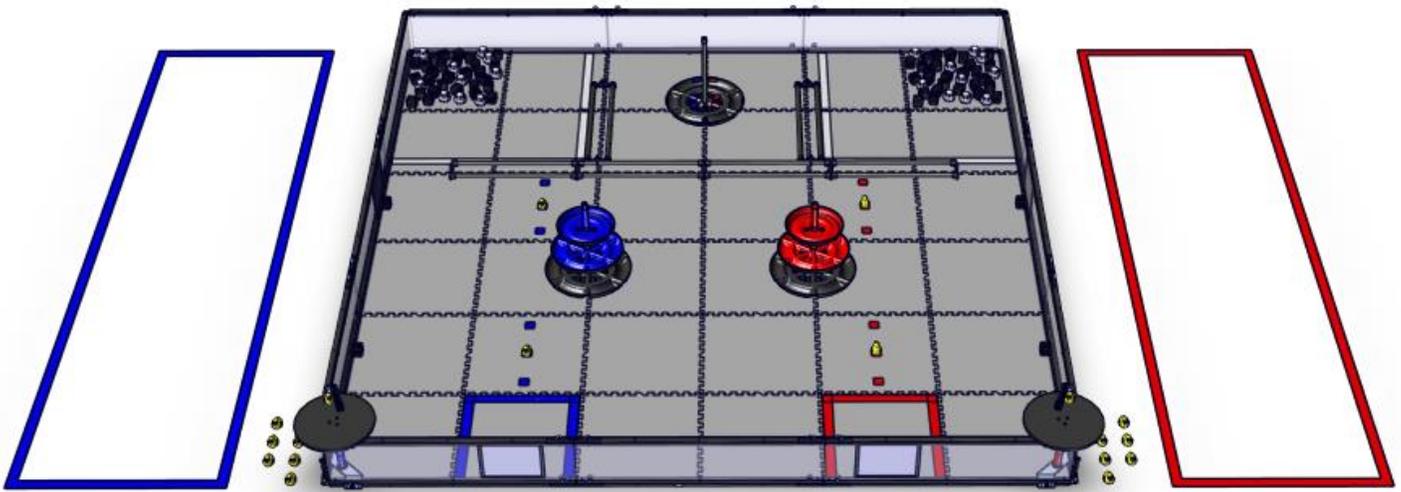


PRESENTED BY  Raytheon
Technologies



2021-2022 *FIRST*[®] Tech Challenge Field Assembly Guide

Rev 1.0

AndyMark[®] Field Components for 2021-2022 *FIRST*[®] Tech Challenge

This guide contains instructions for assembling the Field Elements for the 2021-2022 *FIRST*[®] Tech Challenge Game.



Read through all the instructions and take inventory before you begin to assemble the game elements!

REVISION HISTORY

Rev.	Date	Description
1.0	9/7/2021	Initial Release

ASSEMBLY VIDEOS CAN BE FOUND ON OUR WEBSITE:
AndyMark.com/FTC

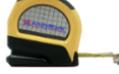


Recyclable materials are used throughout the FREIGHT FRENZYSM playing field. Take note of recycling symbols on game elements and think about ways to reuse or recycle after the season is over.



CAUTION!
Edges of field parts may be sharp. File or deburr sharp corners or edges as needed.

TOOLS NEEDED

Component	Quantity	Part Photo
Safety Equipment		
Ratchet (Optional)	1	
3/8" Nut Driver or Socket	1	
Cable Tie Cutters	1	
1/8" Hex Driver	1	
File	1	
Utility Knife	1	
25' Tape Measure	1	
Mallet	1	
Scissors	1	

ADDITIONAL REQUIRED ITEMS

2" RED Gaffers Tape	1	
2" BLUE Gaffers Tape	1	
2" WHITE Gaffers Tape	1	
Permanent Marker (Black)	1	
White 8.5x11" or A4 (international) Cardstock for Navigation Target (Printed from FIRST Resource Library)	8	
Velcro® Dots	1-pack	
Clear Page Protection Sleeves (Similar to Staples P/N 40713)	4	

