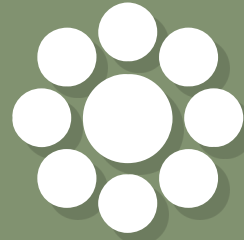


Waste is a Design Flaw

ENGR 1501 FALL 2023 - Week 9



Attendance



Seaweed Over Plastic? The Next Sustainable Innovation?

500 billion or more plastic bags are used worldwide each year.

October 3, 2022 by Valuuti [Leave a Comment](#)



Farmed seaweed is emerging as a promising climate solution, and not just for plastic. The U.S. government has funded research into its use as a biofuel, and it can lower the carbon footprint of agriculture, both as a petroleum-free fertiliser and as a feed supplement that reduces methane emissions in cattle.

Seaweed also sequesters what's known as blue carbon, the buzzword for carbon that is stored in marine ecosystems. It's a promising innovation as blue carbon is expected to be many times more efficient than on land forests.



Today's Agenda



1

CREATIVITY

2

DESIGN THINKING

3

IDEATION

4

DIVERGENCE/
CONVERGENCE



Course Objectives



- Learn how waste creation is designed into our linear economy
- Understand engineering frameworks for designing out waste and designing with waste
- **Explore what main components of electronics do and how to work with them**
- **Create a Leave-No-Trace Disassembly and Reassembly outline for an E-waste product**

Component(s) of Interest Identification



Due Today

Identify component(s) from your teardown that are of interest to you

What is the name/part name for the component?

- What is the cost of the component?
- Does it need any refinement to be used? If so what?
- What are examples of uses for the component?
- How do you use the component? (coding, circuitry, power needs, etc.)
- Anything else of interest?

Assembly Ideas



**Due Next
Week**

Please list all of your ideas (wild and crazy encouraged!) for builds to create from the components you salvage
(you are able to have some additional pieces but the build should rely primarily on the salvaged pieces)

Pick your top 3 (can prioritize marketability, ease of creation, creativity, etc.)



Creativity

Ever wonder what the most desirable quality is in future leaders? According to a survey conducted by the World Economic Forum, the answer is **creativity**, described as "The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem."

Creativity

How many ideas do you have a day?

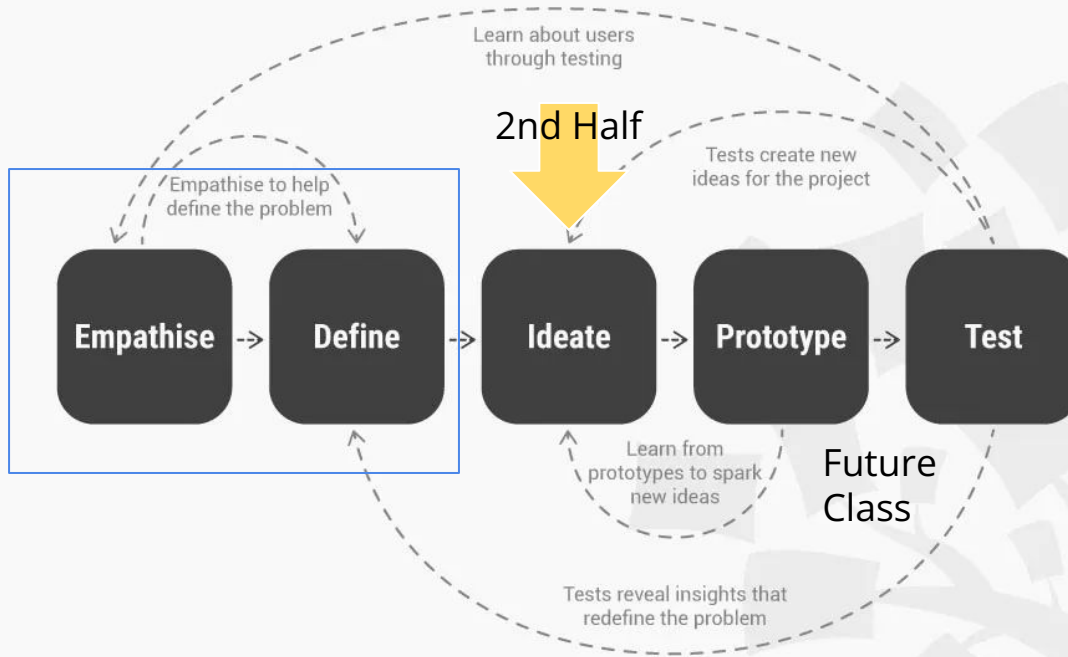
What do you think the most important aspects of creative idea generation are?

