processes, biomes, human impacts and their consequences; natural resource use and management, land use conflict – Grade 11
- Energy use and management; concepts of renewable and non-renewable resources; the environmental costs of energy provision; global warming; sustainability; new forms of energy and energy conservation – Grade 11
- Development and sustainability at global and national scales: models, theories, strategies and case studies to address development problems – Grade 11
- Settlement and sustainability issues in urban and rural contexts, including land redistribution and informal settlements, pollution, political influence, governance, Agenda 21 – Grade 12
- Climate hazards and human responses, risk and vulnerability – Grade 12
- Water in SA, sustainable use and management – Grade 12
- Economic activities – response of people to environmental and social justice linked to economic activities – Grade 12.

Students work through this content while undertaking investigations (e.g. fieldwork doing an interview survey among neighbours about litter, or an energy audit) and action projects (e.g. starting a waste - or energy reduction programme). Writing a research report on such activities then helps develop interpretation, synthesis and problem-solving skills.

The National Curriculum Statements aim to develop critical and responsible citizens and decision-makers, who can challenge social and environmental injustices, and make sound decisions as they contribute to the development of society and the environment. In this way the new social sciences curricula differ from past curricula, which taught about the physical environment and society, but did not always foster an ethic of involvement, care and commitment.

Also See:

Environment in Social Sciences: Exploring people and places, past and present, for a fair future in a healthy environment. In *Environment in the Curriculum. A Resource to Support Local Action and Learning for Sustainable Living in the Natural Curriculum Statements*: Share-Net, Howick.

Environment in Geography: Sustainably developing society and environment. In *Environment in the Curriculum. A Resource to Support Local Action and Learning for sustainable Living in the Natural Curriculum Statements*: Share-Net, Howick.

Work It Out Questions

- Agenda 21 features in Grade 9 and Grade 11 Geography. Use this book to find an electronic copy of Chapter 36 of Agenda 21, and summarise its key points.

- Use Unit 3.1 to develop a lesson for Grade 11 Geography students.

- Work out a lesson for Grade 2 and 3 learners, linked to Eco-School activities to conserve water, energy or other resources. See Unit 5.1 for possible resource materials to consult.

Environmental Education in Maths and Science

UNIT 2.3

SECTION 2 CURRICULUM

Key Ideas

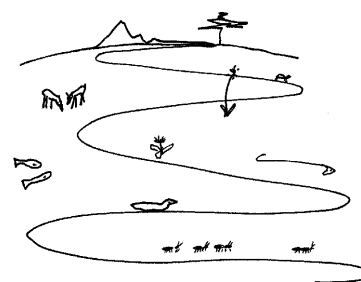
When students plan and conduct simple enquiries in the *Natural Sciences*, using a variety of sources of information, including their own investigations, they get to know and appreciate how nature works and how ecosystems benefit people. They are also challenged to consider critically people's interactions with nature, including the impacts of technology (such as pollution) and to suggest better practices. The Grade R-9 Natural Science learning outcomes and the given content for the different phases, are opportunities to study local plants, animals and ecosystems, to investigate our impacts on biodiversity, and solve problems about conservation.

In Grades 10-12, *Life Sciences* prepares learners to apply scientific knowledge in their personal lives and as responsible citizens, in order to develop a healthy lifestyle (choosing foods and activities that build and support their bodies rather than put them at risk), and to contribute to the sustainable management of natural resources like water, energy and biodiversity. Students explore life processes and interdependence in humans and the natural world in more depth, using scientific enquiry, problem-solving and critical thinking skills. Sustainability versus exploitation, waste management, rehabilitation of the environment, and the value of and threats to biodiversity, are all relevant content areas. It is important that Life Science teachers move beyond topics like litter as they must also source and teach grade-appropriate content on challenging topics like biotechnology and genetic engineering (e.g. genetically-modified crops). When topics such as the introduction of exotic species are studied, this also needs to be done with the depth suitable to the grade. Values and ethics feature prominently, and learners must deepen their understanding of the impacts of science and technology on people and nature.

The *Physical Sciences* for Grades 10-12 also follow these themes, and in Matter and Material students explore the impacts of plastics; in Earth and Space they look at ozone depletion, an environmental issue that has been caused by scientific products, but which has also been successfully addressed when society made concerted efforts. They also study energy use, sustainability and the environmental impact of various forms of energy. At this level learners need to look beyond the obvious and teachers must provide good quality, unbiased content, particularly in relation to renewable energy sources and nuclear energy, where those with strong interests are not above producing biased materials for schools.

Mathematics and numeracy skills are important for learners – and citizens – for understanding environmental issues and for planning steps to address them. It is difficult to read about or listen to a speech on environmental risks like global warming, radioactive waste, population growth or the use of quotas in the fishing industry, if one fails to understand concepts like 'exponential' or 'probability'. And in the early grades, students will struggle to understand or report investigations into issues, such as water audits, or the rate at which rubbish dumps fill up, if they cannot do basic calculations, or misunderstand units and the use of graphs.

Grade R-9 *Mathematics* must clearly lay these vital foundations of learning. At times, the teacher will use environmental issues through which to develop the necessary mathematical skills. For example, a simple audit of water used and wasted at the school toilets (or





Results of the water audit conducted in the school's toilets.

taps, or irrigation system) can be used to teach about units of measurement, calculations (adding and multiplying) and symbolic presentation (bar graphs comparing water usage in boys' and girls' toilets).

At the same time as numeracy skills are developed, the learners are exposed to the environmental issue in a meaningful way, and they also learn how mathematics is used to address environmental sustainability issues: How much water can we save if we replace the washers in the leaking taps? Maths lessons are not the main place for teaching about

the workings and sustainability of freshwater ecosystems (or plumbing), but the National Curriculum Statements do require maths to be taught in "contexts that build awareness of ... human rights, social ... and environmental issues".

High school learners, too, will find mathematics exposing them to environmental concerns. In Grades 10-12 data handling, in *Mathematical Literacy*, is taught and assessed through the investigation of real life issues with social, political and environmental aspects. Examples might again be water conservation, traffic safety near the school, the amount of waste produced by different groups in society, or the percentage time that township dwellers spend on commuting, because of the lack of suitable public transport in some areas. Interviews can be used and data must be carefully analysed and interpreted critically. Students of *Mathematics* can also be involved in investigative projects, which can then be used for authentic integrated assessments. Teachers need to design these projects well, so that they are realistic opportunities to learn the required skills, and do not become distractions from the actual learning outcomes intended.

Work It Out Questions

- In Unit 3.3 there is a story about Macassar High School in Khayalitsha, where Biology students are involved in monitoring the rehabilitation of dunes in a sand mining area near their school. How would you design such a project, as a science teacher?

What maths would be required in the project you have designed? For which grade or grades would such mathematical work be most relevant and beneficial?

Also See:

Environment in Natural Sciences and Environment in Life Sciences. In: *Environment in the Curriculum. A Resource to Support Local Action and Learning for Sustainable Living in the Natural Curriculum Statements.* Share-Net, Howick.

Biodiversity in Life Sciences. A handbook for educators to support biodiversity conservation education in the Cape Floristic Region in the Grades 10-12 Life Sciences Curriculum. C.A.P.E. Conservation Education Programme, Rhodes University Environmental Education and Sustainability Unit.

Environmental Education in Life Orientation

UNIT 2.4



Foundations (Grades R-9): Healthy Environment, Healthy Me!

Life Orientation aims to help students to learn to make wise, informed decisions about their own health, and the health of their community and environment. (See Learning Outcome 1, Health Promotion, <http://education.gov.za>).

People can only be healthy if their environment is healthy, too. We need clean water, fresh air, nutritious food and safe surroundings. We need to exercise our bodies if they are to develop well, and we even need to enjoy the beauty of nature.

In Life Orientation learners participate actively during the early years of schooling, by identifying environmental health issues in their homes, school and community, then exploring what can be done to make their world safer and healthier. As the teacher provides new information about how we keep the Earth and ourselves healthy, the students learn to make wise choices and to take action. This lays foundations for further learning, for example in Grades 10-12, when citizenship (making informed decisions, taking responsible actions) is part of the Life Orientation curriculum.

NOTE ON ADAPTATION

The South African National Curriculum Statements (<http://education.gov.za>) feature a learning area called Life Orientation for both foundational and further education. Life Orientation combines elements of Life Skills Education, Physical Education, Religion Education, Citizenship Education, and Guidance and Counselling. Other curricula are likely to include variations of these.

SCHOOL STORY: Using the School Garden for Early Foundational Learning

Like many schools, Kanyamazane Primary has a permaculture garden where vegetables are grown and beneficial wildlife is encouraged. The Grade 2 learners dig in compost, plant seedlings and water them, and count the kinds of creatures that arrive in the garden. Their curriculum for assessment is not to learn how to garden. It is to “*suggest and investigate actions to make the home and school environment healthier*” (LO1). So their teacher provides them with new knowledge - lessons and pictures that show why their bodies need fresh vegetables, why plants need water, healthy soil and friends like earthworms. It then becomes clear why a permaculture garden is therefore a good action to make their school a healthier place. Appropriate reading, writing and numeracy tasks are linked.

The Grade 3s contribute to compost making by recycling cuttings and peels from the nearby fruit sellers and the soup kitchen in a compost area in the same garden. They progress from their Grade 2 learning by *grouping* and *counting* the diversity of creatures in the healthy, compost-rich soil, and *comparing* it with the smaller number of creatures in a bucket of soil from a barren patch elsewhere in the school grounds. In this way, they “*participate in a recycling project and explain how recycling contributes to environmental health*” (LO1). The teacher gives them related comprehension and numeracy tasks, and makes links to associated science concepts.



Further Education (Grades 10-12): Active Citizens in a Challenging World

Life Orientation equips older learners (Grades 10-12) with the *skills, knowledge* and *values* to respond positively to life's many challenges and opportunities, as they get ready to take their place as active members of society. The subject does this by focussing on Personal Well-Being (LO1), Citizenship Education (LO2), Physical Well-Being (LO3), and Career Choices (LO4, see <http://education.gov.za>).

Citizenship Education is the backbone of the environmental learning in Life Orientation. Responsible citizens take care of their health and their relationships; they care about others and take action to address problems in their environment. When disadvantaged people suffer from environmental issues like pollution, while others benefit, it is an issue of environmental justice (see Unit 3.1). Tackling such issues requires the ability to act democratically, using laws, policies, relevant channels and community action to exercise rights and responsibilities. Life Orientation gives learners the chance to learn these skills and clarify their own values, as they identify issues and join others in appropriate activities and services.



SCHOOL STORY: Youth Environmental Action Projects

Many schools participate in programmes offered by service providers. In one such programme, learners had to identify an environmental or sustainable development issue affecting Cape Town, develop an action project to address it, and present their project at a youth conference to their peers and the local authority.

Eva Hani used this opportunity to provide content and interest to her Grade 10 Life Orientation classes. She taught a lesson and distributed copies of a reader-friendly report on the social and ecological challenges in the city (City of Cape Town *State of the Environment Report*, www.capetown.gov.za/environment). She grouped the class in fours. Each group chose an issue, for example, what to do about waste (with dump sites filling up); floods and the loss of wetlands; the energy crisis; and coastal pollution. Over the course of the year, students received lessons to help them investigate their chosen issue, find and make sense of information, plan an appropriate action (e.g. waste reduction projects, restoring wetlands, distributing energy saving bulbs, lobbying for bins at all beaches) and to prepare a report. The best projects were presented at the youth conference.

Because several different environmental topics were involved, and Mrs Hani wanted the students to work with good quality content at a level appropriate for Grade 10, she made careful use of the environmental organisations that supported the youth conference. She also invited the English Second Language teacher, Ndumiso Jacobs, to join her. The youth conference projects had to be presented in English, and most of the students have difficulties writing and speaking in that language. By planning well in advance, Mr Jacobs made related comprehension readings, the project report and the project presentation part of his English teaching and assessment. The hard work that the Grade 10s and their teachers put into the youth project, therefore led to solid curriculum outcomes: English reading and writing outcomes, and Life Orientation LO2, AS1: *Identify social and environmental issues and participate in a group project to address a contemporary social and environmental issue*. The learners also did very well with their presentations at the conference thanks to the team efforts of their teachers.

Work It Out Questions:

- Students must “*report on participation in or planning of the local celebration of a national day*” for Life Orientation (Grade 9, LO2). How would you use Water Week, Human Rights Day or a similar special day, to support environmental learning?

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Also See:

Environment in Life Orientation. In: *Environment in the Curriculum. A Resource to Support Local Action and Learning for Sustainable Living in the Natural Curriculum Statements*. Share-Net, Howick.

Environmental Education in Art, Technology and Design

UNIT 2.5

Key Ideas



Environmental concerns are integral to the *Technology* Learning Area for Grades R-9, in learning outcomes that are integrated with the Natural Sciences: Students must learn about the links between technology, society and the environment. In what ways do technological products and processes benefit society, or benefit the environment? In what ways do they harm society, or harm the environment? How did traditional societies use indigenous technologies, and what lessons can we learn from these?

As learners develop the basic skills of designing and producing technologies, they need to consider the environment as well. Might the technology they produce cause harmful impacts on the environment or people? How can they reduce this impact? How can they keep themselves safe, reduce the amount of waste they produce, and dispose of the waste without harming the environment? But also, can they design a solution for a particular environmental problem?

In *Arts and Culture*, the Grade R-9 students not only use materials from the natural environment, and recycled items, to create art and awareness of the environment. In Grades 5 and 8 they must also express a growing understanding of social and environmental concerns using the arts: performance art such as role play or poetry, or visual arts.

In Grades 10-12, students can choose various art, design and technology subjects. In all these, the themes of environmental and social considerations, and positive and negative impacts on environment and society, are evident in learning outcomes and content.

In *Mechanical Technology*, *Electrical Technology*, *Information Technology* and *Computer Applications Technology*, students must be alerted to the impacts of various industrial processes and products, machines, electricity and electronic hardware and e-waste, on the environment. They must consider how to reduce these impacts in their own activities and future practice: examples might be recycling oil and disposing safely of hazardous waste; choosing energy-efficient appliances; switching appliances off at the wall when not in use; minimising the use of paper and other consumables. They should also consider that because environmental impacts had not been taken into account during their development, some current technologies will become obsolete in the future, and alternatives must be developed. For example, many packaging materials in use today cannot be recycled, or only with considerable energy and pollution. (See Unit 3.7 for more).

The environment is a key consideration in the *Design* subject. How does the environment (climate, physical features, landscape, nature) influence design? Students could compare holiday homes built along the coast. Do the design of these homes and their gardens show a sensitivity to the natural environment, or is there no connection with it? In another context, students could consider how low-cost ('RDP') housing could be made safer and more comfortable, by taking the environment (sun, slope, wind, water table, temperatures) into account. But design also shapes environments. Does a particular design exacerbate an environmental issue (e.g. a large brick building surrounded by paving built on soil dumped in a wetland will change water flow and reduce habitats for wildlife) or challenge the issue? (e.g.

a series of small, linked timber buildings on stilts with indigenous vegetation and water flow intact around them). Professional designers today are using the green trend, or the quest for environmental sustainability, to come up with new products and processes (e.g. solar cell phone chargers). Students must explore this trend, not only because it is an important design and economic opportunity, but because the well-being of the planet and society depends on better design. Graphic designers will find that an understanding of nature and environmental concerns may be in high demand as this trend is set to continue. And finally, designers need to know how to safely and responsibly use and dispose of materials used in the design and production process.

The aim is to produce citizens that are responsible and sensitive to environmental and social justice issues, and able to act practically in keeping with these values.

SCHOOL STORIES: Renewable Energy Projects

Coal-fired power stations generate electricity that has helped society to live more easily and produce more goods, quite cheaply, although not everybody has access to electricity yet. But the by-products of these stations make water and soil acidic, thus killing fish and making it harder for farmers to produce crops. They also pollute the air that people breathe, and contribute to the warming up of the atmosphere that might change life on Earth dramatically. At Bishop's Boys School in Cape Town, Grade 10 student Thomas McLennan grappled with this problem before designing and making a small wind generator that generated enough electricity to power a light bulb – or the electric score board at the school's cricket field! At many rural schools, children design and make 'hot boxes' – solar cookers that cook a one-pot meal using inexpensive materials and the free power of the sun.



Work It Out Questions

- Prepare a lesson for a Design class, to consider the environmental impacts of paper production and investigate the pros and cons of various types of paper, e.g. acid free paper, low chlorine, recycled, etc. Consider aspects such as: Can these be used for printing? What is their quality, look and feel? What are the cost implications? Which clients might most value more environmentally sustainable paper production processes?

Environmental Education in Agricultural Sciences

UNIT 2.6

Mr Willem Maartens
Blyvooruitsicht Farm
Clarens

Dear Mr Maartens

I am writing to warn you of the dangers of pollution on the farm. Did you know that pollution is caused by:

- using too much fertilizer? (which also wastes your money)
- using too much pesticide or herbicide? (also wastes money)
- dumping oil and drums with leftover poison?

Pollution is a problem. When birds of prey die from eating poisoned carcasses, you lose a natural form of pest control. When the water on your farm turns green and slimy, it has too many phosphates and nitrates from fertilizer run-off. This can interfere with irrigation and can kill off water life. Poisons kill fish, workers can become sick and your children cannot fish anymore. As the river runs from your farm into dams providing drinking water, and the sea, you have a big responsibility to keep it clean. At the end of the day it will save you hassles and money and your children will inherit a healthy farm. So please:

- Use just enough fertilizer according to instructions.
- Use only enough poison and don't spray in windy or rainy weather.
- Think about going organic – you can get better markets and prices.
- Send used oil to the recycling depot at the Co-Op.

Yours faithfully,
Patsy Pholo

Key Ideas

This subject prepares informed and responsible citizens who can manage natural resources to produce food and other commodities sustainably, as farmers and in related careers like extension, agri-business and horticulture. It teaches learners to understand and manage a farm that is environmentally sustainable.

A healthy environment sustains agriculture. Sustainable agriculture is about taking good care of the natural environment, in order to maintain the long-term productivity and profitability of agriculture itself. Farmers need to use water wisely, or they will run out of this vital resource. They need to nurture and protect the soil, or it will be harder to produce healthy crops. They must protect crops and livestock from pests, but they must also look after biodiversity, or there may be no insects to pollinate the crops, or no natural predators

to keep competing wildlife in check. Farmers must take care not to contaminate their farms and water bodies with pollutants which can have long-lasting ill-effects. They need to reduce wastage of products and energy, and they must consider the impacts their actions can have on consumers and farm workers, as well as future food security and livelihoods.

Students should learn about all these aspects, and the legislation on environmental sustainability. They may need to *un-learn* many of the tried and trusted farming methods and principles that have been applied historically. A new approach is necessary, if we are to sustain the natural resources on which agriculture so deeply depends. To stay in business, it is no longer 'business as usual'! Students also need to learn to use a range of information sources, and problem-solving skills with which to tackle sustainability issues.



