E-waste: Golden Solution

Objective

- Students will learn about e-waste, its impact on the environment and ways to dispose of it
- Students will design their own e-waste infographic to communicate what electronic devices are comprised of and how they can be recycled.

Materials

- A copy of "Golden solution" the 3M discovery infographic in the July 2016 Canadian Geographic (attached)
- E-waste category worksheet (attached)
- Access to a world map, globe, atlas or online map of the world
- Connection to internet (for student research)
- Any additional supplies students need to create their infographics.

Grade level

- 7-12

Preparation/Set up

Provide a copy of "Golden solution" the 3M discovery infographic in the July 2016 Canadian Geographic to each student and have them review this article prior to this lesson.

Introduction

Write the word "e-waste" on the board. Individually or in pairs, ask students to brainstorm a list of words that fit in the category. Once students are finished, create a class definition of the term "e-waste" and compare it with the following:

E-waste is a term used to cover all items electrical and electronicequipment and its parts that have been discarded by its owner as waste without the intent of re-use.

-United Nations, 2014 The Global e-waste monitor

According to the United Nations, e-waste can be divided into six categories: temperature exchange equipment (fridges, stoves), screens, lamps, large equipment, small equipment, small IT and telecommunications equipment. Ask students to examine the list they made previously and write them under the correct category using the worksheet provided. Take up answers with the class to ensure everyone has examples of equipment under each category.

Development

Bring attention to the "Golden solution" article students were asked to review prior to this lesson. Check for understanding by asking the following questions:

- What surprised you about the article?
- What problem is the world facing with e-waste?
- Why is it difficult to recycle e-waste?
- What are scientists like Stephen Foley trying to do to address this issue?
- Why are scientists trying to separate essential elements like gold, copper and nickel?

Have students explore the infographic displayed in the article and discuss the research and effort needed to properly separate essential elements like gold from the rest of an electronic device. Ask students to consider where their e-waste has gone after they have thrown something in the trash out and if their community offers a program to properly dispose of e-waste?

Divide your class into six groups and assign each group a different e-waste category. Instruct each group to select one device under their category to explore. Inform students that each group will design their own infographic highlighting what their selected device is comprised of and how it can be recycled. Students can create their infographic online using free programs like Google draw and venngage or on poster paper. To assist students with research and infographic development, write the following guiding questions on the board:

- What materials make up your device? Are they easy to separate and recycle? Why or why not?
- Are their any minerals or elements found within it? Which ones?
- How do people use this device? How often do people replace them? How many (per household) does the average person have?
- What research is being done to address the recycling of this product?

Connections to the Canadian National Standards for Geography

Essential element 5:
Environment and Society

- Impact of natural and technological hazards/ disasters on the human and physical environment
- World patterns of resource distribution and utilization
- Use and sustainability of resources

Essential element 6:
The Uses of Geography

- Role of multiple points of view in contemporary geographic policies and issues

Conclusion

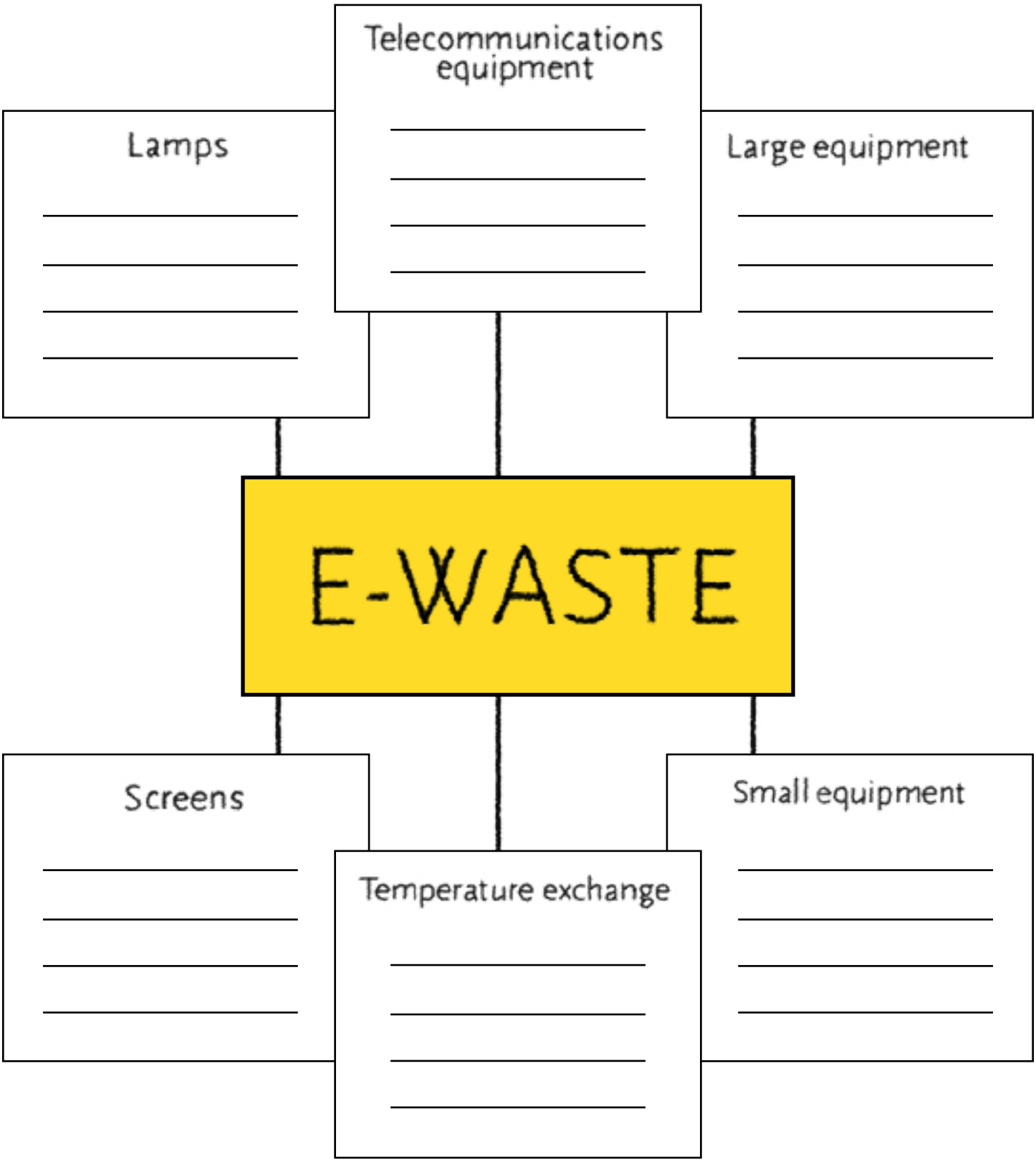
Allow time for each group to share their infographic with the rest of the class. Ask students to discuss any patterns and trends they may see among each category.

