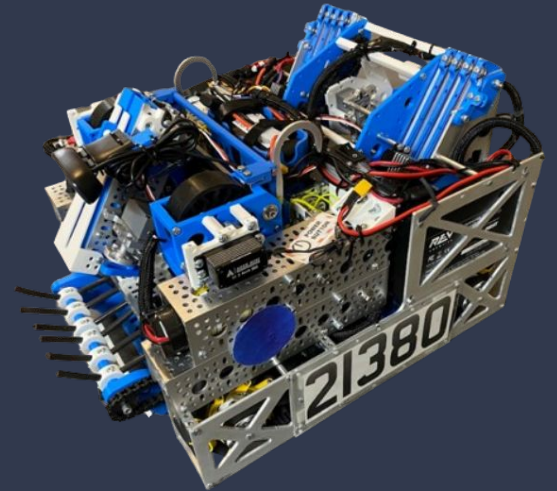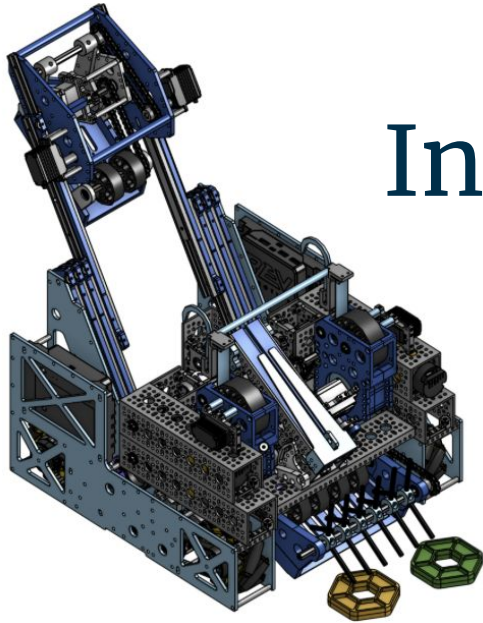# Intro to CAD – Onshape

Team 21380
Beyond Robotics

Intro

- **Who are we?**
  - We are Team Beyond Robotics 21380, established in July 2022. Our team is based in San Marino, and we compete in League C1, La Cañada.
- **Competition History**
  - Powerplay: Ranked #1 NP-OPR in SoCal
    - ILT: WAC, Motivate
    - Champs: FAC, Control 3rd
  - CenterStage: Ranked #1 NP-OPR in SoCal
    - ILT: Inspire 3rd, WAC, Design, Promote, Compass 3rd
    - Champs: Think 3rd, Compass
- **We are always open to questions or team connecting! You can contact us via Email or Instagram**
  - Email: contact@beyondrobotics.org
  - Insta: @beyond_robotics_team
  - Website: beyondrobotics.org

Engineering Design Process
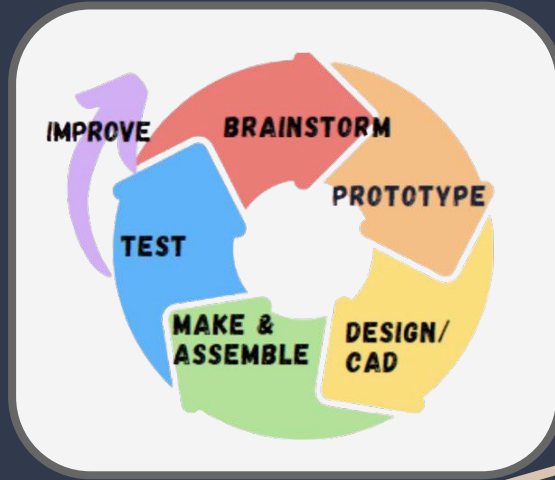
- **Brainstorm**
  - Brainstorm ideas after analyzing the game.
  - Decide on the pros and cons of the ideas and choose one to base the prototype off of.
- **Prototype**
  - Run tests using the prototype to see whether or not our design is viable
- **Design and CAD**
  - Analyze the flaws and pros of the prototype and improve the design through 3D designing tools such as Onshape.
- **Build**
  - Build the bot using parts 3D printed out and from parts from goBilda and REV Robotics
- **Test**
  - Test the bot in a imitation match to see how it behaves, and afterward, brainstorm ways to improve the design.
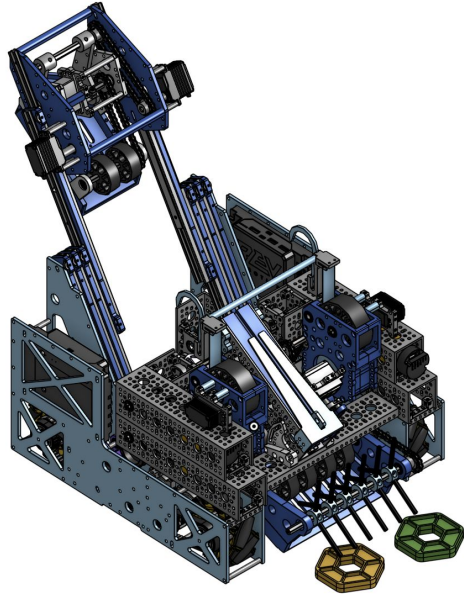
What is CAD?

