Tags
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Terrestrial Waste

Plan for the week: Ch. 16 (text), Ch. 19 (frog iPad book)
Class one: Definitions, generation, reduce/reuse/recycle (modules 51-52)
Class two: Landfills, hazardous waste, future solutions (modules 53-55)
Free Response questions: 2016.3, 2015.2
Module 51: Humans and waste
Terrestrial Waste:
Waste: Defined as anything from human activity that is not saved or re-used
"Humans are the only organism that produce waste others cannot use"
n.b. Previous chapters around air pollution and water pollution BOTH had as part of their solution burying waste:
air pollution: fly ash, smokestack ash->sanitary landfill
water pollution: sewage treatment plant sludge-> sanitary landfill
Sample FR question:
The wonderful city of Fremont, on the banks of the beautiful Fremont River hosts 10,000 people in 2021 (about the size of Waimea). Each person produces 5 lbs (2.5 kg) of solid waste per day. The sewage treatment plant produces 2 kg of waste per day per person, and the coal fired power plant produces 1.5 kg of coal ash per day per person.
a. What is the total daily landfill impact of the current population of Fremont?
b. If Fremont has a growth rate of 3.5%, how many years will it take for the population to double?
c. When this doubling has occurred, what will be the daily landfill impact then?
d. If the landfill is 100m x 200m in size, how deep will this have to be in meters for each day, assuming a waste density of 1 kg/m3
e. What steps could the population take to reduce this?
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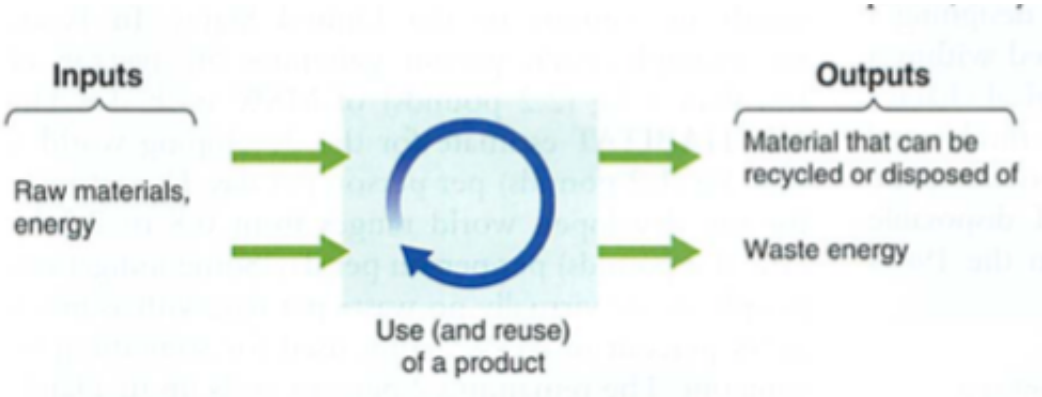
p. 573: paper or plastic?
Styrofoam:

- Lighter
- Better insulator
- Cheaper to transport
- Can be reused

- 3 grams of petroleum
- No water
- Toxic emissions in production

Paper cups:

- Need liners HOT!
- 2 grams petroleum
- 33 grams of water
- 2x energy
- More water
- Uses bleach and dioxin



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Typical waste stream:

