Guidelines and tools for Incorporation of Environmental Protection into Science & Social Studies Curricula

UNESCO Regional Workshop on Thematic Issues in Education for Sustainable Development (ESD) under the Mobile Training Team (MTT) Project

26-29 October 2009

Hanoi, Vietnam

Developed by
Robert Steele
Sustainability Asia / AtKisson Group
Contents

Introduction
What is the Environment?
What are the Causes and Consequences of Environmental Problems?
How Can We Solve the World’s Environmental Problems?
What is the Role of Education in Helping to Solve Environmental Problems?
Ecological Literacy
Ecological Literacy and Systems Thinking
Environmental Protection . . . Where to Start?
Running a Thematic Curriculum Integration
How Can Your Students Help Solve the Problems—Both Now and in the Future?
Tools and Guidelines for Thematic Issues Curriculum Integration
  ➢ About The Tools
  ➢ The Compass: A Symbol Of Direction & Sustainability
  ➢ A Guideline Steps for Incorporate of Environmental Protection into Science and Social studies Curricula.
    o Get Ready: Identify Learning Goals and Central Issue.
    o Step 1: Issues Identification . . . Where do we want to focus? What is it linked to?
    o Step 2: Systems Thinking. . . How do things relate? Where can we integrate into the Curriculum?
    o Step 3: Lesson/Activity Ideas ... for integrating into our curriculum
    o Step 4: Strategy and lesson Plan
    o Step 5: Capstone . . . an Agreement to Act!
    o Evaluation and assessment

Curriculum Integration Worksheets
  ➢ Worksheet 1: Learning Goals
  ➢ Worksheet 2: Identify the Central Environmental Issues
  ➢ Example Stakeholder Perspective Wheel
  ➢ Worksheet 3: Stakeholder Perspective Wheel
  ➢ Worksheet 4: Stakeholder Perspective Wheel and Roles
  ➢ Worksheet 5: “Behaviour over Time Graphing”
  ➢ The AtKisson Sustainability Compass
  ➢ Worksheet 6: Brainstorming Driver & Effect
  ➢ Example Issue System Relationship Map
  ➢ Worksheet 7: Issue Relationships, Leverage Points and Curriculum Doorways Map
  ➢ Worksheet 8: Lesson Ideas Brainstorming
  ➢ Worksheet 9: ESD Integrated Thematic Lesson Planning Framework
  ➢ Worksheet 10: Capstone Proposal and Agreement
  ➢ Worksheet 11: Evaluation and Assessment

Annex 1: Global Environmental Issues
Annex 2: Eleven Basic Ecological Concepts
Annex 3: Designing Lesson Questions
UNESCO – MTT Regional Workshop on Thematic Issues in ESD (1-5 June 2009)

Annex 4: Project Planning Form…Project based Learning
Annex 5: Sources & Resources
Introduction

If the environment is “everything that surrounds us”, then its eminent collapse should be a reason for serious alarm amongst everyone of our species. As is often said in sustainability circles, when the environment collapses, everything collapses. There are many historical cases to choose from for us to learn from, from Easter Island to the Maya Civilisation in the Yucatan, to the Khmer Kingdom in what is now Cambodia. However, as we lament this quickening destruction or our planet’s environment and ecosystems, the majority of humankind continues to contribute to its continued degradation and destruction as if this was just hearsay.

This begs the question, why, as well as the more important question; what can be done to shift this complacent mindset to one which holds the environment dear and protects this thing that gives us almost everything we need for life? The truth is that many things on which your future health and prosperity depend are in dire jeopardy: climate stability, the resilience and productivity of natural systems, the beauty of the natural world, and biological diversity.

The most common and most practical answer to the seeming paradox is to raise awareness and increase our knowledge about the environment and its problems and then we will protect it. Unfortunately, we have been doing this very thing for over four decades through environmental education, and we are still accelerating faster and faster towards the abyss. What is the problem? The problem is one of education.

It is worth noting that this situation that we find ourselves in is not the work of ignorant people. It is, rather, largely the result of work by people with BAs, BSs, LLBs, MBAs, and PhDs. The problem lies in the way our education has prepared us to think about the natural world. Instead, one could say that all education is environmental education. By this, I mean that what is included or excluded in our curriculum teaches students that they are either a part of or apart from the natural world. To teach economics, for example, without reference to the laws of thermodynamics or those of ecology is to teach a fundamentally important ecological lesson: that physics and ecology have nothing to do with the economy. In a sense, this is flawed education. The same is true throughout most a school’s curriculum.

This guideline has been designed to try and provide teacher trainers and teachers with some tools, one possible framework and some processes for bringing environment into the realm of all subjects, not just those of science, as has traditionally been the case.

What is the Environment?

As mentioned already, the most general, and probably most known definition for the environment is “everything that surrounds us”. This is pretty basic, pretty broad and pretty uninspiring. If we want people to develop proper values around wanting to protect the environment, we need a definition that accounts for the complex ecological and social relationships of all species, particularly humans. Thus, a more inclusive definition is: “the ‘environment’ is the complex set of physical, geographic, biological, social, cultural and political conditions that surround an individual or organism that ultimately determines its form and the nature of its survival.” Essentially, the environment is a hybrid, part bio-physical and part social, for nowhere on the earth’s surface is there an environment (or nature) untouched by human impact. The environment is the product of both bio-physical and social structures and processes, which we are a part of.

Furthermore, it seems that, to be something that humans care about, it is crucial that any articulation of ‘environment’ must emphasis the inextricable connections to human societies by articulating in simple language how the environment influences one’s own life and development. The environment essentially influences how people live and how societies develop. For that reason, people, progress, development and the environment are all closely linked. And for development to be sustainable—meet the needs of the present without compromising the ability of future generations to meet theirs—
it is essential that people must take into account environmental concerns just as strongly as they concentrate on economic progress.

What are the Causes and Consequences of Environmental Problems?

The pressures on the world’s environment and ecosystems are numerous and come from myriad and diverse sources. Natural resources, land, water, forests and other species are being degraded or lost at an alarming rate in many throughout the world. The reasons for the magnitude and rate of this destruction are many and complex. They include: poverty, greed, untenable economic models, mismanagement of resources, lack of adequate education and trained personnel, under-development, deforestation, illegal dumping of hazardous wastes, global warming, the depletion of ozone layer, pollution and many more. Essentially, over emphasis on economic development without environmental system considerations lies at the heart of why our planet’s environment is in such peril. See Annex 2: Global Environmental Issues, to find some of the core reasons for the different environmental problems/ issues that we face.

How Can We Solve the World’s Environmental Problems?

To say that a system or process is sustainable is to say that it can be continued indefinitely without depleting any of the material or energy resources required to keep it running. Trees, fish and other biological species are able to grow and reproduce at rates faster than that required just to keep their populations stable. This built-in capacity allows every species to increase or replace itself following some natural disaster, such as from flash floods, extreme droughts, wildfire, etc.

Because of this ability to reproduce rather quickly, it is possible to harvest a certain percentage of trees or fish every year without depleting the forest or reducing this fish population below a certain unsustainable base number. As long as the number harvested stays within the capacity of the population to grow and replace itself, the practice can continue indefinitely. This is what is referred to as ‘sustainable yield.’ It becomes non-sustainable only when cutting or catches exceed the capacity for the species to recover its numbers adequate to survive over time. Sustainable yield can also be applied to freshwater supplies, soils and the ability of natural systems such as the atmosphere or a river to absorb pollution without being damaged. In contrast, the global trends illustrated in Figure 1 can all be seen to be racing ever more quickly beyond what can be considered sustainable yields. They are not sustainable!

Extending this concept further, we can speak of a sustainable society as a society that continues generation after generation, neither depleting its resource base by exceeding sustainable yields nor producing pollutants in excess of nature’s capacity to absorb them.

Therefore, when the concept of sustainability is applied to our modern society, it takes on added dimensions. Beyond just having our species survive, the sustainability of society implies preserving the capacity to explore, reflect on and understand new things, all the hallmarks and foundations of education.
Integrating Environmental Protection into Science and Social Studies Curriculum

What is the Role of Education in Helping to Solve Environmental Problems?

Environment and education are both vital elements of human existence that can be utilised to enhance the quality of the human condition. The environment provides the space and essential ingredients for life where man is able to interact with other people, infrastructure, and the environment itself. On the other hand, education is the process and result through which teaching and learning operate. Through this process, knowledge, values, attitudes and skills are imparted to the learner. With the growing awareness of these environmental problems, consideration should be given to the types of educational programmes that can meet the requirements for creating a sustainable world.

There is no doubt that education is an essential component of development and one of its preconditions. In the Asian region, environmental education has been given a high importance and place in educational renovation and reform due to the pre-eminence of the natural environment in everyday life and culture. Concern for nature and natural resources has been a part of Asian civilization for hundreds of generations. The people of Asia share common scriptures and folklore, which are replete with examples that show how their earlier ancestors were environmentally conscious and advocated concepts of sustained usage of resources through many social customs, myths, taboos, traditions and religion.

