DEVELOPED FOR GRADES 6 – 10

DISCOVER THE TECHNOLOGY LOOP!

A dynamic, cross-curricular, skill-building teaching resource to help students explore the environmental and social impacts of the computer electronics life cycle.

Learning for a Sustainable Future
LSF

hp invent

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DEAR EDUCATOR:

Welcome to Discover the Technology Loop! a dynamic, cross-curricular, skill-building unit that addresses provincial curriculum expectations in grades six to ten.

Electronic products are used in every school, home, and office building throughout Canada. They are an integral part of daily life, helping us live, work and enjoy our free time. However, according to Environment Canada, more than 140,000 tons of electronic equipment accumulate in Canadian landfills each year. That figure is expected to triple by 2010. Though we may not be conscious of it, we all take part in the life cycle of electronics. The decisions we make every day in choosing, using and disposing of electronics have a tremendous impact on all living things here in Canada and abroad.

HP and LSF have collaborated to bring you ready-to-use, engaging activities that help students to:

- understand the social and environmental impacts and opportunities involved in the life cycle of electronics;
- responsibly choose, use, and dispose of technology products;
- analyze the life cycle of a common object in their lives;
- communicate their suggestions for improvements to everyday objects to the companies that manufacture them;
- raise awareness and critical thinking about the impact of electronics on all living things.

We hope you and your students enjoy this unit.

Sincerely,

HP Canada
Learning for a Sustainable Future

About HP

Incorporated in 1939, HP is a technology company that operates in more than 170 countries around the world. HP explores how technology and services can help people and companies address their problems and challenges, and realize their possibilities, aspirations and dreams.

HP is committed to being a leader in global citizenship. HP is proud of its efforts as global stewards, helping to reduce environmental impacts, raise standards in HP's global supply chain and investing in communities to help people learn, work and thrive. HP conducts business with uncompromising integrity and strives to live up to every one of its commitments to their customers, partners, employees and shareholders. Furthermore, HP believes that with global reach comes global responsibility. HP takes its role seriously by being an economic, intellectual and social asset to each community in which they do business. For more information, visit www.hp.com/hpinfo/globalcitizenship.

About LSF

Founded in 1991 by a diverse group of youth, educators, business leaders, and government and community members, Learning for a Sustainable Future is a Canadian non-profit organization with a mission to promote, through education, the knowledge, skills, perspectives, and practices essential to a sustainable future. See www.lsf-lst.ca.

Resources4rethinking.ca is an online database where educators and the general public can search for the high quality, peer-reviewed, curriculum-matched teaching resources on issues related to the development of an ecologically, socially, and economically sustainable society. Resources4rethinking.ca allows teachers to search for resources matched to their curriculum by: sustainability issue, subject, grade, and/or language (English/French). Resources4rethinking.ca identifies hundreds of print, electronic, and audio/visual resources that teachers can use to facilitate engaging activities related to sustainability issues. The resources have been published by commercial publishers, non-profit organizations, government agencies, or teachers themselves. Please visit www.resources4rethinking.ca.

Purpose and Overview of the Unit

This unit goes far beyond reacting to the waste that our communities generate. Its overall purpose is to help students develop the knowledge, skills and attitudes necessary to analyze the entire life cycle of electronics (from design, sourcing their materials, manufacturing, distribution, use and end of use). It will challenge students to consider the technology life cycle using a global perspective that encompasses humans and the rest of the natural world, and in so doing, help students come to understand that humans are in fact an integral part of nature, and not distinct from it.

Students will use puzzles to learn about the advantages and disadvantages arising from the use of resources such as plastic, bioplastics, copper and cardboard during the technology life cycle. The puzzles will also prompt them to consider why they should care about the issues they uncover. Students will use these puzzles, and a case study describing the sustainability initiatives of one electronics company, to conduct a hands-on analysis of the life cycle of a common object. After the analysis, students will be provided with at least two opportunities to suggest a positive change regarding an aspect of the object's life cycle.

Lesson-by-Lesson Summary of Objectives and Student Tasks

Lesson		Objective	Task Summaries
1	A	Students learn about the resources consumed and conserved in the design, manufacturing, distribution, use and end-of-use stages in the life cycle of electronic products. Students develop skills related to reading nonfiction.	Students read an article about the resources that are used to produce electronics. They create a "word wall" to learn the relevant vocabulary and create a graphic organizer to take effective notes about the article.
	B	Students learn about the opportunities and drawbacks that arise from the consumption and conservation of each resource involved in the life cycle of electronics. They are urged to consider these using a long-term global perspective that encompasses humans and the rest of the natural world.	Students receive pieces of a puzzle with facts about resources used in electronics. Students put the pieces into a logical order and justify their choices.
2	A	Students demonstrate their level of understanding of opportunities and drawbacks that arise from the consumption and conservation of resources so as to plan for review/remediation as necessary.	Quiz
	B	Students reflect on what they have learned from the previous exercise.	Students use a graphic organizer to reflect on what they have learned. The task focuses on the question "So what?"
3	A	Students will apply their knowledge of the benefits and drawbacks of resources (copper, plastic, etc.) used in electronics (from Lesson 1) to deepen their understanding of the life cycle of electronic products (computers, printers, cameras, etc.).	Students take puzzle pieces with the different stages of a product's life cycle and put them in the "correct" order.
	B	Students will learn about the environmental opportunities and drawbacks of each stage of a product's life cycle.	Students use a graffiti-type activity to brainstorm opportunities and drawbacks about the life cycle of a desktop computer. Students consolidate the class' ideas in their own graphic organizer.
4	A	Students learn about the social and environmental concerns and opportunities of the end-of-use stage of a product's life.	Students watch two film clips. One examines the positive and negative impacts of the electronics recycling industry in China. The other addresses what leading electronics companies are doing to properly manage electronics at the end of their use. Older students are also given the opportunity to learn about a United Nations initiative to manage electronics at the end-of-use stage.
	B	Students consolidate their learning to date.	Jeopardy-style trivia game.
5	A	Students will learn about positive changes that can be made throughout the product life cycle to benefit all living things.	Students read a case study about positive changes Hewlett-Packard has made to products at different stages of the life cycle. Students practice reading skills learned in Lesson 1.
	B	Students develop skills and knowledge that contribute to the critical analysis of the design of everyday objects. Students engage in an effective telephone call or email exchange in order to obtain information.	Students dismantle an everyday object and analyze it to identify both negative and positive aspects of its life cycle.

Lesson-by-Lesson Summary of Objectives and Student Tasks Continued...

Lesson		Objective	Task Summaries
6	A	Students identify specific ways to improve all stages of the life cycle of an everyday object.	Using their analysis of the everyday object, students recommend both short and long-term changes that will benefit humans and the rest of the natural world.
	B	Students will learn how to communicate their concerns or appreciation about specific business practices directly to a company. Students will gain experience and confidence in communicating to companies.	Students read reviews of companies that manufacture the everyday object they examined earlier. Students use these reviews and their own analysis of the object to communicate to the companies about what they think is being done well and/or provide suggestions for improvements to the product's life cycle.
7	A	Students learn an effective process and related skills about taking action for positive change.	Students conduct an action project to make a positive change concerning the short and long-term impact electronics have on humans and nature.
Summative Assessment Task		Students learn how to use a flexible tool to demonstrate their learning and their reflections about the unit.	Students create a concept map to summarize and consolidate their learnings from the unit.

Curriculum Links

This resource can be used to address provincial curriculum expectations in many different subjects in grades six to ten. To identify which specific units of study can be addressed using this unit, visit www.r4r.ca and search for "life cycle analysis" to find a review of this resource and other sustainability-related resources.

In this kit, the following materials can be used to promote your students' literacy:

- An article about how computers are made;
- A case study about sustainable practices at Hewlett-Packard;
- Vocabulary-building activities;
- Note-taking organizers.

Take an interdisciplinary approach to this unit wherever possible.

Take it Outside

Wherever possible, conduct the enclosed activities (and any of your other lessons!) outside. Your students will perceive the extra effort as your tacit confirmation that the outdoor world is important and that experiencing it is worth making an effort.

An easel, a class set of clip boards, and a class set of foam rectangles to sit upon (which can be found in the gardening section of your local hardware store) is all that you need to create an outdoor classroom.

Walk the Talk

Despite the hectic pace of teaching, try to take some time to ensure that your implicit teaching is as powerful and as positive as your explicit teaching. The little things that you do will signal to students that you genuinely care about the issues that you are working to encourage them to care about. You might consider:

- Having your drink in a reusable beverage container;
- Providing a box to collect paper that has already been used on one side;
- Encouraging your students to use paper that has already been used on one side for note-taking;
- Using 100% recycled paper for copying your handouts;
- Turning lights off whenever possible and when leaving the classroom;
- Teaching outside whenever possible.

For a more detailed list, visit www.resources4rethinking.ca/en/toolbox.

Additional Resources

Additional resources that complement this resource are:

- "Stuff: The Secret Lives of Everyday Things," by John C. Ryan and Alan Thein Durning, North West Environment Watch
- www.greenercomputing.com
- www.eicc.info/
- "Cradle to Cradle: Remaking The Way We Make Things," by William McDonough and M. Braungart, North Point Press

Additional Sustainability Education Teaching Resources:

Learning for a Sustainable Future (www.lsf-lst.ca) hired teachers across Canada to perform a four-hour review of sustainability-related teaching resources. The best resources were chosen, matched to curricula from all 13 regions of Canada, and entered into the database. Teachers can search the database by grade and subject as well as by keyword. To search for resources which address your curriculum needs, go to: www.resources4rethinking.ca.

PART A: Electronics are Made from Resources

Objectives:

- Students learn about the resources consumed and conserved in the design, manufacturing, distribution, use and end-of-use stages in the life cycle of electronic products.
- Students develop skills related to reading non-fiction.

Materials:

- The article "Electronics are Made from Resources" – one copy for each student
- Overhead of the above article
- Blank overhead and markers for creating graphic organizer while thinking aloud
- Large pieces of scrap paper, sticky tack, markers for the "Word Wall"
- Bulletin board space with the title: "The Life Cycle of Electronics…". Consider at least two sections: 1. What Do People Think About When They Design Electronics? 2. Questions We Have About Designing Electronics.

Activities:

1. Ask students to find a partner and a piece of paper. (We suggest using paper that has already been used on one side – you may want to put a box in your classroom to collect this type of paper instead of putting it into the recycling bin.) Ask pairs of students to brainstorm answers to this question: "What do people who make computers think about when they design a computer?" Provide some examples (e.g. making computers more affordable, easier to use, better than other computers, able to work more quickly, etc.) and solicit a few examples before giving the pairs approximately five minutes to generate their own list.

2. After the pairs have created their lists, solicit their answers to create a master list that can be posted in the classroom throughout the unit. You may wish to record their answers on the back of a poster or piece of bristol board that has been used on one side.

3. Tell students the overall purpose of the unit: to examine the life cycle of electronic products in order to identify what is being done well and what can be improved. Students should be asked to consider the impacts of the life cycle on all living things. With this in mind, tell students that you are going to "read" an article about electronic products and that you are going to model at least two strategies for reading non-fiction articles (the students will practice these strategies again in Lesson 5). For additional reading strategies, go to: www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy/files/Reading.pdf

4. Reading strategy one: previewing vocabulary. Tell students that you are going to skim the article to search for words/phrases with which you are not familiar. Define "skim". Do this aloud so that the students hear your thought process. For each word:
   a. Write the word in big letters on a scrap piece of paper;
   b. Ask volunteers what it means. Use a dictionary or encyclopedia where necessary. Write the definition on the paper;
   c. Ask a student to sketch a picture of the object beside the definition;
   d. Post the words around the room for use throughout the unit.