SCHOOL STORIES: Teaching Sustainable Agriculture

Source: *Environment in Agricultural Science. Environment in the Curriculum: A Resource to Support Local Action and Learning for Sustainable Living in the Natural Curriculum Statements. Share-Net, Howick. The first lesson was adapted from Sisitka, L. et al. in Focus on Agricultural Science, Grade 10, Maskew Miller Longman).*

This is a story about a teacher who recently started teaching Agricultural Sciences:

"I'd like to share two of my lessons. The first was for the Grade 10s, towards LO1, Investigate and Analyse, and LO4, Integrated Issues. I taught a section from a textbook, on agricultural pollution and its impact on natural resources, biodiversity, and the sustainability of farming. Since the Assessment Standard requires learners to investigate and interpret information they collect themselves, I set a task: they had to contact any farmer they know, and find out how these farmers deal with any the sources of pollution we discussed. In the next period we discussed the information they collected, so that they broadened their knowledge, and I could correct any mis-interpretations. The next activity was to pretend that they were extension officers. They had to write to a farmer to explain why it is important to prevent agricultural pollution, and what farmers can do to prevent pollution. I assessed their letters towards Learning Outcomes 1 and 4."

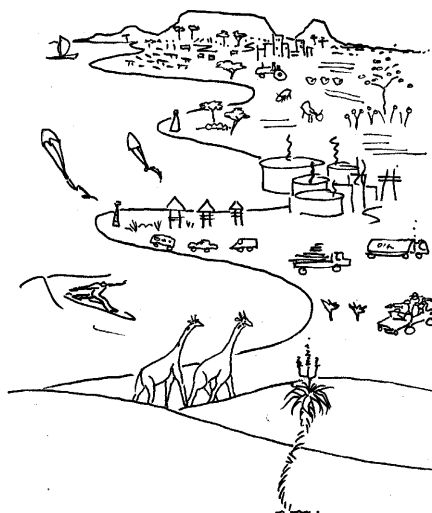
"The other lesson was for Grade 12. In the first term we did legislation as part of Interrelated Issues (Learning Outcome 4). At the end of the term, the learners had to complete the table below, which I then used for assessment towards Assessment Standard 4: *Demonstrate responsible interpretation of legislation on natural resource utilization*. The best answers needed extra pages for the last column!"

The farmer wants to:	Name one law the farmer must consider	What does the law require farmers to do?	What is your view on this law?
Plough up natural vegetation for a new field			
Get rid of a leopard which is killing stock			
Prevent wild fires			
Build a dam			
Stop the spreading of invasive plants or animals			
Sell the yellowwood trees on the farm			

Environmental Education in Tourism

UNIT 2.7

Key Ideas



South Africa has a spectacular natural environment that is one of its main attractions to international and local tourists alike. Visitors are drawn to the African wildlife in parks like Kruger and Pilanesberg, to the long white beaches, the beautiful scenery of the Cape and the unique desert areas. Alongside and interwoven with this natural heritage, is the cultural heritage of the country, ranging from ancient Khoi-San middens and other archaeological sites, to the modern-day crafts of diverse communities around the country, rooted in traditions that often celebrate nature.

We need to make the most of our environmental draw cards for tourism. In many parts of the country, eco-tourism (where the natural environment features prominently) is one of the best or only development opportunities. Yet many residents are unaware of the potential of the natural environment, being so used to it, or having little sense of the attraction it can hold for those living in built-up, polluted towns and cities with little wildlife and natural interest left.

At the same time, we need to make sure that tourism developments (roads, trails, advertising, accommodation and waste management) are done with care, so that they don't destroy the natural resources that attracted the development in the first place. Visitors and staff must be taught how to treat the local environment appropriately: If you learn how to foil baboons, you don't have to destroy them; they are after all, part of the attraction! Sustainable tourism means doing environmental impact assessments and taking actions to minimise negative environmental impacts, and to make the most of the natural beauty and biodiversity. This may sustain tourism over the long term, protecting natural resources and ensuring human livelihoods – sustainable tourism.

The Grade 10-12 subject Tourism (www.education.doe.gov.za) requires students to note the connections between tourism and a healthy environment; and to explore conservation as an important tourism sector. Examples of protected areas used for tourism are botanical gardens, national parks, provincial and municipal nature reserves, marine protected areas; as well as community and private game lodges.

Sustainable Tourism is addressed in a specific learning outcome (LO2) which requires students to become acquainted with the concepts of environment and sustainability, and the natural and cultural heritage of the country, including world heritage sites like the Table Mountain National Park, the St Lucia Lakes/Isimalingo Wetlands and the Cradle of Mankind at Sterkfontein. They learn to evaluate and promote the environmental aspects of their own surroundings, and to consider what it would take to improve and maintain the local environment. Local communities play an important role, not only by making tourists feel welcome, but by keeping the environment clean and safe; by valuing, protecting and restoring natural vegetation, wildlife, rivers and wetlands; collecting and sharing indigenous knowledge and traditional stories about the treasures of the local environment and its history; and finding ways to benefit financially without inappropriately developing or destroying valuable natural assets.

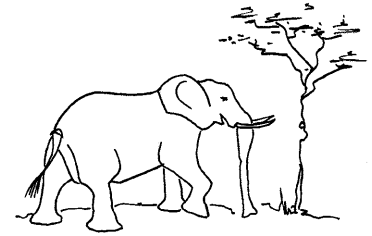
NOTE

The Grade 10 students who take Hospitality Studies (www.education.gov.za) will also come across environmentally sound practices in Grade 10, when they will learn about environmental health in food preparation, and sound waste management including recycling.

Did You Know? Biodiversity Facts

South Africa has a wealth of wildlife. The country is home to:

- The world's largest land mammal (African elephant)
- The smallest (a shrew the size of a human fingertip)
- The tallest (giraffe)
- The fastest (cheetah)
- The heaviest reptile (leatherback turtle)
- The largest antelope (eland)
- The largest bird (ostrich)
- The heaviest flying bird (Kori Bustard)
- 900 bird species – 10% of the world's variety on 1% of its land area
- 6 000 different spiders, 175 varieties of scorpion and 100 different snakes
- 23 200 different plants. South Africa is the richest zone on Earth in terms of species to area ratios.



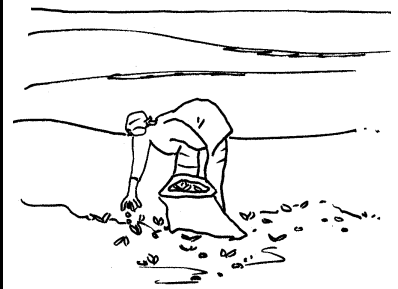
SCHOOL STORY: **Tourism Exploration in Hawston**

Hawston is an old settlement of primarily coloured families, largely cut off from other communities in and around nearby Hermanus. This coastal village is infamous as the poaching capital of the Southern Cape, as many residents illegally collect and sell perlemoen (abalone).

With the help of the local Eco-Schools coordinator, the Travel and Tourism teacher at Hawston High School developed a tourism project. Her Grade 11 students investigated local natural and cultural heritage, and compiled a pamphlet on what they had found. The pamphlet told visitors what is special about Hawston, and what is worth seeing and doing. To this end, the Eco-Schools coordinator invited the students on a whale watching trip, which was for many their first outing on a boat.

Thus the students developed some first hand knowledge about the world-famous whale tourism in Hermanus and about the role that conservation of the sea and coast can play in bringing visitors and job opportunities to the Southern Cape. They could see another side to conservation, which is perhaps most often seen as the enemy of Hawston. Furthermore, by researching the history of the graves and traditional cottages in the area, students could see the more integrated past of the area, where people of various colours and cultural backgrounds had lived together for generations.

As the town of Hermanus grows, smaller villages like Hawston, with its quaint historical cottages, might well become a destination of choice for those who do not want hustle and bustle on their holiday. This is counter-intuitive for young people who prefer bright lights and loud music – but worth exploring if one is to really start seeing the tourism potential in one's local environment. The Tourism teacher might think of the next Grade 11 class interviewing some visitors to the area.



Also See:

The International Marketing Council of South Africa provides resources to help us promote the country: www.brandsouthafrica.com

Fair Trade in Tourism South Africa (FTTSA) is a non-profit organisation that promotes sustainable tourism development through awareness raising, research and advocacy, capacity building and by facilitating the world's first tourism Fair Trade certification programme. www.fairtourismsa.org.za

Fairness in a Fragile World: Environmental Justice and Sustainability

UNIT 3.1



In preparing for the World Summit on Sustainable Development, which was held in Johannesburg in 2002, the German analyst Wolfgang Sachs put together a collection of papers to describe the problem of sustainability and what we should be striving for. He called it *Fairness in a Fragile World*. (The Heinrich Boll Foundation: *The Jo'burg Memo. Memorandum for the World Summit on Sustainable Development*. www.joburgmemo.org).

Key Ideas

Earth may remain long after we have come and gone. As a planet, the Earth seems durable. But for humans and other creatures, it is a fragile home.

Scientists say that our home planet has limits beyond which it will no longer serve as a source of supplies and a sink for wastes. There are more than six billion people alive today, and our great numbers and powerful tools have huge impacts. The world's fresh water is becoming toxic. Richer nations have fished out most of their marine foods and are now trawling the waters around other countries. All are at risk as the Earth gets hotter because its atmosphere is thickening with pollution gases.

The limits within which life as we know it can be sustained, are in some ways very narrow. Changing the temperature, the acid level or composition of the air, water or soil beyond these limits, has big effects, especially on the plants, animals and micro-organisms that share the Earth with us and make it such a viable and vibrant home.

Disturbing ecosystems with pollution or over-use, puts at risk the Earth's ability to provide food and shelter (see e.g. *Nature Supporting People: The Southern African Millennium Ecosystem Assessment*, at www.millenniumassessment.org) – that is, its ability to sustain (nourish and maintain) life. It is for this reason that we are being called to consider the *sustainability* of the community of life on Earth. How can we live and develop so that we sustain the Earth's life support systems and therefore humankind? What is sustainable living and *sustainable development* all about?

Development is failing many people – all those who still live in poverty, without food, toilets, a safe home or clean water. Development has brought many advantages, but only to some. There is a downside to development and technology, which harms both people and the Earth. Examples include the effects of nuclear waste, described in the extract below (Somali Pirates), or the effects of extracting too much water from an ecosystem, as described in the story *Water in a Packet of Chips*, Unit 3.4).

It is the poor and marginalised who suffer most from the downside of development – children, men and women who have ironically not benefited much from that development. Those who live in makeshift homes near petrol refineries or busy roads breathe in toxic fumes, but may never afford their own vehicles. Workers fall sick from exposure to poisonous chemicals and other pollutants, but share little of the profits made by what they produce,

and lose all income when they are too weak to work. These are issues of *environmental justice*. (For a description of what we mean by *environment*, see Unit 1.2 and Figure 1.) In America, activists working for environmental justice have pointed out that there is a direct correlation between where harmful industries and waste dumps are situated, and where minority groups such as Asians, Mexicans, African-Americans and Indigenous Americans live.

Environmental sustainability issues share roots with development issues such as poverty, economic inequality and social injustices associated with race and gender. The economic systems most common in the world today in many ways feed greed, not need. This highlights the need for new development paradigms, that are both socially just (providing *some for all*) and environmentally sustainable (providing '*some for all, forever*').

Sustainable living: "Living as if tomorrow belongs to all of us, or it will belong to none of us" (UNESCO).

Ubuntu is, amongst other things, at the core of our (African) ethos, it may mean the happiness and joy engendered by a caring society – or that the community is the single most important factor in our lives. It means that we count our wealth not in money and profit, but in joy and happiness.

Our community stretches from the ancestors, to our distant unborn progeny, we are under obligation to leave the world a better place.

(MARTIN ERASMUS, GRAPHIC DESIGNER, 1998 UNDP REPORT)

Sustainable development is being promoted as the way forward. But there are different approaches to sustainable development. Professor Johan Hattingh of Stellenbosch University (Hattingh, J. 2004. Speaking of sustainable development and values ... *Southern African Journal of Environmental Education*, vol. 21, pp.157-165) describes a 'weak' version of sustainability which says that environmental conservation, economic growth and social well-being must be in balance – that they are three pillars on which sustainability rests. The 'strong' version of sustainability, on the other hand, describes economic growth as nested within (in the service of) social well-being, both of which are nested within, and dependent on, environmental sustainability. This is in keeping with Wolfgang Sachs' view, that "there is no poverty eradication without ecology".

Development is more than economic growth ... The UN Development Programme defined development as "a process of enlarging people's choices" by empowering them to achieve their potential to lead a long and healthy life, to acquire knowledge and to have access to resources and opportunities for a decent standard of living (UNDP. 1998. *HIV/AIDS & Human Development South Africa 1998*. Amabhuku, Pretoria.)

Sustainability is in many ways a difficult concept (see Rosenberg, E. 2004. Sustainable development – Maintaining profits, or sustaining people and planet? *Enviropaedia*, pp.229-232. Eco-Logic Publishing, Cape Town; www.enviropaedia.com). It is hard, for example, to predict a rate of using natural resources that will be sustainable. At what rate can we catch a particular fish before the stocks collapse, or pump pollution into the air, before irreversible changes make the planet less liveable? Our science and mathematical models do not give us a perfect grasp of the natural world. For this reason, management of our natural resources must be adaptive and reflexive. Perhaps weakest of all are our social and political systems. We have not yet found many ways to manage our use of the world's natural resources fairly and wisely. For example, the South African government has introduced fishing quotas as a means of making the resource (fish) last longer, and make sure there is 'some for all, forever'. But government is struggling to find the best way to regulate this measure. Some smaller fishers may be unfairly disadvantaged when licenses are allocated. An unintended practice

that has developed, is that companies sometimes dump a whole catch (of dead and dying fish) back in the sea, if it consists of ‘low value’ species, in order to fill their quota with species which fetch a higher price on the market.

Sustainability is best seen not as a fixed destination, but as a journey, a journey in which the world society and local communities will continuously need to make adjustments as we learn more. Fortunately there is much that we can do already, and with an open, enquiring mind we can learn from our actions, so as to continuously find better ways. Educators can share with learners what is already being done, the things they themselves can do to make a difference, and the challenges that still remain. (See for example the Handprint booklets, Share-Net, Howick, and *Environmental Education, Ethics and Action: A Workbook to Get Started*.)



STORY FOR CONTENT: **Somali Pirates, Social Justice and Sustainability**

Extracted and adapted from: The Truth about Modern Pirates, by Hari, J. *The Sunday Independent*, p.13, January 11, 2009.

In 1991, the government of Somalia collapsed. Its 9 million people have been on the brink of starvation ever since – and some in the West have seen this as an opportunity to steal the country’s food supply and dump nuclear waste in their seas.

Once the government was gone, mysterious European ships started appearing off the coast of Somalia dumping vast barrels into the ocean. Then people in coastal communities became sick, with strange rashes, nausea and malformed babies. After the 2005 tsunami, hundreds of the leaking barrels were washed ashore. People started to suffer from radiation sickness, and more than 300 died.

The United Nations envoy to Somalia says: “Somebody is dumping nuclear material here. There is also lead and heavy metals such as cadmium and mercury – you name it”. Much of this hazardous waste can be traced back to European hospitals and factories, which seem to be passing it on to the Italian Mafia for cheap ‘disposal’.

At the same time, other European ships have been looting Somalia’s ocean of its greatest resource: seafood. European nations destroyed most of their own fish stocks by over-exploitation, and some are now trawling Somali waters. More than \$300 million worth of tuna, shrimp and lobster are being taken each year by illegal trawlers. A local fisherman told the Reuters news agency: “If nothing is done, there soon won’t be much fish left in our coastal waters”.

This is the world in which the ‘pirates’ of Somalia have emerged. Fishermen have taken speedboats to try to dissuade the dumpers and trawlers, or at least to levy a ‘tax’ on them. They call themselves the Volunteer Coastguard of Somalia.

Yes, some Somalis are thugs and gangsters. But there are also those with a different story to tell. Pirate leader Sugule Ali said: “We don’t consider ourselves sea bandits. We consider sea bandits [to be] those who illegally fish and dump in our seas”. The governments of the world have done nothing about starving Somalis paddling in someone else’s toxic waste, watching their fish being snatched away to be consumed in London, Rome and Paris. But when some fishermen responded by disrupting the sea passage used for 20% of the world’s oil supply, these governments took swift action, and the navies of more than 20 nations are currently sailing into Somali waters to ‘take on the pirates’. They will hunt them down and even chase them onto land, into one of the most broken countries on Earth.

The story of the 2009 war on piracy is perhaps summarised by another pirate in history, who lived and died in the 4th century BC. He was captured and brought before Alexander the Great, who demanded to know what he meant by “keeping possession of the sea”. The pirate replied: “What do you mean by seizing the whole Earth? Because I do it with a petty ship, I am called a robber, while you, who do it with a great fleet, are called emperor”.

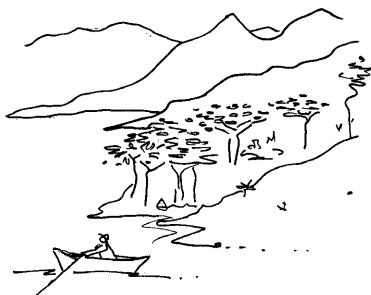
Work It Out Questions:

- How would you use the above newspaper story ...
 - In English Home Language? Consider the National Curriculum Statement Grade 8 Learning Outcome No.6 and “examining how language is used to construct gender, race, the environment, health, etc and how the reader is positioned”.
 - In a History lesson?
 - In a teacher education programme, to explore the idea of environmental justice?

- Where else in the curriculum could you use this article, and additional content about the wise or sustainable use of natural resources such as fisheries?

- Where in the curriculum could you use this article, and additional content about nuclear energy and nuclear waste?

- Where in the curriculum could you use this article to teach about human-environment interactions in Africa and the world, conflicts, inequalities and strategies to address development problems?



Of course, nature is not always kind to humans: storms, pests and droughts make life hard and create economic losses. But such challenges get even worse when we neglect to care for the Earth.

Ecosystem Services, Human Well-being, Resilience and Risks

Developers often discuss people, profits and the planet as if they are all separate, and necessarily opposed to each other. The idea of *ecosystem services* helps us to understand some of the ways in which the health and livelihoods of humans are dependent on the bio-physical world, and the risks to us, and to economic activity, of not managing this connection well. The concept of ecosystem services helps us to see that protecting natural resources is not in opposition to human well-being and development. Rather, we need to rethink the best ways in which to ensure the welfare of human populations into the future, by taking better care of ecosystems. This idea should be fundamental to sustainable development.

So, what are ecosystem services? Firstly, an ecosystem is “a natural system on land or water, or both, in which the living community interacts with its physical and chemical environment” (Irwin, 2001). A mountain rainforest is a type of ecosystem; a coastal mangrove swamp is an ecosystem, and so is a grassland near the Maluti mountains. In these ecosystems, micro-organisms and different plants and animal species interact with each other and with the particular types of soil, nutrient levels, rainfall and other conditions that prevail. (For an overview of the kinds of interactions involved, see Irwin, P, 2001, *Ecology: An Introduction to Principles*. Share-Net, Howick) There is competition for space and other resources, but also cooperation, as the activities of one set of organisms, often benefit others. In the process, ecosystems also give human beings many benefits, goods and services. Together, these benefits, both tangible and intangible, are called ecosystem services.

