# Disability Inclusion: Catalyzing Change Through Sport

May 5 - 7, 2025
**Park City, Utah**

MOVE UNITED EDUCATION CONFERENCE

Hosted By

NATIONAL ABILITY CENTER


# 3D printing for sports and recreation

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May 6th, 2025

Move United Education Conference

www.herl.pitt.edu

# Human Engineering Research Laboratories (HERL)


## Jonathan Duvall

**Associate Professor in Physical Medicine and Rehabilitation - Pitt**

**Research Biomedical Engineer - VA**


- **BS in Mechanical Engineering**
- **PhD in Rehabilitation Sciences**

**OUR MISSION:**

To continuously improve the mobility and function of people with disabilities through advanced engineering in clinical research and medical rehabilitation.

**OUR VISION:**

To create a world where all people with disabilities have unencumbered mobility and function so that they can fully participate in and contribute to society.

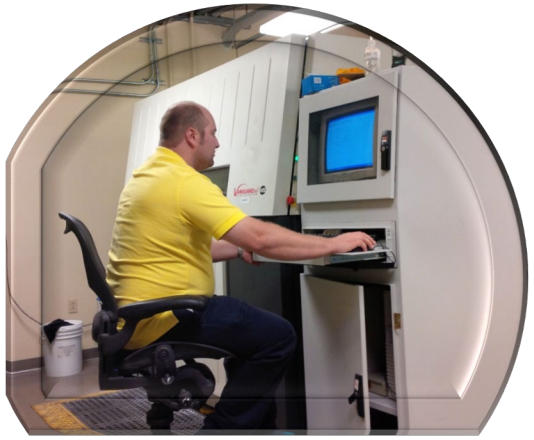
# Overview

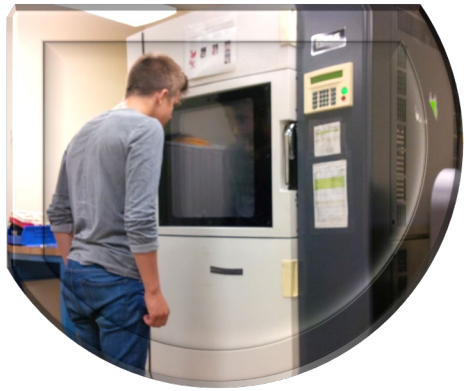
- What is 3-D printing?
- How can you use it and/or access it?
- Examples for sports and recreation

# What is 3-D Printing?

# Additive Manufacturing (3-D Printing)

- **Start with nothing and continuously build the part layer by layer**
- **Many different methods**
  - SLA, SLS, FDM, etc.
  - https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/?msclkid=0e374412b5c111ecabd9fc75652dc8bb
  - https://www.3dsourced.com/3d-printers/main-types-of-3d-printer-explained/
- **Many different materials**
  - ABS, Nylon, PLA, Etc.
  - https://www.simplify3d.com/resources/materials-guide/





# Material Extrusion

- Fused Deposition Modeling (FDM)
- Easiest and cheapest to get your own machine
- Almost exclusively plastics
- Like decorating a cake

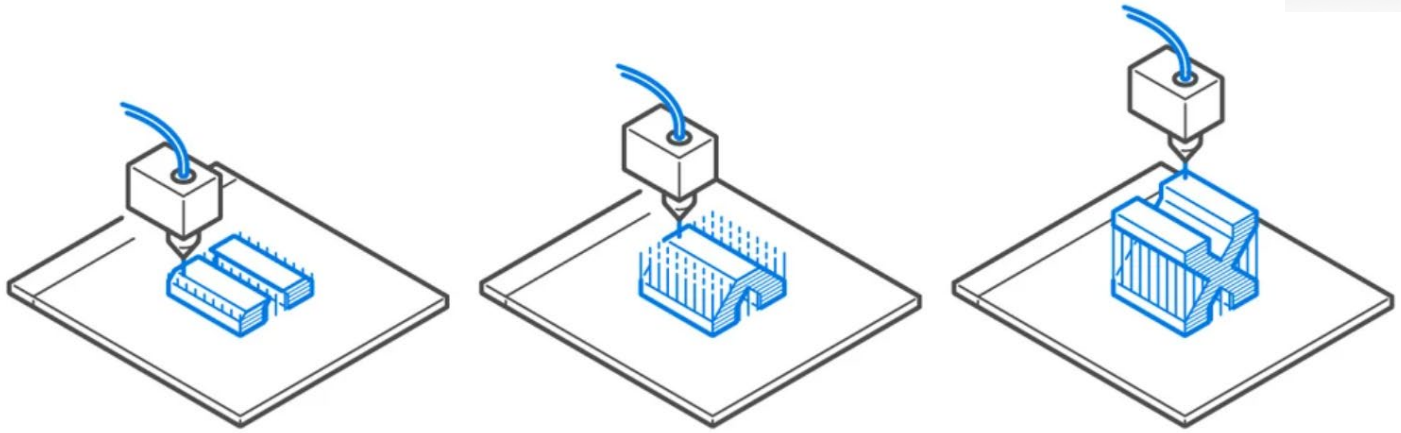



Image from: https://all3dp.com/1/types-of-3d-printers-3d-printing-technology/?msclkid=0e374412b5c111ecabd9fc75652dc8bb