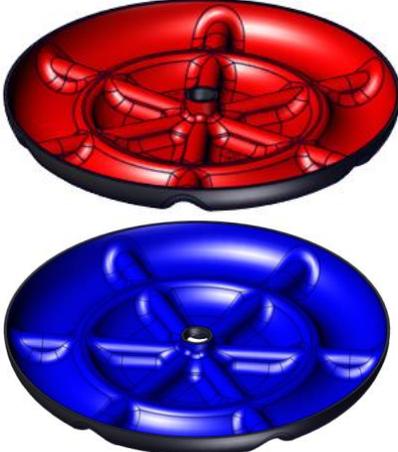
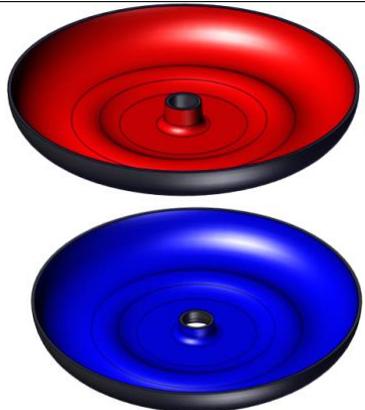
Tool Set (am-4500_Tool) and Tape Set (am-4301_Tape) can be purchased from AndyMark

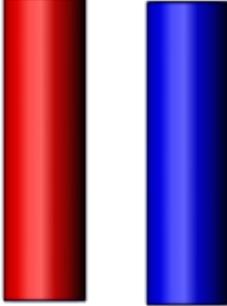
GAME PIECES and ELEMENTS

Component	Part #	Quantity per Field	Part Photo
Block (a.k.a. Boxes)	am-4508	60	
Ball (a.k.a. Cargo)	am-2850	20	
Duck	am-4510	24 (20 for game + 4 spares)	
Weight	am-4495	42 (40 for game + 2 spares)	
O-ring	am-4496	50 (40 for game + 10 spares)	

See Field Setup Guide for placement information.

Alliance Shipping Hub

Component	Part #	Quantity per Field	Part Photo
Molded Base BLACK	am-4217a	2	
Lower Tray BLACK Level 1	am-4491	2	
Middle Tray RED/BLUE Level 2	am-4492_Red am-4492_Blue	1 Red 1 Blue	
Upper Tray RED/BLUE Level 3	am-4493_Red am-4493_Blue	1 Red 1 Blue	

<p>Inner Pipe BLACK 20" long</p>	<p>am-4552</p>	<p>2</p>	
<p>Pipe Sleeve RED/BLUE</p>	<p>am-4553_Red am-4553_Blue</p>	<p>3 Red 3 Blue</p>	
<p>Pipe Cap Top RED/BLUE</p>	<p>am-4297_Red am-4297_Blue</p>	<p>1 Red 1 Blue</p>	
<p>Base Fastener</p>	<p>am-1310</p>	<p>8</p>	

Shared Shipping Hub

Molded Base BLACK	am-4217a	1	
Lower Tray BLACK Level 1	am-4491	1	
Inner Pipe BLACK (20" long)	am-4552	1	
Pipe Cap Top BLACK	am-4297_Black	1	
Base Fastener	am-1310	4	

Carousel

Carousel Platform	am-4497	2	
Carousel Axle	am-4550_Axle	2	
Pipe Sleeve RED Pipe Sleeve BLUE	am-4557_Red am-4557_Blue	1 Red 1 Blue	
Pipe Bottom Cap BLACK	am-4499	2	
Carousel Screw	am-1324	6	
Carousel Nut	am-1042	6	

Grommet	am-4498	4	
Bottom Carousel Support Bracket	am-4505	2	
Top Carousel Support Bracket	am-4506	2	
Thumb Screw	am-4558	8	
Top Sweeper Arm (6" long)	am-4502	2	
Underneath Sweeper Arm (3.5" long)	am-4504	2	
Sweeper Arm Cap	am-4501	2	

Sweeper Bracket	am-4503	2	
Sweeper Screws	am-1310	12	
Pinch Point Sticker	st-4550	2	
Height Spacer	am-3896-2000	2	

Barrier

Horizontal Short Barrier Pipe (28" long)	am-4548	8	
Vertical Long Barrier Pipe (29.5" long)	am-4549	4	
Barrier Pipe Anchor	am-4042a	12	
Under Tile Plate	am-4547	10 (9 for game + 1 spare)	
Cable Tie 8"	am-1552	20	

