



## Lesson Plan 020106

“Toxic Transmission” Teacher Information - Pg 1  
(Target: Grades 7-9)

### Objectives:

1. Create awareness for technology pollution and for its growing threat to public health.
2. Create awareness for the specific area of cell phone pollution, especially its ripple effects in other parts of the world.
3. Challenge students to become active in supporting safe cell phone collection and recycling.
4. Challenge schools and other organizations to begin participating in cell phone recycling and collection efforts.

### Materials/Sources:

1. “Toxic Transmission” Cell Phone Pollution Facts Page.
2. National Geographic Cell Phone / Saving Apes Article.
3. “Toxic Transmission” Activity Page.
4. “Toxic Transmission” Classroom Comic.
5. Computers connected to the Internet/world wide web.

### Methods:

1. Distribute “Toxic Transmission” Cell Phone Pollution Facts page and National Geographic Cell Phone / Saving Apes Article to students. Have them spend 15 minutes reading and reviewing these pages.
2. After students have read these pages, hand out the “Toxic Transmission” Activity page and Classroom Comic. Have them complete the activity page in class.
3. HOMEWORK: Using the web resources on the Classroom Comics page and other searches, students will conduct online research about:
  - A. Different types of cell phone and technology collection and recycling services and programs. Students will choose the program that interests them most and give reasons why they chose it.
  - B. Various dangers posed by electronics waste. Have each student choose one type of electronic device (computer, CRT monitor, mp3 player, handheld PDA, etc.) and find facts about current numbers in circulation, estimates of potential landfill waste (by the ton or millions of units), newer, less toxic technologies.
4. NEXT CLASS PERIOD: Student-led discussion.
  - Question 1: What cell technology recycling/collection program interested you most? Why?
  - Question 2: Which type of electronics technology do you think is the most potentially dangerous to soil and groundwater? Why?

### Background Information for Teachers:

*INFORM, Inc. is a national environmental research organization, based in New York City, which identifies practical ways of living and doing business that ensure environmentally sustainable economic growth. For over a decade, INFORM has been a leader in the study of closed-loop materials systems and the practical application of extended producer responsibility (EPR),*

*a policy approach designed to hold manufacturers responsible for their products at end of life. INFORM has published over 100 reports, including more than a dozen studies and manuals for businesses, policy makers, schools, and communities on strategies for preventing wastes at their source.*

*INFORM’s study “Waste in the Wireless” World analyzes the environmental problems created by cell phones, which also apply to other wireless electronic devices, such as personal digital assistants, portable e-mail devices, pagers, pocket PCs, and MP3 music players. All are made of similar materials and present similar problems with respect to the waste they generate. Wireless waste poses particularly acute problems when these small devices are sent to landfills or incinerators, where releases of the many toxic materials they contain create threats to human health and the environment.*

*Cell phones are typically used for only 18 months before being replaced, and as of 2005 about 130 million of these devices, weighing approximately 65,000 tons, are being retired annually in the US. Most of them will initially be stored away in closets and drawers, creating a stockpile of about 500 million used phones that will soon enter the waste stream.*

*“Because these devices are so small, their environmental impacts might appear to be minimal,” said Bette Fishbein, INFORM Senior Fellow and report author. “But the growth in their use has been so enormous that the environmental and public health impacts of the waste they create are a significant concern. Now is the time to address them.”*

*Waste in the Wireless World presents a series of specific recommendations for minimizing the environmental and health impacts of cell phone waste:*

- **The use of toxic substances in cell phones – particularly lead and brominated flame retardants – should be reduced.** Toxic substances contained in cell phones include a number of persistent and bioaccumulative toxic chemicals, or PBTs, which have been associated with cancer and a range of reproductive, neurological, and developmental disorders. PBTs pose a particular threat to children, whose developing organ and immune systems are highly susceptible to toxic insult. PBTs in cell phones include arsenic, antimony, beryllium, cadmium, copper, lead, nickel, and zinc. Additional health threats are posed by brominated flame retardants used in plastic components. These toxic substances can leach into soil and groundwater from landfills and form highly toxic dioxins and furans during incineration and recycling.
- **A single technical standard for all cell phone carriers, along with standardized cell phone design elements, should be implemented in the US and worldwide.** Phone



## Lesson Plan 020106

### “Toxic Transmission” Teacher Information - Pg 2 (Target: Grades 7-9)

systems in Europe all use a single standard, used in over 130 countries by two-thirds of the world's cell phone subscribers. In contrast, the US has several competing technical standards, forcing users to purchase a new phone when they change service providers or travel abroad. As a result, more phones are purchased and more discarded. Design standardization would allow adapters and other accessories to be used with many makes and models of cell phone. At present, accessories are dedicated to specific devices, creating additional waste whenever consumers buy a new phone. Like cell phones, such accessories contain toxic components and frequently create more waste than the phones themselves.

