

School Footprinting Initiative

Teacher Manual

Version 1.0

April 2007

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University of Technology, Mauritius
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Mauritius Research Council



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Preface

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Through this manual, we plan to give an outline for the implementation of the School Footprinting Initiative (SFI). Chapter 1 begins by introducing the SFI as a 14-week Project Based Learning program; expressing the driving problem statement and explaining the program rationale. The key information for getting started with the SFI is condensed into Chapter 2. This is followed in Chapters 3-7 by our guide to facilitating each of the program phases: 1) Organising Team & Project, 2) Designing Investigation, 3) Carrying out Investigation, 4) Reporting & Reducing and 5) Reflecting & Presenting. Chapter 8 provides a set of examples to help clarify the activities explained in the earlier chapters. The manual closes in Chapters 9 and 10 with extra information about two concepts central to the project: Ecological Footprinting and Project-Based Learning.

The manual should be read by the facilitating teacher in conjunction with the training session delivered by the SFI team, and should be kept as a reference source throughout the process of running the program. Experience has shown that this process can be rewarding and challenging in equal measure and the teacher and pupils are encouraged, building on this manual, to develop innovative ways to achieve the key aims of the SFI, suited to their particular local context.



Foreword Foreword Foreword Foreword Foreword Foreword

The School Footprinting Initiative (SFI) is an Environmental Education (EE) program that has been jointly developed by the University of Technology, Mauritius, Mauritius Institute of Education (MIE), Mauritius Research Council. It involves an active teaching and learning method called Project Based Learning (PBL) to link different components of the curriculum, and bring a holistic approach to EE.

The collaboration of the Ministry of Education and Human Resources (MOEHR) has been an important factor. MOEHR has played a vital role in the promotion of education from Pre-Primary to Tertiary levels and has recently taken quality initiatives to meet World Class Quality Education in Mauritius. Together with other ministries such as the Ministry of Environment and National Development, MOEHR recognises the need for everyone to be aware of the various dimensions of the environment, environmental problems and to be conscious of the duty to protect and preserve the environment so as to provide a better quality of life for present and future generations. Therefore, considerable effort has been made to promote EE at all levels through formal, non-formal and informal education, often in collaboration with stakeholders to bring about meaningful environmental learning among students [31].

The program has been developed on teaching and learning methods research findings from MIE, a major stakeholder of the MOEHR [30-32], as well as input from sources at Massachusetts Institute of Technology (MIT). In particular, the MIT Terrascope Program is acknowledged as a source of ideas and guidance for the PBL methods employed [2-5], and also the Buck Institute for Education, whose implementation tools have been developed for use in the program [6-7].

Finally this program builds on a pilot project in the Hindu Girls College, Curepipe, undertaken in January 2007, which challenged students to collect data for use in conjunction with an Ecological Footprint calculator developed by the policy institute Redefining Progress [9].



About The School Footprinting Initiative

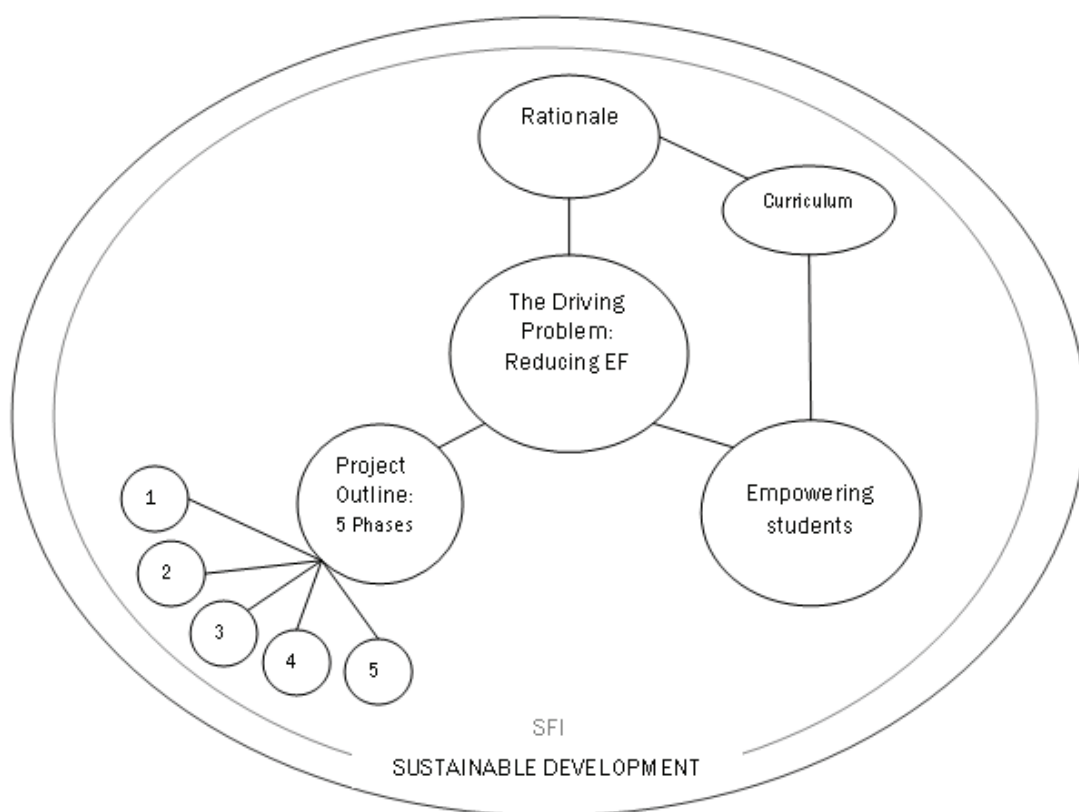


1. About the School Footprinting Initiative

Chapter Summary

In Chapter 1 the School Footprinting Initiative is introduced as a 5-phase team project-based learning program. The program is centred on a driving problem, which we express in full. Student empowerment is presented as a central program aim, positioning it in line with the 2006 Mauritius Curriculum Reform. An outline of the project Phases is given and the educational and wider rationale for undertaking the project is discussed.

Concept Map



The Driving Problem

The starting point of the School Footprinting Initiative (SFI) is the driving problem, addressed to students, of understanding and reducing the environmental impact of their own school community. This school community was chosen because, here, students can make a real difference within the timeframe of the program, underlining the message that many environmental issues are the result of simple, everyday consumption decisions. Students will be prepared to better understand and tackle broader environmental issues in Mauritius, such as the problem of soil erosion, linking with Environmental Education [30].

In line with Project-Based Learning methods, the problem statement is deliberately open-ended. The concept of sustainability is introduced, alongside the challenge of making their school community more sustainable, using the tool of Ecological Footprinting:

“You are one out of six and a half billion people living and using our planet. As a Mauritian, you personally take up an average of 1.9 hectares of fertile land just to sustain all the activities which make up your lifestyle: eating food, using transport, consuming products like clothes, electrical goods, cosmetics, using services like banking, insurance, and telecommunications and renovating and maintaining your home. The trouble is that with increasing global population and rising personal consumption, there isn't enough land left on the planet to soak up our waste and provide us with resources we use. We have developed a phrase to describe this situation: we are unsustainable. This means that if we continue the way that we are living nowadays we may prevent future generations from prospering.

The change towards a sustainable future will involve changes to our lifestyle; to do this effectively we need to find out which activities have the biggest impact, or Ecological Footprint, and then work out ways to reduce this impact. The School Footprinting Initiative is for students who want to do this in their school.

To get you started, the Footprinting for the Future team has helped out a bit:

- You will be part of a team; you can come up with more creative ideas, make better decisions and cover a lot more ground
- We have some money for you to spend on your ideas; once you are ready to spend it wisely!
- We have split up the School Footprinting Initiative into five phases;
 - Organizing your team
 - Designing an investigation
 - Carrying out the investigation
 - Reducing and reporting
 - Reflecting and Presenting

...but ultimately it's down to you to make a difference to your school.”

Rationale

To promote active learning through team work and to increase awareness on ecological issues relevant to Mauritius. This rationale fall in step with the following:

Government and International Initiatives

The SFI's driving problem statement connects students directly with the broad and global concern of achieving sustainable development. The importance of doing this is emphasised in the Mauritius Strategy for both SIDS and Agenda 21 (Rio Declaration) [10]. Furthermore, UNESCO has declared the period 2005-2014 as the decade of Education for Sustainable Development [11]. In response, the Ministry of Environment & National Development Unit and Ministry of Education & Human Resources are making considerable efforts to promote Environmental Education at all levels through formal, non-formal and informal education. The SFI is therefore timely and falls squarely within this call for education to play a pivotal role in achieving sustainability.

National Curriculum Reform

The 2006 National Curriculum Reform, 'Towards a Quality Curriculum' [1] envisions empowering the young people of Mauritius to become rationally autonomous individuals. The SFI shares this vision, and offers a practical and measurable way to meet the expressed goals of promoting individual development, fostering an understanding of the world and developing creative thinking skills.

Science Curriculum

The SFI will challenge students to understand the science which links human consumption of resources and generation of waste to the environmental impact of these activities. Key concepts include an understanding of planetary cycles such as carbon and water and the principles of mass conservation and energy conservation. Much of the students' learning in this area is expected to be self-directed, but the process will be an introduction pack that covers the key pedagogical material.