Forests

From forests, human societies have for centuries obtained materials like timber and rubber, as well as food and medicinal plants. Forests are places of great biodiversity, of spiritual value and aesthetic beauty which enrich our existence. Biology teachers will tell us that forest trees and plants also absorb carbon dioxide and release the oxygen that we breathe; they keep the soil intact, and they release water vapour which helps to bring rain. The destruction of the world’s forests for timber and cattle farming, is one of the main contributors to the increase in greenhouse gases and global warming. Around the world, where people have failed to look after their trees, the land has become bare and barren ... No wonder the 2004 Nobel Peace Prize winner, Wangari Maathai, decided to tackle Kenya’s problems by planting trees! (Also see ‘The man who planted trees’ in *Have you sequestered your carbon?*, Handprint booklet, Share-Net, Howick).

Freshwater Ecosystem Services

Although the surface of the Earth is mostly water, it is only a small portion of this water that is not salty, but fresh and therefore fit for human use. As a dry country, South Africa’s

freshwater systems – streams, rivers, wetlands and estuaries, as well as groundwater – are especially precious (See Unit 3.4, Water).

Ecosystem processes and wildlife, economic activity and human health all depend on an adequate supply of unpolluted freshwater. We realise this when we open a tap and nothing comes out!

When wetlands are damaged by construction works, or farming practices which cause soil erosion, they lose some of their ability to protect us from floods. When they are drained for housing or farming, or dry up because the flow in their upstream catchments is reduced too much by invasive weeds, forestry, dams or irrigation, they lose their ability to filter out impurities like sand, pathogens and excess fertilizers. Damage to a river, such as when river bank vegetation is cut down or ploughed up, also increases the silt and pollution load in the river and wetland. Water is critical for food security. (See Unit 3.6) Dry or damaged wetlands are no longer the lifelines they have been for many rural people, who rely on them for staple crops when the rains fail. (For more, see *Windows on our World: Wetlands*, Share-Net, Howick).

When rivers and wetlands become dry or too polluted, interesting and useful plants and animals die. Worse, lack of access to safe water is a leading cause of death among children in South Africa.

Estuaries are where rivers meet the sea. They are often at risk from development, because they are attractive places for development. But when they become dumping grounds for sewage, litter and industrial effluent, they lose their attraction for recreation and tourism development. Estuaries are also the breeding and feeding grounds for many crab, fish and prawn species, many of which are harvested commercially. By not preventing the pollution of estuaries, we put these food and development sources, as well as nature's biodiversity, at risk. In the year 2000, only 62% of South Africa's estuaries were considered to be in good condition. (See *Windows on our World: Wetlands*, Share-Net, Howick.)

School Stories

Many students and teachers have been venturing out and testing the pollution levels in wetlands, canals and rivers near their schools. Some have used the S.W.A.P. Water Testing Kits, to measure levels of turbidity, pH and coliform bacteria, among others. Others have included the SASI indicators for freshwater life, which are also used by scientists to establish the environmental health of rivers. The River Health Programme has produced useful reports on the state of various river systems around the country. These reports include information on various indicators of river health, main threats to a particular river, and in some cases the historical landscape changes that have taken place over time at this river.

Fynbos and Grasslands

Fynbos and Grasslands ecosystems are closely intertwined with the freshwater systems found in or near them. In the Western and Eastern Cape, fynbos vegetation helps to slow down and capture rainfall runoff. Unlike invasive weeds, indigenous plants help to increase the infiltration, replenish underground aquifers and make clean water available to streams, rivers, and eventually dams for agricultural and residential use. The same is observed in grasslands, and the denser vegetation along rivers. Where fynbos, grasslands or riverbank vegetation are invaded by weed species such as Port Jackson trees or black wattle, water either runs off too fast and is lost to the system, or is used up by the thirsty, non-indigenous trees.

Grasslands are among our most productive ecosystems, and have been grazed by wildlife and domestic cattle for hundreds of years. Grazing can actually increase biodiversity under some circumstances. The wise farmer knows the carrying capacity of the land, does not graze too many animals, or at the wrong time of year, and avoids sensitive areas like steep slopes, marshy areas and stream banks, to limit soil erosion. (For more, see *Windows on our World: Wetlands*, Share-Net, Howick).

The Atmosphere

The atmosphere is the layer of air around the Earth. It is not an ecosystem, but it connects with other systems and provides us with valuable services. The composition of the atmosphere is unlike that of any other planet, and it makes life as we know it possible. The Earth's atmosphere buffers us from extreme temperature changes, and softens the fierce radiation from the sun.

DID YOU KNOW?

It is possible to make seawater fresh in a process called desalination. Countries like Israel use this technology. Distillation and filtration processes are used. Distillation involves heating the water so that it evaporates off the salty components. Heating requires a lot of energy, though, and desalination makes every drop of water very expensive. This illustrates how much we owe our wetlands, rivers, grasslands and fynbos mountain catchments, for providing at least some of our water, for free!

Among the constituents of the atmosphere are atmospheric ozone, methane and carbon dioxide (CO₂). These (and others) are referred to as 'greenhouse gases', because they capture some of the sun's heat – like the glass in a gardener's greenhouse – to keep the air at a good temperature for plants and other life on Earth. But according to scientists there is an ongoing and escalating increase in greenhouse gases in the atmosphere. They attribute this to a rise in pollution: CO₂ from the burning of carbon-containing fossil fuels – oil and gas – e.g. in cars, planes and power stations; from the loss of forests; from the death of plankton in warmer waters; and from methane from natural decay but also from livestock in the meat and milk industry, growing rice and rotting rubbish dumps. As the atmosphere gets 'thicker' with greenhouse gases, the Earth gets warmer. The temperature rise may make the weather even more unpredictable than it is already. There could be more storms, more floods and more droughts, and they could be getting worse.

A small increase in global temperatures can have many other consequences. The ice caps at the north and south poles have started to melt. Rising sea levels will flood low-lying islands and countries like Bangladesh and the Netherlands. According to a recent report Bangladesh farmers are finding wells that were formerly sweet, turning salty, presumably as seawater starts infiltrating underground water sources. Rainfall patterns will change, with dry areas, including much of Africa, getting drier, and wet areas (like the east coast of SA) getting wetter.

Such changes will affect people's livelihoods. Most vulnerable are people with few development options, for example those who rely entirely on growing their own food, or on having some fruit and vegetables to sell at the market. Losing one's source of income to storms, floods and droughts, can destroy the livelihoods of families. Commercial farming will also be affected, and with it food prices and workers' employment. Environmental health could be affected. Diseases could spread and become more frequent, as the organisms which carry cholera or malaria, for example, thrive in warm conditions. The stocks of fish and other marine organisms, which are sensitive to temperature changes, may decrease, again affecting both commercial operations, and the livelihoods of poorer people.

FIXED: The hole in the ozone layer!

The story of atmospheric ozone is a positive case study of what we can do when we put our minds to it. When scientists discovered a 'hole' or a thinning in the layer of ozone (O₃) in the outer atmosphere, they called our attention to the risk. They pointed out that atmospheric ozone protected people and the planet from too high levels of solar radiation. Without this protection, people will develop more skin cancers and the plankton (microscopic plants and animals) which form the basis of the food chain in the oceans, will get 'burnt' and die. It was thought that atmospheric ozone was being destroyed by man-made chemicals, such as chloro-fluoro-carbons (CFCs), which had made it to the outer atmosphere. Environmental groups like WESSA and WWF then launched campaigns to ask consumers to avoid products with CFCs (such as aerosol spray cans and some cooling systems e.g. fridges). Industries got together, phased out CFCs and started producing alternative chemicals for aerosols and coolers. Recent images show that, perhaps as a result of this action, the ozone layer is again intact.

Oceans of the World

More than half the world's population lives within 200 km of the sea. In 2025, this will be the case for more than three-quarters of the world population! This shows that the sea and coast provide many natural resources like food, gas and diamonds, but also the development and employment opportunities associated with people wanting to live or relax by the sea. Industries value the shipping links, and many use the sea as a 'sink' for waste.

Managing resource use and pollution, so as to protect the ocean's ability to sustain such big populations, and its

biodiversity, is a challenge. By better controlling fishing practices, the industry could provide more jobs and feed more people, especially in developing countries. Unfortunately, most fishing zones are being fished out. This has much to do with fishing methods which kill huge amounts of 'by-catch'. Big fishing boats not only haul in the species they are looking for, but other species they do not want. They throw most of these – dead or dying – back into the sea, even if they are edible, but do not fetch a good price! In this way, millions of tons of fish are being wasted.

The United Nations Convention on the Law of the Sea, also known as the Montego Bay Declaration, was signed in 1982 and ratified by 130 states. The Declaration only came into force 12 years later. It set up exclusive economic zones giving coastal countries the exclusive fishing rights within a 370 km limit from their coasts. This aims to prevent countries which have exhausted their own fish stocks, from plundering the resources of other, often poorer, countries. (See the environmental justice story, Pirates of Somalia, in Unit 3.1) The countries have also undertaken to protect and exploit the biological resources of the high seas in such a way that sustainability is ensured. This can be achieved by using selective fishing techniques that reduce waste to a minimum and by monitoring fishing operations. It is also important to create protected areas, where no fishing is allowed, in order to replenish fishing stocks. The Tsitsikamma National Park was the first marine protected area in South Africa; others are following, with the help of the Marine and Coastal Management division of the Department of Environmental Affairs & Tourism, and WWF.

Is *aquaculture* the answer? Farming with fish, prawns or mussels may help to reduce the pressure on localised marine and coastal resources. Unfortunately, aquaculture is very susceptible to pollution, particularly near cities. This farming practice is also very aggressive towards the environment, because it discharges excess nutrients and antibiotics into the water, and destroys coastlines. The destruction of mangrove forests through fish farms and hotels have exposed coasts and islands to the devastating effects of tsunamis. This is an example of how an ecosystem which might look useless – a mangrove forest – has provided a service as a buffer against extreme weather, and how inappropriate developments have reduced the resilience (ability to bounce back) of the environment, and the local people.

For more on South Africa's marine and coastal resources see the Coastcare Fact Sheet Series from Marine and Coastal Management and accessible on www.sacoast.uwc.ac.za/publications. A general resource for schools is *Tell Me About the Oceans* from UNESCO Publishing, www.unesco.org.



Soil

We might not think of the soil as an ecosystem, but it is teeming with life! Literally thousands of different kinds of microbes and bigger organisms like earthworms live in the soil, and play a vital role in helping plants and agricultural crops to grow. The tremendous diversity of micro-organisms is dependent on the right chemical composition and availability of nutrients and moisture. Where the land is degraded and soil health compromised, it becomes much harder to grow food. Many schools and communities are seeing the benefits of food gardens, and feeding the soil naturally. For more on the links between healthy soils and food security, see Unit 3.6.

A *species* is a group of organisms which shares unique characteristics that distinguish them from other organisms. Spider monkeys are one species, vervet monkeys another. The Northern Cape's kokerboom, *Aloe dichotoma*, and the Eastern Cape's bitter aloe, *Aloe ferox*, are two different aloe species that look quite different from each other.

What is Biodiversity?

'Bio' means life, and diversity means variety. So 'biodiversity' refers to the spectacular variety of life forms on Earth. Scientists distinguish between three levels of biodiversity:

- **Species diversity.** This refers to the variety of types of plants, animals, and micro-organisms. Rainforests have very high species diversity, as they are home to thousands of different kinds of plants and animals.
- **Genetic diversity.** This refers to the variety of genes within a species of plant or animal. Healthy plant and animal populations have a genetic variety, that is, they are not all from the same small number of parents. Having gene diversity makes a species more resilient to diseases, climate changes and other risks.
- **Ecosystems diversity.** This refers to the variety of natural systems which provide the homes or habitats for all organisms. Examples of ecosystems are grasslands, fynbos, forests, mountain streams, rocky shores and sand dunes.

Why Value Biodiversity?

In Unit 3.2, Healthy Planet, Healthy People, we note that ecosystems provide us with a number of valuable 'ecosystem services':

- Services such as flood control (indigenous river bank vegetation), water purification (wetlands), crop fertilization (bees).
- Intangible values, e.g. spiritual places, a lovely view, relaxation.
- Tangible goods, such as water, fish, grass.

Biodiversity is fundamental to all these ecosystem services. For example, wetlands can purify water because a variety of plants and microbes live on those plants and at the bottom of the wetland, and help to filter out suspended soil and pollutants. Without the plants and microbes, a body of water (such as a dam) does not do the purification job nearly as well.

In mountain catchments, natural vegetation traps rainfall and slowly releases it to streams which eventually feed into wetlands and dams. In the process, they also purify the water. Natural resource economists calculate that this ecosystem service saves municipalities and rate payers millions of rands. Without indigenous plants in the catchments, water would arrive in dams carrying a load of eroded soil and other impurities; dams would silt up more quickly, and it would be more expensive to purify the water for consumption.

Biodiversity and the Economy

Biodiversity is also a vital element of many recreation - , tourism - and property development opportunities. People travel far to see the diversity of plants in the Cape Floristic Region, or the wildlife in the Kruger National Park. People also pay more for a house with a view over a sparkling river or estuary. Few want to live near a polluted canal!

Tourism is the fastest growing sector of the South African economy, and nature-based tourism, or eco-tourism, is an important element of the country's tourism economy. Visitors to national parks, beautiful beaches or other places of scenic beauty spend money and need services which in turn provide the basis for jobs and small businesses.

Work It Out Questions:

- Are there any holiday destinations and tourism attractions near to where you live? Do any of these rely on ecosystem services in which biodiversity plays a role?

- What biodiversity-based attractions might there be, that are currently un-developed, but could be developed in future?

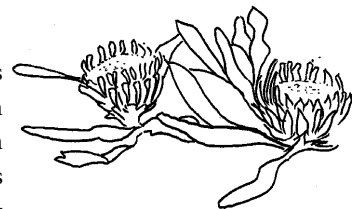
- How could current and potential nature-based tourism opportunities be managed for sustainability? (See also Unit 2.7 on Environment in the Curriculum: Tourism).

Many local economies are built on natural resources like fish, rock lobster and other marine and coastal species; on grazing for cattle and sheep; or on reeds and timber for building and crafts. Some people's livelihoods depend entirely on resources such as medicinal plants they collect in the wild, and supply to traditional healers.

Biodiversity – What's it Worth?

It is not easy to put a money value to biodiversity. A recent natural resource economics study estimated the total economic value of the Cape Floristic Region as at least R10 billion per year. This is equivalent to over 10% of the Gross Geographic Product for the Western Cape. A detailed study found that in 1999, wild fynbos flowers harvested on the Agulhas Plain in the South Western Cape contributed about R10 million to farm incomes. In that year, the fynbos flower industry as a whole generated a gross income of nearly R150 million from exports and local sales. Of this, about R86 million worth of flowers were harvested from the wild.

Among other fynbos resources, R12 million worth of buchu is exported each year. Its oils are used for food flavourants and perfume. In addition, about R5,6 million worth of thatching reeds were harvested in 1999. Fynbos also contributes to the honey and fruit industries in the Western Cape. Cape honeybees carry out an essential pollination service in the fruit-producing areas. (See also *The buzz on honey bee economics*, Handprint Booklet, Share-Net,



Howick.) When the fruit trees are not in flower, the bees forage in the fynbos. Without the fynbos to sustain the bees, the fruit industry could not be sustained. And last but not least, marine resources such as line fish, rock lobster, abalone and bait species also contribute to the provincial economy, with the industry being worth over R1 300 million a year.

Protecting Biodiversity

A large portion of South Africa’s eco-tourism income comes from visits to two protected areas: the world-famous Kruger National Park, and the Table Mountain National Park, a world heritage site renowned for its natural beauty, fynbos diversity and cultural significance. South Africa has many other national parks, as well as other kinds of protected areas like provincial parks and nature reserves, municipal reserves, private nature reserves in conservancies, and community game lodges. These are smaller, but dotted all around the country where they provide local opportunities for employment and tourism income generation, not only in the parks and reserves themselves, but through arts and crafts, restaurants, accommodation and other tourism-related activities in surrounding areas.

Protected areas are not only economically important. They are places where we can relax, get away from the stresses of life in cities and townships, and experience the tranquillity, beauty and interest of nature. They are places for children to learn about their natural and cultural heritage, and where scientists study nature and make recommendations on how best to manage natural resources.

And of course, they are a haven for wildlife. These days we find few wild elephants, lions and leopards outside of protected areas! But most of South Africa’s remaining threatened plants are on private land. It is therefore important that private farmers are joining government in setting aside land for biodiversity protection. They form part of conservancies or formal stewardship programmes, where the farmer agrees to leave a section of his farm undeveloped, for the survival of indigenous plants and animals.

Biodiversity Threats and Positive Sustainability Practices

Human beings co-exist with other species, but not always in harmony. When a species is extinct, it no longer exists. Some species are extinct in the wild - they only exist in zoos or botanical gardens. A species which is threatened (such as polar bears) or endangered (such as the Giant Panda) is at risk of becoming extinct.

There are many reasons why species become endangered or go extinct, but human practices usually play a big role. In Africa’s colonial history, hunting caused the demise of many animals, such as the Cape buffalo and the Cape lion. Hunters later helped to establish the first protected areas. Farmers protecting their stock with traps and poisoned bait have made some predator and scavenger species locally extinct, such as vultures, eagles, wild dogs and brown hyenas.

Remember the acronym HIPPO!

Habitat Conversion

Key factors that today contribute to species extinction are: Habitat conversion; Introduced species; Pollution; Population growth; Over-exploitation.

When we dig up natural areas for farming or mining, or drain and pave them for roads and housing developments, we destroy the homes of soil organisms, water life, trees, insects, birds and other animals.

Steps are being taken to reduce the impact of habitat conversion on biodiversity. We noted the role of private landowner stewardship in protecting biodiversity, above. Government

has also put in place legislation so that developers and local authorities must first do an Environmental Impact Assessment (EIA) before they can receive permission to develop a natural area. The EIA must, among other things, look at whether biodiversity will be threatened by the development. Developers may be required to rehabilitate the area which they have disturbed, so as to bring back the vegetation and wildlife which occurred there before the development started. This applies particularly to mining companies.

Introduced Species

People often deliberately or accidentally introduce a new, exotic or 'alien' species into a particular habitat. For example, we plant roses and mealies – species which did not naturally occur in Africa. Most of the time these introduced species have few harmful effects. But some of them wreak havoc among the locals. For example, introduced predatory fish favoured by anglers compete with or kill local fish, some of which are highly threatened because they occur only in very small areas. Invasive plants such as lantana, the long-leaved wattle and black wattle, are a problem because they crowd out the more valuable indigenous plants, use up a lot of water, degrade the soil, and can create a fire hazard, too. These plants, many of which are from our overseas neighbour Australia, are called *invasive* because they spread so quickly.

Government has launched a number of clearing initiatives, including the well-known Working for Water Programme. This programme creates jobs while taking out invasive weeds and trees and therefore securing a better water supply. Many schools have joined in hacking activities through which children learn about the threat of invasive weeds, the importance of protecting water and biodiversity, and how biodiversity protection can help create meaningful work. (For more, see *Clearing Invasive Weeds*, Handprint booklet, Share-Net, Howick).

Pollution

Many different kinds of pollution can lead to biodiversity loss. Contamination of the soil with hazardous wastes including the leachate from poorly managed landfills and mines, is an example. Agricultural run-off, and industrial and domestic effluent in water courses and the sea, increase nutrient levels in the water to a point where some algae overgrow and eventually kill other life. Plastic pollution in the sea kills thousands of sea birds and other marine creatures every year. We also intentionally use poisons to kill animals and plants regarded as pests; in the process others are unintentionally killed. And, toxins which build up in ecosystems sooner or later enter the food chains which link to humans. We should not need to eat a poisoned fish to realise that we are truly interconnected!