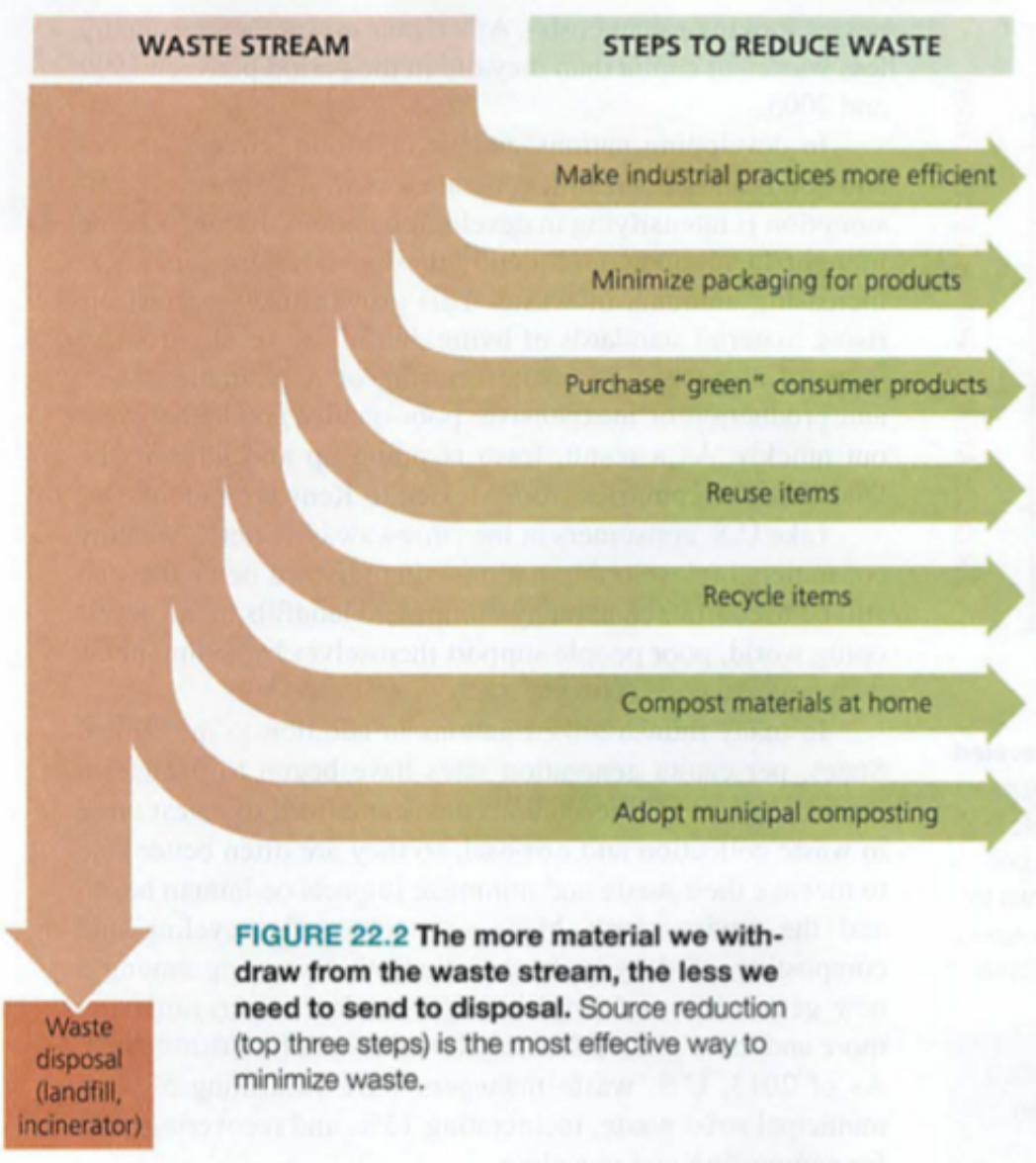

FIGURE 22.2 The more material we withdraw from the waste stream, the less we need to send to disposal. Source reduction (top three steps) is the most effective way to minimize waste.

