

The Learning Resource: The TAKE-MAKE-WASTE Project

The Take-Make-Waste Project

a learning resource to accompany the thesis

“Science Content Through Sustainability Contexts: A Systems Thinking
Approach for Learning Resources in Secondary Level Education”

by

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DRAFT

This learning resource, created by me, Mona Marie Alice Beaulac Maxwell is in draft phase and is intended to be partial fulfillment of my Masters of Education Thesis. Comments, insights, suggestions are appreciated. Contact me at **mona2max@hotmail.com** or at the **Manitoba CRYSTAL website at <http://umanitoba.ca/outreach/crystal/resources.html>**

Every effort has been made to acknowledge original sources and to comply with copyright law. If cases are identified where this has not been done, please notify me. Errors or omissions will be corrected. Sincere thanks to the authors and publishers who allowed their original material to be adapted or reproduced.

When using this resource, refer to the page titled “Spirit and Intent”

Draft 1
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Committee Members

Dr. G. G. C. Robinson
Dr. Christina McDonald
Dr. Brian Lewthwaite



Canadian Arm of The International Natural Step



Manitoba Education, Citizenship and Youth



UNIVERSITY
OF MANITOBA

Manitoba Conservation Sustainable Development Innovation Fund

DEDICATION

To Dr. Gordon G. C. Robinson.

To all who supported me in the creation of the pages of this learning resource.
To those who open the doors of classrooms; invest the courage and time to lift
this learning resource off of the pages; and see potential in extending what has
been created here for seven generations to come.

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Electronic Resources (refer to flash memory drive)

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CRYSTAL-Maxwell-50-question instrument-
enlarged

Educator Feedback Template

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AudioVisual Resources

DVD copy of Ecology of Commerce: Captain W Productions (n.d.). Ecology of
Commerce. Schumacher College: Dartington Totnes Devon, UK: Captain W
Productions

Supporting Research Binder (available upon request)

SPIRIT AND INTENT

The purpose of this resource is NOT to indoctrinate the students with a view of sustainability that is “correct”. Rather, it is intended

- a. to cause the learner to examine their own understandings of how they relate to global sustainability issues on a personal level (called “mental models”)
- b. to facilitate a healthy interaction between the learner and global sustainability issues
- c. to cause the learner to examine the role and utility of science/technology in that interaction with global sustainability issues

Practical Tips to Aid Educators in Maintaining the Spirit and Intent

1. Using “we” instead of “you” when addressing the class. This includes the educator in the discussion and recognizes that there is no “us” and “them” in sustainability issues – there is only “us”. This might help reduce defensive stances, feelings of isolation, guilt, “doom and gloom” effects, etc.
2. Be conscious of the “doom-and-gloom” effect. That is, sustainability issues might cause uncomfortable feelings of discouragement/frustration/fear of global decline/feelings of doom. This affects different students to different degrees.
3. Be conscious that any analysis of one’s mental models can provoke feelings of guilt in some students. While it is desirable that students are impacted by the learning resource, it is not desirable that we cause undue stress by the resource.
4. Remind students that it is not their sole responsibility to “save the world”. Rather, encourage the notion that youth are vital components of any movements toward sustainability.
5. Remind students that it often feels difficult to move society toward sustainability, regardless of age.

This resource is meant to be adapted to your particular needs but it is hoped that the following basic ideas are adhered to:

*the resource is structured into lessons but it is understood that classes vary in length

*any changes are in the lessons are recorded on the educator feedback template

*The intent of the learning resource is not only to present content to students but to do so in a way that students construct as much of the meaning themselves with the educator being a facilitator of that construction.

*Recommended strategies from Senior Years Science Teacher Handbook (SYSTH) are listed and will be referenced by using SYSTH. Copies of templates and more information can be obtained from that document (see reference list for thesis).

*Any activities described are suggestions only. Feel free to adapt the instructions as you see fit. For example, “DIRECT students to read” can mean that students read individually, in pairs/small groups, or even use jigsaw learning.