- **Cell phones and their accessories, including power sources, should be designed for disassembly, reuse, and recycling.** The key to reducing waste and making reuse and recycling cost-effective is product design. For example, products designed to last longer will generate less waste, and products that contain alternatives to toxic components will be cheaper to recycle. Similarly, if manufacturers make ease of disassembly a priority, designers will create products with parts that can be easily removed for repair or reuse and materials that can be easily separated for recycling. Mandated recycling targets provide a powerful incentive for producers to make such design changes. In anticipation of EU requirements, for instance, European researchers have developed a phone that can disassemble itself in 1.5 seconds.
- **US manufacturers should implement effective take-back programs for cell phones.** An effective program includes targets for collection and reuse/recycling, reporting requirements, and enforcement mechanisms. Most voluntary take-back initiatives for cell phones and/or other electronic equipment in the US lack all of these crucial components.
- **Rechargeable batteries, which are particularly toxic, should be a target for take-back.** Cell phones are powered by any of several rechargeable battery types, all of which contain toxic substances that can contaminate the environment when burned in incinerators or disposed of in landfills. If each of the 130 million cell phones that will be discarded each year by 2005 uses two sets of batteries before being retired, 260 million of these batteries will enter the waste stream each year from cell phones alone. Today, the only nationwide, industry-wide product take-back program in the US is for rechargeable batteries. This program, run by the Rechargeable Battery Recycling Corporation, represents a positive step for the US, since producers that participate take full financial responsibility

for managing their products at end of life. However, the program has not reported regularly on its recycling rates, has failed to meet its targets, and has had to face no consequences for the shortfall.

#### Progress Abroad, Pressure at Home

INFORM's study documents efforts in Europe, Japan, and Australia to deal with this fast-growing and hazardous waste stream. For example, Australia has implemented the world's first and only nationwide take-back program dedicated to recovering and recycling cell phones. In the European Union (EU), pending directives will require electronics manufacturers to phase out toxic components and take responsibility for waste generated by products marketed in the EU. And forthcoming design guidelines in Japan will result in more long-lasting and recyclable electronic products with fewer toxic components. In the US, no such national commitments have been made.

“Despite the lack of any current or pending federal legislation addressing the end-of-life management of electronics, US government and industry are likely to be influenced by trends abroad,” said Fishbein. “For example, state-level legislation is being considered in California, Massachusetts, and Minnesota that would make producers responsible for paying the costs of managing the waste generated by their electronic products. Additionally, US manufacturers will have to follow the applicable requirements abroad for internationally marketed goods by eliminating toxic substances from these products and funding their take-back. With such changes on the horizon, American industry has even more reason to get ahead of the curve.”

SOURCE: [http://www.informinc.org/pr\\_wireless.php](http://www.informinc.org/pr_wireless.php)

## Cell Phone Pollution Facts

Partial Source: [www.collectivegood.com](http://www.collectivegood.com)

Mobile phones and other mobile devices (pagers, PDAs) present a growing threat to the environment. There are almost a billion mobile phones waiting to be recycled around the world; either in drawers, or already in the waste stream. Another 130 million or so will be added this year from the US alone. Once in the waste stream, these devices may leak Lead, Mercury, Cadmium, Arsenic and other toxic substances into the water supply. Municipalities often incinerate their waste, instantly putting these toxic elements into the air, and they return to earth in rain water. Since life on Earth depends on water, the threat is clear.

### Toxic Transmission: Lead

Lead can cause damage to the central and peripheral nervous systems, blood system and kidneys in humans. Effects on the endocrine system have also been observed and its serious negative effects on children's brain development has been well documented. Lead accumulates in the environment and has high acute and chronic toxic effects on plants, animals and microorganisms.

**Consumer electronics constitute 40% of lead found in landfills.** The main concern in regard to the presence of lead in landfills is the potential for the lead to leach and contaminate drinking water supplies.