# How can you access and use 3-D printing?

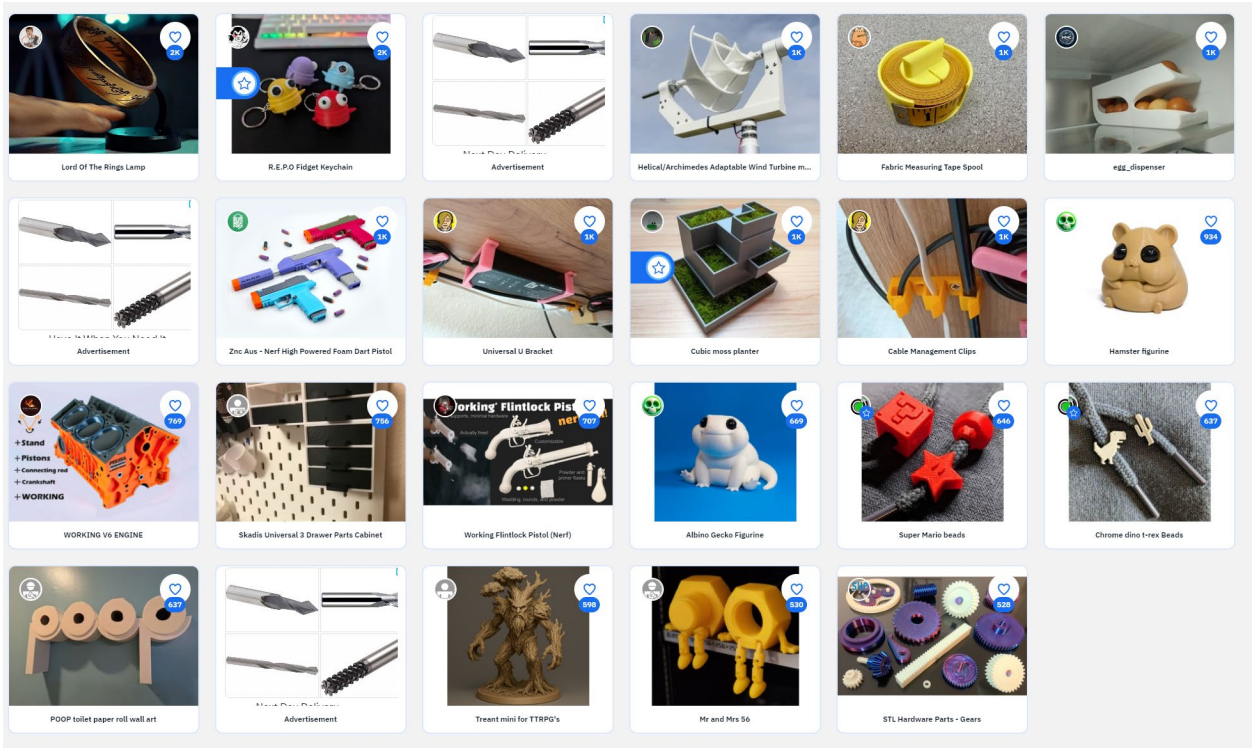
# Accessing 3-D Printing Yourself

- **The model**
  - CAD software
    - Solidworks, AutoDesk, TinkerCAD, FreeCAD, etc.
    - https://www.adamenfroy.com/cad-software
- **The Printer**
  - Many affordable machines, but aren't industrial quality
    - Makerbot, Flashforge, Creality, AnyCubic, etc.
    - https://buyersguide.org/3d-printers/t/best?msclkid=9de8a71265f8186311d7c57ff098d10d&m=e&d=c&c=73049062557357&oid=kwd-73049508386518:loc-190&qs=3d%20printer&lp=96499&li=&nw=o&nts=1&tdid=9795496

# 3D Printing Existing Designs

## Models and communities available on the web

- **Thingiverse**
  - https://www.thingiverse.com/
- **NIH 3D Print Exchange**
  - https://3dprint.nih.gov/
- **Pinshape**
  - https://pinshape.com/
- **Tikkun Olam Makers (TOM)**
  - https://tomglobal.org/search



# Accessing On-Demand Printing

**Making the part**

- **UPS**
  - https://www.theupsstore.com/print/3d-printing
- **Digikey**
  - https://www.digikey.com/en/resources/jabil-3d-parts-printer
- **Protolabs**
  - https://www.protolabs.com/services/3d-printing/
- **3D system on demand manufacturing**
  - https://www.3dsystems.com/video/3d-systems-demand-manufacturing
- **Stratasys**
  - https://www.stratasysdirect.com/

- **Many Schools have maker spaces with 3D printing**

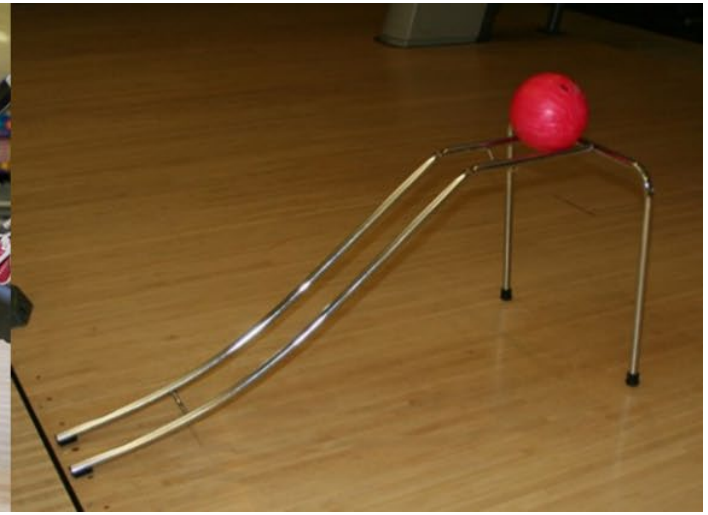
# Complete Assistance

- **Organizations assisting with design and fabrication**
  - Power of Play!
    - https://powerofplay.ahs.illinois.edu/sraat-repository-and-submissions/
  - TOM
    - https://tomglobal.org/search
  - Inglis
    - https://www.inglis.org/programs-and-services/innovation-center/innovation-center-pittsburgh
  - Many schools and Universities look for ideas for design classes!

