

TEACHER INFORMATION SHEET

THE SUSTAINABILITY OF ECOSYSTEMS

For the Answer Key please request by e-mail at zooanswers@torontozoo.ca

Summary

The aim of the pre-activity, the Zoo activity and the post activity is to have students investigate, research and present information on the factors that effect the survival and population of an ecosystem.

Overall Expectations

- o demonstrate an understanding of the dynamic nature of ecosystems, including the relationship of ecological balance and the sustainability of life;
- o investigate factors that affect ecological systems and the consequences of changes in these factors;
- o analyse issues related to environmental sustainability and the impact of technology on ecosystems.

Specific Expectations

Understanding basic concepts

By the end of this lesson/activity, students will:

- o examine the factors (natural and external) that affect the survival and equilibrium of populations in an ecosystem;
- o examine how biotic factors affect the survival and geographical location of biotic communities.

Developing Skills of Inquiry and Communication

By the end of this lesson/activity, students will:

- through investigations and applications of basic concepts:

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- o formulate scientific questions about observed ecological relationships, ideas, problems and issues;
- o select and integrate information from various sources, including electronic and print resources, community resources and personally collected data, to answer the questions chosen;
- o analyse data and information and evaluate evidence and sources of information, identifying flaws such as errors and bias;
- o select and use appropriate vocabulary and numeric, symbolic, graphic, and linguistic modes of representation to communicate scientific ideas, plans, results and conclusions.

Relating Science to Technology, Society and the Environment (STSE)

By the end of this lesson/activity, students will:

- o assess the impact of technological change and natural change on an ecosystem;
- o identify and research a local issue involving an ecosystem: propose a course of action, taking into account human and environmental needs; and defend their position in oral and written form;
- o identify and evaluate Canadian initiatives in protecting Canada's ecosystems
- o explain change in popular views about the sustainability of ecosystems and human responsibility in preserving them;
- o describe careers that involve knowledge of ecology or environmental technologies, and use resources such as the internet to determine the knowledge and skill requirements of such careers.

Relevant Background Information

Extinction

For every species that is alive today, perhaps a thousand more have lived previously and become extinct. Most of these extinctions occurred before humans evolved, and the species are known to us only through fossils. The extinction of species and populations as a result of natural processes is a neutral event. Throughout the millennia of geological time, the natural extinction of certain species has tended to be balanced by the evolution of new species. Extinctions are a natural part of evolutionary processes, but through most of the history of life on Earth, biological diversity has been increasing. Periodically, however, major changes in the conditions on Earth have caused the collapse of living systems, and large percentages of species have become extinct. These species will never return. It takes millions of years for life forms to diversify again.

The current extinction crisis is unique, in that the loss of biodiversity is occurring very rapidly, and the causes of the crisis are the activities of a single species: human beings. Some scientists believe the current crisis began when humans and their domestic animals first began to colonize the various parts of the globe. Others believe it began around 1600, when human

population growth exploded, and the level of per capita resource consumption began to rise dramatically in some parts of the world. Of the species that are best known, the so-called "higher animals," more than one percent has become extinct in the last 400 years and the overwhelming majority of these extinctions are anthropogenic. During the last 400 years also, some 490 described species of animal are known to have become extinct. Many more species are in danger of becoming extinct if we do not act quickly to conserve them.

Extinction Rates

The background rate of extinction is the number of extinctions that would be occurring naturally in the absence of human influence. Estimates range from one to ten species per year for the past 600 million years. It is difficult to estimate this rate, in part because the number of species in existence is not known. The background rate of extinctions establishes a baseline from which the severity of the current extinctions crisis can be measured. The current rate of extinction appears to be hundreds, or perhaps even thousands, of times higher than the background rate. It is difficult to be precise because most of the disappearing species today have never been identified by scientists.

The background rate of extinction has been interrupted periodically in Earth's history by episodes of mass extinctions, periods in which a large percentage of the existing species become extinct in a geologically short amount of time. Mass extinction episodes represent major collapses of biodiversity and ecosystems, and they lead to fundamental changes in the make-up and distribution of life on Earth. The species that are most likely to survive mass extinctions are widespread generalists such as cockroaches.

There are five widely recognized major mass extinction episodes in the Earth's history, and many scientists believe that we have now entered the sixth. However, there is a fundamental difference. In the past, mass extinctions have been caused by climate change, extreme geological activity, huge meteors colliding with the Earth or other natural factors. These changes in the environment took tens of thousands or even millions of years to occur. The sixth great extinction episode has been precipitated by human activities, and it appears to be happening very quickly.

