APES CHAPTER 16 NOTES (MRS. BAUCK):
WASTE GENERATION AND WASTE DISPOSAL

MODULE 51: Only Humans Generate Waste

I. Humans Generate Unusable Waste
   A. Humans are the only species that produces waste that other organisms can't use!
   B. **waste**—*material outputs than are not useful or consumed*
   C. A society's potential for waste generation is proportional to their wealth.
   D. When you throw something away, where is AWAY?
   E. thought questions…
      1) What have you thrown away so far today?
      2) Have you recycled any items today? If so, what were they?

II. Our Solid Waste Stream
   A. **Municipal solid waste (MSW)—** *trash or garbage, from households, small businesses, and institutions*
      1) Examples of MSW—packaging, food scraps, grass clippings, discarded furniture, computers, tires, discarded appliances, etc.
      2) Non-examples of MSW— industrial, nuclear, hazardous, construction waste (C-waste depending on location)
      3) Presently, over half of the U.S. garbage goes into landfills.

   B. *** EPA's Facts and Figures about Materials, Waste, and Recycling ***
https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management-0#Materials
      1) paper
      2) plastics
      3) rubber, leather, textiles
      4) metals
      5) glass
      6) compostable waste: yard waste, food, wood
      7) *e-waste (electronic waste: old CRT TVs, newer TVs, computers and related hardware, newer and older cell phones)*

   C. Options of local government control
      1) Local government owns the collection trucks etc.
      2) Using private contractors for services
      3) Recycling tax
      4) PAYT – pay-as-you-throw
      5) Household recycling bins
      6) Private companies in charge of recycling

MODULE 52: The Three Rs and Composting

I. The Three Rs

Pinellas County recycling: http://www.pinellascounty.org/utilities/recycle.htm

A. **reduce**—*decreased production of waste*

1) **source reduction** *(waste prevention, pollution prevention P2)—"pre-cycling"—the reduction of the amount and/or toxicity of waste at or before the point of generation*

from https://www.epa.gov/p2

"Pollution prevention (P2) is any practice that reduces, eliminates, or prevents pollution at its source, also known as 'source reduction.' Source reduction is fundamentally different and more desirable than recycling, treatment and disposal. There are significant opportunities for industry to reduce or prevent pollution at the source through cost-effective changes in production, operation, and raw materials use. The opportunities for source reduction are often not realized because existing regulations focus upon treatment and disposal."

2) examples
   a) making packaging lighter, using less materials
   b) keep records and store them electronically
   c) donation of unwanted items to charities and thrift stores
   d) selling unwanted items online
   e) copying two-sided documents
   f) product maintenance and repair rather than disposal
   g) buy items with less bulky packaging
   h) mulching and backyard composting of yard waste

3) benefits (from the EPA)
   a) saves natural resources
   b) reduces toxicity of waste
   c) reduces costs to communities, businesses, schools and consumers
   d) prevents emissions of many GHG (Greenhouse gases)
   e) saves energy
   f) reduces the need for new landfills and combustors

B. **reuse**—*finding another use for the object or substance without any transformation*

C. **recycle**—*use of the material as a source raw material, involves physical transformation*

"Recycling is defined as the recovery of materials, such as paper, glass, plastic, metals, construction and demolition (C&D) material and organics from the waste stream (e.g., municipal solid waste), along with the transformation of materials, to make new products and reduce the amount of virgin raw materials needed to meet consumer demands."

1) *recovery*—process to recover useful material from mixed waste
2) *raw materials*— crude or processed materials that can be converted by manufacture, processing, or combination into a new and useful product
3) levels of recycling
   a) **closed-loop** (primary) **recycling**—*when the original waste material is made back into the same material* (newspaper → newsprint paper)
   b) **open-loop** (secondary) **recycling**—*when the original waste material is made into some other product* (newspaper → cardboard)
   c) tertiary recycling—breaking material down to components that composed the original product; often through depolymerization

4) municipal recycling
   a) different cities have different guidelines for pickup etc.
   b) characteristics of a successful recycling program
      - PAYT charges
      - mandatory, with fines for violators
      - curbside pickup with free bins
      - a community effort—business and residential
      - organized and clear-cut guidelines and goals

5) recycling of *paper* and paper products www.afandpa.org
   https://www.epa.gov/recycle/how-do-i-recycle-common-recyclables#pap
   a) plain paper, envelopes, newspaper, magazines, phone books, cardboard…
   b) *post-consumer waste*—paper recycled by consumers
   c) *pre-consumer waste*—scrap paper at the processing plant, not ever sent out as a product
   d) demand for recycled paper fluctuates; some forest-poor countries pay for used paper
   e) recycled paper is made into new newsprint, boxes and office paper, paper towels, tissue products, insulation, cereal boxes, molded packaging, hydro-mulch, gypsum wallboard, even compost and cat litter

6) recycling of *glass*
   https://www.epa.gov/recycle/how-do-i-recycle-common-recyclables#gla
   a) food and beverage containers; clear/green/brown
   b) some characteristics of glass
      - nonporous and impermeable
      - does not deteriorate, corrode, stain or fade
      - glass is 100% recyclable
      - Glass containers can go from recycling bin to store shelf in as little as 30 days.
   c) basic glass vocabulary
      - cullet— pieces of glass, ordinarily discarded, that are added to new material to assist in the melting and making of new glass
      - sand—fine-grain, loose, granular quartz (SiO_2) used in making glass
      - soda ash— commercial sodium carbonate (Na_2CO_3) used as a raw material for making glass
   d) bottle laws—requiring a deposit on beverage containers
      http://www.bottlebill.org/
      - bottle deposit law states: California, Connecticut, Hawaii, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, Vermont