What challenges do you face with creativity?



DESIGN THINKING: A NON-LINEAR PROCESS

First Half



INTERACTION DESIGN
FOUNDATION

INTERACTION-DESIGN.ORG

Ideation:

Goal: Quantity over Quality

Stages:

1. Skimming the pot - ideas you already have
2. Bad ideas - what may seem like the worst thing ever
3. New connections - gets really tough to think of new things
4. The FLOWwww - past new connections you find a rhythm



Creativity Activity:

- Brainstorm new toys
 - 4 Minute on Miro
 - Individual
 - How many can you get?

When did you feel stuck?



Creativity Activity:

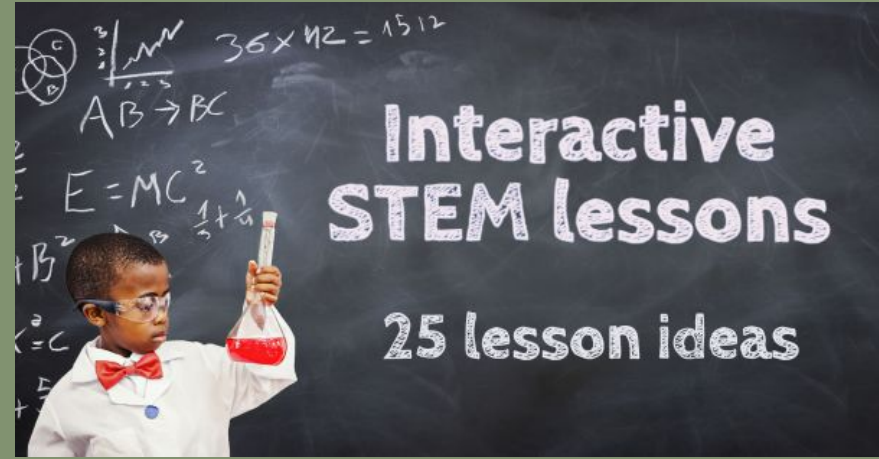
- Brainstorm new restaurants for Charlottesville
 - 5 Minutes
 - Miro but we move around the room and when it gets to you, you say one of your ideas



Creativity Activity:

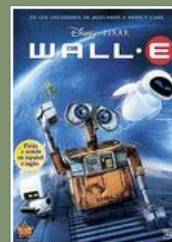
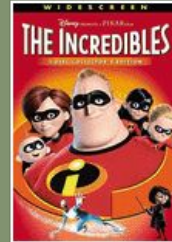
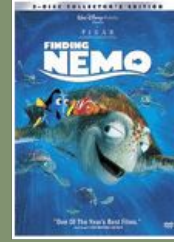
- Brainstorm Stem Kit Ideas for schools
 - 2 Minutes individual
 - STOP: Each share one idea
 - 2 Minutes individual

Make your own robot, generator, hydroponic system, etc. add a SPIN!!



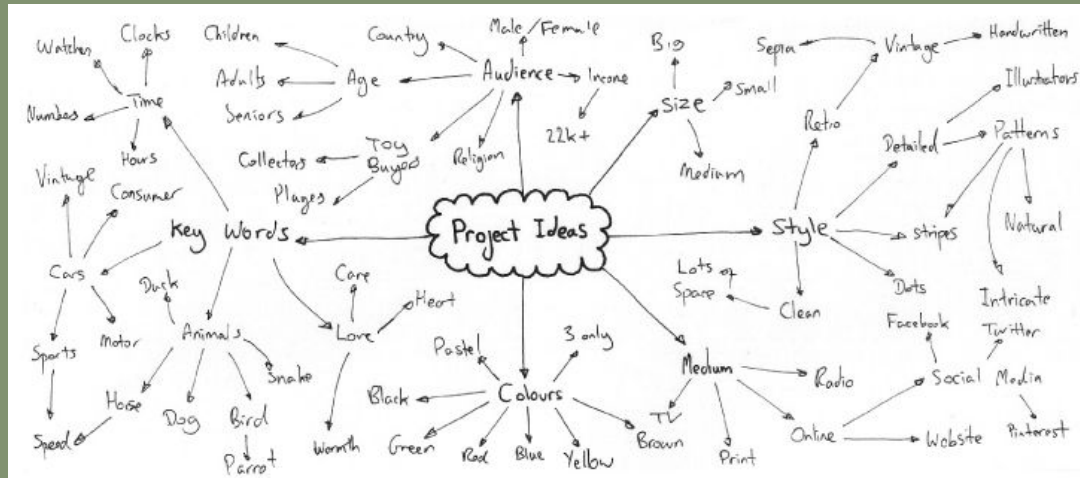
Creativity Activity:

- Brainstorm new animated movies
 - Ideas 1 minute
 - Pick favorite and expand it 1 minute
 - 3 minute draw/make a collage for it



Discussion:

- Which worked best for you?
- What did “best” mean? Most ideas? One really good idea? Fleshed out ideas?



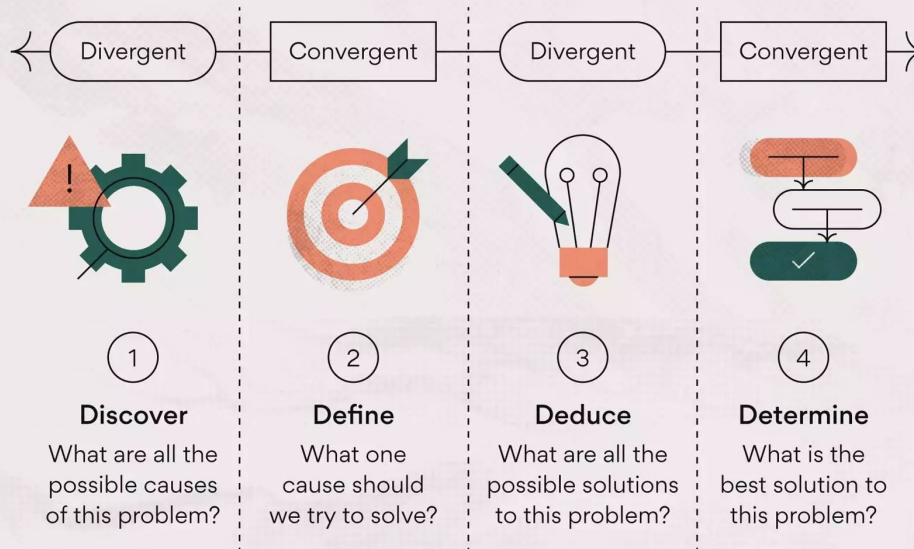


Divergence & Convergence:

- Divergence is brainstorming
 - Quantity over Quality
 - Wild and crazy ideas
 - How far can the range go
- Convergence is narrowing down
 - Based on design criteria and goals
 - Choosing several ideas and fleshing them out

Divergence & Convergence:

The creative cycle of convergent and divergent thinking





Divergence & Convergence:

- Usually we would identify many different problems
- Narrow down to a few
- Then generate many different solutions
- Narrow down to a few

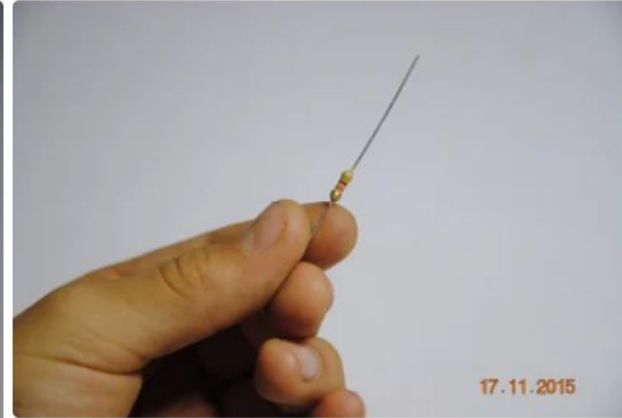
BUT, we have a recipe list restricting what we can use and no problem we have to solve. So we are going to generate ideas for the problem of we have stuff!

Assembly Guide

- Use at least one item from your E-waste
 - Goal is to use as much from E-waste as possible
- Make something that captures value
- Made with sustainable practices and foundations
 - Design for next life as well



Step 2: Close a Plastic Bag With a Resistor!





Assembly Guide

INSTEAD

Come up with an idea that interests you. Then find assemblies and see how you could incorporate your parts into the assembly.



Assembly Guide

- What sustainable practices will you use?
- What areas will you focus on for easy disassembly/repair?
- How will you design for next life?