*Remember our own eco-footprint...we are role-models

*Within each lesson under “Materials needed”, “class sets” of handouts are often listed. It may not always be necessary for each student to have their own copy depending on level of groupwork, assessment, homework expectations, etc. Also, it may sometimes suffice to have an overhead prepared of the handout.

SUGGESTED USE OF THE DVD RESOURCE: ECOLOGY OF COMMERCE

DVD: Captain W Productions (n.d.). Ecology of Commerce. Schumacher College: Dartington Totnes Devon, UK: Captain W Productions

*this DVD is one of only many that are open lectures and exclusive interviews from Schumacher College's 2 and 3-week residential courses. These titles are collections (2 or 3 on a DVD) of straight lectures except where indicated in the blurb. In general, each DVD title represents one particular course. These DVD's provide a flavour of the kinds of ideas and levels of discussion that take place at the college.

Except where indicated, these talks are accessible to a general audience. These are available at a very modest price at <http://www.captainw.com/webvidm.htm>

Its description is as follows:

PAUL HAWKEN, author of "The Ecology of Commerce" describes the current ecological crisis in terms of design and predicts the coming trends in ecological thinking within the commercial world

KARL HENRIK ROBERT, founder of The Natural Step describes the process of coming to consensus with industry about the steps needed to move towards a sustainable society

JONATHON PORRITT gives an optimistic analysis of the progress being made in industry towards sustainability

SACHS – 11th Stop

Contact: William Thomas, Schumacher College, The Old Postern, Dartington Totnes, Devon, TQ9-6EA, England

Phone 01803 860057

Fax 01803 866899

THIS DVD should be previewed and the following notes considered. It was prepared for a college audience and thus, many not be as appropriate for high school students. I have suggested portions to view that are appropriate (but still need your preview as only you know your class) and I have included some questions that you may want to distribute for answering during the presentation. Feel free to adapt other portions of it into your teaching.

Suggested Use of the DVD Resource: Ecology of Commerce (cont'd)

Suggested Use see Lesson: Project:TAKE

**Title 2: Paul Hawken – The Ecology of Commerce
(22:22-31:30)**

Notes:

1. Hawken refers to “pimps” in reference to those who dress in black. It appears to be an inside joke between Hawken and the participants but you may want to omit it.
2. There is a reference to “China” as having figured out that the west prefers heavier silk and so adds tin and chromium to their silk to make it heavier. Some might take offense to this comment being directed at the entire nation of China rather than only the companies within China who utilize that practice.

Suggested Questions:

1. Hawken details the Intelligent Product System in which there would be true “product responsibility”. Goods would be one of 3 types described below. Give an example of each one.
 - a) products that are consumable
 - b) products that provide services and are then taken back to the manufacturers in “de-shopping” centres to be used again/disposed of
 - c) un-usables that cannot be sold but can be used in manufacturing as long as they are tagged molecularly so that when we found them in nature we could return them to the manufacturer

Suggested Use of the DVD Resource: Ecology of Commerce (cont'd)

Suggested Use: see Lesson: Restabilizing Earth – 4 Guiding Principles

**Title 2: Paul Hawken – The Ecology of Commerce
(41:27-47:40)**

(Question & Answer period)

A participant asks about the pressure that owners/ corporations have to make money and how that is compatible with these ideas on sustainability. Hawken provides two examples of how businesses have made money by moving toward sustainability. The first is a company from Sweden (I could not understand the pronunciation).

The second is Interface (chair, founder and former CEO, Ray Anderson). The science behind what they changed was not very difficult. They simply separated the top of their carpets (made of nylon 6,6) from their backing (made of PVC). With this change, rather than having the carpet go into the landfill. It goes into the recycling bin and it can be repolymerized and used again. This allowed the company to save a great deal of money. The company did other changes too.