5. Reading strategy two: discuss the purpose for reading the article. Why are you reading it? What do you want to know? Remind them of the purpose of the unit. Ask students to anticipate what the article is about by scanning the article. Think aloud as you model how to create a graphic organizer to organize your notes while reading the article. Your graphic organizer may look something like this:

What Do I Want To Know About?	Main Points
Circuit boards and hard drives	
Plastic housings	
Monitors	
How does this relate to the purpose of the unit: the pluses and minuses of how electronics are designed, made, used and dealt with at the end-of-use stage?	

6. Ask students to create and complete their own graphic organizer using yours as a model.

7. After the students have completed their own graphic organizers, ask students for issues/questions/big ideas related to designing electronics. For example, one issue found in the article is that additives and different types of plastics that are mixed together make recycling difficult. Another example is that some companies are looking for alternative materials that lessen the impact on the environment, such as plant-based resources like corn which is used in bioplastics.

PART B: The Life Cycles of Resources Have Benefits and Drawbacks for All of Us

Objective:

Students learn about aspects of various resources involved in the life cycle of electronic products. "Life cycle" refers to the entire life of a product, from design and manufacture to distribution, use and end-of-use stage. The focus of the activity is to examine the advantages and disadvantages of each stage of the life cycle using a global perspective that considers humans and the rest of the natural world.

Materials:

- Copies of puzzles found on page 9. One copy of each puzzle for each group of two to three students. **Cut the puzzles into pieces before you give them to the students so that they do not know the correct order.**
- Used envelopes
- One copy of each puzzle copied on an overhead transparency and then cut into pieces
- Overhead projector
- One copy of "Puzzle Analysis" sheet on page 12 for each student

Activities:

1. Ask students to get into groups of two to three people – for tips on helping students develop their group work skills, go to www.resources4rethinking.ca/en/toolbox. Provide each group with six envelopes – one puzzle per envelope. Tell students to put the pieces into the order of occurrence of the facts based on logic and clues within the puzzle pieces.

2. Once the group is finished, ask them to discuss the following questions:
   - Were there any surprises for you?
   - Did any of the facts worry you?
   - What are the benefits and drawbacks of each resource?
   - What are some of the stages in the life cycle of a product in which resources are used?

3. Once everyone has finished completing the puzzles, ask volunteers to put the sequence they chose for each puzzle on the overhead projector using the copy made on overhead transparencies. Ask the group to explain the logic they used to create the order. Ask the class for meaningful (not simply polite!) feedback on this logic. The point of the puzzles is to carefully read and reflect on the facts in the puzzles and to begin to think about the life cycle of products and the resources we use to make them – there may be more than one logical order to each puzzle.

Give students the "Puzzle Analysis" sheet found on page 12. Ask students to complete the table and read the article about the 4R Hierarchy on page 13, and review the puzzles in preparation for the quiz during the next lesson.

WHAT ELECTRONICS ARE MADE FROM

When electronics are manufactured, resources from the earth are gathered and processed into basic materials used in the manufacturing process. These basic materials are used to make the various components that are put together to make the computer products that you buy.

A desktop computer includes: a video card, a hard drive, a main circuit board commonly called a “motherboard”, and other components in a large case. The microprocessor, or “central processing unit” (CPU), works with the operating system to control the computer. It essentially acts as the computer’s brain. The CPU produces a lot of heat, so a desktop computer uses circulating air, a fan and a “heat sink” to draw heat away from the processor, to help keep it cool.

Circuit Boards and Hard Drives

Circuit boards are used to connect different parts and components together inside the computer. Components such as resistors, connectors and the microprocessor are attached to the circuit board. Copper is used to create pathways on the circuit board that conduct electricity from part to part. Circuit boards and hard drives also contain metals such as iron and gold. Until recently, metals such as lead have also been used to make circuit boards. These can be harmful to the environment if disposed of improperly. While older products may still contain lead, newer products have eliminated it from circuit boards and electronic components.

A hard drive stores digitally encoded data on rapidly rotating platters with magnetic surfaces.

Plastic Housings

Plastic is commonly used in many electronic products. While most plastics are manufactured from petroleum oil, some companies are using plant-based resources such as corn to create bioplastics. Bioplastics are not typically used in computers because they cannot tolerate heat very well and will deform at the temperatures at which most desktop and notebook computers operate. Many different types of plastics may be used in a single electronic product. If the plastics are not manually separated at the beginning of the recycling process, they can get mixed together during later steps. Once plastics are ground up and mixed together, they are difficult to separate and become hard to recycle. Some plastics contain additives such as flame retardants that also complicate recycling.

Monitors

There are two basic types of monitors. The cathode-ray tube (CRT) found inside some monitors is a funnel-shaped, leaded glass tube with a metal frame inside. The lead in the glass provides shielding from electromagnetic rays produced inside the cathode-ray tube, which produces the picture on the screen. Much of the glass can be sold for reuse in new CRT glass or can be sent to metal smelters to recover the lead. Liquid crystal display monitors (LCDs) use small fluorescent lights, which contain very small amounts of mercury in order to make them work. When LCDs are properly recycled, their materials can be used in other products.

RESOURCE PUZZLES

Note to teacher: these puzzles contain facts that may be concerning to students. Be sure to use the other lessons in this guide to assure students that some people are working to maximize the opportunities involved with using resources and to reduce the negative social and environmental impacts of using resources. In addition, use the lessons in this guide to provide students with an opportunity to react positively to the concerns presented in the puzzles by working on a change in their own community. **Please note:** footnotes in the text below refer to sources listed on pg. 35.

COPPER

Copper is used to build integrated circuits and chips, among many other computer parts. It is quickly replacing aluminum as the main chip material. Studies show copper not only makes computers more affordable, but also helps improve speed. This boosts performance and makes copper the more energy-efficient choice. Saving electricity helps us to avoid putting pollutants into the air that we all breathe.[1] ❐

On average, one kg of ore taken from an open pit mine yields 90g of copper. That means that in order to build an average desktop computer, about 135kg of rock must be moved to uncover the ore. As well, an average of 130kg of ore needs to be processed to build one computer. Many plants and animals live in places where people want to mine metals. Mining disturbs and sometimes destroys the habitat of many living things.[2] ❐

When companies develop large metal mines, the local area's economy and environment can be affected. For example, farmers may have to move off their land when a large mine is built. New mining developments can also bring job opportunities. Toxins created during the mining process can enter the water, making it undrinkable. This may mean that local people may not be able to use the water again, even once all of the metal has been taken out of the mine, because toxins last a long time.[3] ❐

Refining copper produces sulfur dioxide. Sulfur dioxide (SO_2) is one of the two gases responsible for "acid rain", a serious environmental problem in Canada which pollutes rivers, coastal waters, forests and soils.[4] Some companies are working to reduce SO_2 emissions. For example, the BHP Copper Metals smelter – the largest copper smelter in North America – uses a system that traps as much as 99 percent of the SO_2 produced during copper smelting. Even so, one third of the sulfur dioxide emissions in Canada come from mining operations.[5] ❐

During shipping, high heat and humidity can cause many metals to rust. Copper doesn't rust easily, that's why it's an ideal metal for shipping long distances.[6] ❐

Copper's recycling rate is so high that nearly all of the copper that humans have ever mined is still in circulation.[7] Recycling copper reduces the demand for newly mined copper. This reduces the habitat destruction and air pollution that copper mining and refining can cause and saves money too![8] ❐

BIOPLASTICS

Bioplastics are made from renewable materials like soy beans and corn. At some stages in their life cycle bioplastics are more environmentally responsible than conventional plastics. The production of bioplastics results in the emission of less carbon dioxide, a gas which accelerates climate change. ■

Bioplastics are not as heat resistant and tough as conventional petroleum-based plastics. Some manufacturers blend bioplastics with petroleum-based plastics to make them stronger while still keeping some of the environmental benefits of bioplastics. ■

Bioplastics are biodegradable and can be composted in composting factories. This is much better than sending them to landfills. Bioplastics are new, so there is a risk that many people won't yet know they can be composted and will send them to the landfill or recycling factory instead. At the recycling factory, bioplastics would spoil the conventional plastics, perhaps making them unusable. ■

Bioplastics are often made from genetically modified soy and corn. Unlike conventional plastics which come from oil, which is a non-renewable source, soy and corn are a renewable resource. There are concerns about using genetically modified crops because we still don't understand their long-term effects or the impact on small farms.[10] ■

A few leading electronics companies have developed products made with bioplastics. In 2002 HP developed a prototype printer that was made with a bioplastic shell, and in 2007 Fujitsu introduced a notebook with a chassis made from cornstarch. ■

Over-cultivating crops for bioplastics can cause soil erosion, biodiversity loss, water pollution, and a reduction in land available for growing food. It can also increase the use of fertilizers and pesticides.[9] ■

CARDBOARD

Paper and cardboard are made from trees. It is important to protect our forests because forests help clean the air and are home to many animals. Canada's boreal forest is home to caribou, foxes, wolves and bears. A million acres of boreal forests are logged annually in Canada, which has put several species of plants and animals at risk.[11] Trees can be cut down (harvested) responsibly – maintaining biodiversity, soil, water and air quality, and preserving endangered and old-growth forests. A number of organizations have developed processes to help consumers identify wood and paper products that have been harvested responsibly. ❍

Canada is the world's leading exporter of forest products. The forestry industry contributed $40.4 billion to Canada's trade surplus in 2000. It provides employment, directly or indirectly, to approximately one million Canadians.[12] ❍

In Canada, forestry was first practiced by First Nations people who used the forest for food, clothing, medicine, boat-building and shelter. Today, many First Nations communities still rely on forests for their livelihood, their health and their well-being. Their access to healthy forests is sometimes compromised by industrial logging operations.[13] Recently, more than 50 new business partnerships, worth hundreds of millions of dollars, were established between Aboriginal Canadians and forest companies.[14] ❍

As with many forms of manufacturing, pulp and paper mills create air pollution. The chemicals in the pollution are thought to be related to a number of health consequences including asthma, lung cancer and heart failure.[15] Converting mill waste into renewable energy now provides almost 57% of the paper industry's total electricity.[16] ❍

Corrugated cardboard is used in virtually every shipping box. It often eliminates the need for additional packaging and overwrap, while protecting the product.[17] Corrugated cardboard is much lighter than traditional wooden crates and requires smaller amounts of fuel to transport. This reduces the amount of climate-changing gases produced. Climate change worsens extreme weather events like floods, droughts, and hurricanes.[18] ❍

Paper and cardboard made with recycled fibre (from used paper and cardboard) is more environmentally responsible. It takes less electricity, water and greenhouse gases to make paper from used paper than from new tree fibre. Using previously used paper to make new paper also protects forests (and the other plants and animals in the forest).[19] Printing the English editions of "Harry Potter and the Deathly Hallows" on recycled, bleach-free paper saved 197,685 trees and 7.9 million kilograms of greenhouse gases.[20] ❍

CONVENTIONAL PLASTICS

Conventional plastics can achieve a level of performance that no other material can match. Computer designers choose plastics for their toughness, durability, flexibility and their electrical insulation properties. Plastics have made it possible to reduce the weight of many electronic products and make them much smaller, which means less material is used in production.[21] ●