Very broad, don't need exact technical details yet



Assembly Ideation

- Divergence
 - 2 minutes of Ideation
 - Share an idea
 - 2 minutes of Ideation
 - Share top 3
- Convergence
 - Pick 3 and flesh out each 3 minutes
 - 3 minutes of drawing
 - Share favorite

Thought for the class:

“Dr. Robert Epstein, a visiting scholar from the University of San Diego, suggests incorporating creative activities into one’s daily routine. By doing so, we not only allow our imagination to grow, but we take away some of the tension experienced throughout our everyday life. By denying ourselves creativity, we make ourselves more susceptible to stress, and therefore we’re more inclined to feel fatigued and unproductive.”

Recommended Media:

“How Do Disney and Pixar Come Up with Those Ingenious Stories? Through Research & Development” (Link below)





Appendix Slides




Type of Plastics: Broad

- **Thermoplastics** soften on heating and harden on cooling. Examples include polyethylene (PE), polypropylene (PP), polytetrafluoroethylene (Teflon), polyethylene terephthalate (PET), polyamide (PA), polyvinyl chloride (PVC) and polystyrene (PS).
- **Thermosets** never soften once they have been molded. Examples include Epoxy resins, polyurethane (PU), polyester resins, and Bakelite.
- **Elastomers** are elastic in character, so they can return to their original shape after stretching. Examples include rubber and neoprene.

Microplastics - less than 5mm

Type of Plastics: Numbers and Initials



Which plastics are recyclable?







Resin Identification Number (RIN) & Type

Resin Identification Number (RIN)	Type	How To Recycle
1	PETE	Widely Accepted
2	HDPE	Widely Accepted
3	V	Rarely Accepted
4	LDPE	Rarely Accepted <small>Check local retail bag collections.</small>
5	PP	Moderately Accepted
6	PS	Rarely/Never Accepted
7	Other	Rarely/Never Accepted

Plastics # 1 & 2 are the most desired material. Check with your local service provider for details on your local recycling collection program.

EcoStrategiesGroup.com

Type of Plastics: Numbers and Initials

 PETE	 HDPE	 PVC	 LDPE	 PP	 PS	 OTHER
polyethylene terephthalate	high-density polyethylene	polyvinyl chloride	low-density polyethylene	polypropylene	polystyrene	other plastics, including acrylic, polycarbonate, polyactic fibers, nylon, fiberglass
soft drink bottles, mineral water, fruit juice container, cooking oil	milk jugs, cleaning agents, laundry detergents, bleaching agents, shampoo bottles, washing and shower soaps	trays for sweets, fruit, plastic packing (bubble foil) and food foils to wrap the foodstuff	crushed bottles, shopping bags, highly-resistant sacks and most of the wrappings	furniture, consumers, luggage, toys as well as bumpers, lining and external borders of the cars	toys, hard packing, refrigerator trays, cosmetic bags, costume jewellery, CD cases, vending cups	

Current Plastic Recycling

1. Sort
2. Wash
3. Shred
4. Melt
5. Pellet






Precious Plastic

MAKE IT
PRECIOUS

Start a business from plastic waste!

[Learn how to start](#)