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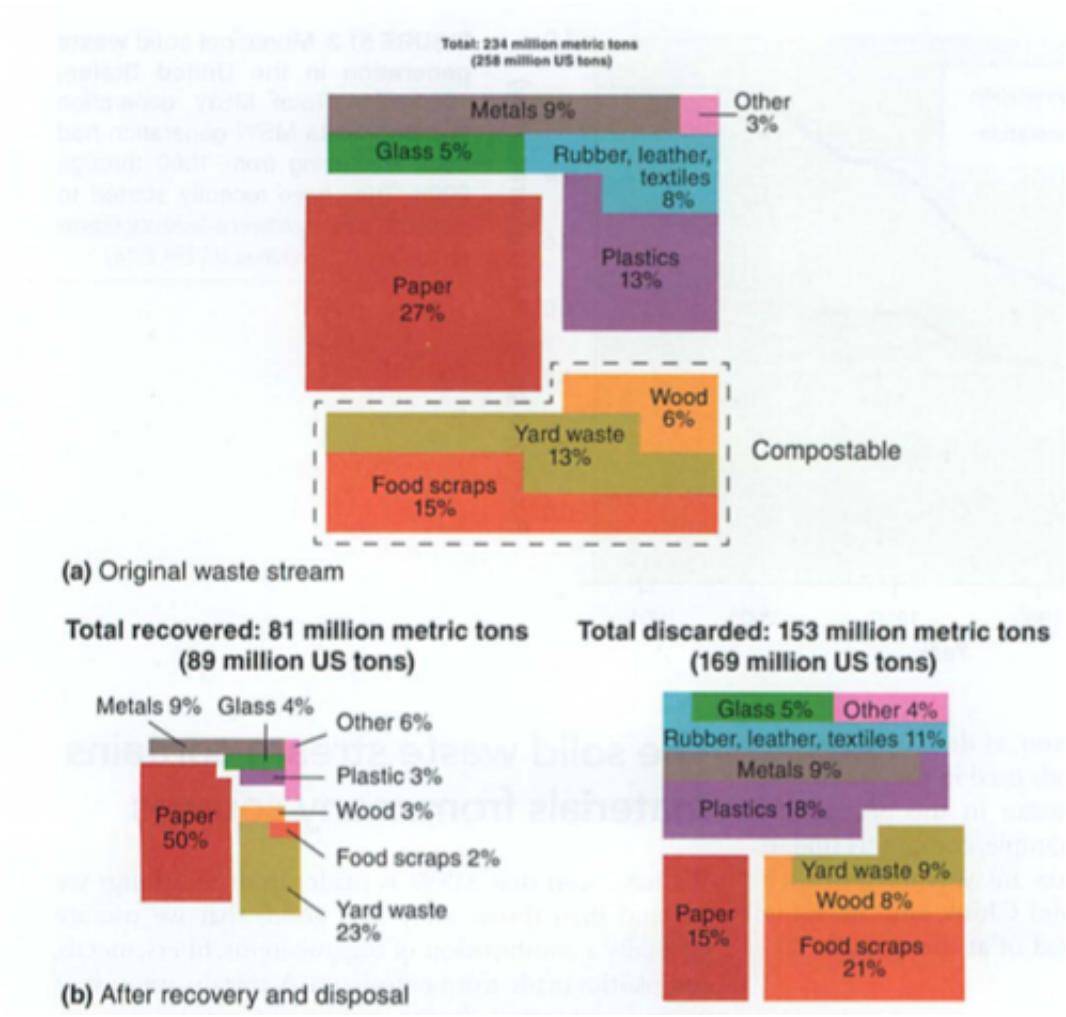
MSW=municipal (city) solid waste

Creepy comparison:

- US: 2.2 kg/day (about 5 lbs)
- Japan: 1 kg/day
- Developing world: 0.5 kg/day
- Indigenous people: 0 kg/day WHY?

Module 52: Recycling

MSW recycling (2014)



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How and why is this different here in Waimea?

E-waste: a growing issue, why? What companies are doing something about it?