More indirect is the effect of air pollution, which can acidify soils and water courses to a point where sensitive water life is affected. These creatures, so small that they seem insignificant, are the basis of many food webs. Gases from burning fossil fuels and from rotting landfills, contribute to global warming (see Units 3.2 and 3.5). Scientists believe that the increased global warming we currently witness is a largely human-induced process of climate change that will change habitats, making some hotter and wetter and others hotter and drier. In the process, many plants and animals will lose the homes they are adapted to, and if they cannot find other suitable habitats, they will go extinct, either locally, or totally.

SCHOOL STORIES: Working for Biodiversity

Macassar High School in Khayalitsha, Cape Town, monitors the rehabilitation of sand mining operations in the dunes near their school. Other schools are establishing water wise indigenous gardens or small wetlands in their grounds; these bring back wildlife, and create places where children can study biodiversity, habitat adaptations and ecosystem interactions. In other positive case studies, community groups and traditional healers have started indigenous nurseries.

SCHOOL STORY: **limbovane Ants Study**

In an innovative project which teaches high school learners about science and the environment, and gives them an opportunity to contribute to 'real science', children trap and count ants in their school grounds, degraded environments, and natural areas (academic.sun.ac.za/limbovane/limbovanescience.htm). Using exact protocols, they send their data to a laboratory at Stellenbosch University, where the ants are identified, and data stored and analysed. The scientists hope to eventually plot the distribution of ants, and how they may be affected by climate change and habitat loss.

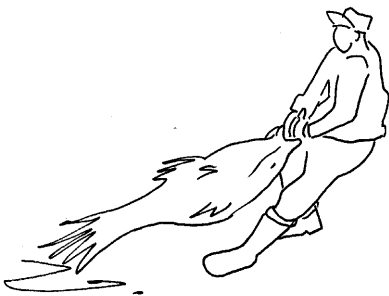
Population Growth

Factors responsible for biodiversity loss are caused or worsened by the exponential growth of the human species, on the planet as a whole, and in particular localities, through urbanisation, the migration of refugees and other movement patterns.

'Overpopulation' is perhaps best addressed through greater livelihood opportunities and economic security, and more equal power sharing between the sexes. Poor people with few resources and options may tend to have many children, partly because this is a way of ensuring enough hands to help make a living, particularly when parents grow old or ill. It is important that girls and women are educated and able to make wise decisions about their fertility, and have the right to 'say no'. With better education, employment opportunities and economic security, women – and men – have more options to choose from.

Over-Exploitation

Efforts to reduce the load on the Earth by slowing down population growth rates must go hand in hand with efforts to reduce over-consumption. In the words of Wolfgang Sachs, (2002, *Fairness in a Fragile World. Memorandum for the World Summit on Sustainable Development*. The Heinrich Boll Foundation. www.joburgmemo.org), there is no ecology without equality ... and poverty reduction requires wealth reduction. One wealthier person has a much bigger environmental footprint than ten poorer people together; the wealthy consume more resources and more energy, and produce more waste and pollution. Each person who becomes more affluent, would want to follow in those footsteps – unless the affluent start to set a better example.



CASE STORIES: **Trying Out New Ways**

Different roleplayers are looking for ways to stop the loss of biodiversity caused by the over-exploitation of resources. South Africa's government has declared marine protected areas, where marine and coastal natural resources are protected from fishing and harvesting, so that stocks can be replenished. It has also instituted a system of regulating catch sizes through licensing fishing companies and individual boats. Fisheries researcher Bernacia Andreas' first job was to accompany fishing boats to size their catches! But the licensing system is proving difficult to implement.

WWF trainer Sindiswa Nobula works with fishers to develop a greater awareness of the issues. The NGO also funds a technology design innovation, an SMS hotline which customers can use to find out whether a sea food is threatened (red), at some risk (orange) or ok (green). This is called SASSI, the South African Sustainable Seafood Initiative. Due to this kind of consumer awareness, retailers are starting to switch to 'green' species and turning away threatened species; this may in turn motivate fishing companies to start thinking 'sustainability'.

Water – Our Most Precious Resource?



STORY FOR CONTENT: Water in a Packet of Chips

It's break time, and you have a packet of potato chips to munch. Amazingly, this crispy snack connects you to the water cycle! (1)

Perhaps the potatoes in your packet have been grown in the Sandveld. Situated on the West Coast of South Africa, the Sandveld is hot, dry and sparsely populated (2). Mrs Rina Theron is a farmer whose family has learned to work with the limits of this environment. She grows seed potatoes, and sells them to farmers around the country, who in turn grow potatoes for food, closer to the markets. In this way, two generations of Therons have been able to sustain themselves and their workers on this land (3). But things have changed. In 2006 Rina and other concerned people called the Minister of Environmental Affairs and Development Planning for the Western Cape to the Sandveld to witness a water crisis (4). The boreholes which supplied the area with water were drying up (5). Not only was there no longer water to grow potatoes, but factories and homes in the town of Lambertsbaai were also without water. All had relied on groundwater, but the level of fresh water below the surface, the 'water table', had sunk very low. Sea water has started to fill the underground spaces which previously held freshwater (6). Now, if a borehole did pump up water, it was salty. How did this *landscape change* happen?

In the early 1990s Eskom brought more electricity to the rural areas on the West Coast. This encouraged farmers to exploit the local conditions including the sandy soils to grow the large potatoes that are ideal for the fast food industry. Electricity allowed them to now irrigate large fields with underground water, and they started farming on a bigger scale than before (7). While this was an example of development and growth, the higher level of water use was not sustainable for the Sandveld (8). If it continues, there may soon be no more potatoes at all from this part of the world, and another door to development may be closed to the local people.

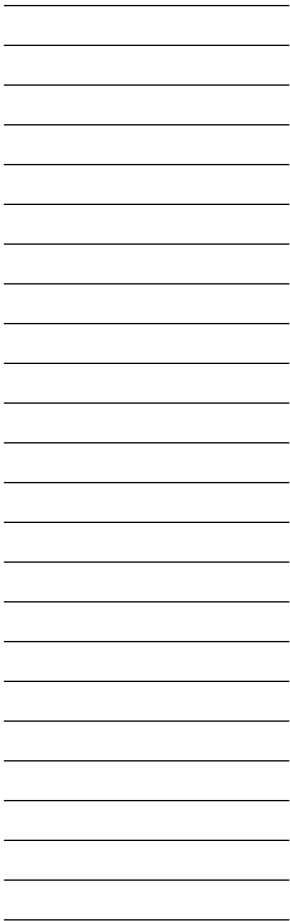
NOTE:

Numbers in the following sections, refer to numbers in the story above.

1. We often hear that water is essential for life, and the lifeblood of our economy. But we don't always consider how water is part of many everyday things. Learning how the water cycle works (see e.g. Irwin, P, 2001, *Ecology: An Introduction to Principles*. Share-Net, Howick) is a good starting point, and we need to picture ourselves, our daily habits and our development practices (such as producing food and other commodities) within this cycle.
2. South Africa is a dry country. Our mean annual rainfall of 450 mm is amongst the lowest in the world and we have frequent droughts, that is, long periods when the rains stay away. To make matters worse, most rain falls on a narrow strip along the eastern and southern coasts, and the rest of the country receives only a quarter of the rainfall. This is why there are fewer people and fewer jobs in places like Bitterfontein and Pofadder, than in Durban! Another factor making South Africa a water-stressed country is that only 10% of our rainfall is converted to runoff, which we can capture for consumption and development. Much of the rainfall simply evaporates. If global warming further reduces rainfall in the dry west and centre of South Africa, people's livelihoods will be even further at risk. Some climate change models suggest that

[illegible]

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Water Fit For Use

As the flows and volumes of water in our rivers and dams dwindle, water quality becomes a bigger and bigger issue. The National Water Act has a comprehensive definition for water quality, but here water quality simply means how pure and useable our water is. Many factors can pollute water and make it unfit for use. Among these factors are the following:

Heavy Metal Contamination

The mining of coal, diamonds, gold and other metals produces pollution in the form of sediment (sand), salts, acids, heavy metals like copper, and radioactive substances. Some of these hazardous wastes seep into groundwater, and/or contaminate rivers flowing out of mining areas. Although South Africa is a world leader in mine-water treatment, many mines have been closed due to changing markets, and some have been left ownerless ('ghost mines') and un-rehabilitated, in a state in which they continue to pollute freshwater systems.

Acid Rain

Industrial processes and power generation create air pollution. When waste gases such as sulphur dioxide (SO₂) and nitrous oxides in the atmosphere combine with rain, they make streams and rivers more acidic. Water organisms like to live at very specific acid (pH) levels. In many lakes in Europe, acid rain caused by air pollution blown across from Britain has killed all water life. Streams in the Drakensberg have turned acidic, even far from the sources of pollution.

Eutrophication

The accumulation of nutrients in rivers and dams causes an overgrowth of algae, which can choke the life out of a freshwater system. Eutrophication is said to be one of the most serious ecological problems facing the planet, and South Africa is one of the countries most affected. In 19 of our 20 biggest water catchments, nutrient levels are higher than the recommended guidelines.

A nutrient overload (also known as 'enrichment') can result in the growth of blue-green algae. These produce toxins that kill fish and other water life and may also harm humans; we don't yet know! What we do know, is that the levels of these toxins in our dams are among the highest in the world. What causes the nutrient overload in the first place? One factor is the use of too much fertilizer on fields, gardens and golf courses, which is washed by rain and irrigation into rivers and supply dams. Another source of excess nutrients is human waste, which runs into rivers from faulty or overburdened sewage works, and from informal settlements without adequate toilets. Water contaminated with sewage is a major source of disease including the diarrhoea which kills thousands of small children each year. At times, contaminated water carries contagious diseases such as cholera. In 2007, 14 million South Africans did not have access to adequate sanitation (toilet facilities). Even where municipalities have sewage treatment plants, many lack the resources and expertise to keep up the facilities, or respond to growing populations. And as our water becomes more polluted, with industrial, agricultural, mining and human wastes, the job of getting it clean enough for use, becomes even more difficult and expensive.

Endocrine Disruptive Chemicals (EDCs)

When we see a tin can or a plastic bottle bobbing in the water we might feel sorry for the frogs and fish. But humans are at risk, too. Tin cans and plastics are sources of EDCs which can mimic or suppress hormone activity, interfering, for example, with our natural growth

and fertility. Another good reason not to allow litter in our water courses! EDCs also come from pest-killers, detergents (like washing powders), cosmetics, toys and flame retardants used in the building industry. Which of these do you use? It seems that everyone has an act to clean up!

Better Practices

We must not waste water, and we need to do more with less. The concentration of potentially harmful substances increases as the water in a river, dam or wetland decreases. How can farmers, factories and families contribute?

One way in which government and many individuals are helping, is by clearing invasive weeds. These plants, especially trees like Port Jacksons and wattles, drink a lot of water which is then no longer available to farmers and other users, or to indigenous forests, grasslands and wetlands. Investigate the Working for Water programme or similar 'alien clearing' initiatives by your local authority.

Eastern Cape orange farmers have taken to mulching their orchards with a cropped growth of weeds. This improves the penetration of water into the soil during irrigation, and reduces waste. This sustainability practice also reduces the use of weed killers!

South African Breweries is determined to reduce its own water use, and that of its suppliers. Its Soft Drinks Division is aiming to reduce the amount of water used to produce one litre of cool drink from the current 2,4 litres, to below 2 litres.

Many schools have conducted water audits to investigate how much water they use, and where they can save water. They have taken positive actions such as fixing leaking taps, asking the municipality to fix leaking pipes, growing indigenous gardens and installing water wise toilets and urinals, and low-flow shower heads in hostels.

By reducing and managing our waste, we also protect water quality. We can invest in the reduction of the amount of pollution that lands up in our freshwater systems, from mines, old and new, from various industries, and from our cities, towns and informal settlements. For example, there are many alternative sanitation options to explore, such as urine-separators and composting toilets.

ALTERNATIVE SOLUTIONS: Urine Diversion Toilets

Waterborne sewerage is hardly a solution in a dry country like South Africa. Rural families have a free allocation of 300 litres per day. Should they flush any of this down the toilet? Other solutions such as urine diversion and dry composting are being explored. Teddy Gounden is helping the eThekweni Municipality to address sanitation problems through urine diversion toilets. (See <http://www.eco-sanres.org/>) In these toilets the acidic urine is diverted before it mixes with the faeces, where it would normally prevent bacteria from naturally breaking down the faeces. When the urine is diverted, the solid waste safely decomposes, before it comes into contact with the surrounding soil. To date some 55 000 of these toilets have been installed in the greater Durban region.

Finally, we need to value wetlands as natural water purification works. With their rich plant and microbial life, and the ability to slow down water flow, wetlands can trap and even filter out sediments, excess nutrients and contaminants like heavy metals. Looking after wetlands, means looking after our water supply.

Work It Out Question

- As a problem-solving exercise in science or technology subjects, investigate options for providing safe low-cost toilets to more South Africans.

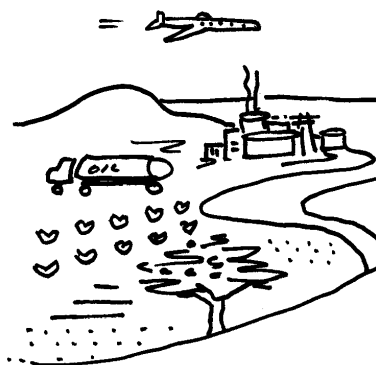
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Exploring water.

Also See:

Hattingh, H. et al. Overview on Water in *Enviropaedia*, www.enviropaedia.com, accessed 9 March 2009.

Jackson, T. 2009. South Africa: A ticking water bomb? *Africa Geographic*, pp.29-31.



Key ideas

Starting with definitions and concepts is not always a good idea. We can look up ‘what is energy?’ in a science text book and still be none the wiser on energy as a sustainability issue. It may be more useful to start with the contexts in which children encounter energy: electricity which they may or may not have at home; petrol in the car or bus which brings them to school; the kind of energy they may or may not have for work and play when they did or didn’t have a good meal.

Just like a person without energy, a car without petrol or a home without electricity, a country and continent has far fewer options when it does not have a steady supply of energy. Economic development depends on energy. South Africa’s main energy sources are oil, which we convert to diesel and petrol, some natural gas, and electricity which we generate almost exclusively from coal and enriched uranium.

It is the availability or lack of these supplies which is an environment and development issue, as well as the ways in which we obtain and use them – because the generation and use of energy has many health and environmental impacts. Currently there is a need to:

- ‘Save’ energy or use energy more efficiently
- Find new fuel sources, preferably renewable, and
- Find cleaner ways of generating energy, so as to minimise the impacts of energy generation and use.

Energy Stories

Power cuts in Cape Town

Where were you when the power failures of recent years first started? I was in Pretoria, helping with national curriculum training. My husband was writing exams at the Stellenbosch Business School. Each night, after putting our son to bed, he had to study. Early the next day he would drop our son with a relative and ‘race’ through 20 km of Cape Town’s traffic to sit the exam. Imagine the impact on him, when the power started failing! He suddenly had to study by candle light, and could no longer access the Internet or online notes. Worse, he was stuck in traffic jams at each of the dead traffic lights on the way to the university, worrying not only whether he would make it in time to the exam hall, but whether he would make it at all!

Heat wave nearly causes a nuclear melt-down

Earlier that same year, 2006, a heat wave had hit Europe. Many people died from the soaring temperatures. The extreme weather also placed the safety of nuclear power stations in France at risk, with reactor casings approaching a 500° Celsius danger zone. Attempts to cool the reactors by spraying water from the outside, largely failed. To avoid a meltdown, the French authorities were forced to release water at 300° C (three times the temperature of boiling water) into rivers, contravening their own laws. The risk of exposing the public to dangerously high levels of radioactivity, and therefore radiation sickness, was simply too high.

What do we learn from these stories?

A steady supply of electricity is fundamental to our modern lives. Everyone who has experienced power cuts will have a story to tell of how it affected them: going to school with crumpled clothes ... helping a shop owner to unpack spoiled food from a fridge ... noticing a smell when the pump at the sewage works failed ... being stuck in a lift ... or scared at night by the unusual dark. Take a moment to think of those whose lives are like this, all the time! Millions of Africans are still without access to electricity, and others struggle to afford it. Some feel that it is their right to have what others have, and make illegal and unsafe connections to the national grid.

The story of nuclear safety in a heat wave is an opportunity to discuss the different ways in which energy can be generated, and their impacts. Table 1 lists three methods for generating power. Today, the biggest issue being discussed around energy is climate change. Burning coal to generate electricity creates huge volumes of greenhouse gases, which contribute to global warming (see below). Nuclear power is an alternative to coal fire power stations, as are renewable energy sources like wind, wave and solar power.

However, most forms of energy generation have some environmental (as well as social and economic) impacts, and we need to consider these. In the 1990s, nuclear power was discussed as a big risk, in the wake of the 1986 explosion at the Chernobyl nuclear plant in the Ukraine, which unleashed high levels of radiation that killed and deformed generations of people, and created vast permanent 'no-go' zones. Today, new nuclear reactors are being designed, but a number of concerns remain about the technology (see Table 1). Among them is the fact that nuclear power is not really a clean form of energy, as CO₂ and other forms of pollution are still produced during the full production cycle. (For more, see *Enviropeadia* 2006-2008, Energy, pp.94-97, www.enviropeadia.com). Renewable energy sources, too, have impacts, and in South Africa they are still underdeveloped.

To understand the energy picture well, we must draw on the social sciences, physics and life sciences, as well as economics, technology and design. Table 1 provides some starting points for further investigation.

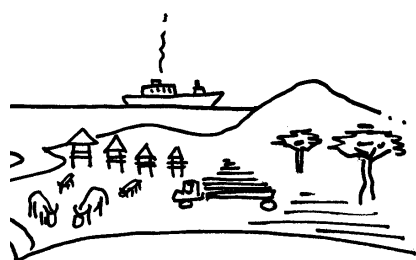
Impacts of Current Energy Practices: Global warming

There is a layer of gases around the Earth called the atmosphere. Some of these are called greenhouse gases, because they trap some of the Earth's rays, making the Earth a relatively warm planet, good for plants to grow, and good for people. By destroying forests, and pumping vast volumes of extra gases into the atmosphere, human activities have increased the greenhouse effect. As a result, temperatures are rising. Changes in the climate (from hot to icy) have always been part of the planet's history. The current temperature increases are however faster than any we can trace in the planet's history. Unit 3.2 has more on sources of greenhouse gases and the impacts of global warming.

South Africa has few opportunities to generate hydro-electric power, no oil and little natural gas. We do have plenty of sunshine, space and wind, and we also have coal and uranium, as well as the technology to access biogas (e.g. methane from landfill sites). Where should we put the emphasis, as we move to providing *all* South Africans with access to sustainable energy supplies?

