A Creative Approach
to Environmental Education

Teaching Resource Kit for
Dryland Countries

UNESCO

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Entire table of contents as anticipated for the teacher's manual
(subject to changes)

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Introduction

UNESCO's Man and the Biosphere (MAB) Programme is currently developing two teaching resource kits for environmental education. These kits are intended for primary and secondary schoolteachers worldwide and are based on an innovative approach appealing to the creativity and artistic sensibilities of pupils aged 6-15 approximately. The first kit is designed for use in dryland countries, and the second in mountainous countries.

The purpose of this document is to present **an extract of the Teaching Resource Kit for Drylands**, and its content echoes the United Nations General Assembly declaration proclaiming 2006 as the International Year of Deserts and Desertification.

The objectives of the kit

In dryland ecosystems, populations are affected by desertification and erosion problems that result in environmental degradation and affect their ability to live decent lives in a challenging natural environment.

The purpose of the kit is to help teachers transmit scientific information and environmental knowledge to their pupils in an entertaining and appealing way.

The longer-term objective is to develop the ability to combat land degradation and desertification among pupils and their communities while endeavouring to conserve biodiversity. As such, the kit is consistent with the activities developed as part of the Decade of Education for Sustainable Development (2005-2014), the promotion of which falls within UNESCO's fields of competence.

The creative approach

The kit includes a teacher's manual containing activities appropriate to the dryland ecosystem, developed in accordance with a creative approach to environmental education.

Initially, the activities harness the environment's aesthetic and inspiring qualities in order to arouse pupils' curiosity and keep their attention, encouraging them to become more aware of the aspects of the natural environment in which they live.

Building upon their newly-acquired knowledge, pupils then explore, in real-life situations and through specific exercises, the relationship between the ecosystem and local culture. In this way, they develop their capacity to think critically about the impact of human activities on the environment.

In short, the creative approach works in two stages:

• Awakening environmental knowledge through creative and thought-stimulating activities that encourage rediscovery and appreciation of the natural environment and biodiversity;

• Developing awareness of sustainable development through more advanced and equally creative activities requiring the sustained participation of the pupil and the class as a whole.

Who is the kit intended for?

The kit is designed chiefly for primary and secondary schoolteachers who, in the frequently poor rural regions that make up drylands, work for the most part in difficult conditions. It is designed for teachers of various disciplines, such as geography, biology, physics and plastic arts. It is broadly aimed at all teachers wanting to carry out an environmental education project, either alone or as part of a team, in a formal or non-formal educational setting. The structure of the project will depend on individual teachers' motivation for embarking on it, and their ability to organize themselves and combine their efforts. Teachers may, for instance, develop a thematic project (along the lines of a themed class or one based around an artistic or cultural project) or even conduct the activities in the kit as part of broader educational or pedagogical innovation projects.

Structure and content of the kit

Once completed, the kit will comprise a teacher's manual divided into three thematic chapters:

Chapter 1: *Discovering the Ecosystem and its Biodiversity*
Chapter 2: *The Water Cycle*
Chapter 3: *The Importance of Plant Life*

Each thematic chapter will contain around eight activities ranked according to content and complexity. Each chapter begins with two "easy" activities, followed by three "intermediate" and three "advanced" activities.

The kit will also contain classroom materials designed to be used with the teacher's manual, namely pedagogical items (maps, posters) for collective use.

Presentation of an extract of the Teaching Resource Kit for Dryland Countries

The selected extract is from the first chapter of the teacher's manual: *Discovering the Ecosystem and its Biodiversity*. Here, teachers will find three progressively graded activities: one "easy", one "intermediate" and one "advanced". In ***Collecting Treasures*** (Activity 1), the teacher encourages pupils to take a fresh look at the environment through the collection of natural objects, an exercise

that inspires pleasure and wonder while teaching pupils to identify the physical qualities of species in their natural habitat. By organizing the items they have gathered, pupils develop a better understanding of the relationships between species and their habitat and among the species themselves, and soon gain a basic grasp of the notion of "the ecosystem" as a working whole.
In ***Land, Rock and Erosion*** (Activity 2), the teacher helps pupils to understand the local landscape by exploring its geological structure and features. This activity develops an understanding of certain physical mechanisms linked to the mobilization and transport of movable elements in the soil and substrate. Kindling knowledge of desertification through the use of one's eyes and imagination to explore the landscape also helps to identify tangible ways of addressing and establishing foundations for combating desertification.
An ***Inventory of Useful Plants*** (Activity 3) is an advanced activity requiring pupils' longer-term participation. The teacher helps them to question the local population's use of the environment from a sustainable development perspective. The exercise serves to position humans in the ecosystem by exploring the extent to which they play a vital role therein, the importance of the ecosystem to the well-being of all, and how biological diversity meets each of the diverse needs of human beings.
Regarded as a source of crops and bounty, the ecosystem is likened to a garden whose fruits are consumed by the community: a nourishing garden (edible plants), a healing garden (medicinal plants and oils) and a protecting garden (the use of plants in house building and clothes manufacturing).
The pupils consider how, in return, the community looks after nature. The activity encourages exchanges with living holders of indigenous knowledge, such as shepherds, farmers, trackers, foresters and healers. Their deep knowledge of the environment constitutes the living memory of the relationship between ecosystems and local cultures. The pupils learn to place this knowledge in a scientific context, exploring, for instance, how such knowledge can lead to a better understanding of species conservation and to the sustainable use of environmental resources.

How to use the teacher's manual?

This presentation document also provides a brief overview of how the activities in one particular chapter of the manual are organized.
Graphic symbols next to the description of each activity allow teachers to better identify and grasp the pedagogical material. In particular, they will be able to assess:
• The level of the activity (its level of difficulty in terms of content and implementation);
• Whether the activity is to be conducted outside or in the classroom;
• How many sessions are required in order to complete the activity (session length is entirely determined by the teacher, but it is two to three hours on average depending on the time available).

The description of each activity starts by setting out its **objectives**.
For "easy" and "intermediate" activities, objectives are "environmental discovery", "knowledge" to be transmitted or "comprehension".
The "advanced" activities aim to create "aptitudes" and develop "skills", in addition to transmitting knowledge. The objectives are clearly set out in each case.

The required **methodology** is illustrated by the division of the activity into sequential stages, each summarized by a verb indicating a specific action ("collect", or "organize", for example). This provides both a sense of dynamism and a clear order of progression.
Scientific and technical terms relating to ecology and the environment are clearly identifiable: they are highlighted in pink and direct the reader to a **glossary** at the end of the document. In this way, the teacher's knowledge base is strengthened and the requisite knowledge specified.

Chapter 1

Discovering the Ecosystem and its Biodiversity

01 Collecting Treasures

Level
easy

Place
classroom and outdoors

Duration
2 sessions

Objectives

1. Discovery of the environment

By collecting natural objects in their own familiar landscape, pupils become aware of the biological diversity of their environment. This exercise usually generates a sense of wonder.

