Scientific Literacy and Disaster Preparedness

The RADAR Approach for Training Teacher Trainers and Facilitators

Asia Pacific Programme of Educational Innovation for Development (APEID)
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Natural Disasters

Photo courtesy of USDA NRCS.

Sustainable Environment

Lake Cuc, Thai Nguyen City, Vietnam
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Part One: Introduction

Overview

We have no control when and where natural disasters will happen. What we can control is how people, communities and governments confront/deal the dangers caused by natural disasters. Scientists have identified disaster-prone areas such as the Pacific Ring of Fire where earthquakes usually take place, where volcanoes are active, those places vulnerable to typhoons, storms and hurricanes, coastal areas where tsunami’s would possibly occur. Accurate methods of predicting disasters and warning the public quickly have been installed in certain parts of the world. The purpose of the warning system is to quickly inform the population of safe evacuation routes. Emergency warnings and evacuation plans are not enough. In earthquake prone areas, infrastructure needs to be strong and flexible to prevent collapse. In places where typhoons and flooding are constantly occurring people must not build their houses near rivers/canals or close to dams where there are possibilities of overflowing water and strong currents. In many poor countries, many deaths and tremendous damages of homes, farms and properties are reported. Much international aid is required not only in terms of food, clothing and shelter, but also in fixing infrastructure. The effects of the 2004 tsunami which devastated Aceh, Indonesia, the 2005 earthquake in Kashmir, Pakistan and the typhoon in Myanmar were made worse by poor infrastructure and widespread poverty. People need to be aware and ready on the risks in their area, and those affected by disasters also need social rehabilitation to help them go back to normal life. Even in rich countries, unpreparedness to natural disaster takes a lot of efforts, time and money.

In 2005, a World Conference on Disaster Reduction was held in Kobe. Many topics were taken up including “Education and Training” of which the following recommendations were proposed: (1) Promote the inclusion of disaster risk reduction knowledge in relevant sections of school curricula at all levels and the use of other formal and informal channels to reach youth and children with information; promote the integration of disaster risk reduction as an intrinsic element of the United Nations Decade of Education for Sustainable Development (2005–2015); (2) Promote the implementation of local risk assessment and disaster preparedness programmes in schools and institutions of higher education; (3) Promote the implementation of programmes and activities in schools for learning how to minimize the effects of hazards; (4) Develop training and learning programmes in disaster risk reduction targeted at specific sectors (development planners, emergency managers, local government officials, etc.); (5) Promote community-based training initiatives, considering the role of volunteers, as appropriate, to enhance local capacities to mitigate and cope with disasters; (6) Ensure equal access to appropriate training and educational opportunities for women and vulnerable constituencies; promote gender and cultural sensitivity training as integral components of education and training for disaster risk reduction.

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The recommendations are within the four major thrusts of the Commission for Sustainable Development, and in accordance with the International Implementation Scheme of the Decade of Education for Sustainable Development (2005 – 2014). These are: (1) promotion and improvement of basic education; (2) re-orienting existing education at all levels to address sustainable development; (3) development of public understanding; and (4) awareness of sustainability and training.

Education can provide an excellent opportunity for building awareness about natural disaster preparedness and for implementing a variety of activities that can minimize the future negative impacts of natural disasters. One important means for everyone to learn about disaster preparedness is by acquiring scientific literacy, through curriculum and material development, and the training of future teachers and those teachers already in the service.

**Rationale**

This Guide uses the RADAR approach for training of teacher trainers and facilitators. A training innovation, the approach involves: Review of resource papers written by famous science educators/scientists; Analysis of issues bases on the resource paper and from learner’s experience; Debate and discussion to listen from the views of other learners; Agreement on commonalities and differences of ideas and identifying trends; and Re-orienting knowledge, skills and attitudes to promote civic and social responsibility. This approach will allow the learner to comprehend the relationship of Scientific Literacy (SL) and natural disaster preparedness, or of other topics for the development of HOTS.

Scientific literacy is usually taken to mean developing the ability to utilise science knowledge creatively in everyday life, to solve problems, make decisions and hence improve the quality of life. This is based on acquiring educational skills at the intellectual, attitudinal, societal and interdisciplinary levels. SL within formal schooling can be interpreted as ‘science which is intended within the school curriculum such that science education can maximise its role in aiding students to acquire the goals of general education, as stipulated by society.” In other words, science is taught in schools, because it is seen as an important part of general education. A scientifically literate person (1) knows something of the role of science in society and appreciates the cultural conditions; (2) knows the conceptual inventions and investigative procedures; (3) understands the interrelationships of science and society, ethics, the nature of science, including basic concepts and the interrelationships of science and humanities; (4) appreciates the role of science in a humanistic way, and feels comfortable when reading or talking with others.

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3 RADAR APPROACH is proposed by the Lucille Gregorio, as an innovation for training of facilitators and trainers.
4 HOTS mean Higher Order Thinking Skills.
about science at a non-technical level; (5) curious about the how’s and why’s of materials and events - and genuinely interested in hearing and reading about things that claim the time and attention of scientists; (6) may never create any ideas pertaining to science, but will be conversant with the ideas that are being considered.5

Mayer, in his presentation at the Tokyo Seminar in 2005,6 explained that a framework using the Global Science Literacy (GSL) and Earth Systems Education (ESE) constructs would serve well in developing a “Framework for Natural Disaster Preparedness.” It is in this context that this Guide using the RADAR7 Approach for Training of Teacher Trainers and Facilitators on “Scientific Literacy and Natural Disaster Preparedness” is developed.

**General Training Objectives**

1. To Review the framework for natural disaster preparedness based on the Global Scientific Literacy and the Earth System Education;

2. To Analyze and identify the major components Scientific Literacy applicable to Natural Disaster Preparedness;

3. To Debate /discuss the issues at hand through participatory and cooperative learning;

4. To Agree on an alternative conception and utilize the information in developing an exemplar training lesson on “Scientific Literacy and Natural Disaster Preparedness”;

5. To Re-orient Knowledge, Skills and Attitude for promoting civic and social responsibility on natural disaster preparedness.

**Target Trainers and Facilitators**

This Training Guide is purposely intended for science teacher educators as well as master teachers conducting in-service workshop for pre-service and in-service teachers and members of professional teachers’ associations on “Scientific Literacy and Natural Disaster Preparedness.” This guide will also assist teacher-training institutions to integrate the concepts in the pre-service teacher curriculum and school-based in-service training activities.

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7 RADAR stands for Review, Analyze, Debate, Agree, Re-orient knowledge, skills, and attitude to promote civic and social responsibility to prepare for natural disaster.
The RADAR Training Approach and Activities

The four training units are implemented utilizing the RADAR approach which will lead to a ‘minds-on, hands-on, and hearts-on’ experience. The training tasks are set and Resource Papers written by world-famous and respected science educators/scientists are provided. For a start the trainers need to have a thorough understanding of the RADAR approach, and thus should possess a fair understanding of the concepts and ideas described in the resource papers. The concepts and ideas are presented in a way that trainees have opportunities to review, analyze, debate, agree and re-orient KSA\(^8\) to promote civic and social responsibility to prepare for natural disaster. The learners will eventually be able to develop their own contextual-based learning materials, adapting the approach. The tasks are performed based on participatory, learner-centred, and cooperative learning strategies with emphasis on developing higher order thinking and communication. The training units will subsequently be piloted to invite comments and suggestions before revision and implementation.

There is no time frame indicated. The amount of time required for undertaking each training unit will depend on the readiness of the trainers/facilitators in the English language, and to readily comprehend the concepts. For some countries, translation to local languages maybe necessary.

\(^8\) KSA means Knowledge, Skills and Attitudes
**Part Two: The Training Units and Resource Papers**

**Training Unit 1:** Global Scientific Literacy and the Earth System Framework: Proposed Framework for Natural Disaster Preparedness.

*Resource Paper 1: The Global Scientific Literacy (GSL) and Earth Systems Education (ESE)*

**Training Objectives:**

1. *To compare the different views between global scientific literacy and standard science teaching-learning by reviewing the ideas presented in the resource paper.*

2. *To argue that global scientific literacy is relevant to natural disaster preparedness.*

**Training Task 1:** Individually Review Resource Paper 1

**Training Task 2:** Join a group of 5 members each. Brainstorm the view that global scientific literacy is largely different from standard school science teaching-learning. Fill in the columns 2 and 3 indicated in Worksheet 1.

**Worksheet 1: Difference between Global Scientific Literacy and Standard Science Teaching-Learning**

<table>
<thead>
<tr>
<th>Global Scientific Literacy</th>
<th>Standard Science Biology/Chemistry/Physics/ Geography/etc</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Organized conceptually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Accepts the idea that there are aesthetic incentives to the understanding and appreciation of the subject of all science, the Earth system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Incorporates as a major objective an understanding of how human activities</td>
<td></td>
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</tr>
</tbody>
</table>
impact, often negatively, the earth system.

4. Incorporates the science methodology and thinking of the system sciences as well as that of the physical sciences.

5. Recognizes the role of science in society by incorporating objectives from the social studies curriculum construct of global education thus capitalizing on the unique advantages of science and the science curriculum in promoting cross cultural understanding.

6. Curricula are taught with learning strategies or environments that accurately represent the nature of science and the nature of the learner. As a result, such curricula use student-oriented activities and rely heavily on student’s investigative abilities.

7. Incorporating the systems science concept and thinking, it accommodates Eastern thinking and worldviews thus providing a wider international basis and cultural acceptance for the science curriculum.

*Training Task 3:* Debate/discuss the commonalities and differences between Global Scientific Literacy and the Standard Science Curriculum. Which do you think
effectively promotes Higher Order Thinking Skills (HOTS)? Explain your answer in the context of ESD.

**Training Task 4:** Refer to the Earth System Framework proposed as shown in Resource Paper 1. Fill in Worksheet 2 below. Fill in the Columns and Indicate which part could be covered in the Standard Science Curriculum or a Scientific Literacy Component. Note down your reasons in the Remarks Column.