7) recycling of *plastics*
   https://www.epa.gov/recycle/how-do-i-recycle-common-recyclables#pla
   a) recycling codes

Code 1 PETE or PET: Polyethylene terephthalate
Code 2 HDPE: High density polyethylene
Code 3 V: Polyvinylchloride (or PVC)
Code 4 LDPE: Low density polyethylene
Code 5 PP: Polypropylene
Code 6 PS: Polystyrene
Code 7 OTHER, PC: polycarbonate
Code 7 OTHER, PMMA: polymethyl-methacrylate
Code 7 OTHER, N-66 nylon-66

b) how plastics are made, from the EPA

"*Plastics are polymers*. The simplest definition of a polymer is something made up of many units. *Polymers are chains of molecules*. Each link of the chain is usually made of carbon, hydrogen, oxygen, and/or silicon. To make the chain, many links, are hooked, or polymerized, together.

To create polymers, petroleum and other products are heated under controlled conditions and broken down into smaller molecules called monomers. These *monomers are the building blocks for polymers.* Different combinations of monomers produce plastic resins with different characteristics, such as strength or molding capability.

Plastics can be divided in to two major categories: thermosets and thermoplastics. A thermoset is a polymer that solidifies or "sets" irreversibly when heated. They are useful for their durability and strength, and are therefore used primarily in automobiles and construction applications. Other uses are adhesives, inks, and coatings.

A thermoplastic is a polymer in which the molecules are held together by weak bonds, creating plastics that soften when exposed to heat and return to original condition at room temperature. Thermoplastics can easily be shaped and molded into products such as milk jugs, floor coverings, credit cards, and carpet fibers.

Plastic resins are processed in several ways, including extrusion, injection molding, blow molding, and rotational molding. All of these processes involve using heat and/or pressure to form plastic resin into useful products, such as containers or plastic film."

8) recycling of metals

a) *aluminum* https://www.americanbeverage.org

- We use about 392 cans per person per year.
- Recycling aluminum saves about 95% of the energy it would take to produce aluminum from its original source, bauxite.
- Aluminum recycling is so efficient that it can take as few as 60 days for a can to be collected, melted down and made into a new can sitting on a grocery store shelf.

b) *steel*— alloy of iron (Fe; "ferrous"= Fe^{2+}, with C and other metals such as Mn, Si, Cu, Al, B, Cr, Co, Mo, Ni, Ti, W, V, Zr

- "More than 1,000 facilities in the US make and process steel, and most are located in the Great Lakes region and the South.
- Other sources of steel in the MSW stream are containers and packaging, such as food packaging and aerosol cans.
- Large quantities of steel and other ferrous metals are found in construction materials and transportation products, such as automobiles, locomotives, and ships, but these are not included in calculations of MSW. These non-MSW products are, however, highly recycled." (EPA)

9) other items of interest: tires. holiday trees, batteries, aerosol cans, textiles (fabrics)

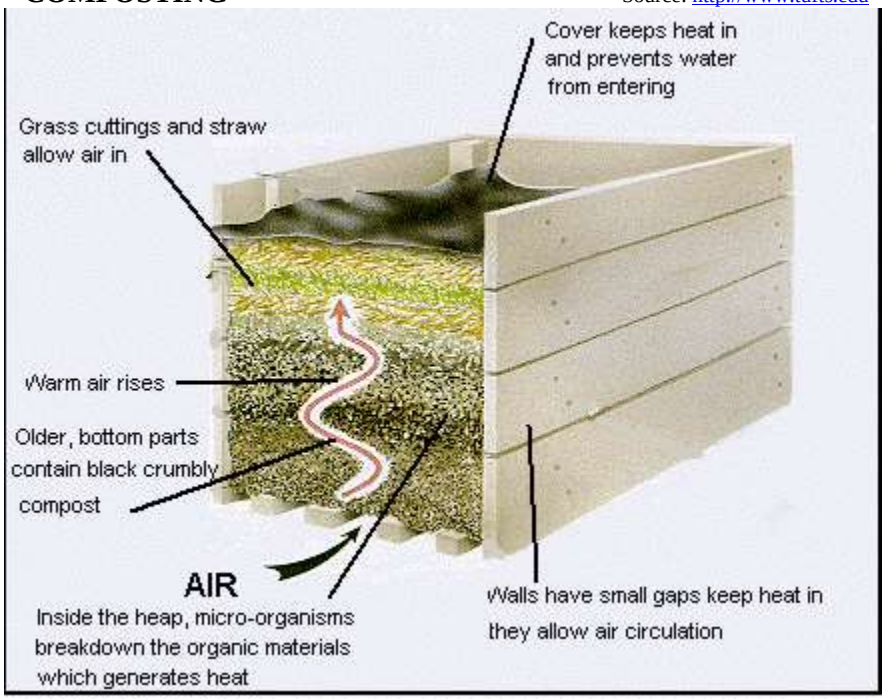
10) items that require special handling/drop-off: fluorescent bulbs, motor oil, oil-based paint, electronics, "white metal"(appliances)

D. completing the Three Rs: buying recycled
   1) The "cycle" part of the word is important, and to complete a cycle, four phases must be gone through: collection, sorting, reclamation and marketing.
   2) Recycling may be mechanical, chemical or thermal.