Aims: Student Empowerment

Developed in line with the 2006 National Curriculum Reform, 'Towards a Quality Curriculum' [1], the central aim of the School Footprinting Initiative is to produce a transformed, empowered student. The profile of this student is one who is committed to environmental values and has confidence in his or her ability to make a positive change in the world. Specifically, the objectives of the School Footprinting Initiative are:

- To develop an environmental mindset amongst participating students that spills over into the wider community and is sustained through time.
- To develop the team-working, problem-solving and communication skills important to participate in the world of work
- To stimulate self-directed learning as an effective and enjoyable way to acquire the right knowledge to succeed.
- To deliver achievable projects for implementation that have a positive environmental impact

Outline of Project Phases

The SFI is divided into five phases, as indicated by Figure 1. The first phase is to engage in creative decision making, achieved through group brainstorming. The student group will make a choice about which Ecological Impact Groups, such as food or transport, they most want to cover. Sub-teams then list what quantities they could measure in order to assess the total Ecological Footprint (EF) of the Ecological Impact Group they have formed around.

In phase two, the students will design their method of investigation: how they plan to measure the size of their sub-team's EF. This is reviewed before they go on to carry out the investigation during phase three and ultimately produce an estimate of the school's EF.

In phase four, students will begin to think of ways to reduce the school EF and how to deliver their message to the school and wider community. Each school will be competing for implementation grants to enable its students to carry out these proposals. Finally the students will reflect on what they have achieved and the lessons they have learnt, preparing a presentation which will be delivered to a judging panel at the end of phase five.

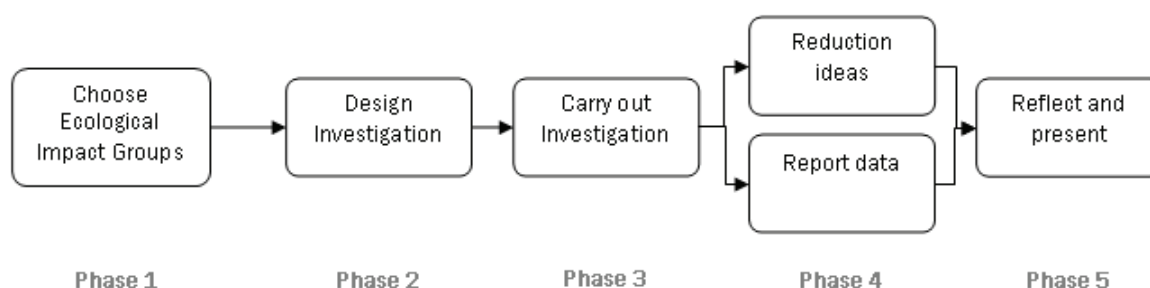


Figure 1: Simplified SFI Program Flowchart

Getting Started With The School Footprinting Initiative

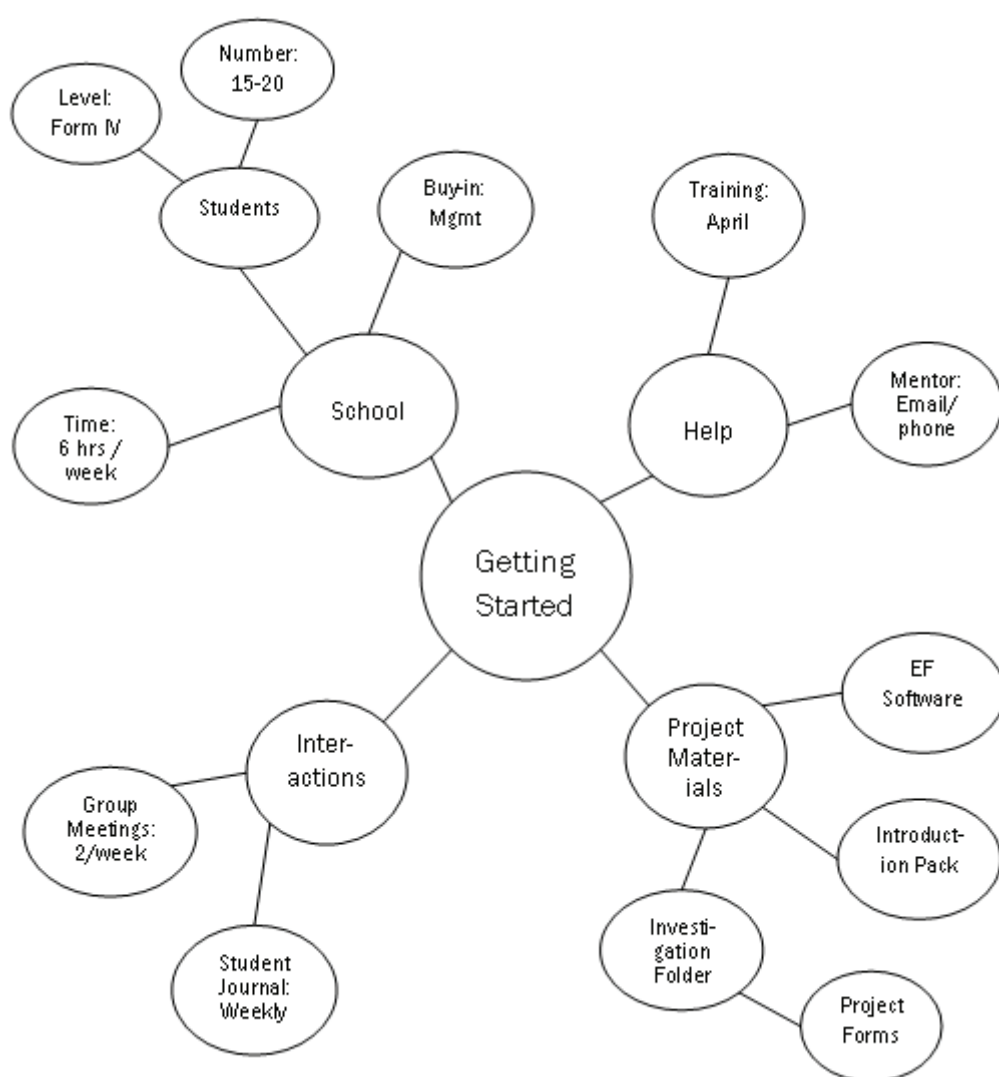


2. Getting started with the School Footprinting Initiative

Chapter Summary

Chapter 2 explains the key information needed to get started with the School Footprinting Initiative. This begins by explaining the level of time commitment that students should devote to the project and buy-in required from the school management. We show how you will be trained and how to get continued help from us. The key ways in which you will communicate with the students, through meetings and the Student Learning Journal, are discussed. Finally the starting project materials for students are described.

Concept Map



Time Commitment

The SFI extends for fourteen weeks. Workload may vary between different weeks and groups, but as a guide we **estimate** the following amounts of time will be spent on the project:

- Contact time - 2 hours per week
- Student working time - 4 hours per week
- Teacher preparation time - 1 hour per week
- Mentoring time on demand

For teachers, the time commitment will be divided between reading and responding to student learning journals, and preparing for group meetings. Meanwhile, the student working time refers to time spent independently carry out project activities in spare time available at or outside of the school.

Background of Students

The program is designed to be carried out by a range of Form IV level students from various disciplines. Form IV was considered the optimum level, the result of a trade-off between students possessing sufficient maturity and having sufficient spare time to complete the project. Cross-disciplinary enrollment reflects the SFI's philosophy of developing life skills applicable to everyone.

The process of forming this group of students is left to the discretion of the teacher, but we comment that students who have volunteered to take part will naturally take more ownership of the project. An ice breaking exercise is suggested for when the students are first brought together as to ensure full participation.

Number of Students

The student group should ideally comprise up to sixteen students. This group is then split into sub-teams of between 4-6 members. The number of students in each sub-team is a key factor affecting the development of team-related skills we objectivised earlier.

A total of four sub-teams should be aimed for so that the range of investigation does not become too narrow. The manual assumes that four sub-teams have been chosen, but could be readily adapted if otherwise.

School Buy-In

Another important factor affecting program success is the level of support and commitment given to it by the school management. Outlined are a few of the areas where this will be particularly important:

- Arranging for a room to meet in, access to IT facilities, printing and internet
- Arranging access to certain data such as energy consumption information, expenditure on consumables/durables like furniture or textbooks
- Arranging for extra-curricular meetings, launch visit, possible workshops etc.



Teacher Training – April 2007

The SFI team will provide training to teachers from each participating school. 2 training sessions are planned to build the teacher's understanding of and confidence with the project facilitator role and ecological footprinting:

- Session 1: Project Based Learning (PBL) methods

The first session will simulate the early stages of PBL, with the trainer taking the role of the project facilitator, and teachers playing the role of students who are undertaking a project. The trainer poses a real world problem and the teachers will go through an ideas generation brainstorm, then select their best ideas and set preliminary group milestones. The session concludes with an evaluation and discussion of the methods.

- Session 2: Ecological Footprinting Workshop

The final session aims to convey the key facts and background knowledge about Ecological Footprinting and then give teachers practical experience of conducting an EF Investigation, following the methods set out in Phases II & III.

Supporting Mentors

Support for teachers will be made available by the SFI team, through a mentoring system. A mentor will be assigned to each teacher, with whom issues and problems can be raised by email or telephone. Further to this, at least one mentor visit to the school will be arranged, to monitor progress and give and receive feedback.



