YAMAHA RightWaters Trash Interceptor

Jonathan Draigh | Emily Haggard | Mohamad Kassem | Martin Senf | Andrew Walker

T518 Team Introductions

Jonathan Draigh

Materials Engineer

Martin Senf

Manufacturing Engineer

Emily Haggard

Fluids Engineer

Andrew Walker

Manufacturing Engineer

Mohamad Kassem

Controls Engineer

Martin Senf

Sponsor and Advisor

John O’Keefe

YAMAHA

<u>Engineering Mentor</u>
John O'Keefe
Yamaha Motors

Shayne McConomy

<u>Academic Advisor</u>
Shayne McConomy, Ph.D.
Senior Design Professor

Martin Senf

Objective

To implement an effective land-based trash interceptor, collecting debris – primarily plastic wastes – in storm drains before being released into bodies of water

Martin Senf

What is a Storm Drain?

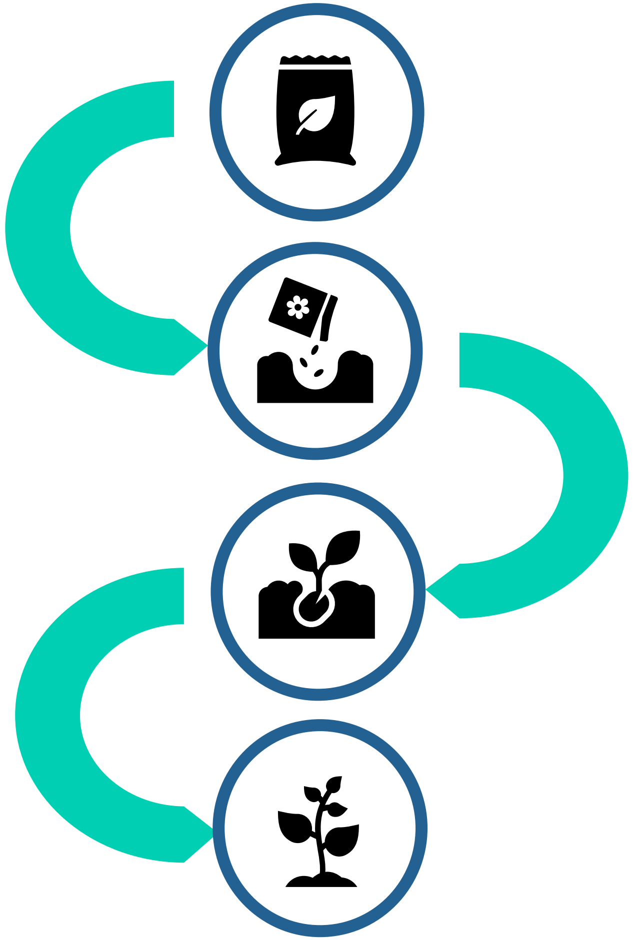
Not this

Not this

THIS

Martin Senf

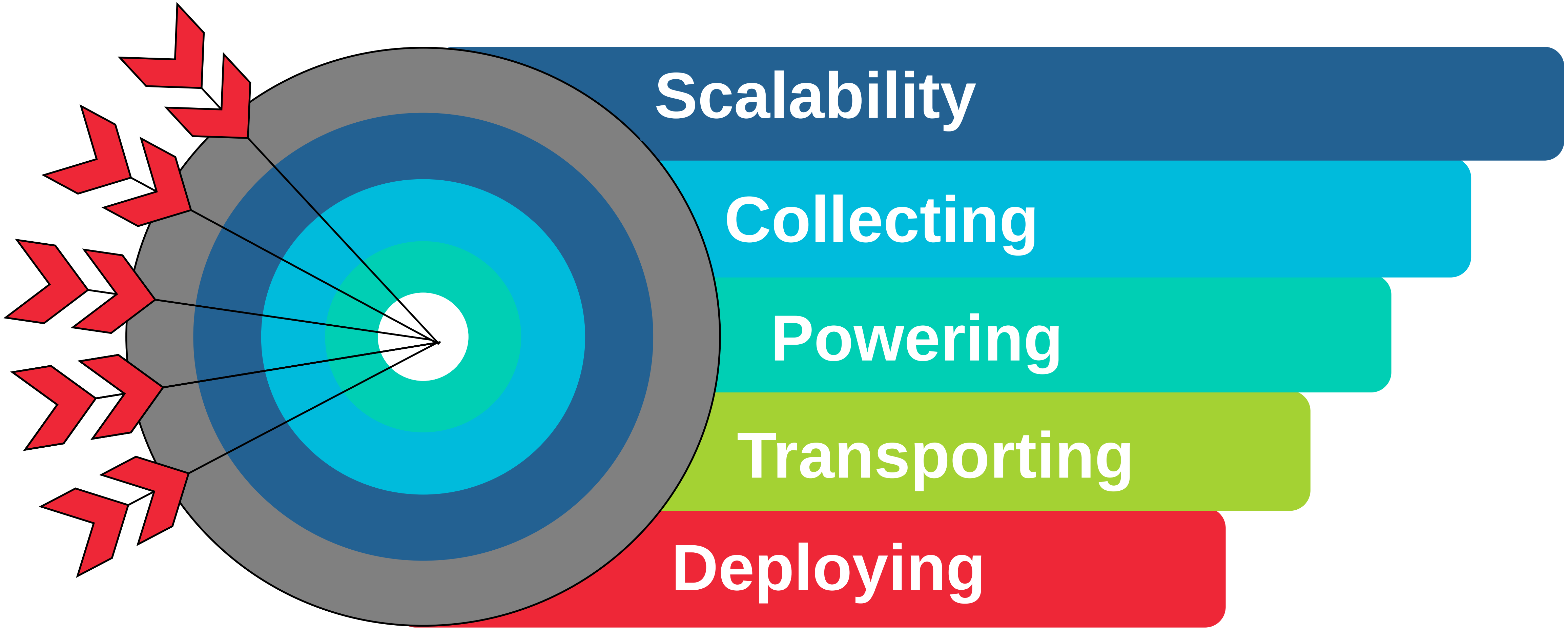
Key Goals



- **Scalable** - Allows the device to fit in various sized storm drains
- **Expendable** - Allows the device to be inexpensive and can be replaced if damaged
- **Economical** - Inexpensive to ensure that it can be bought by a larger market
- **Deployable** - Will be easily deployed by skilled contractors

Martin Senf

Targets and Metrics



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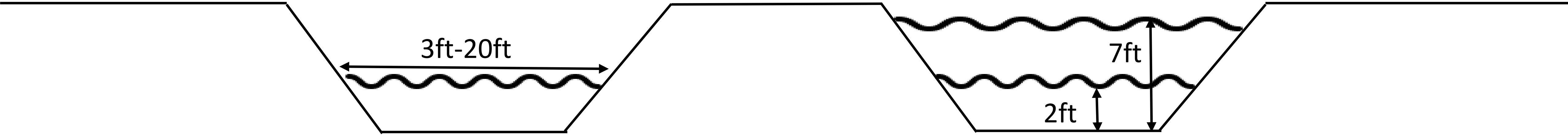
Scalability Metrics