# Considerations of Sports and Recreation Designs

# Design goals

- Allow the end users to dictate what they want to do

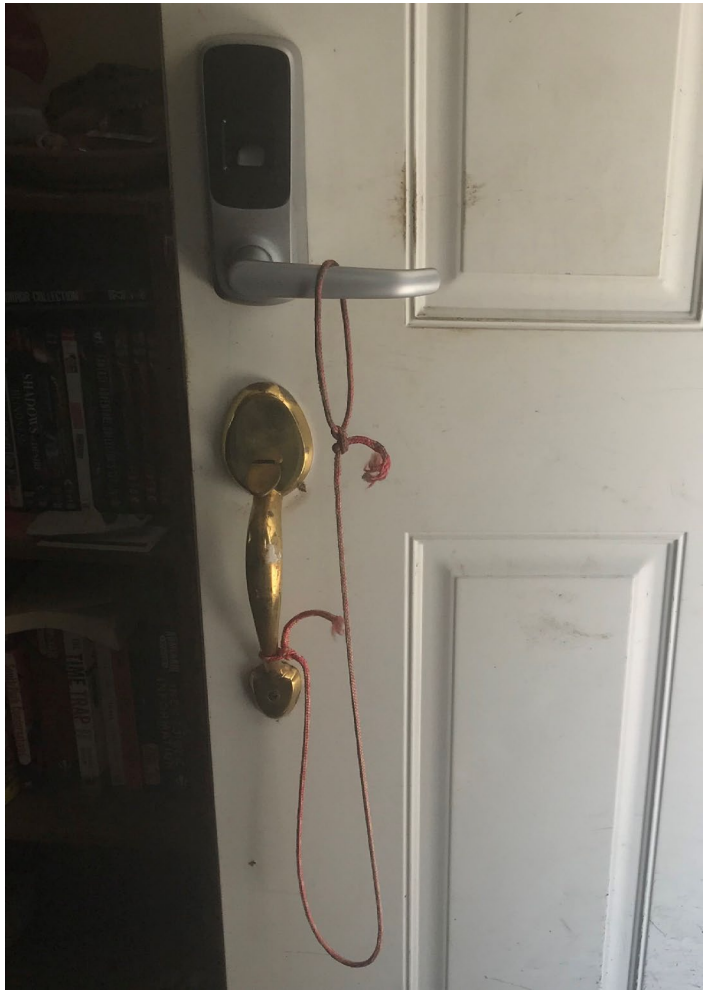
# Design goals

- Consider if you're