Group Meetings

Meetings between the student group and the teacher are a cornerstone of the SFI program, vital to making key project decisions and managing group resources to ensure timely project completion. By altering the seating arrangement to allow a 'round-table' discussion, and bringing together students from different classes, the atmosphere of these meetings should foster student empowerment. Sometimes the group will split into sub-teams, to have more directed discussions, but students should never be working individually during meeting time.

We recommend meeting twice a week during Phase I, thereafter the regularity of meetings might be reduced to avoid 'meeting fatigue'. The use of an 'advance organise' is another suggestion for improving the effectiveness of meetings. An advanced organise is simply a prominent visual display of the meeting agenda, for instance, on the blackboard or a large sheet of paper.



Student Learning Journal [5,6]

Students will complete a [Student Learning Journal](#) throughout the program, designed to capture student's learning points and bring up problems and concerns. It will be a pre-printed booklet with directed headings to give students the chance for reflection. The journal should be a confidential, personal communication between the teacher and student, although the SFI team members may also have access to the students' journal in order to better support the teachers in their role.

We recommend that students fill in their journal every week. In this way, the teacher can quickly respond to problems and students can make the transition to being self-aware learners.



Introduction Pack

The SFI team will provide an [Introduction Pack](#) to each student undertaking the project. This will begin with the exposition of the SFI problem statement and go on to give a very brief outline of each project phase, including a timeline of key events. The remainder of the pack is taken up with explaining pedagogical material related to environment and science concepts and Ecological Footprinting. Each student attending the SFI program launch will be provided with a copy of the Introduction Pack.

Sub-Team Investigation Folder

Each sub-team will receive an [Investigation Folder](#) containing guidelines and forms needed to work through SFI program. The folders should also be used to archive notes taken during the investigation.

Ecological Footprint (EF) Software

[EF Software](#) will be supplied to each school, enabling students to estimate the school's EF. The software uses conversion factors to convert measured/collected data into the corresponding share of EF (in hectares). (See Chapter 9 for a definition of Ecological Footprint, and further background material)



Phase I: Organising Team and Project

2 Weeks

3. Phase I: Organising Team and Project

Chapter Summary

In chapter 3 the first phase of the School Footprinting Initiative, Organising Team and Project, is described. This phase is shown to be important to the project's later success: you will be bringing together a group of students from a variety of backgrounds and experience and the teacher's role is to facilitate the transformation of this group into a self-directed team capable of addressing a complex, real-world problem.

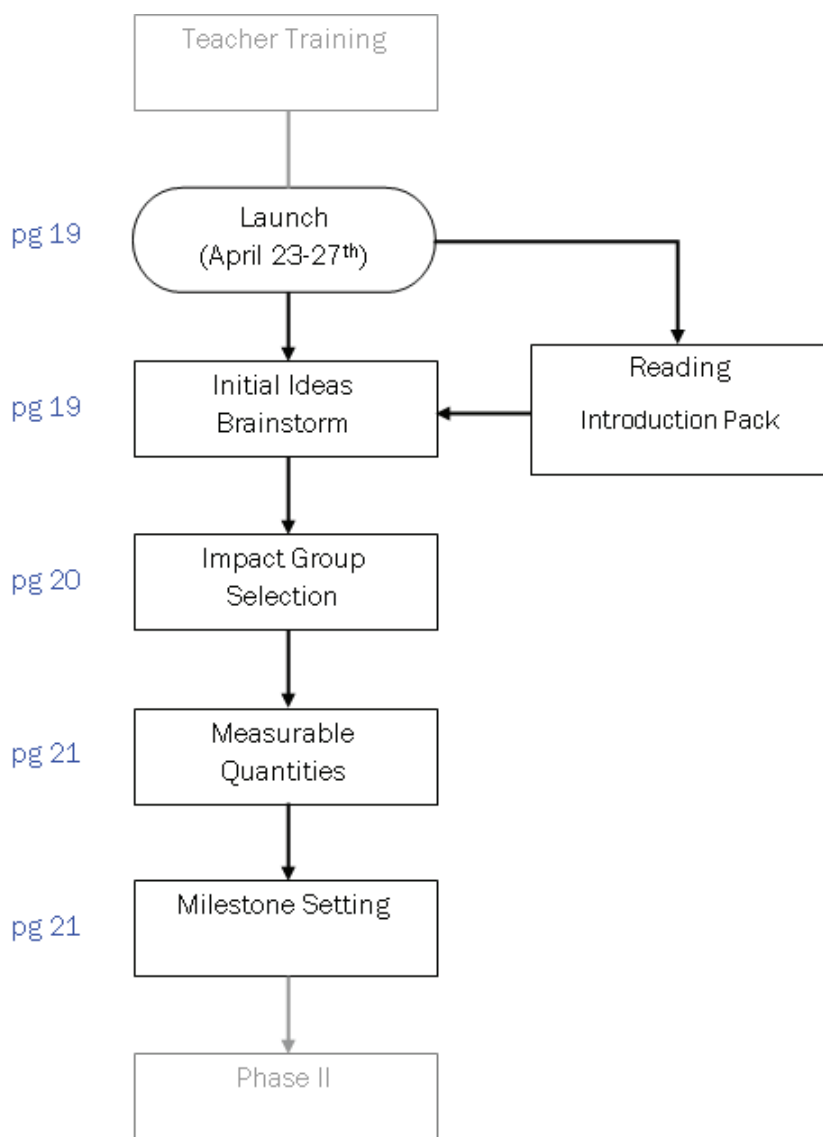
Before starting this phase you will have:

- Read the teacher manual
- Attended teacher training
- Chosen which students will participate

Objectives of Phase I:

- To select Ecological Impact Groups for investigation
- To organise sub-teams into Ecological Impact Groups
- To construct a set of project milestones

Phase I Flowchart:



Student Launch – April/May2007

The School Footprinting Initiative (SFI) will provide a powerpoint presentation to the teacher, with which he/she may launch the project to the group of students. The presentation will explain and motivate the project to the students, beginning with an exposition of the problem statement, and may be delivered either by the teacher or the supporting mentor. Contact will be made on an individual basis to arrange this.

The teacher should arrange for at least twenty students to attend the launch, to allow for loss of interest amongst some students. The Footprinting for the Future team will make contact with each teacher individually to arrange a separate one hour time slot to attend the launch.

Initial Ideas Brainstorm [5]

The first meeting should use brainstorming to bring out ideas for what the students could investigate, an effective way to establish student ownership of the project. Specifically, the brainstorm will pose the question: what activities and modes of consumption, taking place in connection with school, have an environmental impact that we could investigate? The importance of answering this fully will be a strong motivation tool; if students miss an idea, it will be missed forever. See Figure 2 for the striking volume of ideas which can be created by group brainstorming:

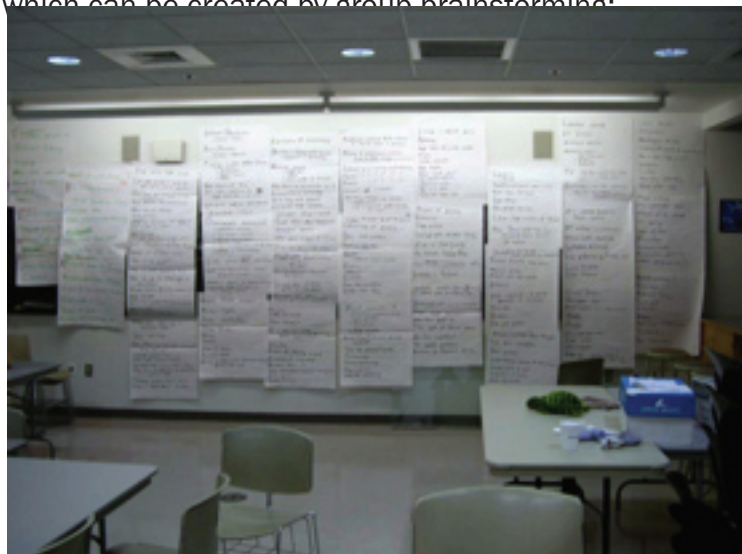


Figure 2: MIT Terrascope Program - after a creative brainstorm[26]

Further advice:

- Time to be spent: 30-40 minutes, with 5 minute break just over half way
- The teacher should write on flip chart paper stuck to the classroom walls
- Anything goes; all of the students ideas should be written down without hesitation
- Aim to create a high energy atmosphere in which group members contribute
- The teacher may suggest exaggerated or silly ideas, to inspire further thought or break the ice
- Omissions are as interesting as what is included, don't aim for perfection

Based on the sticker vote and ensuing discussion, the group will choose the four EIGs which the soon-to-be-formed sub-teams will go on to separately investigate. We suggest that each student privately indicates his/her first and second choice of EIG to the teacher at the end of the meeting. In the interval between meetings the teacher should assign students sub-teams, also taking into account the equality of numbers and skills.

Measurable Quantities

In the third meeting the newly formed sub-teams will begin discussing their EIG in detail. The sub-teams will aim to produce a list of measurable quantities for investigation during Phases II & III. In addition, each sub-team should nominate a leader, discussing both his/her and other team member's responsibilities.