Worksheet 2: Analysis of the Earth System Framework

<table>
<thead>
<tr>
<th>Framework</th>
<th>Standard Science Curriculum</th>
<th>Scientific Literacy Component</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Understanding 1: Earth is unique, a planet of rare beauty and great value.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 The beauty and value of Earth are expressed by and for people through literature and the arts.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Human's appreciation of planet Earth is enhanced by a better understanding of its subsystems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3 Humans manifest their appreciation through their responsible behaviour and stewardship of subsystems.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Understanding 2: Human activities, collective and individual, conscious and inadvertent, affect planet Earth.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Earth is vulnerable, and its resources are limited and susceptible to overuse or misuse.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Continued population growth accelerates the depletion of natural resources and destruction of the environment, including other species.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3 When considering the use of natural resources, human’s first need to rethink their lifestyles, and then reduce consumption, then reuse and recycle.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 By-products of industrialization pollute the air, land, and water, and the effects may be global as well as near the source.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 The better we understand Earth, the better we can manage our resources and reduce our impact on the environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
environment worldwide.

**Understanding 3: The development of scientific thinking and technology increases our ability to understand and utilize Earth and space.**

3.1 Biologists, chemist, and physicists, as well as scientists from the Earth and space science disciplines, use a variety of methods in their study of Earth systems.

3.2 Direct observation, simple tools, and modern technology are used to create, test and modify models and theories that represent, explain, and predict changes in the Earth system.

3.3 Historical, descriptive, and empirical studies are important methods of learning about Earth and space.

3.4 Scientific study may lead to technological advances. Regardless of sophistication, technology cannot be expected to solve all of our problems.

3.5 The use of technology may have benefits as well as unintended side effects.

**Understanding 4: The Earth system is composed of interacting subsystems of water, rock, ice, air, and life.**

4.1 The subsystems are continuously changing through natural processes and cycles.

4.2 Forces, motions and energy transformations drive the interactions within and between the subsystems.

4.3 The Sun is the major external source of energy that drives most system and subsystem interactions at or near the Earth's surface.

4.4 Each component of the Earth system has characteristic properties, structure, and composition that may be changed by interactions of subsystems.

4.5 Plate tectonics is a theory that explains how internal forces and energy cause continual changes
within Earth and on its surface.
4.6 Weathering, erosion, and deposition continuously reshape the surface of the Earth.
4.7 The presence of life affects the characteristics of other systems.

**Understanding 5: Planet Earth is more than 4 billion years old and its subsystems are continually evolving.**

5.1 Earth's cycles and natural processes take place over time intervals ranging from fractions of seconds to billions of years.
5.2 Materials making up planet Earth have been recycled many times.
5.3 Fossils provide the evidence that life has evolved interactively with Earth through geologic time.

**Understanding 6: Planet Earth behaves according to the same physical principles.**

6.1 Earth's cycles and natural processes take place over time intervals ranging from fractions of seconds to billions of years.
6.2 Materials making up planet Earth have been recycled many times.
6.3 Fossils provide the evidence that life has evolved interactively with Earth through geologic time.
6.4 The position and motions of Earth with respect to the Sun and Moon determine seasons, climates, and tidal changes.
6.5 The rotation of Earth on its axis determines day and night.

**Understanding 7: There are many people with careers that involve study of Earth's origin.**

7.1 Scientists, and technicians who study Earth are employed by businesses, industries, government agencies, public and private institutions, and as independent contractors, analyses and experiments in the laboratory.
7.2 Scientists from many cultures throughout the world cooperate and collaborate using oral, written, and electronic means of communication.
Some scientists and technicians who study Earth use their specialized understanding to locate resources or predict changes in Earth systems.

Many people pursue a vocations related to planet Earth processes and materials.

Training Task 5: Form a group of 5 members each. Analyze the group view whether they “agree” or “disagree” from Worksheet 2 and relate to natural disaster preparedness. Prepare a group report for presentation in the Class.

Training Task 6: From the view of the class, agree on a Framework for Disaster Preparedness.

Training Task 7: The Class will compile the group and class report in the “Portfolio of Outcomes on Scientific Literacy and Natural Disaster Preparedness.”

Resource Paper 1: The Global Scientific Literacy (GSL) and Earth Systems Education (ESE)

Introduction

To provide a sound basis for science education and its role in disaster mitigation it might be well to briefly discuss the types of disasters that occur in our world today. Nature initiated disasters include Drought, Earthquakes, Tsunami’s, Hurricanes and Typhoons, Floods, Landslides, Volcanic Eruptions, Tornadoes, Wild Fires, and Pandemics. Many of these events are linked in their causes and effects. An earthquake that takes place on the ocean floor can initiate tsunamis such as the Indian Ocean Tsunami in 2004. Others can be caused by volcanic activity in the oceans such as the tsunami associated with the eruption of Krakatoa in 1883. Landslides can occur during typhoons with their associated rain as happens in the coastal mountain areas of Japan. So too can floods be caused by typhoons as occurred in Gifu in 1997. The point is that all of these are events within the earth system and the various processes in nature are linked through their operation within or between the various earth subsystems. Human initiated disasters can be truly catastrophic. Global Climate change for example, caused by the sudden release of carbon dioxide and methane into the atmosphere as a result of human activity has the potential of enhancing the natural disasters of floods, hurricanes (Katrina), tornadoes, droughts and pandemics. Global Climate Change is also likely to totally change our climate.

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9 Mayer, V.J. 2006. Science Education for Disaster Preparedness and Sustainable Development: Global Scientific Literacy. NIER Tokyo
systems bringing sub arctic conditions to northern countries such as Great Britain and northern Europe and causing deserts where once prosperous farms existed. Other human initiated disasters include Terrorism, Fire, War, and Atmospheric Pollution. All have effects within the earth systems. And of course all disasters can be best understood by individuals with a solid base in the science understandings of how our earth systems function. Procedures for disaster prevention and effect mitigations can best be determined through applying the thought processes developed in the systems sciences. This knowledge and thought process is developed in earth systems education, which is the basis of Global Science Literacy.

Working for almost eight months in 1996 with colleagues at the Global Education Program of Hyogo University of Education in Japan, the concept of Global Science Literacy (GSL) was developed. The ESE construct was used as the science curricular basis for developing the philosophy and characteristics of an international version of science literacy. One of the basic ideas is that science is an ideal curricular medium for promoting global understandings of culture. Through combining objectives of the social studies curricular effort of global education and integrating its philosophy with that of ESE, the GSL construct was achieved. GSL was developed in the post-Cold War era. It looks to the future challenges of science and science curriculum in an era of social unrest and environmental change. It is not directed toward the use of technology in commercial or military developments but only the uses of technology for expanding our knowledge of the Earth system we all share and for ameliorating the destructive environmental consequences of unfettered technological development. It provides a strong basis for an education for sustainable development and for disaster mitigation.

**Essentials of Global Scientific Literacy**

GSL differs from the standard science curriculum, as it exists in most parts of the world today, in several ways:

1. It is conceptually organized rather than organized by science discipline.
2. It accepts the idea that there are aesthetic incentives to the understanding and appreciation of the subject of all science, the Earth system.
3. It incorporates as a major objective an understanding of how human activities impact, often negatively, the earth system.
4. It incorporates the science methodology and thinking of the system sciences as well as that of the physical sciences.

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5. It recognizes the role of science in society by incorporating objectives from the social studies curriculum construct of global education thus capitalizing on the unique advantages of science and the science curriculum in promoting cross cultural understanding.

6. GSL curricula are taught with learning strategies or environments that accurately represent the nature of science and the nature of the learner. As a result, such curricula use student-oriented activities and rely heavily on student’s investigative abilities.

7. By incorporating the systems science concept and thinking, it accommodates Eastern thinking and worldviews thus providing a wider international basis and cultural acceptance for the science curriculum.

Conceptually organized

GSL curricula contrast sharply with the traditional way of organizing science curricula based simply on the various disciplines—a reductionism approach that does not allow for an adequate rendition of the actual subject of all science—our earth system. We have taken a cue from Laszlo (1972) who describes the systems view of nature.

In sum, nature, in the systems view, is a sphere of complex and delicate organization. Systems communicate with systems and jointly form super systems. Strands of order traverse the emerging hierarchy and take increasingly definite shape. Common characteristics are manifest in different forms on each of the many levels, with properties ranged in a continuous but irreducible sequence from level to level. The systems view of nature is one of harmony and natural balance. Progress is triggered from below without determination from above, and is thus both definite and open-ended. To be ‘with it’ one must adapt, and that means moving along. There is freedom in choosing one’s paths of progress, yet this freedom is bounded by the limits of compatibility with the dynamic structure of the whole.

We suggest then that future science curricula, following the GSL approach, are conceptually organized rather than being organized by science discipline. That is, content is organized around the concept of the Earth as a system, often with the various Earth system cycles as components of the organizing framework. Since the Earth system and its environment in space are the subjects of study of all disciplines of science, content from the various disciplines is woven into this framework as it helps to explain the functioning of Earth processes. This focus for the organization of content brings science to the immediate interest and experiences of the learner. Instead of having to learn abstractions of natural occurrences, often confined to a laboratory setting, students apply basic science understandings within a familiar context, their habitat, a context that is often of aesthetic as well as intellectual and practical interest to them. We have used an unique organization of the content standards.

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developed by the National Research Council of the National Academy of Sciences\textsuperscript{13} and combined them with seven Earth Systems Education Understandings\textsuperscript{14} to illustrate and guide the nature of the science content development in GSL curricula. Through such an approach students will see science\textsuperscript{15} not just for its technical applications but for “such ‘soft’ factors as our view of nature, man and world.”

\textit{Incorporates aesthetics}

The first Earth Systems Understanding is “Earth is unique, a planet of rare beauty and great value”. This understanding was included at the insistence of scientists participating in a weeklong conference to define those basic understandings to be included in science curricula\textsuperscript{16}. They argued that one of the reasons they pursued a career in science was that they found beauty in the Earth system. It could have been sunsets, the aurora, plants, and animals, any of a wide variety of natural features that they found aesthetically pleasing and stimulating. This was a major incentive for them to follow a career that would lead them to a deeper understanding and valuing of Earth. Since this is true for scientists, science educators should also see the value of earth aesthetics as a part of the science curriculum. By including it as a context for teaching about earth processes teachers can attract a broader variety of students to an interest in science. For this reason, we believe that it should be included in science teaching and have thus included it as an understanding of ESE, the science curricular basis for GSL.