Plastics take up valuable room in landfills because they don't degrade naturally. Once the plastic reaches the landfill, it may leak chemicals into the local ground water which then circulates throughout the water system. This can impact the health of living things. ●

Many people are concerned about the health risks associated with certain types of plastics. PVC, labeled with a number three in the recycling symbol found on the bottom of many plastic objects, has been linked to cancer, liver problems and fertility problems.[23]
A number of companies in the high-tech industry have taken steps to eliminate PVC from products and packaging. ●

Recycling programs recover lots of plastic that can then be used to manufacture new products. Using recycled plastic instead of new plastic saves electricity, water and waste. ●

Plastics help to make electronics products smaller and lighter in weight. This means that less fuel is required to transport them. This avoids the production of climate-changing gases. Climate change has many consequences including more severe weather events like hurricanes, droughts, floods and ice storms. ●

Conventional plastics are made from oil. In the Athabasca Oil Sands in Northern Alberta the production of one barrel of oil requires two to five barrels of water. Using this much water is lowering the water levels in streams, lakes, ponds and wetlands.[22] Many living things rely on this water. ●

FOSSIL FUELS AND OTHER FORMS OF ENERGY

Fossil fuels include oil, natural gas and coal. When burned, they release energy which can power vehicles, machines, and generate electricity. Burning fossil fuels emits carbon dioxide, a greenhouse gas that speeds up climate change. Climate change has many consequences including the damage of coral reefs. Over a million different species of fascinating plants and animals live in coral reefs.[24] Also, climate change increases the spread of pests and diseases like West Nile Virus and malaria, which compromise the health of many people around the world.[25] ▲

Fossil fuels are one of many forms of energy, some of which are renewable. Renewable energy resources can be replenished in a short period of time and have less impact on the environment than extracting and using fossil fuels. The five renewable energy sources used most often include hydro power (water), solar (sun), wind, geothermal (heat from within the earth), and biomass (organic material made from plants and animals).[26] ▲

In the area around the Athabasca Oil Sands of Northern Alberta, there is concern that water pollution resulting from oil production is negatively impacting human health. Abnormally high rates of cancers and other serious illnesses have been documented in the First Nations community of Fort Chipewyan. ▲

A benefit of the Athabasca Oil Sands project is that many jobs have been created in the area which has resulted in the strongest period of economic growth ever recorded by a Canadian province. Alberta's 2006 unemployment rate is the lowest level ever recorded.[27] ▲

Fossil fuels are burned in the transportation of products. Some forms of transportation use more fuel than others. For example, every ton of freight transported by air for one kilometer results in 0.6 kilograms of carbon dioxide emissions, compared to 0.003 kilograms for ocean transport.[28] ▲

Coal, oil and natural gas are often mined in remote areas and must be transported long distances to the places where people want to use them. There have been media reports that the construction of oil and natural gas pipelines in Canada threatens fragile Arctic and boreal forest plants and animals. For example, caribou need to migrate longer distances each year in order to find enough food to survive. Their travel is often restricted by oil and gas pipelines. Caribou are important to the well-being of many First Nations people.[29] ▲

FLAME RETARDANTS

Many companies are investigating replacements for brominated flame retardants. In February 2003, the European Union adopted the Restriction of Hazardous Substances (RoHS) Directive, which restricts the use of six chemicals in the manufacture of various electronic and electrical equipment, including two flame retardants used in some plastics. In response to this directive, some companies that sell products internationally are restricting and eliminating the use of these chemicals in all their products – not just the ones they sell in Europe. ▼

Most electronic components, circuits and cables have flame retardants, as do many of the outer plastic covers of electronic products, especially TVs. Flame retardants save lives. In 2005 an Air France jet crashed on landing at Toronto International Airport and caught on fire. All three hundred passengers and crew members survived. Safety officials have credited flame resistant materials in the plane as a key factor in preventing loss of life.[31] ▼

Adding flame retardants to plastics can complicate recycling by altering the chemistry of the materials. Two pieces of plastic of the same type might have two different flame retardants, so when they are ground up and melted, it is difficult to make pure plastic. Recycling companies are working to overcome this problem. ▼

One class of flame retardants (brominated) has been found to accumulate in the bodies of animals and humans and has been found in human breast milk.[30] ▼

When plastics are not recycled properly and are burned improperly, some types of flame retardants release toxic chemicals, such as dioxins, which may be linked to serious health concerns including cancer and birth defects.[32] ▼

Flame retardants are chemicals used to help ensure that products do not catch on fire. They also allow people more time to safely exit a building if there is a fire because they can slow down or even completely prevent a fire. ▼

PART A: Resource puzzle

COPPER

1. Copper is used to build integrated circuits and chips, among many other computer parts. It is quickly replacing aluminum as the main chip material. Studies show copper not only makes computers more affordable, but also helps improve speed. This boosts performance and makes copper the more energy-efficient choice. Saving electricity helps us to avoid putting pollutants into the air that we all breathe.[1]
2. On average, one kg of ore taken from an open pit mine yields 90g of copper. That means that in order to build an average desktop computer, about 135kg of rock must be moved to uncover the ore. As well, an average of 130kg of ore needs to be processed to build one computer. Many plants and animals live in places where people want to mine metals. Mining disturbs and sometimes destroys the habitat of many living things.[2]
3. When companies develop large metal mines, the local area's economy and environment can be affected. For example, farmers may have to move off their land when a large mine is built. New mining developments can also bring job opportunities. Toxins created during the mining process can enter the water, making it undrinkable. This may mean that local people may not be able to use the water again, even once all of the metal has been taken out of the mine, because toxins last a long time.[3]
4. Refining copper produces sulfur dioxide. Sulfur dioxide (SO_2) is one of the two gases responsible for "acid rain", a serious environmental problem in Canada which pollutes rivers, coastal waters, forests and soils.[4] Some companies are working to reduce SO_2 emissions. For example, the BHP Copper Metals smelter – the largest copper smelter in North America – uses a system that traps as much as 99 percent of the SO_2 produced during copper smelting. Even so, one third of the sulfur dioxide emissions in Canada come from mining operations.[5]
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1. Bioplastics are made from renewable materials like soy beans and corn. At some stages in their life cycle bioplastics are more environmentally responsible than conventional plastics. The production of bioplastics results in the emission of less carbon dioxide, a gas which accelerates climate change.
2. Bioplastics are not as heat resistant and tough as conventional petroleum-based plastics. Some manufacturers blend bioplastics with petroleum-based plastics to make them stronger while still keeping some of the environmental benefits of bioplastics.
3. Over-cultivating crops for bioplastics can cause soil erosion, biodiversity loss, water pollution, and a reduction in land available for growing food. It can also increase the use of fertilizers and pesticides.[8]
4. Bioplastics are often made from genetically modified soy and corn. Unlike conventional plastics which come from oil, which is a non-renewable source, soy and corn are a renewable resource. There are concerns about using genetically modified crops because we still don't understand their long-term effects or the impact on small farms.[9]
5. A few leading electronics companies have developed products made with bioplastics. In 2002 HP developed a prototype printer that was made with a bioplastic shell, and in 2007 Fujitsu introduced a notebook with a chassis made from cornstarch.
6. Bioplastics are biodegradable and can be composted in composting factories. This is much better than sending them to landfills. Bioplastics are new, so there is a risk that many people won't yet know they can be composted and will send them to the landfill or recycling factory instead. At the recycling factory, bioplastics would spoil the conventional plastics, perhaps making them unusable.

CARDBOARD

1. Paper and cardboard are made from trees. It is important to protect our forests because forests help clean the air and are home to many animals. Canada's boreal forest is home to caribou, foxes, wolves and bears. A million acres of boreal forests are logged annually in Canada, which has put several species of plants and animals at risk.[10] Trees can be cut down (harvested) responsibly – maintaining biodiversity, soil, water and air quality, and preserving endangered and old-growth forests. A number of organizations have developed processes to help consumers identify wood and paper products that have been harvested responsibly.
2. Canada is the world's leading exporter of forest products. The forestry industry contributed $40.4 billion to Canada's trade surplus in 2000. It provides employment, directly or indirectly, to approximately one million Canadians.[11]
3. In Canada, forestry was first practiced by First Nations people who used the forest for food, clothing, medicine, boat-building and shelter. Today, many First Nations communities still rely on forests for their livelihood, their health and their well-being. Their access to healthy forests is sometimes compromised by industrial logging operations.[12] Recently, more than 50 new business partnerships, worth hundreds of millions of dollars, were established between Aboriginal Canadians and forest companies.[13]
4. As with many forms of manufacturing, pulp and paper mills create air pollution. The chemicals in the pollution are thought to be related to a number of health consequences including asthma, lung cancer and heart failure.[14] Converting mill waste into renewable energy now provides almost 57% of the paper industry's total electricity.[15]
5. Corrugated cardboard is used in virtually every shipping box. It often eliminates the need for additional packaging and overwrap, while protecting the product.[16] Corrugated cardboard is much lighter than traditional wooden crates and requires smaller amounts of fuel to transport. This reduces the amount of climate-changing gases produced. Climate change worsens extreme weather events like floods, droughts, and hurricanes.[17]
6. Paper and cardboard made with recycled fibre (from used paper and cardboard) is more environmentally responsible. It takes less electricity, water and greenhouse gases to make paper from used paper than from new tree fibre. Using previously used paper to make new paper also protects forests (and the other plants and animals in the forest).[18] Printing the English editions of "Harry Potter and the Deathly Hallows" on recycled, bleach-free paper saved 197,685 trees and 7.9 million kilograms of greenhouse gases.[19]

CONVENTIONAL PLASTICS

1. Conventional plastics can achieve a level of performance that no other material can match. Computer designers choose plastics for their toughness, durability, flexibility and their electrical insulation properties. Plastics have made it possible to reduce the weight of many electronic products and make them much smaller, which means less material is used in production.[20]
2. Conventional plastics are made from oil. In the Athabasca Oil Sands in Northern Alberta the production of one barrel of oil requires two to five barrels of water. Using this much water is lowering the water levels in streams, lakes, ponds and wetlands.[21] Many living things rely on this water.
3. Many people are concerned about the health risks associated with certain types of plastics. PVC, labeled with a number three in the recycling symbol found on the bottom of many plastic objects, has been linked to cancer, liver problems and fertility problems.[22] A number of companies in the high-tech industry have taken steps to eliminate PVC from products and packaging.
4. Plastics help to make electronics products smaller and lighter in weight. This means that less fuel is required to transport them. This avoids the production of climate-changing gases. Climate change has many consequences including more severe weather events like hurricanes, droughts, floods and ice storms.
5. Recycling programs recover lots of plastic that can then be used to manufacture new products. Using recycled plastic instead of new plastic saves electricity, water and waste.
6. Plastics take up valuable room in landfills because they don't degrade naturally. Once the plastic reaches the landfill, it may leak chemicals into the local ground water which then circulates throughout the water system. This can impact the health of living things.