Horizontal Expansion
3ft – 20ft

Vertical Expansion
2ft – 7ft



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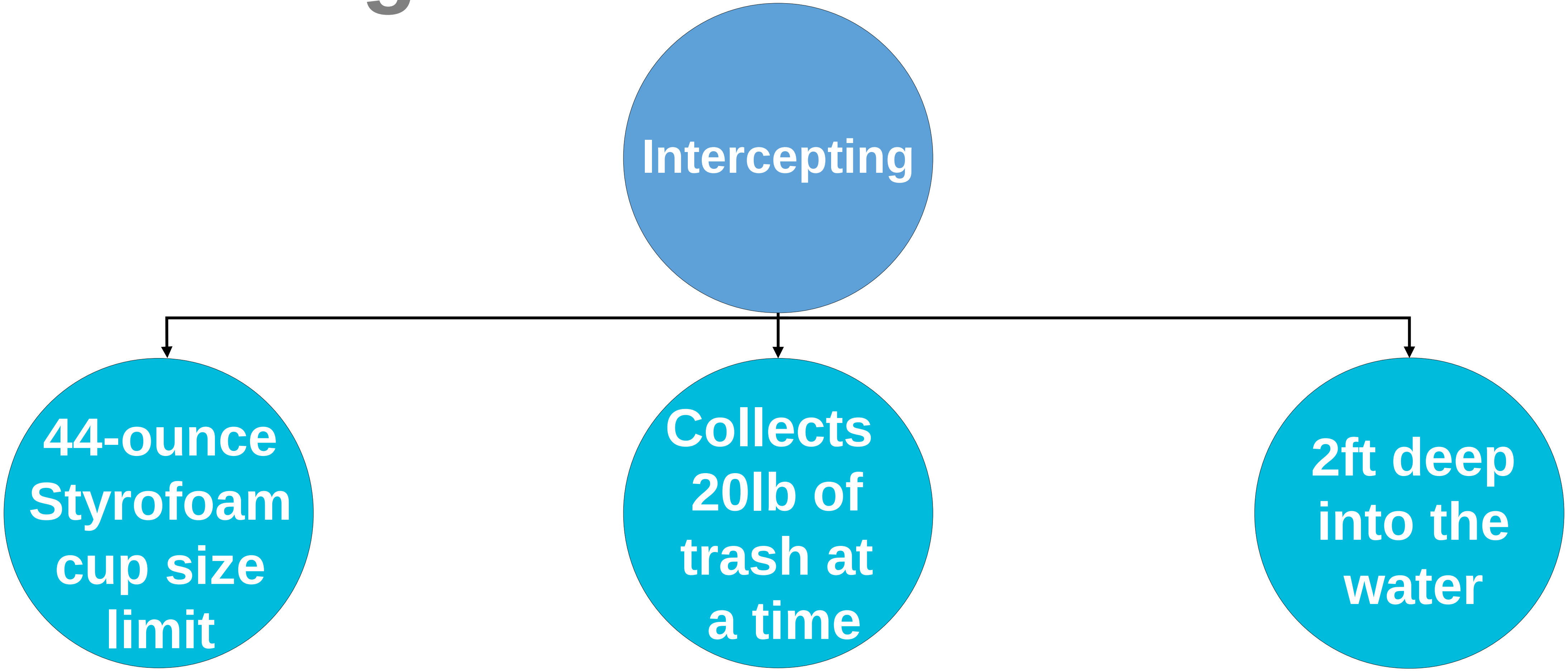
Collecting Metrics



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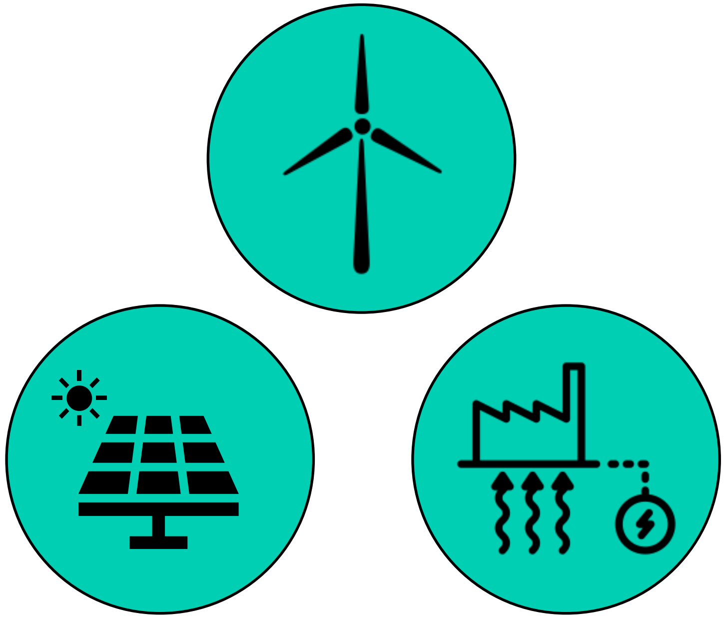
Powering Metrics

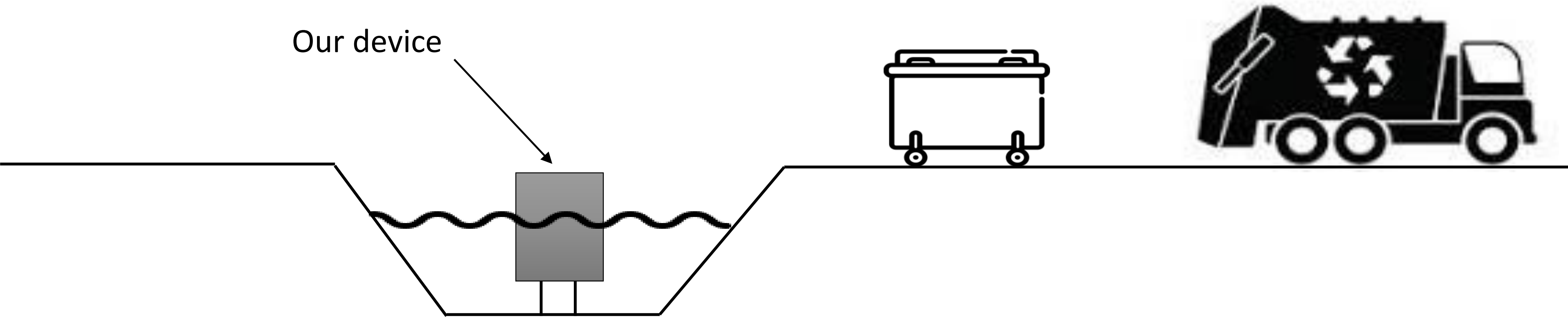


- 700lb-ft to move 50lbs of trash for 60 seconds
- 11.67lb-ft per second
- Potential energy sources are wind, solar, and/or geothermal

Martin Senf

Transporting Metrics

- 8-yard slant dumpster
- 71.5in wide by 80in long
- Volume of 216 ft^3 and weight limit of 1,600lbs
- 4,700 44-ounce Styrofoam cups



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Deploying Metrics

50ft long by 8.5ft wide size limit

Maximum of three people to deploy it

50lb weight limit per person

100lb weight limit per part

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Methods Used

- Biomimicry
- Brainstorming
- Crapshoot
- Morphological Chart

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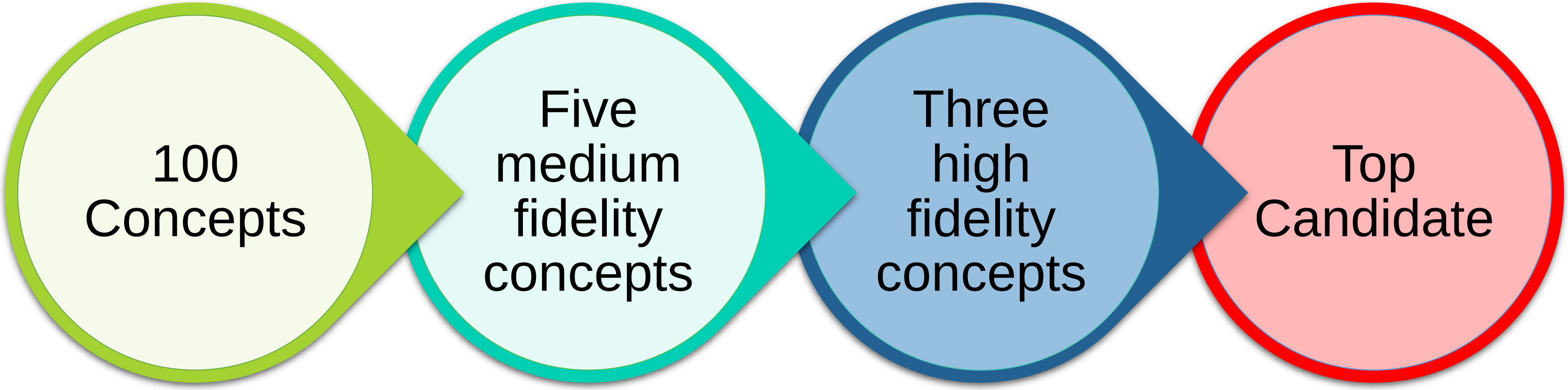
Concept Generation