II. Composting

A. **composting**— *aerobic biological decomposition which creates humus*
   1) benefits of composting… from the EPA
      a) "Suppress plant diseases and pests.
      b) Reduce or eliminate the need for chemical fertilizers.
      c) Promote higher yields of agricultural crops.
      d) Facilitate reforestation, wetlands restoration, and habitat revitalization efforts by amending contaminated, compacted, and marginal soils.
      e) Cost-effectively remediate soils contaminated by hazardous waste.
      f) Remove solids, oil, grease, and heavy metals from stormwater runoff.
      g) Capture and destroy 99.6 percent of industrial volatile organic chemicals (VOCs) in contaminated air.
      h) Provide cost savings of at least 50% over conventional soil, water, and air pollution remediation technologies, where applicable."

COMPOSTING Source: http://www.tufts.edu



   2) Can be done individually or on a larger scale industrially
https://www.urthpact.com/industrial-composting-what-it-is-and-how-it-works/

3) EPA: What to compost

Animal manure	Fireplace ashes	Sawdust
Cardboard rolls	Fruits and vegetables	Shredded newspaper
Clean paper	Grass clippings	Tea bags
Coffee grounds and filters	Hair and fur	Wood chips
Cotton rags	Hay and straw	Wool rags
Dryer/vacuum cleaner lint	Houseplants	Yard trimmings
Eggshells	Leaves	
	Nut shells	

4) EPA: What not to compost and why

Leave Out...	**Reason…**
Black walnut tree leaves or twigs	Releases substances that might be harmful to plants
Citrus rinds	Might contain fruit flies and eggs
Coal or charcoal ash	Might contain substances harmful to plants
Dairy products	Create odor problems and attract pests such as rodents and flies
Diseased or insect-ridden plants	Diseases or insects might survive and be transferred back to other plants
Fats, grease, lard, or oils	Create odor problems and attract pests such as rodents and flies
Meat or fish bones and scraps	Create odor problems and attract pests such as rodents and flies
Pet wastes	Might contain parasites, bacteria, germs, pathogens, and viruses harmful to humans
Yard trimmings treated with chemical pesticides	Might kill beneficial composting organisms
Source: https://www.epa.gov/recycle/composting-home	

MODULE 53: Landfills and Incineration

I. Landfills
  A. **sanitary landfill** or municipal solid waste landfill (MSWLF)
    1) definition: *depositing waste on the ground and burying it with at least 6" of dirt; as little environmental contamination as possible*
    2) "receives household wastes but can also receive non-hazardous sludge, industrial solid waste, construction and demolition debris"
  B. advantages of landfills
    1) minimal air pollution
    2) constant burying of the layers—vermin (rats, etc.) are kept to a minimum

https://www.epa.gov/environmental-topics/land-waste-and-cleanup-topics

"Modern landfills are well-engineered and managed facilities for the disposal of solid waste. Landfills are located, designed, operated and monitored to ensure compliance with federal regulations. They are also designed to protect the environment from contaminants, which may be

present in the waste stream. Landfills cannot be built in environmentally-sensitive areas, and they are placed using on-site environmental monitoring systems. These monitoring systems check for any sign of groundwater contamination and for landfill gas, as well as provide additional safeguards. Today's landfills must meet stringent design, operation and closure requirements established under the Resource Conservation and Recovery Act (RCRA)."

C. general procedures
   1) landfill **siting** (approval)
      a) characteristics of landfill siting: high ground, significant distance above the water table
      b) multiple steps, from http://dnr.wi.gov/topic/landfills/sitingfaq.html

including site inspection, public hearings, reports, environmental analysis, negotiation, arbitration

   2) landfill expansion
   3) landfill closure
   4) landfill reclamation (golf course, etc.)

D. types of landfills
   1) **sanitary landfill (**municipal solid waste landfill or MSWLF)
   2) *bioreactor landfills (bioreactors)*— a special type of sanitary landfill to quickly transform and degrade organic waste
   3) *industrial waste landfill* **-** designed for management of non-hazardous industrial process wastes
      a) *construction and demolition debris (C & D) landfill*
         - only accepts concrete, asphalt, brick, wood, drywall, asphalt roofing shingles, metals, and some types of plastics
         - less stringent standards than sanitary landfills
      b) *Coal Combustion Residual (CCR) landfill* – used to manage and dispose of coal combustion residuals (CCRs or coal ash)
   4) **secure landfills** (see MODULE 54)

E. main parts of a landfill
   1) leachate collection system
   2) contoured floor
   3) layers of soil, sand/gravel, clay in a pyramidal shape
   4) layers of refuse (trash) buried

(quote from http://www.floridacenter.org/)

"Typically, *landfill leachate collection systems are positioned above the liner and are designed to function in a free-flowing gravitational mode for the entire active and post-closure periods. Leachate collection systems consist of: underdrains, collection trenches and pipes, line clean-out ports, pumps and lift stations, and storage tanks or wet wells*. Clogging of any portion of the system can lead to higher hydraulic heads within the waste zone and increase the potential for leakage through the liner."

