# What's in Our Electronics?

## E-Cycle Wisconsin Activity

**Summary:** *Through research and categorization students learn about the materials used in making modern electronics and why it is important to recycle them.*

**Audience:** Grades 6-8
**Subject:** **Environmental Science, Earth Science**
**Time:** Two 45-minute class periods
**Supplies:** Ingredient cards (print out from below and cut into individual cards); copies of "Research Prompts" (print out from below and photocopy for groups); computers or other research tools; white board/chalkboard and markers or chalk.

## Background

In the United States, only 25 percent of electronic waste generated each year is recycled. Electronics contain valuable materials as well as toxic materials. When we landfill or dump electronics, the gold, silver, nickel, steel, glass, aluminum, plastic and hundreds of other materials inside them are lost to us forever. While a cell phone or tablet may seem like an insignificant thing to throw away, there is actually more gold in a ton of old cell phones than there is in a ton of ore pulled out of a gold mine.

Tossing electronics wastes energy, fossil fuels, water, materials and potential local jobs. Recycling is a big business in Wisconsin that depends on a steady stream of materials from local consumers. In addition, improper disposal of electronics can contaminate our water and soil. Taking electronics to responsible recyclers creates jobs and helps keep valuable materials in the production stream and toxic materials out of our actual streams.

## Warm up

Ask students: What's in a cell phone? TV? Computer?

Divide students into groups of four to five students. Assign each group an electronic device from this list: laptop computer, desktop computer, old-style TV, flat panel TV, tablet and smartphone. Give students three minutes to work with their group to come up with an ingredient list for the item that you assign to them.

## Activity

Hand out two or three ingredient cards created from the list at the end of this activity to each group. Let the class know that these are ingredients that show up in all electronics. Have students compare the ingredient you gave them with the ingredients they have listed for their device from the warm up. Some people may receive an ingredient they had on their warm up list, while others may not. Our electronics are so complicated and contain so many compounds (a flat panel TV has about 4,500 materials in it) that this is to be expected.

Instruct students to divide into pairs within their groups. Each pair should take an ingredient card and research where this material is used in various electronic devices, what the purpose of the material is (conduct electricity? capture heat?), whether the material can be taken out of the electronic device and reused, and whether the material is toxic to humans or the

environment. Use the worksheet below as a guide for what to ask students. This portion of the activity can be done in the classroom or as a take-home project.

While students complete their research, draw a Venn diagram on your board. Label one circle of the diagram as "toxic," one as "reusable," leaving the overlap to be toxic and reusable. When their research is complete, have students take turns placing their material where it belongs on the Venn diagram.

After all of the items are placed on the diagram, discuss the results as a class. In general, everything but the flame retardants is reusable. Use your discretion with toxics. Students can make arguments for and against many of these items as being reusable. Use the list at the end of this activity for reference.

Encourage students to bring up other ingredients from the warmup activity and decide where these items would go on the Venn diagram.

## Conclusion

Summarize for students that electronics are filled with valuable materials and toxic materials. These ingredients are not nicely separated–but almost all of them are reusable. In fact, more than 90 percent of the materials in most electronics are reusable. But they are not easy to recycle. Proper and safe recycling of electronics needs to be done at reputable, high-tech facilities where the environment and workers are protected.

## Assessment

Have students create a class PowerPoint that will "dissect" an electronic device into some of its ingredients. Present the PowerPoint to another class.

## Further study

Have students research the certification programs used in the United States to encourage responsible electronics recycling (Basel Action Network's E-Stewards process and R2 Solutions' certification process). What are the concerns these programs have and how do they determine if recyclers are doing it "right"?

## Resources

E-Cycle Wisconsin schools page: http://dnr.wi.gov/topic/Ecycle/Schools.html
Ingredient list based on E-Waste Guide's list: http://ewasteguide.info/node/220
R2 Solutions: http://www.r2solutions.org/
E-Stewards: http://www.e-stewards.org/

**Wisconsin Department of Natural Resources**
**Bureau of Waste and Materials Management**
PO Box 7921, Madison, WI 53707-7921
(608) 266-2111 *DNRWAe-cycling@wisconsin.gov*



**PUB-WA-1673 2014**

## Answer Key

| Ingredient | Reusable? | Where Found | Comments |
|---|---|---|---|
| Steel | Reusable | Housing | TVs/Computers=important source |
| Aluminum | Reusable | Housing | TVs/Computers=important source |
| Copper | Reusable | Circuit board/Wiring | Valuable metal |
| Lead | Reusable/Toxic | Solder/CRT/Battery | CRT glass expensive to manage |
| Glass | Often Reusable | Screen/CRT/Bulb | CRT/LCD glass difficult to reuse |
| Plastics | Reusable | Housing | Correct grade for new electronics |
| Cadmium | Reusable/Toxic | Battery | Known carcinogen |
| Chromium | Reusable/Toxic | Circuit board | Exposure=DNA damage |
| Mercury | Reusable/Toxic | Bulb/Circuit board | Nervous system damage |
| Gold | Reusable | Circuit board/Connectors | Valuable. |
| Silver | Reusable | Circuit board/Connectors | Valuable. |
| Gallium | Reusable | Circuit board | Scarce. Used in new tech. |
| Indium | Reusable | Circuit board | Scarce. Used in new tech. |
| Flame Retardants | Toxic | Housing | If burned, releases toxins. |

## Ingredients cards

| | |
|---|---|
| Steel | Chromium |
| Copper | Mercury |
| Aluminum | Gold |
| Lead | Silver |
| Glass | Gallium |
| Plastics | Indium |
| Cadmium | Flame Retardants |

## Research Prompt

Name of Ingredient:

Where is this ingredient found in nature? How do we get it?

Where is this ingredient found in electronics?

What purpose does it serve in electronics?

Is this material expensive or cheap? Rare or common? Toxic or non-toxic?

If the item is toxic, what problems does it cause to humans or the environment?

Can this item be taken out of electronics and reused or recycled?