FOSSIL FUELS AND OTHER FORMS OF ENERGY

1. Fossil fuels include oil, natural gas and coal. When burned, they release energy which can power vehicles, machines, and generate electricity. Burning fossil fuels emits carbon dioxide, a greenhouse gas that speeds up climate change. Climate change has many consequences including the damage of coral reefs. Over a million different species of fascinating plants and animals live in coral reefs.[23] Also, climate change increases the spread of pests and diseases like West Nile Virus and malaria, which compromise the health of many people around the world.[24]
2. Fossil fuels are one of many forms of energy, some of which are renewable. Renewable energy resources can be replenished in a short period of time and have less impact on the environment than extracting and using fossil fuels. The five renewable energy sources used most often include hydro power (water), solar (sun), wind, geo-thermal (heat from within the earth), and biomass (organic material made from plants and animals).[25]
3. In the area around the Athabasca Oil Sands of Northern Alberta, there is concern that water pollution resulting from oil production is negatively impacting human health. Abnormally high rates of cancers and other serious illnesses have been documented in the First Nations community of Fort Chipewyan.
4. A benefit of the Athabasca Oil Sands project is that many jobs have been created in the area which has resulted in the strongest period of economic growth ever recorded by a Canadian province. Alberta's current unemployment rate is the lowest level ever recorded.[26]
5. Fossil fuels are burned in the transportation of products. Some forms of transportation use more fuel than others. For example, every ton of freight transported by air for one kilometer results in 0.6 kilograms of carbon dioxide emissions, compared to 0.003 kilograms for ocean transport.[27]
6. Coal, oil and natural gas are often mined in remote areas and must be transported long distances to the places where people want to use them. There have been media reports that the construction of oil and natural gas pipelines in Canada threatens fragile Arctic and boreal forest plants and animals. For example, caribou need to migrate longer distances each year in order to find enough food to survive. Their travel is often restricted by oil and gas pipelines. Caribou are important to the well-being of many First Nations people.[28]

FLAME RETARDANTS

1. Flame retardants are chemicals used to help ensure that products do not catch on fire. They also allow people more time to safely exit a building if there is a fire because they can slow down or even completely prevent a fire.
2. One class of flame retardants (brominated) has been found to accumulate in the bodies of animals and humans and has been found in human breast milk.[29]
3. Many companies are investigating replacements for brominated flame retardants. In February 2003, the European Union adopted the Restriction of Hazardous Substances (RoHS) Directive, which restricts the use of six chemicals in the manufacture of various electronic and electrical equipment, including two flame retardants used in some plastics. In response to this directive, some companies that sell products internationally are restricting and eliminating the use of these chemicals in all their products – not just the ones they sell in Europe.
4. Most electronic components, circuits and cables have flame retardants, as do many of the outer plastic covers of electronic products, especially TVs. Flame retardants save lives. In 2005 an Air France jet crashed on landing at Toronto International Airport and caught on fire. All three hundred passengers and crew members survived. Safety officials have credited flame resistant materials in the plane as a key factor in preventing loss of life.[30]
5. Adding flame retardants to plastics can complicate recycling by altering the chemistry of the materials. Two pieces of plastic of the same type might have two different flame retardants, so when they are ground up and melted, it is difficult to make pure plastic. Recycling companies are working to overcome this problem.
6. When plastics are not recycled properly and are burned improperly, some types of flame retardants release toxic chemicals, such as dioxins, which may be linked to serious health concerns including cancer and birth defects.[31]

PART B: Analysis of Advantages/Drawbacks of Resources

On a scrap piece of paper, create a chart like the one below to list some of the advantages and drawbacks of each resource (e.g. bioplastic – more environmentally responsible at end-of-use stage, higher financial cost).

Resource	Advantages	Drawbacks

PART C: 4R Hierarchy

Many of us are familiar with the 4Rs –"rethink, reduce, reuse, recycle". What many people are less familiar with is that the 4Rs are said in the order in which they have the most benefit to Earth and all of us. For example, rethinking the way we design things can have huge benefits. For example, compact fluorescent light bulbs use 75% less energy than traditional light bulbs.

Reducing is more advantageous to Earth and all of us than recycling. For example, when you recycle an aluminum can, you use approximately five percent of the resources that would have been used if you had purchased a new can. This is much better than using a new can! However, you do use additional resources when you have someone come to your house or school to pick up the can to bring it to the recycling plant. Every time you do not use an aluminum can at all, you effectively use zero percent of the resources you would have consumed if you had used a new can!

Rethink. If that doesn't work, reduce. If that doesn't work, reuse; and only if all of that doesn't work, recycle.

PART A:

Objective:

To determine students' level of understanding of opportunities and drawbacks involved in consuming and conserving resources so as to plan and provide review/remediation as necessary.

Materials:

- Short quiz on content from Lesson 1 (Teacher to prepare based on data from Lesson 1).

Activities:

Ask students to complete a short quiz on content from Lesson 1 to ensure they understand the benefits and drawbacks of the resources used during the product life cycle.

PART B: So What?

Objective:

Students reflect on their knowledge and feelings about the opportunities and drawbacks that arise from the consumption and conservation of each resource involved in the life cycle of electronics. They are urged to consider these using a long-term, global perspective that encompasses humans and the rest of the natural world.

Materials:

- Chart paper or bristol board or posters that have been used on one side, markers that do not bleed through the page. Optional: glue, scissors and old magazines.

Activities:

1. Model this activity first with a few examples for the whole class and then ask students to complete the activity with a partner.
2. Write the phrase "electronics are made from resources" in a small box in the centre of the large piece of paper. From the box, draw a small line in any direction. Write the phrase "So what?" on top of the line. Draw a new box at the end of the line. Ask aloud: "So what?" and sketch (or ask a student to sketch) **your own personal answer** to this question. For example, "Mining metals involves clearing a large section of land". From the second box, draw another line in any direction. Write "So what?" on top of the second line. Draw a new, third box. Ask aloud "So what?" in response to the previous answer (e.g. "so what?" if mining metals involves clearing large sections of land). An answer could be, "Animals were probably living on the land before the humans cleared it". A "So what?" response could be, "it would make me sad to see animals harmed". Continue adding to this line of thought or start a new one from the centre box. Provide a second example that involves the benefits/opportunities in a material's life cycle (e.g. jobs, recycling opportunities, etc.).
3. Share these ground rules with the students:
   i. Make it personal. This chart is about your own **personal** reaction to the puzzles, not the "right" reaction. Generally, the final box in a chain should describe how the individual student feels about the consequences outlined in that chain.
   ii. Use pictures more than words (sketch pictures or cut and paste pictures from old magazines).
   iii. Think big and broad. Think about all living things, near and far, now and in the future.
4. Post the completed "So what?" charts around the room. Place them at a height that students can reach in order to add and refer to them throughout the unit.

PART A:

Objective:

Students will apply their knowledge of the benefits and drawbacks of the **resources** (e.g. copper, plastic, etc.) used in electronics (from Lesson 1) to deepen their understanding of the life cycle of electronic **products** (computers, printers, cameras, etc.).

Materials:

- Copies of the "Product Life Cycle" puzzle on page 16: one per group of students, cut into small pieces
- Envelopes (one per small group; preferably envelopes that are being reused)
- One set of puzzle pieces made on an overhead transparency and cut up
- Overhead projector

Activities:

1. Distinguish between **resources** (= ingredients in a product, e.g. copper, plastic, cardboard) and finished **products** (e.g. desktop computers, printers, notebook computers, cameras, etc.).
2. Ask students to get into groups of two to three. Provide each group with an envelope with the "Product Life Cycle" puzzle. Ask students to put puzzle pieces into a logical order. Some of the students will see that the pieces create a loop or cycle rather than a sequence.
3. Ask one group to present the cycle using the overhead projector.
4. Solicit questions and big ideas for the current discussion and for the bulletin board.

PART B:

Objective:

Students will learn about the **environmental** opportunities and drawbacks at each stage of a product's life cycle.

Materials:

- Chart paper, bristol board or posters that have already been used on one side
- Sticky tack or conventional tacks
- Markers that do not bleed through the paper
- Blank Life Cycle Worksheet on page 18
- Before class, put the name of one stage of the product life cycle (e.g. "manufacturing" or "distribution") on one big piece of paper and hang it on the wall in the room. The teacher repeats this for all of the stages. The papers are spread throughout the room. **This would be an excellent activity to do outside. The papers could be put on flattened cardboard boxes on the ground.**

Activities:

1. Provide an example of an environmental drawback or opportunity at the Design stage of a desktop computer. For example, an opportunity is that computers could be designed to be made from only one type of plastic for more efficient recycling. A drawback is that the cost of upgrading components on your current desktop computer may sometimes be more expensive than buying a whole new one, resulting in discarded systems that still have many working components.
2. See page 17 for more examples. Solicit an example for the Distribution stage. For example, an opportunity is that computers could be distributed to stores by trucks powered by hydrogen fuel cells, or by train, instead of trucks powered by gasoline. A drawback is that the polystyrene foam in packing boxes is not accepted by many recycling programs in Canada. Note: there will be some repetition among the stages. For example, reducing the amount of potentially hazardous materials in a computer can be considered a design challenge as well as a manufacturing challenge. Tell students to focus more on the ideas than on the particular stage in which they should be considered.
3. Divide students into six groups. Each group starts at a different poster/stage and writes as many ideas as possible about an environmental drawback or opportunity at this stage. The groups rotate to a new poster/stage when the teacher asks a student to shout "cycle". At the next stage, the new group reads the work of the previous group and then adds ideas. The students "cycle" until each group has visited at least three stages. At each stage, encourage the students to carefully read the work of the other groups as they will need as many ideas as possible for their summary sheet so they can prepare for the "Jeopardy" game in the next lesson.
4. Give each student a copy of the blank Life Cycle Worksheet on page 18. Ask students to complete the sheets individually, but encourage them to consult the posters around the room to get as many ideas as possible.
5. Ask students to revisit their own personal "So What" charts/graphics from Lesson 2 and consider whether or not there is anything that they would like to add to the chart. Invite students to add another piece of paper to the chart if necessary.

PRODUCT LIFE CYCLE PUZZLE

DESIGN

Designers and engineers make choices that affect how computers are made, how they are used, and how they look.

RESOURCES

Resources are the materials from which computers are built and can be both natural and human-made.

MANUFACTURING

Manufacturing is the process of taking raw materials and energy and turning them into computers.

DISTRIBUTION

Distribution is the process of getting products from the factory to users.

USE

We use computers on a regular basis for both work and play.

END OF USE

RECYCLING

DISPOSAL

There are several choices for managing aging or unwanted computers: extending their life through reuse and refurbishment, and recycling for use in new products. Unfortunately, they are often still disposed of in landfill sites.