Teardown Steps

1. Safety
2. Disassembly
3. Identification
4. Sorting

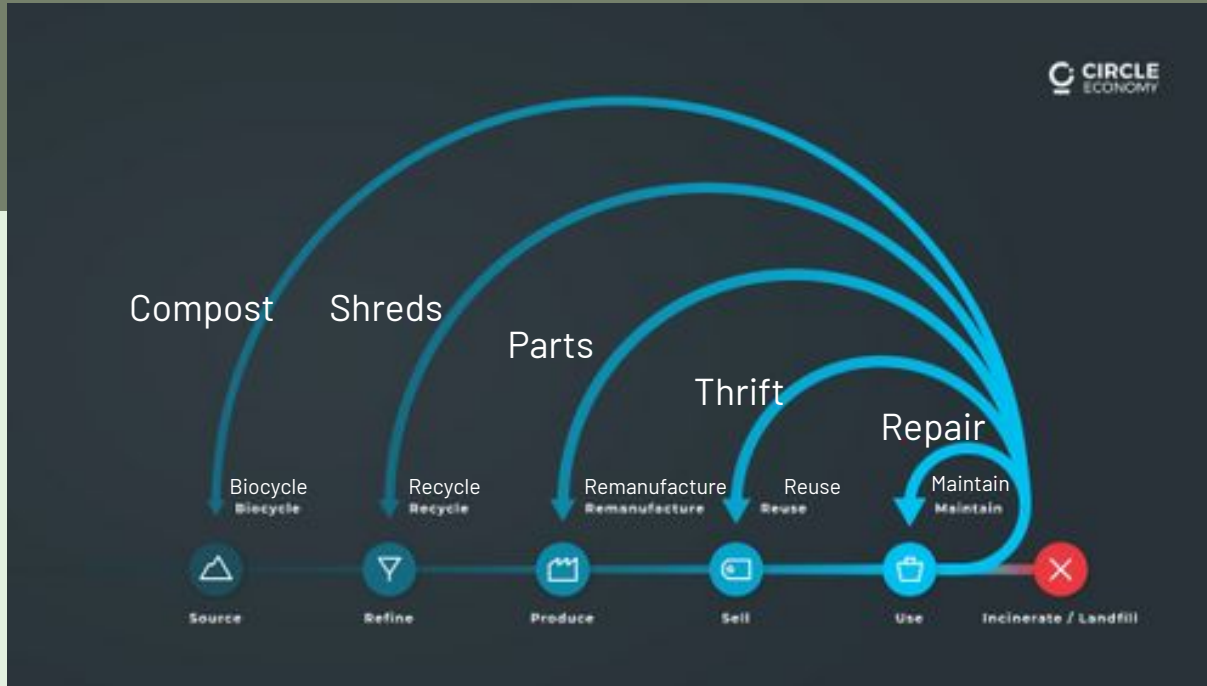


E-Waste Recycling Process

1. Collection
2. Storage
3. Disassembly
 - a. Data Deconstruction
 - b. Toxic Waste Removal
4. Recovery (Recycle, Remanufacture, etc.)
5. Reintegration (Donation/Selling)

CIRCLE ECONOMY

Common Language for reintegration process





Class Naming Convention of 12 Principles

1. Safety First
2. Prevention
3. Low resource separation and purification
4. Optimization
5. Limit Extraneous thinking
6. Hard Work to Salvage Gold
7. Realistic Design Goals (Durability)
8. Necessary design
9. Minimize material diversity
10. Integration and interconnectivity of resources
11. Long-term designing
12. Renewable sources



How Companies Design Waste?

1. Hardware
2. Software
3. System

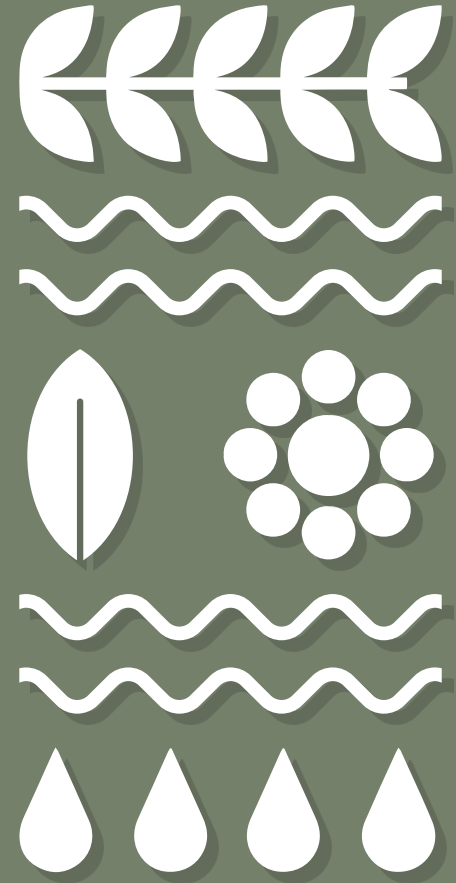


Simon Game
Uno Game

That means each year we waste 90 billion tons of resources. This also means that we create 90 billion tons of potential resources.