F. environmental consequences of landfills
   1) *leachate generation*
      a) **leachate**—*water tainted with pollutants*
      b) forms from percolation and dissolving chemicals
      c) *can have heavy metals, battery acid, cleaning fluid, pesticides, POPs…*
   2) *methane production*
      a) buried wastes promotes anaerobic bacterial action
      b) **biogas** is produced (usually 2/3 CH_4 with H_2 and CO_2)

- biogas seeping underground can poison root systems of plants
- biogas can seep upward into homes and may cause explosions
- LFG = landfill gases – typically 50% CH_4, 42% CO_2, 7% N_2, 1% O_2

from http://www.floridacenter.org/

"*Old landfills that have been closed or are in need of closing, but have no gas management plan, can be a significant source of odors and greenhouse gases*. Gas extraction tends to be expensive and out of the reach of most small communities managing their solid waste facilities. An attractive alternative is to *incorporate a bio-reactive layer into the design of a landfill cover or in areas with significant release of gas into the atmosphere (typically referred to as hot spots)*… These barriers will reduce emissions of NMOCs (non-methane organic compounds) and should also reduce odors."

3) *settling*
   a) settling and compacting of waste as it decomposes
   b) monitoring the area to maintain a level surface
4) *land values and land use*

http://realtormag.realtor.org/daily-news/2015/07/10/landfills-dont-always-drop-home-values

NIMBY – "not in my backyard" LULU – "locally unwanted land use"
NIMTOO – "not in my term of office!"

G. Landfill GTE = gas-to-energy
https://www.advanceddisposal.com/for-mother-earth/education-zone/landfill-gas-to-energy.aspx

1) clean, safe energy source to generate electricity
2) EPA's Landfill Methane Outreach Program (LMOP) http://www.epa.gov/lmop/
   "a voluntary assistance and partnership program that promotes the use of landfill gas as a renewable, green energy source."

E. Pinellas County's Bridgeway Acres Landfill
3095 114th Ave. North, St. Petersburg (727) 464-7500

http://www.pinellascounty.org/solidwaste/landfill-garbage.htm

"Pinellas County Solid Waste manages the only landfill in the county that takes household garbage. Under the ground in Pinellas County there is a natural layer of clay. Our landfill was made by building a clay wall around that natural clay layer underground. The man-made clay wall and the natural clay floor join to make a sort of 'bathtub.' The clay 'bathtub' keeps waste in our property and out of the land around it. Because there is limited landfill space, we try burying only waste that can't be burned or recycled such as:

Big items - boats, mattresses, or couches; Construction debris – walls from a house;
Large amounts of waste that we cannot burn, from companies – such as a truckload of lipstick, paintballs....

Trash taken to the landfill is spread, crushed, and covered with ash from the waste-to-energy plant. Though there are some things that are not burned, and sometimes we can't burn our garbage if the waste-to-energy plant is down for repairs or maintenance, *most of our waste **(85%)** is recycled or made into energy in the waste-to-energy plant."*

II. Incineration

A. **incineration**—*the combustion of waste to reduce volume and sometimes generate heat or electricity*

B. advantages

1) reduction of the weight and volume of trash
2) reduction of toxic substances into two types of **ash** *(inorganic residue)*
   a) **fly ash** *(collected from fumes)*
   b) **bottom ash** *(collects at the bottom of the boiler)*
3) trash picked up as usual, just to a different destination
4) electricity can be produced in **waste-to-energy (WTE)** facilities
   - *resource recovery*—separating materials before and after combustion

C. *Pinellas County WTE facility* http://www.pinellascounty.org/utilities/wte.htm

1) 3001 110th Avenue North, St. Petersburg (727) 464-7500

The Waste-to-Energy (WTE) facility has the capacity to burn 3,000 tons of garbage every day. The WTE facility processes about one million tons of garbage every year. The process can produce up to 75 megawatts (MW) per hour of electricity. It sells about 60 MW to Progress Energy for distribution within the community, and the remainder powers the plant itself. *This electricity powers approximately 43,000 homes and businesses every day.* The WTE facility uses state-of-the-art air pollution control technology, which continuously monitors WTE emissions, ensuring the plant's emissions fall within the United States Environmental Protection Agency's (EPA) standards.