Types of Extinction

The word "extinction" can refer to several different phenomena. Most of the world's extinctions have been true extinctions, when a species completely dies out and leaves no descendants. A few have been pseudo-extinctions, when the original or ancestral species has become transformed by evolution into another species. All species living today, including ourselves, evolved from another species.

True extinctions and pseudo-extinctions are both a type of global extinction. Global extinction is the complete elimination of a particular species everywhere in the world. Many endemic species have a limited geographic range, such as a single island. No matter how small that area is, their disappearance from it is a global extinction if the species is not found anywhere else.

A local extinction is the extirpation of a species from a portion of its geographic range. Local extinctions mean the loss of the genetic diversity represented by that population and the

removal of that species' contribution to the local ecosystem. Because members of the species still exist in other locations, local extinctions can be reversed if the original causes are addressed, and the species can re-colonize or can be reintroduced into the area. Unfortunately, local extinction is often the precursor to global extinction.

Extinction is not limited to application at the species level. Extinctions in the ancient past frequently are described in terms of whole groups of related species, such as a genus or a family. The farther back in time, the more difficult it is to distinguish different individual species from one another on the basis of fossils, and sometimes scientists can only tell when all the members of a genus or a family disappear. In contrast, it is often useful to categorize extinctions in the recent past by distinctions that are finer than the species level, such as subspecies and populations.

Another important type of extinction is extinction in the wild. Members of a species may exist in captive breeding programs in zoos, but if there are no individuals living in their natural habitat, that species has become extinct in the wild. Similarly, a species may be effectively extinct, if members of the species are still alive, but the species has no chance of reproducing. These cases include those in which all the remaining individuals are of a single sex.

Listed below are the main causes of our present day problem of possible mass extinction brought about by man

1. Habitat destruction
 2. Habitat fragmentation
 - loss of habitat, primarily due to the demands of the ever growing human population
 3. Overkill
 - killed for pelts, skins or feathers
 - killed for medicinal purposes or folklore
 - over collected for food or the pet market
 - killed for sport or trophy
 - war, which puts modern weapons into many hands, for example, poachers
 - poisoning and predator persecution, victims of pesticides or herbicides
 4. Invasive species
 - introduction of non-native animals
 - competition with domestic animals for food and water
 - danger of disease transmission from domestic animals
 5. Secondary effects cascading through an ecosystem from other extinctions.
- (Robert May, 1995)

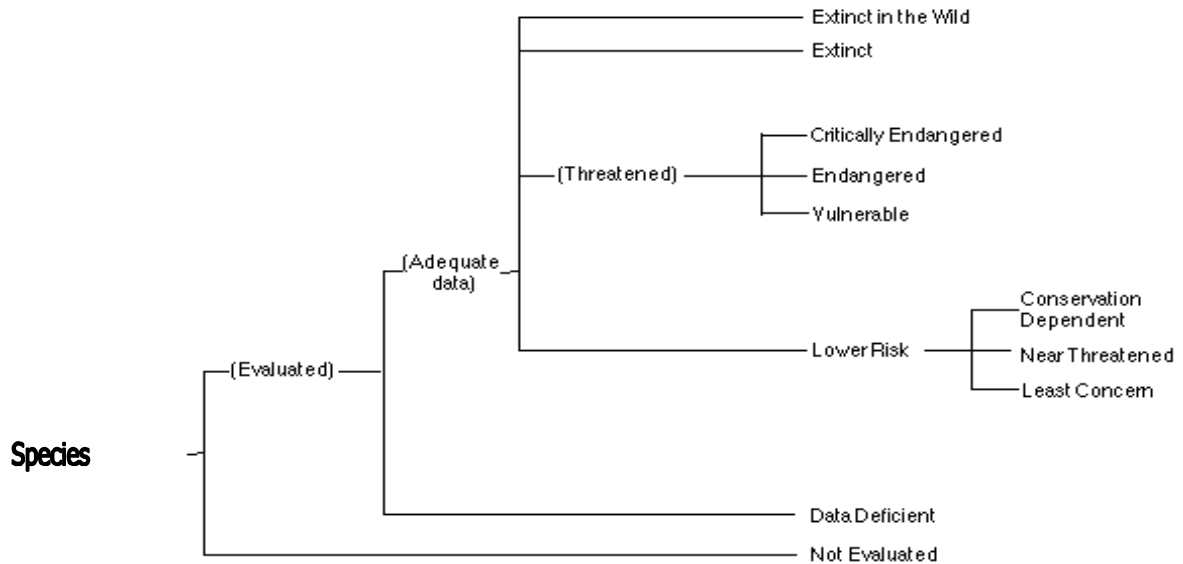
Current conservation strategies and policies in practice