- **What is CAD (Computer Aided Design)?**
  - Short for Computer Aided Design
  - Programs that allow you to design 3D models
- **Why Use CAD?**
  - Make 3D models of robots and simulate movements
  - Design custom parts for 3D printing/laser cutting
  - Share and document design ideas
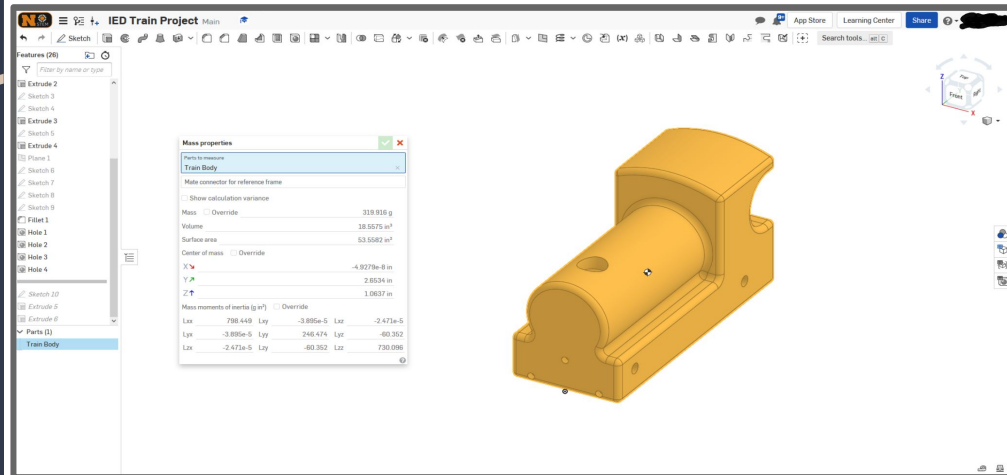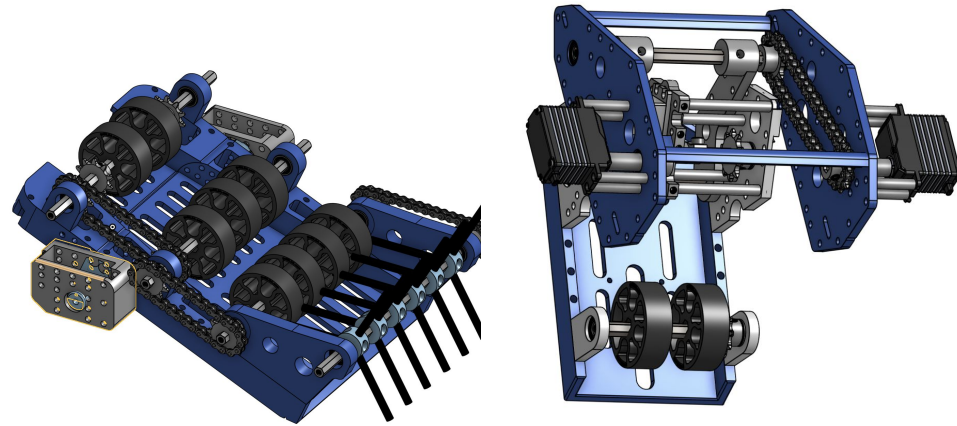
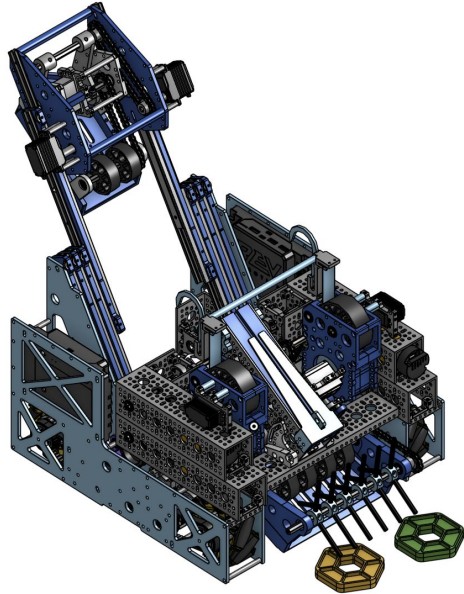# Centerstage Design Showcase

