Human Waste

- Anything we use or generate in everyday life
- Materials that are no longer useful to us or simply no longer used
- A large part is municipal solid waste (MSW), or all the "stuff" that we throw away
- In 2017 in the US we generated 267.8 million tons of MSW(U.S. short tons) or 4.51 pounds per person per day

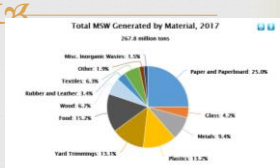


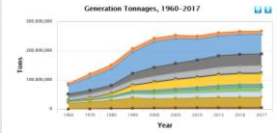
Waste Generation

- Higher in developed countries
- Increases with affluence (less need to save or recycle things)
- Varies by location, urban vs. rural, time of year, economies, etc.

Composition

- USA waste generation:
  - 25% paper and paperboard (largest component)--decreasing
  - 13.1% yard trimmings—decreasing
  - 13.2% plastics—increasing (up from 8.2% in 1990)
- US waste gen peaked in 2000
- EPA: In 2017 MSW…
  - 35.2% recycled or composted
  - 12.7% combusted with energy recovery
  - 52.1% landfill





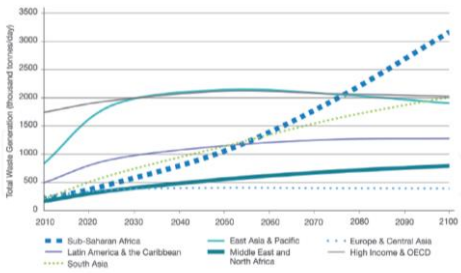


Figure 1.
Total municipal solid waste generation by region (adapted from [1]).

Source: Godfrey, et al 2019

Issues with Human Waste

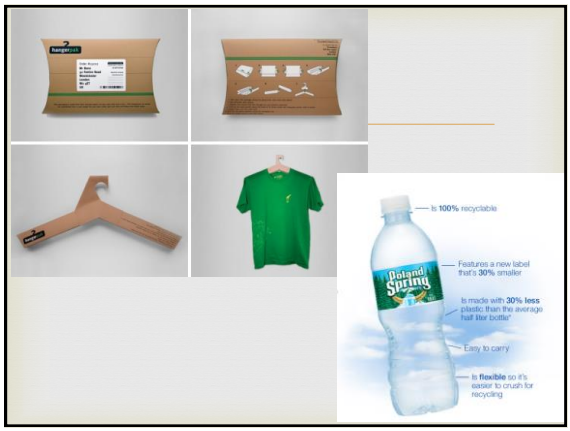
- Not useable in a healthy way by other organisms
- Non-renewables that are disposed of deplete stores
- Contamination from some products harms the environment

The Three R's

- Essential for a sustainable future
- Many products we use are limited resources (metals, minerals, anything from the lithosphere)
- Need creative ways to limit consumption but maintain quality of life—prioritise REDUCTION, the reuse and recycling/reclaiming

reduce

- Use less material in production of goods
- Example: sustainable packaging



reuse

- Reusing materials to increase cycle life
- Energy cost of reusing needs to be less than manufacturing new materials

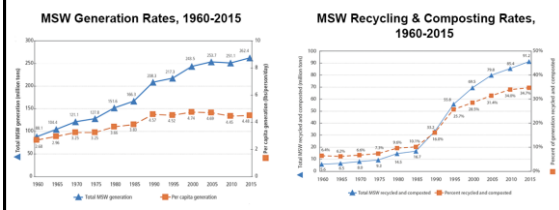
recycle

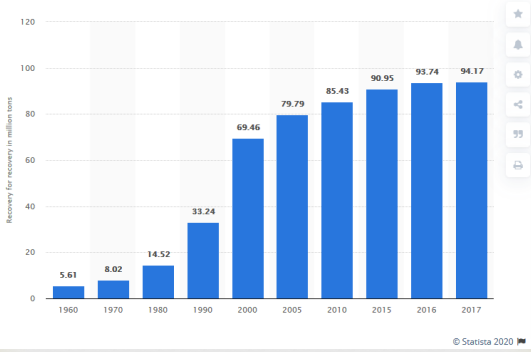
The possibilities are endless.

- Used materials collected, processed, and reformed into new materials
- Two types:
  - Closed-loop: Old product is recycled into the same thing (aluminum cans, many metals)
  - Open-loop: Old product is recycled into something new and different
  - Closed loop lessens demand for initial product while open loop doesn't (but better than nothing!)