The main applications of lead in computers are: (1) soldering of printed circuit boards and other electronic components (2) glass panels in computer monitors (cathode ray tubes). Between 1997 and 2004, over 315 million computers have become obsolete in the USA. This adds up to about 1.2 billion pounds of lead!

People, animals, and fish are mainly exposed to lead by breathing and ingesting it in food, water, soil, or dust. Lead accumulates in the blood, bones, muscles, and fat. Infants and young

children are especially sensitive to even low levels of lead.

### Damages Organs

Lead causes damage to the kidneys, liver, brain and nerves, and other organs. Exposure to lead may also lead to osteoporosis (brittle bone disease) and reproductive disorders.

### Affects Brain and Nerves

Excessive exposure to lead causes seizures, mental retardation, behavioral disorders, memory problems, and mood changes. Low levels of lead damage the brain and nerves in fetuses and young children, resulting in learning deficits and lowered IQ.

### Affects Heart and Blood

Lead exposure causes high blood pressure and increases heart disease, especially in men. Lead exposure may also lead to anemia, or weak blood.

### Affects Animals and Plants

Wild and domestic animals can ingest lead while grazing. They experience the same kind of effects as people who are exposed to lead. Low concentrations of lead can slow down vegetation growth near industrial facilities.

### Affects Fish

Lead can enter water systems through runoff and from sewage and industrial waste streams. Elevated levels of lead in the water can cause reproductive damage in some aquatic life and cause blood and neurological changes in fish and other animals that live there.

### Toxic Transmission: Mercury

When inorganic mercury spreads out in the water, it is transformed into methylated mercury in the bottom sediments. Methylated mercury easily accumulates in living organisms and concentrates through the food chain particularly via fish. Methylated mercury causes chronic damage to the brain.

**It is estimated that 22% of the yearly world consumption of mercury is used in electrical and electronic equipment.** It is basically used in thermostats, (position) sensors, relays and switches (e.g. on printed circuit boards and in measuring equipment) and discharge lamps. Furthermore, it is used in medical equipment, data transmission, telecommunications, and mobile phones. Mercury is also used in batteries, switches/housing, and printed wiring boards. Although this amount is small for any single component, 315 million obsolete computers as of 2004 represents more than 400,000 pounds of mercury in total.

### Toxic Transmission: Cadmium

Cadmium compounds are classified as toxic with a possible risk of irreversible effects on human health. Cadmium and cadmium compounds accumulate in the human body, in particular in kidneys. Cadmium is adsorbed through respiration but is also taken up with food. Due to the long half-life (30 years), cadmium can easily be accumulated in amounts that cause symptoms of poisoning. Cadmium shows a danger of cumulative effects in the environment due to its acute and chronic toxicity.

In electrical and electronic equipment, cadmium occurs in certain components such as SMD chip resistors, infrared detectors and semiconductors. Older types of cathode ray tubes contain cadmium. Furthermore, cadmium is used as a plastic stabilizer.

Between 1997 to 2004 over 315 million computers have become obsolete and this represents almost 2 million pounds of cadmium content.

## Can Cell-Phone Recycling Help African Gorillas?

Stefan Lovgren for National Geographic, January 20, 2006 • [http://news.nationalgeographic.com/news/2006/01/0120\\_060120\\_cellphones.html](http://news.nationalgeographic.com/news/2006/01/0120_060120_cellphones.html)

Recycle your cell phone, save the gorillas.

It may not be as simple as that, but a recycling program to collect old cell phones at the San Diego Zoo and other American zoos is highlighting the little-known connection between cell phone use and the survival of African gorillas.

Conservationists point out that recycling cell phones protects landfills from the many potentially hazardous chemicals found in the phones, including antimony, arsenic, copper, cadmium, lead, and zinc.

**But cell phones also include coltan, a mineral extracted in the deep forests of Congo in central Africa, home to the world's endangered lowland gorillas.**

Fueled by the worldwide cell phone boom, Congo's out-of-control coltan mining business has in recent years led to a dramatic reduction of animal habitat and the rampant slaughter of great apes for the illegal bush-meat trade.

"Most people don't know that there's a connection between this metal in their cell phones and the well-being of wildlife in the area where it's mined," said Karen Killmar, the associate curator of mammals at the San Diego Zoo.

"Recycling old cell phones is a way for people to do something very simple that could reduce the need for additional coltan...and help protect the gorillas," she said.