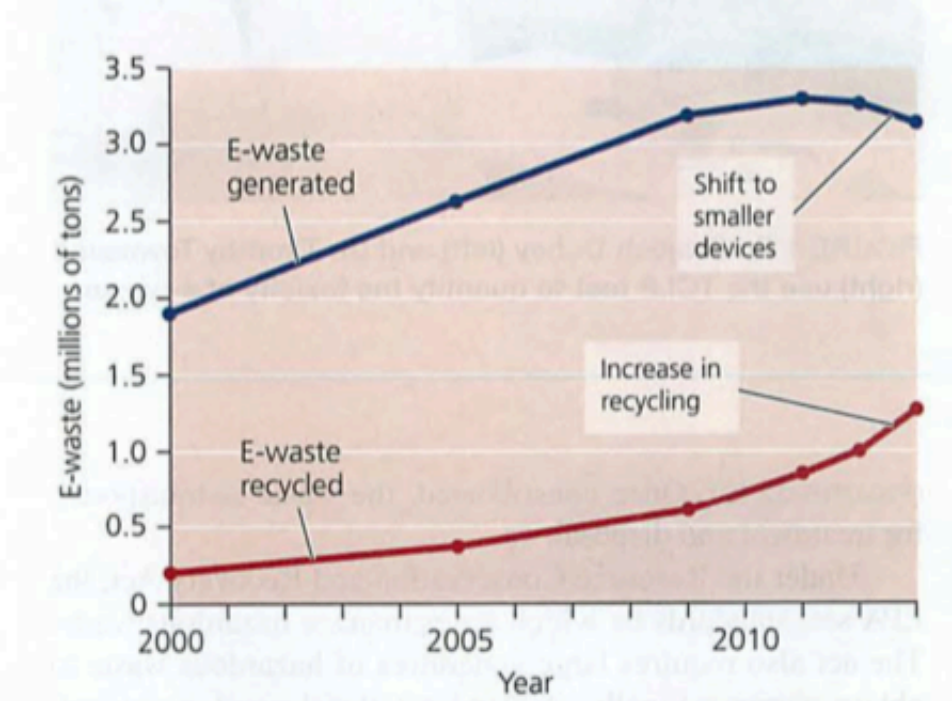


FIGURE 22.17 More and more electronic waste is being recycled. The total amount of electronic waste generated each year in the United States has risen, but the shift to mobile devices and tablets has helped decrease this amount since 2011. Meanwhile, we are recycling greater amounts of e-waste each year. *Data from U.S. Environmental Protection Agency, 2015.* Advancing sustainable materials management: Facts and figures 2013. *Washington, D.C.: EPA.*

Daisy, the Apple robot that recycles iPhones: https://www.theverge.com/2018/4/19/17258180/apple-daisy-iphone-recycling-robot

Question: why would the white mac laptops in our classroom cost more to recycle than the aluminum ones? Which is cheaper? Which is cheaper after counting the value of the parts inside each?

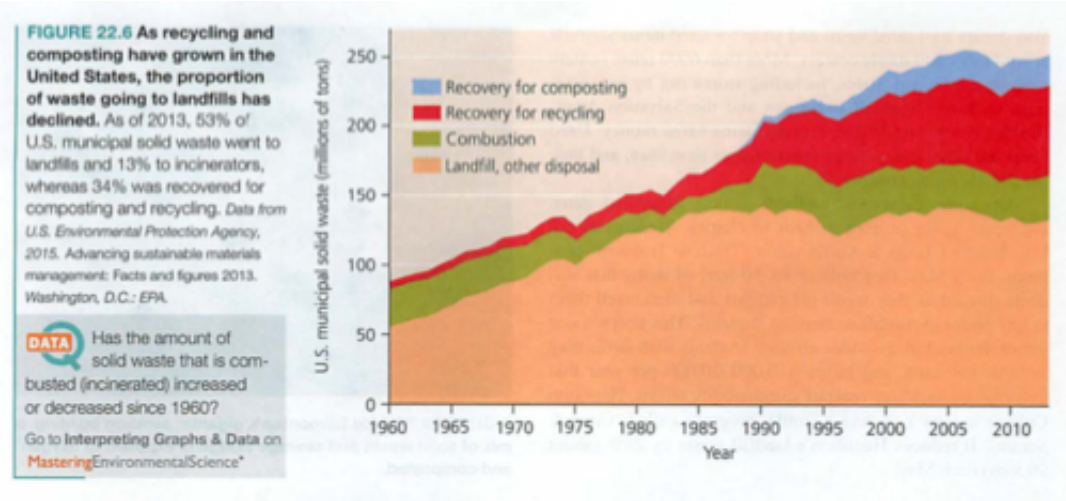
(see cradle to cradle design-William Mcdonough) and "source design"
"all children of all species for all time"

- e2: design 1.6 deeper shades of green-upcycling (10:00-17:00)
- e2: design 2.5 adaptive reuse in the Netherlands
- e2: design 3.6 super use

Reduce: Source design

Re-use: upcycling
Recycle: new use for old stuff, or re-creating
Plastic to fleece: open loop recycling
Aluminum cans: closed loop recycling