\textit{Focuses on the human uses of the environment and their impact on the earth system.}

Through achieving an understanding of how the various earth processes and cycles are known to function within the earth system, students will achieve a better understanding of how a technological society and a world market affects that system. Through including objectives of global education, they will be better equipped intellectually to suggest and support governmental policies that ameliorate the negative effects of industrial and commercial developments. They will have the knowledge and skills to move their communities toward a sustainable development future and one that will help communities to counter the effects of disasters they may encounter.

\textit{Incorporates system science methods}

The science curriculum as it exists in almost all secondary schools throughout the world emphasizes the content and methodology of the physical sciences. This elevates the controlled

experiment to the highest levels of science “quality” in the minds of the teachers and their students—and in fact the citizens that have benefited from quality education during their college and pre-college educational experiences. This emphasis upon “experiments” as being the hallmark of good science went so far during the days of the United States’ National Science Foundation curriculum projects in the 1960’s and 1970’s that the only widespread curriculum effort in the Earth sciences,\textsuperscript{17} used controlled experiments in its textbook. Many Earth science teachers were treated to the experience of a class of 30 children shaking pieces of rock in metal coffee cans during an effort to determine erosion rates in a contrived “experiment” that controlled for time and rock type. Ignored, even in this curriculum, were the methods of scientific investigation typically used by the geologist and ecologist\textsuperscript{18}. In reviewing the characteristics of the system sciences, such as geology, have called these methods “systems science methods”\textsuperscript{19}. It is these methods that Darwin used in developing his theories of evolution and natural selection, and they are the methods that are informing us about the reality of global warming. They are also the methods of science that will be most useful in future attempts at solving some of the environmental and social problems we have inherited from a century of war and economic conflict. GSL incorporates this type of science methodology as a cornerstone for modern science education programs.

\textit{Integrates objectives of global education}

The nature of science investigation is such that it promotes inter-cultural cooperation and understanding. Its subject, the Earth system and its relationships to the Solar System and the Universe in general, is one held in common by all scientists the world over. The methodology of science facilitates communication among its participants, despite differing cultures and languages. These conclusions about the international nature of science as it is practiced can be verified by examining the authorship of science research studies published in most scientific journals. This understanding of the cross-cultural nature of science and combined topics of science curriculum from the American national science standards with objectives of the social studies curriculum area of global education to formulate the content structure of Global Science Literacy\textsuperscript{20}. Global education is a curriculum construct that seeks to develop a global perspective among students. Five elements\textsuperscript{21} of a global perspective have been identified: (1) perspective consciousness; (2) state of the planet awareness; (3) cross-cultural awareness; (4) knowledge of global dynamics; and (5) awareness of human choices. These are understandings

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{17}Earth Science Curriculum Project. 1967. Investigating the Earth. Boston: Houghton Mifflin Company.
\item \textsuperscript{21}Hanvey, R.G. 1975. An attainable global perspective. New York: Centre for War/Peace Studies.
\end{itemize}
\end{footnotesize}
appropriate for inclusion in science curricula—in fact, supported by the very nature of science, its methodology and its content. They also bring a cultural focus to concerns about environmental changes, whether slow acting or sudden, and their impacts upon all nations.

**Use effective learning strategies**

A variety of learning strategies are available to the teacher for both classroom and field-oriented activities. A sequence of inquiry skills adapted from the National Research Council Publication (2000), Inquiry and the national science education standards: A guide for teaching and learning, are especially useful in investigations. The original skills, included in figure one below, were used by a geologist while studying the occurrence of a “fossil forest” along the Pacific coast. By applying these thought processes and skills, he was able to determine that forest was evidence of a severe earthquake that had occurred several hundred years earlier. (i) Makes observations; (ii) Exhibits curiosity, defines questions, from knowledge background; (iii) Gathers evidence using technology and mathematics; (iv) Uses previous research; (v) Propose a possible explanation; (vi) Published explanation based on evidence; (vii) Considers new evidence; (viii) Adds to explanation; (ix) Explanation informs public policy.

Some examples: (1) Charles Darwin undoubtedly used these and other type of inquiry processes in his classic works dealing with evolution and the theory of natural selection. A fascinating device on field experience following the footsteps of Darwin’s development as an earth system scientist in his home area of Shropshire, England. This can be a model for types of field trips conducted in other areas where famous scientists lived; (2) The “jigsaw” version of cooperative learning is especially useful in both classroom and field activities and has been used in a number of workshops at Ohio State including one held for Cleveland City teachers at Stone Lab in Lake Erie. In this version of Cooperative Learning students belong to two groups. One, the “base” group coordinates information on a topic from different sources. Each of the base group members is also a member of an “expert” group. These groups acquire information from different sources. Individuals then reassemble into their base groups and share their information with the other members of their group; (3) Japanese educators have found student independent investigations carried outside of school hours and during school breaks and vacations to be especially useful for outdoor activities. An independent study of temperature variations in her home community was conducted. Several different patterns over the seven months of investigation were found. These patterns of temperature were dependent upon factors such as; developed vs. lesser-developed areas, hill vs. valley, summer vs. winter and morning vs. evening. Her science teacher assisted in the design of her study. Her father transported her to the various collection sites; (4) Parent assisted investigations outside of...

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school hours have also been successful in both Japanese and American contexts. These are aided by the development of inquiry guides by the teacher specific to the area or topic to be studied, one on the geology of the Miura Peninsula was developed. It was published and made available to all of the 9th grade earth science classes of the Prefecture. Students and their parents used the guide to locate sites of investigation and to learn information about each of those sites. Also included in the guide were laboratory investigations that could be done at home. School laboratory sessions provided introductory and summarizing experiences for the students; (5) Conducting outdoor experiences and indoor laboratory and cooperative learning activities will require the cooperation of all of the teachers in a school. Administrative support is especially important. It requires someone who is not afraid of potential liability occurrences, willing to provide the extra funds necessary for transportation, laboratory materials, computers and resource materials, and for rescheduling classes and teachers to permit extended periods of time in which to conduct these experiences. Finally it is important for the teacher to integrate carefully the out of school experiences into the on-going science curriculum.

Accommodates aspects of Eastern thinking

The concept of the Earth as a system with humans as a subsystem is one that contrasts with the Western idea of the distinctness of man from the natural world—the philosophy in which modern science was founded. This Western idea led to the ascendancy of the physical sciences as a tool used in protecting us from the natural world and in wresting natural resources for our use. Science was useful since it enhanced our ability to utilize the resources of the natural world in our daily activities. This contrasts with the Eastern concept of people as integral parts of nature, depending upon and existing in harmony with natural processes. The system science methodology also reflects this type of thinking. Its conceptual schemes include the human being as an integral part of the life system and illustrate the interrelationships of the human with other Earth systems. Thus GSL, incorporating system science methodology and with content structured around the concept of the Earth as a system, presents a curriculum in science much more in harmony with Eastern thinking than one founded entirely upon the thinking and philosophy inherent in the physical sciences. Therefore, students from both Western and Eastern cultures can be culturally comfortable with science curricula that use GSL as their philosophical and developmental basis.

Higher Order Thinking Skills (HOTS) for Sustainable Development

Developing strategies for sustainable development and natural disaster mitigation in a world already seriously damaged by human intervention will require a workforce and

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commercial and political leadership well equipped with higher order thinking skills. “Process Skill Enhancement in the STS Classroom”, the 1932 National Study of Education Yearbook through the AAAS Benchmarks (1993) and the National Standards (1996) arrive at their conclusion that: (1) Science education has always articulated a need to have students develop their thinking and reasoning skills. The processes that scientists use have been seen as important to impart as “learning’s” in science courses; (2) Most science educators have believed that science can uniquely serve the curricular objectives of developing critical thinking among pre-college students. Thus, there has been an ongoing effort over the years to structure science curricula to be “activity-oriented”, “investigative”, “process oriented”. In doing this, however, educators have relied on a single stereotype of the “nature of science” and its methodology. Thus the broad nature of science and its methodology has been poorly represented in current science curricula.

In 1986 the late Stephen Gould (1986), Agassiz Professor of Zoology at Harvard University, described our science education and its methodological emphasis as follows: “Most children first meet science in their formal education by learning about a powerful mode of reasoning called "the scientific method." Beyond a few platitudes about objectivity and willingness to change one's mind, students learn a restricted stereotype about observation, simplification to tease apart controlling variables, crucial experiment, and prediction with repetition as a test. He goes on to point out that science curricula fail to provide a background in an essential component of the system sciences, that of history. In fact, they condition students to feel that a science that focuses on description and one in which experiments cannot be conducted is not science at all.”

This focus on “experimental science” extends across the Atlantic as well. In the report entitled “Beyond 2000” British science educators recommend that the ideas about science in secondary school should include how to design a simple investigation of the relationship between two variables, keeping other variables and factors constant. Thus the impression given is that the only acceptable type of science methodology is the controlled experiment of the physical scientist. Left out of the American Science Education Standards, the Benchmarks of the American Association for the Advancement of Science, and indeed all science curricula worldwide, including Japan’s, is a treatment of the predominant methodology of the earth and ecological scientists--what we have termed, system science methodology.

If an important objective of science teaching is the development of thinking skills as suggested above, then why does the science curriculum focus on an investigative methodology

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that is useless to the average citizen? How often can you or I solve a problem in our daily lives by thinking through a controlled experiment? Certainly the attention paid to the variety of variables in our problem assists us in our endeavours. But, we can seldom run a controlled experiment to gather data to help us think through or solve our problem. It is our contention that the system science approaches, however, are useful to the average citizen. Thus they should be given status in any science program in which problem solving and thinking skill development are important objectives. They are especially important in a democratic society when the citizen is to judge developmental policies for their relevance to a sustainable future.

The characteristics of higher order thinking\(^\text{29}\) as: (1) non-algorithmic (the path of action is not specified in advance); (2) often complex (the total path is not mentally visible from any single vantage point); (3) yielding multiple solutions (each results in certain costs and benefits rather than unique solutions); (4) involving nuanced judgment (and interpretation); (5) applying multiple criteria (which sometimes conflict with each other); (6) involving uncertainty (not everything needed will be known); (7) involving self-regulation of the thinking process ((it is not guided at each step by someone else); (8) imposing meaning (develops order among apparently disorganized information); (9) requiring effort (considerable mental work is necessary).