- **Our CenterStage Robot**
  - Outtake
    - Releases pixels on backdrop
    - Compliance wheels
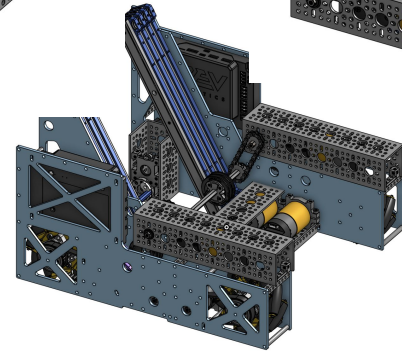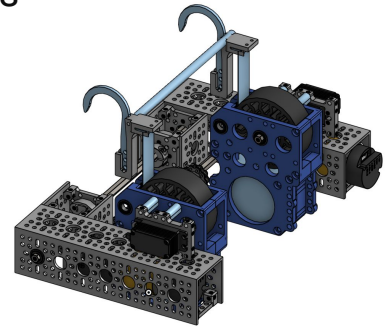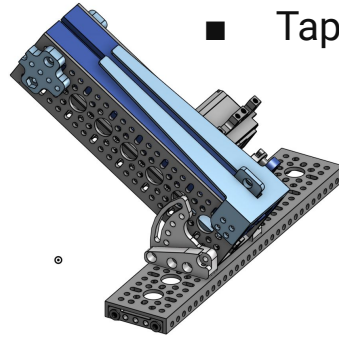   - 3d printed pixel holder
  - Intake
    - Takes in the pixels to the outtake
    - 3d printed ramp
    - Tubing

Centerstage Design Showcase

- ○ **Launcher**
  - ■ Launches the airplane
  - ■ Scotch Yoke Mechanism
- ○ **Mecanum Drive Train, Slide**
  - ■ Odometry
  - ■ 4-stage linear slide
- ○ **Hanger**
  - ■ Hangs the Robot
  - ■ Laser cut hooks
  - ■ Tape measure

Beyond Robotics Centerstage Robot
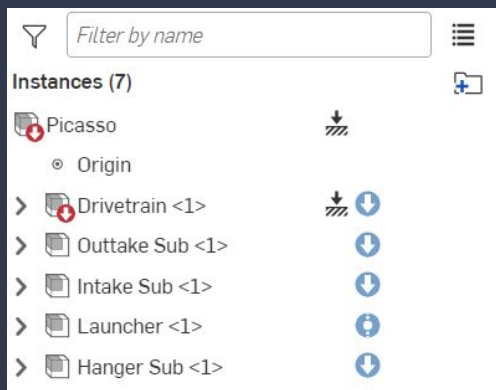
- ○ **Onshape View Control**
  - ■ Zoom
  - ■ Pan
  - ■ Rotate
- ○ **Camera Options**
  - ■ Top/Front/Right
  - ■ Isometric to reset

Isometric
Dimetric
Trimetric
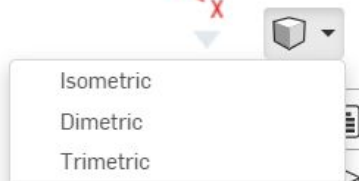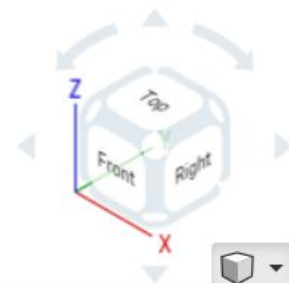
- ○ **Picasso and Its Sub-assemblies**