Composting: similar to sewage treatment, aerobic breakdown of organic solids (not metals or glass)
needs AIR, so labor intensive
also a pest issue if not contained (e.g. rats)



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Reduce and reuse:

TABLE 22.1 Some Everyday Things You Can Do to Reduce and Reuse

- Donate used items to charity
- Reuse boxes, paper, plastic wrap, plastic containers, aluminum foil, bags, wrapping paper, fabric, packing material, etc.
- Rent, borrow, or lend items instead of buying them
- Bring reusable cloth bags shopping
- Make double-sided photocopies
- Keep electronic documents rather than printing items out
- Bring your own coffee cup to coffee shops
- Pay a bit extra for durable, long-lasting, reusable goods rather than disposable ones
- Buy rechargeable batteries
- Select goods with less packaging
- Compost kitchen and yard wastes
- Buy clothing and other items at resale stores and garage sales
- Use cloth napkins and rags, not paper napkins and towels

Recovery rates:

TABLE 22.2
Recovery Rates for Various Materials in the United States

MATERIAL	PERCENTAGE RECYCLED OR COMPOSTED
Lead-acid batteries	99
Steel cans	71
Newspapers	67
Paper and paperboard	63
Yard trimmings	60
Aluminum cans	55
Tires	41
Glass containers	34
Total plastics	9

Data from U.S. Environmental Protection Agency.

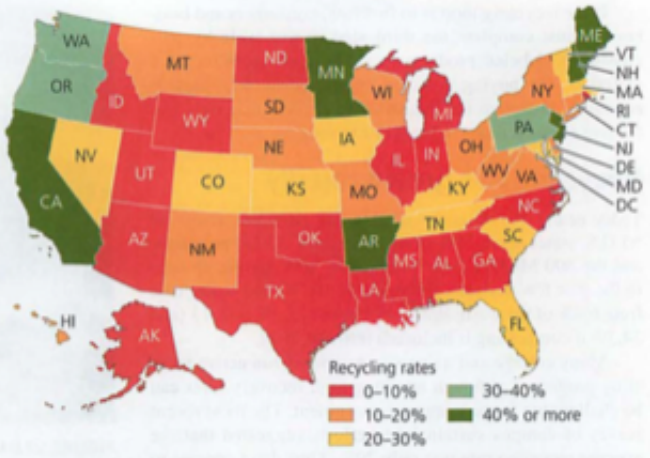

FIGURE 22.10 U.S. states vary greatly in the rates at which their citizens recycle. *Data from Shin, D., 2014. Generation and disposition of municipal solid waste (MSW) in the United States—A national survey. New York: Columbia University, Earth Engineering Center.*

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Bottle Bills:

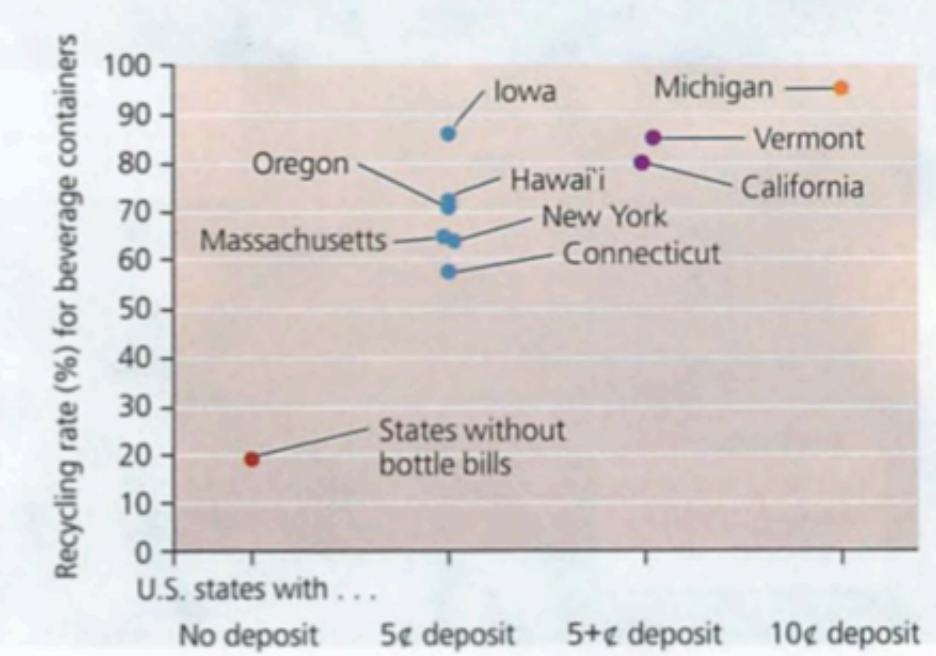


FIGURE 22.11 Bottle bills increase recycling rates, and higher redemption amounts boost these rates further, data suggest. States with bottle bills have much higher recycling rates for beverage containers than states without bottle bills. Maine also has a bottle bill but has not kept detailed data on recycling rates. *Data from Container Recycling Institute, Arlington, VA, 2015.*

DATA How many times greater is Michigan's bottle recycling rate than that of states without bottle bills?

Go to **Interpreting Graphs & Data** on MasteringEnvironmentalScience®

Module 53: Landfills

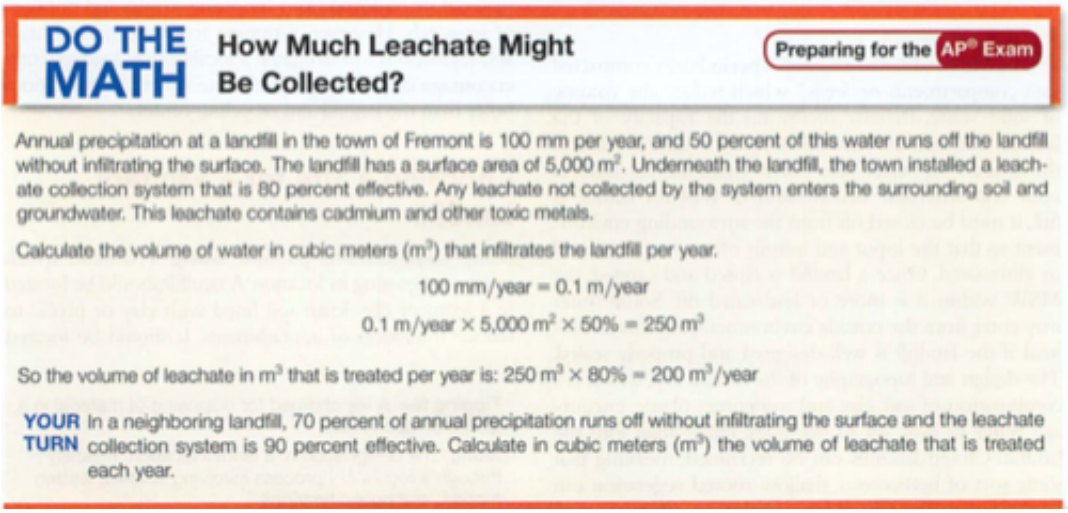
2 types: open landfill and sanitary landfill

Both produce methane (gas) and leachate (toxic)

Open landfills may have extraction tubes for methane

Closed landfills may also, but need a waterproof floor (not always perfect, often leaks

into groundwater)
"Tipping fees": high in Kona (so no commercial trucks at the Waimea dump)
$6 per BAG of trash in Orcas Island, San Juan Islands
Sample problem:



DO THE MATH How Much Leachate Might Be Collected? Preparing for the AP® Exam

Annual precipitation at a landfill in the town of Fremont is 100 mm per year, and 50 percent of this water runs off the landfill without infiltrating the surface. The landfill has a surface area of 5,000 m^2. Underneath the landfill, the town installed a leachate collection system that is 80 percent effective. Any leachate not collected by the system enters the surrounding soil and groundwater. This leachate contains cadmium and other toxic metals.

Calculate the volume of water in cubic meters (m^3) that infiltrates the landfill per year.