2. Knowledge and comprehension

The process of classifying the objects and assembling them into collections gives pupils a first, visual notion of the terms "biotope", "biocenosis" and "ecosystem".

Methodology

1. Guide

In drylands, the landscape can appear monotonous and austere. Consequently, the teacher encourages pupils to explore the environment "with a fine tooth-comb" and identify microhabitats where biodiversity exists to a greater or lesser degree.
The teacher introduces the notion of **biodiversity**[1], a general term used to designate the variability of the plants, animals and micro-organisms that exist on earth, their variability within a single species and the variability of the **ecosystems** to which they belong. By and large, biodiversity covers genetic diversity, species diversity and **habitat** diversity.

2. Identify

In the desert landscape, usually characterized by uniformity, the teacher identifies at least two zones that are different from a geographical or **plant cover** perspective.
Given the usually vast scale of arid regions, the teacher may allow the class to explore the landscape by vehicle.
The class learns to observe changes in vegetation cover ranging from an area dominated by rocks to an environment with one vegetation stratum, usually covered with bush formations, shrubs and plants that are characteristic of arid and semi-arid zones (such as *cereus or saguaro cactus bush* in Latin America).

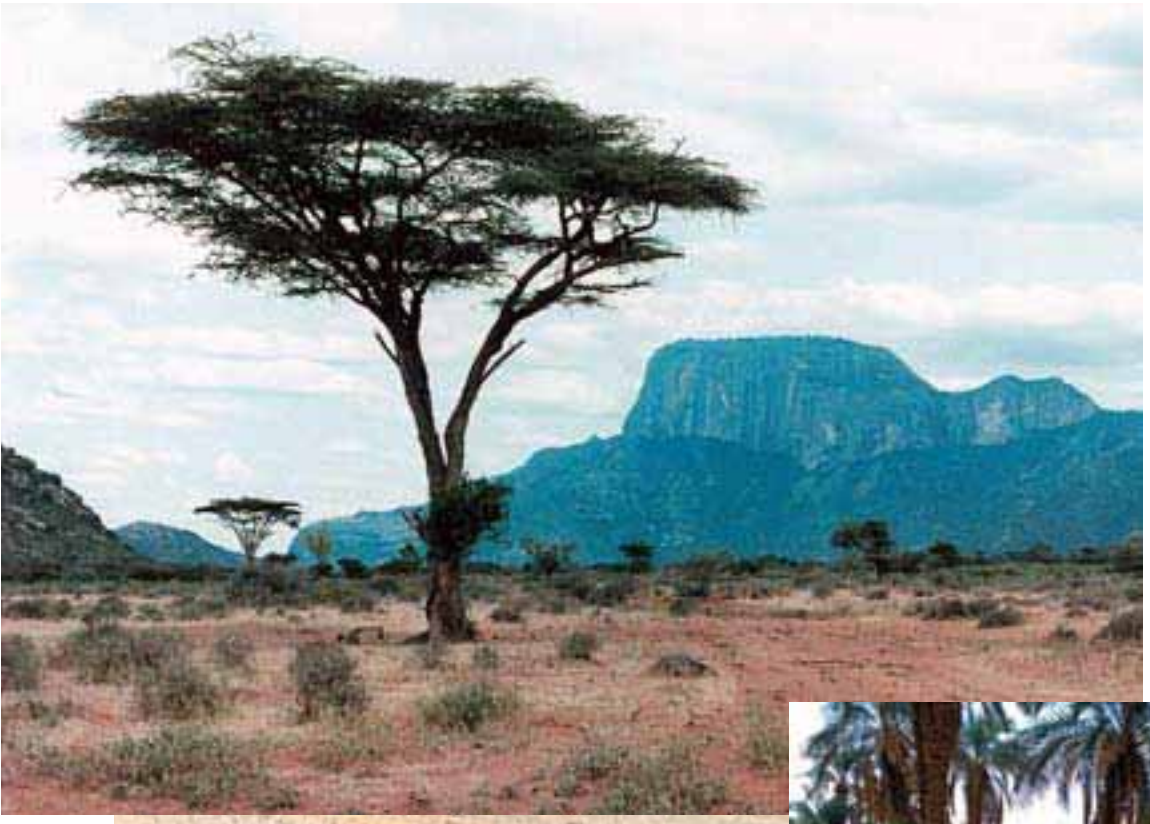
Other potential examples of identifiable zones:

A dry savannah zone;
A more humid zone, such as a pond, a wadi (even when dry), the periphery of a watering hole or a riverside;
An oasis zone containing cultivated plots or fields.

3. Collect

The pupil explores the various identifiable zones in turn, collecting as many different natural objects as possible within each zone: fragments from rocky strata, unusual stones, soil and mud samples, small containers of sand, bush and shrub branches, leaves, stalks and tufts of grass, leaves

1. Terms highlighted in pink are defined in the glossary on the inside back cover.



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1. *Acacia senegalensis* in a semi-arid zone, North Kenya

2. Palm trees at *Oued Guir*, *Tazzouguert* region, *Tamlelt* Plain, Morocco, 2005

3. Palm grove, *Timimoun* Oasis, Algeria, 2002

and flowers of herbaceous plants (except the most fragile), fruit and grains of all kinds, cones, unearthed tubers and bulbs (irises, tulips, wild onions), root fragments, pieces of bark, fungi and lichens, fossils, dead insects (beetles, grasshoppers), detritivores, empty cocoons, small mammal bones and teeth (fennec foxes, rodents), bird feathers, shells, eggs fallen from nests, the shed skin and scales of reptiles and so on.
Surprise! These objects are like hidden treasures revealed in the palm of your hand.

4. Clean

Where necessary, the pupils clean the objects carefully so as not to damage them.

5. Observe

► During class, pupils work in groups to study each individual object. It is interesting to learn about them by examining them from different angles, observing them in minute detail and comparing them with other objects of the same type (such as two fruits).
► The teacher asks the class to identify any similarities among the objects in terms of shape, texture and colour.

6. Identify

Only then will the pupils proceed to identify the objects:
What do they belong to? Do they belong to the plant or the animal kingdom? Do they belong to the same species? Are they earth resources (such as soil, for instance)?

7. Classify

The pupils classify their finds according to a set of distinctions:
Does it belong to the plant kingdom?
Does it belong to the animal kingdom?
Is it living matter?
Is it dead matter?
Has it always been dead (a rock, for example)?

8. Integrate concepts

► The teacher takes the children outside again in order to consider each object individually and appraise it in its natural context. The teacher may also select the objects one by one from the pupils' collections.
► The idea is to start with the individual object (the smallest unit) and increase in scale through species and habitats to considering the ecosystem as a whole.

Example:

A particular object can provide clues about the species and its natural habitat.
What is the lifestyle of the species in its habitat?
What are its feeding habits?