Picasso | Drivetrain | Intake Sub | Outtake Sub | Hanger Sub | Launcher Sub

- ○ Simulate Robot Movements
  - ■ Slide Up/Down
  - ■ Intake
  - ■ Adjust Launcher Angle

Onshape CAD Steps for FTC


```
Create a OnShape Document
            |
            v
Sketch 2D shapes
       |        |
       v        v
   Extrude    Revolve
       |        |
       v        v
Custom Parts CAD Objects        FTC Library CAD Objects
            |                        |
            v                        v
Assembly (Robot and Sub-Assemblies)
            |
            v
Manufacture(3D Printing/Laser Cutting) & Build
```

Sketch

- **Sketch**
  - First thing to do when we start the document.

  - The sketch button to create a plane that we draw on.

  - When the sketch is finished we can use it to create 3D shapes using mechanics like Extrude and Revolve.

  - The sketch tool lets designers create a 2D drawing of whatever part they are making.

  - There are many tools that we use such as the lines, shapes, trims, and dimensions.

  - Sketch is very entertaining and lets you be as creative as you want and lets you make 2D sketches that will be turned into 3D tools and parts.

Extrude

Extrude 3

Solid	Surface	Thin

New	Add	Remove	Intersect

Faces and sketch regions to extrude

Blind

Depth   25 mm

> ☐ Direction

> ☐ Starting offset

☐ Symmetric

☐ Draft

> ☐ Second end position

- **Extrude**
  - Allows you to visualize how big your design would look like.

  - It extend your design to a size you want it to be.

  - Creates 3D parts or surfaces using the sketch tool

  - Provides a view of the depth of your design of your will.

  - Extrude is very simple: All you have to do is to make your design, then click the extrude button and done! You got your block of your design.

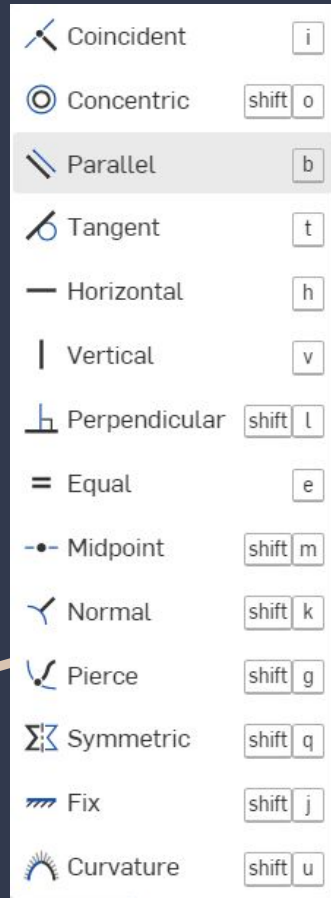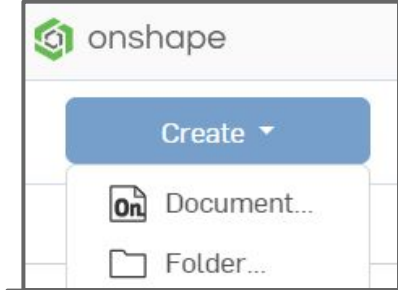# Revolve

- **Revolve**
  - Revolving is an important tool when it comes to creating a ROUND object
  - similar to an extrude, except that it requires an axis line to go around
  - Revolve allows us to create more complex shapes using curves
  - Examples:
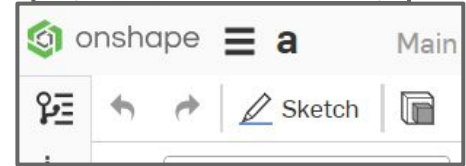   - Donuts, cones, cylinders with an empty hole, and spheres.