- scientific research into the behaviour, diet, reproductive physiology, genetics and breeding of the species
- endangered species breeding programs, some examples are:
 - SSP - Species Survival Plan
 - EEP - European Survival Plan
 - ASPM - Australasian Species Management Program

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- educating of the public
- fundraising for research anti-poaching patrols and anti-poaching legislation
- regulation of the trade of endangered species (CITES)
- establishment of reserves for the protection of threatened species

Risk Categories



For a complete description of the criteria used by the International Union for the Conservation of Nature (IUCN) to classify threatened species go to:
http://www.redlist.org/info/categories_criteria.html

PRE- ACTIVITY

Suggestion for co-operative learning

Students are divided into groups of three (randomly or at the discretion of the teacher) to encourage maximum learning. It is suggested that these students are kept in the same grouping for the zoo activity and the post- activity.

Part I. Mental/Anticipatory Set

Two mental/anticipatory sets have been presented; both aimed at preparing the students for the subject to be covered. These activities should be used as “warm- up” activities to introduce the students to the main portion of the pre-activity (Part II).

You may have students do both or either of the pre-activities.

Mental/ Anticipatory Set

1. Preparation/ Materials:

Students should sit quietly at their desks and each student should have a pen and a sheet of paper in front of them.

“The Ramble”

Have students close their eyes and visualize the following:

a. “You are walking through the woods on a mild spring day. You feel the cool breeze on your face and you hear swish of the branches of the trees and the rustling of their leaves. You look up and you see patches of the deep blue sky through the green covering made by the towering trees. As you walk, you look around you; you see the waving green grass and the lovely wildflowers. Colourful butterflies are flitting from flower to flower as you walk by. You soon come across a brook running through the woods and since you are a bit tired with your rambling, you decide to sit down under a magnificent willow tree growing on the banks of the brook. The air is full of the sound of birds chirping. You see two squirrels quickly run across the ground in front of you and up a tree. How do you feel?”

Open you eyes now and write a few words to describe how you feel.

b. “Close your eyes again and imagine that you are still sitting under the tree relaxing, listening to the sounds of the water flowing over the rocks. Now that you are rested you decide to continue with your walk. As you continue walking you are suddenly aware of an eerie

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silence; you no longer hear the sounds of the birds or see butterflies flitting around. Suddenly the woods open up to reveal a great empty gap; there are no trees, only stumps; no grass or flowers, just dried branches; no animals, just silence. This view stretches as far as your eyes can see. Vaguely you hear a strange sound in the distance and as it gets louder you suddenly realize..... that it is the sound of a power saw. How do you feel?"

Open your eyes and write a few words to describe how you feel.

- o have students share how they felt walking through the woods during the first part (a.) of their walk within their group (or to the class)
- o have students share how they felt walking through the woods during the second part (b.) of their walk within their group (or to the class)

OR

2. Preparation/Materials:

Space is required to perform this activity. The desks in the classroom can be moved aside and the activity can be done in the classroom itself. However the hall can be used or more appropriate and relevant, the activity can be performed outdoors (if possible).

Name tags for each student and a large ball of yarn is required.

" Web of Life"

Students are assigned roles based on ecological relationships. After the roles are randomly assigned, the students are required to write their respective roles on their name tag and place it on their person so that it is visible to the other students.

One student is assigned the role of the sun and another the role of Man. The rest of the students are assigned the roles of various decomposers (bacteria, worms), producers (plants), primary, secondary and tertiary consumers (rats, snakes, hawks). (More than one student may have the same role).

The student whose role is that of the sun is given the end of the ball of yarn. Students are then asked to name something that is directly dependent on the sun (plants); the ball of yarn is then passed on to that student (with the sun still holding on to the end). The ball of yarn is then passed to the student/s who depend/s on plants for survival (rats). This process is continued until a web is formed connecting all the students to each other.

This shows the students visually the connections amongst the various components in a habitat and emphasizes the idea that all species in an ecosystem are inter-dependent.

The student/s who represent a certain species is/are then asked to let go of the yarn, this represents the idea that they have been removed from the ecosystem. Students who are directly connected to them (i.e. dependent on them) are asked to let go of the yarn. This is continued until the whole web collapses.

This activity should help the students realise that the species in an ecosystem are not only dependent on each other, but that the fate of one species adversely affects the other..... including Man.