► This is how the teacher introduces the concept of **biocenosis** – a community of living organisms (animals, plants and micro-organisms) that coexist in the same natural habitat (see glossary).
► The teacher then introduces the concept of **biotope** – a defined natural area characterized by specific conditions, that supports animal and plant species adapted to these conditions (see glossary).

Examples:

In *nebkha* zones (sand dunes formed around plants by the wind, typical of some North African regions), bushes (salsola), insects, rodents (gerbils) and herbivorous mammals (gazelles and goats) cohabit and, consequently, share the same biotope.
By extension, the acacia and the giraffe, both of which live in one particular area of dry, wooded savannah, also share the same biotope.

9. Create "collections"

Using this knowledge, the pupils will each create a **collection** based on their own finds and discoveries, with the aim of presenting the objects they have collected in a visual form that illustrates the recently acquired notions of biotope and biocenosis.
► A flat box or simple cardboard surface could be used to present the collection.
How might one illustrate the unity that exists within a community of living organisms in one place?
► The teacher explains at this point that an ecosystem can be regarded as the dynamic combination of a biocenosis and a biotope, and, more broadly, as a set of interacting units, biotopes and biocenoses (see glossary).
► The pupil recalls the place where each object was found. What are the key characteristics of this landscape unit in the ecosystem?
► The pupil then places each group of objects on a cardboard base representing a particular biotope:
- To this end, the pupil first creates a coloured background representing the soil of the biotope by rubbing or sticking appropriate mineral samples on to the tray. Sand could be sprinkled on to a layer of glue, for example, creating an effect that closely resembles the real thing in terms of texture and substance;
- Additional elements can be drawn and pasted on;
- Alternatively, the display could remain more abstract, the objects grouped and presented on the base in a specific order (starting with a rubbed-on soil sample representing the soil of the biotope,

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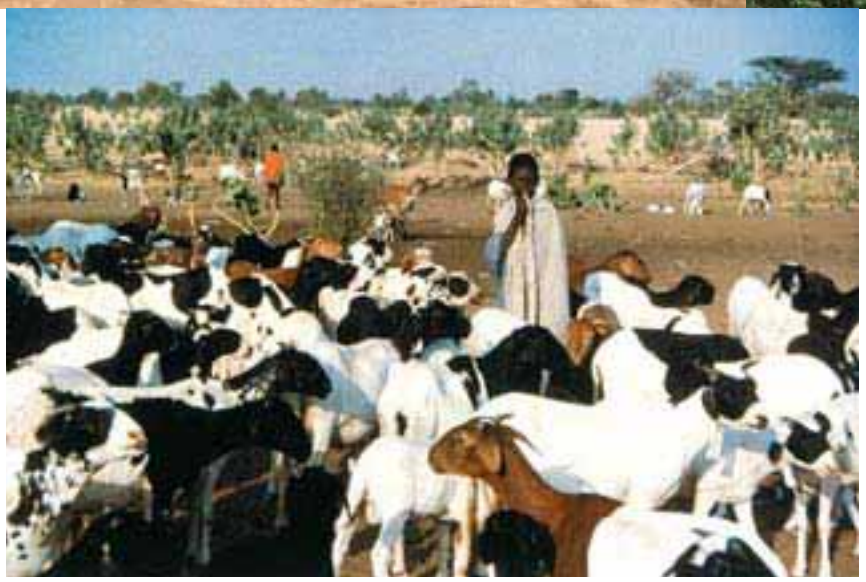

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4. Mixed formation of woody and herbaceous plants in the dry season, *Sahel*
©UNESCO-MAB

5. Giraffe grazing on a bush, *Sahel*
©UNESCO-MAB

6. Young shepherd with herd of goats, *Sahel*
©UNESCO-MAB

followed by objects from the actual species, grouped so as to represent either the food chain, species families or kingdoms).

► The pupils themselves propose how first to represent the ecosystem on the basis of their finds and the information initially provided to them, in order to illustrate the unity and diversity of a given living place in the landscape.

► The teacher's role is to shape the collection according to the reality of the environment. Depending on the diversity of locally available habitats, the teacher might suggest focusing not only on the diversity of the collected objects, but also on their numbers and relative proportions.
Consequently, the collection might emphasize the comparing of objects of the same kind (several types of leaf or several bird feathers, for example).

► This allows the teacher to bring in quantitative elements (numeric information) and introduce more precise concepts, such as species richness and abundance, or, conversely, the rarity or decline of species that mark the difference between one biotope and another.
With regard to species decline, the teacher introduces the notion of the impact of human activities on conservation and the environment.

► And so pupils may create as many mini-collections as there are identifiable habitats, each collection corresponding to a specific biotope. These genuine "collections of places" help pupils to comprehend the ecosystem by picturing it as an ensemble of separate units, just as it can be studied by ecologists.

02 Land, Rock and Erosion

Level **intermediate** ★ ★

Place **outdoors**

Duration **2 sessions**

Objectives

1. Discovery of the environment

Through learning about relief formations and the constitution of the geological landscape with their teacher, the pupils establish a relationship between rock and soil quality, and between rocks and sediments.

2. Knowledge and comprehension

After several brief interventions in the mineral landscape (tracing shapes and making sculptures), the pupils visualize the phenomenon of erosion through a series of drawings (in particular wind action in drylands) and understand the importance of soil nutrients in the ecosystem.

Methodology

1. Identify the mineral

In drylands, it is often the rock rather than the vegetation that characterizes the landscape. The pupils and teacher select one or more points in the landscape where mineral elements predominate.

2. Observe the geological formation of the landscape

The class visits the site with the teacher and learns about relief formations and the constitution of the geological landscape;

► The teacher describes the type of rock that comprises the landscape:
This could be sedimentary rock, formed by the deposition and cementation of the weathered remains of other rocks (shale, siltstone and sandstone), the deposition of the results of biogenic activity (limestone), or by precipitation from solution (halite and gypsum).

► The pupils probe the soil in several places within the landscape:
They discover that it consists of **sediments** produced by the degradation of the rock that composes the relief – fragments of disintegrated or eroded rock, such as stones, pebbles, sand, silt and clay. The soil may have formed a thick deposit or a thinner one, such as a fine veneer on block fields or large rocks. The pupils identify this phenomenon by moving about the landscape.

► The pupils are encouraged to make the connection between stones scattered here and there and the rock that comprises the relief:
The teacher explains geological formation as it occurs (for sedimentary rocks) through sediment accumulation; in other words, by strata or superimposed layers that are visible for example in sandstone, in the horizontal stratification of the plateaux and tables that are characteristic of the relief of drylands, and in stones scattered over the ground.

For a better perspective, the pupils can split or break fragments or slabs of rock, the easiest being cleavable rocks such as shale, slate, some sandstone and limestone, and calcshale.