D

A Measurable Quantity (MQ) is sub-set of an Ecological Impact Group (EIG) which can be quantified through an investigation. Sub-teams will sometimes need to make critical decisions about how to aggregate consumption into MQs. For example, a 'Food and Drink' EIG would have an almost limitless list of possible items, and aggregate MQs such as 'Fruit Juices' or 'Bread Products' would have to be used. This process of is facilitated by a form, [List of Measurable Quantities](#). The final number of MQs will vary between EIGs but the list of MQs should be kept focused and short.

Halfway into the meeting each sub-team leader should present their draft list to the rest of the group, and areas of possible overlap between EIGs should be identified for later discussion between the relevant sub-teams. Changes to the list could be made in response to feedback given by the group or teacher, but when finalised it should be sent to the SFI team. Each school's EF Software will be customised at University of Technology, Mauritius to match the list which the students have chosen.

Milestone Setting

The final meeting of Phase I sub-teams is for planning and setting milestones. The task of designing an investigation should be broken down into separate project activities. Completion of each activity marks a milestone for the team, and each should be recorded on the [Milestone Setting form](#) [6].

Towards the end of the meeting, the sub-team leader should communicate these milestones to the whole group for critical review. We suggest that a student-nominated secretary keeps a copy of each sub-team's milestones for review in later meetings.

Phase II: Designing Investigation

3 Weeks

4. Phase II: Designing Investigation

Chapter Summary

Chapter 4 describes the second phase of the project; Designing Investigation. Unlike in Phase I, where a step-by-step explanation of all group activities was given, we describe the program schedule more generally, reflecting the open-ended nature of the School Footprinting Initiative.

This phase involves sub-teams working independently to complete their investigation design, reporting on their progress against milestones during group meetings. The design process will be recorded on an Investigation Design Form, and the phase ends with a Technical Review.

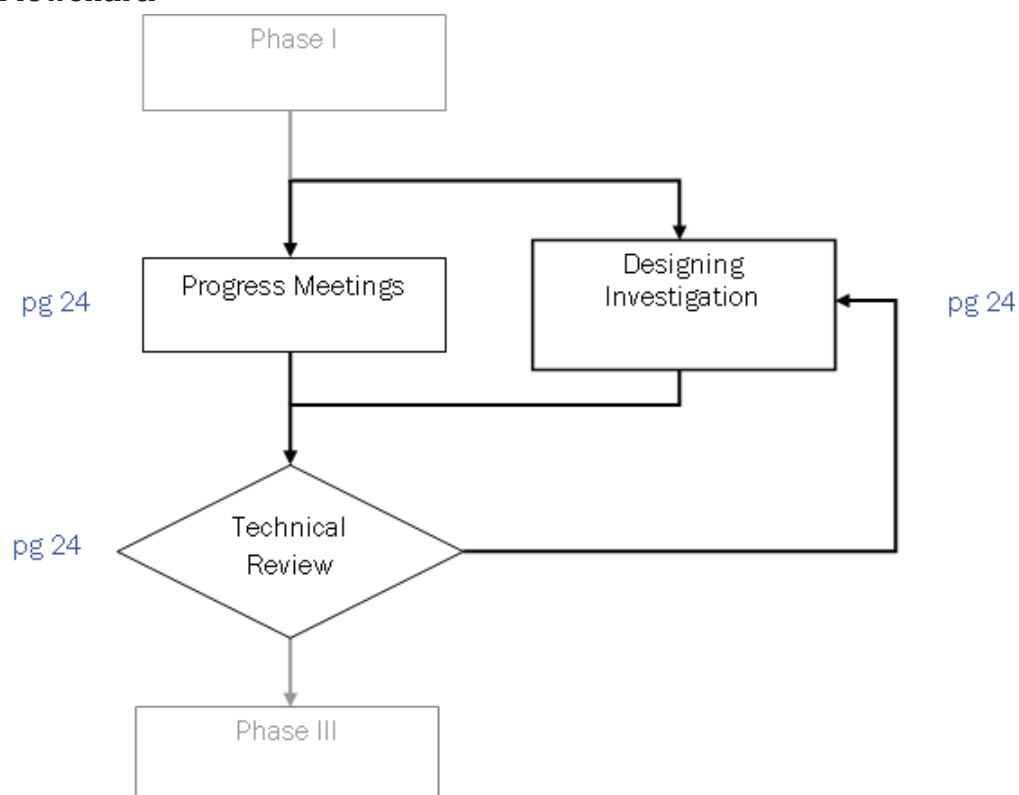
Before this phase the group will have:

- Chosen Ecological Impact Groups and Measurable Quantities
- Split into sub-teams

Objectives of Phase II:

- To complete an Investigation Design Form for each Measurable Quantity.
- To defend the design in a Technical Review

Phase II Flowchart:



Designing Investigation

Each sub-team will work independently to design their investigation. The aim is to determine a method of estimating the value of each Measurable Quantity (MQ) and hence determine the total EF of their Ecological Impact Group (EIG). Many assumptions will need to be made, and this is a creative and challenging part of the project process for teachers and students alike. Successful sub-teams will demonstrate teamwork, critical thinking and self-directed learning.

In order to structure the design process, the sub-teams will complete an [Investigation Design Form](#) for each MQ. Key categories included on the form are:

- **Define boundaries:** Students must fully understand and express the boundaries of the Measurable Quantities.
- **Potential overlaps:** They should note down potential overlaps with other quantities.
- **Units of measure:** They must decide what units of measure they will use. In most cases they should use a yearly timebase e.g. kg / year or Rs / year.
- **Key sources:** The students should write down the different sources of consumption
- **Data collection method:** They should explain how they will collect information.
- **Formulae used:** Where appropriate the students will write down formulae they will use
- **Data omissions and sources of error:** These should be qualitatively discussed.
- **Questionnaire:** If they plan to conduct a questionnaire they should write out the questions they will pose

For potentially sensitive data such as expenditure on energy, furniture, and school equipment, we suggest that the teacher takes the Lists of Measurable Quantities to the school administration and establishes points of contact for students.

Progress Meetings

Group Progress Meetings will continue through Phase II. We suggest, but do not impose, the following format:

- Sub-team discussion/preparation (20 minutes)
- Whole group meeting (20 minutes)
 - Sub-team reports on progress against milestones
 - Sub-team raises issues / problems
 - Hand in Student Learning Journals

Technical Review – June 2007

Each sub-team will defend their investigation design in a Technical Review at the end of Phase II. During the technical review, the sub-team will sit down with the teacher and a member of the Footprinting for the Future team for 20 minutes to review their Investigation Design Forms. The aim of the review is to assess whether the students are ready to move on to Phase III, and in some cases we may suggest that teams refine their forms, or correct errors. However, care should be taken that students do not come to rely on adults to correct their work for them [5].

Phase III: Carrying out Investigation

3 Weeks

5. Phase III: Carrying Out Investigation

Chapter Summary

In Phase III of the SFI, students will carry out the investigation they have just designed. Chapter 5 discusses how this might be achieved. In addition, the training into use of EF Software is described. The phase ends with a group data entry session.

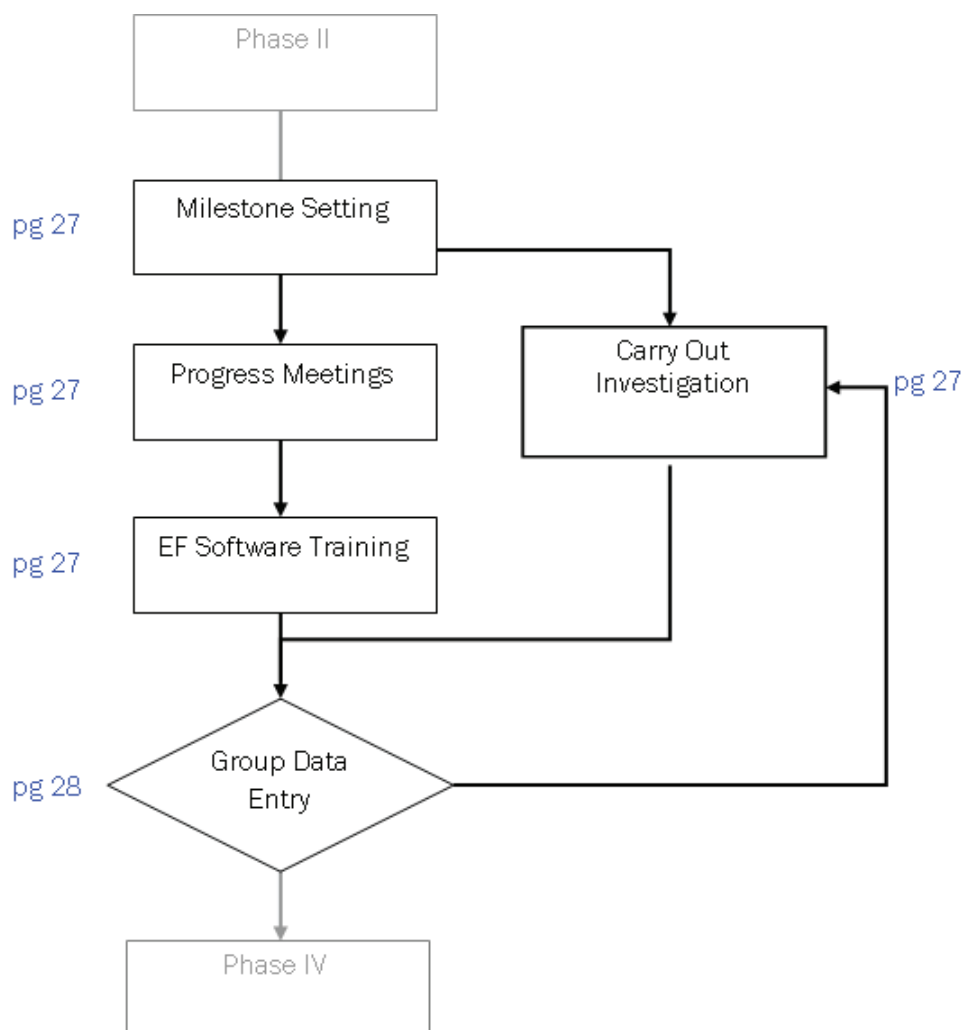
Before this Phase the group will have:

- Completed an investigation design form for each Measurable Quantity

Objectives of Phase III:

- To carry out the investigation, collecting data for each Measurable Quantity
- To input all the collected data into the EF Software, forming the school's Ecological Footprint Investigation
- To discuss and have an understanding of the school's Ecological Footprint

Phase III Flowchart:



Sub-Team Milestone Setting

During the first meeting of Phase III the sub-teams should plan the implementation of their Investigation Designs. The implementation should be broken down into separate activities which are then recorded on the Milestone Setting form. Towards the end of the meeting, the sub-team leader will communicate these milestones to the whole group for critical review.