Part II. Instructional Input

The aim of this activity is to:

- o introduce students to the basic terms and concepts dealing with the subject to be covered
- o have students involved in co-operative learning and the sharing of ideas

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- o give the teacher an idea as to any misconceptions the students may have on this subject, from the feedback given.
- o assist the students to chart their progress, through the pre-activity, the Zoo activity and the post activity.

Materials/Preparation:

Students are introduced to the terms such as extinct, extirpated, threatened, endangered, and vulnerable. They can be initially asked to state the meanings of these words as they understand them, for the teacher to have an idea as to the level of understanding the students may initially have on the specific subject area. You might also ask the class, collectively, to rank these terms in order of severity. Proper definition of these terms are given for the students to take note of or students can be referred to Nelson Science 10 Page 14.

It is suggested that the students are kept in the same grouping for the Mental/Anticipatory Set activity, the zoo activity and the post- activity so as to encourage maximum learning. Students then begin an activity on endangered species using graphic organizers. See Figure I for a suggested outline. Students are to work together as a group to come up with specific information on threatened species:

What I know

- o examples of endangered species
- o reasons why these species became endangered
- o how individuals can help in assisting the animals
- o why conservation should be practiced
- o examples of extinct species

Each group is supplied with chart paper and markers. Using the format given as the example, each group by discussing and brainstorming with members within their respective group, is to produce a chart showing the above information.

What I want to know

- o each group is then asked to record on their graphic organizer the information they would like to know about the subject collectively as a group.

At the end of this activity, each group is then asked to present the information gathered as a group on **what I know** and **what I want to know**.

The charts are then posted in the classroom to be used as part of the post activity lesson, dealing with **what I have learnt**, after visiting the zoo and completing the Zoo activity.

ZOO ACTIVITY

Description Sheet

Average class size: 30-35

1. Students are to be placed in groups of three; averaging therefore 10-12 groups of three. It is suggested that the students are kept in the same groupings as in the pre-activity.

2. Each group is assigned a role.
Suggested roles to be played:
 - a. National Geographic Researchers
 - b. Sir David Attenborough and colleagues in the process of making a wildlife documentary
 - c. Conservation biologists
 - d. Anti- Poaching Patrol

3. Groups are to be divided up equally (if possible) and sent to their specific geographical region and one other (of their choice). The geographic regions comprise the following:
 - a. Africa
 - b. the Americas
 - c. IndoMalaya
 - d. Australasia

4. Each group is to complete the general activity and one specific question pertaining to their geographical area of investigation. They are required to record their data and suggestions in the data record sheets provided.

5. Before arriving at the zoo and beginning the zoo activity, it is suggested that:
 - o the groups know of the specific geographic region they are to concentrate on
 - o the groups decided on the second geographic region that they will visit, apart from their specific region of investigation.
 - o each student has a copy of the activity that pertains to the specific geographic region that they will be investigating, for example, all students in the group/s doing Activity 1 will be visiting Africa and one other region of their choice.
 - o students understand and are familiar with what they are to do to complete their respective activity accurately and thoroughly.

Suggested Resources:

Websites:

<http://www.conservation.org.htm>

<http://foe.org>

<http://www.ran.org>

<http://www.projectwild.org>

<http://www.speciesatrisk.gc.ca>

Bibliography:

The Ontario Curriculum.(1999). Ministry of Education and Training.
Grades 9 and 10. Science

Endangered Species Teacher Resource Kit. Metro Toronto Zoo.

Green Teacher No. 66. Page 25

Nelson Science 10. (2001). Nelson Thomas Learning

Primack, R.1993. Essentials of Conservation Biology. Sinauer Associates Inc., Massachusetts.

Pollack,S. (1993). The Atlas of Endangered Animals. Belitha Press.

Websites:

<http://www.adhost.com>

<http://www.redlist.org>

<http://www.bbc.co.uk>

<http://www.amnh.org/museum/press/feature/biofact.html>

http://www.enn.com/enn-features-archive/1998/09/091698/fea0916_23526.asp

<http://www.iucn.org/redlist/2000/news.html>

<http://www.sciam.com/article.cfm?articleID=0009E9C9-E1E4-1C67-B882809EC588ED9F>

POST ACTIVITY

Main Post-Activity

I. This activity occurs in the classroom. It is suggested that the students are kept in the same groups as in the pre-activity and the Zoo activity. Students are then given their original chart paper showing **“What I know”** and **“What I want to know”**. They are then asked to complete the chart, working in their respective groups, on the final topic for discussion dealing with **“What I have learnt”**.