making a universal or custom device

# Design goals

- **Low tech first**





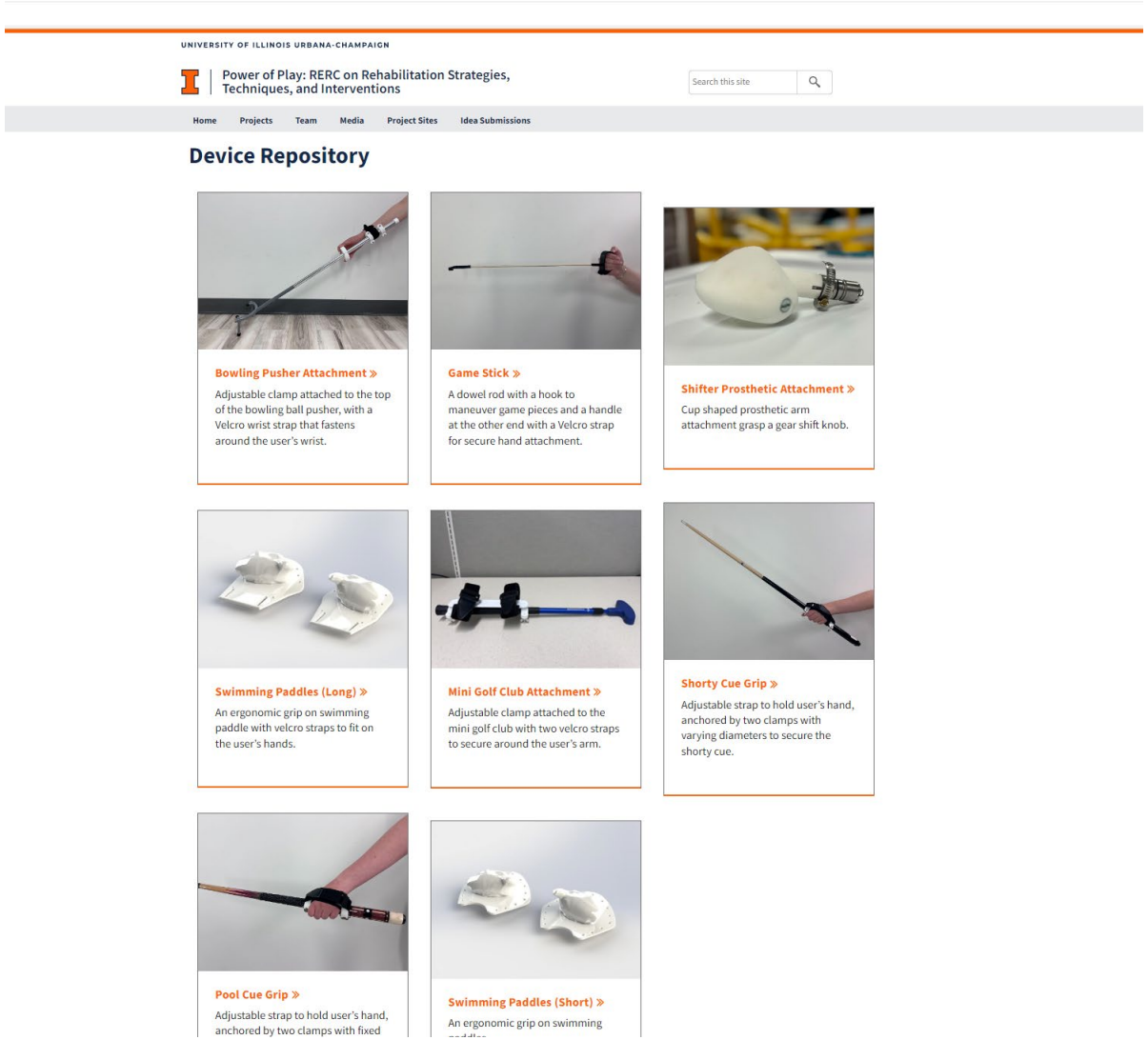
# Design goals

- **Re-appropriating existing devices may be best solution**

