

E-waste: A Resource?



INTRODUCTION

The lesson plan introduces students to the different resources including precious metals which could be recovered from E-waste if it is recycled efficiently.

Objectives:

Students will be able to

- list the different types of materials which could be recovered from E-waste.
- identify and mark on the periodic table various materials which could be recovered from E-waste.

Eco-Schools Steps: Environmental review, Curriculum linkages, Inform and Involve

Curriculum Linkage: Science/ Environmental Studies/Social Science/Chemistry

Time required/ Duration:

- **Classroom Session 1:** 45 minutes for the teacher to do a background introduction on e-waste followed by internet based investigation and classroom work.
- **Home Assignment:** Two days for a home based interaction with parents.
- **Classroom Session 2:**
 - 90 minutes to put up a display on the Eco-Schools bulletin board
 - The display could be kept for two to four weeks.

Resources Required:

- Resource 3 (The value of E-waste)
- Internet
- Writing materials
- Bulletin board/ board pins
- Laptop/Computers



13-16
Years



Activity

Classroom session 1

- Start with a discussion introducing students to E-waste specifically introducing the different materials which can be recovered from E-waste.
- Divide the class into groups of 3-4 students.
- Guide the students to undertake an online search to investigate the different types of materials (inventory of chemicals - precious and others) which can be recovered from E-waste. Resource 3 (The value of E-waste) and Resource 4 (Periodic Table), can also be used by students to initiate the process.
- Following the research students should mark on the periodic table the different types of elements which can be recovered, if the E-waste is routed efficiently. Periodic table from Resource 5 (Blank Periodic Table) can be made use of for the same.

Home Assignment 1

- Ask individual students to carry home their periodic tables and discuss the same with their parents.

Classroom session 2

- Ask students to prepare for a display of the work on the Eco-Schools bulletin board to highlight the importance of an efficient E-waste recovery process.

Evaluation:

A quiz could be organized by the teacher to assess the understanding of the importance of the different types of materials.

Resource 3

The value of E-waste

A large variety of valuable materials and plastics are contained in electric and electronic appliances. Up to 60 elements from the periodic table can be found in complex electronics, and many of them are technically recoverable, though there are economic limits set by the market. E-waste contains precious metals including gold, silver, copper, platinum, and palladium, but it also contains valuable bulky materials such as iron and aluminium, along with plastics that can be recycled.

E-waste also contains rare earth, hazardous, and scarce metals. Common hazardous materials found in E-waste are: heavy metals (such as mercury, lead, cadmium etc.) and chemicals (such as CFCs/ chlorofluorocarbon or various flame retardants).

Proper management systems of E-waste also need to be established to allow for the recovery of the impressive value of precious and valuable materials contained in discarded equipment. In order to exploit this opportunity and simultaneously mitigate pollution, good policies are needed to facilitate the creation of an infrastructure and encourage the recovery of valuable materials.

Pollutants and their occurrence in waste electrical and electronic equipment

Pollutant	Occurrence
Arsenic	Semiconductors, diodes, microwaves, LEDs (Light-emitting diodes), solar cells
Barium	Electron tubes, filler for plastic and rubber, lubricant additives
Brominated flame proofing agent	Casing, circuit boards (plastic), cables and PVC cables
Cadmium	Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
Chrome	Dyes/pigments, switches, solar
Cobalt	Insulators
Copper	Conducted in cables, copper ribbons, coils, circuitry, pigments
Lead	Lead rechargeable batteries, solar, transistors, lithium batteries, PVC (polyvinyl chloride) stabilizers, lasers, LEDs, thermoelectric elements, circuit boards
Liquid crystal	Displays
Lithium	Mobile telephones, photographic equipment, video equipment (batteries)
Mercury	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
Nickel	Alloys, batteries, relays, semiconductors, pigments
PCBs (polychlorinated biphenyls)	Transformers, capacitors, softening agents for paint, glue, plastic
Selenium	Photoelectric cells, pigments, photocopiers, fax machines
Silver	Capacitors, switches (contacts), batteries, resistors
Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances

Source (http://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf)

Potential value of raw materials in E-waste in 2016

Material	Kilotons (kt)	-----
Fe	16,283	3,582
Cu	2,164	9,524
Al	2,472	3,585
Ag	1.6	884
Au	0.5	18,840
Pd	0.2	3,369
Plastics	12,230	15,043

Source: (https://colleGlobal-E-waste_Monitor_2017__electronic_single_pages_.pdfactions.unu.edu/eserv/UNU:6341/)

Resource 4

Periodic Table

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Period ↓ 1	1 H																	2 He	
2	3 Li	4 Be																9 F	10 Ne
3	11 Na	12 Mg																17 Cl	18 Ar
4	19 K	20 Ca	21 Sc					26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
5	37 Rb	38 Sr	39 Y					44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
6	55 Cs	56 Ba	57 La					76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
7	87 Fr	88 Ra	89 Ac					108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og	
								62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu		
								94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr		

Resource 5

Blank Periodic Table

PERIODIC TABLE OF THE ELEMENTS

1 1																	18 2
3 2	4											13 5	14 6	15 7	16 8	17 9	18 10
11 3	12											13 13	14 14	15 15	16 16	17 17	18 18
19 4	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
37 5	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55 6	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
87 7	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118

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57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103

Source: <https://www.periodni.com/images.html>

References

Baldé, C.P., Forti V., Gray, V., Kuehr, R., Stegmann, P. : *The Global E-waste Monitor – 2017*, United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna. ISBN ISBN Printed Version: 978-92-808-9053-2 ISBN Electronic Version: 978-92 https://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__electronic_single_pages_.pdf
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