CBC's The Hour featured a short interview with Ray Anderson:

Ray Anderson on The Hour (added August 3, 2007)

<http://www.cbc.ca/thehour/video.php?id=1333>

“Remember the doc 'The Corporation'? It argued that corporations are like psychopaths. And there was a guy in that doc that stole the show, he was aiming to make his company sustainable, he was different, he was really inspirational, that guy was Ray Anderson.”

**Title 2: Paul Hawken – The Ecology of Commerce
31:30 – 37:17 (or 41:27)**

Notes:

1. Between 37:17 – 41:27 there is a reference to “God” – as part of a story told to Hawken about a teacher who told her students to draw something that they loved. The student named “Mary” replies that she will draw God, to which the teacher replies that we do not know what God looks like. “Mary” replies that we will once she draws her picture.

Suggested Questions:

1. Who started TNS?
2. How was it started?
3. What does Hawken mean when he says “ The richer we get, the poorer we get”?

Suggested Use of the DVD Resource: Ecology of Commerce (cont'd)

Suggested Use: see Lesson: Project: WASTE

Title 4: Sachs – 11th Stop
(entire title only about 2 or 3 minutes long)

New vocabulary: affluence

Suggested Questions:

1. Can you think of other examples of the following:
 - a) Our understanding of “ the good life”
 - b) We have been “rich” in objects and “poor” in time
 - c) All goods are “thieves of time”
 - d) “Limit your material satisfaction to maximize your internal satisfaction”

BACKGROUND TO THE NATURAL STEP DECISION-MAKING FRAMEWORK

The Natural Step

Source: Robèrt, K. (2002). *The natural step story: seeding a quiet revolution*. British Columbia, Canada: New Society Press.

What do IKEA, Home Depot, Interface Inc., the Whistler Games, and Starbucks have in common? All of these are Natural Step organizations. The Natural Step has "...worked to accelerate global sustainability by guiding companies, communities, and governments onto ecologically, socially, and economically sustainable paths." (website)

The decision-making model of The Natural Step was a most applicable one for the Manitoba curriculum because

*it is science-based. It suggests that to move toward sustainable society, we must use these four science-based "system conditions" to guide us. This prioritizes science as a fundamental subject of study as it is a conduit through which we understand the ecosystems that are the underlying "capital" from which we afford our well-being.



*its use in curriculum is not limited to this specific resource. Educators can envision and create further resources that fulfill Manitoba curriculum outcomes. Example: System condition 1 of the Natural Step Framework states that in order to move toward sustainability, we must eliminate our contribution to systematic increases in concentrations of substances extracted from the earth's crust (Robèrt, 2002).

The Natural Step, 2006, Retrieved September 20, 2007 from <http://www.naturalstep.ca/>

One can link this to topics that involve metals (metallic bonding, predicting chemical reactions, "solid in solid" solutions, etc.) in the grade 11 (Senior 3) Chemistry curriculum. References to typical nonmetals (sulphur) are made in this learning resource as well.

BACKGROUND TO THE NATURAL STEP DECISION-MAKING FRAMEWORK (cont'd)

***it is kid-friendly**

The links between economy, environment and society – the traditional three pillars of sustainable development are made in a more holistic way. The economy is viewed as the playing field upon which the environment and society play. The Natural Step posits that sustainability can be profitable and provides case studies that highlight this possibility and reality (Robèrt, 2000). Students ears perk up when they hear about IKEA, Home Depot, Interface Inc., the Whistler Games, and Starbucks and this lends a sense of hope as they learn that sustainability is being addressed by businesses and communities.

***it uses real-life examples**

The Natural Step is self-described as “...part of an international non-profit research, education and advisory organization that uses a science-based, systems framework to help organizations, individuals and communities take meaningful steps toward sustainability. The mission of The Natural Step is to act as a catalyst to bring about systemic change, by making fundamental principles of sustainability easier to understand and effective sustainability initiatives easier to implement” (The Natural Step, 2006, Retrieved September 20, 2007 from <http://www.naturalstep.ca/>) This means that students can realize that although sustainability sounds realistic, companies and organizations and communities are taking steps to move toward it.