# Examples of Sports and Recreation Designs

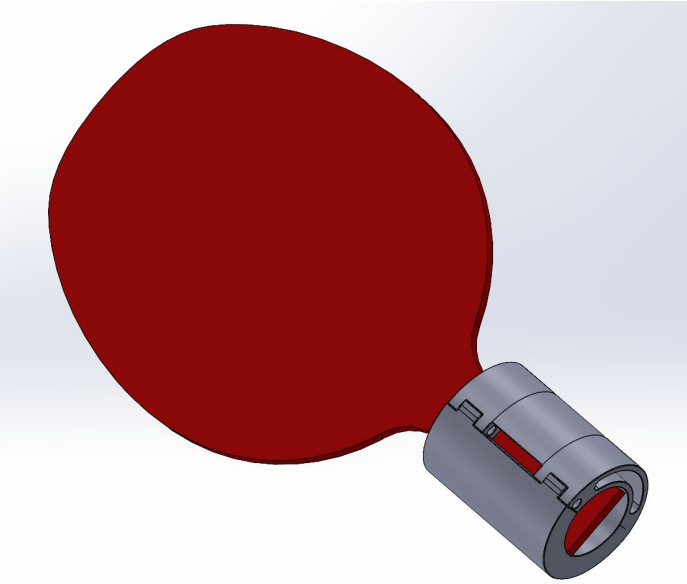
# Device Repository

https://powerofplay.ahs.illinois.edu/device-repository/



# Billiards

# Table Tennis