### Reselling Phones

There are more than 150 million cell phone users in the United States alone.

With technology changing, the average lifespan of a cell phone is 14 months. There may already be 500 million unused cell phones in the United States, with as many as 100 million added each year.

The San Diego Zoo is among 46 zoos that have joined the recycling

program, which is run by Eco-Cell, a cell phone-recycling firm based in Louisville, Kentucky.

Eco-Cell collected 21,000 phones last year and hopes to triple that figure this year.

The phones are sold in bulk to a handful of refurbishing companies that in turn resell the handsets in developing markets, such as Africa and Latin America.

Eco-Cell started in 2002 but began honing in on zoos in 2005. The proceeds it makes from selling the phones go to supporting various conservation groups, primarily zoos.

"It just made business logic to focus on zoos, since 130 million-plus people went to North American zoos last year," said Eco-Cell president Eric Ronay. "We set up a collection point at the front gate of those zoos and invited the public to bring in their old cell phones."

Ronay said learning about the devastating impact of coltan mining on African gorillas "really made lightbulbs go off for us."

### Illegal Miners

Columbite-tantalite—coltan for short—is a metallic ore that, when refined, becomes metallic tantalum, a heat-resistant powder that can hold a high electrical charge.

These properties are ideal for making capacitors, which are used in many electronic devices, including cell phones.

Eighty percent of the world's known coltan supply is in the Democratic Republic of the Congo. There, it is mined by hand by groups of men digging basins in streams, scraping away dirt to get to the muddy coltan underneath.

The cell-phone boom in the last decade induced a flood of more than 10,000 illegal miners into protected parks in central Africa.

"The mining itself certainly destroys habitat, so human activity at the very least disturbs the animals there. But more of what happens is that the animals are hunted and killed," said Killmar, the San Diego Zoo curator. "The impact is nothing but negative."

Conflict, illegal mining, and the growing bush-meat trade (the hunting of wild animals for food) have all contributed to a 70 percent population decline of the eastern lowland gorilla, according to some estimates.

Congo's coltan trade has cooled off, however, as prices for the ore have plummeted. While the tech boom caused the price of coltan to skyrocket to U.S. \$220 per pound (\$480 per kilogram) in 2000, a pound was worth about \$30 (\$66 per kilogram) in 2004.

### E-Waste

Sharon Dewar, a spokesperson for the San Diego Zoo, says the objective of the recycling program is conservation education.

"Many people have cell phones at home in a drawer that are old, and they don't know what to do with them," she said.

"These phones contain toxic elements. What we're saying is, Please don't throw your cell phone into a landfill."

"If a cell phone can be refurbished, that might also help diminish the demand for coltan mining, which could in fact help gorillas and other animals in their habitat," she said.

To Ronay, the Eco-Cell president, used cell phones are only one part of a growing e-waste problem.

"No one really understands how critical this is going to be, especially as technology progresses and more technology becomes abandoned," he said.

"We are going to look up one day and be in the middle of a crisis."

Read the “Cell Phone Pollution Facts” Page, and then answer the following:

Around the world, there are almost \_\_\_\_\_ cell phones waiting to be recycled. In the US alone this year, \_\_\_\_\_ cell phones will be retired. Cell phones and other electronic technologies pose a real threat to human health, because they contain several toxic metals such as \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_. The most damaging of these is \_\_\_\_\_, which causes harm to several human organs including the \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and other organs. Exposure to this metal may also cause the brittle bone disease \_\_\_\_\_. Sadly, this metal is most harmful--even in low levels--to \_\_\_\_\_, who suffer brain damage, learning deficits and lowered IQ.