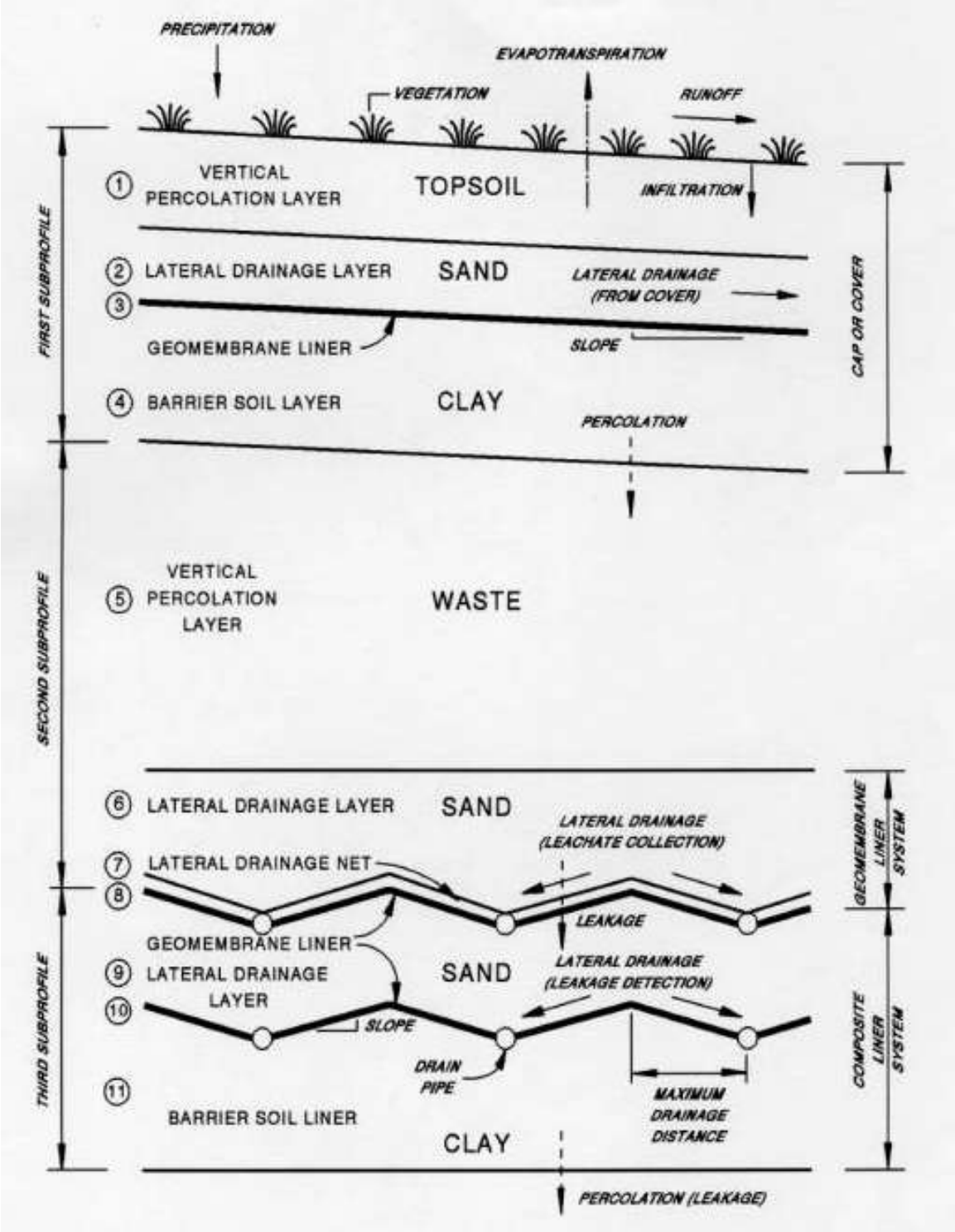
There is a 70,000 square foot building next to the WTE facility that contains the Materials Recovery System (MRS) used to recover metals in the garbage. The MRS contractor separates combusted metals from the WTE facility ash, shreds the metals, and sorts them using mechanical equipment such as magnets and eddy currents. The recovered metals are sold to steel mills and smelters for recycling.

2) operating facility procedures
   a) *inspection* of incoming waste; removal of recyclables and noncombustibles
   b) *magnetic treatment to remove iron* for recycling
   c) waste is put through a *shredder*
   d) waste is blown into *boilers*
   e) water flowing in the boiler walls is converted to *steam* to turn *turbines* to generate power
   f) **bottom ash** is sent to a processing facility
   g) ash is sent to landfills

D. Disadvantages of WTE

1) health effects from particulates, heavy metals, dioxins, etc.
2) expensive to build
3) ash is sometimes tainted with hazardous substances (cannot be reused)
4) may conflict with recycling programs for combustible materials

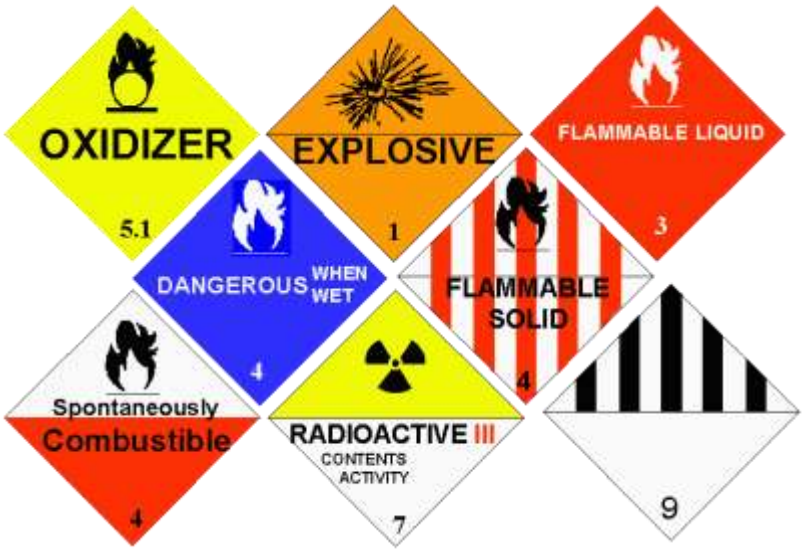
LANDFILL DESIGN Source: http://msw.cecs.ucf.edu/collegestudents.html