Few of these characterize the thinking involved in the experimental sciences. System scientists such as geologists, however, can identify most of these characteristics, in the reasoning procedures they use. The characterization of the system science methodology used by geologists\(^\text{30}\) is that the reasoning methods of the geological sciences as hermeneutic or interpretive, and historical. The geologist applies this type of reasoning to the various characteristics of an outcrop, “judging which characteristics or patterns in the rock are significant and which are not”. It is apparent that in this process, preconceptions will be involved in making judgments. Thus, the data used by the geologist will be meaningless to the uninitiated until “the geologist introduces concepts for ‘seeing’ the rock”. In a sense, this type of reasoning may be a tool in the development of all human knowledge, even in the ‘objective’ physical sciences\(^\text{31}\). However, it is basic to the system sciences. There are three characteristics of hermeneutics that play fundamental roles in geological reasoning. They include: (1) the “hermeneutic circle--the fore structures of understanding, and the historical nature of knowledge”. The hermeneutic circle is a process of back and forth reasoning where earlier conceptions are used as new data are presented to continue to build a conceptual structure. Thus, “wholes at one level of analysis become parts at another”. This is the means by which all understanding progresses; (2) fore structure, relies upon the scientist’s preconceptions and


foresight. Preconceptions are the theoretical basis upon which the interpretation of data is approached and foresight the “presumed goal of our inquiry and our sense of what will count as an answer”; (3) the nature tools and sets of procedures or practices that are brought to the collection and processing of data also shapes the types of data acquired and their interpretation. This will include the discussions and critiques of colleagues as interpretations are developed or discussed in the literature. As these interpretations are accumulated over time, “the body of scientific knowledge comes to have a strongly historical component”.

In the collection of essays entitled Earth Matters the preface states that the Earth sciences provide a model of reasoning that is more attuned to the realities that we face in our daily lives than do the physical sciences. The Earth sciences have a distinctive method of reasoning……that is deliberative rather than simply calculative, interpretive rather than purely factual, and historical rather than experimental—again, like our own personal and public lives. He further argues the appropriateness of the system science methodology as a model for reasoning since knowledge can no longer be treated as discrete packages of information. Now and in the future, disciplines will need to be able to indicate how their information relates to that of other disciplines in a political and logical manner that fit the concerns of society

In our opinion, it is crucial that the systems science mode of thinking become an important component of all secondary school science curricula, and especially those that claim to develop higher order thinking skills. Not only will this serve our students and future citizens well in their life long endeavours, it will also help to correct the misconceptions about the nature of science. Perhaps most important however, is that such programs will help to equip future citizens with the thinking skills essential in solving our environmental problems while ensuring an improving life style for all the world’s citizens.

A Framework of Earth System Education

Understanding 1: Earth is unique, a planet of rare beauty and great value.

1.1 The beauty and value of Earth are expressed by and for people through literature and the arts.
1.2 Human’s appreciation of planet Earth is enhanced by a better understanding of its subsystems.
1.3 Humans manifest their appreciation through their responsible behaviour and stewardship of subsystems.

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Understanding 2: Human activities, collective and individual, conscious and inadvertent, affect planet Earth.

2.1 Earth is vulnerable, and its resources are limited and susceptible to overuse or misuse.
2.2 Continued population growth accelerates the depletion of natural resources and destruction of the environment, including other species.
2.3 When considering the use of natural resources, human’s first need to rethink their lifestyles, and then reduce consumption, then reuse and recycle.
2.4 By-products of industrialization pollute the air, land, and water, and the effects may be global as well as near the source.
2.5 The better we understand Earth, the better we can manage our resources and reduce our impact on the environment worldwide.

Understanding 3: The development of scientific thinking and technology increases our ability to understand and utilize Earth and space.

3.1 Biologists, chemists, and physicists, as well as scientists from the Earth and space science disciplines, use a variety of methods in their study of Earth systems.
3.2 Direct observation, simple tools, and modern technology are used to create, test and modify models and theories that represent, explain, and predict changes in the Earth system.
3.3 Historical, descriptive, and empirical studies are important methods of learning about Earth and space.
3.4 Scientific study may lead to technological advances. Regardless of sophistication, technology cannot be expected to solve all of our problems.
3.5 The use of technology may have benefits as well as unintended side effects.

Understanding 4: The Earth system is composed of interacting subsystems of water, rock, ice, air, and life.

4.1 The subsystems are continuously changing through natural processes and cycles.
4.2 Forces, motions and energy transformations drive the interactions within and between the subsystems.
4.3 The Sun is the major external source of energy that drives most system and subsystem interactions at or near the Earth’s surface.
4.4 Each component of the Earth system has characteristic properties, structure, and composition that may be changed by interactions of subsystems.
4.5 Plate tectonics is a theory that explains how internal forces and energy cause continual changes within Earth and on its surface.
4.6 Weathering, erosion, and deposition continuously reshape the surface of the Earth.
4.7 The presence of life affects the characteristics of other systems.

Understanding 5: Planet Earth is more than 4 billion years old and its subsystems are continually evolving.
5.1 Earth's cycles and natural processes take place over time intervals ranging from fractions of seconds to billions of years.
5.2 Materials making up planet Earth have been recycled many times.
5.3 Fossils provide the evidence that life has evolved interactively with Earth through geologic time.

Understanding 6: Planet Earth behaves according to the same physical principles.

6.1 All bodies in space, including Earth, are influenced by forces acting throughout the Solar System and the universe.
6.2 Nine planets, including Earth, revolve around the sun in nearly circular orbits.
6.3 Earth is a small planet, third from the Sun in the only system of planets definitely known to exist.
6.4 The position and motions of Earth with respect to the Sun and Moon determine seasons, climates, and tidal changes.
6.5 The rotation of Earth on its axis determines day and night.

Understanding 7: There are many people with careers that involve study of Earth's origin,

7.5 Scientists, and technicians who study Earth are employed by businesses, industries, government agencies, public and private institutions, and as independent contractors, analyses and experiments in the laboratory.
7.6 Scientists from many cultures throughout the world cooperate and collaborate using oral, written, and electronic means of communication.
7.7 Some scientists and technicians who study Earth use their specialized understanding to locate resources or predict changes in Earth systems.
7.8 Many people pursue a vocations related to planet Earth processes and materials.

Conclusion

Our objective in Global Science Literacy is to continue to teach students science and enrol them in the practice of scientific thinking and problem solving methodology. We differ from the science that is practiced in most science classrooms around the world in that we argue for the inclusiveness of the ‘systems sciences’ approaches to investigative methodology in classrooms. We argue that science needs to focus on the grand ideas about how the Earth system and its environs in space function using them as the organizational framework for science courses rather than the traditional science disciplines. Science instruction should capitalize on the beauty inherent in our habitat by including the role of aesthetics in the teaching of science. Science instruction should emphasize the implications of science methodologies and practices in facilitating cross-cultural communication and understanding. Science based on GSL will emphasize those science understandings that shape our philosophical view that places us as a human species within the earth system, our home in space. Such a
science program can provide the core for effective environmental education, preparing students to support and understand sustainable development policies.

For citizens, company administrators and politicians, science programs centred on GSL will provide the integrated understanding of our earth systems and the effects upon them of human actions that will help them to develop and support effective policies and actions of avoidance and mitigation of nature initiated and human initiated disasters. Such a program would satisfy many of the objectives of ESD also. The following topics included in the Broad Framework and Content Framework for ESD would be systematically treated in such a program; energy renewal, science and technology, nature studies, biodiversity, human development, intercultural understanding, sustainable consumption and production, global education, health education, and population education\textsuperscript{33}. It is a vision of inter-cultural cooperation and communication—a vision that offers to students and their teachers a fuller understanding and appreciation of their habitat, its history and future, and the potential nature initiated and human initiated hazards. With its inclusion of systems science methodology it offers an improved basis for developing critical thinking skills giving students the skills necessary to develop and support measures leading to sustainable development and hazard avoidance and mitigation.

Training Unit 2: Scientific Literacy and Natural Disaster Preparedness

Resource Paper 2: Rethinking Scientific Literacy and Implications to Natural Disaster Preparedness

Training Objectives

1. To synthesize ideas to address the issues of scientific literacy and implications to natural disaster preparedness.

2. Draft a proposal to address the relevance of scientific literacy to disaster preparedness.

Training Task 1: Individually Read/Review Resource Paper 2

Training Task 2: Analyze the major components of scientific literacy and application to natural disaster preparedness. Identify strategies for Teaching and Learning. Note down in Worksheet 3.