Carry Out Investigation

Each student sub-team will now independently carry out their investigation, in order to determine the value of each Measurable Quantity (MQ) in their Ecological Impact Group (EIG). No matter how carefully planned the investigations are, the sub-teams should not be surprised to face challenges during this. Successful sub-teams will be able to respond to these challenges in a self-directed manner. Unless directly sought for by the students, teacher input in the process will only be made through progress meetings and responding to Student Learning Journals.

Local context and previous group decisions determine how the investigation will be carried out, but we mention:

- The time taken to process the collected information is easily underestimated; processing often takes longer than actually collecting the data.
- To gain access to existing school records of data, students should be responsible for liaising with the point of contact established earlier; avoid handing it to them piecemeal.
- Each sub-group should keep records of their results, investigations and calculations in their Sub-Team Investigation Folder.

Progress Meetings

Group Progress Meetings will continue through Phase III. Again, we suggest the following format:

- Sub-team discussion/preparation (20 minutes)
- Whole group meeting (20 minutes)
 - Sub-team reports on progress against milestones
 - Sub-team raises issues / problems
 - Hand in Student Learning Journals

Ecological Footprint (EF) Software Training

Towards the end of Phase III, a member of the SFI team will hold a training session into the use of the EF Software for the student group and teacher. The session will focus on the process of feeding each sub-team's MQ figures into the Microsoft Excel based software program, and then how to view and interpret the charts and data tables which are outputted.

Group Data Entry

The group data entry session is contingent on each sub-team completing its investigation. The session gives students a fixed milestone to aim for, and brings a sense of closure to the phase.

The group should gather around a computer operated by a single group member. Data collected for every MQ is entered into the EF Software, which converts these figures into Ecological Footprint (EF). See Figure 4 below for an example of the type of graph produced for the 'Food' EIG.

A discussion interpreting the results should be initiated by the teacher. The discussion will be a useful and important way of gauging how much students are learning about Ecological Footprint. Some pertinent questions to ask are:

- Which EIG has the largest EF, and why?
- Which MQ has the largest EF, and why?
- For a given MQ, how do explain the different types of land usage?
- How accurate do you think your results are?
- How accurate do you think the conversion process is?

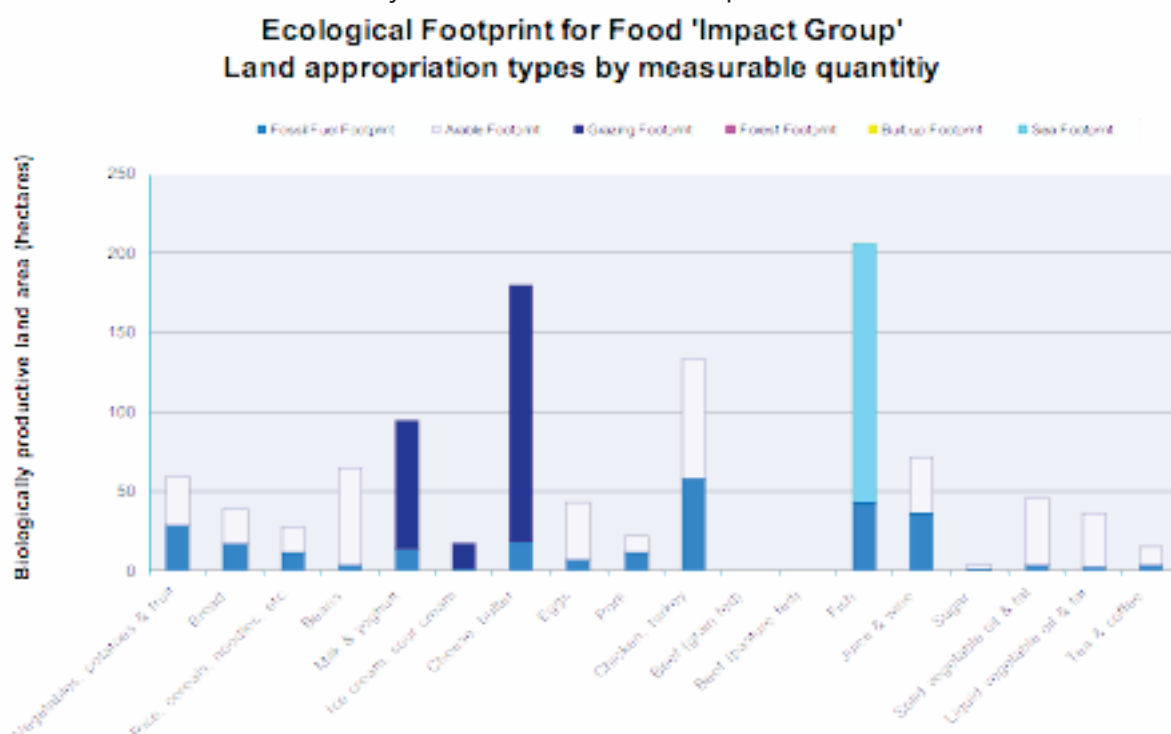


Figure 4: Example EF Chart for 'Food' Ecological Impact Group (Categories from Wackernagle et. al) [9]

Phase IV: Reporting and Reducing

4 Weeks

6. Phase IV: Reporting and Reducing

Chapter Summary

Chapter 6 describes Phase IV of the program, justifiably the longest of the School Footprinting Initiative. There is a change in program emphasis away from collecting and analysing data and towards making use of this information to drive a positive change. A second group brainstorm is used to generate fresh ideas and four weeks are given for the sub-teams to research these ideas and draw together a written proposal for consideration by the implementation grants judging committee.

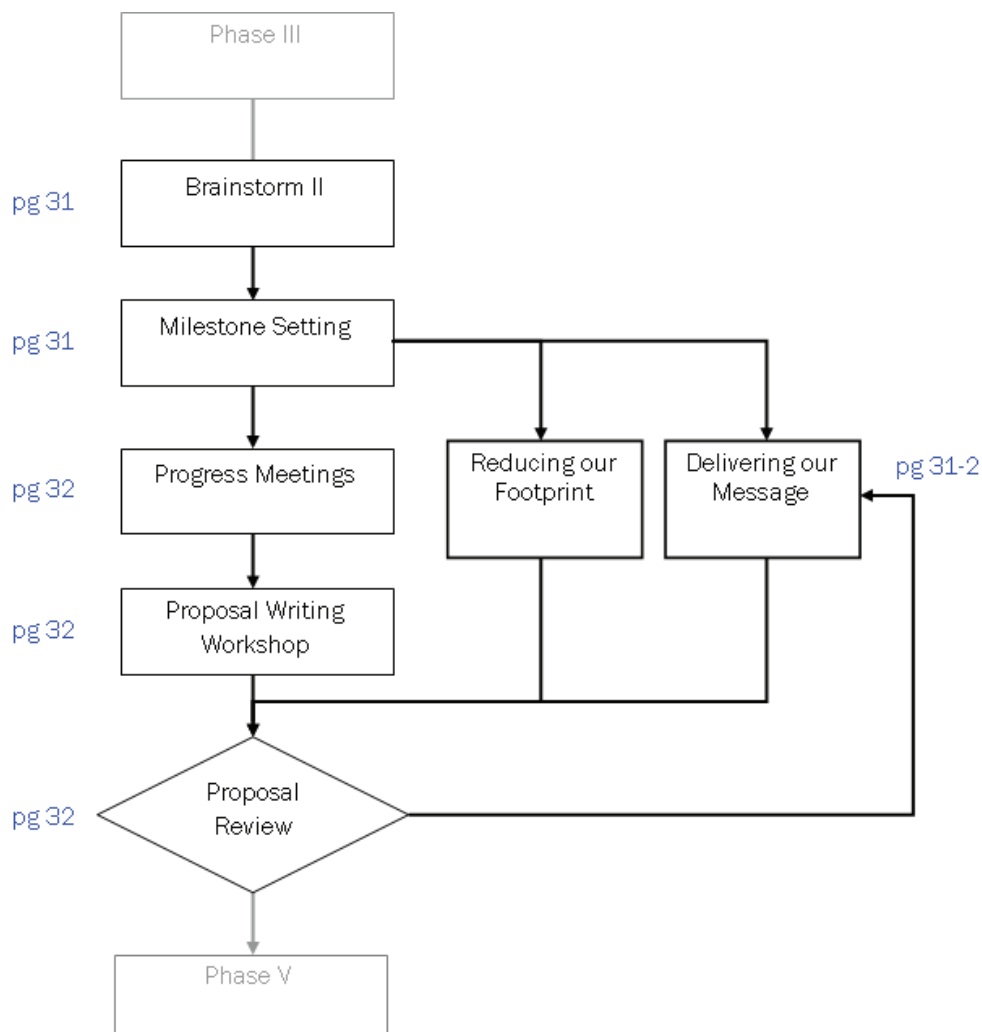
Before this Phase the group will have:

- Completed an Ecological Footprint (EF) Investigation of the School

Objective of Phase IV:

- To creatively select ideas to reduce and report the school's EF
- To develop written communication skills by attending a proposal writing workshop
- To research and produce a proposal for how to reduce the school's EF
- To research and produce a plan for reporting the key Messages from the EF Investigation

Phase IV Flowchart:



Brainstorm II

The teacher should begin Phase IV of the School Footprinting Initiative by facilitating a second group brainstorm. The format for this brainstorm should be guided by experience gained during the Initial Ideas Brainstorm. Ideas are being sought for:

a) Ways to reduce the school's Ecological Footprint

Examples of ideas: Use of energy efficient lights, design of lighting control system, transition to vegetarian food, automatic shut down of equipment such as computers, changing bus routes, awareness campaign, recycling of paper, composting of waste.

b) Ways to deliver the key messages from the EF Investigation to the school and wider community

What are the key messages?

Examples of presentation methods: Big 'event', Talk in school assembly, Set up museum-type exhibit, A lunchtime workshop, Large poster, Create a document.

Following the brainstorm and ideas selection process, the group should re-organise so that one sub-team works on message delivery and remaining sub-teams work on one reduction idea each.

Sub-Team Milestones

During the next meeting, sub-teams will begin to discuss their idea in detail. In keeping with Project-Based Learning methods, they should assess what they know now, and what they need to know in order to proceed. This will influence how they will research, investigate, arrange and ultimately write-up the idea generated in brainstorm II. Students will refer to the relevant set of guidelines to help structure this discussion. Milestones coming out of these discussions are recorded on the Milestone Setting form, and towards the end of the meeting, the sub-team leader will once again communicate these milestones to the whole group for critical review.

Reducing our Footprint

The product of this phase of the program is an Idea Proposal Document. In this, the sub-team's selected idea of how to reduce the school's ecological footprint will be recorded. The document will explain their idea, how it will be implemented, how much it will cost and the anticipated benefits. We supply a set of guidelines to help facilitate the whole process, [Idea Proposal Guidelines](#). The final report will be broken down into the following headings:

1) Idea Title, 2) Idea Summary, 3) Background, 4) Expected Impact, 5) Action Plan, 6) Budget, 7) Risk Assessment, 8) Verification Plan

Delivering our Message

For the sub-team working on the method of delivering the group's message, the final product of this phase is a Message Delivery Proposal. In this, they will write a plan for what activities they intend to carry out in order to deliver the key messages from the school's Ecological Footprint Investigation. Again, we supply a set of guidelines to help facilitate the process, Message Delivery Guidelines. The final document will contain information under the following headings:

a) Target audience, b) Summary of Message, c) Implementation plan, d) Budget, e) Risk Assessment, f) Evaluation plan

Progress Meetings

Group Progress Meetings should continue through Phase IV. Again, we suggest the following format:

- Sub-team discussion/preparation (20 minutes)
- Whole group meeting (20 minutes)
 - Sub-team reports on progress against milestones
 - Sub-team raises issues / problems
 - Hand in Student Learning Journals

Proposal Writing Workshop

During Phase IV, the SFI team will arrange for each school to attend a proposal writing workshop, held by the British Council. The aim of this workshop will be to develop the written communication skills the students will need in order to produce a clear and effective proposal.

Implementation Grants

Schools will be competing for Implementation Grants, given out to facilitate the execution of the best submitted proposals. These grants are offered both for the inherent value of implementing these ideas, and also to motivate full commitment to participation in the program; their team's actions can make a very real change in the world. At the time of writing, we intend to distribute the following Implementation Grants:

Gold implementation grant

Silver implementation grant

Bronze implementation grant

Idea implementation grant

Proposal Review – July 2007

The Proposal Review which concludes Phase IV should take place between 3-5 days before the final proposal submission deadline. By giving students this 'false' deadline, time will be available to refine and improve their proposal ahead of the 'real' submission deadline. We suggest that the teacher meets each sub-team individually for 30 minutes to conduct the review.

Phase V: Presenting and Reflecting

2 Weeks

7. Phase V: Presenting and Reflecting

Chapter Summary

Chapter 7 describes the closing phase of the School Footprinting Initiative. Here, the group is challenged to reflect on the project, and present their experience to others. This is an important part of the Project-Based Learning process, instrumental to consolidating the lessons learnt during the program. Final oral presentations are delivered to the judging panel ahead of the awards ceremony.

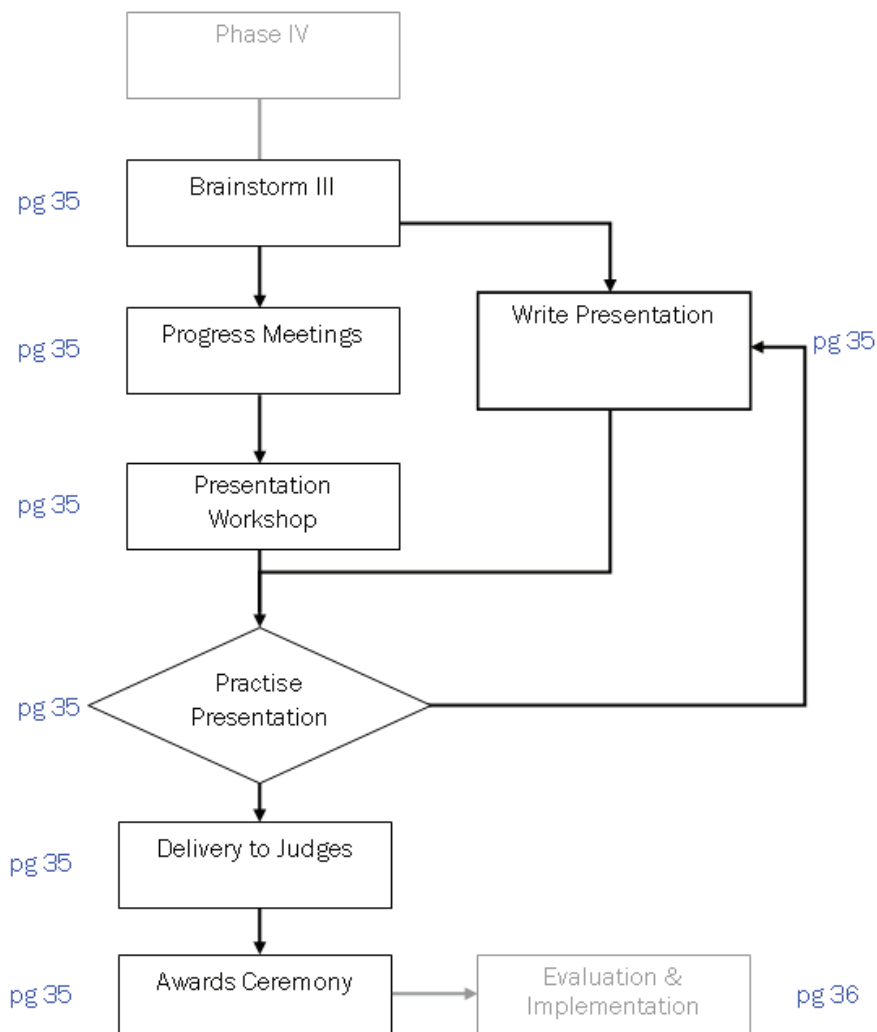
Before this phase the group will have:

- Completed an Ecological Footprint (EF) investigation of the School
- Submitted proposals for their ideas to reduce the EF of the School
- Submitted a proposal for how they intend to deliver their group's message

Phase V Objectives:

- To reflect, discuss and consolidate lessons learnt during the program
- To develop oral presentation skills by participating in a presentation workshop
- To deliver a final presentation to the School Footprinting Initiative judging panel
- To evaluate the program

Phase V Flowchart:



Brainstorm III

The teacher should begin Phase V of the School Footprinting Initiative by facilitating a third group brainstorm. Ideas should be sought for:

- a) What did we learn?
- b) What did we do well?
- c) What could we have improved?

Write Presentation

Following on from the group brainstorm, students will be challenged to write an oral presentation using PowerPoint or similar package. The presentation should reflect on what the group has learnt and what the group has achieved. Further advice, guidelines and suggestions will be given in the document Final Presentation Guidelines. Notably, a time limit of 10 minutes for the entire presentation will be imposed.