Part Preparation

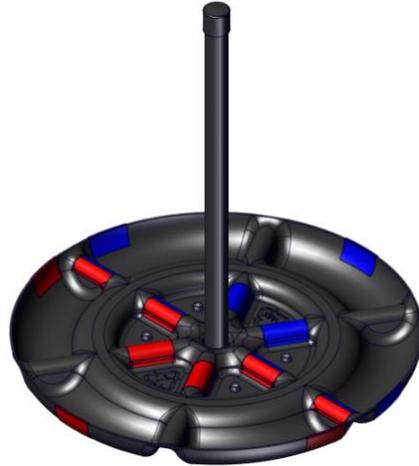
The playing field is custom manufactured out of aluminum and plastic parts. The edges of some of these parts may be sharp. Be careful when handling and use a file to smooth any rough edges as needed prior to assembly.

Some of the flat sheets may have a protective plastic film on one or both sides to protect the surface from scratches during manufacturing and transportation. These protective covers can be peeled off and discarded.

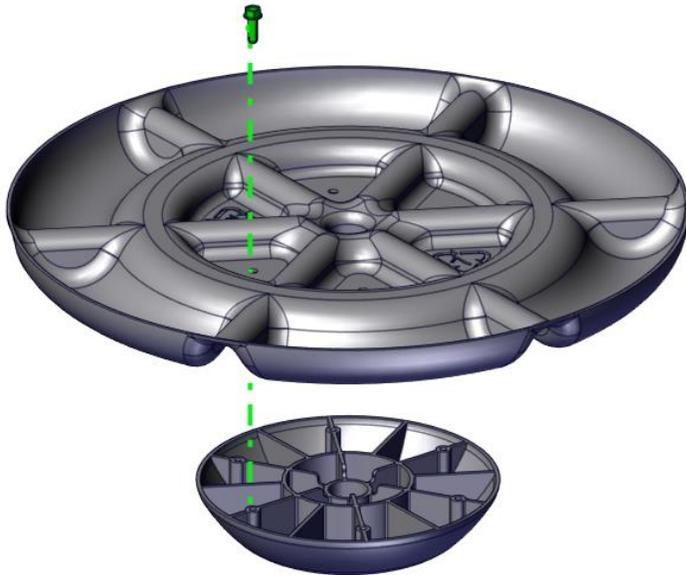


Shared Shipping Hub Assembly Instructions

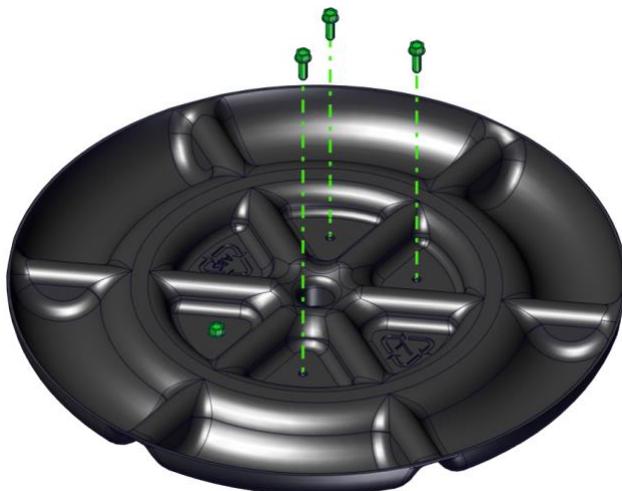
There is one Shared Shipping Hub on a full field.



1. Locate a Lower Tray (am-4491) and a Base (am-4217a) and align the screw holes.
2. **Loosely** screw in a Base Fasteners (am-1310) through the Lower Tray and into the Base.



3. Loosely screw in the three remaining Base Fasteners.



4. Tighten the Base Fasteners (am-1310) to secure the Lower Tray to the Base. Be careful not to overtighten the Base Fasteners to avoid damaging the assembly.



Note: The screws at first can be partially tightened until all screws are partially in, and then fully tightened.

5. Insert the Shipping Hub Inner Pipe (20" long) into the center hole in the assembly. Ensure the pipe is pressed fully down into the Base. When fully seated, the pipe should extend approximately 17.25" from the top of the Lower Tray to the top of the pipe.