Onshape Part Studio
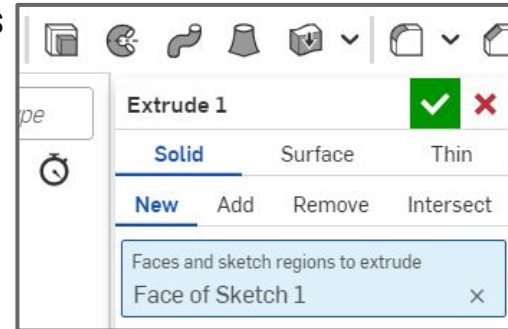

- ○ **New Document**

- ○ **New Sketch**

- ○ **Basic Shapes**

- ○ **Sketch Constraints**
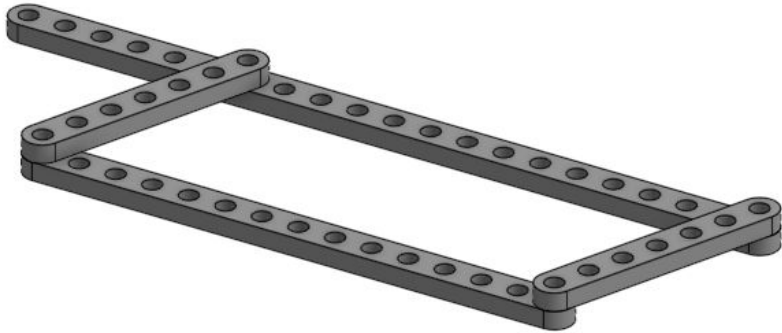- ○ **Sketch Dimensions**
- ○ **Extrude**
    - ■ New
    - ■ Add
    - ■ Remove
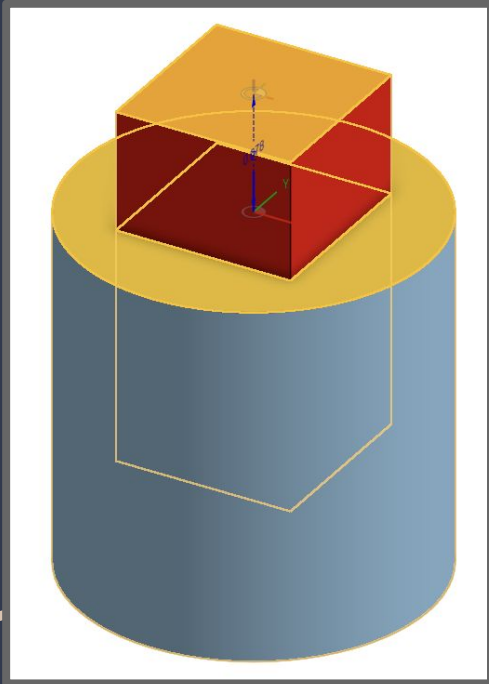- ○ **Revolve**
    - ■ Cone
    - ■ Donut

Assembly

What are assemblies used for?

- Simulating movement in your mechanisms
- Demonstrates interactions between many mates pretty well
- Allows you to incorporate part files and other assemblies into a larger assembly
- Easy connection through mates.
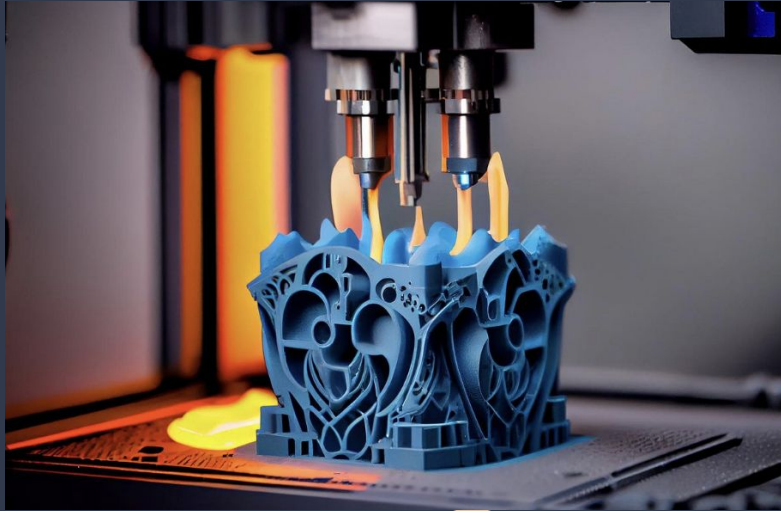- Mates are easy and quick to make

Mates

Mates

- Fastened mate
  - Doesn't allow for any motion
- Slider mate
  - Allows for linear motion along an axis
- Revolute mate
  - Allows for rotational motion along an axis
- Cylindrical mate
  - Allows for both rotational motion and linear motion along an axis

3D Printing

- **What is 3D Printing?**

  3D printing is an additive process of creating 3D prints from layers and layers of PLA. 3D printing can only be done after you have created a model or have found a model and then download the file so that it can be uploaded to a 3D printer.