Oral Presentation Workshop

During this phase, the SFI team will arrange for each school to attend a presentation workshop, held by the British Council. The aim of this workshop will be to develop the communication and IT skills they will need to produce an effective presentation [8]

Practise Presentation

The presentation should be practised some 3-5 days before final delivery to the judging panel. Again this 'false' deadline allows time for the presentation to be refined and practised before it is finally delivered. The practise presentation should be delivered to the teacher, and the rest of the group; the short presentation length limiting the number of students who can actually present. A useful exercise is for the group to anticipate the judges later questions and practise giving clear answers to these.

Presentation Delivery to Judges – August 2007

Final presentation delivery will take place in University of Technology, Mauritius, attended by the teacher and presenting students. A panel of three to four judges will listen to the presentation and follow up by asking questions for 10-20 minutes.

Awards Ceremony – 7th August 2007

The School Footprinting Initiative will close with an awards ceremony, held at Mauritius Institute of Education. This will be an opportunity to reward students for their participation in the SFI, and in so doing, crystallise their experience. The student's parents and selected staff from schools around the country will be invited to attend the event.

A key note speaker will make a short speech, and distribute implementation grants. In addition to this, we may invite some of the schools to deliver a short presentation about their project. Further to the implementation grants, we will provisionally make the following awards:

- Prize for Best Ecological Footprint Investigation (school)
- Prize for Best Final Presentation (school)

- Reward for Successful Completion (every student)

Program Evaluation

The SFI team intends to complete a full program evaluation. The aim of such an evaluation is to determine the effectiveness of the program and guide the future direction of the SFI. The program outline presented in this manual demands a significant time commitment from both teachers and students; our sponsors and we want to discover whether this has been worthwhile.

The evaluation will be achieved by distributing a [Program Evaluation Questionnaire](#) to students, asking for numerical scoring of learning outcomes and inviting both focused and general written feedback, complemented by a focus group evaluation with teachers, exploring issues and recommendations in more depth.

Ideas Implementation

The implementation of ideas will be addressed in separate document, [Implementation Guidelines](#), covering:

- Distribution of grants
- Reporting requirements

Examples

Initial Ideas Brainstorm

Impact Groups & Measurable Quantities Form

Sub-Team Milestones Form (Phase I)

Investigation Design Form

Student Learning Journal

Abridged Results From EF Investigation

Sub-Team Milestones Form (Phase IV)

8. Examples

Chapter Summary

In Chapter 8, we follow a fictional implementation of the program through from the initial ideas brainstorm to preparing to write an EF reduction idea proposal, offering a snapshot of what is involved in the School Footprinting Initiative. The following set of documents is included:

- List of Measurable Quantities form
- Milestones Setting Form for Phase II: Designing Investigation
- Investigation Design Form (for one MQ)
- Student Learning Journal entry from Phase III: Carrying out Investigation
- Abridged results of an Ecological Footprint Investigation
- Milestones Setting Form for Phase IV: Reporting and Reducing

Please note that the design of these documents has been condensed in order to save space.

Initial Ideas Brainstorm

The group created a list of 137 ideas ranging from socks to school bus, via sandwiches and shuttlecocks.

Ecological Impact Groups

The following impact groups were selected by the group:

- Food and Drink
- Classroom Equipment
- Building Services
- Transportation

List of Measurable Quantities (MQ) Form

Below is an example List of Measurable Quantities selected by the 'classroom equipment' EIG. Observe that even at the MQ level, aggregation is still needed. For example, the Stationary MQ includes a range of sub-items. In some cases it was more relevant or practical to use Rupees as the unit of measure.

List of Measurable Quantities Form	
The following Ecological Impact Groups were chosen by the group:	
- Food and drink - Classroom Equipment - Building Services - Transportation	
Our Ecological Impact Group is:	
Classroom Equipment	
We decided to create the following list of Measurable Quantities:	
Description	Units
Books	kg / year
Paper	kg / year
Stationary (incl. pens, pencils, calculators, etc.)	Rs / year
Desks & Chairs	kg / year
Electrical Equipment	Rs / year

Sub-Team Milestones Form (for Phase II - Designing Investigation)

The example Sub-Team Milestones Form below shows how the students could split up

Sub-Team Milestones Form		
Milestone	Due Date	Completed?
Choose List of Measurable Quantities	9th May	Y
Define Boundaries, identify overlaps	16th May	
Conduct Research	16th May	
Short description of Data Collection	23rd May	
Write up full investigation design forms	30th May	
Technical Review	1st June	

Adapted from Buck Institute of Education [6]

Investigation Design Form

This example Investigation Design Form for a 'Books' MQ shows the complexity of designing and carrying out an EF investigation:

Investigation Design Form	
Ecological Impact Group:	Classroom Equipment
Measurable Quantity:	Books
Units of Measure	kg / year
Define Boundaries	
Books are defined as bound, printed paper objects, characterized by a relatively long life. Examples include textbooks for classes and library books but not exercise books. The books must be related to school activities.	
Potential Overlaps:	
Exercise books, brochures, handouts, forms all belong to the Paper Category . Personal home reading books are not included in the School Ecological Footprint.	
Key Sources:	

<ol style="list-style-type: none"> 1. Library books bought by the school 2. Textbooks bought by the school 3. Textbooks and other personal school-related books (e.g. Revision guides)
Data Collection:
<ol style="list-style-type: none"> 1. Library books: <ul style="list-style-type: none"> • Count number of books in library, NB • Collect random sample of 35 books • Weigh each book, MB1, MB2...MB35 (units = kg) • Note down age since purchase of book A1, A2...A35 (units = years) 2. Textbooks (school bought): <ul style="list-style-type: none"> • Consult school records for number of yearly text book purchases NT • Collect appropriate sample n of textbooks • Weigh each book MT1, MT2...MTn 3. Textbooks (personal bought): <ul style="list-style-type: none"> • Distribute questionnaire to a sample of pupils (find NPT – average number of personal textbooks per year) • Sampling strategy – same as all other questionnaires, see separate document
Formulae:
<p>Average Library Book weight (kg) $MBav = 1/35 * (MB1+MB2+...MB35)$</p> <p>Average Library Book age (years) $Aav = 1/35 * (A1+A2+...A35)$</p> <p>Library Book Consumption (kg / year) = $NB * MBav / Aav$</p> <p>Textbook consumption (kg / year) = $1 / n (MT1+MT2+...MTn) * (NT + NPT)$</p>
Questionnaire:
<p>On average how many books a year which you use for school-related activities do you or your parents purchase?</p> <p>Answer: _____ books / year</p>
Omissions and sources of error:
<p>Sampling Errors</p> <p>Personal-bought textbooks may be a different weight to school-bought textbooks</p>

Student Learning Journal (from Phase III - Carry out Investigation)

Below is an example journal entry for a student who is in charge of sending out a questionnaire on his/her sub-team's behalf. Here, the teacher would be moved to respond quickly to resolve the student's problem with photocopying. It will be encouraging to read the student's description of what he/she learnt.

Student Learning Journal	Wk 6
My goals were:	
To send out a questionnaire on behalf of our sub-team	
I accomplished:	
I prepared the questionnaire using MS Word	
My next steps are:	
To photocopy the questionnaire and send it out to the sample group	
My most important concerns are:	
The staff member in charge of photocopying would not let me use the machine, even though I explained I was doing a school project!	
I learned:	
I was going to write the questionnaire by hand but our team thought it would be better to use a word processor. I can see now that this was the right choice because it looks very professional.	

Adapted from Buck Institute of Education [6]

Abridged results from Ecological Footprint Investigation

The students' investigations will yield the data in the second column of the table below. Conversion factors for each MQ are worked out by the SFI team and used to calculate the EF of this consumption.

This process is used to calculate the EF of each EIG, again summing the contribution of all MQs. The total school EF here is estimated to be 700 hectares. For a 1000-person school this equates to 0.7 Ha / person, which seems sensible in comparison with the national average EF of 1.9 Ha / person, shared between home, school and public consumption.

Results for Ecological Impact Group: Classroom Equipment

Measurable Quantity	Estimated Value	Ecological Footprint (Hectares)
Books	2800 kg / year	16
Paper	5600 kg / year	32
Stationary (incl. pens, pencils, calculators, etc.)	1,100,000 Rs / year	16
Desks & Chairs	5400 kg / year	21
Electrical Equipment	1,200,000 Rs / year	16
Total		105

Combined Results for Whole group

Ecological Impact Group	Total Footprint (Hectares)
Food and drink	140
Classroom Equipment	105
Building Services	210
Transportation	140
Total	700

Reduction Ideas

The group selected the following ideas for reducing the school's ecological footprint:

- Automatic shut-down of equipment
- Installation of solar water heater
- Recycling of paper, glass and plastic

Sub-Team Milestones Form (Phase IV – Reporting and Reducing)

The example Sub-Team Milestones form below shows how students may begin to split up the task of researching and writing up a proposal for their EF reduction idea: to install a solar water heater.

Sub-Team Milestones Form		
Milestone	Due Date	Completed?
Further Data Collection; how much water do we use?	4th July	
Research list of possible	4th July	
Obtain quotations from suppliers	11th July	
Discuss idea with school management	11th July	
Write up idea	18th July	
Proposal Review	20th July	

Adapted from Buck Institute of Education [6]

More About Ecological Footprinting



9. More about Ecological Footprinting

Definition



The Ecological Footprint (EF) of an activity is defined as the total area of biologically productive land that activity appropriates through the direct and indirect consumption of resources and generation of wastes.