MODULE 54: Hazardous Waste

I. Hazardous Waste Handling and Disposal
   A. **hazardous waste**—substances that are harmful to humans and/or ecosystems
   B. *HAZMAT—hazardous material*
   C. properties of classification
      1) *ignitability*—catch fire easily
      2) *corrosivity*—eat away skin, storage tanks, or equipment
      3) *reactivity*—chemically unstable; potentially explosive or fume-producing
      4) *toxicity*—poisonous when consumed
   D. nine classifications from www.fau.edu/divdept/envhs/DOT.html

EXAMPLE PLACARDS (SIGNS) USED FOR HAZMATS

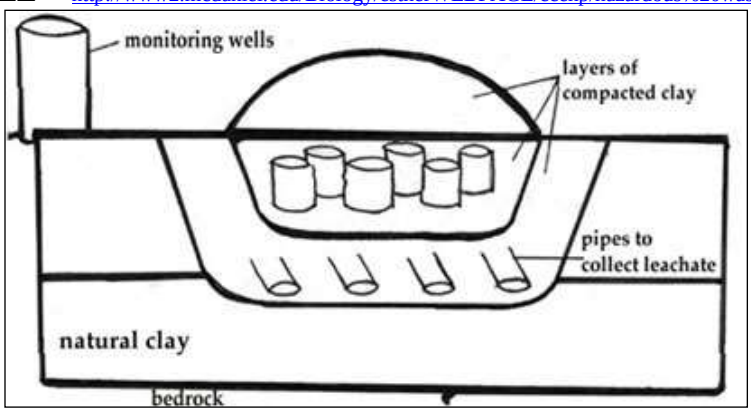


   E. Sources of Chemicals Entering the Environment
      1) accidental spills, explosions, etc.
      2) mining processes
      3) refining processes
      4) deliberate application: example— pesticides and fertilizers
      5) chemical and industrial byproducts
      6) evaporation of volatile materials
      7) particulate matter from combustion
      8) landfill leachate
      9) businesses like drycleaners and gas stations
      10) household chemicals (HHW—household hazardous waste)
      http://muextension.missouri.edu/xplor/wasteman/wm6003.htm

   F. **secure landfills**
      1) four critical elements:
         a) stable hydrogeologic site
         b) bottom liner
            -- two impermeable liners (clay, plastic, or composite)
            -- state-of-the-art HDPE landfill liners are 1/10 of an inch thick

c) leachate collection system
d) cover or cap (clay dike and clay cap)
-- at least 10 ft. from bottom liner to water table
-- careful groundwater monitoring by wells

SECURE LANDFILL http://www2.mcdaniel.edu/Biology/estherWEBPAGE/ccehp/hazardous%20waste/landfilljpeffinal



II. Waste and Hazardous Waste – Major Legislation

A. **Solid Waste Disposal Act of 1965**
1) gave financial and technical power to the Bureau of Solid Waste Management
2) established grant programs to support the use of improved methods for disposal
3) established grant programs to support the development of solid waste disposal plans by states and interstate agencies

B. **Resource Conservation and Recovery Act (RCRA) of 1976** ("rick-rah")
From http://www.epa.gov/lawsregs/laws/rcra.html
1) background info

"**RCRA** *gave EPA the authority to control* hazardous waste from the 'cradle-to-grave.' This includes the *generation, transportation, treatment, storage, and disposal of hazardous waste*. RCRA also set forth a framework for the management of non-hazardous wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see CERCLA)."

2) primary law governing the disposal of solid and hazardous waste
3) **a**mended the Solid Waste Disposal Act of 1965
4) goals
a) To protect human health and the environment form the potential hazards of waste disposal
b) To conserve energy and natural resources
c) To reduce the amount of waste generated
d) To ensure that wastes are managed in an environmentally sound manner
5) summary
a) "*from cradle to grave*"
b) "command and control" approach
c) closures of local dump sites
d) regulations for landfills
e) regulations of combustion facilities
f) required states to formulate solid waste management plans

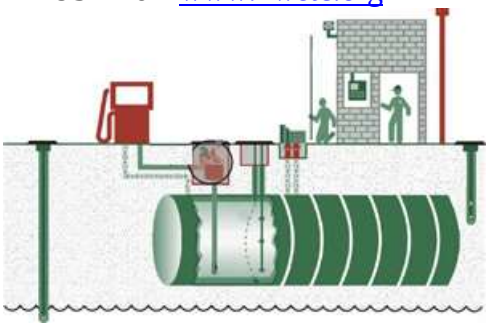
C. **Hazardous and Solid Waste Amendments (HSWA) of 1984** ("hiss-wah")

1) *the most significant set of amendments to RCRA*

"**HSWA**—*The Federal Hazardous and Solid Waste Amendments are the 1984 amendments to RCRA that required phasing out land disposal of hazardous waste*. Some of the other mandates of this strict law include increased enforcement authority for EPA, more stringent hazardous waste management standards, and a comprehensive underground storage tank program."