***links well to Manitoba curriculum decision-making framework**

The Natural Step links to the decision-making framework in Manitoba. It does limit the options available when making decisions because it holds in high regard the limits imposed by natural systems themselves. This means that solutions proposed by consensus **MUST** be guided by the 4 guiding ideas presented by the Natural Step in order to be considered as moving toward sustainability.

BACKGROUND TO THE NATURAL STEP DECISION-MAKING FRAMEWORK (cont'd)

Here is an additional caption that portrays the environment-economy-society relationship in an alternate way.

Copyright not obtained

Source: Chambers, N., Simmons, C. & Wackernagel, M. (2000). *Sharing Nature's Interest*. London:

Earthscan Publications Ltd., p.112. (Caption reads: The real challenge is the play-off between the 'wants' of society (quality of life goals) and environmental limits. The economy should be viewed as merely the playing field.)

The Natural Step's Four System Conditions for Decision-Making

Source: Robèrt, K. (2002). *The natural step story: seeding a quiet revolution*. British Columbia, Canada: New Society Press.

The four system conditions are:

1. Eliminate our contribution to systematic increases in concentrations of substances from the Earth's crust.
2. Eliminate our contribution to systematic increases in concentrations of substances produced by society persistent and unnatural compounds.
3. Eliminate our contribution to the systematic physical degradation of nature through over-harvesting, introductions and other forms of modification.
4. Contribute as much as we can to the meeting of human needs in our society and worldwide, over and above all the substitution and dematerialization measures taken in meeting the first three objectives. This means using all of our resources efficiently, fairly and responsibly so that the needs of all people on whom we have an impact, and the future needs of people who are not yet born, stand the best chance of being met. (Robèrt, 2002)

Nuts and Bolts

1. Flash Drive

*responses to Educator Feedback Template can be backed up here

2. Lessons with Educator Notes (Microsoft Word)

*assumes familiarity with various approaches described in Senior Years Science Teachers Handbook (SYSTH), namely THINK-PAIR-SHARE.

*specific reference is made to record responses directly on the powerpoint slides to make it easier to refer back to the information later. These are in a very noticeable font that looks like this:

TYPE ANSWERS DIRECTLY ON THE SLIDE FOR LATER REFERENCE

*specific references are made so that the educator can link the content to the project. These are in a very noticeable font that looks like this:

PROJECT LINK →

3. Student Handouts (some are available in print only and not electronically)

4. Please respect the copyrights within such that all references are copied and retained with the caption/exerpt. For example, in Lesson 5 - The Scientists for Global Responsibility in particular wants to ensure that the cover page is included with each handout and so a cover page has been added to each scientists biography.

Educator Guide to the Take-Make-Waste Project

This is only one example of how this learning resource could be used

This framework is meant to provide a sustainability issue as a context for what you are already teaching. Many concepts can be taught through contextualizing of the outcomes of your course using this idea of creating a product. This project is an example using a few selected products that were chosen to highlight organic chemistry. Other products (electronics, for example) could be used in the project to highlight heavy metals issues and so bring to light the necessity of understanding various curricular outcomes such as solutions in Chemistry grade 11 for example. Your regular lessons can be injected as the need for the knowledge is demanded by the students in order to complete the project.

Powerpoint titled “Project: TAKE-MAKE-WASTE”

There is a separate powerpoint created to guide students through the project so that educators can fit in the project as time/students' needs permit.

Educator Guide to the Take-Make-Waste Project (cont'd)

Assessment

Templates for rubrics are given but each educator will want to discuss expectations for the assignments and discuss the rubric criteria with the students to ensure authentic and fair assessment. Students can be reminded that their marks are not used for research purpose and that participation or non-participation in the research will not influence their mark.