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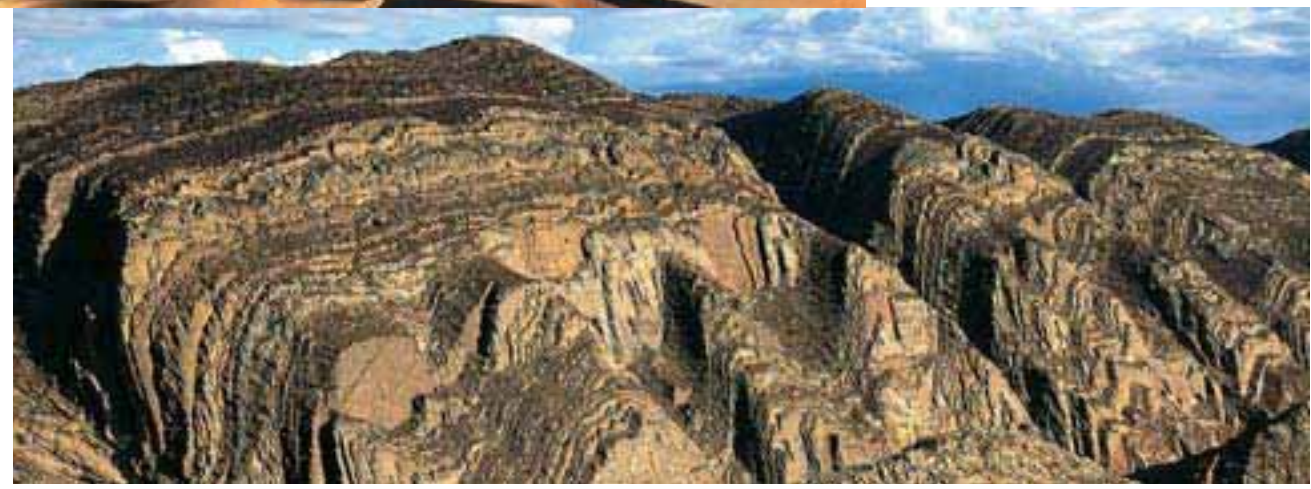
7. Dunes of the *Namib* Desert, *Swakopmund* region, Namibia

8. Mountains at *Brandberg West* (2,573m), *Damaraland* region, Namibia



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3. Make the connection between soil and relief and place oneself in the landscape

Next, the pupils make the connection between the soil under their feet and the relief in the distance through a number of brief interventions in the landscape:
To this end, they will handle mineral matter by creating sculptures from collections of stones and sediments (tumuli, cairns, circles), tracing figures with their footprints and creating chromatic compositions using minerals.
The teacher encourages them to establish a proportional scale (human scale, natural scale) between their interventions and the landscape:
• A propped-up stone or artificial tumulus a few score centimetres high could represent a major landscape relief. These creations, arranged in the foreground for the benefit of the viewer, with the relief as backdrop, appear as large as the background relief and reflect its appearance and texture. The similarity is striking!
• A straight line traced with the foot on flat ground and symmetrically aligned with the relief may, owing to the effects of perspective, create a link between the person on the ground and the relief in the distance, between the human scale and the landscape scale, and between the ground and the vertical form of the relief.
These sculptures or artificial drawings introduced to the landscape also represent evidence of human endeavour in vast natural expanses: a way for pupils to capture two kinds of action and creation –the human and the natural– and become part of the landscape!

4. Identify wind action and erosion marks

► With their ground drawings, the pupils observe the visibility of the marks made by their feet. By breaking or lifting the top layer of the ground's surface, the marks appear darker or lighter than the original ground.
► The teacher points out the **desert varnish** (or *eolian polish*) coating the ground and rocks.
This allows the teacher to change themes and introduce the role of the wind in shaping the contours of the landscape.
The teacher first reminds the class that **erosion** is the process by which the earth's surface is worn away and transformed by agents such as water, wind, ice and heat.

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9. Eroded rock, *Tamrit* region, *Tassili N'Ajjer*, Algeria, 2002
©Olivier Brestin

10. Abandoned Tuareg camp, Erg *Admer*, *Tassili N'Ajjer*, Algeria, 2002
©Olivier Brestin

11. *Ischigualasto* geological formation, Moon Valley, *San Juan*, Argentina
©UNESCO/Liliana Madrid de Zito Fontan

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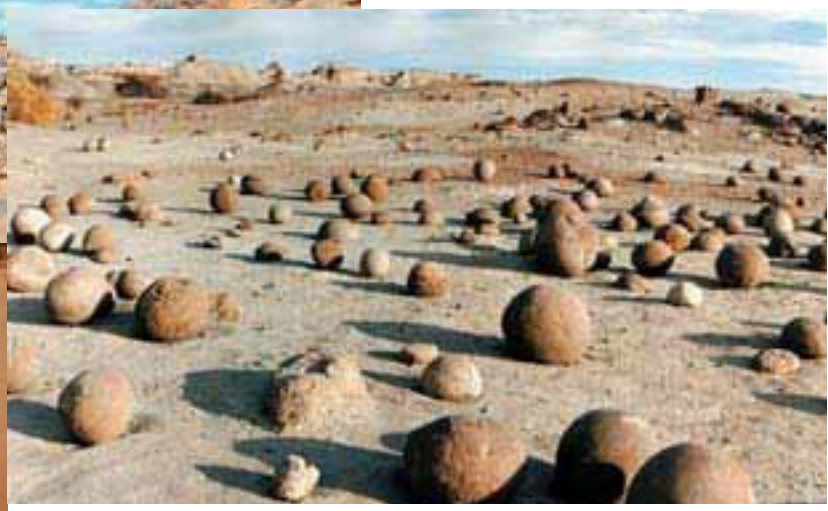

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The teacher then explains that **eolian erosion** is the process by which winds erode the earth's crust by wearing away rocks, thereby changing the contours of the relief.
The teacher may use examples to illustrate *corrasion* – the abrasive effect of wind containing grains of sand or quartz on landscape reliefs and ground surfaces. The teacher also explains *deflation*, the process by which winds lift and transport small particles from the ground, depositing them to accumulate elsewhere (dune displacement).
The teacher concludes by pointing out that, contrary to what one might expect in drylands, water erosion (fluvial erosion, seepage into the water table) is often more influencial on the landscape than eolian erosion. None-the-less, eolian erosion is a form of surface erosion that is harmful to soil productivity. Finally, the teacher mentions the important role of thermal erosion in the fragmentation of rock blocks in drylands.

5. Draw

The pupils go on to identify one or more instances of eolian erosion and comprehend, through drawing, the "plastic" effect of winds on the landscape.
Equipped with sketch pads, they may (depending on the location and context):
► Capture the crumbling of the rock into worn rocks, or landscape reliefs made uneven by accumulated forms;
► Portray the formation of dune masses by "sketching" the dunes according to the direction in which the crest is moving, one side in sunshine and the other in shadow, and highlight the whorls and light contrast;
► Draw "close-ups" (where the phenomenon exists) of jagged ridges emerging from soft ground or unusual (sometimes hollowed-out) rock contours;
► Depict furrows made in the sand or in fossilized sandstone by the wind, by drawing parallel serpentine lines and using contrasting tones (light/dark).
The bareness of the landscape is reflected throughout.