Note: It's helpful to push down on a hard surface like the floor to ensure the pipe is fully secured in the base.

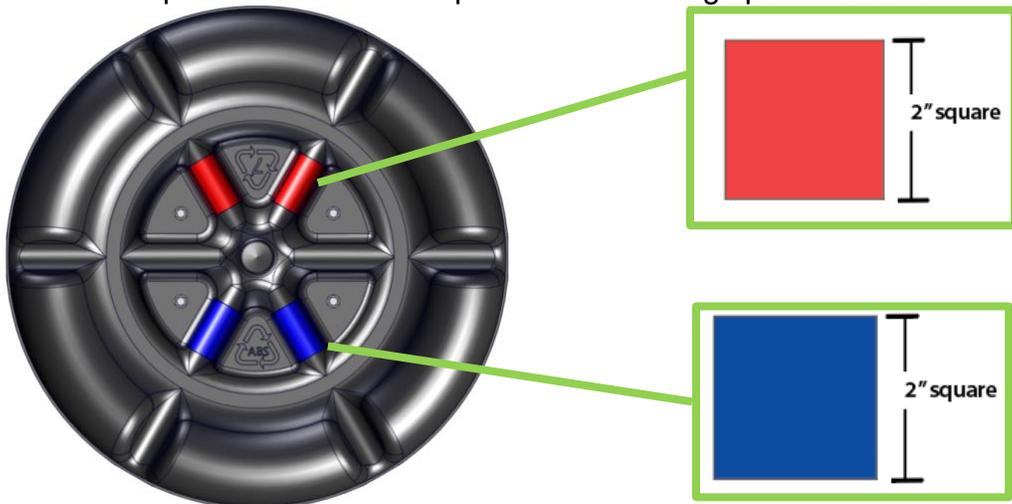
6. Press the Black Pipe Cap onto the Inner Pipe to create the Shared Shipping Hub.



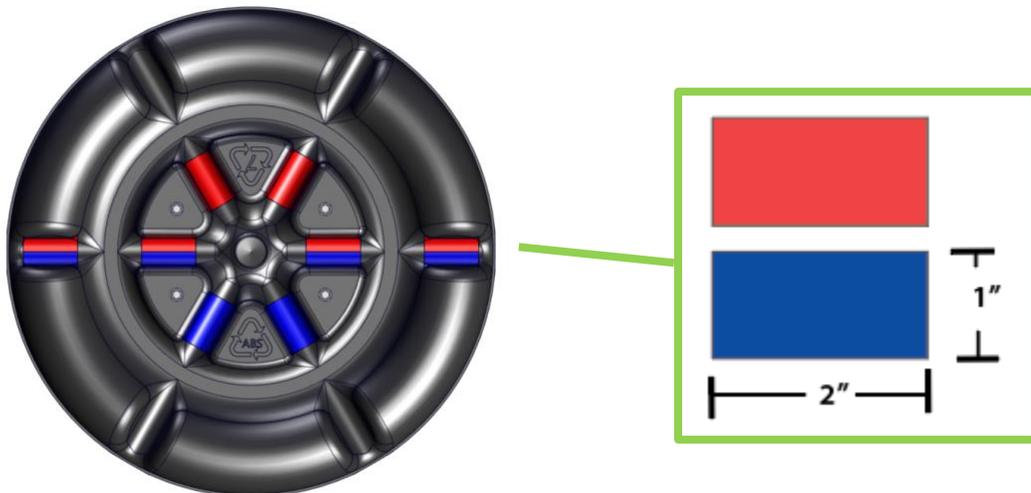
Build 1x Shared Hub per Field

7. For gameplay, the shared hub is split into a red and blue half delineated by gaffers tape markings. To help with tape alignment, a Shared Hub Tape Tool STL is available for download at <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>.

