STEPWISE Case Method

CELL PHONES - A NEW PLAN NEEDED?

Introduction

Cell phones are almost as common today as TV sets in homes. It is estimated that there are 1.6 billion cell phone subscribers worldwide and this could increase to 2 billion by 2006 (www. zdnet.co.uk). Cell phones have become a commodity that is undergoing a rapid evolution. Technology continues to improve to make cell phones smaller, more efficient, and equipped with countless 'bells and whistles' including games, cameras, email access, browser capability. The latest 'gimmick' in wireless technology is using cell phones to pay for goods and services simply by passing the phone over a scanner that will capture a data-encrypted stream from your phone for authorization. In fact, Nokia has just joined with Visa to embed radio-frequency ID chips in cell phones for this purpose. It also won't be long before 3 gigabyte cell phones double as MP3 players (New Scientist). Based on industry research, cell phone users currently upgrade their phones on average every two years and as technology options continue to improve, users are trading in older models even more quickly. Because cell phones are so cheap to produce, and technology is changing so rapidly, it is predicted that new phones will soon have an obsolescence of a year or less. In fact, some companies have been marketing "disposable" phones since 2003. It is estimated that cell phones in the US alone will be thrown away at a rate of 130 million per year starting in 2005 and this equates to 65,000 tonnes of waste containing toxic metals (www.earthworksaction.org). Obviously, the implications of such wide spread use should be a serious concern but very little is being done to curb this trend.

The outlook on the human health and environmental impact of cell phones is not good. The Environmental Protection Agency (EPA) in the US classifies cell phones as hazardous waste because they contain persistent toxic metals that accumulate in the environment such as mercury, cadmium, lead, gallium, arsenic, antimony, beryllium, copper, nickel and zinc. When discarded phones are sent to an incinerator or a landfill site these toxic metals (65,000 tonnes of them in 2005!) decompose over time and can leach into soil and ground water. This can have a significant environmental impact – streams, lakes and rivers could become contaminated, wildlife could suffer, drinking water could be impacted, and human health concerns could arise - some toxins have also been linked to cancer and neurological disorders. However, the issues associated with cell phones don't stop at pollution from toxic waste. For instance, there is considerable environmental damage and energy consumption required to mine these metallic ores, radio-frequency waves are under suspicion for health impacts, and if that isn't enough, cell phones have even been at the center of a devastating civil war.

STEPWISE ANALYSIS

<table>
<tr><th>WISE Issue</th><th colspan="3">Resources/Factors in Decision-making</th><th>WISE Action</th></tr>
<tr><td rowspan="4">Impact of refuse on the environment</td><td>STSE Expertise</td><td>Products Expertise</td><td>Activism Expertise</td><td>Possible Action Projects</td></tr>
<tr><td>Environmental and health impacts associated with the production, use and disposal of electronic devices.</td><td>Extraction, purification, and refining of minerals for use in technological devices

Physical characteristics of minerals and alloys.</td><td>Assessing the benefits and hazards of a specific technology

Developing and carrying out an action plan</td><td rowspan="2">Community campaign e.g., old cell phone collection drive followed by proper disposal.

Personal lifestyle change e.g. avoiding use of cell phones; dispose of old cell phones only when malfunctioning; dispose of broken cell phones through organized cell phone disposal program.</td></tr>
<tr><td>NoST Expertise

Opportunities to explore:
the economic and cultural factors that can influence science and technology</td><td>Skills Expertise

Expertise for:
Questioning, hypothesizing, experimenting, developing prudent conclusions</td><td>Project(s) Findings

Results and conclusions from correlational studies on community cell phone use and disposal practices</td></tr>
</table>

Prior Knowledge

Students should be able to:

- Minerals such as gold are mined, refined, and used in the production of technological products.
- The disposal of technological devices adds to the volume of landfill, and pollutes the environment with toxic byproducts.

Curriculum Expectations Addressed

This case is appropriate for the following grades and strands:

Grade	Course	Strand	Specific Expectations Addressed
7	Science and Technology	Life Systems: Interactions in the Environment/Interactions within Ecosystems	IE1.01 investigate the impact of the use of technology on the environment (e.g., greenhouse effect, disposal of obsolete technology such as computers and personal audio devices, use of pesticides) and identify personal choices that can minimize these impacts. IE1.02 identify factors (e.g. economic, social, environmental) that should be considered in the management, use and preservation of the environment for sustainability (e.g., the cost of recycling, environmental impact of ecotourism) and communicate the pros and cons of the decisions.
		Structures and Mechanisms: Structure and Function	SF1.01 describe the life cycle of a familiar structure (e.g. basketball shoe, cell phone, hand bag), identifying the need it meets and describing its production, use, and eventual method of disposal.
9	SNC 1D, SNC 1P	Chemistry: Atoms and Elements	CAE1.2 Assess the social and environmental impact of the production, use and disposal of elements or compounds and propose a plan of action that addresses the impact. Issue: What are the economic benefits and environmental costs of diamond/metal mining?
11	SCH 3U	Chemical Reactions	CR1.1 research and report on the safety concerns related to human health or the environment, and associated with the production or use of a chemical substance in industry (e.g., mining, agricultural, pulp and paper, automotive).
12	SES 4U	Earth Material	EM1.1 assess the direct and indirect impact of the exploration, extraction and refinement of Earth materials (e.g, gold, uranium, diamonds, sand, gravel, dimension stone, and fossil fuels) on local, provincial or national economies (e.g., metals mined in one community are refined in a second, processed in a third, used to assemble products in a fourth and then sold all over the province or nation.)

Student Activity

1) Use the periodic table to identify mercury, cadmium, lead, gallium, arsenic, antimony, beryllium, copper, nickel and zinc
   - What group of elements do each of these belong to?
   - Compare the physical and chemical properties of these substances and consider what makes them attractive for technology manufacturing
   - Investigate whether these substances are mined in Canada
2) What are some of the environmental impacts associated with mining these substances?
3) What is the impact of heavy metal accumulation in the natural environment?

Coltan – the new diamond?

Currently, one of the world's most sought after materials is an ore referred to as columbite-tantalite or 'coltan' for short. When coltan is refined it produces a highly heat-resistant metal powder called tantalum that is becoming increasingly vital to life in the twenty-first century. Tantalum is used in everything from mobile phone to computer chips to stereos and VCRs. Tantalum is a rare, hard and dense metal, very resistant to corrosion and high temperatures and is an excellent electricity and heat conductor. It is used in the microchips of cell phone batteries to prolong duration of the charge. In addition, these properties make it a vital element in creating capacitors (the electronic elements that control current flow inside miniature circuit boards). Tantalum capacitors are used in almost all cell phones, laptops, pagers and many other electronics. (www.globalpolicy.org)

Student Questions:

- How is coltan refined?
- Is coltan mined in Canada? If yes, where?
- What other substances have been used to hold charge in batteries?

How Is Coltan Mined?

Coltan is even more enticing for corporations because extraction does not entail heavy capital costs --it is obtained by digging in the mud. Coltan is mined through a fairly primitive process similar to how gold was mined during the 1800s. Dozens of men work together digging large craters in streambeds, scraping away dirt from the surface in order to get to the coltan underground. The workers then filter water and mud in large washtubs, allowing the coltan to settle to the bottom due to its heavy weight(about 3 x heavier than iron). A good worker can produce one kilogram of coltan a day. Coltan mining is very well paid in Congo terms. The average Congolese worker makes $10 a month, while a coltan miner can make anywhere from $10 to $50 a week.

The Feeding Frenzy

As the high-tech boom took off in 1999, so did the demand for coltan. At one point, the price of coltan skyrocketed to as much as $400 a kilogram and mobile phone companies, such as Nokia and Sony, struggled to meet demand. Sony had to delay its launch of PlayStation 2 in North America because of shortages of coltan. Although this demand has subsided somewhat, sales of tantalum are still valued at as much as $6 billion a year. So, most would ask "what is the problem?". Well, it turns out that 80% of the world's supply of coltan is situated in the eastern part of the Democratic Republic of the Congo (DRC). In many situations, such a find would be great news for the people of a country however this has not been the case in the DRC. The DRC has been immersed in civil war since August 1998 and much of the war has focused around control of the country's natural resources, including coltan (DRC has two-thirds of the world's cobalt and the second-largest reserves of industrial diamonds, as well as gold, copper, and coltan). Corruption, amassing of massive personal wealth, and mounting debt lead to a significant economic downturn that has plagued the country for years. Militia groups and rebels arose and began fighting for control of the rich natural resources in the area. Rebel groups, many funded and supplied by neighboring Rwanda and Uganda, have been exploiting coltan mining to help finance the civil war. There are reports that forces from neighboring Rwanda, Uganda and Burundi are involved in smuggling coltan

from Congo, using the revenues generated from the high price of coltan to sustain their efforts in the war. By one estimate, the Rwandan army made at least $250 million over a period of 18 months through the sale of coltan, even though no coltan is mined in Rwanda.