100 mm/year = 0.1 m/year

0.1 m/year × 5,000 m^2 × 50% = 250 m^3

So the volume of leachate in m^3 that is treated per year is: 250 m^3 × 80% = 200 m^3/year

YOUR TURN In a neighboring landfill, 70 percent of annual precipitation runs off without infiltrating the surface and the leachate collection system is 90 percent effective. Calculate in cubic meters (m^3) the volume of leachate that is treated each year.

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Another option: incineration (burning at high temperatures, often with oxygen or forced ventilation)
Still creates ash (needs to go into sanitary landfill, it is toxic with heavy metals)
Fly ash is banned for use in construction in EU
Waste to energy: H-Power plant on Oahu
Module 54: Hazardous Waste
Definition: solid, liquid, gas or sludge that is toxic to humans
Household hazmat: batteries (acid), cleaning supplies (chlorine), smoke detectors (Americium 231, radioactive), motor oil, fuels
Definitions:

- *Ignitable.* Likely to catch fire (for example, gasoline or alcohol).
- *Corrosive.* Apt to corrode metals in storage tanks or equipment (for example, strong acids or bases).
- *Reactive.* Chemically unstable and readily able to react with other compounds, often explosively or by produc- ing noxious fumes (for example, ammonia reacting with chlorine bleach).
- *Toxic.* Harmful to human health when inhaled, ingested, or touched (for example, pesticides or heavy metals).

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You might look for the red label ("1993") on trucks. Here are some common numbers:
1075: Propane
1203: Gasoline
1202: Diesel fuel
3334: Aviation fuel

Look up BLEVE on youtube (Boiling liquid expanding vapor explosions)
https://www.youtube.com/watch?v=UM0jtD_OWLU

Two key laws:
CERCLA ("Superfund"): (1980) Comprehensive Environmental Response, Compensation and Liability Act

-taxes chemical and oil industries to fund cleanup and recovery sites "superfund sites"
RCRA: (1976, 1984) Resource Conservation and Recovery Act-solid waste laws
Look up Love Canal, Hooker Chemical
Look behind the elab for a brownfield site...

Module 55: Future solutions

Life Cycle Analysis: Cradle to grave analysis (e.g. white MacBooks vs. aluminum MacBook pros)
(see cradle to cradle above)

e2: design 3.6 super use

1. Cesere says that “the only abnormal thing is mankind” Why?
2. Do you recognize the recycling station in the Netherlands? (hint: think locally)
3. What is the connection with waste streams?
4. Why are architects uniquely crucial in the video?
5. What recycled materials to you recognize in the espresso bar?
6. What is the psychological aspect they mention?
7. How is the design process “backwards thinking”?
8. What did you think of the shoe store? Would you shop there? Why?
9. What can you imagine using 6 billion tires per year for globally?
10. If the tires are not recycled globally, what disease do they promote?
11. There is a "gimmicky" aspect of these projects-how practical are they, and what special intelligence must be involved in any project? How does this compare to traditional projects?
12. Again, psychologically how does curiosity about a store engage the customers?
13. What is the "harvest map”? How could the internet make this more possible?
14. What are the health aspects of using recycled materials? Why is it easier to use new materials from this aspect?
15. Quantity, standardization and ease of use are cited-why?
16. If "cradle to cradle” reuse becomes more pervasive, could some materials be created with recycling in mind? What are you thinking of?
17. How does the Welpeloo project (glass home lady, Ingrid Blans) compare with the elab Living Building Challenge? Were any recycled materials used in the elab?
18. What about her kitchen?
19. All wood in the elab was “SPF” and “FSC certified”. Why are these important?
20. Rotterdam was completely demolished in the second world war, as was Dresden

and several other European cities. Architects love the architecture of Chicago. What do these three cities have in common, and what opportunities do they present?

21. Why would the newer apartment buildings have insulation on the North side, and glass on the South side?
22. Refurbishing existing buildings is a huge market, as opposed to tearing down a structure and starting from scratch. What are the benefits outlined in the video?
23. What does "cheaper" really mean in the broadest sense?
24. Why is "close by" important?
25. Why are the “layers” in the design mentioned important?
26. How does this reverse the normal design process?