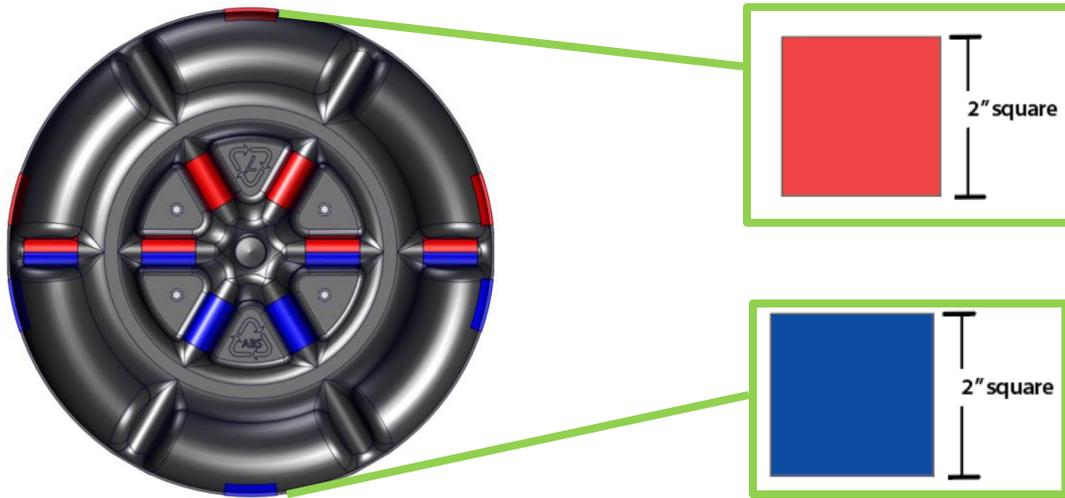
a. Add 2x2" square red and blue tape to the inner ring spokes as shown.



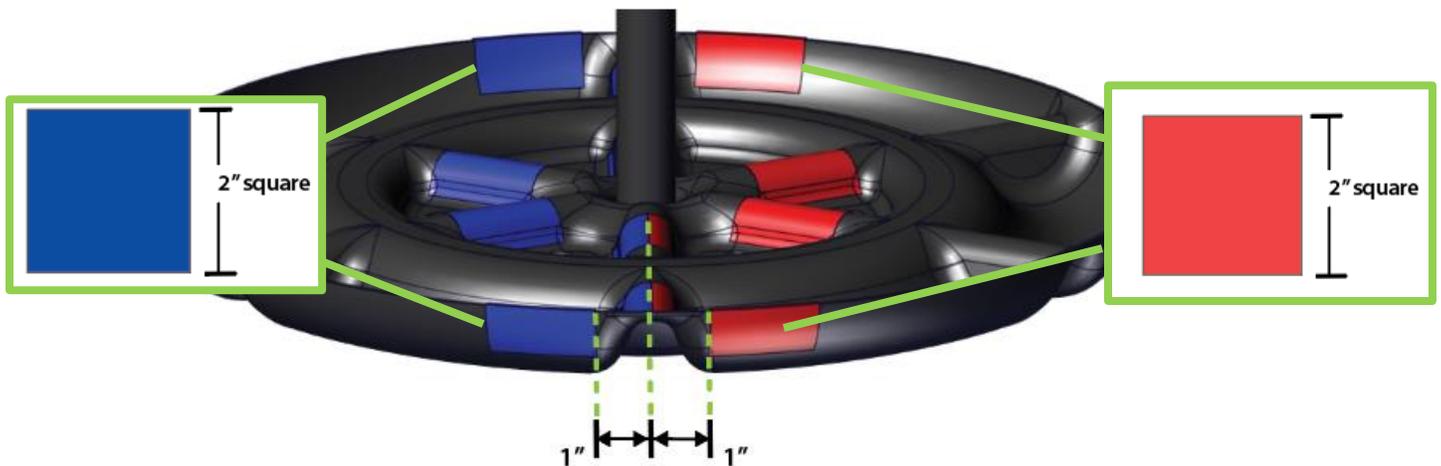
b. Divide the remaining with 1"x2" strips of red and blue tape to both the inner and outer rings.



c. Fold 2x2" tape over the outer edge in each center red and blue section. .