Conclude the lesson by bringing attention to the "e-waste by numbers" section of the infographic. Discuss what these numbers mean and how they may change in the future. Using a world map have students predict which regions of the world may produce more e-waste than others and how this may impact the environment. What possible solutions are available now to solve or address this issue?

Extend your geographical thinking

Encourage students to continue to investigate global regional e-waste impact by heading to the UN website and accessing the **Global E-waste Monitor Report (2014)**. Either using a blank map of the world, or creating their own comparison chart, have students work in pairs or small groups to compare and contrast how e-waste differs across the globe.

E-waste six categories worksheet



DISCOVERY

INFOGRAPHIC

Golden solution

A new and simple way to extract gold from electronic waste

By Thomas Hall

YOU KNOW those old cell phones rattling around at the back of your desk drawer? It turns out they're not worthless after all. Like most electronic waste, they contain a small amount of gold, which conducts electricity well and doesn't oxidize — properties that make it perfect for covering copper and nickel connections on circuit boards.

The problem is that extracting gold from e-waste hasn't been cost-effective or environmentally friendly — until now. University of Saskatchewan chemists have found that dipping e-waste in 99 per cent acetic acid — basically concentrated vinegar — and then adding zinc to the resulting solution yields gold that's 90 per cent pure. Stephen Foley, who led the research, says only 100 litres of acetic acid, which costs about $70, is needed to dispose of five to six tonnes of e-waste and recover about one kilogram of gold, worth about $51,000. What's more, the acid only needs to be neutralized before being poured down the drain. In North America and Europe, the main methods of recovering gold from e-waste are pyrometallurgy, where waste is crushed and burned and 60 per cent of the gold is retrieved, or hydrometallurgy, where waste is bathed in *aqua regia*, a toxic soup of hydrochloric and nitric acid, and anywhere between 60 and 99 per cent of the gold is retrieved. The biggest drawback of using acetic acid? The stink. "You know what vinegar smells like," says Foley. "Imagine having 100 litres of the pure stuff."

Still, he cautions that acetic acid isn't a solution to the growing and global e-waste problem. "We're stripping the gold off, but you still have the circuit board left," he says, "so we're just one step in a process."

Learn more about e-waste and how gold is extracted from it at cangeo.ca/ja16/ewaste.

E-WASTE BY THE NUMBERS*

- **41.8 million** Estimated total amount in tonnes generated globally in 2014.
- **US$52 billion** Approximate worth of potentially usable resources represented by that total.
- **6.5 million** Proportion of that total in tonnes that was "documented and recycled with the highest standards."
- **12.8 million** Proportion in tonnes of global total that was small equipment (microwaves, toasters, electric shavers, etc.), which represented the largest amount of any type of e-waste.
- **1 million** Proportion in tonnes of global total that was lamps, which represented the smallest amount of any type of e-waste.
- **725,000** Tonnes produced in Canada in 2014.
- **140,380** Tonnes diverted from landfill in Canada in 2014.

*Sources: *Waste Crime – Waste Risks: Gaps in Meeting the Global Waste Challenge* (UNEP); *The Global E-waste Monitor 2014: Quantities, flows and resources* (UNU).