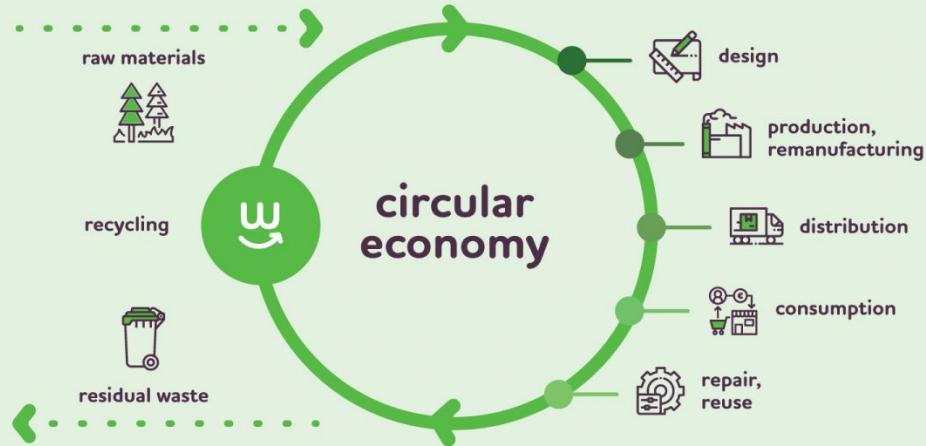
The current dominant economy is linear in its processes: it takes resources, makes goods, and quickly wastes them.

-CIRCLE REPORT, 2021



CIRCLE ECONOMY

The circular economy is an economic system where waste is designed out, everything is used at its highest possible value for as long as possible and natural systems are regenerated.



These 2 will be our main focus



USE **WASTE** AS A RESOURCE

Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.



STRETCH THE LIFETIME

While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable.

The 12 Principles of Green Engineering

- Principle 1:** Designers need to strive to ensure that all material and energy inputs and outputs are as inherently nonhazardous as possible.
- Principle 2:** It is better to prevent waste than to treat or clean up waste after it is formed.
- Principle 3:** Separation and purification operations should be designed to minimize energy consumption and materials use.
- Principle 4:** Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.
- Principle 5:** Products, processes, and systems should be “output pulled” rather than “input pushed” through the use of energy and materials.
- Principle 6:** Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.
- Principle 7:** Targeted durability, not immortality, should be a design goal.
- Principle 8:** Design for unnecessary capacity or capability (e.g., “one size fits all”) solutions should be considered a design flaw.
- Principle 9:** Material diversity in multicomponent products should be minimized to promote disassembly and value retention.
- Principle 10:** Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.
- Principle 11:** Products, processes, and systems should be designed for performance in a commercial “afterlife”.
- Principle 12:** Material and energy inputs should be renewable rather than depleting.

Through *the* 12 Principles **GREEN** *Engineering*

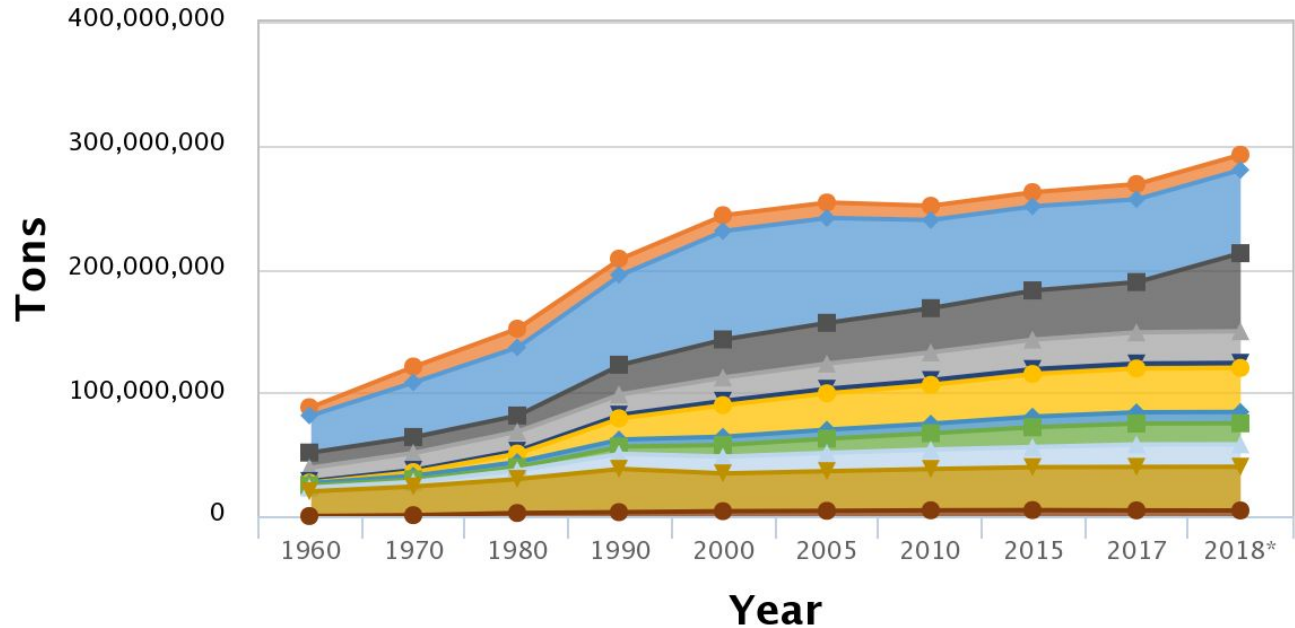
Let's make a memorable summary phrase/word for each principle so they can be easily referenced