Six types of land area are identified by Wackernagel et. al :

“ (i) growing crops for food, animal feed, fibre, oil and rubber (ii) grazing animals for meat, hides, wool and milk (iii) harvesting timber for wood, fibre and fuel (iv) marine and freshwater fishing (v) accommodating infrastructure for housing, transportation, industrial production and hydro-electric power and (vi) burning fossil fuels.” [17]

Origins

Like all living plants and animals, humankind consumes resources from its environment and generates and deposits wastes which are absorbed by the environment [13]. The impact of these plant and animal activities are vital to the earth's ability to self-regulate. Current temperature levels and concentrations of atmospheric gases, which make the planet hospitable to life, were only reached and now maintained through the combined action of many billions of plants and animals [14]. For example, the level of atmospheric carbon dioxide, shown to play an important role in regulating average global temperature, is strongly influenced by the mobilization of carbon through photosynthesis and respiration [15]. But the increased action of mining, industrialized food production and burning of fossil fuels and biomass over the last two centuries has meant that humankind is playing a dominant role in affecting natural cycles and ecosystems. [16] The deleterious effects of excessive human consumption are seen in phenomena such as deforestation, desertification, pollution and climate change.

The Ecological Footprint was developed as a 'sustainability index' - an accounting tool which enables us to measure the impact of human activity on the earth. The term Ecological Footprint (EF) was coined by William Rees, University of British Columbia in 1992 and the method has since been developed principally by Mathis Wackernagel.

Applications

Investigations undertaken to estimate the EF of each nation in the world present an alarming picture of humankind's appropriation of biologically productive land [17, 18]. See Figure 5, from the WWF Living Planet Report, for the trend of global EF growth, expressed as the proportion of the total amount of biologically productive land available on the earth's surface, or biocapacity. Since the late 1980s, EF has exceeded biocapacity; as a result the planet's ecosystems are put under strain.

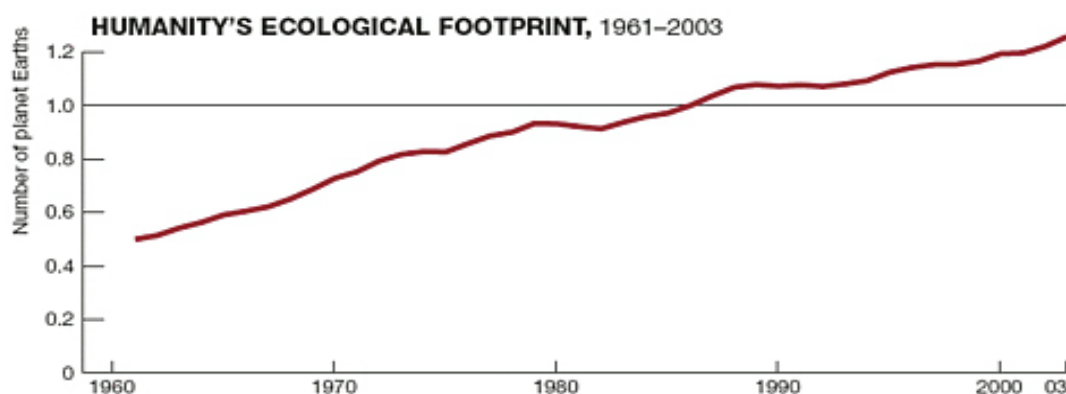


Figure 5: Ecological Footprint 1960-2003 (WWF Living Planet Report 2006) [18]

The report also breaks down the global Ecological Footprint of each nation, highlighting a clear relationship between EF and a country's income. Higher income countries are shown to have a higher EF (see Figure 6). At this point, there is an overriding call for developed and developing countries to halt the potentially catastrophic trend of per capita footprint growth and overall population growth.

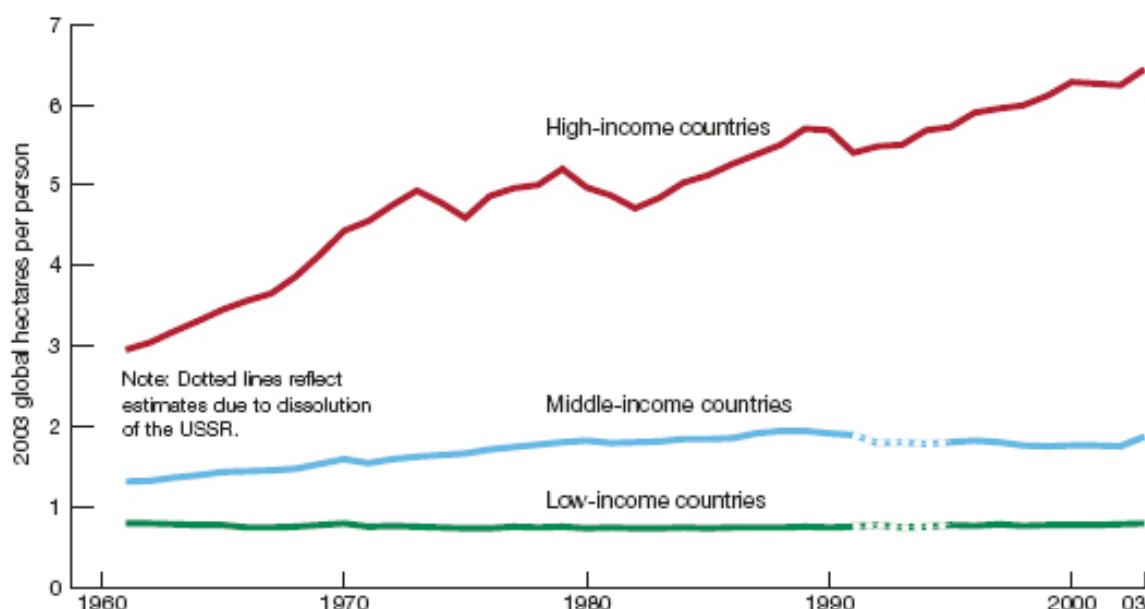


Figure 6: Ecological Footprint by Average Nation Wealth 1960-2003 (WWF LPR 2006) [18]

Ecological Footprinting, Mauritius & the SFI

Over the last two decades Mauritius' economic growth has been almost exponential. Undoubtedly this has led to increased standards of living, but it does come at the cost of increasing the nation's EF. In a business-as-usual scenario, further GDP growth will almost certainly be coupled to a growing EF (and yet the link to raised standards of living becomes increasingly unclear or complex) [27]. It is imperative that Mauritius challenges this business-as-usual scenario and aims to decouple EF from GDP growth. Ways of achieving this include a shift towards non-fossil fuel energy sources and more efficient consumption practices. The SFI program, to measure and reduce EF, may offer a model of achieving the latter which could ultimately be replicated in other communities (and countries).

More About Project-Based Learning



10. More about Project-Based Learning

Origins

Both Problem-Based Learning and Project Based Learning (PBL), the latter an offshoot of the former, can be broadly categorised as experiential learning methods. The concept of Experiential Learning as conceived by Dewey in 1930s involves learners seeking to make meaning out of reconstructing experiences [19]. Problem Based Learning itself can be traced back to its introduction in the 1960s at McMaster Medical School, Canada, as documented by Barrows and Tamblyn (1980) [20]. The topic has subsequently generated many research studies and articles; for an overview of the evolution of these ideas, we point the reader towards books such as Savin-Baden and Major (2004)[21]. One definition of PBL recently arrived at by the Buck Institute for Education is put forward for the reader's consideration:

“[PBL is] a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks” [6]

D

Benefits

Experts agree that the benefits of Problem-Based Learning are best observed first-hand, by watching what students can accomplish when they are challenged to answer a complex problem [28, 29]. Observers will see a creative, vocal environment where small groups openly discuss the problem and their solutions. Equally instructive is to view a student who has taken the initiative to fill in a gap in his/her knowledge by finding and reading the appropriate book, internet site or resource person, and can now make progress with the project. These are the twin benefits of PBL described in colour; the development of team-work related skills and self-directed learning.

Links with the School Footprinting Initiative

The School Footprinting Initiative begins with the posing to the students the authentic problem of reducing the school's ecological footprint. The open-ended nature of this problem will require (i) social interaction on the part of the students [22] (ii) the application of pre-existing knowledge and experience to a new situation [23], (iii) the self-directed acquisition of new knowledge [24] and (iv) critical thinking on the part of the students [25].

Throughout this manual we presented a structure of Project-Based Learning techniques to assist this process. In particular, we used Group Brainstorming, Milestone Setting, Progress Meetings, Review Sessions, a Student Learning Journal and independent reading.



List of Project Resources



11. List of Project Resources

In Table 2, below, we set out a complete list of resources which are referred throughout this manual, indicating the program phases in which the resource will be used:

Table 2: List of Project Resources

Resource	Phase
1) Introduction Pack	I
2) Student Learning Journal	I-V
3) Sub-Team Investigation Folder:	I
a. List of Measurable Quantities	I
b. Milestones Setting Form	I, III, IV
c. Investigation Design Form	II
d. Idea Proposal Guidelines	IV
e. Message Delivery Proposal Guidelines	IV
f. Final Presentation Guidelines	V
4) Ecological Footprint Software	III
5) Implementation Guidelines	V
6) Program Evaluation Questionnaire	V

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