6. Interpret the drawings and understand the effect of eolian erosion on the environment

► The teacher facilitates the interpretation of the drawings and explains how wind action is the cause of degradation in soil that is impoverished by drought or over-use by humankind.
The (fertile) topsoil is blown away by deflation; the rock is scoured and exposed; living organisms become scarce.
► The teacher establishes a causal relationship between absence of vegetation and intensity of eolian erosion: wherever the earth is unprotected by vegetation, the wind easily carries sediments away in the form of sand and dust clouds. And the more intense the deflation, the more it lays bare vast expanses of terrain, to the detriment of flora since plants cannot grow without soil (except lichens).

7. Identify an area of land that is protected from erosion

The pupils identify an area that is less bare or exposed to the wind than the areas they have just surveyed.
► What is it that protects the area from the wind? Its orientation? A relief? Human developments, such as green barriers of tree and bush plantations? Windbreaks or hedges made of branches or palms? Is it a more humid area? A fertile area? A farming area, or an area of wild vegetation?
► What are the constituents of non-sterile soil? In addition to sediments: **humus**, **nutrients**, water, air, identifiable living elements or organisms such as roots, worms, detritivorous organisms and other, invisible organisms such as mushroom filaments, bacteria and other micro-organisms.

8. Take earth samples from several locations and appraise its physical qualities

The pupils proceed to take soil samples from the various sites visited in the course of the exercise. These samples are conserved in transparent receptacles which serve to display their composition, texture and colour.

Examples:

Where soil is exhausted or has been swept away, the pupils can take a little sand, white if from gypsum terrain, yellow or orange if the quartz in the sand is heavy in metal oxides. From other points in the landscape, they can take thicker samples of silty or clayey earth (and show the various different qualities of clay). They may also take a bit of mud from a riverbank or riverbed or from a watering hole.

The pupils conclude the sampling exercise by wetting their samples and rubbing them on to paper or material in order to show the different colours of the soils.

12. Cypress, *Tamrit* region, *Tassili N'Ajjer*, Algeria, 2002

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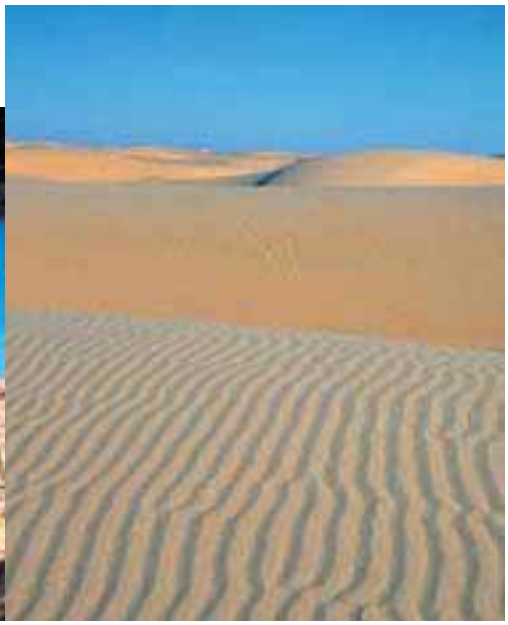
13. Sand dunes, *Hassi Khalifa* region, Algeria, 2002



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03 An Inventory of Useful Plants

Level
advanced ★★★

Place
classroom and outdoors

Duration
6 sessions

Objectives

1. Knowledge and comprehension

By using drawings to create a picture inventory, pupils will gain a full understanding of the direct uses of plants in many areas of community life.
The pupils are encouraged to ask questions about harvesting methods, plant use and, by extension, the consumption of natural resources.

2. Aptitudes

The teacher encourages pupils to engage in real dialogue with holders of local knowledge in the community.

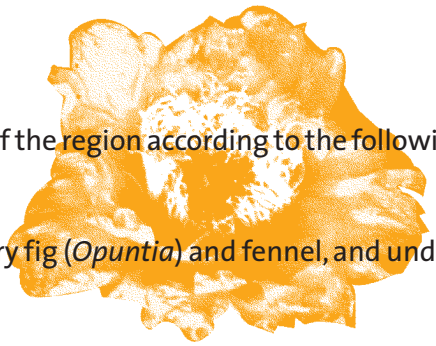
Notes and suggestions:

For this laboratory workshop on the role of plants throughout their lifecycle, the pupils and teacher will use either a separate room or the back of the classroom.
They mount three large panels of paper or cardboard onto the walls, thereby creating an area for an inventory and plant display, a reception area and an area for tasting and small experiments (plant pots, dyeing).
The teacher leading the activity takes a holistic view of the relationship between human beings and their environment (regarding the local population as playing an integral part in its ecosystem): as humans, we receive a multitude of benefits and products from ecosystems which enhance our well-being and quality of life. In this way, the ecosystem can be regarded as a source of crops and bounty for humankind, a **garden** in the broadest sense from which the community picks its fruit.
The teacher may consider classifying the plants according to three themes illustrated by three wall panels:
A. The Nourishing Garden;
B. The Healing Garden;
C. The Protecting Garden.

Methodology

The teacher divides the class into three groups of pupils, each responsible for one of the three panels in the inventory of "plants useful to the community".
Each group considers how their wall panel will be arranged. The ceiling height provides room for the pupils to hang specimens upside-down above each panel if necessary.
The pupils begin classifying the plants according to their use:
• Food;
• Treatment, medicine and rituals (bodily health and spiritual well-being);
• Raw materials for building homes (protective cover for the family) and making clothes (individual protection).
Some plants have a number of uses and will therefore feature on several panels.
In their groups, the pupils agree on how their wall panel will be arranged. With guidance from the teacher, they devise the sub-categories within each panel.

A. The Nourishing Garden



1. Classify

The pupils conduct an initial classification of edible plants of the region according to the following categories:
• **Edible bulbs,** e.g. garlic, onion;
• **Edible stalks,** e.g. overground, fleshy stalks such as Barbary fig (*Opuntia*) and fennel, and underground stalks (tubers) such as potatoes;
• **Edible roots,** e.g. carrots and turnips;
• **Edible leaves,** e.g. common garden cress;
• **Fleshy fruits:**
- **Berries or seeded fruits,** e.g. jasmine berries, toothbrush tree berries (*Salvadora persica*), watermelon, courgette, African cucumber (belonging to the gourd family);
- **Drupes or single-seeded fruits,** e.g. dates, olives, jojoba and karite fruit;
• **Dry fruits:**
- **Pods**, e.g. all peas and beans (belonging to the legume family), including pigeon peas (*Cajanus cajan*), tamarind (*Tamarindus indica*), cow peas (*Vigna unguiculata*);
- **Grains,** e.g. wheat, sorghum, millet, corn (belonging to the grass family);
- **Single-seeded dry fruits,** e.g. the kermes oak acorn.
In this way the pupils form an initial view of the **natural resources** available, whether cultivated or non-cultivated plants.