We will also go through any questions you all have on the principles for how to implement and what they mean.

We will be testing Miro for this, so please go to the announcements page on Collab

- Average U.S. person produces 4.9 pounds of waste per day
- That's 1,788.5 pounds a year. Almost a full TON per person.

Generation Tonnages, 1960-2018



Click on legend items below to customize items displayed in the chart

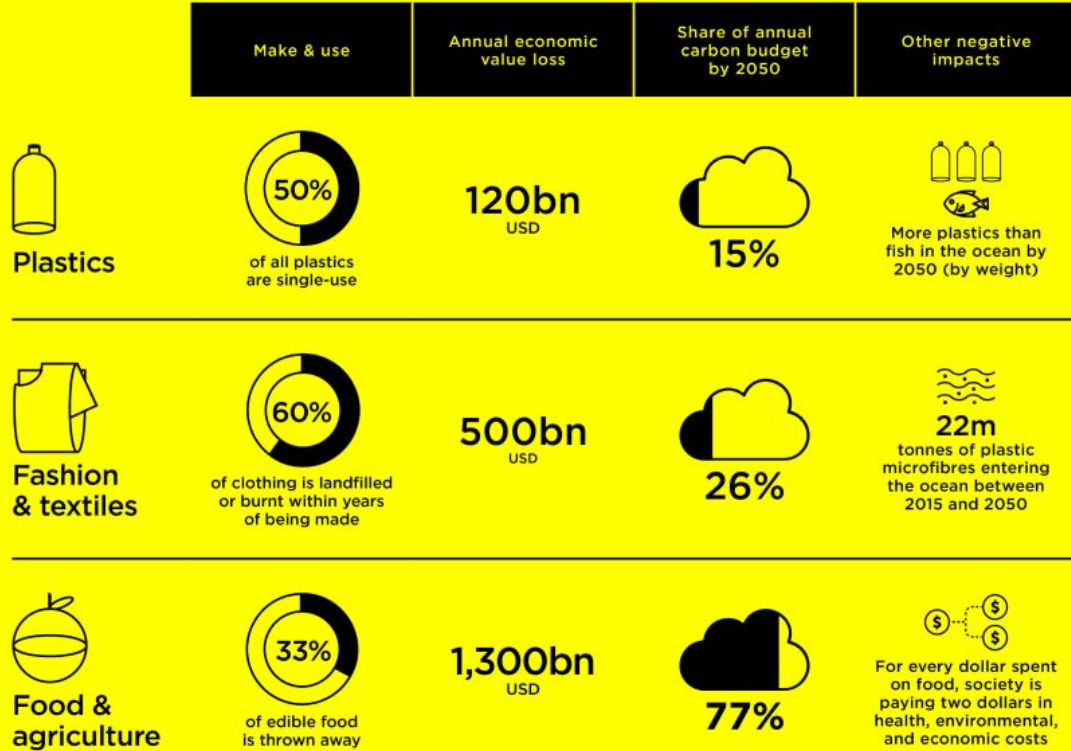
- Glass**
- Paper & Paperboard**
- Food**
- Metals**
- Misc Inorganic Waste**
- Plastics**
- Rubber & Leather**
- Textiles**
- Wood**
- Yard Trimmings**
- Other**



By 2000, global waste production per year was at 54.9 billion tons and as of 2019, it surpassed 100 billion tons,

Of the 100 billion tons of resources used by the global economy each year, only 8.6% are cycled back.





Source: Ellen MacArthur Foundation, *Financing the Circular Economy: capturing the opportunity* (2020)