2) created the new regulatory program for underground storage tanks (UST)
3) hazardous waste facilities owned or operated by federal, state, or local government agencies must be inspected annually, and privately owned facilities must be inspected at least every two years

UST from www.nwetc.org



D. **The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, is commonly known as the **Superfund Act** (1980)

1) provisions
   a) "established prohibitions & requirements concerning closed and abandoned hazardous waste sites
   b) provided for liability of persons responsible for releases of hazardous waste at these sites
   c) established a trust fund to provide for cleanup when no responsible party could be identified"
2) *Superfund sites*—areas of high, priority-level pollution
   a) old factories where chemicals were dumped on the ground
   b) landfills where HAZMATs were dumped
   c) remote places where people secretly dumped HAZMATs
   d) old mines
   e) There are **1322 Superfund sites across the U.S. on the National Priority List;** 1 in Pinellas County listed as a priority on the final NPL (presently being cleaned up)
3) EPA's RCRA/Superfund Hotline (800) 424-9346
4) https://www.epa.gov/fl/list-superfund-sites-florida
5) A famous Superfund site: Love Canal – Niagara Falls, NY

- Pre-1910 Wm. T. Love planned to build a small three-block community
- 1920 Love Canal designated a municipal and industrial dumping site
- 1942-1953 Hooker Chemicals and Plastics dumped chemical wastes into canal
- 1953 Hooker Chemical filled the canal and sold it to the city for $1.00, warning them not to disturb the clay cap covering the wastes
- Late 1950s Area developed with 100 homes and a school

- ~1978 Chemical leaching observed; development of the area causes a "bathtub" effect that released harmful contaminates.
- Many health problems resulted: skin lesions, birth defects, etc.
- The company was sued for damages – resident Lois Gibbs became an activist

E. **SARA** overview

"The **Superfund Amendments and Reauthorization Act (SARA)** amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on October 17, 1986…

- *stressed the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites*
- required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations
- provided new enforcement authorities and settlement tools
- increased State involvement in every phase of the Superfund program
- increased the focus on human health problems posed by hazardous waste sites
- encouraged greater citizen participation in making decisions on how sites should be cleaned
- increased the size of the trust fund to $8.5 billion"

F. **SARA, Title III: The Emergency Planning and Community Right-to-Know Act (EPCRA)**

From http://www.michigan.gov/deq/0,1607,7-135-3307_3667_4137-11426--,00.html

1) Why it was established

"In response to continuing community concern regarding hazardous materials and chemical release tragedies, a reauthorization and expansion of Superfund was signed into law in 1986. It is known as the *Superfund Amendments and Reauthorization Act (SARA)*…"

2) What it does

"SARA Title III *establishes requirements for* Federal, State and local governments, Indian Tribes, and industry regarding *emergency planning and 'Community Right-to-Know' reporting on hazardous and toxic chemicals*. The Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment."

3) Four major components
   a) Emergency planning
   b) Emergency release notification
   c) Hazardous chemical inventory
   d) Toxic chemical release inventory

Toxics Release Inventory (TRI) http://www.epa.gov/tri/

"*The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities.* This inventory was established under the **Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA**) and expanded by the Pollution Prevention Act of 1990."

G. worker protection: **OSHA Act** and "**Right to Know**"

1) **Occupational Safety & Health Act of 1970 (OSH or OSHA Act)**
2) *OSHA: Occupational Safety & Health Administration*

From http://www.osha.gov

"*OSHA's mission is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.*

OSHA and its state partners have approximately 2100 inspectors, plus complaint discrimination investigators, engineers, physicians, educators, standards writers, and other technical and support personnel spread over more than 200 offices throughout the country. This staff establishes protective standards, enforces those standards, and reaches out to employers and employees through technical assistance and consultation programs."

3) "**Worker's right to know**" example: every year, school faculty and staff members view a mandatory video about chemicals; lists are available to check chemicals on campus
4) MSDS (material safety data sheets). SDS (Safety data sheets)

H. **Toxic Substances Control Act of 1976 (TSCA)**

From http://www.epa.gov/lawsregs/laws/tsca.html

"The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress to give EPA the ability to *track the 75,000 industrial chemicals currently produced or imported into the United States. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard*. EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk. Also, EPA has mechanisms in place to track the thousands of new chemicals that industry develops each year with either unknown or dangerous characteristics. EPA then can control these chemicals as necessary to protect human health and the environment."

I. **Brownfields**

From http://www.epa.gov/swerosps/bf/

"A brownfield is defined as '*a real property where expansion or redevelopment is complicated by actual or perceived environmental contamination.*' Every city and county, rural and urban, has vacant, underused, and potentially contaminated properties. Many programs are available to assist with the redevelopment of such properties… Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment…"

5) provides incentives for developers
6) rehabilitates unused, unsightly facilities— often in low-income areas
7) ~450,000 brownfields nationally
8) state and local governmental control

J. **orphan sites (**from www.deq.state.or.us)

1) definition

"Orphans are sites contaminated by a release of hazardous substances that poses serious threats to human health or the environment, where the parties responsible for the contamination are either unknown -- or unable or unwilling -- to pay for needed remedial actions."