TABLE 1: Comparing Different Options for Generating Electricity

COAL	NUCLEAR POWER	RENEWABLES (Wind, Sun, Waves, Biogas)
- Coal power stations can produce electricity in large quantities, and support high-energy applications. Unfortunately this power cannot be stored, and peak demand determines the level at which the plants must operate all the time. - South African coal is cheap and results in the cheapest power in the world, giving South African industries a competitive advantage, and making the country attractive to foreign investment. However, the low price does not include the price of pollution, and does not motivate us to use electricity sparingly and efficiently. - The technology for generating electricity from coal is relatively inefficient and wasteful. It also uses vast volumes of a limited resource, water. - Coal (and nuclear) power stations must be situated near coal mines, or water, and it is expensive to distribute power from here to distant areas. - Both coal mining and coal power station emissions cause acid rain which harms freshwater systems and agricultural land, making food production more expensive. Large solid waste (ash) dumps are also produced. - Burning coal creates SO_x, NO_x and CO₂ which are greenhouse gases, and also contribute to lung and heart diseases.	- Nuclear reactors also generate sufficient quantities of power to support energy-intensive industries. - They do not emit air pollution and greenhouse gases during the electricity-generating process. - However, nuclear energy production does create pollution during uranium mining, the release of radiation and the production of hazardous waste. When the life cycle of nuclear energy is considered, including the decommissioning of the reactor, nuclear energy produces 3-4 times more CO₂ per unit of energy than renewable energy sources. - While radioactivity is natural, nuclear power generation produces radioactivity beyond natural levels. Extensive safeguards are therefore necessary against the risk of releasing the highly destructive radioactivity generated in a nuclear reactor. Where this has happened, e.g. through human error, it has caused radiation sickness and barren zones. - Nuclear wastes takes thousands of years to become safe and there are no long-term storage facilities for this hazardous waste. (Some European countries 'export' nuclear waste to Africa (although it is illegal to move nuclear waste across international boundaries) or, as in the case of Spain (Barcelona), started switching to renewable sources.) - It takes 10 – 18 years for a nuclear reactor to produce more energy than it required during building and fuelling; nuclear reactors also have relatively short life spans. - Nuclear reactors are expensive to plan, build, fuel and decommission (close down safely). Big investments in nuclear power reduce the resources available for developing a wider range of alternatives.	- The renewable energy sector and the available technologies are still largely under-developed. This is both a negative and a positive. Scandinavian countries, Germany and now also the United States of America under President Obama, see important development opportunities in renewable energy technologies. - At current levels of development, wind and solar energy cannot generate the amounts of power required by energy-intensive industries such as steelworks or aluminium smelters. The possibility of large solar 'fields' is being explored. - Unlike nuclear and coal power stations, it takes current generation solar nets and photovoltaic cells less than three years, and wind turbines only one year, to generate more energy than was used to build them. - The production and disposal of solar panels produces pollution. In general, though, renewable energy technologies produce considerably less pollution, greenhouse gases or hazardous wastes, than coal and nuclear. - Renewable energy can be applied on a small scale, near to where people live, thus encouraging development in remote areas, provided that people can learn to manage the technology. The windmill familiar to dry parts of rural South Africa is a traditional renewable technology which has been maintained with some success.



More Energy Stories – Towards Sustainability

As a science or technology project, create your own wind-power generator, or geyser blanket. One Grade 10 student made a wind-generator that produced enough electricity to power the scoreboard at the school's cricket field, making his design, in his words, “a valuable awareness-raising tool”.

Plant trees or a spekboom hedge, to sequesterate (trap) carbon. See: “The carbon issue: Spekboom wonderboom”; “The man who planted trees”; and “How to plant a tree”, in *Have you sequestered your carbon?* (Handprint booklet, Share-Net, Howick.).

Do a desk top or Internet analysis of the use of biogas like methane from landfill sites, and biomass converters, as alternative energy sources.

Investigate the social and environmental impacts of producing and using fuel for transport (oil, petrol and diesel, as well as biofuels). See www.enviropaedia.com (Energy, p.96) for some starting points. The online *African Energy News* newsletter provides access to a number of articles on biofuels; see www.energynews.co.za.

Many actions we can undertake to reduce our carbon footprint - such as less private driving, better public transport, reducing consumption and the amount of waste we send to the landfill site, more recycling, switching off phone chargers, heaters and TVs at the wall, and planting more trees - are all good for people and the environment, in general. They can save water and other natural resources, and reduce unhealthy pollution.

Renewable Energy for Rural India

In India, where it is not economically feasible to take main-stream power to the thousands of tiny villages dotted around the country, efforts have gone into alternative energy sources, such as solar panels and biomass digesters, to give rural households a renewable energy source for a fridge, a small TV, some lights and a computer and Internet connection – thus giving them vital links to the outside world, an improvement to their quality of life, and opportunities to advance localised, small-scale development. India is a leader in innovative small-scale, renewable energy.

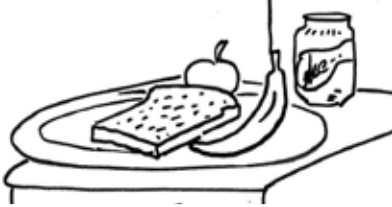
The Situation in South Africa

The South African government has set a target of producing 15% of the country's energy from renewable sources. Individuals and industry have taken the lead, however. The first wind energy in South Africa was generated by a private entrepreneur on a farm near Darling on the West Coast. Recently the battery company Eveready and its associate, Kestrel, built three wind turbines for Pick and Pay's regional office in Port Elizabeth. Pick and Pay is now less dependent on the availability of traditionally generated electricity, and able to feed 'clean' and renewable energy into the national grid.

Work It Out Question

- What amount of carbon does your lifestyle send to the atmosphere?

For a South African carbon footprint calculator, see the Carbon Action Programme (CAP)'s calculator accessed via www.90x2030.org.za. This website also lists comprehensive resources to understand climate change, and various actions to address this issue. Also see www.steadfastgreening.co.za for a range of carbon-footprint calculators.



A Key Issue

When deciding what environmental improvements they want at their schools, many teachers choose to start a vegetable garden. In a large number of South African homes, there is simply not enough food.

Nutrition is thus a social and educational issue, one that is linked to the bio-physical world, and to many economic and political aspects of our environment (see Figure 1 in Unit 1.2). Food demonstrates the links between a healthy environment, and healthy communities. It also illustrates environmental injustices. For, while millions of people go hungry, others produce too much food, and such are our economic and political systems, that extra food is often dumped, rather than distributed. And children who do have access to a variety of foods, and pocket money, may be influenced by advertising and poor examples to make unhealthy choices.

Thus, whether one teaches in an affluent school or in a no-fee school, food is likely to be relevant. In the curriculum it is addressed in various learning areas and subjects, including Agricultural Sciences and Life Orientation, where nutrition and healthy choices are explicitly stated content and learning outcomes.

Cultural Factors Influencing Food

As young children encounter the wider world, at street vendors or in friends' homes, they notice the amazing variety of foods. It is fun to explore with them the dishes favoured by families from different cultural backgrounds. Consider the diverse ways in which Chinese, Afrikaans, Xhosa, English and Indian families prepare chicken!

As people mix and travel around the globe (globalisation), cultural practices change, often becoming more similar. These days you'll find people of all cultures tucking into barbeque chicken with a sweet-and-sour sauce, and a serving of maize meal pap!

We can learn from diets that sustained people for hundreds of years. In Africa, groups who traditionally had a mostly meat and grain diet, had the 'indigenous knowledge' to supplement the meal with *imifino*, dark green 'spinaches', to add more vitamins and trace elements. Some cultures practise vegetarianism, that is, they do not eat meat. Millions of people in India and China get their proteins from pulses (beans and lentils), and they add flavour with spices. Diets based mostly on grains, pulses, vegetables and fruit, make a lighter footprint on the Earth than diets with a high content of meat and dairy produced through intensive farming (see below). New ideas on nutrition also favour such a diet.

However, people in India and China are eating more meat, as their economic circumstances improve. This could be a reason for rising food prices and shortages. Land previously used to grow grains and vegetables, is now being used for meat. It is more expensive to produce meat, and it is also not possible to produce the same quantity of food from a cattle farm, as from a similarly sized grain or vegetable farm.

Bio-Physical Factors influencing Food

The threat of global warming and climate change puts food security at further risk. Already Cape farmers can no longer grow apples where they used to, as the cool season favoured by this crop, is now too short. Farmers with more knowledge and resources will be able to adapt (resilience), but those without such resources, will be more vulnerable to change. Extreme events like floods and droughts may become more frequent and more severe with global warming. They can cost commercial farmers and the insurance industry millions; they can also wipe out the entire livelihoods of subsistence farmers.

Besides temperatures, weather and water, another bio-physical factor vital in food production is the soil. While we cannot control the climate, we can improve soil health and therefore crops. Healthy soils are free of pollution and contain a good balance of nutrients like nitrogen, phosphates and carbon, which millions of soil microbes help to process and make available to plants. Plant roots also modify the environment to suit their needs. (For information and activities, like a compost column in a plastic bottle, and models of soil erosion, see *Soil is life!* from Share-Net, Howick.)

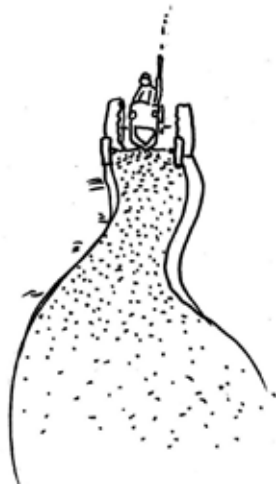
Soil is formed very slowly, and farmers must protect the valuable topsoil from eroding away. Factors which degrade the land and cause soil erosion include over-grazing with too much livestock on the land, for too long, and invasive weeds which don't bind the soil well. (For more on invasive and exotic plants, see *Clearing Invasive Weeds*, Handprint booklet, Share-Net, Howick.) A buffer of indigenous plants along rivers and wetlands stops soil from washing into water courses. It also helps buffer farmers' fields during floods. Many traditional soil protection methods have been forgotten, or are being set aside in efforts to make more money. Thus farmers might plough and plant right up to the water's edge, only to find their crop drowning in a flood, or the river turning green, when fertilizers wash into the water and cause algae to grow in excess.

In the early history of agriculture, farmers used to enrich their soil in various ways, e.g. adding manure or nutrient rich ash from burning plant materials. The Venda people used to laboriously build stone walls when cultivating steep slopes to stop the soil from washing away.

Today organic farmers are returning to compost and manure to feed the soil, rather than chemical fertilizers; they control pests through natural means, such as inter-cropping and resting the soils rather than pesticides; recycle water; and mulch to reduce water loss. Buffers of indigenous vegetation are being protected between fields and along water courses, and form corridors for wildlife. Organic farming methods produce smaller and more variable crops, but have many benefits. Health experts say that eating food containing hormones, pesticides and other artificial substances can harm our health. For this reason, consumers are prepared to pay more for organic produce.

But poor people also need access to healthy food, free of toxins and potentially harmful additives. Fortunately many organisations and communities have seen the benefit of growing fruit and vegetables in home gardens, school and community projects, using permaculture methods. In addition to producing food that promotes human health, these 'low-input agriculture' methods are low-cost, although some of them may be labour intensive. They also sustain and improve the environment, rather than deplete it. On a larger scale, organic or permaculture methods contribute to sustainable agriculture; people can work the land and reap the benefits, for much longer, perhaps indefinitely.

But economic reforms are also necessary to make farming and food production more sustainable, as we note below.



Intensive Agriculture

Agriculture on an industrial scale started with a new technology: In 1909, a German chemist, Fritz Haber, worked out how to make artificial fertilizer. Haber's invention launched intensive agriculture. This type of farming relies heavily on fossil fuels and manmade chemicals for fertilizer and pesticides; on hormones to raise large numbers of animals as quickly as possible, and antibiotics to control disease; and on big machinery (and therefore less manual labour).

The latest addition to the technologies which have revolutionised farming is genetic modification (GM). Scientists insert gene material from one species into another species, for example, a gene portion from an organism which is resistant to a particular herbicide, is inserted into the genes of a crop like maize. Then the farmer can spray his maize with that herbicide to kill weeds, while the maize survives, because of its modified genes. Scientists are also developing GM crops that are drought resistant.

The industrial revolution in farming has allowed us to produce foods which look perfect for the market, in large quantities - enough, in fact, to feed the world. Unfortunately, the methods for achieving this kind of development have a downside. People are concerned about the effects of hormones and antibiotics, herbicides and pesticides now found in our food. Farmers have been heard saying they won't eat the apples or yoghurt they produce on their own farms! We have no studies to reassure us that eating GM foods will not harm our health. We know that millers add large volumes of pesticides to stored grains, to prevent them from being eaten by rats and weevils. More artificial chemicals are added to food during production.

Many common foods like bread, juices and snacks, have long lists of added ingredients, and the processed foods which many of us favour for their convenience and taste, have little nutritional value. More and more people are suffering from allergies and illnesses that are hard to explain and cure. Some are linking these to pollution and the increasingly artificial nature of our environment, including our food and water. Nutritionists have linked children's learning and behavioural difficulties to a lack of good nutrients, and an overdose of artificial chemicals. (See for example www.foodforthebrain.org.) Consumers can make choices, but only if they have full information about the contents of what is in a particular product, and what impact it may have on health. One study found that the bulk of sampled food items on South African shelves contained genetically modified material. This included products that were labelled 'non-GM'.

Environmentalists are also concerned about the effects of agri-chemicals in our ecosystems. In a book published in 1962, called *Silent Spring*, biologist Rachel Carson warned about the effects of pesticides and herbicides on America's wildlife. This was one of the first environmental 'wake-up calls' to be made in the western world. Today there is concern about honey bees which are dying in great numbers (see *The Buzz on Honey Bee Economics*, Handprint booklet, Share-Net, Howick.) Bees and other insects provide a free ecosystem service by pollinating fruit and vegetables. Without them, it would be much more difficult to grow food!

And there is a new warning: the Millennium Ecosystem Assessment (www.millenniumassessment.org) reported that the Earth's freshwater systems are being polluted to such an extent, by, among others, the excess of nitrogen and phosphates that run off from agricultural lands, that the water we have for drinking and producing food is becoming harder to purify. (See Unit 3.4.)

Economic and Political Factors affecting Food

Farmers probably don't set out to pollute the environment! They are under pressure to produce more, as the price they receive for their produce is often barely enough to cover input costs. Farmers have little control over inputs costs, particularly of artificial chemicals. For example, they are at the mercy of the oil price, which is used in agri-chemicals as well as machinery. To access bigger markets, farmers compete against producers in other parts of the world. But if farmers in other countries are receiving higher subsidies from their governments, or have cheaper fuel or labour costs, South Africans may pay less for a bag of oranges produced in those countries, than for local oranges! Economics, marketing and advertising are important determinants of what we grow, and what we eat. For example, farmers may grow crops that are not really suitable for local conditions (such as maize, as opposed to drought-resistant grains like sorghum) because maize is better marketed. In other cases, soya and milk products are relatively easy to produce and often in oversupply; they are marketed so well that they appear in numerous foods, even if their nutritional benefit is less than that advertised. For example, children are taught to drink milk for strong bones, but for humans the calcium in milk is more difficult to absorb, than that in, say, broccoli.

Northern hemisphere countries (those with more economic and political power) have put in place trade regulations that make it more expensive for southern hemisphere farmers (from less powerful countries) to sell their produce overseas. No such regulations exist for the southern countries. Wealthier countries also subsidise agricultural production in their countries more heavily. As a result, some producers have an advantage over others in the global market.

Agri-business has been promoting intensive agriculture as a means to eradicate world hunger. In the process, it has made profits, and helped to increase production including in the southern hemisphere, where its technologies are being sold under the banner of a 'green revolution'. However, case studies of the green revolution in India, and the introduction of GM crops around the world, has shown that farmers can become more vulnerable with the introduction of agri-chemicals and technology, and often end up in worse economic circumstances, at the mercy of escalating input costs. While bigger scale farmers have benefited in some instances, many small-scale farmers have lost their land in the process. Farmers who start using GM seeds are locked into contracts whereby they must keep buying new seed and the herbicides and pesticides which have been designed to go with the GM crop.

Socio-Political Factors influencing Food

It is said that agriculture today produces enough food for everyone in the world to have a solid meal. Yet millions of people are underfed or starving. Many factors are to blame for this.

Among them are socio-political factors such as civil wars, and internal policies. In many parts of Africa, fighting between different ethnic groups, with arms readily supplied by others, has made it impossible for people to grow food. Food donations to refugees are often

SUSTAINABILITY PRACTICES: A Case of Green Coke?

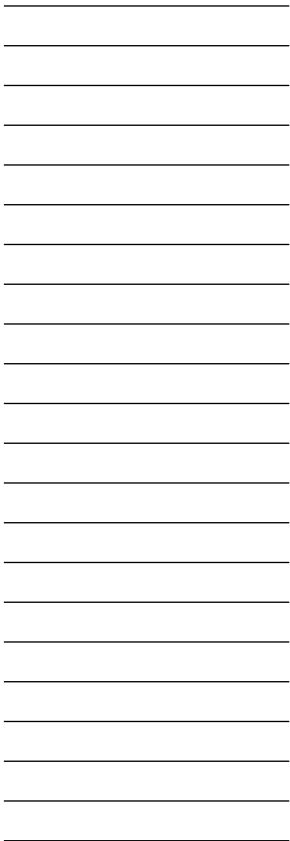
New developments in sustainability practices include product stewardship (see www.productstewardship.org) and eco-labelling. Industries are becoming concerned about their sustainability and public perceptions of their environmental performance. They want to take greater care of the impacts of the products they produce, from the cradle to the grave. Coca Cola International is one such company (see www.thecoca-colacompany.com/citizenship/watermain.html). A big consumer of sugar and water, Coke has been able to reduce water use at its plants (see www.cokefacts.com for a case study from India) and has expressed interest in a Sustainable Sugar Farm Management System (SuSFarMS) produced by a group of sugar cane farmers in Kwa-Zulu Natal, with the help of WWF and WESSA's Mondi Wetlands Programme.

There is much potential in industry, environmentalists, farmers, consumers and governments working together towards a future where enough food is produced, using farming practices that are better for the environment and people's health. As with timber products (where there is an eco-label for forestry stewardship) and seafood (there is a label for tuna, for example, caught by dolphin-friendly fishing methods), agricultural produce can now be labelled to show that producers have given attention to environmental and consumer health. Farmers, industry, consumers and the planet benefit.

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Even good governments may fail to help feed their people. An over-reliance on agri-business puts food security outside the control of those for whom it matters most, namely the farmers and consumers. History has shown that both commercial and subsistence farming need strong support, in the form of financial subsidies, trade regulations, and information. Low-intensity agriculture, which relies less on expensive external inputs, does not produce the volumes, consistency and appearance of produce which global markets may demand. However, it can play a huge role in feeding communities, and ensuring food security.

(For more, see *Creative Garden Design*, Handprint booklet, Share-Net, Howick; *The Organic Classroom* from seed@intekom.co.za, or contact an organisation like Food and Trees for Africa, Abalimi Bezekhaya or WESSA's Eco-Schools programme.)



Growing own food

See for example the description of carbon and nitrogen cycles in *Ecology: An Introduction to Principles*, by Pat Irwin, 2001, order from p.Irwin@ru.ac.za or call 046-622 4800).