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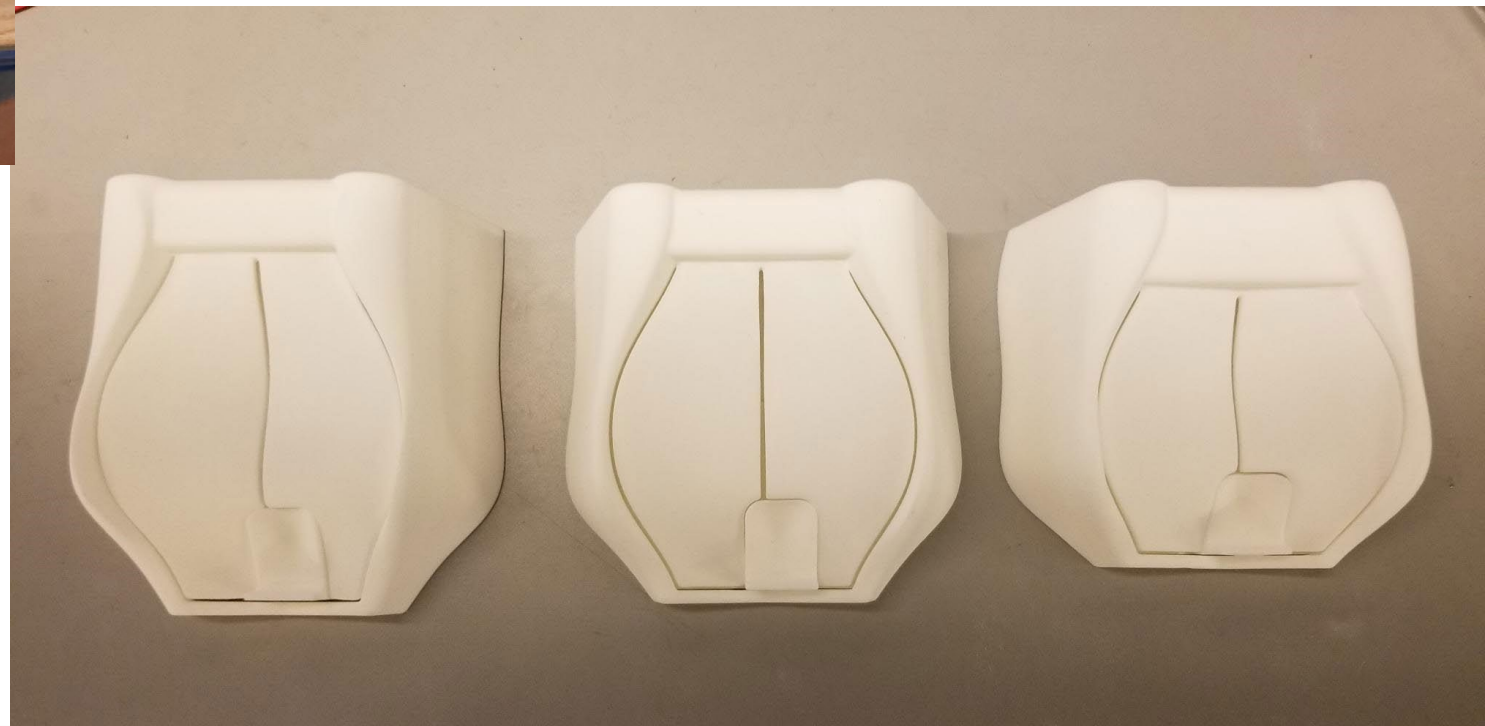
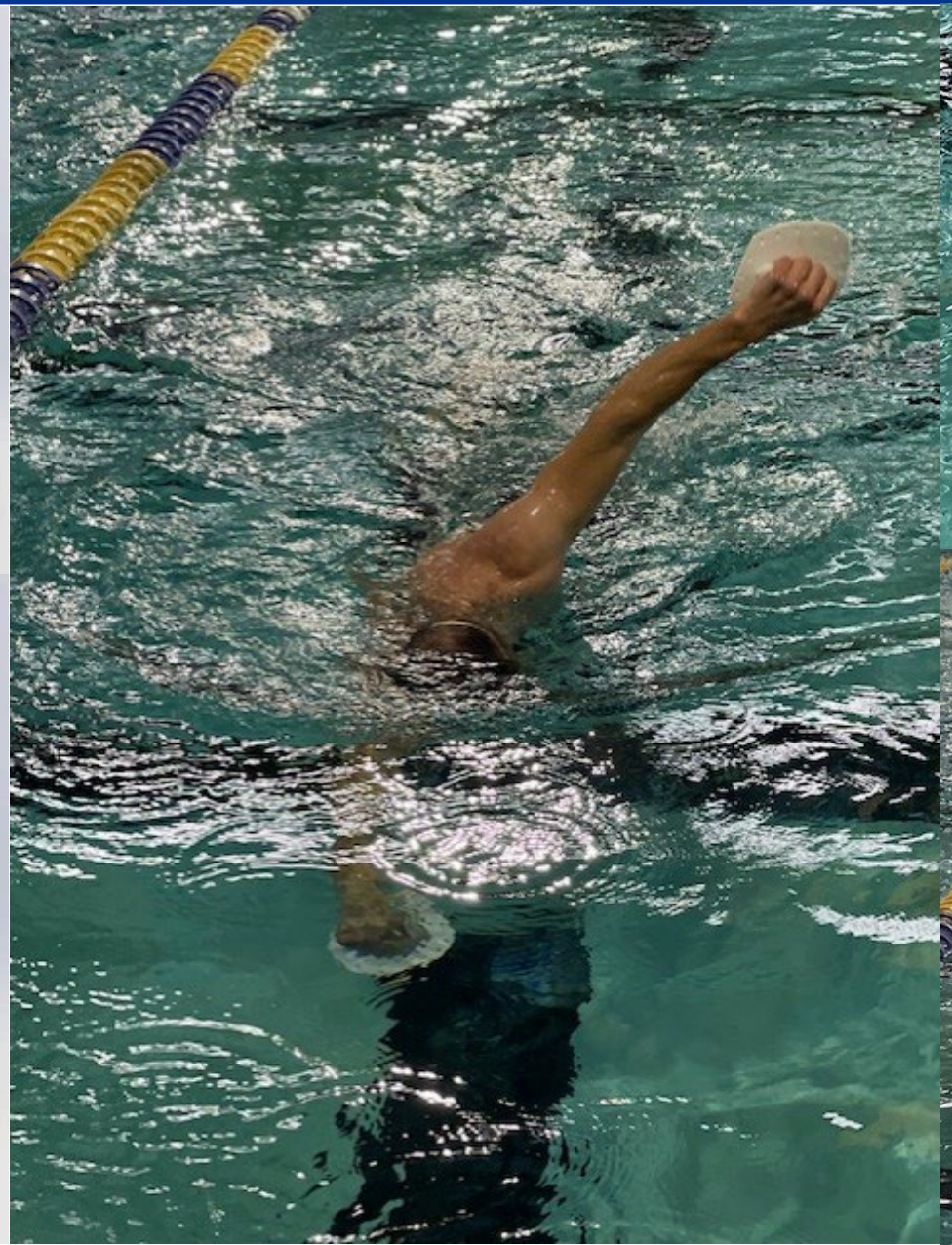
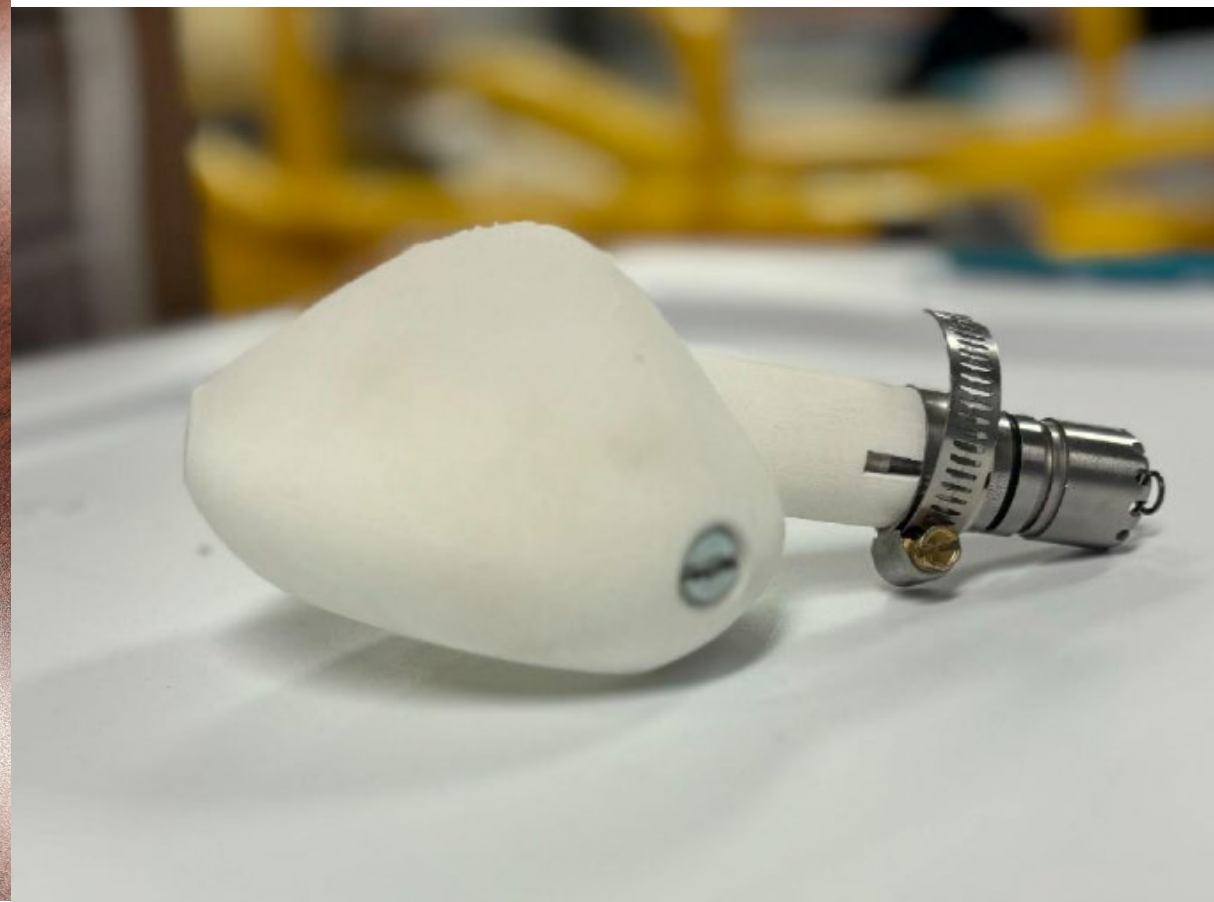
# Prosthetic Hook Mouse