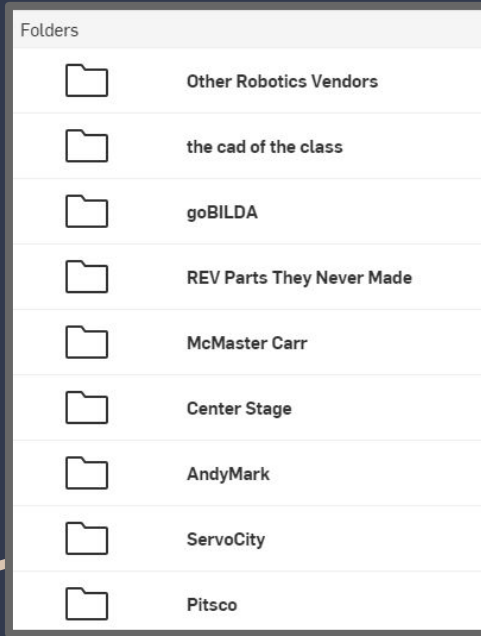- **Why is 3D Printing Important in FTC?**

  3D printing is important in FTC because sometimes you can't find the exact part that you want so you have to create your own custom part. 3D printing is also important to create game pieces for the game.

3D Printers

- **Bambu Lab P1S 3D Printer**
  - Cost: $849
  - Efficiency: 500 mm/s
  - Filament Slots: 4
  - Print Height: 250 mm
  - <u>High cost, fast speed, good print space, multi color</u>

- **Creality Ender 3 V3 SE 3D Printer**
  - Cost: $219
  - Efficiency: 250 mm/s
  - Filament Slots: 1
  - Print Height 220 mm
  - <u>Low cost, mediocre speed, good print space, single color</u>

- **XYZ Da Vinci 1.0 Pro**
  - Cost: $899
  - Efficiency: 150 mm/s
  - Filament Slots: 3
  - Print Height: 200 mm
  - <u>We have not tested this printer yet</u>

CAD Resources

Folders

- Other Robotics Vendors
- the cad of the class
- goBILDA
- REV Parts They Never Made
- McMaster Carr
- Center Stage
- AndyMark
- ServoCity
- Pitsco

- **Onshape Learning Center**
  - Onshape has free educational resources, including self-paced courses, videos, and articles.
    - https://learn.onshape.com/
- **FTC Part Library**
  - Team 2901 created an Onshape Parts Library and has put together a library of parts from ServoCity, GoBilda, Pitsco, AndyMark, and Rev Robotics.
  - For access, email FIRST@ptc.com and state the email addresses of every team member who would like access.
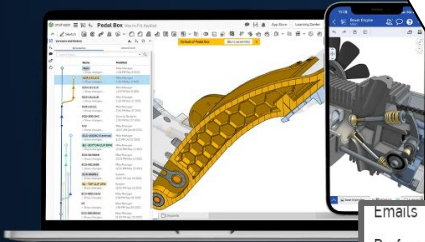
CAD Tips

- **Tips**
  - Try to use the FTC Part Library as much as possible.
  - Keep tabs for higher leveled assemblies and also make as few parts studios as possible
  - Use one folder per subsystem
  - Join FTC CAD discord and ask questions.
  - Don't be afraid of making mistakes.
  - **!! Most important: Practice a lot!**

Making an OnShape Account & Team Management

- **How to sign up for OnShape**
  - You can get a free education account as a student.
    - Once you registered your account, you can create teams.
    - Then, you can add team members by their emails.
    - Finally, you can set up roles, such as member or admin

1

2

- Email: contact@beyondrobotics.org
- Insta: @beyond_robotics_team
- Website: beyondrobotics.org
- Tiktok: @beyond21380
- Connections Lead Discord: et.z

Thanks for Listening

Any questions?