Thus, it is time to really give some careful thought to what type of integrated environment-based education will be most appropriate and how education can best address the current problems in each country. Do people need an understanding of ecological concepts or information about what's causing the problem? Are there specific critical thinking skills such as problem-solving or decision-making that can help them understand and tackle the problems? Are there practical skills that can help people solve the problems immediately, such as learning how to plant a tree or separate their garbage and recycle and compost? Are they motivated to get involved? Do they agree that environmental problems exist? If not, why not? All of these questions concern a different form of ‘literacy’ than has been defined in the traditional sense. We need an ‘ecological focused literacy’ if we are to conserve and maintain the environment that maintains the human species.

Ecological Literacy

In education, we talk about basic literacy – the ability to read, write and do basic arithmetic. These skills we feel are the underlying conditions necessary for a person to successfully make a life for themselves and to follow the rules necessary to live in modern society. Ecological literacy may be something even more important, as we are talking about having the knowledge and competence to live on this planet for the foreseeable future. First coined by American educator David Orr and physicist Fritjof Capra in the 1990s, ecological literacy (also referred to as ecoliteracy) is the ability to understand the natural systems that make life on earth possible. It introduces a new values to education; the “well-being of the earth”.

Basically, to be ecocite means understanding the principles of organization of ecological communities (i.e. ecosystems) and using those principles for creating sustainable human communities. An ecologically literate society would be a sustainable society which did not destroy the natural environment on which it depended. Ecological literacy is a powerful concept as it creates a foundation for an integrated approach to solving the world's environmental problems. Advocates champion eco-literacy as a new educational paradigm emerging around the poles of holism, systematic thinking, sustainability, and complexity.

To condense this a bit, ecological literacy consists of understanding three inter-related concepts:

1. Having the knowledge necessary to comprehend interrelatedness (i.e. how nature works);
2. Understanding how our society and economy ("human systems") depend on clean air water, and soil and other resources (products of "natural systems"). A simple way this reality is often
communicated is to say "everything is connected." A study of these interconnections highlights our dependence on the healthy functioning of the earth’s natural systems which give us clean air, water, soil, food, and all the other resources we depend on; and

3. Understanding how human interactions with the environment can have both positive and negative impacts on people and the natural world. Essentially this means that we must have an attitude of care or stewardship towards the environment coupled with the practical competence required to act on the basis of knowledge and feeling”.

At least some of what we call ecological literacy has been part of many teachers’ programs over the years. Here are a few simple examples:

- science lessons about the water cycle or a food web are building blocks of ecological literacy because they reveal to the student how nature works,
- a social studies unit on a human community (e.g., a family, neighbourhood, region or a country)
- a geography lesson on resource management contributes to ecological literacy as soon as the dependence and impact of the human system/community/ region on natural systems is acknowledged and explored as a vital part of the story.

**Ecological Literacy and Systems Thinking**

At the heart of becoming ecologically literate is learning to think about the world in terms of its systems, both human and natural, and the consequences of their interactions. When we think systemically we acknowledge that the parts of a system (or systems) are highly interconnected. Making a single change usually results in a multitude of other changes.

Ecological literacy is about understanding the principles of organisation of ecosystems and their potential application to understanding how to build sustainable human society. It combines the sciences of systems and ecology in drawing together elements required to foster learning processes toward a deep appreciation of nature and our role in it.

Systems thinking is the recognition of the world as an integrated whole rather than a collection of individual elements. Within systems thinking, basic principles of organization become more important than the analysis of various components of the system in isolation. Ecological literacy and systems thinking implies a recognition of the manner in which all phenomenon are part of networks that define the way that element functions. Systems thinking is, therefore, necessary to understand complex interdependence of ecological, social systems and other systems, on all levels.

With an understanding of ecological literacy, perceptions will naturally shift. Protecting the environment will become a basic principle for prioritizing thought and action in a sustainable society. In the face of the increasing capacity of industrial systems to destroy habitats and the climate system, the explicit declaration of the principles of ecological literacy – and the resulting awareness of the importance of living within the ecological carrying capacity of the earth, is increasingly necessary. Whether ecological literacy can address the infamous value-action gap is unclear.

**Environmental Protection . . . Where to Start?**

To effectively integrate ‘environmental protection’ into your existing curriculum, it is first important to know what the local, regional, and national environmental problems are. It might help to make a list of all the environmental problems that you can uncover and then cluster or group the problems according to type. For example, you could divide the problems into waste issues and into those involving the over – use of resources. You might also want to indicate which problems are most pressing in your local area and whether the problems affect a larger region of the country as a whole.

As you assess the environmental problems and issues, it’s also important to think about, and list, what or who is causing the problems, what the consequences are (ecological, health, social and
Integrating Environmental Protection into Science and Social Studies Curriculum

economic), how the problems can be solved, and what is preventing these solutions from being implemented. In some cases, an environmental problem has many causes, and it’s important to get to the root of the problem to figure out the best solution. For example, if deforestation is a problem, find out who is responsible for cutting the trees and why are they doing so? Is it farmers who are clearing the trees to plant crops? Is it timber companies selling the hardwoods for a profit? Or is it a government policy that’s encouraging livestock grazing, palm oil cultivation or other reasons? Maybe it’s a combination of many causes.

There are many people and resources that you probably can access who can help you assess the problems, their root causes, their effects on people and the environment, and their solutions. University professors; experts in the Ministry of Environment, Agriculture, or Health; and experts working in conservation organizations in your area will be able to supply information about local and regional environmental problems.

Of course, the solutions will vary, depending on the severity of the problem and the resources available. For example, does the government (local or even national) need to set aside nature reserves or pass new environmental legislation, or establish fuel wood plantations? Can the local community take action themselves—for example, can they use better soil conservation techniques to prevent the washing away of tons of topsoil every year? Do people need training to solve the problems they’re facing, such as a course to help them learn how to apply pesticides sparingly and safely? These are all important questions that you will need to ask before planning a unit or lesson on environmental protection.

How Can Your Students Help Solve the Problems-Both Now and in the Future?

In thinking about local environmental problems, make sure to consider the role your students play in causing a problem and the role they could play in helping to solve the problem. For example, are they part of the problems now? How are their families connected to the problems? How well do your students understand the problems and from what perspective? Are they motivated to help find solutions? Have some students taken part in efforts to find solutions?

It’s also important to think about the future role your students will play in the community. Will they be farmers or fishers, industrial workers or white-collar workers, religious leaders or politicians? Will they live in the capital city, in villages, or on small farms—or will they be nomads? Will they hunt, gather firewood, vote in local and national elections, and so on? How will they relate to the environmental problems confronting the country and community, and how will they be able to help solve the problems?

You should also consider how students can help solve environmental problems now. Can they plant trees, design educational exhibits for the community, write to their government representatives, or help others learn how to plough on the contour? (Depending on your background and experience, you might need to ask experts or colleagues about the types of solutions that make the most sense for your students and community.)
Tools and Guidelines for Thematic Issues Curriculum Integration

ABOUT THE TOOLS

The guidelines contained here for integrating environmental protection into core science and social studies curriculum are adapted from the AtKisson Accelerator toolkit which was developed by Alan AtKisson and Associates of AtKisson Group over nearly twenty years of sustainability practice. The tools are copy righted, but organisational/institutional licenses are available.

THE COMPASS: A SYMBOL OF DIRECTION & SUSTAINABILITY

Most every person is aware of what a Compass is used for. It is a tool for helping us to find direction; to assist us to go from point A to Point B, C or D without losing our way. Magnetic Compasses have been a part of human existence/experience for over 800 years.

Most people also understand the core purpose of the Sustainability Compass. The Compass is used as a metaphor for direction finding, and for exploring and linking issues and people together from a 360 degree perspective. Compass is an easy way to symbolize and remember the essential aspects of sustainability. The Compass as we use it, also usefully divides the world into four clear quadrants, while maintaining the feeling of wholeness in its circular shape. As symbology, such thinking reaches back thousands of years in our human story.

Sustainability is about the whole of our world, and it requires the engagement of issues and perspectives from every walk of life, and from every point on the map. It means planning our course to the future we desire, and setting a new direction. That's why the Compass is an effective symbol of sustainability. With the AtKisson Compass the four directions are:

- **Nature (N)**, which refers to the underlying health and sustainable management of key ecosystems, bio-geo-physical cycles and natural resources. These can range from small, local and specific, like the quality of water of a nearby river or stream, to the large, global and general, such as a county’s contributions to global warming through their greenhouse gas emissions.