Students are given a fixed amount of time for this activity to be completed. Each group is then required to contribute to the class one factual piece of information on **“What I have learnt”**.

II. With the information obtained in Question 5 of the Zoo activity, students are asked to use their thoughts and observations written down to express what the animal would have liked to say to humans in any form that they may wish to use.

Suggestions: song, rap, story, poem, monologue, interview

Students can again post these in the school library or around the school to inform and educate the student body of the status of threatened species.

Suggested Post-activities

Activity I

i) Students are placed in pairs

ii) Each pair is to choose one species (plant or animal) that belongs to any one of the following categories:

- extinct in the wild OR
- extirpated OR
- endangered

iii) Each pair, on choosing one species, is to research and compile data on that species. Using the information collected, students are to create a poster aimed at informing the public (school body) about the status of the species.

The poster created should include the following information:

- species' common and scientific name
- the status of the species
- visual or detailed description of the species
- the past range and population of the species before it became threatened.

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- the present range and population of the threatened species
 - reason for the species becoming Extinct in the wild, Extirpated or Endangered
 - recovery procedures put in place by conservationists
 - any other interesting fact about the species
- iv) The posters can then be displayed in the school library or posted throughout the school, so as to educate the rest of the school body about threatened species.

Activity II

- i) Each student is to research one species that has become extinct within the past 100-150 years. All data collected should be recorded in the students' field journal. Students should obtain the following information on the species:
- common and scientific name of the species
 - visual or detail description of the species
 - period identified as becoming extinct
 - the area that the species was found in
 - the cause for its extinction
 - could the extinction of the species have been prevented?
 - strategies or plans that could have been put in place to ensure the survival of the species
 - any other interesting fact about the species
- ii) As an option, the information compiled can be used to develop a poster that can then be displayed in the school library or posted throughout the school, so as to educate the rest of the school body about threatened species.

Activity III

- i) Have students use of library, internet, contacting their provincial or territorial wildlife agencies or other research techniques to obtain information on species that are classified as extinct in the wild, endangered, vulnerable and extirpated.

Information is needed on how the species came to be classified as such and the procedures in place for its recovery.

Students can then compile a master list of the species according to the category in which they are classified and complete the table as follows:

PROVINCIAL OR TERRITORIAL

Species Name	EW	EN	VU	EX	Factors affecting animals status	Recovery procedures in place

NATIONAL

Species Name	EW	EN	VU	EX	Factors affecting animals status	Recovery procedures in place

ii) Student can post this list up in the classroom or library as a means by which the school body can be informed and educated about the species that are threatened in their Province or in Canada as a whole .

Activity IV

In their groups of three have students research careers that involve ecology or environmental technologies. Information on specific careers should include:

- o the level of education needed
- o the specific type of knowledge and skills required
- o previous experience needed in the area of interest
- o amount of post-secondary education needed to become qualified
- o the expected salary range
- o individuals in that specific career that have made a marked contribution

Suggested careers to be researched:

Field/Research Technician
 Laboratory Assistant
 Research Associate/Scientist
 Research Administrator
 Program Manager
 Wildlife Biologist
 Forester
 Natural Resource Manager
 Environmental Consultant
 Environmental Planner
 Park Naturalist
 Program Scientist
 Wildlife Specialist
 Research Assistant
 Environmental Analyst
 Field Ecologist
 Science Specialist
 Outdoor Educator

**Student Activity Evaluation Form**

Please let us know how useful you found these activities. When you return a completed evaluation to us we will send you an attractive poster about gorilla reproduction and endocrinology. *Please return to:*

Education, Toronto Zoo
361 A Old Finch Ave.
Toronto, ON M1B 5K7
FAX: 416-392-5948

Date: _____ Grade Level: _____.

Subject: _____, Your Name: _____.

School: _____.

Please rate the following on a scale of 1 to 5 : 1 poor; 2 fair; 3 satisfactory, 4 good, 5 excellent

1. The activities were appropriate for the curriculum. 1 2 3 4 5
2. The language level was suitable for your students. 1 2 3 4 5
3. The tasks were clearly explained and easily understood by the students. 1 2 3 4 5
4. Did you use this activity as part of your evaluation process for students? (Y / N)
5. Did you or will you be visiting the Toronto Zoo with yours students? (Y / N)
6. Would you use these activities again? (Y / N)
7. How would you change the activity to be more useful?
8. Did you use any other Zoo teaching resource material? (Y / N) (What?)
9. Are there any other kinds of resources you would like the Zoo to provide to support your visit?



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