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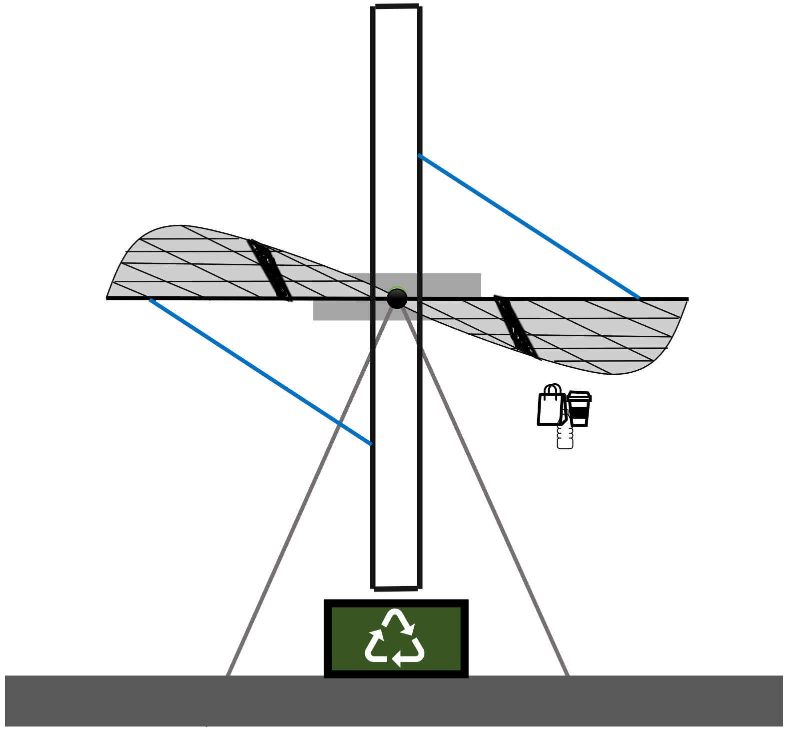
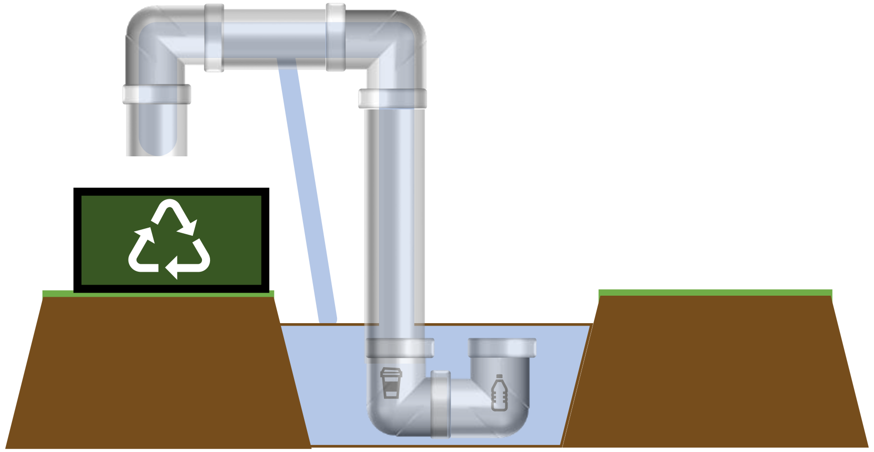
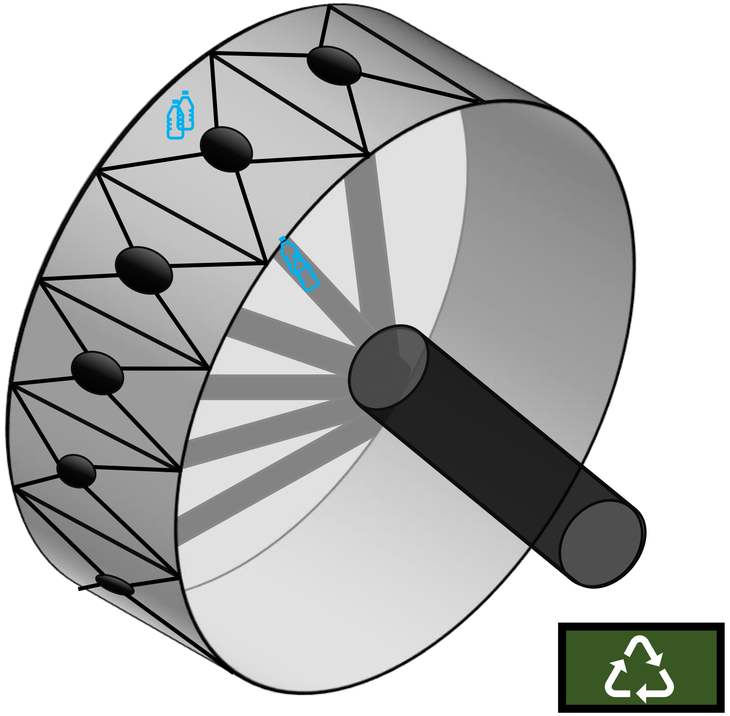
Key Concepts







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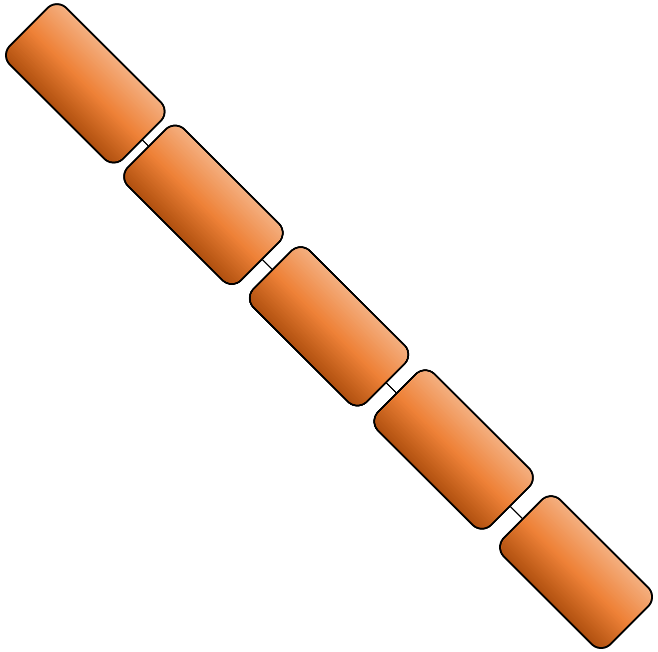
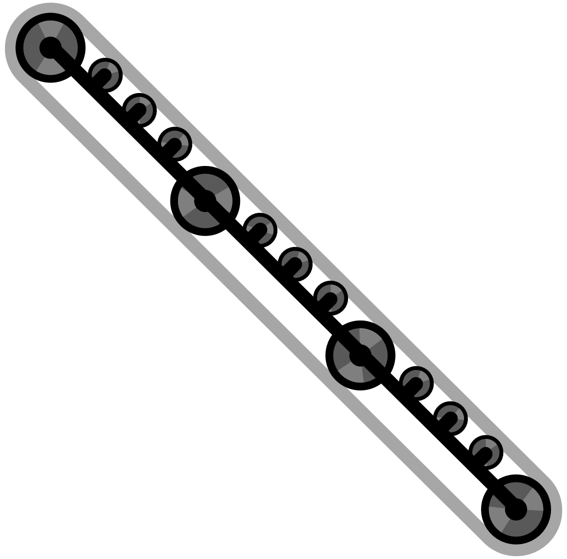
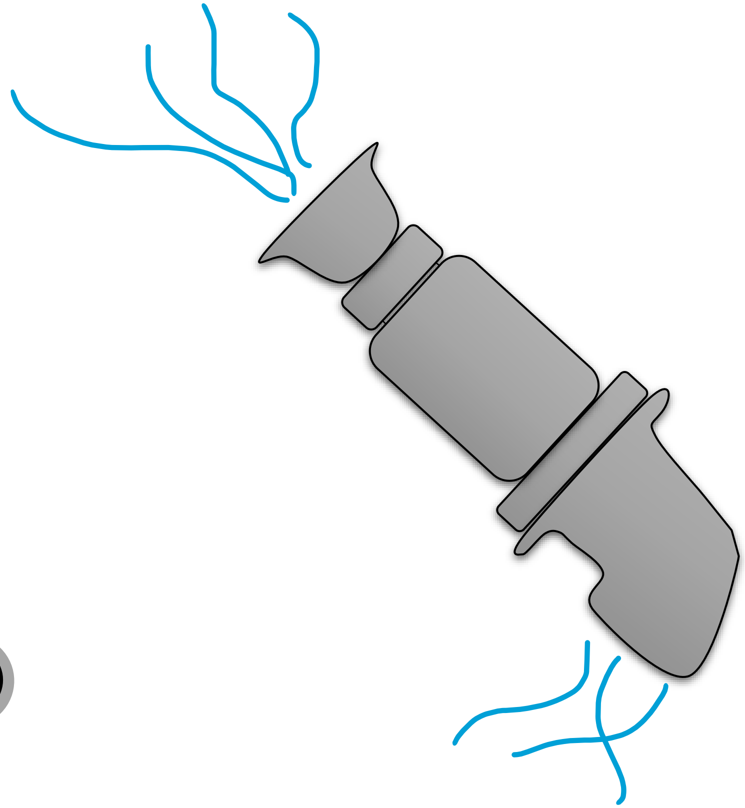
Key Components