- **Economy (E)**, which refers to all the ways human beings work with Nature, with knowledge and with each other to produce the things and services that they need or want. The core issues or topic areas for Economy would relate to such things as production, jobs, markets, transportation, wages, labour conditions, etc. Again, like in the Nature example above, there would be differences based on location, sector considerations (organization, MNC or small SME) and scale or scope of the question (local, national, regional or global).

- **Society (S)** is the category for the social systems, structures and institutions that are driving by people acting collectively. The emphasis here is on the collective rather than the individual. Issues might fall under or relate to some of the following: social cohesion, culture and arts, politics, laws and governance, planning and infrastructure, etc.

- **Wellbeing (W)**, in contrast, focuses on the individual, as well as on the smaller webs of intimate relationships that are crucial to health and happiness. Wellbeing covers many issues that people are most concerned about in their daily lives but that are sometimes left out in traditional sustainable...
Integrating Environmental Protection into Science and Social Studies Curriculum

development models and approaches such as personal health, access to education, quality of life, personal relationships with others, general happiness and fulfillment, etc..

The Compass is a convenient way to organize groups who are doing a workshop exercise. Working with the Compass ensures that we keep the entire "big picture" of sustainability in mind, that we respect and appreciate the diversity that we need to reach sustainability, and that we nurture the connections among the people that are the key to making sustainable development a reality.

A Guideline Steps for Incorporate of Environmental Protection into Science and Social Studies Curricula

- Get Ready: Identify Learning Goals and Central Issue

- **Step 1: Issues Identification** (Identifying Environmental Issues and related factors from four compass directions)

- **Step 2: Systems Analysis** (Finding connections and linking issues across sectors and finding leverage’ and doorways for curriculum units and standards.

- **Step 3: Lesson/Activity Ideas** (Selecting lesson activity ideas that will allow us to successfully integrate ‘environmental protection’ into core curriculum units and/or lessons)

- **Step 4: Strategy and Lesson Plan** (Developing a Lesson Plan that addresses environmental protection and sustainability as well as teaching for ESD)

- **Step 5: Capstone…an Agreement to Act!**

- **Evaluation and Assessment**

![Diagram](image)

The Central Issue, Challenge or Topic
Get Ready: Identify Learning Goals and Central Issue... What do you want the students to learn? What is the local issue that you agree to use as the central issue for teaching?

- **Identify Learning goals-** Use Worksheet 1: *Learning Goals* to identify what do you want the students to learn in term of knowledge, skills, perspectives and values.

**Step 1: Issues . . . What is happening? Where do we want to focus? What is it linked to?**

- **Environmental Issues Review and Brainstorming:** Use Worksheet 2: *Identify the Central Environmental Issues* to identify the local environmental issues refer to the list of global environmental issues found in Annex 1.

Then brainstorm (or research) what you think are the root causes of these issues, what impacts or effects does the issues have on sustainability in general (use whatever level is appropriate… individual, community, nation or planet) , and finally, how is the issues linked with the national and/or global issues.

**Note:** You may choose to use the table of Environmental Issues provided in Annex 1, or you could develop your own table based on your ideas and local situation.

- **Choosing your Central Issue:** Select one central issue that you will focus on for building a lesson that incorporates. Use some criteria to weigh various issues in relation to each other, your curriculum requirements and needs and the sustainability of your community. See the side bar.

- **Exploring Stakeholder Perspectives & Roles:** Use Worksheet 3 to first brainstorm a number of key stakeholder groups your fee are linked to the central issue and assign each person one stakeholder. Then use Worksheet 4 to help each person think about what this particular environmental issue means to them as a stakeholder group, along with what they think their role (from their stakeholder perspective) is in contributing to the problem, in addition to what role they think they have in its solution. Facilitate a discussion among the group (e.g. use a stakeholder wheel poster to help facilitate this discussion) from each other their role- play stakeholder perspectives.

Have the participants fill out *Worksheets 3 & 4 (Stakeholder Perspectives & Roles)*
• **Behaviour Over Time Graphing**: Next, develop a simple “Behaviour Over Time” (BOT) trend graph for the central environmental issue. Groups must first agree on the measurement scale units that would be most appropriate to use. They will then develop a trend graph based on their answers to the following three questions:

- What is the situation now?
- In the past (whatever amount of time your group chooses), what was the situation like?
- In the future (again some time frame agreed on by the participants), what do we think the situation will be if things pretty much stay the same in terms of policy making, training and institutional and human capacity building, organizational structure, people’s behaviour, etc. (i.e. business as usual situation).

**Note:** During the group’s discussions in developing their graph, have them also identify some important or key historical events that you feel influenced the magnitude and direction of the trend you have drawn. *Use Worksheet 5.*

• **Identifying Drivers and Effects**: Next, identify what factors contribute to the central environmental issue by way of causing the problem either directly or indirectly. We call this group of factors ‘pressures’ or ‘drivers’. At the same time, identify consequence of the environmental problem continuing in the direction that it is currently going. We call this group of factors ‘responses’ or ‘effects’. *Use Worksheet 6* for this exercise.

After finish the list of drivers and effects then consider those factors from all four Compass directions (Refer to the AtKisson Compass attachment to help you identify what sort of factor could go into each Compass sectors) and fill them into the second table in *worksheet 6*.  

**Optional:** If you have been working in small groups, pull the whole group together for a quick sharing of what each small group has identified and discussed.

**Note:** Any of the steps described above can be shortened, depending on the time that you have to conduct the workshop, the number and background of the individuals participating in the planning, and how deep you want to go with the learning that takes places alongside the planning.

---

**Step 2: Systems Thinking . . . How do things relate? Where can we integrate into the Curriculum? (Linking the Issues to each other and to the Curriculum)**

• **Consider the Linkage Pathways** - Now consider the central environmental issue and its trend again. Have a discussion (either as a whole group, in your small groups or yourself) focused on this question: *Why is this problem happening?*

Look at the ‘Drivers & Effects’ sub-issues and factors that you identified linked to the main Environmental Issue from Step 1 discussion.

Now, see if you can find the patterns and connections. Are there some pressures / drivers that seem more primary than others? Are there some that seem to be working together, in some way, to drive the central issue / trend (in good or bad ways)? How about the responses or effects that the issue to producing? How are they related to the main issue and each other? Can you find causal relationship pathways between them? Do they feedback somewhere to the original pressures or drivers? *Refer to the Systems Example* that is attached, and *Use Worksheet 7* for this exercise.
• **Develop a Systems Relationship Map** - Take the central issue and create a systems map around it on a large piece of flip chart paper or newsprint. Use sticky notes (with colours for each element corresponding to the Compass Point that it is associated with).

Nature = Green  
Society = Yellow  
Economy = Blue  
Wellbeing = Pink

Use the sticky note cards so that groups can move things around on our map as they work together to figure out the linkage / relationship pathways. First use pencil to draw connecting lines with arrows to show the linkage and direction of influence. Once they have settled on how the system works, they can trace back over their pencil lines with marker to make them more visible.

**Note:** On the maps, ‘pressures/drivers’ to the central issue should be on the left side of the paper and ‘responses/effects’ on the right side. Some elements may sit in the middle as they are connectors between pressures and responses.

**Important Note:** see if you can identify any “feedback” linkages that exist from ‘effects’ back to primary ‘drivers.’ Feedback loops are crucial insights for positive system change.

• **Finding ‘Leverage Points’ for System Change** - Once the system linkages are complete, the next step is to see where in the system that we just mapped out we feel that our school /students could make positive contribution to tackling central environmental issue through an Action Project linked to the syllabus. We call these places where we can make the most effective and long-term system changes, ‘**Leverage Points**. Mark these places on the system map with small "delta" signs (triangles), like this:

• **Finding our Curriculum Doorways** – The last step of the Systems level is focused on finding the points of connection to our syllabus, or what we call ‘Curriculum Doorways’. These are places that we can integrate the environmental issue to our curriculum and syllabus. These places will be marked on the system map with small circles, like this:

Have the team(s) review their syllabus units and learning requirements and have them work to cross link these to any place in the system diagram that they created. Places that they find linkages to their Science or Social Studies syllabus units they should designate with a circle and also put a post-it note next to it summarizing what the linkage is and to which unit, lesson or standard. *Use Worksheet 7 for this step as well. See the Attached example to see how this is done.*

If you are working in small groups, have each group summarize its results briefly for the others.

**Step 3: Ideas ... for environmental protection related lessons, Activities and/or projects. What can we do?**

Now comes the fun part: thinking up fun, exciting, powerful, creative new ideas and ways to teach our existing syllabus, but in a way that integrates environmental issues and environmental protection (Remember: Environmental Protection = Action). First, take some time (5 or 10 minutes) to have people brainstorm individually or in pairs ways to teach the syllabus that link with the central environmental issue and deal with a strong protection aspect.
Integrating Environmental Protection into Science and Social Studies Curriculum

- **Ideas Brainstorming** - Encourage each person to think about the key insights from the previous step. Now that we understand something about why this Environmental Issue is a problem and what is happening, how can we bring it into our curriculum? What can we do involve students in helping to solve this issue?