Worksheet 3: Components of Scientific Literacy and Application to Natural Disaster Preparedness

<table>
<thead>
<tr>
<th>Components of Scientific Literacy</th>
<th>Application to natural disaster preparedness</th>
<th>Strategies for Teaching and Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Value Skills - education is a societal demand. Science education has a duty to aid the development of persons able to integrate and gain skills to function within the society, e.g. science education in relation to cultural, environmental, political and societal understanding, awareness and values.</td>
<td>Values and Attitudes - Help social groups and individuals acquire a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection; mind to respond whenever and wherever something happens; stock goods for natural disaster prevention; customs and manners for the preparedness; active communication within families, stakeholders; respecting traditional values &amp; ethics; valuing human diversity, inclusivity and participation; values with respect and acceptance of</td>
<td></td>
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<tr>
<td>Scientific Method</td>
<td>Methodology</td>
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<td>- encompasses the techniques of investigations, the required skills and activities of inquiry (observation, data collection, formulation of hypotheses, experimentation, etc.) and scientific attitudes (e.g. openness, recognition of errors). As this component exists among all sciences, it has been taken as fundamental for the integration in the different subject areas.</td>
<td></td>
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<tr>
<td>Help social groups and individuals acquire the skills for identifying and solving environmental problems; system thinking and understanding cause effect relationship; skills for prediction; and learning skills from the past experiences.</td>
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<table>
<thead>
<tr>
<th>Personal Skills</th>
<th>Individual Skills</th>
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<tbody>
<tr>
<td>- recognises that students are individuals and that science education needs to play its part in helping individuals acquire a general education that is relevant to their development and in raising their awareness of career opportunities.</td>
<td></td>
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<tr>
<td>- Provide social groups and individuals with an opportunity to be actively involved at all levels in working towards the resolution of environmental problems; participation in community activities; and participation to the disaster drill.</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Science Knowledge</th>
<th>Knowledge</th>
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</thead>
<tbody>
<tr>
<td>- includes facts, concepts, generalisations and conceptual schemes generated by scientists. It also includes abstract ways that knowledge may be organised and the functional applications of knowledge. This has all too often been taken as a major aim of science teaching with the canonical knowledge taught associated with the specific subject areas (chemistry, physics, and biology).</td>
<td></td>
</tr>
<tr>
<td>- Use of other formal and informal channels to reach youth and children with information; promote the integration of disaster risk reduction; help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems; disaster risk reduction knowledge</td>
<td></td>
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<tr>
<th>Higher Order Thinking Skills</th>
<th>Decision Making</th>
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<tbody>
<tr>
<td>-</td>
<td>- help social groups and individuals acquire</td>
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</tbody>
</table>
a major component for science learning, is the ability of students to think, to solve problems, analyse situations, make predictions, evaluate or make judgements based on information available draw conclusions, are of importance to STL learning. STL learning is as much about understanding and utilising scientific concepts and principles as it is about relevance to everyday life.

| a set of values and feelings of concern for the environment, and the motivation for actively participating in environmental improvement and protection; mind to respond whenever and wherever something happens; stock goods for natural disaster prevention; customs and manners for the preparedness; active communication within families, stakeholders acceptance of vulnerability |

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**Training Task 3**: Form a group of 5 members. Discuss strategies for teaching-learning of Scientific Literacy applicable to natural disaster preparedness.

**Training Task 4**: Allow the group to select a strategy for teaching and learning. The following are some examples to select: (a) brain storming; (b) role playing; (c) public inquiry; (d) debate; (e) forum; (f) fieldwork; (g) investigation.

**Training Task 5**: Each group select a topic and apply the strategy for teaching and learning. Reasons for the preferred strategy should be discussed, and prepare for class demonstration.

**Training Task 6**: The class drafts a proposal to address the relevance of scientific literacy to disaster preparedness.

**Training Task 7**: Compile class output in the “Portfolio of Outcomes on Scientific Literacy and Natural Disaster Preparedness.”
Resource Paper 2: Rethinking Scientific Literacy

Introduction

UNESCO’s Director-General in his address during the launching of Project 2000+: Scientific and Technological Literacy for All, said: “Just as education can no longer afford to assume that its essential purpose is to cater for the scholastically gifted, for future university entrants, for the Nobel laureates of tomorrow, so it can no longer afford to maintain the artificial distinction between those who are suited to the sciences and those who are predestined for the humanities. Efforts to achieve ‘Education for All’ must therefore be closely linked to a worldwide drive to raise levels of scientific and technological literacy. In practice, this means ensuring sound numeracy, a grasp of the fundamental concepts and methods of science together with the development of elementary problem-solving skills and associated decision-making capabilities. All are required in a world in which political, economic, social and ethical considerations have become inextricably linked with the consequences of scientific and technological advance. .......in a world increasingly shaped by science and technology, scientific and technological literacy is a universal requirement, if people are not to be alienated in some degree from the society in which they live, they are not to be overwhelmed and demoralized by change, if they are to have the basic knowledge and understanding to make those multifarious political, environmental and ethical choices with which scientific discovery and its consequences are confronting us all.”

The above statements reflect the concerns regarding the seriously increasing gap between science education as it is currently practised and the science and technology know how and the skills that the general day to day living demands. They also reflect the anticipations of forthcoming changes in the years ahead. The concerns are now clear, but addressing these concerns and preparing science education towards making science and technology contextual to society still remains a challenging task. The first challenge is how to prepare existing educational institutions, their programmes, and their staff and to take operational steps.

Rethinking Science and Technology Education

Since science and technology are impinging more and more upon our day-to-day living, assuring literacy in these areas for today’s youth must be a priority of educational reform. If this is true, then it is critical that science education prepare our youth for an increasingly scientific and technological world where citizens will need to learn and apply knowledge to solve real-world problems. Unfortunately, our youths are not learning the nature of science or developing deep conceptual understandings of scientific concepts, nor do they find science

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interesting. Literacy in science and technology encompass a whole range of attributes needed to use and interact with issues that utilise components of science and technology. A level of scientific and technological literacy is important which leads to the recognition of problems, to considerations of how to solve problems, and to an ability to make decisions based on sound judgment and values inherent in the society. All this is in addition to the cognitive skills acquired through laboratory science teaching. The relevant education for which we strive can be expressed as ‘Scientific and Technological Literacy’ (STL) for All. Unfortunately this is not a static target and also can also be achieved at various levels. And as a concept, there are no specific definitions, although the intention is to operationalise teaching in this direction and thus it is the target for science teaching.

The major components that are needed in the development of the objectives of science education in line with STL are as follows: (1) Social Value Skills; (2) Scientific Method; (3) Personal Skills; (4) Science Knowledge; and (5) Higher Order Thinking Skills. These are explained below.

(1) Social Value Skills - illustrates that education is a societal demand. Science education has a duty to aid the development of persons able to integrate and gain skills to function within the society, e.g. science education in relation to cultural, environmental, political and societal understanding, awareness and values. Although not unique to science teaching, very important components of STL teaching are: (i) the ability to recognise and discuss societal problems and issues; and (ii) putting forward informed opinions and making that relate science concepts to economic, environmental, political and social considerations. Social skills also relate to being able to put forward points of view or procedures and being willing to reach consensus as a group. In being able to put forward opinions, students need to be guided to develop values and the ability to communicate these. STL teaching emphasises the need to substantiate points of view with evidence as appropriate to the circumstance and to exercise tolerance with others in putting forward views - appreciating moral views is crucial for social harmony. An STL goal must therefore, be to produce informed citizens prepared to deal responsibly with science and technology related issues.

(2) Scientific Method - encompasses the techniques of investigations, the required skills and activities of inquiry (observation, data collection, formulation of hypotheses, experimentation, etc.) and scientific attitudes (e.g. openness, recognition of errors). As this component exists among all sciences, it has been taken as fundamental for the integration in the different subject areas. Within society, our concern is with the ability to solve problems connected with our daily lives and also the ability to make decisions. Solving problems require a scientific background and knowledge of the scientific method. It is thus very fitting that science teaching should play an important thrust in this area alongside other subject areas. Solving problems begin from recognition of the problem and usually the ability to transform the problem into one that can be answered scientifically. This is then followed by suggesting ways in which the problem can be

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tackled, the materials required for an investigation and the manner in which an investigation can be carried out for meaningful results and then an interpretation of the findings to see whether the problem has been solved. The scientific method requires a background in handling process skills geared to scientific investigations. Such skills as observing, hypothesising, experimenting, analysing and drawing conclusions are important for science education as are handling equipment, controlling variables, measuring, calculating and planning procedures. ‘Recipe following’ when carrying out experimental procedures is NOT regarded as a STL target for scientific method.

(3) Personal Skills - recognises that students are individuals and that science education needs to play its part in helping individuals acquire a general education that is relevant to their development and in raising their awareness of career opportunities. The need to educate the person is also of importance in science education. Students need to be able to utilise science for improving their own lives or health and coping with the changes taking place in our technologically advanced world. The ability to communicate is a major component here. Also of importance for personal skills is the attitude of the individual, especially towards science and technology. Developing an interest in science and the role it can play within society has much to do in promoting science learning in school. The ability to understand scientific concepts, to recognise problems and to suggest methods of resolving such problems also relate to personal skills and of course follow on from an interest in the subject. Finally, personal skills gained from science learning should enable students to be more aware of the range of career possibilities that match their aptitude and interests.

(4) Science Knowledge - includes facts, concepts, generalisations and conceptual schemes generated by scientists. It also includes abstract ways that knowledge may be organised and the functional applications of knowledge. This has all too often been taken as a major aim of science teaching with the canonical knowledge taught associated with the specific subject areas (chemistry, physics, and biology). In this context, knowledge covers the whole range of acquisition of science, from simple factual aspects, to higher order thinking skills. A conceptual error by many teachers is to assume that teaching must follow a sequence from simple knowledge, through understanding before the higher ability learning can take place, if higher ability thinking can be attained at all. STL learning does not recognise such linearity. It recognises that the real challenges are the higher order skills and that these should be introduced as soon as possible. Such skills are as much part of primary school teaching as they are in the upper levels of the secondary school.

(5) Higher Order Thinking Skills - a major component for science learning, is the ability of students to think, to solve problems, analyse situations, make predictions, evaluate or make judgements based on information available draw conclusions, are of importance to STL learning. STL learning is as much about understanding and utilising scientific concepts and principles as it is about relevance to everyday life. Whilst higher order thinking is usually linked with the manipulation of knowledge, they also apply to societal problem solving and decision-making. Higher order thinking skills in science teaching have, in the past, tended to relate to 19th century science abstractions of academic principles and seen as having little to do with the critical thinking needed to relate to the science and technology involved in everyday life. This is serious omission if care for the environment is to be coupled with technological development as
we aspire towards sustainability. Higher order thinking is crucial if important social problems are to be tackled seriously. Teachers have not given much attention to higher order thinking skills due to: (a) their belief that higher order thinking skills are part of hierarchy skills and cannot be acquired until lower order skills have been mastered; (b) their unwillingness to allow sufficient thinking time for students.

**What Scientific and Technological Literacy means**

STL is: ‘Scientific’, because most definitely science concepts and the manner in which problems are approached (scientific method) are very much relevant to an understanding of our world of today. ‘Technological’, because, for relevance, the processes of technology are heavily intertwined with those of science. It is probably fair to say that whenever you look around, it is the products from technology that you see; not the science. Yet the processes by which the products are formed are likely to be based on scientific as well as technological know-how. ‘Literacy’, because it is not good having conceptual understanding if it can not be utilised. It is not good knowing science if it cannot be communicated to help solve problems or handle decision-making for concerns within the society. It is also not good if learning science does not contribute to the development of social values, personal interests, personal responsibilities and career enhancement. And finally, it is not good if learning science in schools does not prepare students for the world of tomorrow, able to face up to the multitude of changes and challenges. Science should teach students to cope with changes and learn to learn.