2) typical orphan sites

"A typical Orphan Site is a property with soil and/or groundwater contamination, where the party responsible for the contamination has gone out of business, and may also have left behind

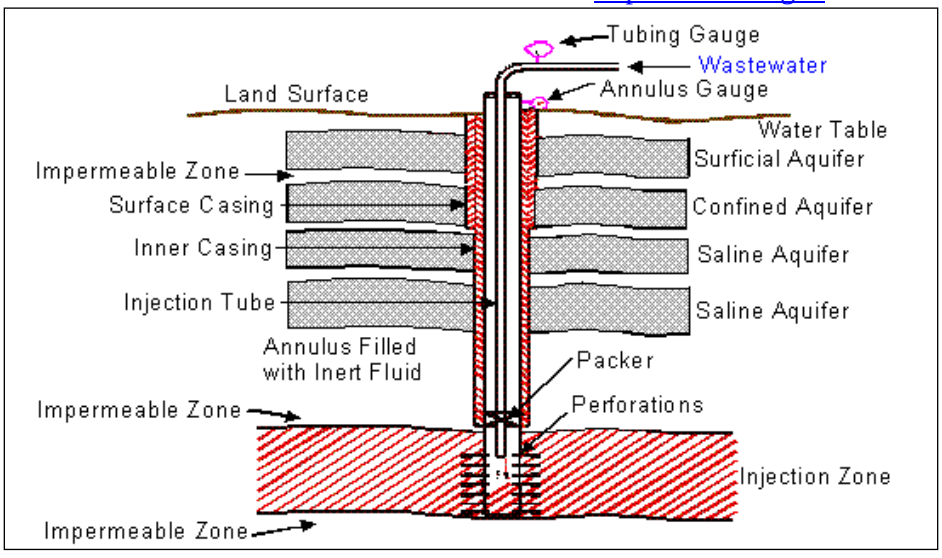
hazardous substances in tanks or drums. Sometimes a company is still operating, but is too small to afford the cleanup. Another type of orphan project is an areawide site where drinking-water wells have been contaminated, but the source of the contamination is unknown."

III. Methods of Land Disposal

A. **deep-well injection** http://www.frtr.gov/matrix2/section4/4-54.html

1) "…place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers."
2) target chemicals: *VOCs (volatile organic chemicals), SVOCs (semivolatile organic compounds)*, fuels, explosives, pesticides
3) limitations
    a) possibility of seismic activity
    b) injected wastes must be compatible with the injection well system
    c) high concentrations of suspended solids (typically >2 ppm) can lead to blockage
    d) corrosion of the injection well components
    e) high iron concentrations may result in fouling when conditions convert soluble to insoluble products
    f) rapid population growth of indigenous or injected bacteria from organic carbon
    g) waste streams saturated with organic contaminants may require pretreatment
    h) extensive assessments prior to approval
4) locations: Louisiana, Texas, Ohio, Oklahoma

DEEP-WELL INJECTION from http://www.frtr.gov



B. **surface impoundments** http://www.epa.gov

"*A topographic depression, excavation, or diked area, primarily formed from earthen materials* (lined or unlined) and designed to hold accumulated liquid wastes, wastes containing free liquids,

or sludges that were not backfilled or otherwise covered during periods of deposition… structures that may be more specifically described as *lagoon, pond, aeration pit, settling pond, tailings pond, sludge pit,* etc."

MODULE 55: New Ways to Think About Solid Waste

I. Life-Cycle Analysis (Cradle-To-Grave Analysis)
   A. an examination of the materials used and released in a product's existence
   B. manufacture, use, and disposal of raw materials

Life Cycle Inventory (LCI) analysis involves creating an inventory of flows from and to nature for a product system. Inventory flows include inputs of water, energy, and raw materials, and releases to air, land, and water.

II. **Integrated waste management (integrated solid waste management)**
   A. EPA definition: *complete waste reduction, collection, composting, recycling, and disposal system*

https://www.thebalancesmb.com/integrated-solid-waste-management-iswm-an-overview-2878106
"An efficient ISWM system considers how to reduce, reuse, recycle, and manage waste to protect human health and the natural environment. It involves evaluating local conditions and need, then choosing, mixing and applying the most suitable solid waste management activities according to the conditions."

   B. progression
      1) landfill (worst option for trash)
      2) incineration (burning trash for fuel)
      3) recycling and composting (materials redone as resources)
      4) reuse (keeping it out of the waste stream)
      5) reduction (don't generate as much trash)

III. Global Movements for Change
   A. **Environmental Justice (EJ)**

from http://www.epa.gov/compliance/environmentaljustice/
"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies… It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work." Fair treatment = no one group should bear a disproportionate amount of negative environmental impact.

   B. Basel Convention

From http://www.basel.int/
"The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention has 169 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management,

transboundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992."

C. Pollution prevention for a sustainable society: getting citizens, businesses, and government working together responsibly

1) **pollution control**
   a) air, land, water pollution
   b) filtration, chemical treatment, air filters, water purifiers, etc.

2) **pollution avoidance**
   a) *changing the production process*
      - better materials management, less waste
      - minimizing or elimination of pollution
   b) *substitution of nonhazardous materials for HAZMATs*
      - **wet cleaning** vs. using organic solvents
   c) *reuse*—clean up and reuse industrial solvents and lubricants

3) **green products**
   a) Products Made with Salvaged, Recycled, or Agricultural Waste Content
   b) Products That Conserve Natural Resources
   c) Products That Avoid Toxic or Other Emissions
   d) Products That Save Energy or Water
   e) Products That Contribute to a Safe, Healthy Built Environment

4) summary of chemical pollution options for sustainability
   a) pollution prevention
   b) recycling
   c) treatment (breaking down)
   d) safe disposal