It has been reported that rebel groups forced farmers and their families to leave their land, they overran the national parks, and chased people off land where coltan was found and even forced them to work in the mines. As a result, there has been widespread destruction to agriculture, the natural environment, and the social effects of such actions have been enormous. It is estimated that 3.3 million people have died since 1998 as a result of the conflict, primarily from disease and starvation. In addition, more than 2.25 million people have been driven from their homes (www.globalissues.org). The coltan trade and battle over the other minerals and resources has also affected DRC's wildlife and environment. National Parks that house endangered gorillas and countless other animals have been often overrun by mining. Increasing poverty and hunger from the war, as well as more people moving into these areas to work in mining has resulted in clearing out large chunks of the area's lush forests and the massacre of these animals, including endangered lowland Gorillas, for bush meat. In Kahuzi Biega National Park, for example, the gorilla population has been cut nearly in half, from 258 to 130.

What is Being Done

Since the peak of the exploitation in 2001 many corporations have instituted requirements that indicate that their suppliers of coltan must comply with company environmental, ethical and human-rights policies, and in some cases corporations have pushed for suppliers to become certified as legal traders of coltan. However, even with these measures corporations admit that it is almost impossible to guarantee that their coltan is coming from legal and reputable sources. This is still an unfolding and very real issue. On February 25th, 2005 nine UN peacekeepers were killed in the eastern Congo by rebel groups who are still fighting to control natural resources such as coltan.

Teaching suggestions:

- Have students brainstorm "what can we do?" together – have them consider both the impacts of hazardous waste from cell phones and the impacts of illegal mining activity
- Have students prepare a presentation or a marketing campaign either about exploitation of resources and mining for technology, recycling of cell phones, cell-phone refurbishment/redistribution, or any other ideas they may come up with
- Help students hold a community-wide 'old-cell phone' drive as there are a reported 500 million cell phones sitting in peoples' houses that are no longer in use
- Have students write letters to corporations encouraging manufacturers to design cell phones for 100% recycling and encourage them to set up effective take-back and responsible recycling programs on a much larger scale than we have now. (These efforts are underway in other countries - Australia has implemented a nationwide cellphone recycling program and the European Union is considering actions to make manufacturers responsible for electronic product wastes)

Possible extensions for student use:

- Explore the life cycle of the cell phone, including how silicon chips are made, found at http://www.enviroliteracy.org/article.php/1119.html and explore how cell phones work at http://www.howstuffworks.com/cell-phone.htm
- Have students prepare a report on the types of metals involved in technology and why they are used
- Have students prepare an 'action plan' for reducing cell phone waste
- Could explore suspicious health risks from prolonged RF exposure and potential impact to blood-brain barrier in humans, especially children

Assessment Rubric

Criteria	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	- demonstrates minimal understanding of the extraction, refinement, and use of rare metals in the production of technological devices such as cell phones.	- demonstrates some understanding of the nature of the extraction, refinement, and use of rare metals in the production of technological devices such as cell phones.	- demonstrates considerable understanding of the extraction, refinement, and use of rare metals in the production of technological devices such as cell phones.	- demonstrates a thorough understanding of the extraction, refinement, and use of rare metals in the production of technological devices such as cell phones.
Application	- connects knowledge of the use of rare and toxic materials in technological devices and the environmental impacts associated with improper disposal of those devices with minimal effectiveness.	- connects knowledge of the use of rare and toxic materials in technological devices and the environmental impacts associated with improper disposal of those devices with some effectiveness.	- connects knowledge of the use of rare and toxic materials in technological devices and the environmental impacts associated with improper disposal of those devices with considerable effectiveness.	- connects knowledge of the use of rare and toxic materials in technological devices and the environmental impacts associated with improper disposal of those devices with a high level of effectiveness.
Communication	-communicates information with limited clarity - Information is communicated with minimal organization. -employs language skills with limited effectiveness.	- communicates information with some clarity - Information is communicated with some organization. -employs language skills with some effectiveness.	- communicates information with considerable clarity - Information is communicated with considerable organization. -employs language skills with considerable effectiveness	- communicates information with a high degree of clarity - Information is highly organized. -employs language skills with a high degree of effectiveness.

References

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http://www.earthworksaction.org/ewa/collectivegood.cfm - recycling cell phones

http://www.globalissues.org/Geopolitics/Africa/Articles/TheStandardColtan.asp

http://www.enviroliteracy.org/article.php/1119.html - life cycle of cell phone

http://www.wrm.org.uy/bulletin/69/Congo.html

http://www.eco-cell.org/cellwaste.asp#moreinfo - resources

http://www.hc-sc.gc.ca/english/iyh/products/cellphones.htm - health issues associated with cell phones

http://www.newscientist.com/channel/info-tech/ - MP3 and VISA

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http://www.cbsnews.com/stories/2002/05/08/tech/main508346.shtml - cell phone waste