[illegible]

Production of a vast variety of non-essential products, and marketing to encourage consumption, have been pillars of the modern world economy, which explains why it is so difficult to reduce our waste and consumption. The waste products of modern societies create three problems:

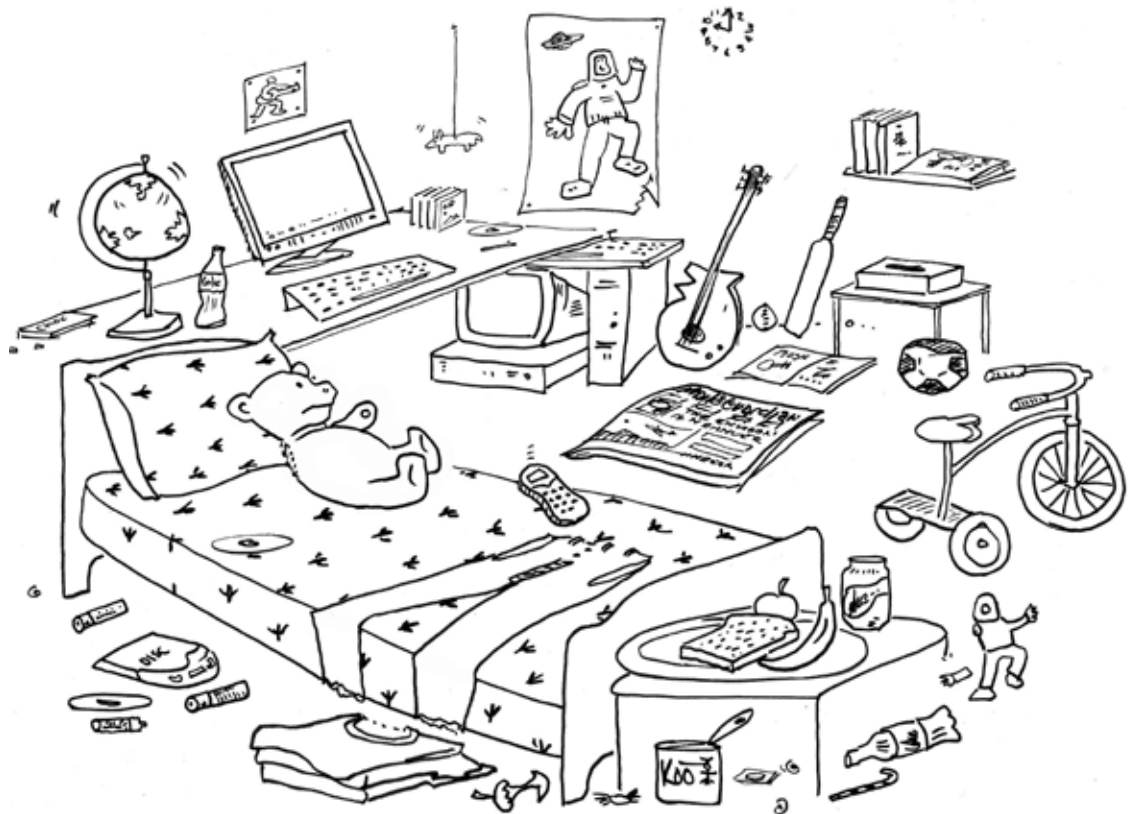
STORY FOR CONTENT: **The Life of a Battery**

In life cycle analysis, scientists examine how products are made, used, and disposed of from beginning to end or 'from cradle to grave', and calculate the impacts they have along the way. Thus they found that one AAA battery pollutes 500 litres of water and one cubic metre of land for 50 years. If we consider that South Africans throw away 50 million batteries each year, which mostly end up in unlined landfill sites, we can use our maths to get a sense of the combined impact on our environment, of just one item in common use.

- **Too much waste** – The lifestyle of each one of us produces on average about 1 kilogram of waste per day ... Landfills are filling up fast with residential and industrial waste and municipalities are struggling to find new and affordable sites. Some cities dump their waste in the sea; others send it to poorer countries where it can provide some form of employment, but also serious health and environmental hazards. (See below.)
- **Pollution** – Both the making and the disposal of modern day products can create pollution. The problem is not simply unsightly litter. Pollution involves a variety of substances that are released into the air, water and soil, where they can harm the Earth and human health. Sea birds die from plastics in the sea; people fall ill when sewage contaminates their water; the planet is heating up as industrial activity fills the atmosphere with more methane and CO₂ than there has even been in history.
- **Ruining resources** – Making all the stuff we eventually discard, uses huge amounts of energy and natural resources like water, timber, oil and minerals as well as land. In the process, natural habitats and biodiversity are damaged or destroyed.

Better Waste Management Practices

SCHOOL STORY FOR CONTEXT: **Room to Reduce, Reuse, Recycle**



Larissa Roux gave her students this task, adapted from *Exploring Your Environment*, by Kay Wilkins, published by Tormont in 2008 (pp.38-39):

You have to tidy this messy room. Some items are broken, no longer used, or simply destined for the bin. If you were to use good waste management practices, what would you do with the following:

Apple core	Plastic bottle
Newspaper	Glass bottle
Old poster	Sweets wrappers
Magazine	Broken toy
Tissue box	Old scooter
Old clothes	Used batteries
Empty tin	Old computer

Recycle – Paper, tins, plastics and glass

When litter lies about, it must be tidied up. But what happens afterwards? One of the easiest ways to reduce the amount of waste we send to the landfill is to recycle the bio-degradable component, like garden refuse, fruit peels, egg shells, newspapers and any other matter on which nature has a 'take back' policy. Compost can be made, following some simple rules, and used to start up or enrich a garden. Or set up a composting wormery and watch nature's recyclers turn food scraps into sweet smelling soil. (See the *Footprints Guide to Earthworm Farming* on www.ru.ac.za/documents/Environment, or the Handprint booklet *Worming Waste*, from Share-Net, Howick).

Paper, glass and tins can usually be recycled quite successfully. Conduct a waste audit to see if you have enough of these items to make recycling viable (see *Working with Waste Guidelines to Recycling Solid Waste*, on the Department of Environmental Affairs and Tourism's website, www.environment.gov.za/nwmsi/Recycling/rec-reports.html). Plastics are convenient, light materials and some can be recycled, although it is hard to sort plastics, and recycling some plastics produce pollutants. Many common items *cannot* be recycled at all, because they have not been designed with the end in mind.

The list of things that we can recycle is growing, but there are limitations to recycling. Among them is the cost to the environment of various steps in recycling processes, like heating (melting and separating) and washing, which uses energy and water, and transporting materials to centres for highly specialised recycling. Sometimes the markets for recycled materials are limited. For example, when there is an oversupply of recycled paper pulp, it is not economically viable for waste businesses to collect more used paper. This is one of the reasons why schools and other drop-off points may sit for months with uncollected materials, which can become a fire and health hazard, and douse everyone's enthusiasm.

In such cases, we need to re-think recycling! (See below and Handprints article, *Waste reduction and creative re-use beats recycling at a Grahamstown school*). You will probably be able to recycle some items, but your first aim should be to reduce waste at its source.

Repair, reuse, reduce – Beat recycling any time!

Repair broken appliances, mend old tools, clothes and toys, and sell or share them. This can create work and skills development opportunities for able-bodied and disabled people. Schools which cannot recycle glass, tin and paper can team up with charities or start new social entrepreneurship initiatives to provide the needy, such as victims of crime, shack fires or floods, with clean, used toys and clothes.

The Department of Science and Technology has published Fact Files and other teachers' resources on bio-technology including biofuels and genetic modification. Access them on www.pub.ac.za. For an article on treating wastewater with bioremediation, see www.engineeringnews.co.za.

Reuse containers and other items. Teachers are masters at collecting and using empty containers, used paper and other bits and bobs for artwork, technology lessons and fine motor development activities. Many school gardens feature used tyres in edging or built-up beds. Younger students re-use one-sided paper to make gift cards or note pads. Older students can explore a business case with a local retailer to re-fill juice, paint or detergent containers.

Recover – Managing E-Waste

A fast growing waste 'stream' is that of electrical and electronic waste, or E-waste. Centres are now being set up to receive broken electrical appliances, old cell phones, computers and other electronic equipment (see www.e-waste.org.za). Articles are fixed and redistributed if possible, or dismantled. Parts that can be re-used are turned into something useful or novel. Where facilities exist, valuable components like gold can be retrieved. Unfortunately, many components cannot be recycled or reused, and the content of some (such as laptop and cell phone batteries) is often toxic. E-waste is therefore a huge problem worldwide. It is also an environmental justice issue. Richer countries have taken to 'dumping' old equipment in poorer countries, where the poorest families work in businesses which use harsh chemical separation processes to retrieve any valuable scraps. These processes are so toxic that workers die on average within seven years.

Restore – Managing sewage and mine effluent

A very different waste challenge is managing sewage. Millions of South Africans do not have access to safe toilets, and informal settlements pollute rivers and groundwater with human waste which can contain disease-carrying organisms. Wetlands are nature's waste treatment works, and if we look after them well, they can filter out some impurities and pathogens and reduce the water purification cost to municipalities. We can also call on nature's biological processes to help break down human wastes (faeces and urine) in a variety of low-cost toilet alternatives to water-borne sewage systems. These include urine separators and composting toilets (See Unit 3.4, Water).

On the high-tech front, scientists and engineers have developed bio-technology treatments for waste, like microbes which are added to sewage waste to purify waste water (bioremediation), and others which take out harmful heavy metals from mine effluent, restoring the water to a state where it can be released back into the environment.

Rethink – Hazardous Waste, Packaging and Production

Once we get involved in better waste management, we realise that clean up campaigns and recycling are not the full answer. We need to rethink the sorts of things we humans have been doing, since we were hunter-gathers!

We don't *have* to pollute our world with the toxins leaking from batteries. One rechargeable battery replaces 1000 ordinary batteries ... but still contains toxins. Some batteries can be recycled: drop them off at Pick and Pay. But battery recycling comes at a cost ... They will be driven to Midrand, sorted, recycled if possible. Some will be shipped to France for specialised processing. Others must be buried at great cost, in concrete blocks in lined landfill sites. Wind-up torches and - radios need no batteries. Batteries that last indefinitely have been designed years ago. At the time, however, this alternative technology was against industry interest. So the patent was bought, but never put into production. Today environmental awareness is growing and consumers will start avoiding harmful products. It is now in industry's best interest to produce alternatives.

We are a thinking, creative species, who can come up with alternatives. Inspire the next generation of engineers, entrepreneurs and homemakers to do just that! We need to rethink, for example:

- Unnecessary packaging
- Harmful production and disposal processes
- Why we buy things we do not really need
- Ways of growing an economy without encouraging excessive consumption.

Replace! Poisons and hazardous chemicals are commonly used as cleaning agents, weed killers and pest killers. Check your school storeroom, home and garage, and see what you can carefully dispose of, and replace with safe alternatives.

Refuse! If a development generates by-products which we are unlikely or unable to dispose of safely, the best option may be to refuse it.



Teaching Well: Methods with Purpose

UNIT 4.1



Key ideas

Section 4 describes some of the many teaching methods that can be used for environmental education in schools. You may think that there are some good ideas for activities in here, to put some zip into your teaching, wake up your students and even inspire your colleagues. And you would be right! But remember: It is important to teach the basics and to get the basics right. South Africa's children need to be taught well. Use methods like projects and dramas wisely, so that students can achieve the required learning outcomes and so that poor results can become a thing of the past.

When choosing a teaching method and a learner activity, always ask yourself:

1. What do the children need to learn?
2. Is this activity the best way for these children to learn this?
3. Does the activity give them access to new knowledge and/or relevant skills?
4. How does this activity connect with what we have done before?
5. Does it prepare students for what we will do next?
6. What must we do afterwards, to check and consolidate learning?
7. How long will it take to do this activity well?

Don't be afraid to try out a new teaching method or learning activity, but only if your answers to most of the questions above, point you in its direction.

It is no coincidence that certain subjects favour certain teaching methods. It relates to the *purpose* of the curriculum, and the potential of the method.

For example, over the years geography teachers have found fieldwork to be a useful method (which is after all also used by practising geographers), while English teachers like to use dramas and debates, to get students to use the language and learn to think well. That is not to say that the Geography class cannot also have a debate about a geography topic (such as sustainable development) or that English teachers cannot use the writing of fieldwork reports as a language activity. But always consider the intended learning outcomes (curriculum purpose) when you select methods and activities.

Also consider: how do children learn? The short answer is: in different ways. For example, foundation phase children, busy integrating left and right brain hemispheres, learn to read and spell *both* through sight (left brain, lumping together) *and* through phonics (right brain, splitting into bits). So multi-sensory methods are recommended (e.g. let them sound out words *and* use flash cards). In numeracy, 'work it

In the 2003 Trends in Mathematics and Science Study (TIMSS) SA learners' results placed South Africa last among 30 developed and developing countries.

In 2005 the Progress in International Reading Literacy Study (PIRLS) tested the reading skills of children after 4 years in school. SA came last of 40 countries. Almost 80% of our learners did not reach the lowest benchmark.

(SEE ROSENBERG, E. 2008 IN *SOUTHERN AFRICAN JOURNAL OF ENVIRONMENTAL EDUCATION*)

out' activities are vital to establish concepts, but rote learning (such as counting in fives, or reciting the 12 times table) also helps with calculations.

There are also learning differences between children at any given age. Some children must be physically active in order to 'get into' something; some must see or touch solid objects to make sense of a concept, while others respond well to a verbal lesson, or a book. All children learn by making connections to what they already know, and fail to learn if there are no connections. (See constructivism and situated learning in Unit 1.2). All children benefit from experiences that help them to make sense and to remember.

The upshot of all this is that teachers should use a *variety* of teaching methods. But use and combine this variety of methods appropriately. Below is a framework to help you do just that.

Putting it all together: Frameworks for combining activities meaningfully

With an educational purpose in mind, educators carefully combine methods for a coherent lesson or learning programme. Rob O'Donoghue developed a framework for active learning (Figure 3) which illustrates *one* way of combining activities that work together towards intended learning outcomes. The process can start anywhere – with an enquiry, an action, or a reflection on something that was learnt previously.

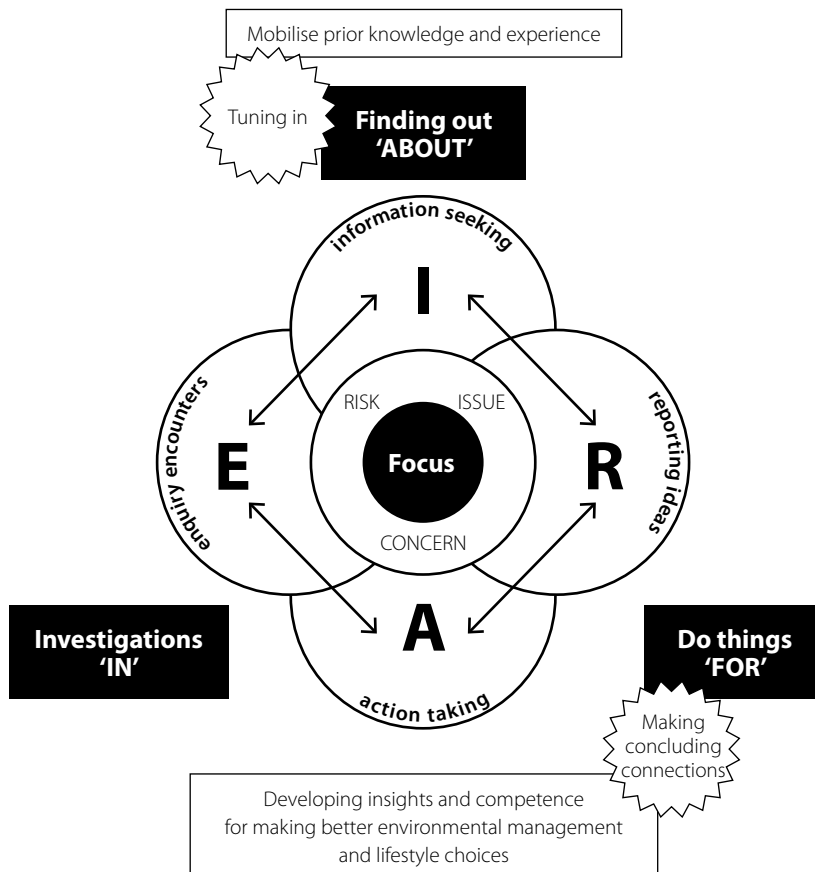


FIGURE 3: Active Learning Framework consisting of Enquiry Encounters, Information Seeking, Reporting and Action Taking (O'Donoghue, 2005)

[illegible]



Choose one or more of the teaching and learning processes (surveys, audits or investigations) but make sure that deliberation is part of all of them. You and your students could start by doing a *biodiversity audit* (count), e.g. of all the different types of plants and wildlife you find in and along a river, comparing areas where there are indigenous plants on the river banks, to areas that are infested with alien species, or canalised. You could walk along the river and *survey* what the landscape looks like. Students could interview local people in a door to door survey, to find out how the landscape

FIGURE 4: Biodiversity Conservation

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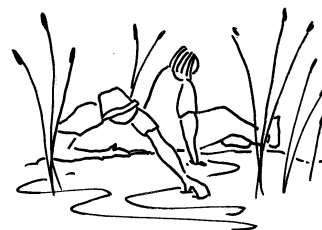
Methods and processes to support change-oriented learning. Towards better environmental sustainability practices. 2008 C.A.P.E. CEP, Rhodes University.

Finding Out: Fieldwork, Audits and Other Enquires

UNIT 4.2

SECTION 4 METHODS

The enquiry methods discussed here involve students going out of the classroom to collect new information, that is not already available in a report or on the Internet. These methods provide children with opportunities to observe carefully and work with data, to develop an understanding of how knowledge is constructed, of the potential pitfalls and the value of access to trustworthy data. They can learn to be critical of claims (such as adverts or political speeches) not backed up by evidence.



If the enquiry (investigation) is well planned and guided, students will, through seeing and doing, learn more about the topic being studied than they would from simply hearing and reading. Remember, however, that enquiries are best supported with good information, such as a textbook or Enviro-Facts. Field enquires also provide those all-important experiences (e.g. of a rubbish dump, of the marvellous diversity in an indigenous forest, or of people being angry about pollution) that not only enrich, but can form the very basis of learning concepts and values. Because the students are actively involved in generating the data, enquiry methods are particularly helpful for those learners who need concrete and physical experiences to 'switch on' to learning. No wonder these methods were popular in many schools, long before outcomes-based education introduced an emphasis on active learning.

Fieldwork is one enquiry method. It is most often used in social sciences, geography, the natural sciences and life sciences. The students try out, at a level appropriate for their grade, the investigation methods which natural and social scientists use to find out about social and ecological issues, and how to manage them better.

There are various ways in which to do fieldwork, but some elements are essential. First, the students must understand what they will be investigating, and WHY. They need to have a question to answer, and they need to know why this is a useful question. The National Curriculum Statements recommend that from early on, learners themselves are involved in deciding what questions to ask and what to investigate, but teachers will need to add to the pool of knowledge so that children also become aware of things they did not know they do not know! A useful question might be: "To what extent are the people living here affected by floods?" in a geography study about the loss of wetlands (which can lead to increased flooding).

The next step is to plan the investigation. Be realistic about what can be achieved: 10 interviews would be more realistic than 100, even for high school students, and Foundation Phase learners can benefit from interviewing just two friends about litter! Students need guidance on how to generate the data – conduct interviews, count species, or measure water and electricity consumption. Give attention to the units they use, and accuracy. Young learners can use cups as measuring units, counting and reporting accurately. Older students, working with millilitres, litres and kilolitres, must not confuse these units in their calculations and graphs. Once the data is collected and presented accurately, they need to interpret or make sense of their findings. Check for accuracy, so that students do not come to wild conclusions that are not supported by data. In fact, the curriculum requires that we teach about biases and errors in data and how to avoid them.