2. Select one edible species

► Each pupil chooses a plant and is asked to identify it in its natural environment and sketch or draw it.
► If it is a common species, the pupil may bring a specimen into class. The pupil takes a careful cutting and hangs it to dry (in the case of a grass, for example). The pupil may also try to replant a young shoot (a Barbary fig cutting, for instance).

3. Draw on the wall panel

Each pupil then classifies the plant according to the above-mentioned categories and produces a full-colour drawing straight onto the wall panel.
The wall panel is divided into several sections corresponding to the various categories. The pupil takes care to produce the drawing in the correct category.

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14. Woman sorting wheat for cooking, high-plateaux region, Bolivia
©UNESCO/Pierre A. Pittet

15. Farm worker and labourer, potato cultivation, Senegal, 1982
©UNESCO/Pierre A. Pittet

16. Traditional production of sun-dried tomatoes, Senegal, 1982
©UNESCO/Pierre A. Pittet

17. Foggara irrigation, *Timimoun* Oasis, Algeria, 2002
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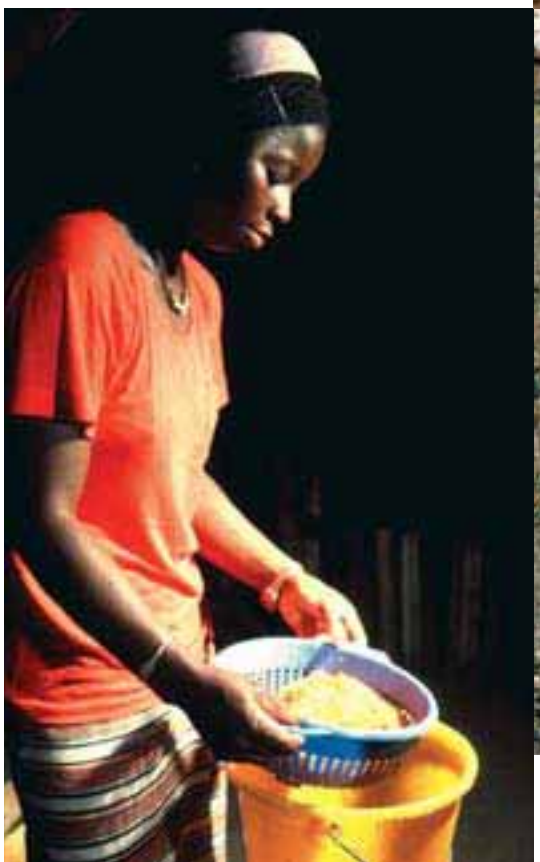

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18. Traditional production of tomato concentrate, Senegal, 1982
©UNESCO/Dominique Roger

19. Women carrying water on their heads, India
©UNESCO/Bernard Henry

20. Women crushing millet, *Djenné*, Mali
©UNESCO/Alexis N. Vorontzoff

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4. Taste

While one pupil draws on the panel, another tastes or asks other pupils to taste the plant in question. For the purposes of this exercise, it is recommended that only well-known edible species are selected.
Blindfolding the pupils tasked with identifying the plant allows the teacher to test their ability to recognize flavours.
Pupils may also bring food from home such as soup, fruit juice or samples of home-made recipes, which, owing to simple variants (such as cooking times or the inclusion of a particular herb), will allow them to rediscover the taste of a commonly used plant or one that, although well-known, has become increasingly neglected or under-used as it has become more rare.

Note:

The teacher's objective in this tasting exercise is to maximise opportunities to taste and identify the different flavours of well-known local plants (both commonly available and less so); In the case of non-cultivated plants, this could mean seeking increasingly rare plant specimens.

5. Seek and integrate information

Back to the wall panel, the pupils add notes and information on the use of plants to their drawings:
► Is it a cultivated/non-cultivated plant?
► If cultivated, is it sown or planted?
► Is it eaten raw or cooked?
► Which adjectives can be used to describe the 'taste' of the plant?
► Is it a common or rare species?
► If it is a naturally growing plant, has it become more rare over time? Is it possible to gather information on the **population growth** of a particular species? (See glossary at the end of the activity or guidelines for more advanced work.)
► Is it an endangered and/or protected species?
► Does the plant contribute to nutritional diversification and development (by meeting specific nutritional requirements)?

Note :

It is important that these written notes be graphically incorporated into the wall panel, be positioned around the drawings, follow imaginary lines, vary in style depending on the sense and meaning and include symbols indicating whether a plant is rare or endangered.

6. Discuss local plants and food production with resource people

At this point in the exercise the teacher encourages contact and interaction with at least two holders of local ecological knowledge from among the population:
• An elder (a respected member of the community) who has a good knowledge of local biodiversity as a source of complementary or replacement foodstuffs (and a source of income) in times of adversity:
• A farmer/breeder who understands the importance of cultivated plants in food production and the role of **indigenous plants** in conserving the local ecosystem.
The teacher encourages the class to engage in dialogue with these local actors. Discussions focus on the impact of the use and consumption of natural resources (particularly plants) on biodiversity and food security:
► Are non-cultivated plants becoming more rare in certain drylands?
► What are the consequences of this decline in (and sometimes **extinction** of) species for the nutritional health of the local population and their means of survival?
► How do land exhaustion (**monoculture**) and the alteration of natural habitats for agricultural or rearing purposes pose a threat to plant **conservation** and, in fragile ecosystems in particular, a region's food security?

► How are local biodiversity and plants in particular essential to food production as a result of the functions they fulfil in the ecosystem?

B. The Healing Garden

1. Meet with an expert on plants and their properties

The pupils pay a visit to the traditional healer or herbalist, the community specialist in essential oils and **medicinal plants**. The pupils ask the healer to take part in creating the second wall panel. The pupils ask the healer to present plant samples to the class and may also, if allowed, go with the healer to pick samples.

2. Draw and record medicinal plants on the wall panel

► Based on the specialist's valuable input, the pupils classify the plants according to their therapeutic or healing properties, draw them in full colour onto the wall panel and dry and hang specimens from the ceiling.

► For the division of the panel into sections, the plants are classified according to their properties: tonic, antipyretic, purgative, diuretic... Teachers may simplify this vocabulary and describe the conditions cured by the plants instead.

Examples:

In Africa, aniseed and fennel have multiple properties. Giant fennel is a painkiller and a purgative (helps with waste elimination).

The bark of the baobab is antipyretic (reduces fever) and its leaves have a number of therapeutic uses, specifically diuretic (increases urinary secretion), tonic, and as a cure for dysentery and lumbago. They are also used as a foodstuff as an ingredient in sauces.

21. Desert oaks, *Kata Tjuta* region, Northern Territory, Australia, 2001
©Olivier Brestin

22. Termite nest, *Kata Tjuta* region, Northern Territory, Australia, 2001
©Olivier Brestin

23. *Eucalyptus caesia*, New South Wales, Australia, 2001
©Olivier Brestin

24. *Aloe vera* in bloom, *La Gomera*, Canary Islands, Spain, 2003
©Thomas Schaaf

25. *Eucalyptus annulata* flower, Western Australia, Australia 2001
©Olivier Brestin

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The red flowered hibiscus (also known as *carcadet* or *bissap*) is a cultivated plant that produces a tea rich in vitamin C (tonic).