REUSE

REFURBISHMENT

TEACHER Answer Sheet for Desktop Computer Life Cycle Analysis

Stage	Opportunities	Drawbacks and Challenges
Design	• Make components within tower easier to change. • Limit the power features on the computer to those which conserve electricity. • Make the initial start-up process quicker so people will be less reluctant to turn computers off. • Design for easy disassembly at end-of-use stage. For example, use snap-fit parts instead of screws and adhesives. • Make plastic casing from 100% recycled content plastic. Where new material is necessary, consider bioplastic. • Use flat screen monitors wherever possible (they take fewer resources to make and less power to run). • Design computers to meet energy compliance standards, like Energy Star. • Design shipping materials that are lighter, reusable and/or are made from recycled content.	• The cost of upgrading components on your current desktop computer may sometimes be more expensive than buying a whole new one, resulting in discarded systems that still have many working components. • Bioplastics may contaminate other plastic recycling streams during recycling process. • Recycled plastics are hard to secure in quantities that are large enough and clean enough for large-scale manufacturing in new products. • Plastics must meet fire-safety requirements.
Sourcing	• Establish a "fair trade" system with suppliers. • Purchase materials only from suppliers who meet stringent criteria related to sustainability principles. • Pay the "true cost" of materials instead of just their financial cost.	• Big companies have many suppliers who may also have many suppliers of their own, making it difficult to know what is happening at all sites.
Manufacturing	• Use factories that are powered with renewable energy and/or have strict energy conservation goals. • Provide safe and fair working conditions for employees at manufacturing facilities.	• Electricity generated from renewable sources may not be available where the factory is located. • Electricity from renewable sources can be expensive, and the costs could be passed on from the manufacturer of the product to the purchaser. • Potentially hazardous materials, like flame retardants, do an important job: it is difficult to find less hazardous materials to replace them.
Distribution	• Use hybrid trucks and/or trains. • Ship by boat instead of by airplane to reduce the amount of emissions per computer. • Sell through stores that use stringent energy conservation techniques (e.g. less air conditioning and heating, fewer lights on, etc.). • Collect shipping containers and other packing materials for reuse. • Use cardboard that is made from 100% post-consumer fibre. • Eliminate as much polystyrene foam (commonly called Styrofoam™) as possible. • Package products in the most efficient way so less space is needed during shipping which reduces CO_2 emissions. • Use companies that are members of programs such as Clean Ways, which provides hook-up pods at service stations so trucks can plug into the building's power and therefore turn off the trucks (less idling means reduced emissions).	• Polystyrene foam is not accepted by some municipal recycling facilities. • Cardboard often contains material from new trees. • Most packaging material is used only once before it is recycled/disposed of. • Shipping by boat is slower than shipping by airplane. • Small packages are easily stolen from stores.
Use	• Set power settings to those that conserve the most electricity. • Use efficiently – turn on when there are a number of tasks to do; do not turn on and off for only one task. • Avoid screen-savers so that the computer will go into a power-saving mode. • Use a printer's duplexing feature to print on both sides of paper.	• Many people leave their computers on 24/7 and use screen savers which prevent the computer from going into power-saving mode.
End Of Use	• Ensure that hardware "take-back" programs are convenient for example, located at retail outlets or offer pick up from home or office. • Sell refurbished goods at regular retail outlets or online. • Provide safe and fair working conditions for employees at recycling and refurbishing facilities. • Improve processes used to reclaim the materials (for example metals) at the end of the product's use so that as much of the material can be recycled as possible.	• The retail cost of most electronics does not currently incorporate the cost of dealing with disposal and recycling. Adding end-of-use services may put the price of the product considerably above other products by other companies.

Recycling

Recycling involves collecting computers, sorting their parts, and processing their components into materials for use in new products.

After a computer is recycled back into basic materials, some of those materials can be made into other products – such as TV screens, metal auto parts, and playground structures.

Refurbishment

When you send your computer to be refurbished, it is repaired and tested to ensure that it works well enough for someone else to use.

Reuse

When you arrange for your computer to be reused (by donating it or giving it to someone), you give it an extended life. This can reduce the need to manufacture a new product which has positive consequences at every stage of the life cycle.

Disposal

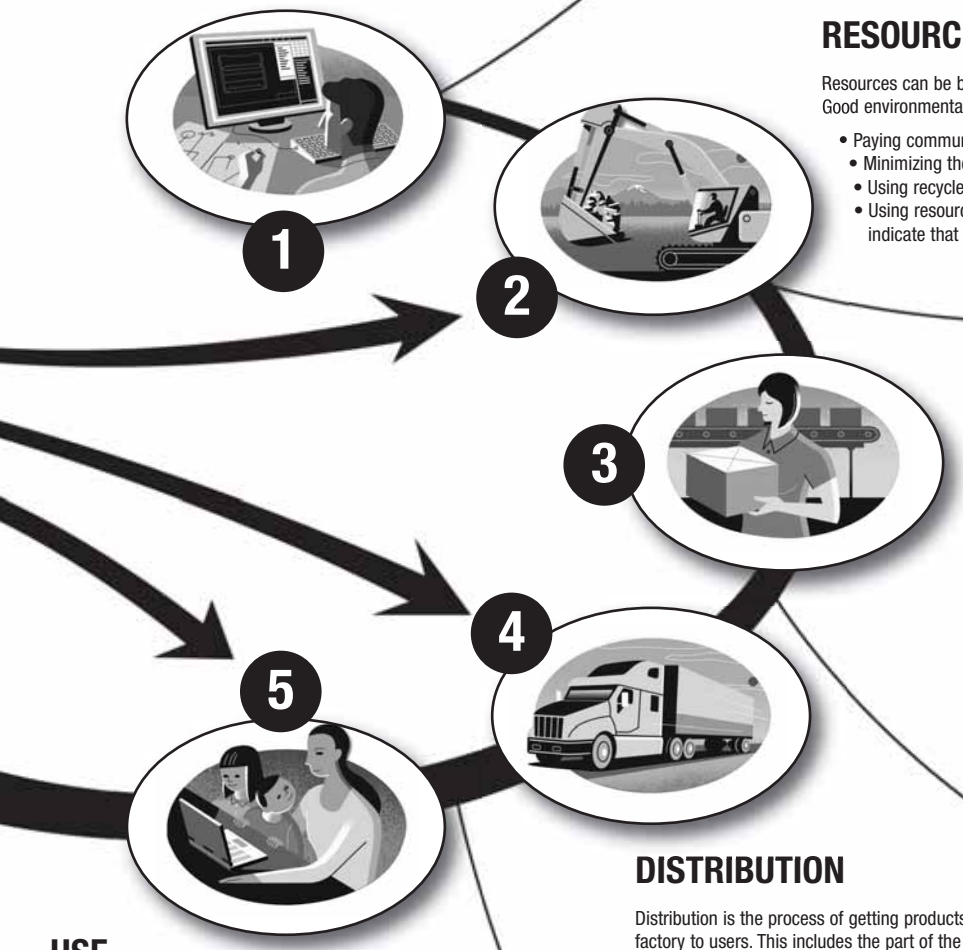
When people do not properly recycle, refurbish or reuse their computers, they often end up in landfills.

A LOOK AT THE LIFE CYCLE OF A COMPUTER

DESIGN

Designers and engineers make choices that affect how computers are made, how they are used, and how they look. They can make a desk top computer more environmentally and socially sustainable by, for example:

- Building it from materials that can be recycled;
- Making it easy to take apart for easier recycling;
- Designing it in a way that makes the price of the computer as accessible as possible to as many people as possible.



RESOURCES

Resources can be both natural and human-made. Good environmental and social choices could include:

- Paying communities a fair price for resources;
- Minimizing the amount of raw materials required;
- Using recycled materials;
- Using resources that have special certifications to indicate that they have been responsibly sourced.

MANUFACTURING

Manufacturing is the process of taking raw materials and energy and turning them into computers. The manufacturing process can be socially and environmentally responsible by, for example:

- Providing appropriate rights and benefits to workers;
- Reducing pollution.

DISTRIBUTION

Distribution is the process of getting products from the factory to users. This includes the part of the life cycle that involves retail stores. Environmental and social considerations during a computer's distribution may include, for example, minimizing:

- How far a product needs to be shipped;
- The amount of packaging used.
- In addition, manufacturers may give preferential treatment to retail stores that that have good energy conservation practices.

USE

How we use electronics can have both short and long-term impacts on communities around the world. To lessen the impact, we can do many things including:

- Activating power management settings;
- Sometimes adding upgrades to current products to extend their useful life instead of purchasing a completely new product.

PART A:

Objective:

Students learn about the **social and environmental** concerns and opportunities involved with the electronics industry regarding the end-of-use stage of a product's life.

Materials:

- Internet access for all students or Internet access plus an LCD projector for whole class viewing (preferred).
- Video #1: "Manufactured Landscapes" by Edward Burtynsky (you can probably find this at your local video store). The clip can be found at the following time signature: 23:25-28:38.
- Video #2:
  - i. Younger students:
    Go to http://edition.cnn.com/video/ and search for "Mining for Computer Gold".
  - ii. Older students:
    Go to http://webcast.un.org/ramgen/specialevents/unu-e-waste.rm (from the United Nations University about the UN StEP initiative – Solving the Electronic Waste Problem). Begin film at time signature: 17 minutes.

    Note: The accents of the speakers may make this film somewhat difficult for your students to understand. Therefore, **before** you show it:

    a. Preview it on your own.

    b. Explain to your students the general nature of the discussion.

    c. Pre-teach important vocabulary like: "Western countries", "industrialized countries", "multi-stakeholders", "legislation, regulations", "environmental burden".

    d. Post the reflection questions found in Part II of the procedure below.
- Reflection questions on overhead or chalk board
- The completed Life Cycle worksheets from Lesson 3

Activities:

Part I – for video 1:

1. Show students this clip about the electronics disassembly industry in financially poor countries from the Canadian film, "Manufactured Landscapes" – clip at time signature 23:25-28:38.
2. Ask students to write and/or draw a response to the following:
   a. Brainstorm words and pictures to capture your first impressions of the video.
   b. Picture your home computer and the computers at the school. What are the benefits and drawbacks to having your computers end up at the location shown in the video?
   c. What would you like to see happen to your own personal electronic equipment when you are finished with it?
3. Ask students to add to their personal schematic of the electronics life cycle (from Lesson 3) with ideas generated from the "Manufactured Landscapes" video clip. Invite students to add another piece of paper to the chart if necessary.
4. Ask students to discuss their responses with a partner.

Part II – for video 2:
(CNN video or UN StEP initiative video – see note in materials section above)

CNN video (younger students)

1. Ask students to get into groups of three to four students to discuss the following questions:
   a. What are two different types of end-of-use initiatives described in the video?
   b. What are some positive things about the initiatives you learned about?
   c. What are some potential problems with the initiatives?
2. Review their discussions as a class.

OR,

UN StEP initiative video (older students)

1. As a class, discuss the following questions to check for understanding:
   a. What are the goals of the StEP initiative?
   b. What does Klaus think the United Nations can offer to this initiative?
   c. Christian said that we need to consider three different dimensions of the e-waste problem at once. One of the dimensions was the social dimension. What were the other two?
   d. Klaus explains that a recycling program in Sierra Leone may be very different than one in Germany. Why?
2. Ask students to get into groups of three to four students to:
   a. Brainstorm everything they learned from the video.
   b. Discuss the positive things about the initiative.
   c. Discuss potential problems with the initiative.
3. Review their discussions as a class.

Part III:

Ask students to add to their personal schematic of the electronics life cycle (from Lesson 3) with ideas generated from both videos. Invite students to add another piece of paper to the chart if necessary.

PART B:

Objective:

Students consolidate their learning about the stages in the life cycle of an electronic product and learn and practice collaboration skills.

Materials:

- Easel, chart paper used on one side and markers for outdoor playing (preferred). Chalk/chalkboard for indoor playing.
- This kit with pages marked with sticky notes for quick reference to material for game questions.