**The Literacy Component**

Acquiring ‘Scientific Literacy’ goes beyond learning from the textbooks. It is dependent on the vision of the teachers and the recognition of science education research findings that stress the advantages of student involvement, constructivist approaches and the role of the teacher as facilitator (rather than provider of knowledge). In some countries, the inadequacy of worksheets, unless used by teachers merely as support material, is of grave concern because they pay scant attention to the literacy dimension. In fact, it is the literacy dimension that, on the one hand, suggests relevancy in science education curricula having uniformity across education systems around the world. The need to strive for conceptual understanding and the process of tackling problems in a scientific manner has worldwide applicability. But, on the other hand, relevance means curricula around the world need to reflect the concerns, priorities, customs and heritage of the society. In terms of relevancy, the context of the science curricula needs to be appropriate to the different societies. All science teaching is geared to the educational objectives (although these objectives change in degrees of expectations at different stages of schooling). How far science education emphasises any specific general education goals will obviously depend on the overall learning environment, and especially the range of learning situations offered in addition to the science lessons. This in turn depends on the range of subjects offered within the total curriculum, the age of the students and the amount of teaching time allocated to science subjects. STL is not a constant target but its promotion depends on the education received and the educational objectives within a specific country. This is a very important point to note in striving towards STL. In fact, it is important to realise that ALL students do achieve some degree of STL. But in putting forward STL as the teaching goal, it is STL
that enables students to acquire educational objectives, to the degree intended by society that is important. And this will be more demanding the longer students remain in school.

_Teaching-Learning Strategies_\(^\text{37}\)

Some useful strategies for teaching and learning Scientific Literacy also applicable to natural disaster preparedness and mitigation are described below.

1. Individual work of learners – applicable to the development of individual problem-solving or decision-making strategies and to all forms of written communication.
2. Brainstorming - learners present their ideas related to the topic being discussed. All ideas are collected and recorded, irrespective of the worth or correctness and without comment. This activity is designed to stimulate thinking and call on learner’s background knowledge, and maybe their misconceptions.
3. Role Playing - individual learners or a group undertake to play a specific role within a group debate or enactment of a scene. The learner undertaking the role tries to act according to the role assigned. The role playing exercises lend itself to decision making, whereby decisions can be made by a judge, a panel, or by a referendum of many people, based on the value placed on the various aspects within the scenario indicated.
4. Public Inquiry – is similar to a role playing exercise wherein the learners create a courtroom and allow individual learners to play the role of various personalities in the enactment of a public inquiry. The bulk of the class acts as the jury and vote on the final decision. The teacher plays the role of the judge advising the ‘jury’ as necessary.
5. Debate – a panel is set-up (often of 3 speakers) that speaks for the motions that is to be debated and is opposed by a similar number of speakers. Starting with the speaker for the motion and followed by the speaker from the opposition. The panel takes turn to present the points as forcefully as possible without duplicating the previous speaker, yet carefully refuting points put forward by the other side. The audience (or a panel) decides the winning team.

Training Unit 3: Impact and Coping Strategies for Natural Disaster Preparedness and Mitigation: Application of Science Literacy

Resource Paper 3: Scientific Literacy and Natural Disaster Preparedness

Training Objective:

1. To identify a specific natural disaster and develop an outline of a training lesson on scientific literacy and natural disaster preparedness.

Training Task 1: Read Resource Paper 3 and Refer to ‘Primer on Natural Disaster Preparedness and Coping Mechanisms’.

Training Task 2: Identify the important messages described in the Resource Paper and in the Primer.

Training Task 3: Develop an outline of a training lesson on scientific literacy and natural disaster preparedness on a particular disaster.

Training Task 4: Form a group of 5 members each. Discuss the outline prepared by each member. Group will decide topic of the training lesson.

Training Task 5: Each group will develop into a training lesson and prepare for presentation.

Training Task 6: The outputs will be compiled in the “Portfolio of Outcomes of Scientific Literacy and Natural Disaster Preparedness.”

Resource Paper 3: Scientific Literacy and Natural Disaster Preparedness

Introduction

We are facing disaster of various types, natural as well as man made since our ancient time. As we can not prevent disasters we can at least make built in contingency planning for disaster management involving preparedness, mitigation, relief and rehabilitation.

Natural disaster preparedness is essential component of any disaster management planning as it “minimizes the adverse effects of a hazard-” Long-term risk reduction measures are intended to minimize the adverse effects of a hazard by eliminating the vulnerabilities which hazards would otherwise expose. These measures directly reduce the potential impact of a hazard before it strikes. Disaster preparedness assumes that certain groups of people or property will nevertheless remain vulnerable, and that preparedness will have to address the consequences of a disaster’s impact. Disaster preparedness must be seen as an active, on-going process. Preparedness plans are dynamic ventures which need to be reviewed, modified,
updated and tested on a regular basis. Some analysts distinguish between “active” and “passive” disaster preparedness measures.

Passive aspects of disaster preparedness include the preparation of disaster manuals, stockpiling of relief goods and the development of computer lists of resources and personnel. “Active” disaster preparedness would include developing comprehensive response plans, monitoring hazard threats, training emergency personnel, and training members of the communities at risk “to ensure timely appropriate and effective delivery of relief.” Disaster management involves the response to or anticipation of a hazardous event through a set of policy and administrative decisions and operational activities which pertains to the various stages of a disaster at all levels.

Preparedness focuses on plans to respond to a disaster threat or occurrence. It takes into account an estimation of emergency needs and identifies the resources to meet these needs. The first objective of preparedness is to reduce the disaster impact through appropriate actions and improve the capacity of those who are likely to be affected most, i.e. the children, the women, the marginalized and the poor, and to get the maximum benefit out of relief. The second is to ensure that ongoing development continues to improve the capacities and the capabilities of the system to strengthen preparedness efforts at community level. Finally, it guides reconstruction so as to ensure reduction in vulnerability. Disaster mitigation includes both disaster preparedness and prevention. One of the most difficult aspects of disaster management is that of timing. Timing is also critical to disaster preparedness. Speed and timeliness are often treated synonymously, causing serious problems in the relationship between relief inputs and their effects. There are certain basic needs in some types of disasters, such as shelter and clothing that may be required immediately. In terms of alleviating immediate distress, speed will be essential. However, there are other forms of relief that, under certain circumstances, may be disruptive unless delayed. There is the obvious example of food. Rushing in excessive amounts of food aid before a clear assessment of local market conditions and agricultural prospects are known can create dependency and undermine local economies. Timeliness, not speed, should be the preparedness criterion.

Table 1: Natural Disaster Preparedness and Mitigation Linked to Scientific Literacy

<table>
<thead>
<tr>
<th>Natural Disaster Impact, Preparedness and Mitigation</th>
<th>Topics with Scientific Literacy Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on Agriculture and Environment</td>
<td>• Destroy crops and devastate household incomes</td>
</tr>
<tr>
<td></td>
<td>• Kill and displace domestic animals</td>
</tr>
<tr>
<td></td>
<td>• Damage or destroy agricultural infrastructure (processing facilities, markets) and storage facilities</td>
</tr>
<tr>
<td></td>
<td>• Devastate the next season’s seed supply (rotting in the field or being eaten by hungry farmers)</td>
</tr>
<tr>
<td></td>
<td>• Make roads impassable to get time-sensitive crops to market</td>
</tr>
</tbody>
</table>
### UNESCO Training Guide
### Natural Disaster Preparedness

<table>
<thead>
<tr>
<th>Preparedness and Mitigation in Agriculture and Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Farmers and partner organization adopt sustainable farming practices, improved natural resource management and biodiversity conservation, diversification (since monoculture is more vulnerable to natural disasters), and the importance of traditional food crops (resistant to wind, rain and sea spray from cyclones), protection of pasture-land from over-grazing and communal systems to protect animal fodder</td>
</tr>
<tr>
<td>• Food security activities focused on distribution of drought-resistant stage and education of farmers about the natural environment</td>
</tr>
<tr>
<td>• Initiation of better practices in the community – wells, firebreaks, situation dams and micro catchments, low technology retaining walls,</td>
</tr>
<tr>
<td>• Environmental education projects – develop construction standards for disaster resistant structures including housing, schools, public facilities and work places, low-cost structures utilizing local materials and know-how, tree-nursery construction, compost training, fuel-efficient stove, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact on Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Natural disasters, such as earthquakes, volcanic eruptions, tsunamis, floods, and others can have devastating impacts on formal, non-formal and informal education.</td>
</tr>
<tr>
<td>• The disasters can disrupt learning for days, weeks, months or even for a lifetime</td>
</tr>
<tr>
<td>• The worst part is the after effects of the event, including trauma, displacement of families, health impacts, the common decrease in food security, etc., all of which can contribute to negative impacts in the education sector and society in general</td>
</tr>
<tr>
<td>• Examples of ways in which natural disasters impact the education sector are: disruption of school calendar including common use of school buildings as temporary shelters and teachers return to their affected communities; lack of access to schools due to disruptions in transportation systems, destroyed bridges, damage to school structures and equipment; psycho-social trauma leading to attention-deficit problems and lack of focus in the classroom; children removed from school by parents because their services...</td>
</tr>
</tbody>
</table>
are needed to clean homes, replant crops, and engage in other livelihood practices; and homeless families relocated in temporary shelters.