Product Promotion Fair

It would be GRAND if you could host a product promotion fair for the rest of the school. The student body would be given a specified amount of “money” (I was thinking of chocolate loonies but I question how sustainable it is to buy candy that is individually wrapped in foil) to buy any product that they wanted. It could be specified that you can only buy one product for ease of tracking. On a specific day, the students in your class would display

- *sample (s) of their products (already done as part of the Organization Profile)
- *posters of the product (already done as part of the Organization Profile)
- *posters of their company (already done as part of the Organization Profile)
- *price information (this would require research into how much it costs to produce their product – they might try to contact the manufacturers of the product and get a “pie graph” that shows the percentage breakdown of the total cost of the product (ie how much is spent on advertising, raw materials, operating the organization, product research, etc.)
- *information pamphlets that promote how sustainable their product is
- *prize draws for student body (perhaps if they give their written opinion about the product and why they chose to spend their limited amount of money on that product instead of all of the other products available). This would be a neat way for them to examine market trends and discuss real-life implications of trying to promote sustainability to consumers (ie will consumers pay more for sustainable products? How much more? (price-points). Student popularity might play a role here too.

Of course the student body simply “pays” for the product and signs their name on a sheet of paper so that your students can track the amount of money it would make if the money was real. The student body understands that they will never actually receive a real product but they will add significantly to the learning of their peers by simulating a real consumer market for them.

See your nearest business ed teacher for discussion of this possibility!

EDUCATOR GUIDE TO TAKE-MAKE-WASTE REPORTS

The following should be included as violations of the 4 system conditions:

<p>The Natural Step Four System Conditions for Decision-Making</p> <p>Source: Robèrt, K. (2002). <i>The natural step story: seeding a quiet revolution</i>. British Columbia: New Society Press.</p>	<u>TAKE</u>	<u>MAKE</u>	<u>WASTE</u>	<u>GENERAL</u>
<p>1. Eliminate our contribution to systematic increases in concentrations of substances from the Earth's crust.</p>	<p><u>Energy Consumption</u> -extraction of petroleum</p> <p><u>Use of hydrocarbon as feedstocks to make the product</u></p>	<p><u>Energy Consumption</u></p> <p>-COMBUSTION during processing</p> <p>-transport of raw materials</p> <p>-transport of finished product</p>		<p><u>Technological advances</u> -sequestration of carbon</p> <p><u>More efficient use</u> -transport by rail instead of truck -decrease the amount of processing to make product</p> <p>local markets/local manufacturing</p> <p><u>Substitute</u> non-hydrocarbon sources of materials to make the product</p>

2. Eliminate our contribution to systematic increases in concentrations of substances produced by society's persistent and unnatural compounds.	<u>TAKE (cont'd)</u>	<u>MAKE (cont'd)</u> ADDITIVES Plasticizers (nail polish) Stabilisers	<u>WASTE(cont'd)</u> Incineration -creation of dioxins	<u>GENERAL</u> Consumer acceptance that cosmetics need to be made fresh Tire Pyrolysis (tires)
3. Eliminate our contribution to the systematic physical degradation of nature through over-harvesting, introductions and other forms of modification.				

<p>4. Contribute as much as we can to the meeting of human needs in our society and worldwide, over and above all the substitution and dematerialization measures taken in meeting the first three objectives. This means using all of our resources efficiently, fairly and responsibly so that the needs of all people on whom we have an impact, and the future needs of people who are not yet born, stand the best chance of being met.</p>	<p><u>TAKE (cont'd)</u> <u>Energy Consumption</u> -extraction of petroleum (oil and war, refineries)</p>	<p><u>MAKE (cont'd)</u></p>	<p><u>WASTE (cont'd)</u></p>	<p><u>GENERAL (cont'd)</u> Solutions to world disparity in resource distribution</p>
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EDUCATOR GUIDE TO PROJECT RESULTS

Since the products listed highlight organic chemistry, the sustainability issues associated with the TAKE and MAKE reports will likely be similar . The chart below summarizes the system conditions that are potentially violated. Students should raise these issues in their reports. The main idea is that all of these synthetically produced items either use phthalates as plasticizers (hormone mimickers), are treated to be fire retardant, or release dioxins when burned. The goal is that the students make decisions within their businesses that move toward sustainability.