Activities:

1. Divide students into mixed-ability teams of four.
2. Explain the rules and lead students through the Jeopardy-style trivia game described below:

Playing

- In this particular game (**unlike** the television game), students are asked a QUESTION and need to provide an ANSWER.
- The teacher is the host.
- Consider allowing students to have their notes in front of them.
- There is no need to post categories and questions. You may simply ask the questions orally.
- Team 1 is given the first opportunity to answer the first question. If they do not answer correctly, the question passes to each team until a team answers correctly. No matter which team answers that question correctly, new question 2 goes to team 2. This question goes around until one of the teams answers correctly. No matter which team answers that question correctly, new question 3 goes to team 3, and so on.
- The teams discuss the correct answer and help everyone to be prepared to answer (discuss and model what this looks like before play begins). Optional: the teacher chooses the team member that must provide the final answer.
- The class hums a song (perhaps more than once) that indicates that the clock is ticking while the playing team collaborates. Focus on thorough answers rather than speed.

Scoring

- For each question, a team has an opportunity to get 20 points: ten points for the correct answer and ten points for collaborating well.
- The decision to award the collaboration points or not is INDEPENDENT of whether or not the correct answer is provided.

During the Game, Use this Kit to Generate Questions About:

- Create questions by asking students for one or two examples that relate to different combinations of the following aspects of the life cycle of electronics products:
  - benefits/drawbacks
  - natural environment/human community
  - the different stages in the product's life cycle
  - focusing on near and/or far
  - focusing on now or in the future

  For example, ask students to name two examples of drawbacks that the end-of-use stage of computers may have on human communities far away.
- Energy efficiency questions threaded throughout the guide
- So What? Questions – refer to the students' charts posted around the room. Ask them to respond with a personal answer about why they care about _____?
- Facts from puzzles
- Also ask them about:
  - The 4R hierarchy (from sidebar on page 13)
  - The need to create a market for recyclables (from sidebar on page 29)

PART A:

Objective:

Students will learn about some of the positive changes that can be made at different stages in a product's life cycle to benefit humans and the rest of the natural world.

Materials:

- HP case study
- Internet access for each student to view video clips within case study or Internet access plus an LCD projector for whole class viewing (preferred)
- Scrap paper, masking tape, markers

Activities:

1. On page 24 there is a written case study with video links about changes Hewlett-Packard has made to its supply chain procedures and to some of its products in the interest of social and environmental gains. Your students will use this case study to practice the reading skills introduced in Lesson 1. Therefore:
   - Review the "Word Wall" procedure from Lesson 1. This time, have students use masking tape to stick the papers with definitions and pictures to their own desks and to the back of their chairs.
   - Review the graphic organizer procedure from Lesson 1. Before they fill in the content, ask students to show their graphic organizer to a partner to see if it works.
2. After the students have completed their graphic organizers, ask them to respond to the questions on the case study handout individually, and then discuss them in small groups.

PART B:

Objectives:

Students will:

- Develop skills and knowledge that contribute to the critical analysis of the design of everyday objects.
- Engage in an effective telephone call or email exchange with someone that they do not know in order to obtain information.

Materials:

- One of each of the following (preferably used/broken) objects (that can be damaged if necessary), one object per group of four students:
  - Toy designed for a child approximately aged four to ten (preferably one which contains different types of materials). **Note to teacher:** be careful not to use products that may have been recalled because of potential lead contamination in paint. See, for example, www.mattel.com/safety/us/.
  - Used juice box
  - Running shoe
  - Lawn chair/ desk chair
  - Broom
  - Backpack
  - Picture frame
  - Stapler

  * **Notes to teacher:**

  - *You may wish to use more sophisticated objects with older students*
  - *If you choose to use objects other than those listed here, ensure that the objects chosen are made/sold by companies that are represented on the business practice assessment sites listed in Lesson 6, Part B).*
  - *Do not use electronics products because of concerns related to the safe disassembly, handling and disposal of component parts and materials.*
- One "Examining Everyday Objects" lab sheet on page 28 **for each group**
- One new copy of blank Life Cycle Worksheet from page 18 **for each student**
- Paper for students to record their observations (preferably paper that is already used on one side)
- Screw drivers, scissors, safety goggles
- Communication skills tips found at www.resources4rethinking.ca/en/toolbox

Safety:

- Consider the particular students in each group when assigning the objects as some of the objects require more or less skill and safety precautions than others.
- Insist that all students wear safety goggles.
- Follow the general safety guidelines described at: www.education.gov.ab.ca/k_12/curriculum/bySubject/science/screport.pdf

Activities:

1. Gather the students into groups of two to four. Provide students with materials required to do the laboratory exercise outlined on page 28 and the important safety instructions outlined above.

2. Have the students complete the activity by following the steps on the laboratory sheet.

3. After students have completed the lab, help students to choose one of the questions marked by an asterisk about which they would like to find a more accurate answer. Help the group to identify the person that could answer this question for them – for tips, see www.resources4rethinking.ca/en/toolbox. Discuss whether or not the information can be more easily attained via email or the telephone.

4. To help your students develop their communication skills:
   a. Model an effective information-seeking telephone call using the tips found at www.resources4rethinking.ca/en/toolbox
   b. Share the tip sheet for composing an effective email found at www.resources4rethinking.ca/en/toolbox
   c. Have students choose one of the following activities depending on whether they are using the telephone or email:
      - Have each group create a script for the call that they will make and participate in a telephone call role-play. Encourage each group to have another group listen to the role-play.
      - Have each group draft an email. Groups should show their email to another group before sending it and ask for feedback.

5. After the students have found the new information, have each group summarize its findings as outlined in part C of the laboratory worksheet. As an alternative to class presentations (where many of the students in the audience are often only marginally involved), you might consider pairing up the groups and have them teach their partner group what they learned about their object. For tips about peer teaching, visit www.resources4rethinking.ca/en/toolbox.

HP CASE STUDY

HP understands that as one of the world's largest information technology companies, its greatest impact on the environment is through its products. Throughout its history, HP has been committed to being a good global citizen and to providing products and services that are environmentally sound throughout their life cycle. Its commitment dates back more than 60 years to HP's founders and is part of the company's DNA. Over the decades, policies and programs have been established to minimize the environmental impact of the product life cycle and to make its operations sustainable – examples of these can be seen below. In 2006, HP created a Stakeholder Advisory Council to provide strategic advice on its sustainability practices. The Council is made up of representatives from outside of HP, such as non-profit organizations, as well as senior HP managers.

DESIGN

HP pioneered a Design for Environment program in 1992. Product experts work with design, manufacturing and marketing teams to incorporate environmental considerations into the design stage of HP products. Some examples include:

- Using recycled polyethylene plastic recovered from HP inkjet cartridges and drinking bottles, instead of polycarbonate plastic in the carriage cover of some scanners;
- Many HP Deskjet printers are designed without paint, plating and flame retardants in outer casings, and have parts that snap together, resulting in fewer screws, and easier disassembly and recycling;
- HP All-in-One printers combine the functions of a printer, scanner, copier and fax in a single unit, reducing total materials needed by up to 40%, compared to separate devices. All-in-One printers also use less energy than all the devices would use separately;
- Sometimes customers encourage HP to replace materials in its products. For example, customers asked HP to remove brominated flame retardants (BFRs) from its products' external plastic cases. HP removed most of them more than ten years ago and removed the remaining in 2006. HP is also phasing out BFRs in remaining parts, as well as polyvinyl chloride (PVC), as alternative materials become available. HP's goal is to have all their products launched in 2009 onwards, entirely BFR and PVC-free.

SOURCING

To ensure that companies that supply parts and products to HP are socially and environmentally responsible, HP developed a Supply Chain Social and Environmental Responsibility policy. In addition, HP worked with its industry peers and major suppliers to establish the Electronic Industry Code of Conduct (EICC).HP's commitment is to:

- Protect worker rights;
- Improve suppliers' working conditions and health and safety;
- Reduce suppliers' environmental footprint;
- Collaborate with non-profit organizations to validate, inform and improve HP's efforts;
- Participate in industry-wide initiatives to help encourage other electronics companies to use some of HP's sustainability practices.

Many of HP's suppliers are located in China where, although there are still many cases of nonconformance with the Electronic Industry Code of Conduct (EICC), HP sees evidence that companies are starting to pay more attention to social and environmental responsibility initiatives. HP has observed progress in the following areas:

- Overtime control: change from no limit to a limit of no more than 60 hours per week for all work, including overtime, at some facilities;
- Minimum wage: some suppliers have changed practices so that workers are paid according to the local labour laws (including overtime wages);

SOURCING cont...

- Child labour: suppliers have tightened their monitoring procedures. Some suppliers recruit only workers over 18 years old, to minimize their risk;
- Communication: suppliers are listening more to workers;
- Environmental health and safety (EHS): improvements have been observed in industrial hygiene, safety, dormitory and canteen conditions.

MANUFACTURING

HP strives to replace a material when scientific data has established a potential health or environmental risk, even if its use is legally permitted. Before substituting a material for these reasons, HP identifies an alternative that has a lower environmental impact and meets quality requirements. For example, in 2006 HP replaced solvent-based paints on some workstations and digital televisions. The water-based paints HP is using avoid organic vapour emissions during the coating process and make the plastics using these paints easier to recycle.

DISTRIBUTION

Improved packaging can bring social and environmental benefits concerning the packaging itself and the transportation of the product. For example, when HP reduced its inkjet print cartridge packaging for North America, the smaller, lighter packages required fewer trucks to ship them. The estimated reduction in greenhouse gas emissions is roughly the equivalent of taking 3,600 cars off the road for one year. Assessing packaging environmental performance is complex, and involves trade-offs. For example, expanded polystyrene (commonly called "Styrofoam™") is easily recycled in many parts of the world, but in some cases its use increases package size compared to the use of other, less readily recyclable materials. Its use may reduce the number of boxes that can fit on a shipping pallet, which would increase the amount of fuel needed to ship each box. To assess all of these factors, HP bases packaging decisions on the best available evidence regarding overall impact.

The cost of alternatives can also impact substitution. In North America, cardboard boxes with 35% minimum post-consumer recycled content cost up to 10% to 15% more than boxes with only new cardboard. In addition, to perform as well as boxes made out of new cardboard, boxes made out of recycled paper fibre currently weigh more, which may raise transportation costs. In such cases, HP considers total costs, including transport and disposal, as opposed to material cost only.

For videos about HP social and environmental initiatives, please visit http://hpcorp.feedroom.com and use search term: "environment".

USE

HP makes products more energy efficient. For example, HP redesigned its Deskjet printers to reduce their power consumption to less than one watt when the printer is in the "off" mode. To ensure that an electronic device uses no energy at all, it must be unplugged. Of course, how products are used by their owners greatly determines their environmental and social impact. By using less electricity, people can reduce CO_2 emissions created during power generation and save money on their electricity bill.

HP provides products and services that help their clients rethink how they do business. In addition, HP examines its own practices. For example, HP inspected the settings of 183,000 monitors within its own company worldwide and found that almost a third were not set to take advantage of the energy-saving features. They were reset to enable energy savings after 20 minutes of inactivity. Virtually no users complained and the change saved 7.8 million kWh of electricity in 2005, equal to more than $600,000 in energy costs and more than 4,000 tons of CO_2.

END OF USE

More than 200 million new PCs are bought each year worldwide. This poses a significant challenge for HP and other suppliers, governments and users to limit the environmental impact of these products when they are no longer in use.

HP offers easy-to-use and environmentally responsible product end-of-life management services, including the choice of trade-in, asset recovery, leasing and recycling.

Having launched its recycling program in 1987, HP is a recognized leader in product recycling, now offering recycling in more than 50 countries, regions and territories. HP makes it easy to recycle used HP inkjet and LaserJet cartridges and rechargeable batteries free of charge and will pick up any brand of computer equipment from your home and/or workplace for a reasonable fee towards costs. HP's state-of-the-art processes and policies ensure that unwanted hardware and printing supplies are recycled responsibly. For more information, visit **www.hp.ca/recycle.**

Energy Efficiency Tips!