Floating Boom



Conveyer Belt



Water Propeller jet

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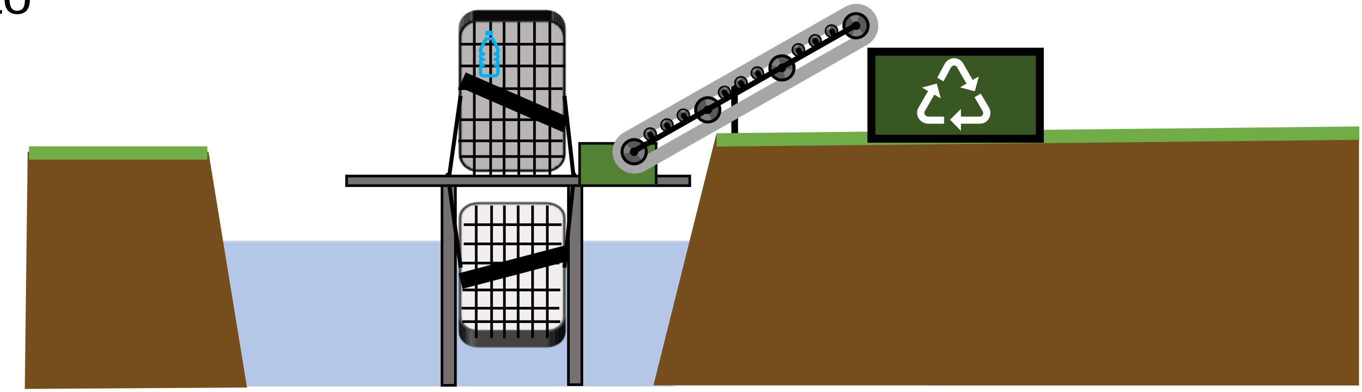
Concept #1

- Floating boom will angle trash
- Water is accelerated by a jet
- Rotating basket-like wheel collects trash
- Trash slides into a reservoir
- Conveyor belt takes trash from reservoir to dumpster



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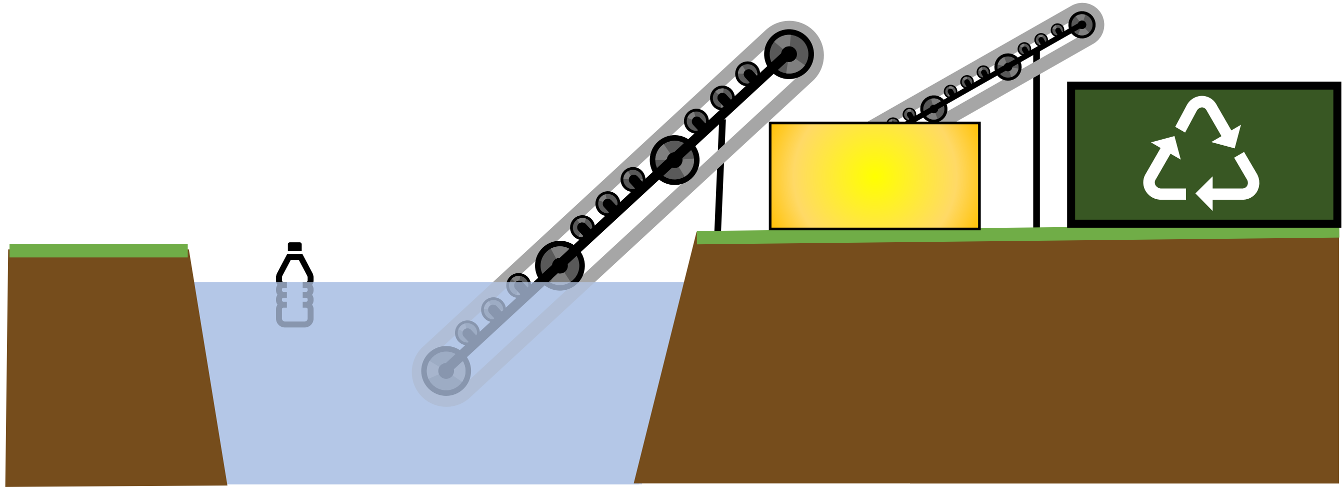
Concept #2

- Floating boom will angle trash
- Water and trash is accelerated by a jet
- A conveyor belt takes trash out of storm drain
- Conveyor takes trash out of reservoir to dumpster



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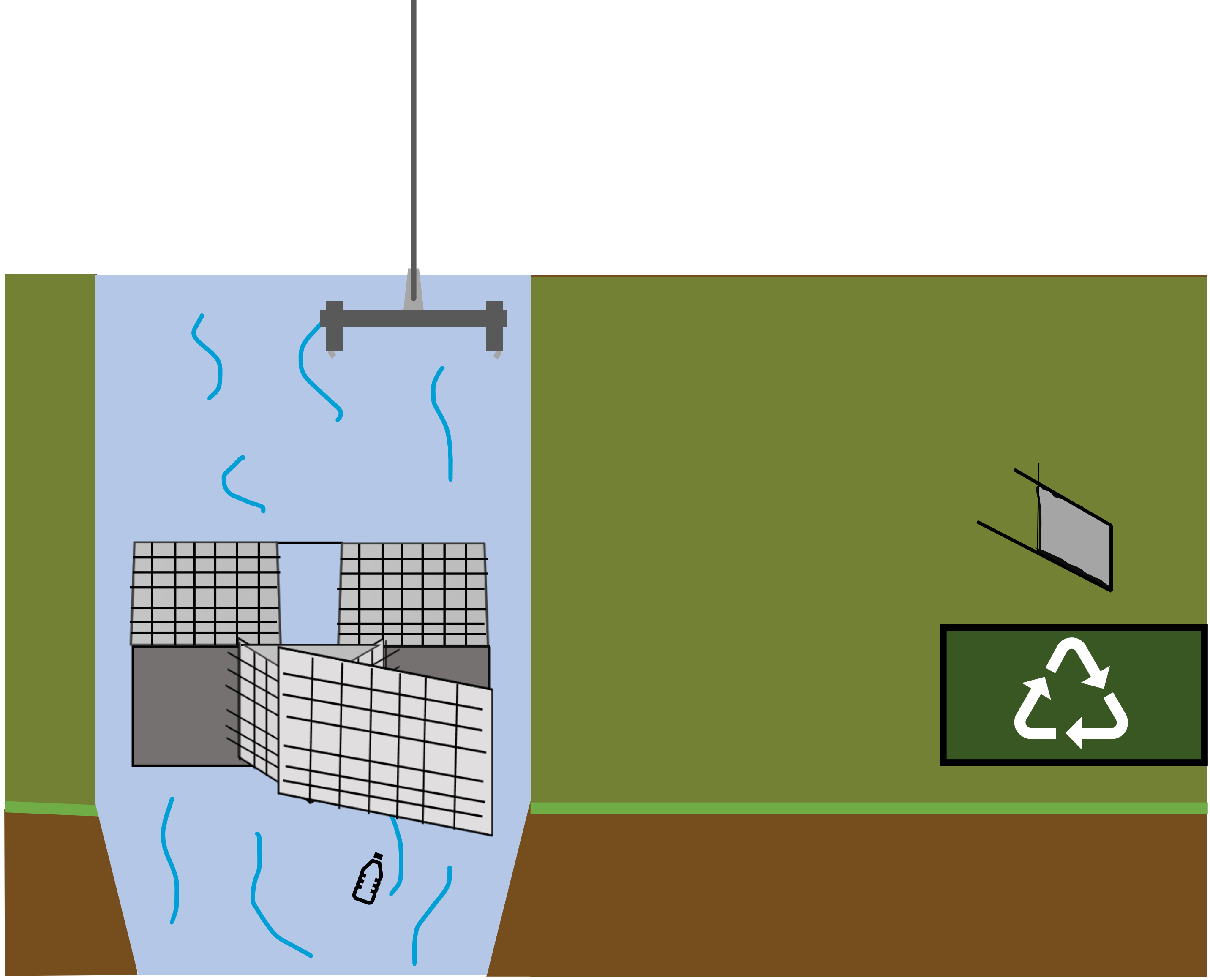
Concept #3

- Funnel lines directing trash and water
- Trash will go into two chambers
- A crane will pick up the full chamber
- Chamber’s door opens to release trash into dumpster.