US Recycling

- Roughly 25% of all MSW is recycled in the US (~35% if you include composted waste)
  - 47% paper and paper materials
  - 25% yard trimmings
  - ~15% is metal, glass, and plastic (only 3% of recycled MSW is plastic!!)
- Has improved drastically, but there is still a lot to do!
- Much recycling isn't done domestically (products shipped internationally, especially plastics)
  - China plastic import ban in 2018 significantly impacted markets





Materials recovery from U.S. municipal solid waste 1960-2017 (Wang, 2019)

	1970	1980	1990	2000	2014	2015
Paper and paperboard	15%	21%	28%	43%	65%	67%
Glass	1%	5%	20%	23%	26%	26%
Metals	4%	8%	24%	35%	35%	34%
Plastics	Neg.	<1%	2%	6%	10%	9%
Yard trimmings	Neg.	Neg.	12%	52%	61%	61%
Selected Consumer Electronics				10%	42%	40%
Lead-acid batteries	76%	70%	97%	93%	99%	99%

Neg. = less than 5,000 tons or 0.05 percent.

What to recycle in Alachua County?

You can recycle all these items in the blue bin

- Plastic bottles & jars (including yogurt cups and margarine tubs)
- Metal cans, including aerosol cans (empty first please!)
- Glass bottles & jars
- Beverage cartons

You can recycle all these items in the orange bin:

- Brown paper bags & newspapers
- Magazines, catalogs & telephone books
- Corrugated cardboard and pasteboard
- Office paper & junk mail
- Paperback books, workbooks and soft-back textbooks.

DON'T RECYCLE…

- Tips:
  - Remove lids (provide a hazard
  - Rinse containers
  - Nothing IN plastic bags—it will all get thrown away!

Blue Bin - Plastic

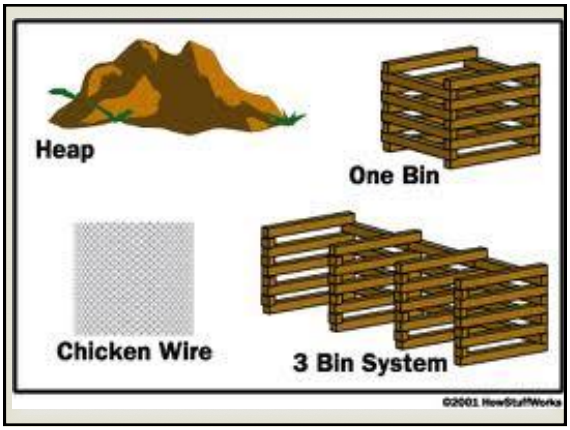
Any plastic containers are recyclable in Alachua County, as long as the containers have a pourable spout or neck up to 2 gallon in size. Yogurt cups and margarine tubs are now recyclable too. Please rinse, remove all caps and lids, and step on plastic to save space! Empty household bleach bottles are acceptable.

Things we cannot accept at this time:

- No plastic bags
- No lids of any kind
- No food trays (ie. frozen food or the like)
- No black plastic of any kind
- No clamshell containers (blueberry containers) or supermarket to-go containers.
- No plastic cups (Solo cups) or take out cups (coffee or soda cups)
- No take out containers of any kind.
- No compostable, biodegradable or degradable containers also commonly listed as "bio-plastics"
- No petroleum product, pool chemical and pesticide containers
- No polystyrene foam also know as Styfroam
- No egg cartons

Composting

- Recycle organic waste in a way that is positive and healthy for the environment
- Organic waste breaks down and increases BOD in landfills—also releases methane
- Composting organic matter lessens this and provides natural, organic fertilizers to soils
- US composted 27 million tons of MSW in 2017– roughly 10% of our MSW

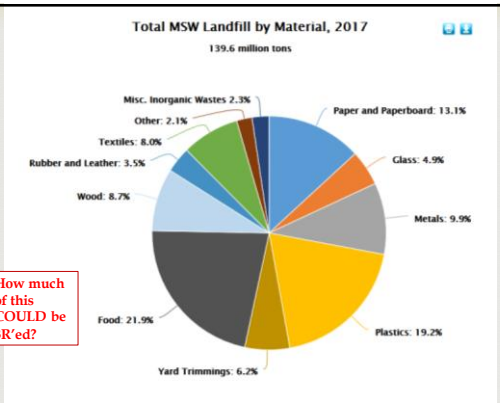


Current Management Strategies

- Many are unsustainable
- Many release pollution into the hydrosphere and atmosphere
- Need to rely on three R's to work towards a sustainable systems and move away from traditional methods

Landfills

- Dig a hole, put trash in it
- More than half of our waste goes here
- Sanitary landfills: lessen contamination of the environment by lining the bottom with a clay pan or plastic liner
  - Leachate is then collected in pipes
  - Some leachate almost always escapes into the surrounding lands
- Should only dispose of less environmentally harmful materials in landfills
- In 2017, US discarded 139.6 million tons into landfills—52% of our MSW



How much of this COULD be 3R'ed?