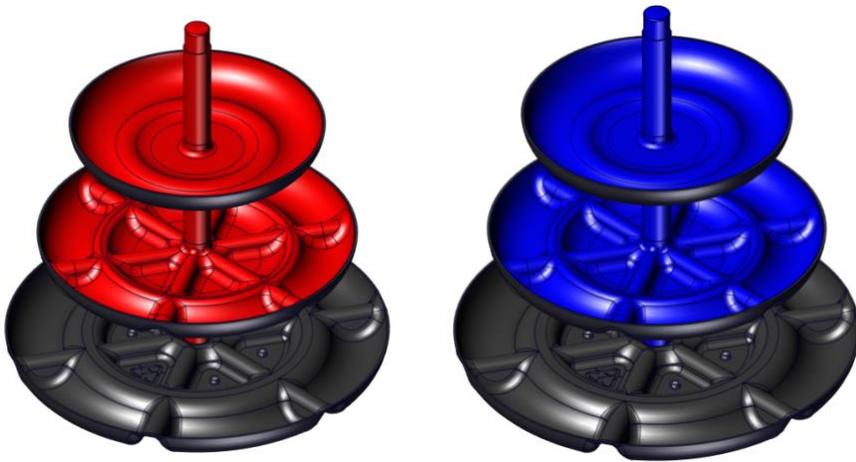


d. On adjacent red and blue sections, fold 2x2" square tape over the outer edge spaced 1" away from the center dividing line as shown.

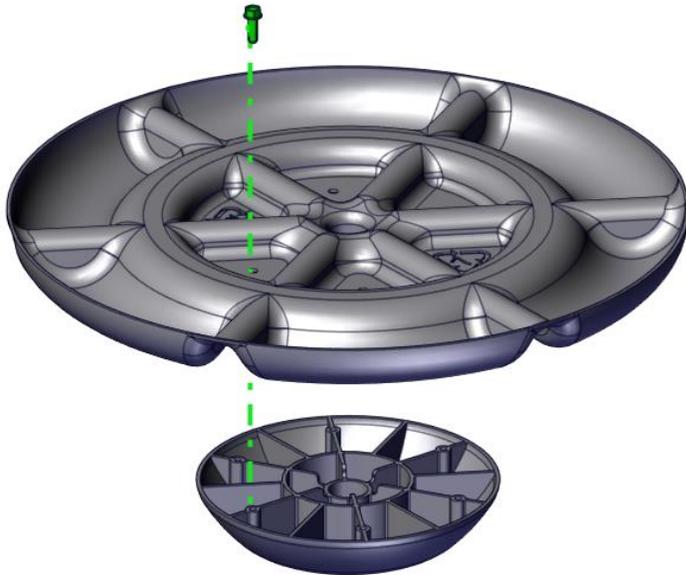


Alliance Shipping Hub Assembly Instructions

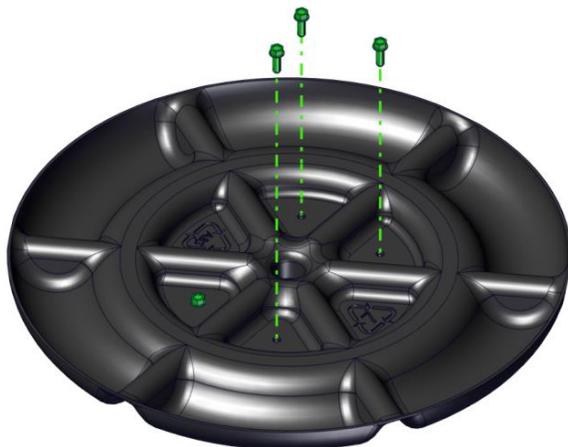
There are two Alliance Shipping Hubs on a full field, one red and one blue.



1. Locate a Lower Tray (am-4491) and a Base (am-4217a) and align the screw holes.
2. **Loosely** screw in a Base Fasteners (am-1310) through the Lower Tray and into the Base.



3. **Loosely** screw in the three remaining Base Fasteners.



4. Tighten the Base Fasteners (am-1310) to secure the Lower Tray to the Base. Be careful not to overtighten the Base Fasteners to avoid damaging the assembly.



5. Insert the Shipping Hub Inner Pipe (20" long) into the center hole in the assembly. Ensure the pipe is pressed fully down into the Base. When fully seated, the pipe should extend approximately 17.25" from the top of the Lower Tray to the top of the pipe.



Note: It's helpful to push down on a hard surface like the floor to ensure the pipe is fully secured in the base.

6. Slide a red or blue Pipe Sleeve (am-4553_Red or Blue) onto the Assembly.



7. Add the same color Middle Tray (am-4492_Red or Blue) to the assembly by pressing the center of the tray onto the pipe. This is Level 2.