A *survey* is one form of fieldwork. Through a survey one can develop a general view. Children can ask local residents about landscape change, or about the ecosystem services they use (see Figure 4). For example, what ecosystem services does a local forest, grassland or estuary provide the residents being interviewed by the students?

Audits are another form of fieldwork. (For a very useful resource on auditing water, waste and energy, see *Global Change. The Green Audit Toolkit*, www.capetown.gov.za/environment). Audits involve activities to find out what is there or verify exactly what a situation is, using quantitative data. Audits involve measuring and counting, to answer the questions: How much? How many of each?

Audits help us to better understand a situation about which we may simply have a 'gut feel'. For example, everyone knows that litter is a problem and we all have ideas about how to solve it, but our solutions do not always hit the spot. By doing a litter pick-up at school or at a beach, and then a waste audit of the content of the collected bags (identifying the different items that were picked up, and then counting how many of each item there is in the waste) students can come up with a plan for how to reduce the litter. Cool drink cans and glass bottles can be recycled, if there are enough of them. Chips packets, lunch wrap, cigarette butts and many plastic bottles *cannot* be recycled, and if these make up the bulk of the collected waste, recycling is not the answer to this litter problem. (See Unit 3.7).

Other examples of audits for schools are:

- Biodiversity audits, that is, counting the number of different plant or animal species in a marked-off area.
- Resource use audits, e.g. measuring the amount of water or electricity used at home or at school.
- Natural resource use audits, e.g. audit the amount of medicinal plants collected by a rural community, or what distances women travel to collect fuel wood or water, in settlements without ready access to these resources (see Environment in the Curriculum: Geography, Unit 2.2).

Audits can be made more meaningful if a sense of scale is introduced. Is 50 a lot, or not? This can be done by doing two audits and comparing their results, e.g.:

- Compare the water use in the staff and student toilets, or electricity use in the different residences in a residential school.
- Compare the amount of water used by a wealthy school, to a no-fee school.
- Compare parents' petrol consumption before and after the introduction of car pooling at the school.

Compare the rich biodiversity in a nature reserve with the limited biodiversity in a plantation; or the biodiversity in the school grounds before and after the school starts its own indigenous garden.

Also See:

Experiments are another form of enquiry and are discussed in Unit 4.6.

Methods and Processes To Support Change-Oriented Learning. Towards better environmental sustainability practices. 2008 C.A.P.E. Conservation Education Programme, Rhodes University Environmental Education & Sustainability Unit, Grahamstown.

SCHOOL STORY: Field Work in the City

Meg Wilding of Wynberg Girls' High School tasked her Grade 9 learners to conduct a local environmental survey for Social Sciences (Geography). They worked in pairs to identify environmental problems in the areas where they live, find out more about them and take action to publicise and address the problems. Meg gave the learners the following project outline:

- 1 Identify any problems in your community. If possible, provide photographs or pictures of these problems. Describe the problems. (Maximum two A4 pages)
- 2 Compose and write a formal letter to the local community newspaper. Highlight the specific problems and suggest possible solutions to these problems. (One A4 page)
- 3 Make an educational poster to raise awareness of these problems and to encourage people to participate in solving them. (A3 size)
- 4 Refer to the outline below on Conducting an Environmental Survey. Draw up a table listing 10 issues and score your environment out of a total of 50 (5 points per issue).
- 5 Include a bibliography of resources used.

Conducting an Environmental Survey

Think of 10 things that affect the environment in your area. Give each a score from 1 to 5:

- Very bad 1
- Bad 2
- Fair 3
- Good 4
- Excellent 5

Add up the scores and find the total out of 50. A low total will mean an unsatisfactory environment. A total above 35 will indicate a pleasant environment.

Examples of Environmental Problems: air pollution, broken pavements, garbage removal, graffiti, homelessness, lack of open space, litter, untidy gardens and yards, vandalism – these are only a few. What else can you think of?

School Story from *Cape Flats Floral Treasures*, by Ally Ashwell.
Used with permission of the Botanical Society of South Africa and City of Cape Town.



Recording observations during fieldwork at the landfill site.

Acting It Out: Drama, Role Play and Debate

UNIT 4.3



Dramas or dramatic plays are a favourite among environmentally minded teachers, and environmental matters are the topic of many a lively school play – whether it be the Foundation Phase learners in butterfly wings and bunny tails, or the high school environmental club performing a play on ‘load shedding’ in an environmental festival. Sometimes we may not realise the educational value of these events, and it is worthwhile doing so, given how much time and effort can go into the preparation and performance of school plays.

The National Curriculum Statement for Grade 8 (Arts and Culture) requires learners to “use the arts to demonstrate an awareness of environmental concerns”. When Grade 8 students take part in writing, producing and performing an environmental drama, this is thus an integral part of their curriculum, and can be assessed as such.

There are some do’s and don’ts for drama as an educational method. For example:

- Do give students good environmental information, and opportunities to experience issues first hand.
- Don’t underestimate how difficult it can be to portray the complexity of even the most common environmental issues in a short play. Make sure you and the students have a good grasp of the content and the nuances of the issues involved. Often, the play must be re-worked a number of times.
- Don’t forget that, even if one is working with serious environmental content, a play still requires dramatic elements like humour, action or surprise. If the play is to be performed, there needs to be equal attention given to the environmental content and the dramatic content (particularly if it is to be assessed for both).
- Do give students guidance in the dramatic art bits (facing the audience, moving on stage, voice projection, diction, body language, etc).

Consider developing a dramatic play towards the end of a learning programme, perhaps in partnership with colleagues teaching other subjects. It is a useful way to help learners to make concluding connections and it provides them with an opportunity to take action, in this case, the action of raising awareness about environmental issues and possible solutions, among their peers and other audiences.

Role-plays are usually less formal than dramatic plays, and need less time, but still provide students with an opportunity to learn through physical, emotional and intellectual involvement. An example might be posing students with a dilemma: “Some of you are the managers of a national park. Some of you farm next to the park. Some of you are animal rights activists” (or, in the case of younger learners, elephants speaking for themselves). “Do a role-play of the day after elephants broke the park fence and destroyed the farmers’ crops.”

Role-plays give both participants and onlookers an opportunity to empathise (put themselves into the shoes of others) and to understand better experiences, contexts, and the complexities of environment and development issues. Communication skills are strengthened, as is the ability to think critically and creatively, not only around the complexity and implications of environmental issues, but also around problem-solving and the possibilities of more sustainable practices.

As with dramatic plays and debates (below) it is important to provide learners with information. For example, if they can read or hear about some of the ways in which conservationists have tried to manage elephants in parks (e.g. translocation, birth control, culling) they are in a better position to deliberate options and develop sensible and realistic suggestions. A role-play which ‘goes nowhere’ might simply make children anxious about the environmental problems in the world, which is not a desirable learning outcome. (Unit 5.1 lists resource materials on a variety of environmental topics.)

Debating is more ‘cerebral’ or abstract and lacks the physical and dramatic elements of drama and roleplay, but has earned itself a spot among the tried and tested teaching methods, particularly in the languages and subjects with controversial content, such as history and geography (think of environmental justice or land use conflicts, as topics for debate). Debates are also useful for consolidation, providing an opportunity for learners to make sense of and display what they have learned through individual or group projects, or classroom study, and to test their ideas against others’. Debates are particularly good for exploring the complexity of environmental issues, for honing language use, reflection and critical thinking skills, and for showing that our arguments must be well-reasoned and backed-up.

School Story

Mabongi Mtshali’s environmental club members have been learning about energy conservation through a project on the solar cooker box (a low-cost technology, also known as a hay box, which continues the cooking and keeps the pot warm through insulation). They have also learnt about the value of wild plants such as the wild spinaches that add to the nutritional value of many rural meals. They then developed a play that helped them to make connections between the topics, and to consider the relevance of what they have learnt. Mabongi explained:

“Our play had two aims: Promoting the use of the energy-saving cooker, and raising awareness of the benefits of knowing and using wild plants as food.

This is the story line of the play, “*Fed from the Veld*”:

The setting is a rural family. There are four characters. Mother (M) from rural area, Daughter (D) from rural area, Girl cousin (G) from the city, Boy cousin (B) from the city.

G visits her rural family. She has brought the cook box as a present. The rural family does not believe the wonders of this cooker. M decides to use it while G is still around. She cooks the mealie pap overnight. To her greatest surprise, when she checks the following morning the porridge is cooked. She affirms that this indeed a miracle. She has saved wood, paraffin and time and top of that, the bottom of the pot remains clean!

With great excitement she wakes up the children to go and collect wild spinach to eat with the pap. B is not keen to join the girls. He believes that food gathering is girl stuff. An argument follows. The city boy argues that rural people end up collecting even poisonous plants, eat them and die. D challenges him about this assertion and concludes that the deaths he refers to are just figments of his own imagination. She in turn reminds him about a number of reported cases of illnesses and even deaths from eating tinned stuff.

G is, however, keen to gather wild spinach. She feels more privileged than her classmates because her teacher has given them a project to identify and study five edible indigenous spinach plants. When the teacher announced this, the class was at a loss and they felt their long weekend had been spoilt. G had brought along her Wild Plant Field Book. She takes it along with her when they go to collect spinach. She feels very envious of her rural cousin’s knowledge of the wild spinach. The city cousin uses her book to check the scientific names as they pick the wild spinach. They find the following species:

- *Imbuya (Amaranthus)*. The city cousin is reminded to pick the young shoots. She learns that some people believe that the young shoots promote the flow of milk in breastfeeding women.

- [illegible]

Did you notice?

- ## Work It Out:

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-
-
-
-
-

Berold, R., Burt, J. and Carklin, M. 2000. *Interactive Drama for Environmental Educators*. Share-Net, Howick.

UNIT 4.4

SECTION 4 METHODS

[illegible][illegible][illegible][illegible]

- [illegible]

[illegible][illegible]

Can Do: Reading and Writing to Learn

UNIT 4.5

Clearly, schools need to teach children to read and write. Environmental education activities must contribute to these learning outcomes, where appropriate. Without these basic skills, children are unlikely to gain schools-based information about their environment.

And, the responsible, involved citizen envisaged by environmental education, is someone who can read to find out more about their environment, its marvels and its issues, someone who can think clearly and logically and who can write when necessary to communicate about and address issues. The 'can do' citizen is the one who, when her newly built house collapses after the first rains, writes a clear, concise letter to the newspaper, the mayor and the building contractor. The 'can do' citizen

is the young man who stands up in a meeting, confident about the facts he read about, and speaks logically about the link between the factory that pollutes the air, and the high rate of asthma in his community.

In the Foundation Phase, much school time is dedicated to learning to read and write. Environmental activities and resources must contribute to this primary goal, which is taken further in the Intermediate and Senior Phases, and in the Further Education and Training band, where the skills of reading and writing in another language (in South Africa, principally English) also becomes part of being a literate, critical and responsible citizen, able to engage effectively with the world.

What are the implications?

- Environmental materials developed or chosen for schools, must be appropriate in terms of supporting the goals of developing literacy skills. For example, the reading level must be appropriate, and the font shape and size must be suitable.
- Note that the National Curriculum Statements recognise the sense in combining literacy (and numeracy) teaching with pertinent environmental and social issues, human rights and justice. (See Languages and Mathematics.)
- Make the most of the interesting content often associated with environmental topics. Some children ‘sit up’ when they read about the plight of a wounded animal; others will be fascinated by maggots in the tap water. For many boys in particular, relevance of content is a big factor in motivating them to read and write. Relevance of content is also important for those children who, despite a teacher’s best efforts, struggle with literacy, because of their home background and/or poor past tuition. Environmental content, well chosen, can be the connecting point to make the letters, words and sentences fall into place!
- Give students ample opportunity to write for different purposes: “Write a report in which you analyse the causes of global warming.” “Write creatively about a future in which only renewable energy is used.” “Write the text for a mural or poster calling the community to save energy.” “Write a letter to the press on the same topic.” Note the different structures, formats, language use! Finally, give students constructive comments on their writing, so they know what to do to improve.

Some 61% of South African students cannot read or write at the age when they are expected to do so.

(DEPARTMENT OF EDUCATION, 2003)



Writing activities are not always popular in schools. Many children find them laborious, and busy teachers with big classes can more easily mark a multiple choice test, than three pages of writing per student. But writing is critical, for language development, conceptual development, and of course functional literacy.

From their first day at school, children can keep a journal; first simply drawing what is on their minds; then adding some scribbled letters using functional spelling: MI KAT ES BULAC (My cat is black). No matter how higgledy-piggledy, this early start makes a vital point to the young student about *purpose*: language is used for a reason (expressing your mind, communicating). It is not just a rote exercise to keep you quiet! Copying from the board can help learners to get the letter shapes right and to get parts of the brain to work together. But there the value of copying probably ends.

Students must do their own writing, express their ideas and their understanding of concepts, as a means to help them think through these ideas and concepts. Such writing is not merely a language activity (although it is vital in developing critical and creative thinking). Writing can help to develop (and reflect for assessment) the understanding of curriculum concepts (like sustainable development) including those in science and maths. Concepts like 'classify' and 'equal to' have a language component. If you don't know the word, it is difficult to express or work with the idea, and this is surely one of the reasons for the majority of South African children's disastrously poor mathematics and science results, as they encounter concepts through a language in which they have had precious little practice.

SCHOOL STORY: Zulu idioms in the environmental club

Mabongi Mtshali asked the members of her environmental club to observe birds at home and to do a survey about them. The students did observe birds but most of them – and their families – did not know the names of the birds they saw. They interviewed community members and asked for traditional idioms about birds, but very few were forthcoming! If Mabongi had left things there, her club members would have learnt little besides the fact that birds are not well-known in their community. Instead, she provided them with a bird guide and a book with Zulu idioms. Their next assignment was to *read* through these and then to formulate, in *writing*, some questions for a visiting speaker from a local bird club.

Case story provided by Mabongi Mtshali, Natal Museum, Pietermaritzburg

Work It Out Questions

- Consider the following two exercises. Compare them in terms of the skills, knowledge and values they are mostly likely to encourage among students:

Exercise 1

Which of the following are associated with global warming:

- carbon dioxide
- nitrous dioxide
- sulphur dioxide
- methane
- oxygen?

Exercise 2

Describe in a few sentences of your own what global warming is all about.

Try It Out: Experiments and Action Projects

UNIT 4.6

NOTE:

Taking action here does not mean 'active learning' (opposite of passive) or taking part in general learning activities. It refers to taking (or planning or proposing) actions that will help to address an environmental issue, make the environment a better place, and sustain it better for the future.

Experiments are a form of enquiry that can happen in the classroom. As a teaching method they have all the benefits of enquiry methods, e.g. an experiment provides a concrete, hands-on learning experience, and gives children the opportunity to try out the ways in which working scientists develop knowledge, find out things about the environment, and come up with solutions to problems. Experiments can also strengthen learning: seeing is believing! They are a valuable means of helping learners come to understand concepts, that may otherwise be simply memorised in rote fashion, and simply forgotten after the exams, or even before! Such rote learning is unlikely to develop the commitment and skills that citizens require to consider environmental issues and develop better sustainability practices.

SCHOOL STORY: Litter at De Hoop

Sindiswa Nobula set up an experiment for demonstration purposes at the conservation education centre at Potberg, in the De Hoop Nature Reserve in the southern Cape. She filled three see-through tanks with beach sand. In each tank, along the front-facing side, she buried an item found on the beach: a banana peel, a plastic bottle and an oil can. She then labelled each tank with the date on which the items had been buried. Visiting school groups can now look at the display and discuss the extent to which each item had degraded in the sand in the preceding weeks and months, and the concept of bio-degradable ... before they set off for a litter clean-up on the beach.

Experiments have always been part of the teaching methodology in some schools, and it is good to know that they do not necessarily require laboratories or sophisticated apparatus. (See for example the adjacent School Story.) Today the National Curriculum Statements emphasise the value of enquiry methods and require children to engage in simple experiments as a basis for learning. The first learning outcomes of the Natural Sciences and Life Sciences require the development of enquiry skills, and students are expected to learn to identify the need for and set up simple experiments, conduct them and observe, record and interpret the outcomes.

Action projects are strongly promoted in some environmental education programmes. For example, the Eco-Schools programme requires schools to do projects to improve their environment (e.g. establishing gardens, or reducing electricity use), and recommends that students participate in these projects. The City of Cape Town is one of many schools'



partners that encourage students to undertake an investigation followed by an action project (see e.g. the Youth Conference on Sustainable Development). Many teachers also find that action projects are a natural outflow of environmental education lessons: once learners have learnt about an environmental topic, they often want to take action in response to what they have become concerned about.

Examples of action projects could be:

- Make a poster that raises awareness of an issue the students investigated
- Do a dramatic play or art work to communicate about the issue
- Write a letter to the council to remove an illegal waste dump
- Run a recycling project at the school
- Start and maintain a vegetable garden at the school
- Design and/or make something to address a problem or need.

Also see the Handprint booklets for ideas.

Proponents of socially critical environmental education believe that by being actively involved in environmental action projects or initiatives, children are more likely to learn about the issue they are addressing in a meaningful way, to gain a positive outlook rather than a sense of despondency, and to develop the commitment and capability to address issues.

South Africa's National Curriculum Statements include citizenship education in the underlying principles of and values of the curriculum (derived from the South African Constitution), and as a specific strand in Life Orientation. In both primary and high schools, Life Orientation students are required to become involved in action projects to address social and ecological issues that affect them and their communities. It starts small, when children must come up with suggestions on how to make their school or home a healthier place. In the Social Sciences, too, there is room for environmental action projects.

We need to remember, though, that children are not always in a position to address the environmental issues they identify or explore in their lessons. They may be too young, the issue could be too big, too complex or controversial, or the time too limited. However, they can come up with solutions and suggest actions, and they can also explore the positive actions that others have undertaken. (See Handprint booklets and Figure 4). Also note that project work does not always include action-taking. For more on project work specifically, see Enviro-Facts: Doing Projects.

SCHOOL STORY: **Starting a garden**

Fadia Abbas and learners from Levana Primary School, Cape Town, have developed an indigenous Strandveld garden at their school. Fadia tells their story:

The Cape Metropolitan Council ran a Water Conservation Competition for schools during 2000. We decided to start a Water-Wise Garden. In May I received a fax from Mr Josephs of the South Peninsula Municipality Water Department offering us R90 worth of plants, which we could collect from Kirstenbosch Gardens. During the June holidays I met with Liesl van der Walt at Kirstenbosch to find out more about their Water-Wise Garden. As I am not a gardener, I also had to get help from other sources. At first I didn't know what to do about our sandy soil conditions, but after attending a workshop at Rondevlei Nature Reserve, I learnt about the plant and shrubs that grow in Strandveld areas. We only started upgrading our rockery at the end of August. I met Cherry of the Sandvlei Trust and she recommended that we use dried pondweed to improve soil aeration and water penetration. The Parks and Forests Department delivered a truckload of these plants that had been removed from Sandvlei. Once the soil was prepared, I collected 36 plants from Kirstenbosch Gardens. The boys in my class laid out the garden one Friday afternoon using bricks to make footpaths (their idea!). They also did the planting.