S	G	E	U	N	A	I	M	E	N	A	A	I	O	I	I	A	O	R	T
E	N	O	D	T	O	D	N	E	D	I	D	D	T	N	I	N	A	E	R
M	I	E	D	S	A	I	R	R	I	D	A	S	O	N	A	D	S	D	L
I	E	T	A	S	S	D	L	N	E	T	O	R	A	E	M	M	R	E	I
C	R	T	S	T	L	C	N	L	E	S	T	I	B	O	A	O	S	D	E
O	E	U	B	I	N	R	I	R	I	H	R	R	E	U	T	S	M	L	C
N	D	O	H	D	T	A	I	R	E	B	A	R	S	E	N	I	C	D	I
D	L	C	L	M	N	R	V	R	C	N	E	N	E	V	R	U	E	S	E
U	O	O	S	L	A	A	M	O	L	U	N	N	E	B	R	I	E	R	D
C	S	Y	B	O	T	O	V	I	M	E	I	C	O	D	N	D	E	B	R
T	U	E	D	O	S	A	D	D	R	D	E	T	A	L	Y	H	T	E	M
O	N	D	T	T	D	E	A	V	O	N	R	R	B	D	R	E	T	U	E
R	E	U	A	S	D	R	E	O	R	T	U	U	R	O	M	O	I	E	R
S	D	T	N	R	A	S	A	S	S	N	I	O	S	N	A	I	E	I	C
C	S	O	S	T	E	R	I	O	P	O	R	O	S	I	S	R	U	N	U
R	A	S	E	I	M	O	S	T	E	B	M	C	A	T	A	C	D	M	R
D	R	D	I	S	M	I	A	N	D	E	C	D	D	S	T	U	R	S	Y
C	N	A	B	O	I	V	I	R	E	R	I	H	N	R	S	U	R	O	R
D	M	E	N	S	E	O	S	M	E	V	V	B	T	A	N	R	E	E	O
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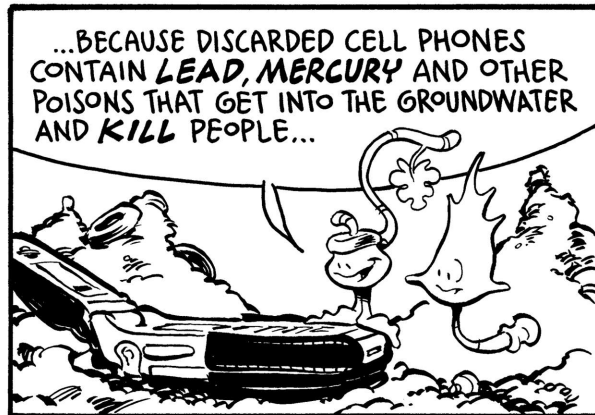
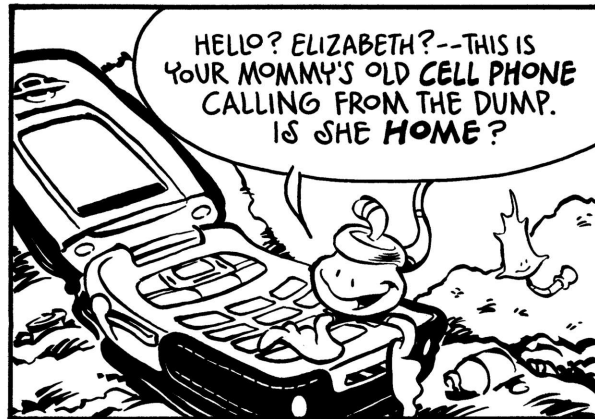
**“Toxic Transmission” Word Find**

(Spaces between two-word terms are not in puzzle)

- |                |                |
|----------------|----------------|
| ANEMIA         | METHYLATED     |
| ARSENIC        | NERVES         |
| BRAIN          | ONE BILLION    |
| CADMIUM        | OSTERIOPOROSIS |
| CHILDREN       | SEMICONDUCTORS |
| CIRCUIT BOARDS | SOLDEREING     |
| LEAD           | THERMOSTATS    |
| MERCURY        |                |

# RUSTLE THE LEAF™

BY PONCÉ & WRIGHT



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## Find out more about technology pollution by visiting:

<http://www.cbsnews.com/stories/2004/12/06/tech/main659234.shtml>  
<http://www.epa.gov/epaoswer/education/pdfs/life-cell.pdf>  
<http://www.peopleandplanet.net/doc.php?id=2644>  
<http://www.legis.state.wi.us/assembly/asm77/news/columns/Call%20Wasting.htm>  
<http://news.com.com/2100-1040-844195.html>

<http://www.realmama.org/archives-fall-2005/recycling.php>  
<http://www.bornfree.org.uk/coltan>  
<http://www.npr.org/programs/re/archivesdate/2001/dec/20011220.coltan.html>  
[http://www.informinc.org/Calling\\_Cellphones\\_front.pdf](http://www.informinc.org/Calling_Cellphones_front.pdf)  
<http://www.wired.com/news/technology/1,65932-0.html>  
<http://greenvilleonline.com/news/2003/11/22/2003112219611.htm>

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