The “beauty” of the project is that students begin by choosing products with seemingly very different chemical and physical properties and yet there is a common thread among projects in that the WASTE (mainly when the product itself is incinerated) is not benign. The issues of dioxin and phthalates as endocrine disruptors will emerge in each of the products and thus, the importance of discussions about HOW MUCH IS TOO MUCH? is paramount. Endocrine “mimickers” can have an effect at very small doses and as is discussed in the article by Dold (1996), *Hormone Hell*, (#10 in the list) the human body has not co-evolved to handle these synthetic hormone mimickers as it has the natural hormone mimickers.

A resource applicable for educators is the International Programme on Chemical Safety. *Global Assessment of the State-of-the-Science of Endocrine Disruptors*. [Electronic version]. Retrieved August 11, 2007 from <http://www.who.int/ipcs/publications/en/toc.pdf>

Product	Hydrocarbon/ Polymer involved (see websites, p. 283)	Sustainability Issue	Student Websites (see p. 283)	Potential solutions (see websites, p. 285)
Anything made of nylon	nylon (monomer is toluene)			
	polyester			
Tires		Dioxins when incinerated	5	<p><u>Tire pyrolysis</u> *scientifically possible but not economically feasible (truly closed loop recycling) <u>Specific to tire pyrolysis</u> Potential solutions Wrolstad, J. (2002). NEWSFACTOR.com <i>Scientists Tweak Old Recycling Technique To Attack Tire Problem</i>[Electronic version] Retrieved August 9, 2007 from http://www.newsfactor.com/perl/story/16721.html</p> <p>U.S. Environmental Protection Agency. (n.d.) <i>Management of Scrap Tires</i>. Retrieved August 9, 2007 from http://www.epa.gov/garbage/tires/science.htm#pyrolysis</p>
Bleached paper Plastics Wood treated with PCP Cigarette smoke	(contains chlorine) (that contain chlorine) (pentachlorophenol)	Dioxins when incinerated	1, 4	Unbleached paper

Product	Hydrocarbon/ Polymer involved (see websites, p. 283)	Sustainability Issue (see websites, p. 283)	Student Websites (see websites, refer to p.283)	Potential solutions (see websites, refer to p. 285)
Electronics (anything with wire cables) Flooring Shoe soles Car undercoating Plastic Food Wrap	PVC (polyvinyl chloride) (or any plastics that have plasticizers (see 2)	Phthalates, (DIDP and DINP) (when incinerated)	2 <u>Specific to Plastic Wrap</u> http://www.madehow.com/Volume-2/Plastic-Wrap.html	Reusable containers Biomimicry Institute Nature as Model Mentor and Measure. Case Studies. Retrieved August 11, 2007 from http://www.biomimicry.net/biomimicryinprintA.htm
Anything with Phthalates in it Perfumes Nail polish		Phthalates (DBP) (phthalates used as a solvent and a fixative) (phthalates used as a plasticizer)	3 <u>Specific to nail polish</u> ENotes.com How Products are Made. Nail Polish. Retrieved August 11, 2007 from http://science.enotes.com/how-products-encyclopedia/nail-polish	<u>Substitutes</u> Essential oils <u>Alternative processing method</u> Vegetable-based nail polish (Tiber River)
Fire retardants Stabilizers				
Feminine hygiene products Diapers	Sodium polyacrylate Rayon	Rayon – Dioxin		

WEBSITES FOR STUDENT RESEARCH

PRODUCTS and HYDROCARBON/POLYMER involved **(How Products are Made)**

Here are some websites to help students find out more about their product. AS WITH ALL WEBSITES, you may choose to print out the information rather than distribute this list as it is hard to control what “pops up” on these very generic websites.