Remind the group that brainstorming is a time for innovative, "out-of-the-box" ideas, as well as ideas that seem practical and familiar. All ideas are welcome!

Teachers should look at the ‘leverage points’ and curriculum doorways that they have identified and mapped out, and find a place to ask the following questions: “How can I teach about this issue at a particular curriculum doorways? Can my students also contribute to doing something real to solve this issue, or at least to contribute towards its solution?

*Use Worksheet 8 to brainstorm* as many lesson ideas as you can, though 3-4 should be plenty to start with.

- **Presenting Ideas and Getting Feedback** - Summarize the project ideas on the sticky notes or cards. Give them descriptive titles that will be easy for other people to understand.

Have each person share their best or their favorite ideas with the group - with the small group first, if you are working in Compass Point teams, or otherwise with the whole group. Designate some time for people to discuss and give constructive feedback to each person’s lesson ideas.

**Note:** If your participants would like to work cross-subjects, they can do a Preference Voting by put the pieces of paper with the project ideas up somewhere, where people can see them.

Give each person a certain number of votes, depending on the number of ideas presented. Each person can vote for any idea – except their own! And they can split their votes up, or concentrate them on one or two project ideas.

If you have time, develop some criteria for selecting the ‘best’ ideas for lessons, such as:

- Location (where?)
- Materials availability
- Time needed
- Teacher has enough background knowledge & experience
- Etc.

If one lesson idea is a clear "winner," that idea moves to the next step, Step 4. Otherwise, if there are several ideas that are popular, have a second vote, or have a discussion to see if you can come to consensus. (Note: sometimes, several ideas can be combined into one lesson that stretches over a period of time.)

**Note:** More about Project Based Learning –Project Planning Form…see Annex 4
Step 4: Strategy . . . and lesson planning. How can we do it?

Using the Lesson Planning Framework provided *(Worksheet 9: ESD Curriculum Integration Planning Framework)* develop a fairly complete lesson plan.

**Note:** If the lesson you are creating requires more extensive planning, then make a "plan to plan." Identify who is going to be involved, when, and what they will need (help, information, and approvals) to create a finished plan.

Step 5: Capstone . . . an Agreement to Act!

Now, summarize the commitment the teaching team is making, to realize the new curriculum initiatives. Put this "Agreement to Act" in the form of a short written statement: "We commit to ________________".

This agreement is a sign of your group’s consensus to make change towards infusing ESD into your curriculum through Thematic integrations into core subject areas. Have everyone who is willing to commit to the statement sign their name to it. *(Worksheet 10: Agreement to Act)*

**Celebrate your success!** ... and have taken a big step in infusing ESD into your school to help create a more sustainable world!

Evaluation...Evaluate your integrated Unit

After implement the lesson plan, you can evaluate the integrated unit by yourself and also you can ask you colleague to give you some feedback for your curriculum improvement by follow these questions. *(Worksheet 11: Evaluate your integrated Unit)*

**Optional:** you can create the question for your Evaluation according to your situation too.
Worksheet 1: Learning Goals

Please identify the learning goals in term of knowledge, skills, perspectives and values that you do want the students to learn.

What **basic knowledge** is necessary for the students to learn or understand?

What **skills** are necessary for the students to learn?

What **perspectives** are necessary for the students to learn?

What **values** are necessary for the students to live sustainably in their community?

Worksheet 2: Identify the Central Environmental Issue

Environmental Issues Brainstorming

Instructions: List out all of the Local Environmental Issues that you and your group can think of then brainstorm (or research) what you think are the root causes of this issue, what impacts or effects does the issue have on sustainability in general (use whatever level is appropriate… individual, community, nation or planet), and finally, how is this issue linked with the national and/or global issues.

<table>
<thead>
<tr>
<th>Local Environmental Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue Name</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

After brainstorming and discussion, the issue that you/ your group agreed to use as the Central Environmental Issue is ________________________________
**Example Stakeholder Perspective Wheel**

This is an example of a Stakeholder Perspective Wheel for a particular Environmental Issue: **Water Pollution**.
Worksheet 3: Stakeholder Perspective Wheel

Instructions: In the circle, write in the names of seven key stakeholders related to your Central Environmental Issue.
**Worksheet 4: Stakeholder Perspectives and Roles**

*Instructions*: List down your own stakeholder and that of the others in your group. Then write down what you think is the role of your own stakeholder in this environmental issue and how they see or view this issue from their own perspective. During the discussion, write down what the others say about their own stakeholders.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>How do they perceive this issue? What does this issue mean to them (i.e. their lives, their job, etc.)</th>
<th>What do you think is their role in this issue both from as contributor to the problem and in working towards its solution (from an outside objective perspective)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Worksheet 5: “Behavior over Time Graphing”

The *Behavior over time (BOT) graphs* are a type of systems thinking tool. Like other basic graphs, they have horizontal and vertical axes, with a line showing how something is changing over time.

You draw a BOT graph in order to depict patterns of behavior that you want to explore from a systems thinking perspective. This type of exercise is an effective way to get teachers/students to divulge their own perspective and knowledge about a particular issue (i.e. why they think the situation is like this and what may have influenced it at different periods of time and so forth) along with their underlying assumptions. This exercise allows individuals to better understand the ‘world view’ others in relation to the same problem.

**Instructions:** With your team/group . . .

1. **Develop a simple BOT or “Trend” graph for the central issue that you will build a lesson around.**
   
   A. Agree on your measurement scale units
   B. Start at the present and assess the situation of your issue in relation to your scale. Where do you think you are now?
   C. Then, go back in time (20 years) and assess what was the situation at that time in relation to this issue
   D. Finally, agree as a group on what will be the situation in the future (20 years) if nothing much different is done in terms of policy making, training and institutional and human capacity building, organizational structure, people’s behaviour, etc. (i.e. business as usual situation).

   **Note:** Remember that you should answer this last question as best you can remembering that it doesn’t sit in a vacuum and is already being driven by other local, national, regional and global trends.

2. **Identify some important or key historical events that you feel influenced the magnitude and direction of the trend you have drawn.**
The AtKisson Sustainability Compass

Nature
- Natural Resources use and mgmt (water, air, soil, forests, etc)
- Land use patterns
- Pollution & Environmental Quality
- Environmental policy, laws & regulations
- Impact on Biodiversity (wildlife and vegetation)
- Ecosystem Services (e.g. clean water, oxygen generation, CO₂ sequestration)
- Indoor built environment

Wellbeing
- Quality of life (work/life balance)
- Physical and mental health
- Sense of personal security
- Working & living conditions
- Education & training
- Relationships
- Spiritual fulfilment
- Happiness

Economy
- Purchasing and resource procurement
- Consumption patterns (energy, raw materials, water, etc.)
- Fiscal Budgets
- Employment levels
- Wages & benefits
- Transportation (how people travel)
- Cost of living & inflation

Society
- Social Cohesion among different groups
- Governance and transparency
- Public Services (waste mgmt, water, electricity, etc.)
- Social Services (child care, health care, education, etc.)
- Ethnic and gender diversity
- Family/work team structure and relationships
- Cultural diversity, identity and preservation
- Corporate Social Responsibility (CSR)
**Worksheet 6: Brainstorming Drivers & Effects**

**Instructions:** Write down your central Environmental Issue and its BOT trend in the middle of the worksheet, then brainstorm as many factors as you can that relate to this central environmental issue. Separate these factors as either a ‘pressures / drivers’ or is a ‘responses / effects’ as a result of this issue’s trend trajectory.

<table>
<thead>
<tr>
<th>Driver</th>
<th>Effect</th>
</tr>
</thead>
</table>

After finish the list of drivers and effects then consider those factors from all four Compass directions (refer to the AtKisson Compass attachment to help you identify what sort of factor could go into each Compass sectors) and fill them into the table below.

<table>
<thead>
<tr>
<th>Nature</th>
<th>Economy</th>
<th>Society</th>
<th>Wellbeing</th>
</tr>
</thead>
</table>

Systainability Asia / AtKisson Group 2009
Integrating Environmental Protection into Science and Social Studies Curriculum

Example Issue System Relationship Map

Pressures

- Climate + Weather
- Natural Geology
- Soil Erosion
- Discharge of Polluted water
- Deforestation
- Poverty
- Education
- Awareness
- Personal values
- Corruption
- Government policy
- Community Values

Responses

- Biodiversity
- Water Quality
- Health
- Water use
- Recreation
- Expenses Budget
- GDP
- Business Opportunity
- Investment
- Community spirit

Doorways

- = Doorways

Leverage Point

- = Leverage Point

Example Issue

System Relationship Map

Deforestation = Doorways

= Leverage Point
**Worksheet 7: Issue Relationships, Leverage Points and Curriculum Doorways Map**

Use this sheet to work out your ideas about how different elements related to your central environmental issue might link together, in cause-and-effect, systemic terms. Then identify the Leverage Point (where is the place that students can make change) for you to link your existing syllabus and/or national standards to the central issue or an associated sub-issue from any Compass Point dimension.