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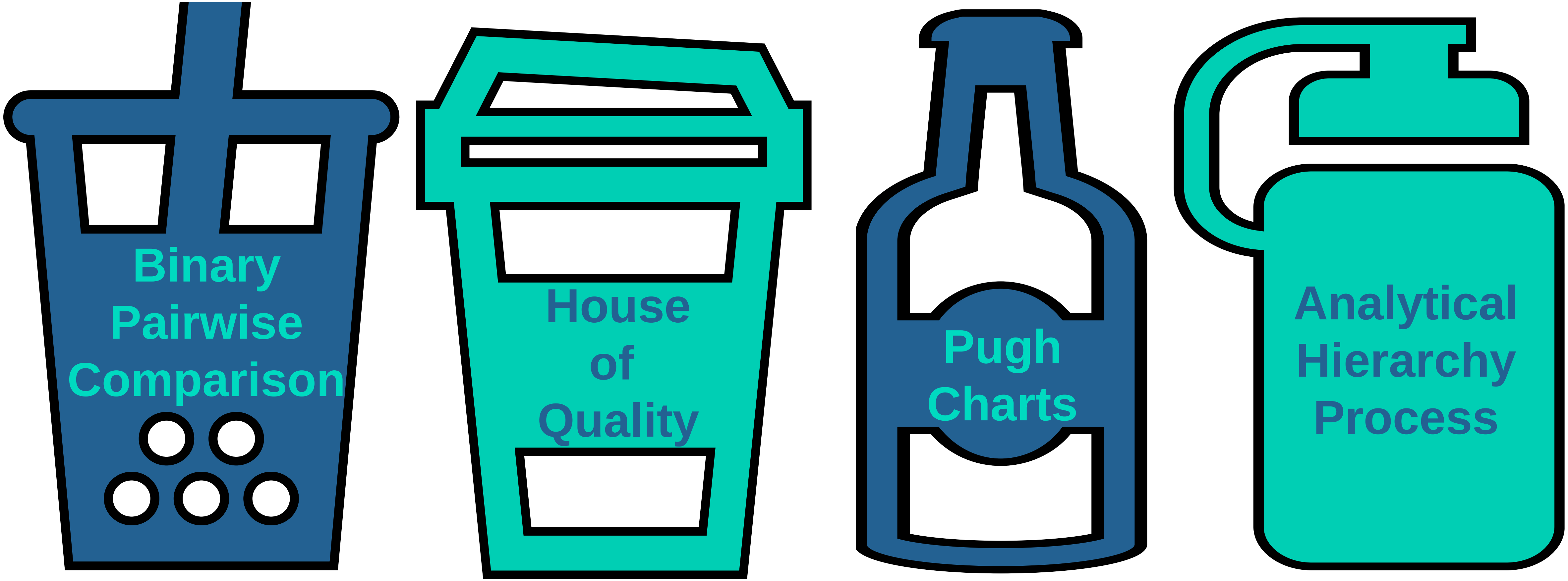
Concept Selection



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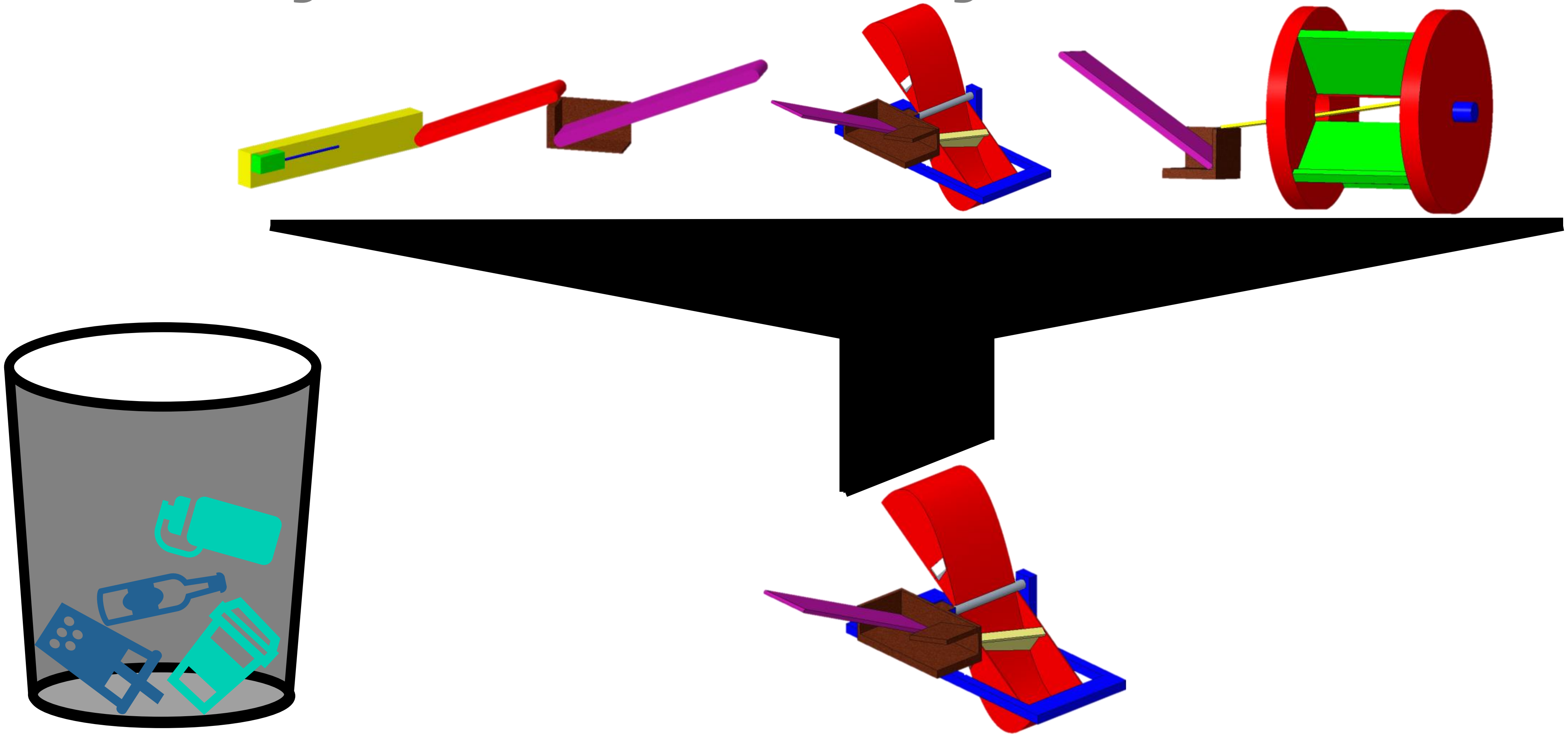
Analytical Hierarchy Process



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Prototyping

- Should the base float at water level or sink to the bottom?
- What is a better way to attack the mesh?
- Is there a better way to allow the slide to move past the structural post?