| Preparedness and Mitigation on Education | • Develop evacuation plan and conduct evacuation drills to minimize risks through the school systems (using appropriate plans for different types of hazards)  
• Incorporating into the Curriculum through a variety of classroom activities into geography, natural science, and history curricula. These include: (i) Classroom Emergency Plans (evacuation routes, fire planning); (ii) Family Emergency Plans (for students to create as homework); (iii) Risk Mapping (small group work as part of geography lesson); (iv) Observational Walk across community as field trip; (v) Weather Forecasting exercise utilizing local periodicals; (vi) Mural Paintings promoting disaster awareness; (vii) Dialogues/Theatre/Puppet Shows; (viii) information about the most likely hazards in the island nation, drought and sea rise, into the national science curriculum  
• Incorporate in all teacher training, provide information to school staff and train teachers and school principals including first aid, and work with parent-teacher associations, parents. clubs, and other community groups  
• Develop summer projects in disaster awareness and training, and provide information to school staff and train teachers  
• Organize mitigation activities to protect the physical infrastructure of the school, building retaining walls and save the school from further erosion, construction of well covers for the school water supply as important preventive measure to protect the water supply from ash storms from the nearby volcano  
• Design pilot curriculum for highly vulnerable schools, such as instructional video to sensitize learners about natural hazards, including volcanoes and hurricanes |
| Impact on Health | • Deaths and severe injuries immediately following the disaster  
• Increased mental health concerns including depression, alcohol and drug abuse, post-traumatic stress and other anti-social behaviours  
• Increased risk of communicable diseases, especially when wells are contaminated and sanitation systems are damaged or destroyed  
• Increased incidence of second generation. disasters including domestic abuse, sexual abuse, rape, and drug/alcohol abuse  
• Disruption of transportation systems and damage to health facilities impacts health care delivery and pharmaceutical deliveries, communities may be left without health care services for weeks or months  
• Healthcare workers leave posts to return to their families leaving
communities without health services
• Overcrowding, lack of medicines, and unsanitary conditions possible at major hospitals
• Damage to water systems and food storage may exacerbate existing health problems, and
• Increased risk of non-communicable diseases (e.g., malaria, dengue fever) from disasters that result in standing water.

Preparedness and Mitigation on Health
• **Water Tank Construction** - increase the available water supply for humans, livestock, and agricultural crops. The capacity-building process incorporated not only information about tank maintenance but also about good practices and how to better mitigate the constant threat of drought
• First aid training and provision and supply of medical equipment and supplies in the event of a disaster
• Construction of fuel-efficient woodstove projects, to decrease deforestation and encourage natural resource management, and improve respiratory health
• Health Fairs providing information about communicable diseases, anti cholera campaign and the prevalence of second-generation disasters (Post-Traumatic Stress, sexual violence, alcoholism) in temporary shelters.

The root causes of most disasters in developing countries include poverty, science illiteracy and inappropriate development. Unsustainable development practices, from hillside agriculture, deforestation, poor watershed management, and inappropriate housing and construction, to inadequate communication and transportation infrastructure, can exacerbate the impacts of even relatively small events like flooding, wind, or drought. Simply responding to disasters, without scientific literacy and sustainable development practices, will lead to a vicious spiral of suffering. “We must, above all, shift from a culture of reaction to a culture of prevention. Prevention is not only more humane than cure; it is also much cheaper.... Above all, let us not forget that disaster prevention is a moral imperative, no less than reducing the risks of war”.

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UNESCO Training Guide  
Natural Disaster Preparedness

Training Unit 4: Development of exemplar training lesson on Natural Disaster Preparedness.


Training Objective: To produce a training lesson on a specific natural disaster from standard science curriculum or scientific literacy components.

Training Task 1: Work in groups of 5 members each to brainstorm and finalize the Outline prepared in Training Unit 3.

Training Task 2: Create a training lesson following the outline, and utilizing the concepts and strategies learned in Training Units 1, 2 and 3.

Training Task 3: Each group report their output, taking turns to present their draft to the class.

Training Task 4: By integrating the comments and suggestions of the class, a final version of the training unit could be produced.

Training Task 5: Compile the outputs in the “Portfolio of Outcomes of Scientific Literacy and Natural Disaster Preparedness.”

Resource Paper 4: Scientific Literacy Training and Natural Disaster Preparedness: Sample Lesson

Title: How to Survive a Natural Disaster

1. Scenario
   One of the WORST disasters that ever struck humankind was a horrific tsunami that devastated the coastlines of Indonesia, Malaysia, Thailand, India, Sri Lanka, the Maldives, Myanmar, Bangladesh, Tanzania, Somalia, and Kenya. More than 200,000 deaths were reported, many more missing, hundreds of thousands of victims affected - family members lost, homes destroyed, and livelihoods ruined. Tremendous efforts are needed, and on longer term needs – putting people back on their feet, rebuilding homes, getting livelihoods going again, rebuilding infrastructure – where sustained efforts must be channelled to affected areas.

2. Science Concept

---

Tsunami is a series of waves of extremely long wavelength and period generated in a body of water by an impulsive disturbance that displaces the water. Although tsunamis are often referred to as “tidal waves,” it is not at all related to tides. Tsunamis are primarily associated with earthquakes in oceanic and coastal regions. When an earthquake occurs, the energy travels outward in all directions from the source. Notice how the waves become larger as they reach shore, where the water is shallower. Detecting tsunamis is a very difficult thing to do. When a wave begins in the deep ocean waters, it may only have a height of about twelve to twenty-three inches and look like nothing more than the gentle rise and fall of the sea surface.

3. **Tasks**

Objectives: At the end of this activity, the course participants should be able to:

1) Demonstrate how sea waves are formed
2) Explain how tsunamis are generated
3) List ways of how to tell people to save their lives during tsunamis
4) Share the various experiences of the participants with regard to other natural calamities
5) Developing Scientific Skills: Throw a pebble into a pond. What happens when the pebble hits the water? Note down your observations. (The pebble represents an energy source, and the pond represents the ocean. Do the ripples radiate out from a point in circular motions?) Analyse newspaper articles or access the internet regarding natural disasters.
6) Acquiring Social Skills: Write a story to inform about the natural disasters and give pointers on what to do during natural calamities. Your story would explain to common people what to do during natural disasters.
7) Strengthening Personal Skills: Communicate to your fellow participants by telling your story.

4. **Assessment**

Participants to develop a checklist to assess: (a) scientific concepts learned; (b) scientific skills developed; (c) social skills acquired; and (d) personal (communication) skills improved.
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Natural Disaster Preparedness

Part Three: How to Use the Training Guide, Piloting and Evaluating Training

I. How to Use the Training Guides

I.1. Roles and Responsibilities of the Trainers

The roles and responsibilities of the trainers are focused on the planning, organization, implementation, monitoring and evaluation of the training activities.

Specifically, the roles and responsibilities of the trainers are to do the following:

- Formulate the criteria for the selection of the participants
- Study the training units, paying particular attention to the objectives and assessment; content and activities; and notes for the facilitator
- Prepare needed materials and plan for equipment needed in the training
- Demonstrate varied methods and activities
- Use the Training Units as a ready reference and guide
- Plan the follow-up and evaluation of the training

I.2. Preparation for the Training

I.2.1 A Suggested Training Schedule of Activities is to be prepared. The trainers may design their own schedule of activities based on the training objectives and the training policy.

I.2.2 A training assessment/pre-test should be given together with the Registration. The trainers should finish filling the forms before the Opening Session, which should be kept short.

1.2.3 Prepare the orientation and conduct the training activities, which may include;
- Clarifying the goal and objectives of the training
- Stressing the need to come on time to the training
- Identifying the venue/s for the various training activities
- Getting to know the teachers and their expectations from the training
- Conducting a mini-demonstration lesson
- Introducing the Lesson Observation Form
- Grouping the participants who will study and present each Unit and demonstrate the activities
- Collecting data for revision of the Units
- Collecting the sample lesson plans

II. Piloting the Training Units

II.1 Purposes

- to determine the feasibility of a proposed training guide
- to provide empirical evidence of viability
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- to determine relevance to a variety of contexts
- to develop new guides in realistic settings
- to encourage experimentation and creativity
- to promote or influence processes of policy change
- to identify possible impediments to change, to build consensus around proposed policy change
- to develop models or capacity for implementation.

II.2 Checklist to Evaluate the Training Units

<table>
<thead>
<tr>
<th>Initial Questions</th>
<th>Yes (✓)</th>
<th>No (✗)</th>
<th>Justification/Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the training unit fulfil a genuine need?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Will the training unit help teacher trainers attain the intended outcome?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Does the training unit address the issue of concern?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Is the training unit designed for the intended audience?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layout</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriateness of Font type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. How many different types of learning experiences are used?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Are there suggestions for reflection (evaluation) on lessons learned and additional follow-up?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Can the activities help learners attain the intended outcome?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Are learners encouraged to think and process what they have done and learned?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Are activities provided for learners to compare, contrast, and evaluate what they have done?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Are activities provided for learners to apply what has been learned to new situations?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Does it follow the experiential learning model: do reflect apply?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using the above criteria to evaluate existing materials will help the team make judgements about their quality and if they can be used to meet the needs of the target audience. Can you justify creating your own materials? That determination must be made in relationship to the intended outcomes, the target audience, the identified needs, and the availability and quality of
existing materials. You should be able to state how existing materials do or do not meet the needs identified.

The final step is to produce a draft copy of the curriculum product to pilot test. It should be reviewed by several members of the curriculum development team, revised, and edited at least once before pilot testing. Allow time for revisions and rewrites. Quality takes time. Curriculum development is a creative process that requires gestation before it bears fruit. Ideally, the draft will include illustrations and resemble the final product.

**II.3. Selection of Trainers and Pilot Test Sites**

1. Determine by the number of conditions affecting members of the target audience
2. Minimum number of test sites is four: two pilot sites with experienced trainers, and two with inexperienced trainers
3. Depending on the characteristics of the target audience, pilot testing should occur at 20 sites or more if the training guides will be used in several places, under differing circumstances.
4. Feedback from the pilot trainers will provide information and to help identify content and method training needs for additional trainers.