3. Identify how healing and rituals are connected by plants

The teacher introduces the sacred aspect of plants and encourages discussion.
Are some plants used in rituals? Are they used in initiation rites, healing rituals and the protection of spaces?
The ritual use of each plant (for religious purposes or spiritual well-being) is described on the wall panel in the above-mentioned therapeutic categories:

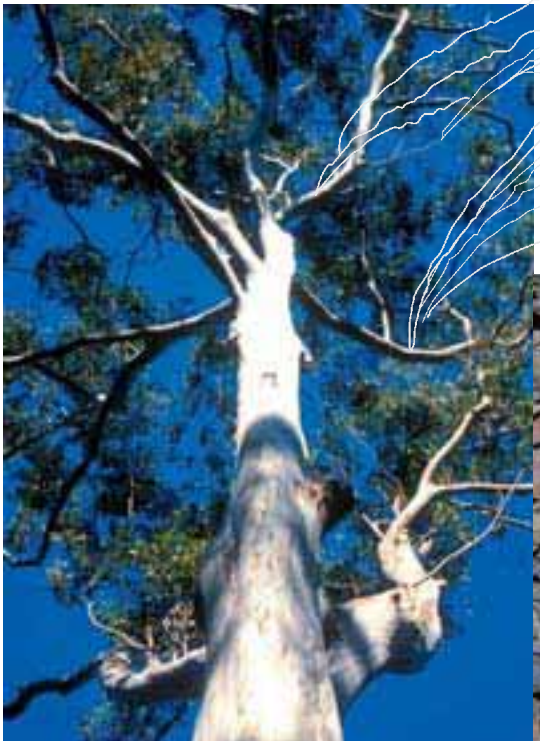
Examples :

In some drylands, myrrh and incense are used in funeral ceremonies and purification and sacrificial rites.
Other species, planted at the entrance of houses or surrounding them in order to afford protection, are used to mark territorial boundaries.
Sea squill bulbs (*Urginea maritima*) are used in the high Algerian plains as borders for agricultural plots.
The pupils can enhance the information on the wall panel by drawing the rituals as they imagine them based on the anecdotes of the healer or herbalist. Here, as before, text and images work in visual harmony on the panel.

4. Explore the relationship between plants, cultural traditions and conservation

Finally, the class explores the consumption of essential oils and medicinal plants and the impact of this consumption on the cultural traditions of healing and rituals.

- Which non-destructive techniques can be used to pick precious non-cultivated plants?
- How can we ensure their conservation?
- Have there been cases of species extinction?
- What are the consequences for cultural traditions?
- To what extent does the herbalist or traditional healer's vast knowledge constitute the living memory of links between local plant diversity and local customs and culture?
- Can restoring local and indigenous knowledge in this particular respect contribute to the conservation of the ecosystem?



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► Can the herbalist or healer transmit their knowledge across the generations via the classroom?
► Does the value accorded to certain plants naturally lead to the protection of specific areas?
► Are any of these areas recognized as sacred natural sites? Can these sites serve to inspire environmental conservation?

C. The Protecting Garden

As well as food, medicine and ritual ingredients, plants also provide shelter that affords "protection and security". The use of plants as a building material for dwellings is the subject of the third wall panel. Locally, however, fibres and bark can also be used to make clothing, another form of protection, and may therefore also be displayed on the wall panel.

1. Make a sketch of one's own house

The teacher asks the pupils to take a close look at their own homes and make a series of drawings and sketches on separate pieces of paper.
Do different types of dwellings exist within villages in drylands?
Is there any evidence of a shift from a nomadic lifestyle to a more settled one, or of an alternation between the two lifestyles among the population?

2. Draw a typical local dwelling on the wall panel

The class compares the various drawings and chooses one that is representative of each type of local dwelling.
The chosen drawing is then re-drawn in large on the wall panel.
Other pupils use words and arrows to identify and clearly label the plants that the houses are made of (for each dwelling type drawn on the wall panel).
For nomadic dwellings:
► What is a tent made of? Is it made entirely of animal materials, such as goats' hair or cow, goat or camel hide? What are "yurts" or "*gers*" made of, common in central Asia and still widely used by nomads in Mongolia?
► Is the nomadic dwelling easy to dismantle, such as a matted straw or latticed panel hut? Which plants are used?
For sedentary dwellings:
► Even if the hut is made of wood or clay (often called *banco*), are plants also used in its construction? What is the roof covering made of?
Example:
Thatched roofs, sometimes made of date palms but more often with grasses such as typhas (*Typha australis* as found in Senegal, Algeria, Mauritania).
What kind of wood are the main beams made of?
Which types of tree are most commonly used for this purpose?
Example:
The date palm is commonly used, but if it is not available, which tree species are used instead? *Acacia tortilis*? *Acacia radiana*?
If these tree species are rare, are any other tree species used?
► Are there any sedentary dwellings made entirely from plant materials?
Examples:
Circular structures made from grasses are typical of some African regions.
A *zeriba* is a lightweight construction that can be made with different plants - straw, for example, or braided or fenced foliage.

26. et 27. House and village, Dogon Country, Mali, 1995

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3. Depict the dwelling in detail

Still focusing on the depiction of the dwellings, another group of pupils produces detail sketches of the main picture, highlighting the detail of the construction by drawing "close-ups" of braids and fixation points or producing a series of sketches showing the stages of construction.
They write down the names of plants turned into rope or thread in order to tie or fix items together.

Examples:

Sisal (*Agave sisalana*) is a fibre extracted from the leaves of the agave, found in South America; Needle grass (*Stipa tenacissima*) is common in the Mediterranean basin and in North Africa.
Gamba grass (*Andropogon gayanus*) is found in Sahelian Africa.

4. Make the connection between environmentally-adapted dwellings and natural resources

The pupils describe the characteristics that show how the plants have adapted over time to the environment and climatic conditions.
The population has learnt over time how to make use of these characteristics, by developing specific and accurate uses for the plants, for instance in the construction of dwellings.
Which plants are best at providing shelter from the wind?
Which plants are insect-resistant?
Which plants protect from extreme heat and dryness?

Examples:

Palm leaf spines arranged side by side allow air to circulate freely and keep the inside of the dwelling cool.
The information is either written or drawn directly onto the wall panel.

5. Conduct an overview of how plants are used in the construction of dwellings

Finally, the entire class discusses the important role of plants in improving the living standards of dryland inhabitants.
Wood is collected for house shells, for general construction and for producing mortar (such as *Acacia albida* or *Gao* in Africa). It is also collected for handicraft and furniture making. But these various uses, along with the collection of **firewood**, also represent one of the principle causes of the **deforestation** that is largely responsible for the rarefaction and disappearance of the plant cover.
Despite ever-increasing need, could it be possible to promote action and encourage behaviour to curb or limit this trend?
Which non-destructive methods can be used to cut down trees while maintaining the forests?
► Using traditional wood-cutting techniques?

