Tech in the Cycle

You will find the latest challenge in recycling as close as your cell phone or your tablet. Used electronic devices are piling up and represent a potential treasure trove of re-usable materials.

GRADES
9-12

ISRI *Voice of the Recycling Industry*

JASON Learning

PREPARE:

Time Required: 2-3 class periods (90-135 minutes) without extensions

- Gather materials (see activity pages).
- Divide students into groups of 3-4.
- Try to obtain an older electronic device with a circuit board (not a television or monitor).
- Confirm students will have access to computers, the internet, and a spreadsheet program such as Excel.

MOTIVATE:

- Show students an "old fashioned" computer. You may be able to find a family member or friend who still has one and can loan it – or even one still in your school! A clip or an image of someone using one will also suffice. Ask students to survey older members of their family tonight for homework, collect the following information from each family member interviewed:
  - When did you get your first calculator?
  - When did your you get your first computer?
  - How many computers have you owned in your lifetime?
  - How is your life different because you have a computer or tablet?
  - The next day, have students share and discuss results.
- Share the following scenario:

  "Imagine that you suddenly spill a soda on your laptop computer. It might be repairable. But it's three years old. There are a lot of faster, more powerful and lighter ones in the stores. So you decide to recycle it. But wait! The computer has information on it, like your passwords and cookies that you don't want to share. It has some components (like chips) that can be used again. It has hazardous components such as batteries and mercury bulbs. And buried in that maze of silicon and steel are bits of some pretty valuable metals. So you need a reliable recycler that you trust. Where would you go?"
- Encourage students to support their ideas as they share.

TEACH:

- Modern electronic devices are made of combinations of very specialized materials. In the development of the IPad2, Steve Jobs of Apple, traveled all over the world to find just the right glass, the right plastics, and the right trace elements to use for a product that worked well and looked good.
- Conduct activity with students. Do not hand out the student data sheets until they have completed step 1.

- When graphing, if students are not familiar with the use of a spreadsheet program such as Excel, then you may need to conduct a quick tutorial.
- Have students consider the process of recycling a typical electronic tool. What do they know about it? Share ideas.
- Discuss the process of recycling an electronic device with students as appropriate (students will explore this in more detail during their research). The first priority in recycling an electronic device is to "scrub" those computers clean. That might mean totally erasing a re-usable hard drive or shredding an older one so no one can ever read it again. Then recyclers must remove anything that might be dangerous or toxic. Safety is a big concern in the recycling industry. The old-fashioned computer monitor might have an electric charge in it, and often is made out of leaded glass. Some electronics contain mercury, lead solder, or batteries. Then the real recycling begins. Many of your phones and computers contain gold, copper or platinum--not much, but at the price worth recovering. The motherboard might be usable again, but if not it's steel and even the plastic casings are worth a second life as a recycled product.
- Divide the class into groups of 3-4 students, assigning each team 1-2 materials in Table I.
- Have students share their presentations with the class.

REFLECT/ASSESS

Students should be able to:
1. Describe some of the challenges associated with recycled electronic devices.
2. Explain 2-3 different options of what to do with an old electronic device to ensure minimal impact to the environment, and why some choices are better than others.

EXTEND

Consider the following campaign: "It's a Matter of National Security: Be a Patriot. Recycle Your Electronics!" Find out what recycling old electronic devices has to do with national security. Is it really a concern? Why or why not?

JOURNAL QUESTION

Have students consider whether or not it is cost effective to recycle these materials. Do they believe recycling the materials is a civic responsibility regardless of the cost effectiveness? Why or why not?