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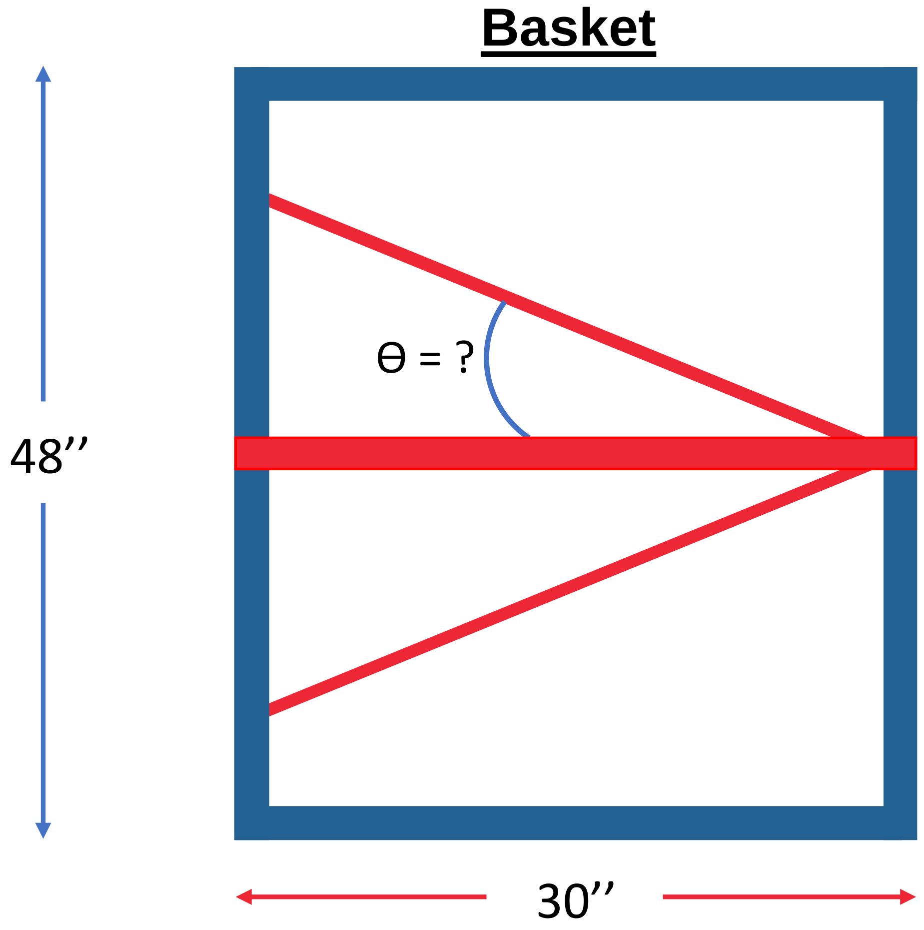
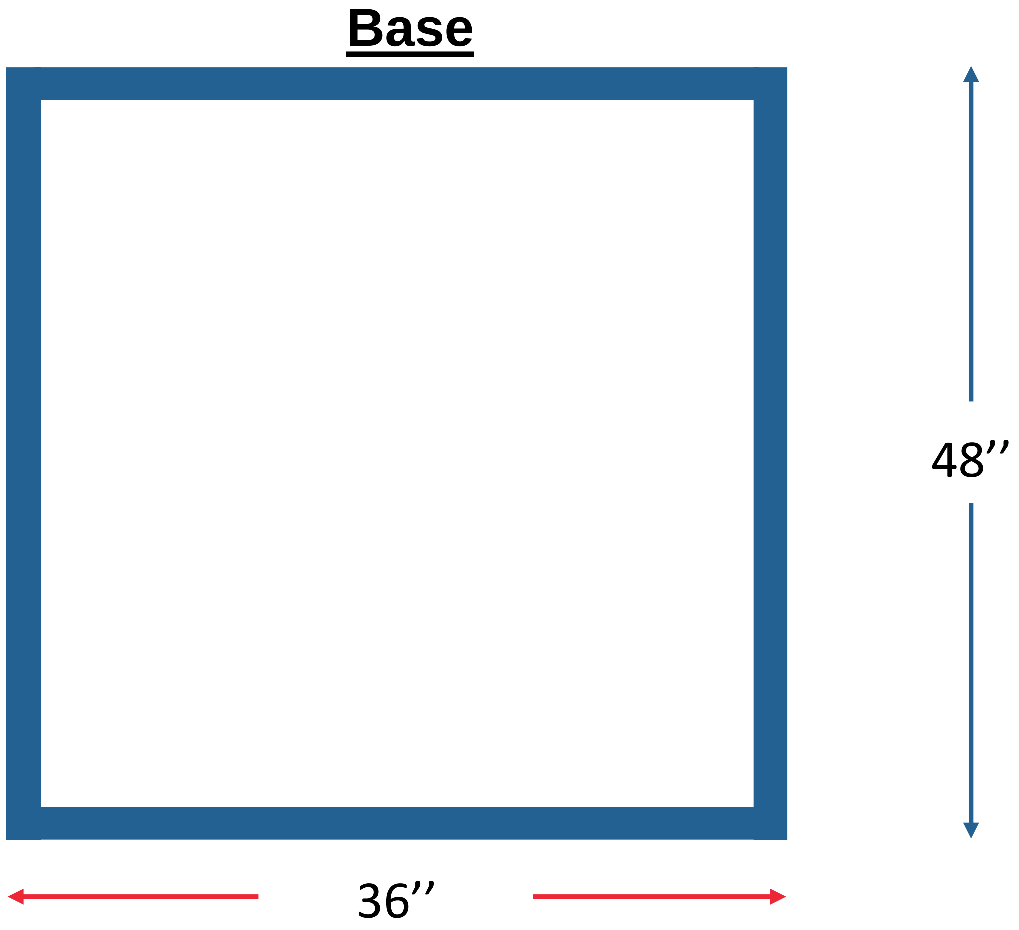
Dimensioning





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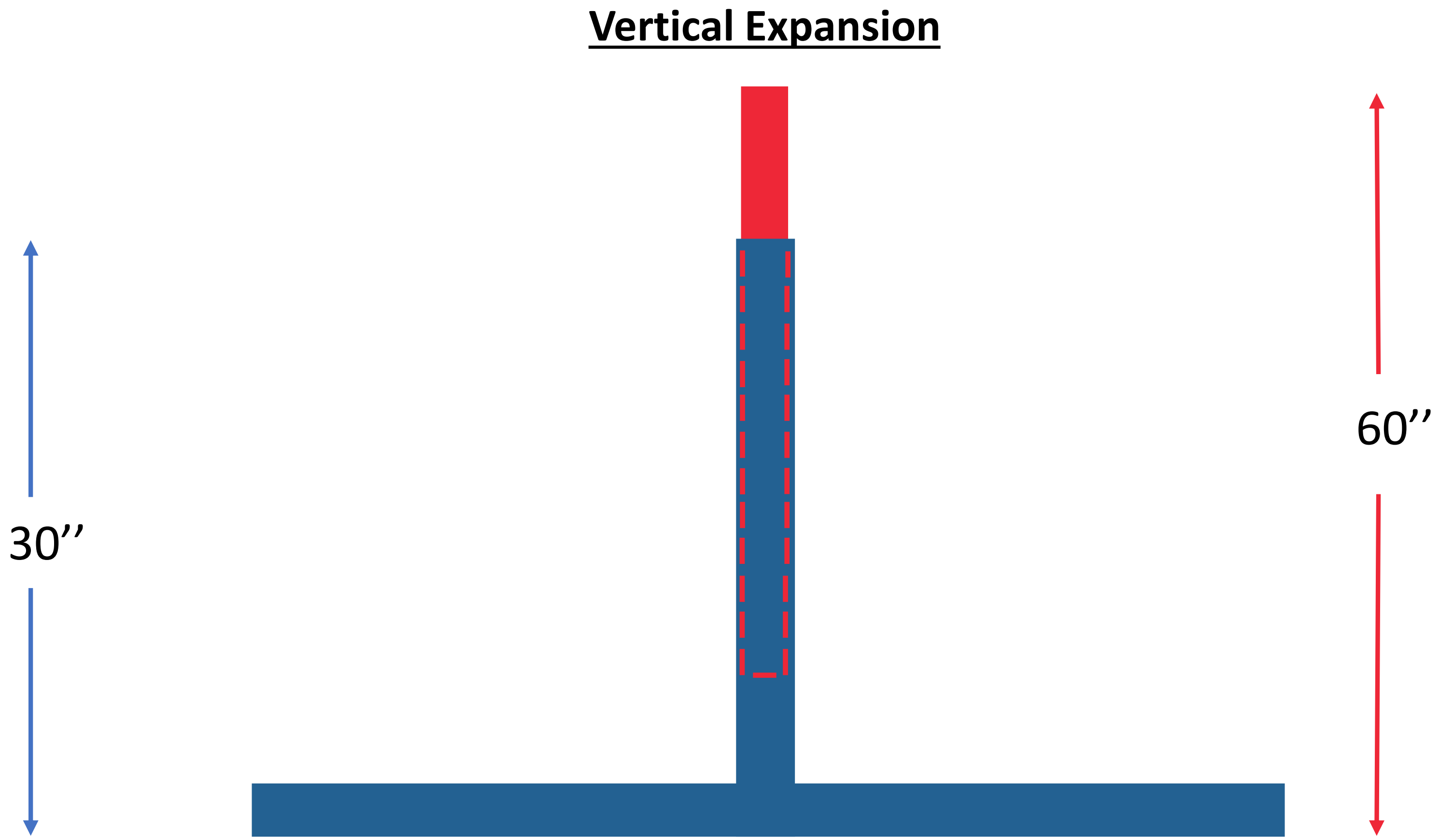
Dimensioning