# Swimming Paddles

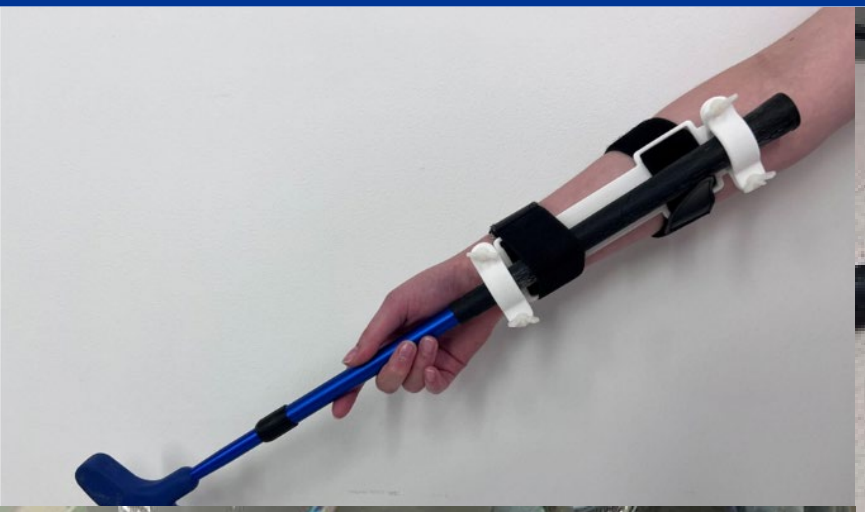


# Shifter



# Board Game Stick

# Mini Golf Putter Attachment



# Curling Stick Head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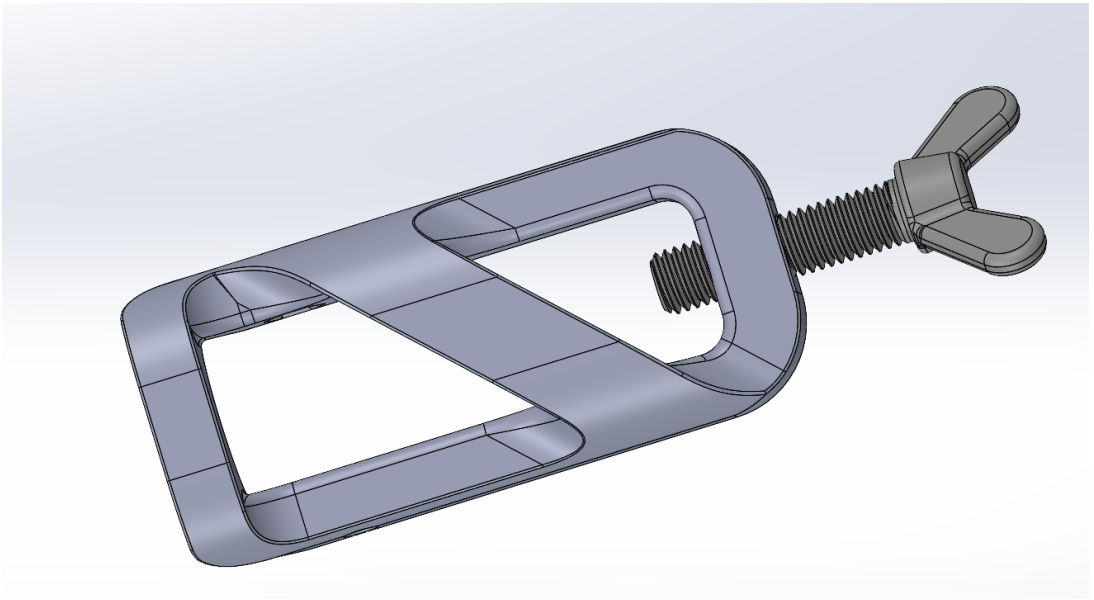

1. Photo from: https://www.va.gov/milwaukee-health-care/stories/the-sport-changed-my-life-paralyzed-veteran-becomes-paralympic-curling-champion/

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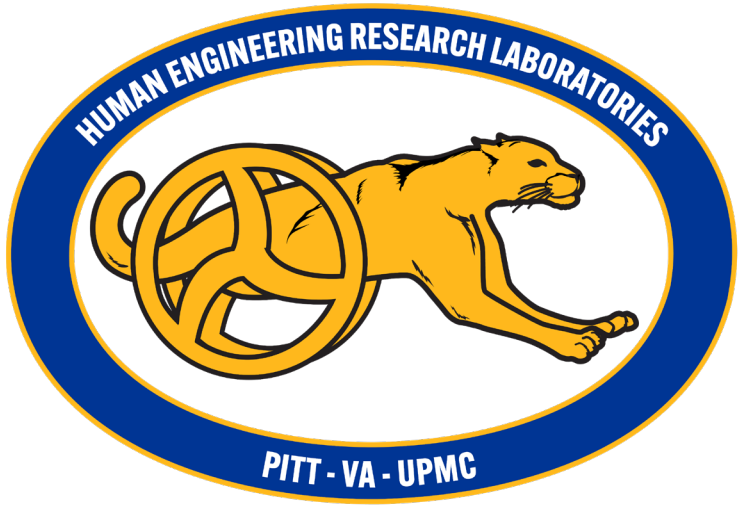
# Ergonomic Configurable Hand-Pedal


# One-handed Wii Remote and large button Box controller

Seth Hills, John Miller - Central Virginia VA Healthcare System

# Thanks for your attention!

- **Questions?**
- **Feel free to look at the physical devices!**

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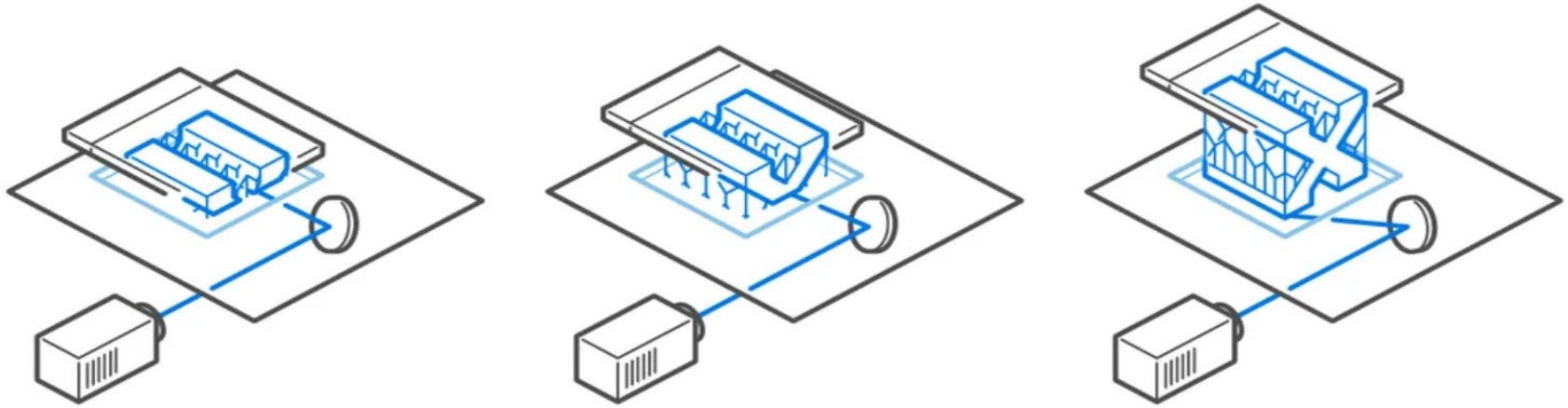
# Card Holder