WEBLINKS

Electronics Donation and Recycling
http://www.epa.gov/recycle/electronics-donation-and-recycling
Article: After Dump, What Happens to Electronic Waste?
http://www.npr.org/2010/12/21/132204954/after-dump-what-happens-to-electronic-waste
Rare Earth Metals and U.S. National Security
http://americansecurityproject.org/wp-content/uploads/2011/02/Rare-Earth-Metals-and-US-Security-FINAL.pdf
Article on Recycling Glass
http://www.britglass.org.uk/infinitely-recyclable
Article on Recycling Lithium Batteries
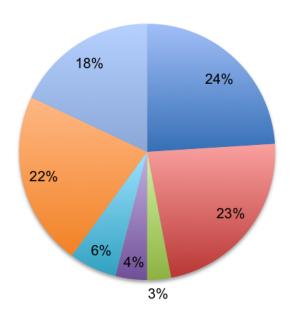http://www.retrievtech.com/recycling/lithium-ion

Tech in the Cycle

Examples

Material/Component	Mass (g)	Percent of iPad2
Display (aluminosilicate glass)	140 g	24
Aluminum	135 g	23
Plastics	17 g	3
Other metals (steel, copper, gold, nickel, and silver)	25 g	4
Circuit board (mostly silicon)	38 g	6
Battery (lithium)	130 g	22
Glass	105 g	18

Material Used in an iPad2

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The tech tools we use every day seem so familiar it's hard to imagine how many materials are used to make them. For example, in the average cell phone there is about one-third gram of silver, .03 grams of gold, and .01 grams of palladium. Tiny amounts—but you couldn't call home without it. In this activity you will create a pie chart reflecting the percentage of materials in an iPad2 and research the potential for recycling.

Materials
- Access to internet and a spreadsheet program
- Access to a presentation program
- Calculator

Part 1: Graphing Materials in an iPad2

1. Consider an iPad! With a partner, brainstorm what kinds of materials it might be made of. Make a list. Share ideas with your class.
2. Take a look at the table provided on the student data sheet. You will find a list of the materials and components in the iPad2. Calculate what percentage of the mass is attributed to each of the materials present in the iPad2 (how will you do this)? Record your calculations.
3. Use a spreadsheet program such as Excel to create a pie chart that reflects the mass percentages of each of the materials found in the iPad2

Part II: Potential for Recycling Materials

1. In your teams, research what should you actually do if you need to get rid of an old discarded piece of electronics. What are some of the issues that need to be considered? What is typically better, re-using or recycling and why? Describe some programs or companies that recycle responsibly and how this differs from companies that might not.
2. Your teacher will assign you one or two materials from the table. Research the potential for recycling these materials. Be ready to discuss the challenges and potential relative costs associated with each and how effective and efficient the methods are that currently exist. Also include any environmental impacts. Finally, include a discussion of how those materials are re-used and in what products they might be found in their "second life". Design a presentation to share what you have learned with the class. Possibilities may include Prezi or PPT.
3. Share your presentation with the class, while completing Table II, based on your classmates' presentations.

Reflect and Apply

- What are some of the challenges associated with recycled electronic devices?
- If you had an old electronic device, explain 2-3 different options of what you could do with it to ensure minimal impact to the environment. Are some options better than others?

Extension

Consider the following campaign: "It's a Matter of National Security: Be a Patriot. Recycle Your Electronics!" Find out what recycling old electronic devices has to do with national security. Is it really a concern? Why or why not?

JOURNAL QUESTION

Reflect on whether or not it is cost effective to recycle these materials. Do you believe recycling them is a civic responsibility regardless of the cost effectiveness? Why or why not?

Student Name: Period:

Table I. Percentage of iPad by Mass

Material/Component	Mass (g)	Percent of iPad2
Display (aluminosilicate glass)	140 g	
Aluminum	135 g	
Plastics	17 g	
Other metals (steel, copper, gold, nickel, and silver)	25 g	
Circuit board (mostly silicon)	38 g	
Battery (lithium)	130 g	
Glass	105 g	

Table II. Recycling Potential

Material	Primary Method of Recycling	Challenges to Recycling/ Environmental Concerns	Efficiency (how much of the material can actually be reclaimed; are methods effective?)	Relative Costs of Recycling	Products or Uses for its "Second Life"
Display (aluminosilicate glass)					
Aluminum					
Plastics					
Other metals (steel, copper, gold, nickel, and silver)					
Circuit board (mostly silicon)					
Battery (lithium					
Glass					