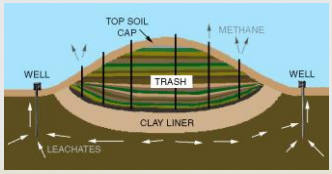
What not to landfill:

Landfill Siting

- Ideally landfills need to be in areas of less rain (decrease leachate), stable lithosphere, and low groundwater contamination risk
- Choosing where to put a landfill is often ethically tricky and politically charged
- People with resources prevent landfills from being built near them, so landfills are built in less ideal places

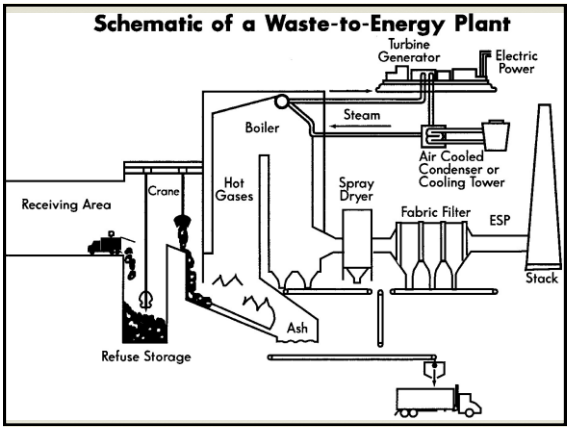
Landfill Issues

- Volume of trash that will not be 3R'ed
- Leachate
- Decomposition rates slow and quickly become anaerobic
  - This releases methane, a powerful greenhouse gas



Incineration

- Burning our trash, sometimes to just get rid of it, sometimes to generate heat and electricity
- Waste-to-energy: using trash to generate energy
  - Potential alternative energy
  - Ultimately still not renewable
  - In 2017 US combusted ~12% of MSW for energy generation



Incineration Issues

- Burning releases chemicals and greenhouse gases into the atmosphere
- Residuals are ash (some released into atmosphere, rest is collected as a solid)
  - Ash might be contaminated with heavy metals
  - Typically dumped into landfills
  - Very difficult to burn materials uniformly

Hazardous Waste

- A lot more expensive and difficult to dispose of HW than SMW
  - Compare mercury disposal with a Starbucks cup
- Must be treated before disposal
- No good way to dispose—best option is reduction of use

E-Waste

- Waste from electronics and their components
- Contain many toxic and poisonous chemicals
  - Lead, Cadmium, Mercury, other heavy metals
- Primarily made from lithosphere resources
- Difficult to disassemble and recycle



What's Been Done?

- U.S Resource Conservation and Recovery Act (1976): tracks and monitors hazardous waste generation
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, AKA Superfund 1980, 1986): cleans up contaminated areas
  - Taxes chemical and petroleum companies
  - Disperses money to clean up sites

Superfunds and Brownfields

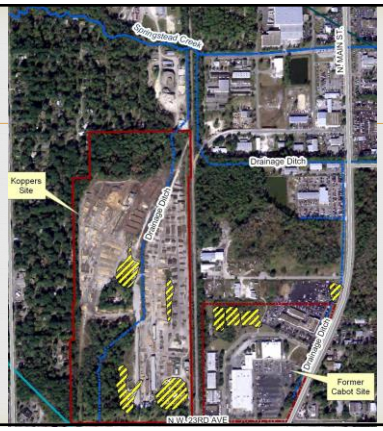
- Superfunds: Maintained by CERCLA and the National Priorities List
  - New Jersey has the most (113), 53 in Florida – 6th most!
- Brownfields: contaminated and need clean-up, but not quite a Superfund
  - EPA program to clean them up, but has been largely criticized for being unable to deal with the roughly half million contaminated sites in the US

Love Canal, NY

- Superfund case study: hazardous waste landfill in NY was covered by a housing development and school
- Benzene (a carcinogenic and industrial solvent) and other chemicals leached into basements
- Many people got sick and Love Canal was designated a Superfund
- Cleaned up by 1994

Cabot/ KOPPERS

- Superfund site right here in Gainesville (out on 23rd near Satchel's… and us!)
- Old wood treatment facility
- Leached arsenic, tar, and petroleum aromatic hydrocarbons into the groundwater, soil, and surrounding water systems
  - All highly carcinogenic
- Company responsible currently being sanctioned by EPA



Integrated Waste Management

- Using waste in a responsible and sustainable way
- Lifecycle Analysis: look at product and materials use at all stages
  - Factors in manufacturing and extraction issues
  - Often plans an end-goal for a product