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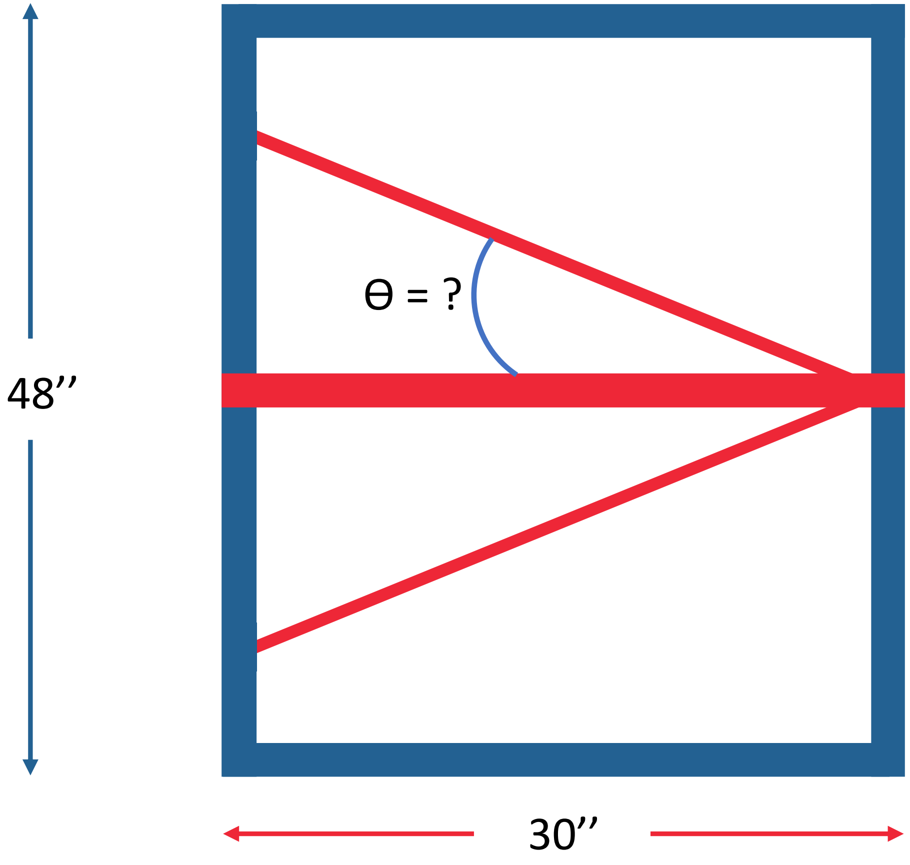
Angle of Slide Testing



- How will we test?
  - Aluminum stand with a slide
  - Allow for an angle change
- Why are we testing?
  - Find optimal angle for sliding
  - Making sure trash will slide

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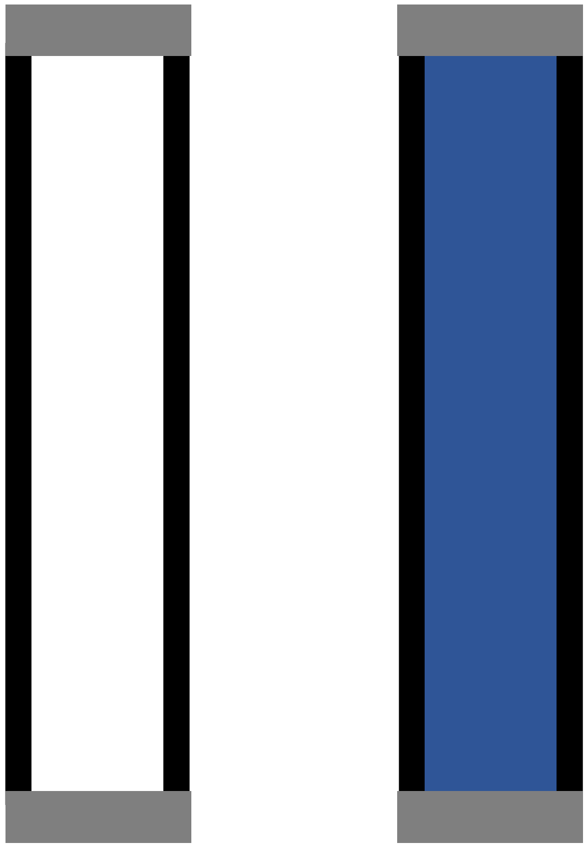
Vertical Expansion Testing



- Solution 1 Using Buoyancy
  - Air Pocket or Spray Foam
  - Simplest Fix

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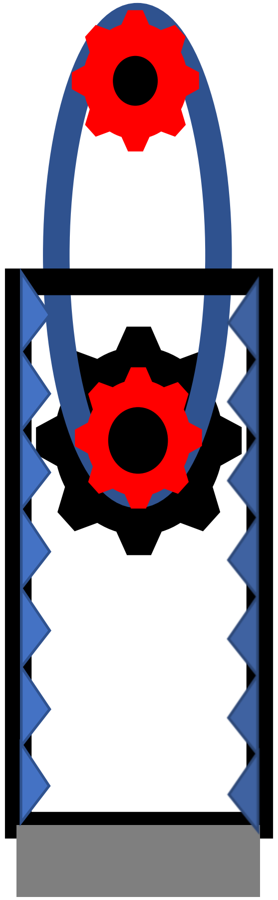
Vertical Expansion Testing



- Solution 1 Using Buoyancy
  - Air Pocket or Spray Foam
  - Simplest Fix
- Solution 2 Using a Rack and Pinion System
  - This system would be more difficult to machine

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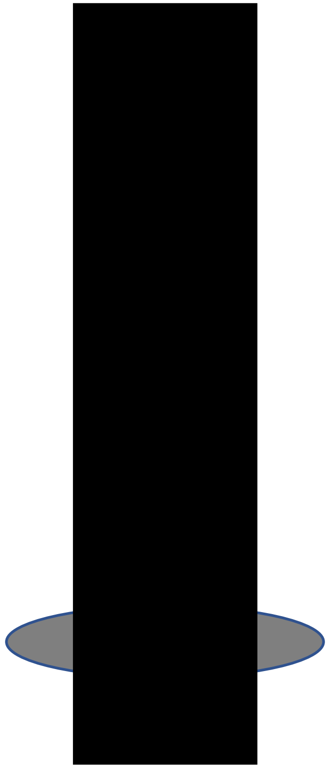
Vertical Expansion Testing



- Solution 1: Using Buoyancy
  - Air Pocket or Spray Foam
  - Simplest Fix
- Solution 2: Using a Rack and Pinion System
  - More difficult to machine.
  - Would need to stay greased
- Solution 3: Using a Leg Adjustment Peg
  - Not autonomous
  - Simple
  - Easy to machine

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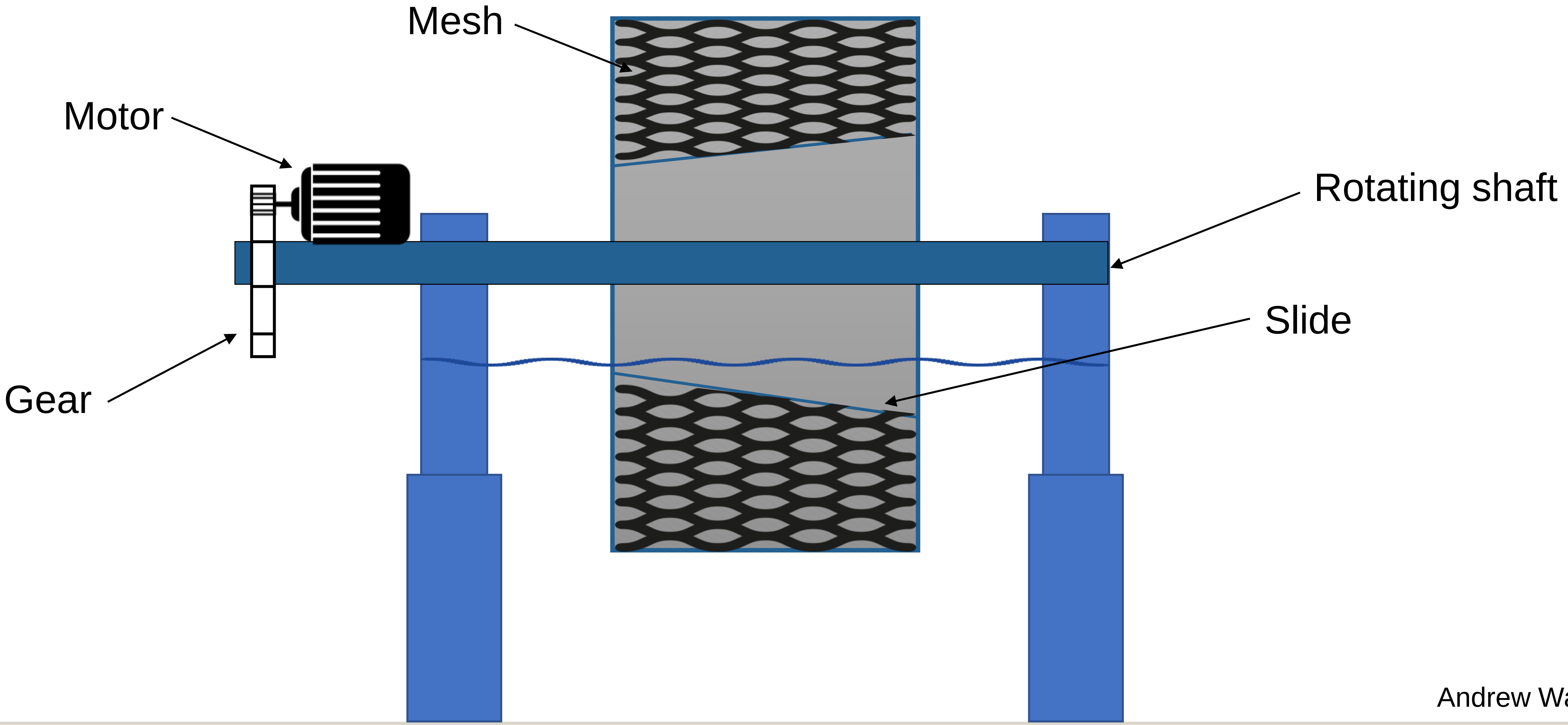
Torque Requirements