**KEEP IT SIMPLE:** There is no wrong way to do this exercise!
**Worksheet 8: Lesson Ideas Brainstorming**

**Instructions** Based on the systems analysis, **brainstorm a list of lesson "ideas"** that could effectively integrate the central environmental issue / topic into your existing curriculum / syllabus. Use the columns to the right to identify the ‘Curriculum doorways’ and the syllabus linkages related to this Lesson.

<table>
<thead>
<tr>
<th>Doorways (from the systems Map)</th>
<th>Activity or Lesson Idea</th>
<th>What are the links to my syllabus and/or standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ____________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The Leverage point that this doorway will lead to is</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>______________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ____________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The Leverage point that this doorway will lead to is</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>______________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ____________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The Leverage point that this doorway will lead to is</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>______________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ____________________________</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The Leverage point that this doorway will lead to is</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>______________________________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Worksheet 9 : ESD Integrated Thematic Lesson Planning Framework**

<table>
<thead>
<tr>
<th>Thematic Topic Area:</th>
<th>Name of Lesson:</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(example: Water Pollution)</em></td>
<td>Time Required:</td>
</tr>
</tbody>
</table>

1. **Science / Social Studies Syllabus Linkages**
   *(for workshop case… what are the linkages with Science / Social Studies Syllabus?)*

2. **Key Concepts**
   *(that can be elaborated from this thematic topic)*

3. **Essential or Driving Question of the Lesson**
   *(linked to what is the key message or understanding that students should know from this lesson)*

4. **Focus, Bridge and Process Questions**
   *(Questions that you will use at the beginning of the lesson to introduce the lesson and links to learner’s past experience & interest)*
   - **Focus Questions:**
   - **Bridge Questions:**
   - **Process Questions:**

5. **Lesson Assessment Questions** *(questions that you will use to assess student understanding)*
### 6. Interdisciplinary Links / Strands to Keep In Mind - (for teaching and assessment)

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Physical, Personal &amp; Social Learning</th>
<th>Other Learning (Interdisciplinary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form, function, change, causation, connection, interdependence, perspective, collaboration, reflection, responsibility, etc.</td>
<td>Health (physical and mental) and physical education, interpersonal development (values), personal learning, citizenship, etc.</td>
<td>Communication, leadership, design, creativity, critical thinking, technology (ICT), etc.</td>
</tr>
</tbody>
</table>

### 7. What do we want the students to learn? – related to the key elements in the curriculum standards from the Ministry of Education

### 8. Activity Description (describe / summarize the activity . . . what will students do and what will they learn?)

**Activity Outline in Relation to Key Learning Modalities** – breakdown the lesson in relation to key learning modalities such as: hands-on investigation, discovery learning, categorizing and describing, analysis and interpretation, creativity, passive listening, dialogue and discussion
<table>
<thead>
<tr>
<th>Learning Assessment – how will you know what the children have learned.</th>
<th>References &amp; Resources for this lesson</th>
</tr>
</thead>
</table>

**Action Component** – Describe how the lesson will incorporate an action component; i.e. have students actively contribute towards some form of solution related to the central environmental issues / problems.

**Source:** Adapted from Marcia Behrenbruch, IBO Asia-Pacific Conference 2007.
Worksheet 10: Capstone Proposal and Agreement

Instructions
The Capstone Agreement is the final step of this workshop. It is an action, or set of actions, that the entire group agrees to take on that will further the lessons learned or ideas generated from the workshop. It creates a connection between the workshop experience and real life.

Each team should develop Capstone Proposal. The Proposal should meet the following criteria:

- The proposal should be realistic
- The proposal should support education system change
- The proposal should consider the results of the integrated process and how it will enhance teaching and learning for sustainable development
- It should seem possible that the entire workshop group could support the proposal

Each teaching team presents its Capstone Proposal, which is recorded on large paper on the wall in front of the group. Once all Capstones have been proposed, discussion ensues about common themes and connections between the Proposals how to craft an Agreement Statement from the four proposals.

Team Capstone Proposal

Capstone Proposal

Capstone Agreement
Worksheet 11: Evaluate the Integrated Unit

Use the questions below to reflect on your integrated unit.

1. What links did you make with among the subject areas?


2. What link did you make with the community?


3. In your view, what aspects of the integrated unit engaged and inspired the students?


4. How effectively did your unit incorporate the ESD (knowledge, skills, perspectives and values) into Environmental Protection?


5. What would you do differently the next time?


6. What ideas and suggestions do you have for improving the integrated unit process?


Source: Adapted from Integrated Unit, The Gary and Jerri-Ann Jacobs High Tech High Handbook
## Annex 1

### Global Environmental Issues List

<table>
<thead>
<tr>
<th>Issue Name</th>
<th>Root Causes</th>
<th>Impacts or Effects on Sustainability</th>
<th>Possible or Proposed Solutions</th>
</tr>
</thead>
</table>
| Acid Rain    | • Acid rain is result of air pollution-any type of fuel is burnt which produce a lots of different chemicals.  
• Pollution from power stations, factories and car burn fuels and therefore all toxic produce polluting gases.  
• Some of these gases (especially nitrogen oxides and sulphur dioxide) react with the tiny droplets of water in clouds to form sulphuric and nitric acids. | • The cause of serious effect on forest, the trees to grow more slowly and soil by dissolve and wash away the nutrients and minerals in the soil which help the trees to grow.  
• The acid rain cause the release of harmful substances such as aluminum into the soil and wear away the waxy protective coating of leaves, damaging them and preventing them from being able to photosynthesis properly. | • Reducing emission by reduce burning fossil fuels usages by utilize the cheapest ways to produce electricity.  
• Find alternative sources of clean energy, for example other sources could be solar energy, wind wills, hydro electric.  
• Greater subsidies of public transport by the government to encourage people to use public transport rather than always traveling by car.  
• Every individual can make an effort to save energy by switching off lights when they are not being used and using energy-saving appliances - when less electricity is being used, pollution from power plants decreases.  
• Walking, cycling and sharing cars all reduce the pollution from vehicles |
| Air Pollution | • sources of air pollution are both natural and human-based  
• Pervasive use of fossil fuels for combustion purposes for transportation and electricity generation all over the world.  
• Design of cities and other human spaces in ways that increase the incidences of air pollution  
• Weak laws and regulations that would monitor and regulate emissions from cars and factories | • The effects of air pollution are diverse and numerous. Air pollution can have serious consequences for the health of human beings, and also severely affects natural ecosystems.  
• The Ozone and other photochemical oxidants in the upper atmosphere is also highly toxic to both plants and animals.  
• Toxic chemicals in the air include carcinogenic chemical, radioactive materials, and other | • By developing and communicating the scientific knowledge and understanding required of ecosystem significant.  
• By analysis of the effectiveness of air pollution problem to human being.  
• By active engagement with the process of developing policy;  
• Building the capacity to identify air pollution problems and to identify and
<table>
<thead>
<tr>
<th><strong>Deforestation</strong></th>
<th><strong>Coastal Erosion</strong></th>
<th><strong>Biodiversity Loss</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Land tenure issues</td>
<td>• Wave action</td>
<td>• Loss of intricate web of ecological relationships that provide innumerable ecological services</td>
</tr>
<tr>
<td>• Erosion in one location may result in accretion nearby.</td>
<td>• Climate change and weather</td>
<td>• Sharp decrease in Food security</td>
</tr>
<tr>
<td>• Coral bleaching caused of decreasing of fishing resources</td>
<td>• Resource extraction</td>
<td>• Loss of economic resources and business</td>
</tr>
<tr>
<td>• Algae bloom (may caused by toxic algal bloom that harmful to human body)</td>
<td>• Vegetation</td>
<td>• Habitat Loss for a host of species from mammals, to insects and bacteria and fungi</td>
</tr>
<tr>
<td>• Property loss</td>
<td>• Coastal Management</td>
<td>• Loss of community values and culture, especially cultures with strong ties to certain species</td>
</tr>
<tr>
<td>• Loss of knowledge about life that humans have yet not discovered or do not understand</td>
<td>• Transportation</td>
<td>• Loss of knowledge about life that humans have yet not discovered or do not understand</td>
</tr>
<tr>
<td>• Beach Nourishment</td>
<td>• Deforestation</td>
<td>• In several ways all life is interconnected through sharing and recycling all elements and sharing the same atoms with building cooperation among every human and other living creature on Earth have ethical.</td>
</tr>
<tr>
<td>• Shrimp farm</td>
<td>• Tourism development</td>
<td>• Maintaining a balance between all the populations in the biotic community.</td>
</tr>
<tr>
<td>• Natural Disaster (Tsunami)</td>
<td>• Natural Disaster (Tsunami)</td>
<td>• Protecting the world’s diversity of species in the integral to a sustainable future</td>
</tr>
</tbody>
</table>