# Gas Cap Turner

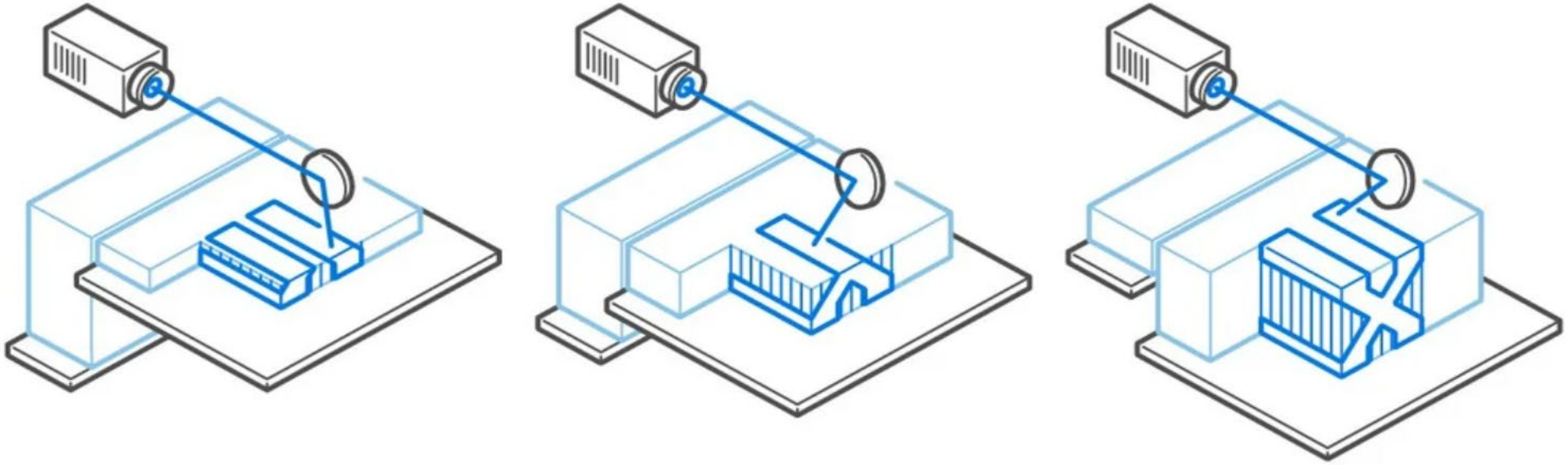
# Vat Polymerization

- Light sensitive resin
- Stereolithography (SLA) most common
- Each layer is cured with the light path
- The part is then lifted (or lowered) for the next layer of resin
- Smooth surface finish



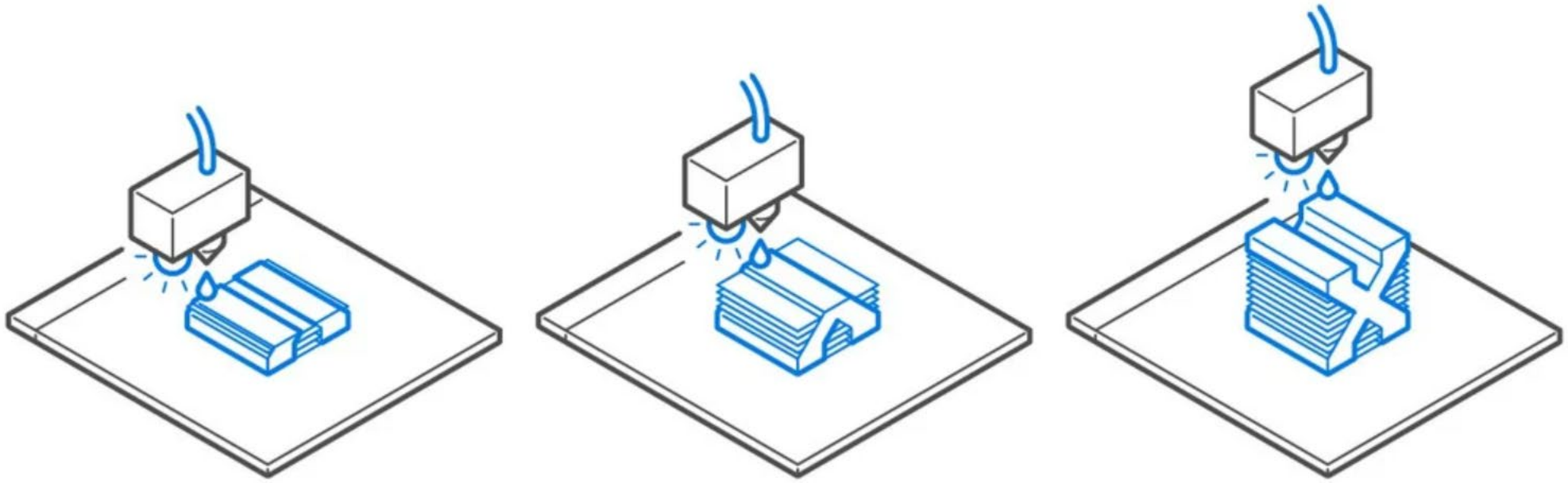
# Powder Bed Fusion

- Selective Laser Sintering (SLS) most common
- Powder layer is cured and then another layer is added
- Plastics, metals, and ceramics
- Very good mechanical properties, functional parts



# Material Jetting

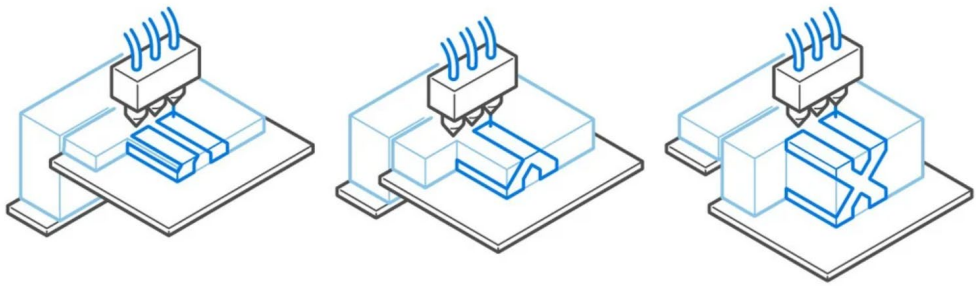
- Light sensitive resin
- Can print multiple colors or material properties in the same part



# Other technologies

**Binder Jetting**

- Similar to SLS, but uses a liquid binder rather than a light source
- Sand, ceramics, metals



**Sheet Lamination**

- Stacking and laminating sheets of thin material
- Need to form layers with laser cutter or router as build progresses
- Paper, polymers, and metals