1. Turn on the energy saving settings on computers. You can find these settings in the Power Options menu in your computer's Control Panel. A computer in idle mode uses 20 to 50 times the power of a computer in standby mode. To increase savings, reduce the time delay before your equipment goes into a power saving mode.
2. "Phantom power" is the electricity that some electronics use even when they are "off" (in "standby" mode) so that they will turn on quickly when you turn them 'on'. Standby power accounts for 10 per cent of U.S. residential electricity consumption, or more than US$6 billion in annual electricity costs. That's equal to the output of 36 power plants.*
3. Stop "phantom power". Plug your cell phone chargers and battery chargers into a power bar. When the items no longer need to be charging, unplug the power bar or use a power bar with a timer that turns off automatically at a convenient time of day.

* www.backbonemag.com/Magazine/Big_Ideas_05010702.asp

END OF USE cont...

Plastics and metals recovered from recycled HP products have been used to make a range of new products, including auto body parts, clothes hangers and park benches. HP would like to use more of the recycled plastics in its own products, but the potential is limited for several reasons. The greatest difficulty is that most recycled plastics contain substances that HP has eliminated from its current products. Also, mixed plastics do not have the mechanical properties necessary for use in new electronics products, and it is difficult to separate dissimilar plastics during recycling. Finally, logistical constraints limit HP's ability to move large volumes of material from the regions where recycling is done to the regions where most new products are made.

In July 2007, HP achieved its goal of recycling one billion cumulative pounds of electronics and print cartridges, six months ahead of schedule, and set a new goal to recover two billion pounds by the end of 2010.

For more information about HP sustainability initiatives, go to **www.hp.com/environment** and **www.hp.com/hpinfo/globalcitizenship/gcreport/**

Questions

1. Based on the context (i.e. the words near the phrase), what do you think the author means by the term "supply chain"?
2. HP hires other companies to supply parts and to assemble some of its products. In your own words, explain how HP tries to encourage the other companies to follow HP's guidelines related to social and environmental responsibility.
3. HP calls corporate social responsibility, "global citizenship". In general, what do you think companies should consider when they strive to be socially responsible?
4. What is your general impression of HP's work regarding bringing sustainability principles into the life cycle of its products?
5. What are some potential drawbacks related to HP's approach?
6. a) Which example in the case study suggests that some of HP's sustainable practices are related to encouragement from their customers?

   b) Does this example encourage you to write to companies whose products you buy to tell them your preferences regarding their business practices? Why or why not?

EXAMINING EVERYDAY OBJECTS

Purpose:

To examine an everyday object to determine the pluses and minuses of the design when considering **the perspective of all living things, near and far, now and in the future.**

Procedure:

A. Take a good look at your object. Take it apart as necessary (be careful not to lose any parts).

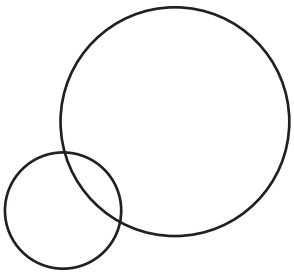
Discuss the following questions as a group and then record your answers on your **own** paper (each person should record her/his own observations). If you do not know the answer, take a guess.

1. What are your initial impressions about how it was designed?
2. a) Where was your object made?
   b) Who do you think made your object?
   c) What do you think the working conditions were like for the person who made your object?
3. a) What types of materials are used in your object?
   b) What is the approximate percentage of each material?
   c) Sketch a pie graph to represent this distribution of materials.
4. What is the financial value of each of the raw materials – (low, medium or high)?*
5. What is the non-financial value of the materials to humans and other living things (low, medium or high)? (For example, oxygen is extremely valuable to all of us, but it has low financial value.)
6. Are any of the materials in your object recycl**ed** (i.e. were they used in something else before) [not recyclable]?*
7. Are any of the materials in your object recycl**able?**
   a) in your blue box program?*
   b) in some other way? (e.g. you need to take it somewhere special to be recycled)*
      i. If yes, is money exchanged in this transaction? If yes, does the service cost money or does the owner receive money for the material?*
8. What kind of products can be made from the recycled materials at your object's end-of-use stage?
9. How easy/difficult is it FOR YOU to **repair** the object (very easy, somewhat easy, somewhat difficult, very difficult)?
10. How easy/difficult is it FOR A PROFESSIONAL TECHNICIAN to **repair** the object (very easy, somewhat easy, somewhat difficult, very difficult)?*
11. How much money would it cost to repair the object?*
12. How much money would it cost to purchase a new object?
13. Do you think that someone will be using this object in eight years?
14. Do you think that anyone in your community will be using an object similar to this one in eight years?

B. Choose **one** of the questions marked with an asterisk and find a more accurate answer to the question by calling stores/technicians/the manufacturer etc. and/or emailing as necessary (your teacher will help you with this).

C. Reflection:

Use a new life cycle chart to summarize the pluses and minuses of the design of this object from the **perspective of all living things, near and far, now and in the future.**



Creating a Market for Recycled Materials

Currently, most products are made from new rather than recycled materials. Why? Recycled materials are sometimes more expensive than products made from new materials. Why?

- Currently, the financial cost of new materials does not usually include all of the costs involved in harvesting that material. For example, the cost of harvesting and refining petroleum to make plastic does not include the cost of municipal recycling programs, the cost of health care related to increased air pollution, etc. (For more information, about the true cost of raw materials visit: **www.epa.gov/epaoswer/non-hw/muncpl/fullcost/costs.htm#environmental)**
- When recycled materials are ground up, they often contain many different kinds of materials. Changing the recycled materials into new products sometimes requires more work than making the products from pure, new raw materials.
- The infrastructure needed to gather materials at the end-of-use stage is not in place in many countries (for example good roads, recycling programs, etc. are not available in many countries.)

In order to encourage manufacturers to use recycled materials, we must purchase these products when they are available and ask for them when they are not available. When facing a financially higher price tag, we, as consumers, must also think of the full cost of the product – to Earth and all living things.

Energy Efficiency Tips!

1. In 2004, California imposed limits on standby electricity consumption for a number of devices. As of January 2006, standby mode could consume no more than three watts; this fell to 0.75 watts in 2007 and 0.5 watts in January 2008. Applying this standard in all wealthy countries would reduce CO_2 emissions by the same amount as removing 18 million cars from roads.[1]
2. A single desktop computer with the power settings turned on saves enough energy to power a 75W light bulb continuously for over a year. Screen savers were once designed to protect the screen, but today's monitors no longer need this feature.[2] Today, screen savers are purely decorative and when on, they use almost as much electricity as you do when you actually use your computer.[3] Turn off your screen savers to reduce energy use.
3. Buy electronic products that have the Energy Star® label on them. These products are up to 50 per cent more energy efficient than conventional products.

1. www.backbonemag.com/Magazine/Big_Ideas_05010702.asp
2. www.onedayvancouver.ca/ask_archive.php?type=2&id=31
3. www.energysolutionsalberta.com/default.asp?V_DOC_ID=1209

PART A:

Objective:

Identify opportunities to improve all stages in the life cycle of an everyday object.

Materials:

- The completed product Life Cycle Worksheet from activity 5B
- A new copy of the product Life Cycle Worksheet (on page 18)
- The object examined in Lesson 5B

Activities:

1. Ask students to join the students they worked with in Lesson 5B. Explain that they are to use the pluses and minuses that they identified in Lesson 5B to look for opportunities for positive change to the life cycle of the object they examined. For example: Design Stage: the object could be fastened together with materials that make it easy to take apart the object for repair and for easy recycling of its components; Sourcing Stage: the object could be made from recycled materials; Distribution Stage: the object could be shipped using trucks that have hybrid engines. The group should use a new copy of the product Life Cycle Worksheet on page 18 to help them to brainstorm opportunities for changes at **each stage** of the product life cycle that would have positive consequences for humans and other living things, near and far, now and in the future.

2. After students have completed step 1, ask them to look for potential trade-offs given the changes they have made to the various stages of the product's life cycle (e.g. regarding cost, longevity, product integrity, etc.). For example, using bioplastic instead of conventional plastic may have benefits at the Sourcing, and End-of-Use stages, but it is more expensive and sometimes it is heavier which may have drawbacks at the Distribution stage.

3. Finally, ask the students to use different coloured highlighters to indicate:
   - Which changes they are confident that they would like to see made.
   - Which changes they would need more information about before they could decide whether or not to make them.
   - The students should leave uncoloured any changes that they would not support.

PART B:

Objectives:

- Students will learn how to communicate to companies about aspects of a company's business practices that the student appreciates and/or would like changed.
- Students will gain experience and confidence in communicating to companies.

Materials:

- Research skills tip sheet to help students to identify the name and email address of the appropriate person in a company to contact regarding the students' thoughts on the life cycle of the company's product. Found at www.resources4rethinking.ca/en/toolbox.
- Internet access for all students

Activities:

1. Help each group to brainstorm what type of company makes the object they examined in Lesson 5B (e.g. food packaging; stationery supplies, etc.) and the specific names of companies that make the object.

2. Some non-profit organizations and business organizations rate the performance of companies with respect to the companies' social/environmental practices. Ask students to use a search engine to find three such rating reports. Suggest search terms for your students to use, for example, "ethical companies", "most admired companies", "ethical shopping", "corporate social responsibility rating", "best corporate citizens", etc. (We suggest trying to conduct the search yourself before the lesson and try out some of the sites that you find.)

3. Ask your students to use the sites to:

   Identify two companies that make the type of object the student examined in Lesson 5B. One company should have a positive rating on at least one of the sites and one of the companies should have a poor rating on at least one of the sites.

   Note: Neither HP nor LSF can vouch for the credibility of these sites.

ALTERNATIVE APPROACH: If finding the rating sites seems like too much for your students to sort out, you may wish to take your students to a local store or simply have them look in their homes to see if they can identify companies that produce the products the students analyzed in Lesson 5B and 6A.

4. Ask students to take some time to revisit their own "So what?" charts. Invite them to emphasize things on their "So what?" chart that feel especially important to them using markers/highlighters and to add new points to the chart. If they visited rating sites, ask them if they care about any of the accomplishments and/or drawbacks in the life cycles of the products highlighted by the rating sites they visited? Why or why not?

5. To each company, the students will send a letter identifying:
   i. The individual student's thoughts about the company's performance. (Highlight that it's important for students to congratulate/thank companies for good performance. It is very easy to complain, but rare that we acknowledge when something is done well. It is important for companies to know that people care about the measures they adopt that foster greater social and environmental justice.)
   ii. Specific suggestions about how the company can improve the social and environmental consequences of producing the product (from the students' own analysis of the products in Lesson 5B and Lesson 6A).

6. Provide a brief lesson/demonstration on:
   a. How to locate the name and email address of a person at a company that manufactures a particular item – see tips at www.resources4rethinking.ca/en/toolbox.
   b. Review email writing tips used in Lesson 5B found at: www.resources4rethinking.ca/en/toolbox.

7. Have a peer edit each student's email before sending them out.

For general tips on ethical shopping, visit **www.newint.org/features/2006/11/01/action/**

Why Provide Students with an Opportunity to Work Toward Positive Change?