**Implement policies to reduce these impacts**
- Developing and implementing suitable controls.
- Massive system switch to renewable energy
- Use of new technology to increase energy efficiency
| Introducing Environmental Protection into Science and Social Studies Curriculum |
|---------------------------------|-------------------|-------------------|
| • The logging industry and commercial is fueled by the need for disposable product. | environmental resources, | Ecological Services for preserving forests in developing countries |
| • acid rain is killing forests in some countries | • social and cultural traditions – alongside | • Building awareness of value of forests in all aspects of human life |
| • the building dams have harmful effect. | • loss of the economic and productive capacity of forestland | • Strengthen government forest policy |
| • Consumption on a huge scale worldwide of forest products such as paper, chop sticks, and general building construction material | • linked to the loss of biodiversity | • Pass community forest laws |
| • Institutionalised and endemic Corruption | • Food security and sustainability of livelihoods as provided by forests. | • Strengthen sustainable forestry certification schemes |
| | • Forests also offer climatic and water resource conservation benefits | • Tackle poverty in rural areas |
| | • The rich medicinal resources stored in forests | | • Reduce paper use |
| | • Higher risk of disaster occurring in communities, including flooding and tsunami | | |

**Global Warming / Climate change**

- On a global scale, carbon dioxide, water vapor and other trace gases in the atmosphere keep the sun’s energy from radiating back out to space, thus sealing it inside the Earth’s atmosphere
- Economies of the world driven by use of non-renewable fossil fuel energy sources
- Lack of government will power and thus lack of sufficient laws and regulations on fossil fuel use and emissions
- Lack of technology and knowledge development on using renewable energy sources up to now

**Ozone Depletion**

- The stratospheric ozone depletion represents unsustainable impacts on the

**Global Warming / Climate change**

- The human system has already damaged soils, forest, and lakes downwind of heavy pollution sources, and may now be altering the entire biosphere.
- Health issues. New disease, flu, etc.
- Food security
- Increasing of energy consumption

**Ozone Depletion**

- They are oxidized by hydroxyl radicals to sulfuric and nitric acids, which dissolve readily in

**Global Warming / Climate change**

- The scientists play a role in the crafting of policy and governments must be bold enough to act and political leadership from nongovernmental organizations were crucial in bring about the Montreal Protocol.
- Reduce emission of Green House Gases
- Energy conservation through use of energy saving appliances, devices and good energy conservation behavior (e.g. switching off lights, appliances, etc. when not in use)
- Massive economic switch to renewable energy sources
- Stop burning of agricultural waste
- Stop deforestation of primary forest

**Ozone Depletion**

- Protecting our atmosphere while also achieving the economic benefits that people value.
sources of acid disposition reveals the presence of two acids, sulfuric acid (H2SO4) and nitric acid (HNO3).

- Its impact on ecosystems, however, when anglers started noticing sharp declines in fish populations.
- Impact on Aquatic Ecosystems is extremely critical because it affects the functioning of virtually all enzymes, hormones, and other proteins in the bodies of all organisms living in.
- Impact on forests, much of the damage of acid precipitation to forests is due to chemical interactions within the forest soils.

### Soil Erosion

- Destructive agricultural practices
- Surface mining, hydro-mining
- Urban / suburban development
- Affects both agriculture and the natural environment.
- Soil compaction, low organic matter, loss of soil structure, poor internal drainage, Stalinization, and soil acidity problems.

### Desertification

- Contamination of water sources
- Loss of topsoil and other essential plant nutrients from the soil
- Farmland may be reflected in reduced crop production potential, lower surface quality and damaged drainage networking.
- Soil credibility is faster infiltration rates.
- The washing out of lanes, roads and fence rows.
- Crop production technology that have maintain as increase yields in spite of soil erosion.
- Crops can be totally ruined so that costly delay and reseeding is necessary.

### Solid Waste

The solid waste defined as the total of all material thrown away from homes and commercial establishment.

- The garbage in the most effective way to human and environmental health.
- Water percolates through any material various

- The conservation particularly at farm level, revisal agriculture policies and changing international at market forces.
- Rapid diffusion and implementation of proper agricultural practices to replace destructive traditional or modern practices like mono-cropping.
- Soil conservation laws and economic incentives for farmers and business
- Increased investment into rural agricultural areas
- Organic farming methods

- Alternatives plants, and reductions in the consumption of electricity.
- Coal washing to remove sulfur is costly, both economically and environmentally.
<table>
<thead>
<tr>
<th>waste)</th>
<th>The solid waste is a problem of trash movement as old dumps and landfills were closed, posing environmental concern.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals in the material mat dissolve in the water and get carried along.</td>
<td></td>
</tr>
<tr>
<td>Solid waste problem is potentially subject to natural decomposition.</td>
<td></td>
</tr>
<tr>
<td>Incomplete decomposition etc. the plastic components are resistant to natural.</td>
<td></td>
</tr>
<tr>
<td>Setting new landfill are sites on high ground, well above the water table.</td>
<td></td>
</tr>
<tr>
<td>Resources.</td>
<td></td>
</tr>
<tr>
<td>Changing lifestyle which include, notably, the growing use of disposable products and excessive packaging.</td>
<td></td>
</tr>
<tr>
<td>People are moving in the opposite direction, making an effort to reduce the amount of materials they discard.</td>
<td></td>
</tr>
<tr>
<td>Environmentally concerned consumers have successfully pressured some producers to reduce their packaging.</td>
<td></td>
</tr>
<tr>
<td>Lightening the weight of many items has reduced the amount of materials used in manufacturing.</td>
<td></td>
</tr>
<tr>
<td>The recycling solution: paper, glass, and aluminum.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Pollution</th>
<th>Every year, 14 billions pounds of sewage, sludge, and garbage are dumped into the world's oceans. 19 trillion gallons of waste also enter the water annually.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions of people live along coastlines and near rivers, meaning these bodies of water are likely candidates for heavy and destructive pollution.</td>
<td></td>
</tr>
<tr>
<td>Many cities and countries dump sewage out at sea. Often, they place it not far from their own coastline, often killing all the sea wildlife in the dumping area.</td>
<td></td>
</tr>
<tr>
<td>Chemicals dumped by industries and governments are another major source of water pollution.</td>
<td></td>
</tr>
<tr>
<td>The effects of water pollution are varied and depend on what chemicals are dumped and in what locations.</td>
<td></td>
</tr>
<tr>
<td>Water pollution kills life that inhabits water-based ecosystems. Dead fish, birds, dolphins, and many other animals often wind up on beaches, killed by pollutants in their habitat.</td>
<td></td>
</tr>
<tr>
<td>Loss of community values and culture.</td>
<td></td>
</tr>
<tr>
<td>Building understanding the role of water management in sustaining and diversifying livelihood particularly poverty reduction.</td>
<td></td>
</tr>
<tr>
<td>Specific focus on measuring the costs and benefits of water management and infrastructure.</td>
<td></td>
</tr>
<tr>
<td>Providing integrative knowledge that can bridge science and policy and utilize interdisciplinary approaches.</td>
<td></td>
</tr>
<tr>
<td>Complementing socioeconomics assessments and policy analysis.</td>
<td></td>
</tr>
<tr>
<td>Specific focus on measuring the cost and benefits of water management and infrastructure.</td>
<td></td>
</tr>
</tbody>
</table>

38
Annex 2

Eleven Basic Ecological Concepts

1. Ecology is the part of biology that examines the interrelationships between organisms and their environment. It also draws heavily upon, and contributes to, other areas of biology, other sciences like chemistry, physics, meteorology, and earth science, as well as to other fields like mathematics, economics, medicine and sociology. As practitioners of a basic science, ecologists seek an accurate understanding of natural phenomena through observation and experimentation. At the same time, ecologists seek to utilize the gathered information toward preserving the ability of the earth to sustain all forms of life (including humans). Like those of other sciences, ecological concepts can change based on new findings and on new interpretations of old data.

2. In nature, a variety of physical and biological factors influence an organism's ability to grow and reproduce in any one place.

3. There is variability in the way that different species respond to the environment, and that causes them to have different ranges. However, a species' actual presence on a site depends upon its ability to disperse onto that site, as well as its ability to survive its environment.

4. Organisms of a given species that occur together comprise a population. Populations can grow, but various environmental factors prevent populations from growing indefinitely. Populations can also decline to the point of extinction.

5. Species that have similar responses to the environment are typically found together in assemblages called communities. Each community is unique, but those occurring in similar environments are generally similar to one another. Adjacent communities often blend into each other.