- The principal and staff of our school were so impressed with the garden that they want the class to upgrade the rest of the school grounds!
- The learners enjoyed working in the garden – it was great fun!!
- Our school came second in the CMC competition – we won a DVD player for the school and the learners had a free trip to the Two Oceans Aquarium. Wow ... what a surprise!!

We definitely see our school garden as an ongoing project ...

Case Story from *Cape Flats Floral Treasures*, compiled by Ally Ashwell.
Used with permission of the City of Cape Town and Botanical Society of SA.



Work It Out Questions

- Consider Sindiswa's example in the first School Story from De Hoop, and design an experiment in which learners compare brown paper bags, plastic bags and cloth bags, in terms of how environmentally-friendly they are.

- If you were teaching at Levana Primary, could you use the indigenous garden referred to in the second School Story, for curriculum-based teaching? Provide your lesson plan.

[illegible]

Also See:

- Action Research and Community Problem-Solving. In *Methods and Processes to Support change-oriented learning. Towards better environmental sustainability practices*. 2008. C.A.P.E. Conservation Education Programme, Rhodes University Environmental Education & Sustainability Unit, Grahamstown.
- Demonstrations & Experiments and Projects and Practical Actions. In *Methods and Processes to support change-oriented learning. Towards better environmental sustainability practices*. 2008. C.A.P.E. Conservation Education Programme, Rhodes University Environmental Education & Sustainability Unit, Grahamstown.
- Hart, P. 2000. Searching for meaning in children's participation in environmental education. In B. Jensen, K. Schnack, & V. Simovska (Eds.) *Critical environmental and health education - Research issues and challenges*. Research Centre for Environmental and Health, Danish University of Education, Copenhagen.
- Meucci, S. & Schwab, M. 1997. Children and the Environment: Young people's participation in social change. *Social Justice*, Vol. 24.
- Hart, R. A. 1997. Children's Participation: The theory and practice of involving young citizens in community development and environmental care, Earthscan, London. (www.unicef.org)

Work it Out, Make it Work: Problem-solving and Design

UNIT 4.7

SECTION 4 METHODS

The teaching methods discussed here involve students in working out solutions to environmental problems, through deliberation, group discussions, and/or practical problem-solving, design, making and building. These are all valuable opportunities to develop the understanding, positive commitment and skills (action competence) to engage in sustainability practices to better address social and environmental issues.

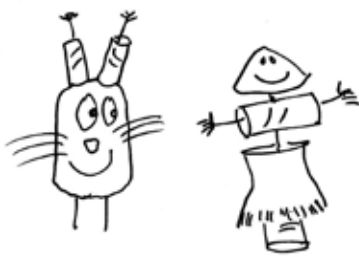
Deliberation means weighing up something for its relative merits, in order to decide whether it is a worthwhile idea or way forward. The English word *deliberation* comes from the French for weigh, which we also find in the Latin for the star sign *Libra* (The Scales). Students deliberate in discussions with each other and their teacher (social learning), but also as they grapple on their own to think through an issue. Deliberation is part of the active language classroom, where the curriculum aims to teach critical thinking and reflective language use. Deliberation is also part of a good design process, where the pros and cons of a particular design must be weighed up, or the advantages and disadvantages of a particular technology (see for example Learning Outcome 1 in the Technology Learning Area).

Group discussions have become very popular since the introduction of outcomes-based education, as a means of encouraging children to mobilise what they already know (linked to constructivist theories of learning) and to learn from each other, which is for some children easier than to learn from teacher, particularly in the foundational years. Group discussions are valued in an approach to learning called social learning. Research shows that girls find mathematics less threatening if they can tackle it in collaborative groups. A note of caution: group work can be overdone, especially when if the teacher fails to provide new knowledge, or adequate access to new knowledge, to help the students build on what they already know. Group work also needs to be well structured and guided, so that children understand the educational purpose of the activity, and know how to manage the process, or to call on the teacher to do so. If handled well, group discussions can be used in all learning areas and subjects across the curriculum, but they are particularly important in those areas (such as the languages and social studies, as well as the sciences) which aim strongly to develop critical thinking and deliberation skills, and the ability to weigh up and back up statements. In the Arts, Technology and Design, group discussions can help children to think more creatively, to collectively come up with better solutions to problems. As with deliberation, however, individual processes can also be valuable.

Problem-solving is about knowing what to do, when you don't know what to do! Problem-solving is a critical learning outcome across the national curriculum, but has a particularly prominent place in the Technology learning area in the GET band, all the technology subjects in the FET band, and the Design subjects. Students are exposed to the process of identifying a problem, and following steps to guide them towards solutions, then design and make these solutions, if possible, try them out, evaluate them, and make a decision about them. Examples of such problems and possible solutions follow.



GET: General Education and Training
FET: Further Education and Training



Stories for Context:

Foundation Phase learners receive a crate filled with clean plastic containers, cardboard boxes and tubes, scrap paper, wool and fabric, some dried flowers, stickers, glue and their classroom stationery. Their task is to make a Mothers' Day gift. With the teacher they plan what they can do, what they will need, and the steps to take. Once their finished work has been displayed and admired, their teacher leads a discussion on why and how we should value and re-use resources such as the items in the crate, and thereby both reduce waste, and expand our pool of resources. The activity is part of the Life Skills learning programme, and addresses learning outcomes related to needs, wants, resources and resource use in the Social Sciences, Life Orientation, Economics and Art.

Mrs Louw asks her Technology students to identify local issues which have both a social and an environmental impact. Jackson Mda and his friends identify the bucket toilets in the township as such an issue. Mrs Louw brings in a resource person for a talk, and then the students use a mind map to analyse the issue and its causes: why is it that this township has a bucket system, and no flush toilets? The students identify apartheid policies, the municipalities' limited funds, the shortage of water in the area, and the limited capacity of the municipal sewage ponds to meet the needs of a growing population. They read through some materials the resource person (from a development agency) left for them, on alternatives to water-borne sewage. Students must now propose an alternative solution within the financial and environmental resource constraints. Jackson proposes a 'pungalutho' (no-smell) toilet, that is based on the principle of urine separation and composting of solid waste. This proposal receives the highest mark because it is well reasoned and presented. The class is keen to put this proposal to the municipality to see if they will try it out on a small scale.

The Grade 11 students at Bishop's Diocesan College participated in the City of Cape Town's 2008 Youth Environmental Conference. They deliberated and identified solutions to some of the environmental problems on their campus: high energy use which contributes to global warming, high water consumption, the production of waste, and the loss of biodiversity. They then designed solutions to address aspects of these issues. Chris Parker and Paul Lassen suggested a 'tri-bin' system (one bin with three coded compartments) to encourage the boys to separate waste for recycling.



Designing with Waste Paper

In an *Arts for the Environment* initiative as part of a conference on Global Warming, FET college learners designed decorative lamps from recycled or recyclable materials, using energy efficient light bulbs.

Resources for Environmental Education

UNIT 5.1

SECTION 5 DIRECTORY

BIODIVERSITY – See for example:

Biodiversity in Life Sciences. A handbook for educators to support biodiversity conservation education in the Cape Floristic Region in the Grades 10-12 Life Sciences Curriculum. 2007. C.A.P.E. Conservation Education Programme, Rhodes University Environmental Education and Sustainability Unit.

Branch, M. 1999. *Explore the Seashore of South Africa.* Cambridge University Press, Cape Town.

Branch, M. 1999. *Explore the Cape Flora. Plants and Animals.* Cambridge University Press, Cape Town.

Coastcare Fact Sheets and Teachers Work Book. Date unknown. Marine and Coastal Management, Department of Environmental Affairs & Tourism, Cape Town.

Enviro-Facts. On a range of topics, including: Ecology (No.2); Biodiversity (No.3); Estuaries (No. 27); River Catchments (No. 28); Rocky Shores (No. 29); Sandy Shores (No. 30); Fynbos (No. 31); Grasslands (No. 32); Succulent Karoo (No. 33); Coastal Conservation (No. 34); Succulents (No. 35); Cycads (No. 36); Invertebrates (No. 37); Freshwater Fishes (No. 38); Sharks (No. 39); Frogs (No. 40); Reptiles (No. 41); Marine Turtles (No. 42); Raptors (No. 43); Cranes (No. 44); Bustards (No. 45); Whales (No. 46); Dolphins (No. 47); Rhinos (No. 48); Elephants (No. 49); Indigenous and Alien Explained (No. 21); *Protected Areas* (No. 59). Share-Net, Howick and Pick and Pay, Cape Town.

Hands-On Field Guides. Share-Net, Howick. Available as printed booklets or an E-Info CD. On various topics related to ecosystems e.g. *Soil and Compost Life, Stream and Pond Life, School yard Life, Grassland Life, A Forest Community, Life Around A Waterhole, East Coast Reefs, East Estuaries and Mangroves, East Coast Sandy Shores, East Coast Rocky Shores, East Coast Dune Plants.*

SANBI, Western Cape Primary Science Programme (PSP) and City of Cape Town. 2008. *Indigenous Plant and Animal Cards* and Teachers Guide. E-mail info@psp.org.za, or visit www.psp.org.za and www.capetown.gov.za/environment

The Convention on Biological Diversity: Biodiversity, Access and Benefit-Sharing. A Resource for Teachers (Grades 10-12). 2006. Biodiversity Series 2. SANBI, Pretoria.

Western Cape Primary Science Programme (PSP). 2007. *Life and Living. Grade 5. We All Depend on Each Other.* PSP, Cape Town. E-mail info@psp.org.za

Windows on the Wild. Science and Sustainability. Senior Phase. 2005. New Africa Books, Cape Town. www.newafricabooks.co.za



ENERGY – See for example:

Energy for Keeps. How to do a project on renewable energy for the senior primary grades. Date unknown. Eskom Energy and Sustainability Programme and WESSA.

Energy. A practical guide to energy management and electricity auditing. Date unknown. Eskom Demand Side Management and WESSA.

Enviro-Facts: Acid Rain (No. 9); Ozone (No. 10); Global Warming (No. 11); Energy and Environment (No. 12); Energy Options (No. 13). Share-Net, Howick and Pick and Pay, Cape Town.

Fact sheets on nuclear energy - www.earthlife.org.za

Getting to Grips with Sustainable Energy. Date unknown. Sustainable Energy & Climate Change Partnership, Earthlife Africa, Johannesburg.

Have you Sequestered your Carbon? Handprint booklet, 2009. Share-Net, Howick.

Learning About Climate Change. An Environmental Education Learning Resource for Educators. Date unknown. Department of Environmental Affairs & Tourism, Pretoria.

Renewable Energy. The Obvious Choice for Energy Development in South Africa. Date unknown. Earthlife Africa, Johannesburg.

Smart Living Handbook. 2007. www.capetown.gov.za/environment

FOOD, CONSUMPTION, GARDENING – See for example:

Creative Garden Design. Handprint booklet, 2009. Share-Net, Howick.

Food on the Run. Making choices about convenience food for our health and our environment. Teacher's Guide and Learner Book. Gauteng Dept of Agriculture, Conservation, Environment and Land Affairs, Gauteng Dept of Education, Gauteng Institute for Education Development. DACE, GDE and GIED, Norwood.

Consumption. Overview article in *The Enviropaedia. Environmental Encyclopaedia and Networking Directory for Southern Africa.* Eco-Logic, Cape Town.

The Story of Stuff. Mini-movie to download for free from www.thestoryofstuff.com

Greening South African Schools – Indigenous Gardening Pack & Handbook. Date unknown. National Botanical Institute, Pretoria, Cape Town and Share-Net, Howick.

Learning to Grow Books 1 & 2, Date unknown. Umthathi Training Project and Share-Net, Howick. These booklets deal with the practical aspects of garden development and link them to a variety of learning areas.

The Organic Classroom. 2004. Foundation Phase Teacher Resource Material. Schools Environmental Education and Development. (s.e.e.d.), Cape Town.

WATER & WETLANDS – See for example:

2020 Vision for Water Project. A Resource Pack for Active Learning in Water and Environmental Conservation in South African Schools and Communities. Department of Water Affairs and Forestry (DWAF), Cape Town.

Clearing Invasive Weeds. Handprint Booklet, 2009. Share-Net, Howick.

Enviro-Facts: Water (No. 16); Wetlands (No. 26). Share-Net, Howick and Pick and Pay, Cape Town.

Mini-SASS Sheets. Share-Net, Howick. Or from www.ground-truth.co.za

Schools Water Action Project (SWAP) Water Quality Audit Kit/Starter Kit. Share-Net, Howick.

Water Wheel. A two-monthly free magazine on water and water research. Water Research Commission (WRC), www.wrc.org.za.

Wetlands Use: Wetlands and People; How Wet is a Wetland? Share-Net, Howick.

Windows on our World: Wetlands. DWAF and WESSA. Share-Net, Howick. A comprehensive and content-rich printed resource with CD on water, wetlands, catchments and catchment management.

WASTE – See for example:

Enviro-Facts. On topics like Waste Management (No. 6), Hazardous Waste (No. 7). Share-Net, Howick and Pick-and-Pay, Cape Town.

Matter and Materials. Date unknown. Looks at litter and the problem of solid waste, with activities, designed for Grade 7. Western Cape Primary Science Programme (PSP), Cape Town. Order from info@psp.org.za or www.psp.org.za

Wise Up on Waste. Fairest Cape Association, Cape Town. A comprehensive, content-laden resource on waste available from www.capetown.gov.za/environment (forthcoming).

Worming Waste. Handprint booklet, 2009. Share-Net, Howick.

FOR A RANGE OF TOPICS, see:

Enviro-Facts. In addition to topics listed earlier, they include: Sustainable Development (No.1); Ecology (No.2); Pollution (No.4); Marine Pollution (No.5); Poisons at Home (No. 8); Timber Plantations (No. 14); Soil Erosion (No. 15); Urbanisation (No. 17); Desertification (No. 18); Deforestation (No. 19); Traditional Medicine (No. 20); Harvesting the Sea (No. 22); Hunting (No. 23); Armed Conflict and Environment (No. 24); Human Numbers (No. 25); Economics and Environment (No. 50); Law and Environment (No. 51); Business and Environment (No. 52); Agriculture and Environment (No. 53); Ecotourism and Environment (No. 54); Public Participation (No. 57); Careers (No. 58); Environmental Conventions (No. 60). Order from Share-Net, Howick and Pick and Pay, Cape Town.

Envirokids Magazine. Wildlife and Environment Society of South Africa. Various topics. Includes an insert for teachers with ideas on how to use the magazine.

The Enviropaedia. Environmental Encyclopaedia and Networking Directory for Southern Africa. (Bi-Annual Editions) Eco-Logic, Cape Town. Various topics including Air Pollution, Energy, Consumption, Water, Sustainable Development.

We Care! Foundation Phase Materials. Date unknown. Juta, Cape Town. Teacher books on themes such as Our Street, Peace, Recycling, The Right Choices.

Courses in Environmental Education

UNIT 5.2



Courses Offered through Delta Environmental Centre

Delta Environmental Centre is an accredited training provider. Courses are offered in Johannesburg, Gauteng, and nationally.

Contact: Ms Di Beeton, di@deltaenviro.org.za

- **Diploma in Environmental Education, Training & Development Practice**
- **Short Courses/Skills Programmes**

Courses Offered at University of Cape Town

B.Ed. (Honours) module in Environmental Education, 24-hour contact course. Duration: 1 semester (4 months).

Courses Offered at Rhodes University

- **Doctor of Philosophy (PhD) and Master of Education (MEd) by thesis only**

The expertise exists within the Faculty to supervise these higher degrees in the field of Environmental Education.

- **Master of Education by coursework and research (MEd)**

This degree is offered in two formats: by 'coursework and thesis' and by 'coursework and research projects'. Both are offered over two years part-time, or one year full-time study and are run in such a way that students from all over southern Africa are able to attend.

- **Advanced Certificate in Education (Environmental Education)**

This two-year part-time qualification is for teachers with a Matric and a three-year qualification, who want to specialise in environmental education or to change career direction. It is a 120-credit course at Level 6. Successful completion enables educators to apply for further study at Level 7.

- **Bachelor of Education (Honours) (BEd - Hons)**

A module in Environmental Education is offered as an optional part of this post-graduate qualification taken mainly, but not exclusively, by practising educators and educational managers in the formal education sector.

- **Post Graduate Certificate in Education (PGCE)**

Environmental Education is taught as a module within this post-graduate diploma, which caters for students wanting a professional qualification in secondary education. In effect every professionally educated teacher leaving the department has the opportunity to complete a module in Environmental Education and its practice at school level.

- **Rhodes University Certificate in Environmental Education**

There are several ways in which this certificate can be obtained depending upon need and context. The options include distance education courses and courses for special groups. It is often termed the Gold Fields Certificate because of the close support over several years from Gold Fields of South Africa. The course has also



been franchised out to other educational institutions elsewhere in southern Africa. Duration of the course varies, but is normally one year and runs on a semi-distance education basis.

From 2009, the course is aligned with the Rhodes Advanced Certificate in Environmental Education [ACEE] and the Advanced Certificate in Education, specialising in Environmental Education [ACE(E)]. Students who successfully complete the Gold Fields short course receive 30 credits towards the ACEE or ACE(E) at Rhodes.

- **Rhodes University/SADC International Certificate in Environmental Education**

This course is for selected students in the SADC region and is run annually requiring two months of intensive work at Rhodes University and the Umgeni Valley Environmental Education Centre (in KwaZulu-Natal) as well as a curriculum development project in the home country. Through the SADC Regional Environmental Education Programme, the Rhodes EE Unit is host to a course developers network.

Contact: Mary-Jane Jackson, Rhodes University Department of Education Professional Development Centre (PDC); m.jackson@ru.ac.za; 046 – 6037263/4; P.O. Box 94, Grahamstown 6140.

Courses offered through WESSA

WESSA (the Wildlife and Environment Society of South Africa) is an accredited training provider. Courses are offered in Howick, KwaZulu-Natal, and nationally.

- **National Certificate: Environmental Education Training and Development Practice**

The National Certificate in EETDP (NQF Level 5) will enable you to select and adapt existing environmental learning programmes; to plan, organise, implement and review a limited selection of environmental learning events using an active learning approach; to select, adapt and use learning support materials; and to work in a variety of contexts and workplaces, including environmental education centres, cultural and natural heritage sites (e.g. nature reserves, protected areas, museums, botanical and zoological gardens), and community and industrial settings.

Credits: 128. **Duration:** 1 year. **Theoretical contact time:** 20 days

- **Developing environmental learning programmes and materials**

Successful completion of this course enables you to develop a learning programme and materials, based on desired learning outcomes (school curriculum, organisation-specific or unit standards-based).

Credits: 10. **Duration:** 2 months. **Theoretical contact time:** 5 days

- **Implement and evaluate environmental learning programmes**

Learn how to implement courses in the environmental arena, and how to evaluate their effectiveness.

Credits: 11. **Duration:** 2 months. **Theoretical contact time:** 5 days

- **Enviro-Eds**

Addressing environmental issues and risks through education for sustainable development. This course can be offered on a themed basis according to workplace related environmental issues and risks

Credits: 12. **Duration:** 2 months. **Theoretical contact time:** 5 days

Contact: *SustainEd*, training@wessa.co.za, 033 – 330 3931 ext 126

P.O. Box 394, Howick, 3290. www.wessa.org.za

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