Example:

Selective pruning and trimming.

► Encouraging the conservation of natural resources through the selection and rational consumption of species according to need?

The teacher demonstrates how, by its very nature and the many different functions it fulfils, species diversity meets the specific needs of the population.

► Promoting natural regeneration?

Re-sowing, creating plantations and maintaining forests; avoiding cutting down young trees and shoots; controlling pasture zones by delimiting the perimeters of protected areas; providing alternative, renewable energy sources such as solar power.

► Finally, the teacher may consider the advantages and drawbacks of modern, urban building materials.

Examples :

Cement and steel are industrially produced and sturdy. However, they are costly and consume both water and energy.

Guidelines for more advanced work:

At various stages in the activity, or once it has been completed, it would be a worthwhile exercise to combine this primarily visual and pictorial inventory with more scientific ones, compiled as part of national or regional action programmes of countries that have ratified the **United Nations Convention to Combat Desertification** (UNCCD).

With regard to the monitoring and evaluation of biodiversity, teachers are encouraged to consult scientific databases such as the GTOS TEMS database, which provides an analysis of environmental quality indicators in places around the world, the BRIM (Biosphere Reserves Integrated Monitoring) programme which is managed by UNESCO's Man and the Biosphere (MAB) Programme and the IUCN Red List of Threatened Species, the world's most comprehensive inventory of the global conservation status of plant and animal species.

28. Holm oak plantation, *Sidi-bel-Abbès* region, Algeria, 2002

Glossary

Activity n°1

Collecting Treasures

Biocenosis
From the Greek "bios" (life) and "koïnos" (common, community). A community of living organisms (animal, vegetable and micro-organisms) that coexist in a defined space (biotope).

Biodiversity
The variability among living organisms from all sources (plants, animals and micro-organisms) on the earth, the variability within species and the variability among the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems.

Biotope
From the Greek "bios" (life) and "topos" (place).
A defined natural area characterized by specific geological, soil and climate conditions, of variable size, usually small, that supports animal and plant species that are adapted to these conditions. Examples: ponds, humid grassland, pine forests.

Plant cover
Collective vegetation covering the ground.

Ecosystem
An interacting complex of a community of living organisms and its physical, chemical and geographical environment. Thus, air, land, water and living organisms, including human beings, interact to form an ecosystem.

Habitat
A place that is home to a particular plant or animal species, and which provides all that the species requires in order to live.

Activity n°2

Land, Rock and Erosion

Desert varnish (or eolian polish)
Dark brown or orange patina coating the surface of sand or rocks in the desert. The presence of metal oxides (iron, manganese) combined with wind action and solar radiation gives mineral particles and rocks this colouring.

Erosion
The wearing away and transformation of the earth's surface by water (rain, river, sea), ice or atmospheric agents (wind, heat, precipitations). Thus one refers to water erosion, eolian (wind) erosion and thermal (heat) erosion. This phenomenon is often aggravated by humankind (deforestation, agriculture, road-building) and results in the transformation of the relief and the carrying away of soils.

Eolian erosion
The wearing away and transformation of the earth's surface through wind action. A form of surface erosion. It includes:
Deflation, which denotes the lifting and transporting of fine soil particles (small and medium-sized grains of sand, dust);
Corrasion, which denotes the mechanical and abrasive effect of particle-laden wind (containing grains of sand and quartz, and ice particles in polar regions) on reliefs and soils.

Humus
A complex mixture of organic substances generated by the breakdown of plant (dead leaves) and animal debris by micro-organisms (invertebrates, bacteria, fungi) living in the soil.
Humus is a dark, earthy substance that is present in topsoil and contributes to soil fertility by releasing nitrogen and other nutritive elements vital for plant growth.

Nutrients
A nutritive substance (chemical elements or compounds), either mineral or organic, that is vital to the functioning of all living organisms.
The nutrients that are absorbed by plants for growth are phosphates, nitrates, mineral salts and potassium.

Sediments
Material resulting primarily from rock erosion (soil, sand, clay, gravel, blocks), that is transported by various agents, such as water, wind, ice and gravity, and which, once set down, becomes compressed and forms a rock. It may also originate from organic matter (shell or coral debris accumulation).

Activity n°3

An Inventory of Useful Plants

Firewood
Wood that is used by the population as the main source of domestic energy: for cooking and light.

Conservation
The protection of ecosystems, species and natural resources against degradation and destruction so that future generations might benefit from them. The conservation of ecosystems, species and natural resources can result in the planned management of their use by humankind.

United Nations Convention to Combat Desertification (UNCCD)
International agreement adopted in 1994 in Paris. 191 countries have ratified the Convention to date (2005). It aims to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification. The action programmes of the Convention are designed to improve land productivity, restore (or conserve) soils, define the best use of water and achieve sustainable development in affected regions.

Single species population growth
An increase in the number of individuals belonging to the same species measured over time. The assessment is often conducted in a single biotope.

Deforestation
All the processes by which humankind is transforming forest ecosystems and causing them to disappear: overuse of wood, forest fires, farming of wooded areas.

Extinction
The entire disappearance of a species from Earth.

Monoculture
A form of agriculture consisting of planting a single species over vast areas. Monoculture is a cause of serious ecological imbalances, since it can result in soil erosion and encourages the proliferation of pests and diseases.

Indigenous plant (or local plant)
A plant that grows naturally in a given geographical area (a portion of the total species range) and whose genetic material has adapted to that location. Where a plant exists only in a single location or region in the world, it is known as an endemic plant (more restrictive).

Medicinal plant
A plant used by humankind for therapeutic purposes.

Natural resources
Mineral or biological elements for which humankind has found a use. The very concept of a resource implies use. These resources fall into two categories:
- Non-renewable resources, consisting of mineral raw materials, such as metals;
- Renewable resources, that can be used without being exhausted, in that their rate of removal is slower than their rate of renewal, such as forests.

Today, there is a persistent and growing trend towards exhaustion of the world's natural resources.

A Creative Approach to Environmental Education

This document presents an extract of the teaching resource kit for environmental education that is currently being developed by UNESCO's Man and the Biosphere (MAB) Programme.

Designed to be used in dryland countries, the kit is aimed at primary and secondary schoolteachers and is based on an innovative approach appealing to the creativity and artistic sensibilities of pupils aged 6-15 approximately.

Conceived with the aim of developing among younger generations the ability to combat desertification while endeavouring to conserve biodiversity, the content of the kit echoes the United Nations General Assembly declaration proclaiming 2006 as the International Year of Deserts and Desertification. It is also consistent with the activities developed as part of the Decade of Education for Sustainable Development (2005-2014), the promotion of which falls within UNESCO's fields of competence.

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