6. On any site, the organisms interact in various ways. Some help each other while others are harmful.

7. All of the organisms on a site, along with its physical environment, comprise an ecosystem.

8. All ecosystem functions depend upon energy. In any given ecosystem, organisms called producers obtain energy from the non-living environment (usually the sun) and convert it into a biologically useful form. Other organisms called consumers obtain that energy by eating the producers and/or other consumers.

9. The bodies of all organisms are built from chemical elements called nutrients. In any ecosystem, producers obtain various nutrients in the form of gasses and minerals from the air, soil, and/or water and convert them into biologically useful forms. Consumers obtain these nutrients by eating producers and/or other consumers. Decomposers convert the nutrients back into their non-biological form.

10. Ecosystems are constantly changing, either rapidly or slowly. Those changes can be due to changes in physical factors, to the arrival or local extinction of the component species, to the organisms progressing through their life cycles, to altered relationships between the species, and to the species changing by evolution.

11. More than any other species, humans have changed the earth's ecosystems. At present, ecologists are particularly concerned about preservation of biological diversity, the effects of global climate change, and the ability of ecosystems to sustain life.
Annex 3
Designing Lesson Questions

The Art of Questioning

To produce a world of critical and creative thinkers that can help solve environmental problems, we need to encourage students to ask questions and think critically. To do this, we need to ask them the right kinds of questions and model good questioning techniques.

Although factual questions are important, they should be balanced with more stimulating questions that make students think about something differently, come to a different conclusion, or reflect on something important. There are many different kinds of questions that can help students grow intellectually and creatively. And there are many strategies for using questions in your teaching. For example, one type of questioning strategy, called Socratic Questioning, is designed to probe deeply and get students to think. It also helps open up discussion and allow students to express themselves freely without worrying about being wrong.

Examples of Socratic Questions:

- How do people decide which career to take? How should they decide?
- Why is having a clean river important? What does it require to have a healthy and clean river?
- Why do factories and businesses have a tendency to pollute the environment? How could they improve?
- What do you think?

Logical sequence of different question types for a lesson:

1. **Focus questions**, the most basic kind of questions, ask for specific information. They often begin with "who, what, or where." For example:
   - What have you heard about acid rain?
   - What does this snail shell feel like?
   - What do you know about an owl that makes it such a great night hunter?

2. **Process questions** have a wider scope of possible responses than focus questions. Process questions ask people to integrate information rather than just remembering or describing.

   Process questions often begin with "What does this mean? What would happen if ...? What experience supports ...? Why did ..?" For example:
   - What evidence indicates pollution is affecting the Chao Phraya River?
   - How does a Stork feed its young?
   - Why are there more water hyacinths in this section of the river?

3. **Evaluative questions** usually deal with matters of value, choice or judgment of the participants. They offer group members a chance to express their feelings. Evaluative questions often begin with "What do you think? What about ...?" For example:
   - What do you think should be done to clean up the Chao Phraya River?
   - How could we all individually help in this effort?
   - Why do you think that the temple would does not want as many birds around?
   - Why is it important to have different kinds of trees in a forest?
## Annex 4

### PROJECT PLANNING FORM

<table>
<thead>
<tr>
<th>Project title:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher(s):</td>
<td></td>
</tr>
<tr>
<td>School:</td>
<td></td>
</tr>
<tr>
<td>Grade level(s):</td>
<td></td>
</tr>
<tr>
<td>Subjects:</td>
<td></td>
</tr>
</tbody>
</table>

STANDARDS-FOCUSED
PROJECT BASED LEARNING
Buck Institute for Education
Begin with the End in Mind

Summarize the theme for this project. Why do this project?

Identify the content standard that students will learn in this project (two to three per subject).

Identify key skills students will learn in this project. List only those skills you plan to assess (two to four per person).

Identify the habits of mind that students will practice in this project (one to two per project).

Does the project meet the criteria for standards-focused PBL?

Craft the Driving Question
State the essential question or problem statement for the project. The statement should encompass all project content and outcomes, and provide a central focus for student inquiry.

- Have you posed an authentic problem or significant question that engages students and requires core subject knowledge to solve or answer?

**Plan the Assessment**
<table>
<thead>
<tr>
<th>Step 1: Define the learning outcomes and project outputs for the project. What will you assess?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early in the Project:</td>
</tr>
<tr>
<td>During the Project:</td>
</tr>
<tr>
<td>End of the Project:</td>
</tr>
</tbody>
</table>

## Plan the Assessment (2)

<p>| Step 2: State the criteria for exemplary performance for each |</p>
<table>
<thead>
<tr>
<th>outcome/output:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>outcome/output:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>outcome/output:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>outcome/output:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria:</td>
<td></td>
</tr>
</tbody>
</table>

- *Do the outcome/output and criteria align with the standards and outcomes for the project?*

**Map the Project**
What do students need to know and be able to do to complete the tasks successfully? How and when will they learn the necessary knowledge, skills, values and perspectives? Look at one major product for the project and analyze the tasks necessary to produce a high-quality outcome.

### Product:

<table>
<thead>
<tr>
<th>KNOWLEDGE AND SKILLS NEEDED</th>
<th>ALREADY HAVE LEARNED</th>
<th>TAUGHT BEFORE THE PROJECT</th>
<th>TAUGHT DURING THE PROJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What project tools will you use?
- Know/need to know lists
- Daily goal sheet
- Journals
- Briefs
- Task lists
- Problem logs

- Do the objectives/outcomes and tasks give all students the opportunity to demonstrate what they have learned?

**Map the Project (2)**
List the key dates and important milestones for this project.

With other teachers and/or a group of students, refine the project design to guide you further in your planning. What other thoughts do you now have on the project?

- What challenges or problems might arise in this project?
Manage the Process

List preparations necessary to address needs for differentiated instruction for special-needs students, or students with diverse learning styles.

<table>
<thead>
<tr>
<th>How will you and your students reflect on and evaluate the project?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Class discussion</td>
</tr>
<tr>
<td>□ Fishbowl</td>
</tr>
<tr>
<td>□ Student-facilitated formal debrief</td>
</tr>
<tr>
<td>□ Teacher-led formal debrief</td>
</tr>
<tr>
<td>□ Student-facilitated formal debrief</td>
</tr>
<tr>
<td>□ Individual evaluations</td>
</tr>
<tr>
<td>□ Group evaluations</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
<tr>
<td>□ Other:</td>
</tr>
</tbody>
</table>

• *What do you expect to learn from this project?*
Annex 5

Sources & Resources

Bibliography

AtKisson, Alan, The ISIS Agreement, Earthscan (2008)


Sterling, Steven, Whole Systems Thinking as a Basis for Paradigm Change in Education, PhD paper, University of Bath. (2003)

Web Resources

North American Association of Environmental Education (NAAEE)
http://www.naaee.org/publications/publications-descriptions

Celebrating 38 years of promoting excellence in environmental education! NAAEE is the professional association for environmental education. Our members promote professional excellence in nonformal organizations, K-12 classrooms, universities (both instructors and students), government agencies, and corporate settings throughout North America and in over 55 other countries. Since 1971, the Association has created opportunities for its members to improve their skills in creating and delivering programs and services that teach people how to think, not what to think.

Center for Environmental Education (CEE) - Green Teacher
http://www.greenteacher.org/?page_id=108

There are hundreds of teachers, educational institutions, nature clubs, NGOs, citizens groups in the country taking working to create awareness about the environment. The efforts of these groups range from helping create a love for nature through camping and adventure, development of educational material, raising awareness about ecosystems, to campaigning against polluting industries and lobbying with the government. Their efforts offer learning for others who would like to use education and communication to bring about change. Selected case experiences of such education-communication initiatives are shared.

Education for Sustainable Development Toolkit
http://www.esdtoolkit.org/default.htm

The Education for Sustainable Development Toolkit will help schools and communities develop a process for creating locally relevant and culturally appropriate education. This Toolkit is based on the idea that communities and educational systems need to dovetail their sustainability efforts. Ideally, local educational systems can reorient existing curriculums to reinforce local sustainability goals. The ESD Toolkit is an easy-to-use manual for beginning the process of combining education and sustainability.
Integrating Environmental Protection into Science and Social Studies Curriculum

AtKisson Group
AtKisson Group
www.atkisson.com
AtKisson Group is an international network of affiliated organizations and individual associates, around the world, called the AtKisson Group. Members of the Group are fully authorized to use and promote the ISIS Method and the ISIS Accelerator suite of sustainability tools.

Acorn Naturalist
http://www.acornnaturalists.com/
Acorn Naturalists has provided educators with unique resources for teaching about science and nature. From creative, hands-on kits, to games, field equipment, animal replicas, optics, activity guides and DVDs, the Acorn Naturalists' collection provides exemplary resources for the field and classroom.