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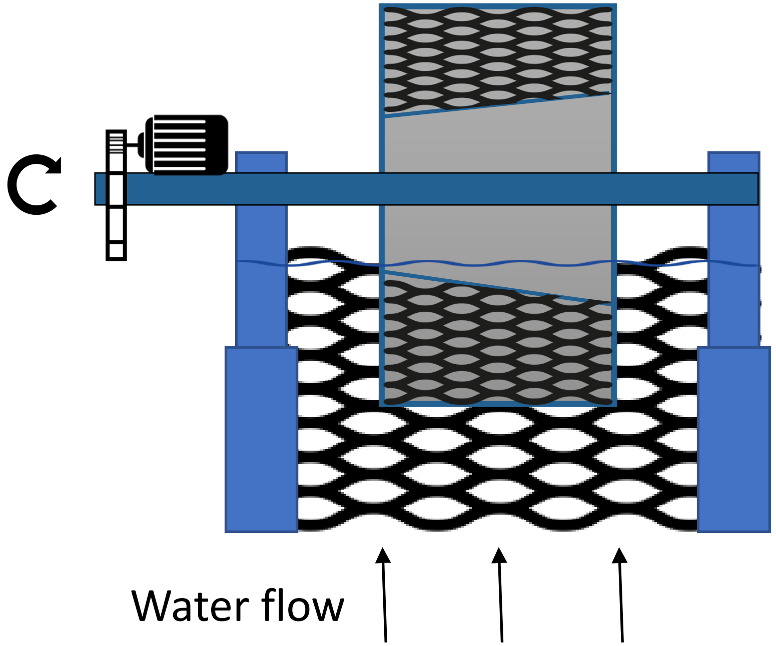
Torque Requirements

- Torque calculator tool
- Testing prototype with a spring
- Simulate design in CAD
  - Moment of inertia, mass, friction forces
- Redesign
  - Mesh wall
  - Switch to follow flow of water
  - No variable torque



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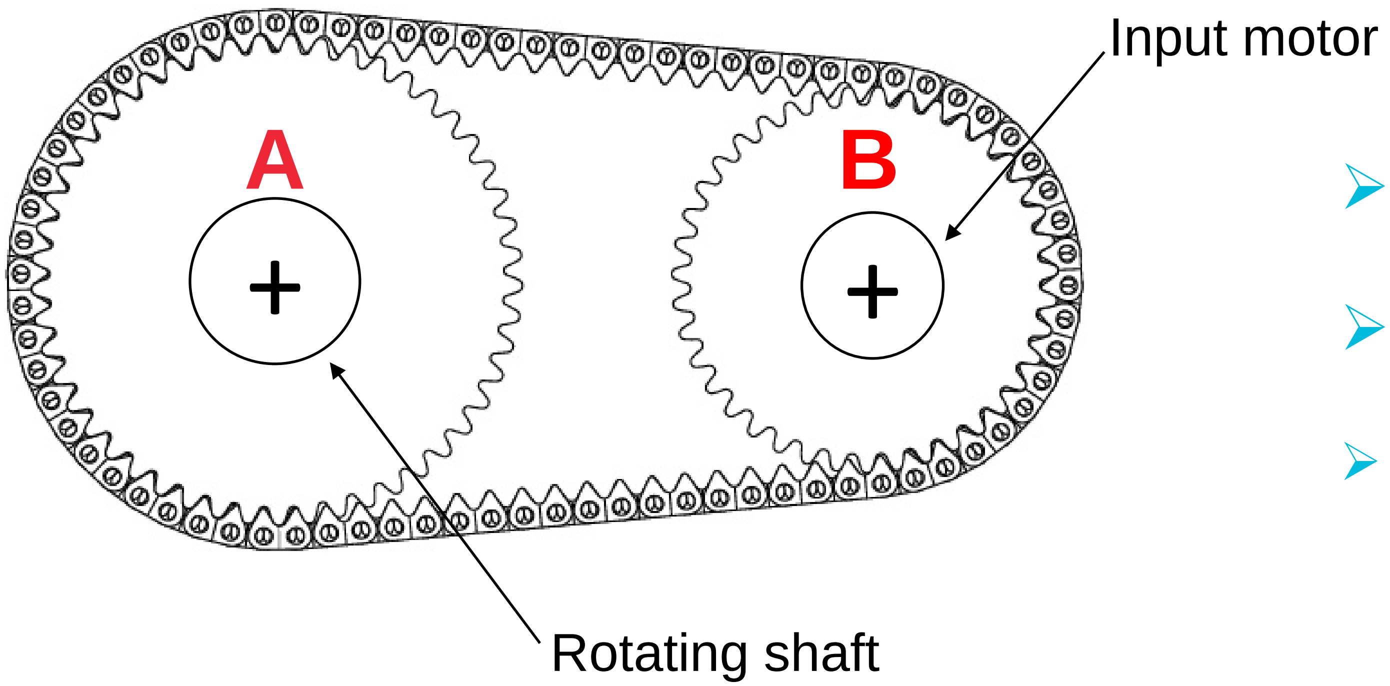
Powering



- Gear A
  - Attached to rotating center shaft
- Gear B
  - Attached to motor
- Higher torque on rotating shaft due to gear ratio

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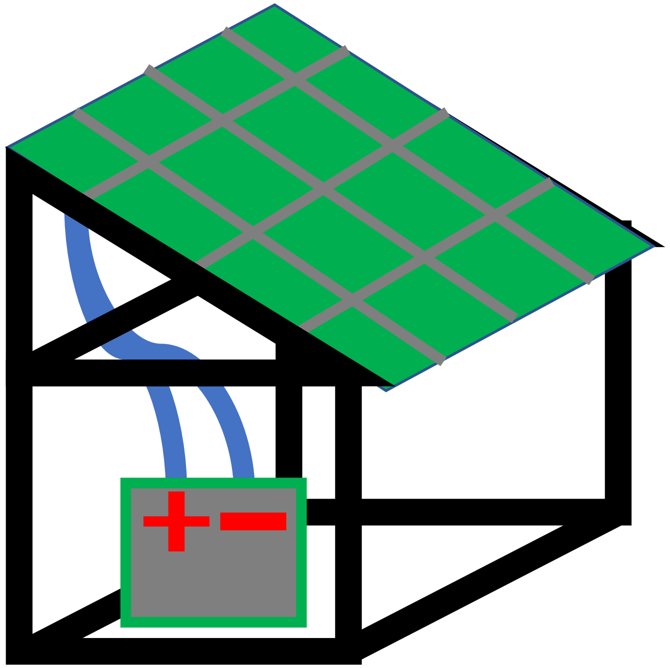
Renewable Energy Source



- Solar panels to power device
- Most readily available for Southeast U.S.
- Not enough water flow for hydro power
- Allow for battery charge when not running

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Material Selection

Base

- Galvanized steel
- Piping rather than plating for concentric pipes

Basket

- Aluminum
- Plating instead of pipes
  - Allows for secure connection of mesh

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Current Challenges

- Testing floating mechanism (Vertical Expansion)
  - Buoyancy, rack and pinion, leg adjustment
- Choosing input motor
  - Finding torque required to move the wheel at a constant speed
- Selecting the appropriate materials
  - Stainless/galvanized steel, aluminum, PVC

Andrew Walker

Future Prototyping

- **Jan. 28** — Test and Finalize Adjustable legs
- **Jan. 28** — Order Parts for Basket
- **Feb. 07** — Create and Finalize CAD & Sim
- **Mar. 04** — Test Motor Speed and Slide Angle
- **Mar. 20** — Test and Detail Final Product

Andrew Walker

YAMAHA RightWaters Trash Interceptor

Jonathan Draigh
jzd18@my.fsu.edu

Emily Haggard
ech18@my.fsu.edu

Mohamad Kassem
mak20ds@my.fsu.edu

Martin Senf
mms18cy@my.fsu.edu

Andrew Walker
andrew2.walker@famu.edu