How Everyday Things are Made (<http://manufacturing.stanford.edu/hetm.html>) The Alliance for Innovative Manufacturing at Stanford University

- *there is a narrator to tell you all about how to work the site
- *you can find your product and the process that is used to make your product
- *you can see videos of how a product is made
- *you can even post a question to a forum if you do not see your product on the site!

Websites for Student Research (cont'd)

SUSTAINABILITY ISSUE

GreenFacts

1. Green Facts - Dioxins
2. Green Facts – Pthalates – DDBP and DINP
3. Green Facts – Phthalates – DBP

Other

4. Halden, R. Public Health News Center [Electronic version]. John Hopkins Bloomberg University of Public Health. Retrieved August 7, 2007 from http://www.jhsph.edu/publichealthnews/articles/halden_dioxins.html
Public Affairs media contacts for the Johns Hopkins Bloomberg School of Public Health: Tim Parsons or Kenna Lowe at 410-955-6878 or paffairs@jhsph.edu. Recent public release from John Hopkins University
5. Nature.com The world's best science and medicine at your desktop. [Electronic version]. Retrieved August 11, 2007 from <http://www.nature.com/index.html>
6. Our Stolen Future (home). Retrieved August 11, 2007 from <http://www.ourstolenfuture.org/>
(focuses on endocrine disruption)
7. Environmental Working Group (home page). (n.d.) Retrieved August 11, 2007 from <http://www.ewg.org/>

*you can read about this group, their funding, their mission on the home page (also referenced below for the Not Too Pretty article)

Discover Magazine On-line

8. Mason, M. (2005).38: *Caution: Farmed Salmon May Cause Cancer*. Discover [Electronic version]. Retrieved August 7, 2007 from http://discovermagazine.com/2005/jan/farmed-salmon-may-cause-cancer/article_print
9. Kunzig, R. (1996). *The Chemistry of Plastics*. Discover [Electronic version]. Retrieved August 7, 2007 from <http://discovermagazine.com/2000/dec/featchemistry/?searchterm=phthalates>
10. Dold, C. (1996). *Hormone Hell*. Discover [Electronic version]. Retrieved August 7, 2007 from <http://discovermagazine.com/1996/sep/hormonehell865> 09.01.1996

Alternate Views

These have links through the GreenFacts website but students may not immediately find them.

11. DioxinFacts.org. American Chemistry Council [Electronic version]. Retrieved August 7, 2007 from

<http://www.dioxinfacts.org/potency.html>

*American Chemistry Council arguing that dioxins pose less risk than presented in GreenFacts

12. World Wildlife Fund Factsheet [Electronic version]. Retrieved August 7, 2007 from http://worldwildlife.org/toxics/pubs/fact_dioxin.pdf

*World Wildlife Fund arguing that dioxins pose more risk than presented in GreenFacts

13. Sierra Club Minnesota North Chapter. Retrieved August 11, 2007 from

<http://www.google.ca/search?hl=en&q=dioxins+in+chlorine+bleached+paper&meta=>

Websites for Student Research (cont'd)

POTENTIAL SOLUTIONS

Specific to Solutions that Use Nature as a Model, Mentor and Measure – includes a walking cane modelled after a bat!

Biomimicry Institute Nature as Model Mentor and Measure. Case Studies. Retrieved August 11, 2007 from <http://www.biomimicry.net/biomimicryinprintA.htm>

Specifically for How Products are Made

The Alliance for Innovative Manufacturing at Stanford University. *How Everyday Things are Made*. Retrieved August 9, 2007 from <http://manufacturing.stanford.edu/hetm.html>

How Products are Made. Retrieved August 11, 2007 from <http://www.madehow.com/>

ENotes.com How Products are Made. Nail Polish. Retrieved August 11, 2007 from <http://science.enotes.com/how-products-encyclopedia/nail-polish>

Specific to Tire Pyrolysis

Wrolstad, J. (2002). NEWSFACTOR.com *Scientists Tweak Old Recycling Technique To Attack Tire Problem* [Electronic version]

Retrieved August 9, 2007 from <http://www.newsfactor.com/perl/story/16721.html>

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