Educating for a Sustainable Future
http://www.education.ed.ac.uk/esf/index.html
The site is dedicated to providing on-line supported self study materials for courses in education for sustainability in teacher education. As the site advocates whole school approaches to education for sustainability it should be of interest to primary and secondary teachers regardless of their area of curricular specialisation. The site consists of resources linked to a study guide which provides suggested activities which should enhance the practice of citizenship through education for sustainable development in schools.

Facing the Future
http://www.facingthefuture.org/
Facing the Future believes in the transformative power of widespread, systemic education to improve lives and communities, both locally and globally. The positive, solutions-based programming is designed by and for teachers, and brings critical thinking about global issues to students in every walk of life. Working within the education system to help teachers help students achieve academic success, while preparing them to create and maintain positive, healthy, and sustainable communities. Facing the future provides curriculum resources, teacher workshops, and service learning opportunities used by teachers, schools, and districts in all 50 states and over 60 countries.

YOU Think!
http://www.youthink.worldbank.org/about/
We give you information about the global issues you said matter to you. Check out the research, knowledge and experience gathered by World Bank experts on international development.

Mongabay.COM
http://www.mongabay.com/about.html
Mongabay.com is one of the world's most popular environmental science and conservation news sites. The news and rainforests sections of the site are widely cited for information on tropical forests, conservation, and wildlife. Mongabay.com aims to raise interest in wildlife and wildlands while promoting awareness of environmental issues.

National Curriculum, UK
'The cross-curriculum dimensions are essential tools to help young people make sense of the wider world. They should permeate the curriculum and the life of a school. The planning guides will help teachers put the dimensions at the heart of lessons and ensure that learners understand the challenges that face the world today, such as creating a sustainable future for the planet.

The Nuffield Foundation
http://www.primaryhistory.org/leadinghistory/cross-curricular-learning,295,SAR.html
This website helps teachers and children to 'do history', based on the seven key principles of Nuffield Primary History and wide range of teaching methods. Lots of free lessons to download. Also show how to do History and Literacy and cross-curricular learning.

International Commission on Education for Sustainable Development Practice
Finding a lack of comprehensive cross-disciplinary programs to train practitioners in the full range of challenges of sustainable development, the Commission proposes a set of recommendations for a new educational system focused on sustainable development practice. Central to the Commissions recommendations is the proposed Masters in Development Practice program. With emphasis on policy and implementation, the MDP program is rooted in four main disciplines: health sciences, natural sciences and engineering, social sciences, and management. The Commission’s recommendations are designed to meet the worlds rapidly growing demand for highly skilled sustainable development practitioners.

Children’s Identify and Citizenship in Europe
In October 2001 a major curriculum reform in Greece reorganised subject content, reconsidered of the place of subjects, and defined wider educational philosophy. In these reforms citizenship education curriculum appears different to earlier content-driven curricula. Citizenship has been coherently organized across compulsory education, and provision made for inter-disciplinary and cross-thematic approaches to learning, build on examining contemporary socio-political and economic issues Problems and themes.

Environmental Learning & experience
An Interdisciplinary Guide for teachers
The ELE Curriculum Maps has been developed to help teachers turn theory into practice for environmental learning by connecting learning outcomes across K-12 curricula with elements of the ELE Guide. Teachers adept at integrating the environment and sustainability into their practice are often well aware of these curriculum links, while others may in the connections less obvious These maps help to show us where the connections already exist, and how we might further incorporate environmental themes into our teaching and learning.

An Interdisciplinary model for teaching
The topic “Foods”: A contribution to modern chemical education.
Modern chemical education aims at teaching based on critical thinking, problem solving and decision-making that may be developed through an interdisciplinary approach. An interdisciplinary model for teaching the topic “foods” is suggested. The goal of the suggested approach is for students to develop their evaluative thinking in order to adopt a responsible behaviour towards health.

Social Studies and Science Education: Developing World Citizenship Through Interdisciplinary Partnerships
http://www.quasar.ualberta.ca/css/Css_35_3/ARDeveloping_world_citizenship.htm
This paper explores the possibilities that interdisciplinary projects in science and social studies have for developing world citizenship. Using the example of a joint project designed around monoculturing, the authors argue that students can develop the analytic skills, reflective qualities, and global awareness necessary to become hopeful and active citizens in the Twenty-first Century.

Rikkyo University – Centre for ESD Research
http://univ.rikkyo.ac.jp/research/laboratory/ESD/eng/index.html
The ESDRC conducts inter-disciplinary research on ESD within the humanities and social sciences. The Centre is developing a network of ESD research in the Asia-Pacific. You will find lots of good data and research on what is happening in ASEAN as well as the rest of the Asia-Pacific countries in ESD.

Global Footprint Network
Sustainability Asia / AtKisson Group 2009
Integrating Environmental Protection into Science and Social Studies Curriculum

http://www.footprintnetwork.org/index
Global Footprint Network serves as the steward of the National Footprint Accounts, the calculation system that measures the ecological resource use and resource capacity of nations over time. Based on approximately 4,000 data points per country per year, the Accounts calculate the Footprints of 152 countries from 1961 to the present. These accounts provide the core data that is needed for all Footprint analyses worldwide.

Sustainable Development on Campus: Tools for Campus Decision Makers
http://iisd1.iisd.ca/educate/
This site includes learning modules, case studies, action plans, environmental policies, resources, forums, and contacts - all designed to help administration, students, or faculty implement sustainable development on campus - and also includes links to a "bookshelf" of key reports and guides covering university leadership, green campus administration, curriculum issues, and student actions.

Sustainability Education
http://www.urbanoptions.org/sustainedhandbook/TheApproach.htm
This site offers the "Multi-strand Approach," which gives teachers a way to customize current curricula to include sustainability concepts. This approach involves changing one's teaching structure from teaching discreet individual topics to choosing a theme and teaching all subjects from within this theme. "Mining a topic from all angles" is a standard style of teaching for K-5 enclosed classrooms, but can be adopted for all grade levels.

To customize current curricula, visitors to the site can link to a list of Sample Activities or consult the Criteria Evaluation to quickly interject varied concerns not included directly within the curriculum. The Criteria Evaluation provides basic guidelines to help teachers evaluate whether or not their curriculum embraces sustainability concepts. This tool is designed to simplify the complex process of incorporating sustainability content into the curricula by breaking down sustainability into its essential, but not inseparable, components.

Teaching and Learning for a Sustainable Future (A UNESCO site)
http://www.unesco.org/education/tlsf/
This is a multimedia, interactive professional development program with materials, exercises, and links that help educators deepen their understanding of education for sustainability and its importance in addressing the economic, social, and environmental issues of the world.

This site presents key educational issues that form the rationale for Education for a Sustainable Future (ESF), including:

• A basic understanding of sustainable development;
• Help in understanding the range of social, economic, and environmental issues facing the world today; the interrelationships among these different types of issues; and the ways that education is key to the empowerment of people working for a sustainable future;
• "Future studies," which explore different ideas and perspectives about the future and include exercises designed to examine personal views as well as writings by futurists, consider probably versus preferable future scenarios, and incorporate these ideas into the curriculum;
• Various strategies for the education community to reorient education toward the broader process of building a sustainable future.

The exercises help develop an appreciation of the range of ESF objectives regarding knowledge, values, and skills, as well as an understanding of the broad scope of actions needed to reorient education. Key themes include the evolving nature of interdependence, citizenship/stewardship, rights of future generations, diversity; quality of life, uncertainty; and sustainability.

Second Nature
http://www.secondnature.org
This site offers guidance and assistance to institutions of higher education in their efforts to make sustainability an integral part of the institution and expand sustainability into personal and community life. The site is designed for a range of audiences and includes resource guides for faculty, administration, and students. These resource guides foster an understanding of sustainability issues and provide examples of how others are working together across traditional boundaries in both campus and community. The site's Resource Center section, originally known as Starfish, provides an extensive database of syllabi for courses that address environmental themes. The Alliance
for Sustainability Through Higher Education is a multi-institution effort to foster awareness and initiatives related to education for sustainability.

- **The Faculty Guide** highlights faculty who are engaged in including the principles of sustainability in their teaching, learning, research, and practices. It also provides resources related to curriculum change and design, interdisciplinary course syllabi, innovative course projects, faculty development, and collaborative efforts for institutional change.

- **The Student Guide** is designed for college and university students who are actively promoting Education for Sustainability. It provides links to resources that can bolster efforts to initiate or continue effective and collaborative change for sustainability on campus, in the curriculum, in research, and in surrounding communities.

- **The Administrator Guide** provides tools and resources to help institutions reflect on their role in the future of the planet, learn more about incorporating sustainability into the institution's agenda, and link to other institutions and administrators who are implementing sustainability goals.
“Never doubt that a small group of thoughtful, committed citizens can change the world; Indeed, it’s the only thing that ever has.”

Margaret Mead