"Service learning bestows responsibility on adolescents weaving them into society rather than alienating them from it."

(David Orr Ecological Literacy 1996, 33)

Teaching students about issues of concern without providing them with an opportunity to do something constructive about the issue, may cultivate apathy. Furthermore, providing opportunities for authentic action:

- Engages and motivates students by making learning relevant and addressing diverse learning styles;
- Enhances learning through authentic experiences which is related to improved test scores on standardized tests (www.seer.org/pages/GAP.html);
- Boosts the credibility of educators as students see that we "walk the talk".

If we want students to become active citizens, we must create safe spaces for them to practice their citizenship skills so that they may build confidence to use them outside of the school context. So…take action!

PART A:

Objective:

To provide students with an effective process and an opportunity to make positive changes in their community.

Materials:

- Different action ideas found below
- Activities and guide to taking action found at www.resources4rethinking.ca/en/toolbox

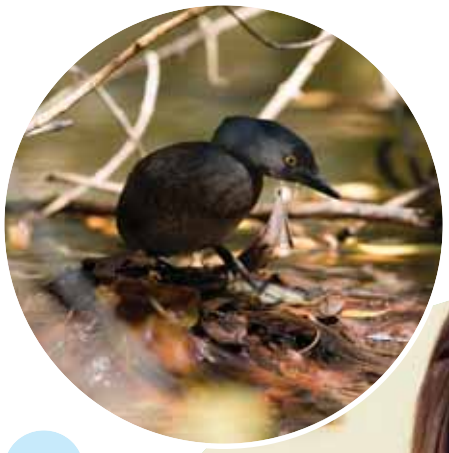
Sample Action Ideas:

- Create and execute an action plan to reduce energy consumption of electronics equipment at home, at school, or in a local community building (e.g. library, arena, etc.). Revisit the energy efficiency tips on the handouts from this unit for conservation suggestions.
- Rent a Kill-a-Watt meter and/or a Power Cost meter from your local library and/or utility company to investigate energy efficiency opportunities in your home.

  Kill-a-Watt Meters
  Kill-a-Watt Meters allow citizens to plug in individual appliances and calculate the amount of electricity being used during a specific time period. The meters will help residents make informed decisions about appliances and products used throughout the home. For example, someone could use this device to calculate the cost of running an old, second refrigerator in the basement.

  Power Cost Monitors
  Power Cost Monitors, which are easily attached to the electricity meter of the home, provide information on energy usage through a portable display device that can be placed anywhere in the home. It can show at a glance how much electricity is currently being used in the house, in both dollars and cents, and in kilowatt hours. As people turn on or off electrical appliances, they will be able to see the adjustment right away on the clock-sized portable display. Tests in Ontario and elsewhere have proven that householders who use real-time feedback can reduce electricity use by as much as five to twenty per cent.

- Determine your school and/or school board's policy regarding choosing electronics companies with which to do business.
- Set up a computer hardware "Pass it on" and recycling program in your school and/or at a family member's place of work. A video that may help students to promote the idea and/or help them design their own promotional materials can be found at www.epa.gov/epaoswer/osw/conserve/plugin/video.htm. Questions students may wish to ask recycling organizations to which they will send hardware to be recycled can be found at www.hp.ca/corporate/recycle/recycle.php
- Identify recycling programs that are available in your community for household products such as paper, newspaper, glass, aluminum, plastic, used appliances, batteries, hazardous waste, etc. What's accepted and not accepted? Encourage people in your community to participate effectively.
- What legislation exists in your province to regulate the recycling of electronics, computer equipment, packaging, etc.? Contact your MP and your MPP for help. Use this site to help you contact your MP: www2.parl.gc.ca/Parlinfo/Compilations/HouseOfCommons/MemberByPostalCode.aspx?Menu=HOC
- Determine your family's policy regarding choosing electronics companies with which to do business. Share with your family the criteria you would like to use for choosing an electronics company with which to do business.
- Identify something in your home that your family is considering replacing. Identify a way in which the old item can be repaired instead of replaced. If it can be repaired, provide your family with an analysis of the social and/or environmental and/or financial costs and benefits of repairing the item.
- Create an education campaign to encourage people in your community to consider the entire life cycle of a product when purchasing an item.
- Challenge: Find out about "closed loop" legislation in other countries. (For example, see www.cartakeback.com/en/faqs.asp for information about the car take back program in the United Kingdom.) Write a letter to your local MP and MPP about your thoughts about this type of legislation.



Steps on the Spiraling Path to Taking **Effective** Action

For activities related to this action process, go to **www.resources4rethinking.ca/en/toolbox**

1. Decide on Goals and Parameters
2. Choose an Issue and an Action
3. Build Motivation
4. Research
5. Make a Plan
6. Define Success
7. Identify Barriers and Supporters
8. Teach/Learn Skills
9. Do it!
10. Celebrate
11. Reflect

SUMMATIVE ASSESSMENT ACTIVITY: MIND MAP

Objective:

Students use a mind map to summarize and demonstrate their learning and their reflections about the unit.

Materials:

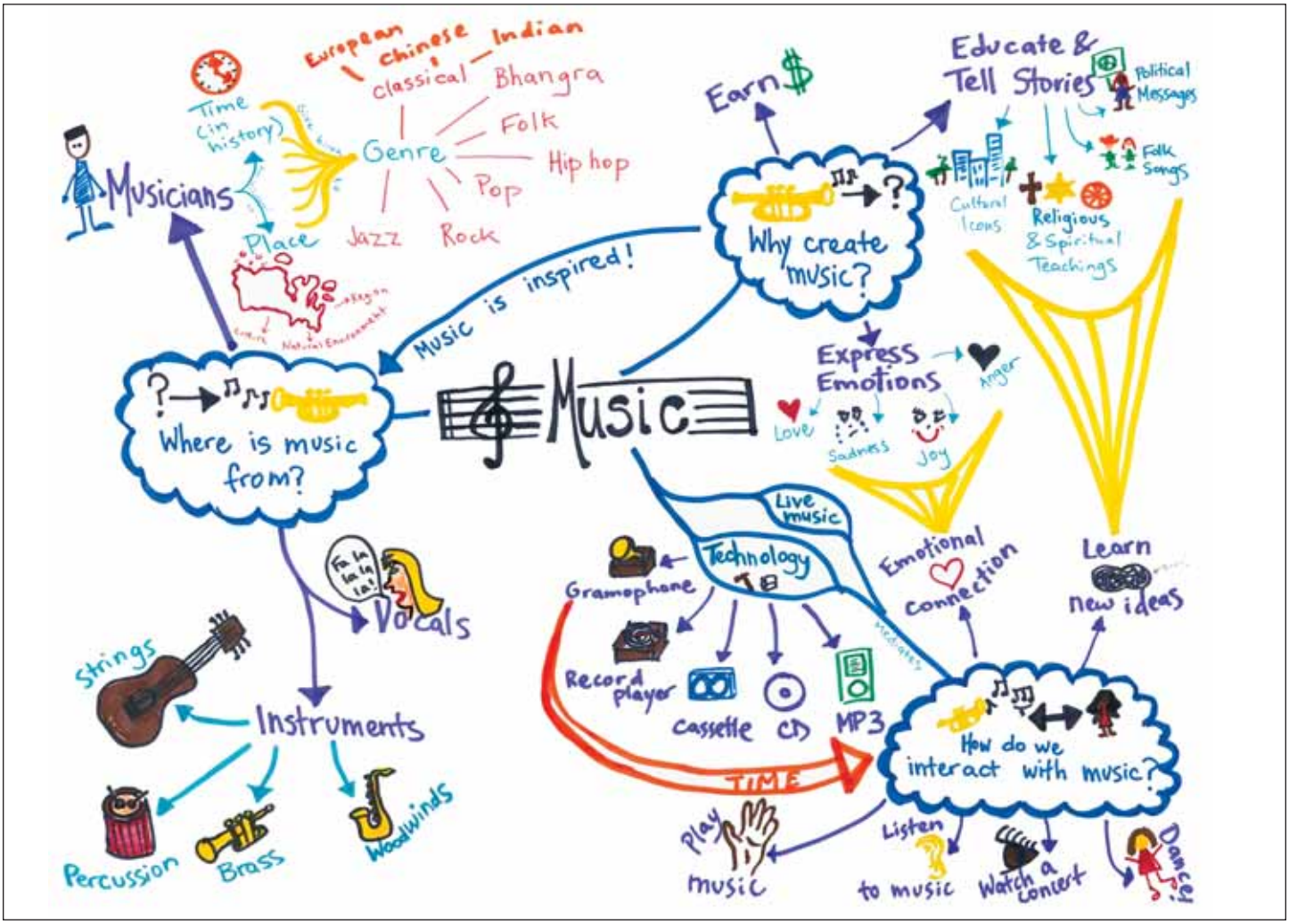
- Big pieces of paper (preferably used on one side), markers that do not bleed through the page, sticky tack or masking tape
- Your own mind map to share with the students. For tips and examples, click these links.
- Assessment rubric that you develop. See samples below.

Procedure

1. Share your model concept map or create one together as a class around a theme that almost everyone can contribute to (e.g. soccer, family, movies, etc.). See this model and the illustration below.
2. Give each student a piece of chart paper. Have each student create a circle in the middle of the paper with the words: "The Life Cycle of Electronics".
3. Ask students to write words and/or pictures around the circle that represent different things they learned about the issue and their own reflections on what they've learned. You might encourage them to use pencil at first. If they want to add details about the words or pictures, you might have them do it on scrap paper and tape them in the appropriate spot in case they want to move the ideas around.
4. Once students have had time to work on their ideas, use your model to discuss the idea of illustrating how the different concepts on the map are connected.
5. Encourage the students to think about and illustrate how the different ideas on the map are connected.
6. Have students pair up and explain to each other what their map represents. Encourage them to actively listen to suggestions from their partner.
7. Encourage students to revise their maps based on the feedback from their partners.

Rubric: Some helpful concept map rubrics can be found at:
http://herh.ccrsb.ca/staff/ComeauT/Exploring%20Technology%2010/Mind%20Map%20Rubric.pdf

http://www.clayton.k12.mo.us/cms/lib/MO01000419/Centricity/Domain/206/Mind%20Map%20Rubric.pdf



SOURCES

1. Source: http://www.copper.org/innovations/2000/01/speeding_up.html
2. Source: “Stuff: The Secret Lives of Everyday Things”, John Ryan, pg. 49
3. Source: http://www.decoin.org/history.html
4. Source: http://www.pollutionprobe.org/Reports/ARP06.pdf, pg. 11
5. Source: http://www.copper.org/innovations/how/howdo4.htm
6. Source: http://adaptation.nrcan.gc.ca/posters/curriculum/science2/ontario_e.php
7. Source: http://www.copper.org
8. Source: http://resources.schoolscience.co.uk
9. Source: ftp://ftp.fao.org/docrep/fao/meeting/011/j9289e.pdf
10. Sources: http://www.davidsuzuki.org/About_us/Dr_David_Suzuki/Article_Archives/weekly11109901.asp
    http://www.defra.gov.uk/environment/acre/biodiversity/guidance/06.htm and http://www.nwri.ca/research/genetics-e.html
    http://www.davidsuzuki.org/About_us/Dr_David_Suzuki/Article_Archives/weekly10279901.asp
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11. Source: http://www.davidsuzuki.org/Forests/Forests_101/boreal.asp
12. Source: http://www.innovationstrategy.gc.ca
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