**II.4 Checklist for Formative Pilot Trials**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Yes (✓)</th>
<th>No (✓)</th>
<th>Justification/Suggestion</th>
</tr>
</thead>
</table>
| 1. Do early trials with a few trainers show that  
  • the training guide is suitable for the target audience  
  • the activities are appropriate  
  • the learners enjoy the learning experience? |         |        |                          |
| 2. Does the training guide satisfactorily achieve specified learner outcomes with the target audience? |         |        |                          |
| 3. From the prospective user, does the training guide have value? |         |        |                          |
| 4. preparation for final pilot testing, have you trained the trainers to facilitate the training after revision? |         |        |                          |
| 5. From the perspective of the trainer, does the training guide have value? |         |        |                          |
II.5 Training of Teacher Trainers

The experiential learning model is utilized as this provides excellent guidance on content and group process (do, reflect, apply). The characteristics of adult learners are kept in mind. The following training activity is proposed for the training of trainers.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Justification/Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trainer introduce learning outcomes, content and methods utilized in the guide</td>
<td></td>
</tr>
<tr>
<td>2. Trainer show trainees and example of a well prepared lesson.</td>
<td>Ask trainees to critique and identify needed improvements</td>
</tr>
<tr>
<td>3. Trainers prepare lessons to present to smaller group of trainees</td>
<td></td>
</tr>
</tbody>
</table>

III. Evaluating the Training

III.1. Checklists on Assessing Training

i) Number of trainers/facilitators involved in the training (Disaggregate by sex, level of education, ethnicity, training programs attended, years of teaching experience, date teacher’s license was obtained) Assessment of training needs (Survey of Training Needs)

ii) Facilities available for trainers/facilitators (Computers, LCD, OHP, Titles of Software for Teaching Learning)

iii) Qualification of trainees (Criteria for Selection—Qualification, Licensure Certificates)

iv) Background knowledge and Skills of Trainers/facilitators (ICT competencies, Adult Learning Methodologies)

III.1.2 Training Content and Methods

i) Understanding of Curriculum Framework

ii) Understanding of Curriculum Framework

iii) Training techniques/methodologies (participatory/learner centred, etc.)

iv) Monitoring progress of learning KSA

v) Others

III.1.3 Training Support

(i) Giving trainees adequate hardware and software for self-learning

(ii) Provision of adequate resources in the schools

(iii) Support from school administrators, peers and community

(iv) Monitoring after the training
III.2. Suggested Form for Evaluating Training

Date of Training: ________________  Venue of Training: ________________

Direction: Please answer the questions or put a tick (v) where appropriate

1. **Objectives**

   *(Objectives may change based on the objectives of the training).*

The objectives of the training:

1.1
1.2
1.3

In your opinion, to what extent were the above objectives achieved?

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Satisfactory</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

State your comments regarding the attainment of training objectives.

2. **Elements in the Training Guide**

In your opinion, how **useful** was the Training Guide in terms of:

<table>
<thead>
<tr>
<th>Elements if the Text</th>
<th>Very Useful</th>
<th>Quite Useful</th>
<th>Not Useful</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities suggested</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
If you think any of the above elements is not useful, please write below your suggestions on how to improve the different training elements.

Suggestions

3. **Conduct of the Training**

How would you rate the conduct of the training?

<table>
<thead>
<tr>
<th>Elements</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Satisfactory</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Trainer’s Preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Trainer’s Presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Use of Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4 Use of Various Training Techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5 Use of Other Resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you think any of the above elements could be improved, please write below your suggestions on how to improve the conduct of the training.

Suggestions

4. Would you wish to introduce more skills-based components in future training?

Yes: ____ please suggest which skills should be addressed:

- Problem-solving
- Training Techniques
- Communicating
- Use of New Technologies
- Other hands-on techniques
- Others (please identify)
- No: _____ Explain why not?

5. **Presentation and group work**

In your opinion, were the group work and presentations useful?

_____ Very Useful       _____ Quite Useful       _____ Not Useful

Please suggest ways on how the presentations and group works might be improved?

6. **Suggestions for the organisation of future training activities in terms of:**
UNESCO Training Guide
Natural Disaster Preparedness

Venue
__________________________________________
Timing and Duration
__________________________________________
Choice of Trainers
__________________________________________
Others
__________________________________________

7. In general how would you evaluate the training?

_____ Excellent
_____ Very Good
_____ Good
_____ Satisfactory

8. General comments and suggestions

Thank You.
### Part Four: Glossary, References and Websites

#### Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistance</td>
<td>Available for extended periods</td>
</tr>
</tbody>
</table>
| Capacities                    | Strengths and resources which can, and should, are mobilized to prepare for and minimize the impacts of natural disasters. While there are many different kinds of capacities/resources for disaster work at the local level, some of the most important include:  
  • Physical/Material - Roads, bridges, transportation, infrastructure, Radios, cellular phones, communications systems, Water tanks, generators, grain storage silos, First aid kits  
  • Human Capacities - Carpenters, plumbers, roofers, Nurses, teachers, Women’s committees and youth groups, NGOs, clubs and associations  
  • Social/Cultural – Traditional coping mechanisms (storing food above usual flood levels, planting famine foods), indigenous knowledge systems (early warning systems about rainfall or drought), disaster-proof housing or other technology |
| Disaster                      | A serious disruption of the functions of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope using only its own resources |
| Disaster Assistance           | The provision on a humanitarian basis of material aid and services necessary to enable people to meet their basic needs for shelter, clothing, water and food.                                               |
| Disaster Awareness Events     |  
  • *Poster Contests* - national poster campaign around the theme of disaster preparedness, lesson plans for teachers about disaster issues, the actual poster contest as an awareness-raising event, and the subsequent distribution of the winning poster  
  • *Community Education Campaigns* – utilization of the community content-based instruction (CCBI), local songs and stage presentations of local people.  
  • *Disaster drills and disaster simulations* – could be sponsored in conjunction with activities of the schools, youth and women, farmer cooperatives or small business groups, parent’s teacher community associations, etc.  
  • *Camps, retreats and workshops* – to include environmental awareness, visit to traditional disaster technology centres/villages e.g. typhoon-proof housing and school-buildings |
<table>
<thead>
<tr>
<th>Disaster Cycle</th>
<th>There are three basic phases of natural disasters: before, during, and after.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaster Mitigation</td>
<td>Refers to longer-term activities that can reduce a community’s vulnerability to the impacts of potential disasters. Disaster mitigation can minimize, or sometimes even eliminate, the negative impacts on people’s health, livelihoods, housing, and general well-being that can be created by wind, water, and other natural hazards. <strong>Put more simply, good development is often the best disaster mitigation.</strong> Some examples of disaster mitigation activities include: (1) Reforestation; (2) Watershed management; (3) Urban planning and zoning; (4) Improved infrastructure (communications, transportation); (5) Utilization of drought-resistant seed; and (6) Improved construction practices (earthquake-resistant housing).</td>
</tr>
</tbody>
</table>
| Disaster Preparedness | Minimizes the adverse effects of a hazard through effective precautionary actions. Includes the whole range of short-term activities that individual people, community groups, whole communities, regions, and national organizations can put in place to get ready for potential disasters. While there are dozens of possible preparedness activities, some of the most common include:  
- Early warning systems (tornado sirens, flood gauges, radio warnings)  
- Evacuation routes and drills  
- Emergency kits (first aid equipment, water, matches, batteries, radio); and  
- Local disaster committee training and preparedness. |
| Drought | Slow-onset disaster of drought in the Horn of Africa is a classic example of the devastating and complicated impacts of this natural hazard. In Kenya, Somalia, and elsewhere in the Horn, the drought has led to deaths of livestock, agricultural disruption, famine, and even political conflict. **Although droughts come on slowly, they are no less of a disaster than a flood or a volcanic eruption.** The impacts of drought can be reduced by integrating preparedness and mitigation activities such as water conservation and drought-resistant agricultural production. |
| Flooding | Can result from rain, tsunamis, cyclones, hurricanes, and a variety of other short-term weather patterns, is a rapid-onset-disaster which is exacerbated by poor environmental management, improper land use planning, and a lack of zoning. |
| Hazard | A rare or extreme event in the natural or human-made environment that adversely affects human life, property or activity to the extent of causing a disaster |
| Natural Disaster | The definition of a natural **disaster** is different from a natural hazard in two important ways. **First**, a disaster happens when a natural hazard has human consequences, such as loss of life, livelihoods, or property. |
**UNESCO Training Guide**  
**Natural Disaster Preparedness**

<table>
<thead>
<tr>
<th><strong>Second</strong>, an event is considered a disaster if the event is beyond the ability of the local community to cope. Therefore, that same hurricane striking a populated island would be considered a disaster if the consequences were so severe that the local community could not cope using their own resources.</th>
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<tr>
<td><strong>Natural Hazard</strong></td>
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<tr>
<td><strong>Rehabilitation and Recovery</strong></td>
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<td><strong>Relief Supplies and Services</strong></td>
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<td><strong>Relief</strong></td>
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| **Vulnerability to Disaster** | The concept that explains individuals and communities susceptibility to the negative consequences of natural disasters. Disasters are not equal opportunity events and some people are much more vulnerable than others. Among the many types of vulnerability are:  
- Physical/Material - Poor Housing, Community Located in Floodplain, Proximity to Volcano  
- Social/Organizational - Poverty (lack of savings, insurance), Gender (women not empowered to make decisions) or other inequalities, Age (young people unaware of hazards), Literacy (non-literate unable to read warning signs), Organizations lack capacity (local disaster committees have no training).  
- Cultural/Attitudinal - Fatalism or cultural beliefs about hazard control |
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Natural Disaster Preparedness

Websites

www.paho.org - Pan American Health Organization has an excellent Emergency Preparedness Program with publications and links to other sites in Latin American and around the world
www.redcross.org - American Red Cross
www.udel.edu/DRC/homepage.htm - Disaster Research Centre, University of Delaware
www.ibhs.org - Institute for Business and Home Safety
www.usaid.gov/bhr/ofda - Office of Foreign Disaster Assistance (OFDA)
www.colorado.edu/hazards - Natural Hazards Research Centre
www.reliefweb.int Relief Web
www.disasters.org/deralink.html - Disaster Preparedness & Emergency Response Association
www.uhh.hawaii.edu/~nat_haz - Centre for Study of Active Volcanoes, University of Hawaii
www.disasterrelief.org - Worldwide Disaster Tracking information
www.ifrc.org - International Federation of Red Cross and Red Crescent Societies

References


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Natural Disaster Preparedness


Part Five: Appendix

Primer on Natural Disaster and Coping Mechanism *(PLEASE INCLUDE HERE)*

(Linked with UNESCO’s “Leading and Facilitating Curriculum Change”, A Resource Pack for Capacity-Building.)