Note: It's helpful to push down on the center of the tray with the assembly on a hard surface like the floor.

8. Slide a 2nd Pipe Sleeve (am-4553_Red or Blue) of the same color to the assembly.



9. Add the same color Upper Tray (am-4493_Red or Blue) to the assembly by pressing the center of the tray onto the pipe. This is Level 3.



Note: It's helpful to push down on the center of the tray with the assembly on a hard surface like the floor.

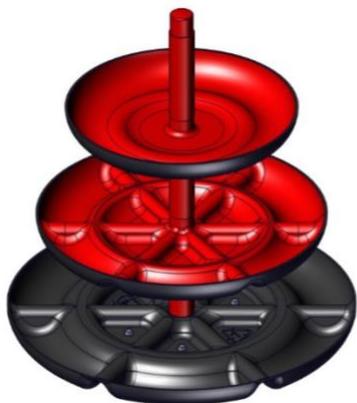
10. Slide a 3rd Pipe Sleeve (am-4553_Red or Blue) of the same color to the assembly.



11. Press the same color Pipe Cap (am-4297_Red or Blue) onto the end of the inner pipe.



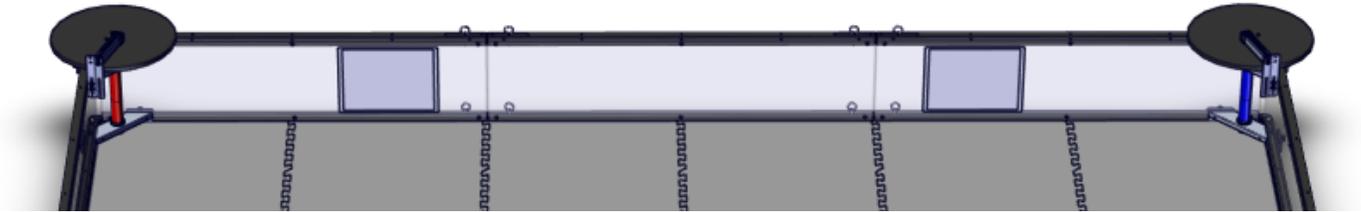
12. The Alliance Shipping Hub is complete! Repeat steps for the second Shipping Hub. Refer to the field setup guide for placement on the field.



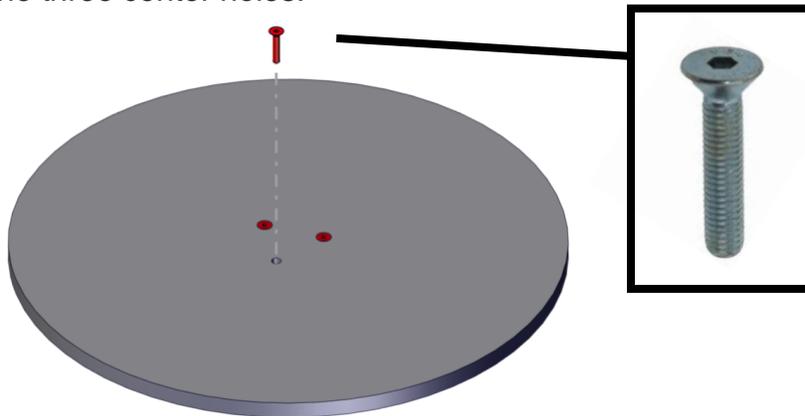
Build 1x Red Shipping Hub and 1x Blue Shipping Hub per full field.

Carousel Assembly Instructions

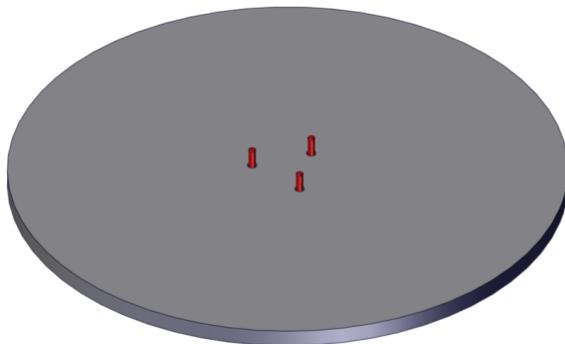
Each full field has one Red and one Blue Carousel located on adjacent corners at the front (audience side) of the field.



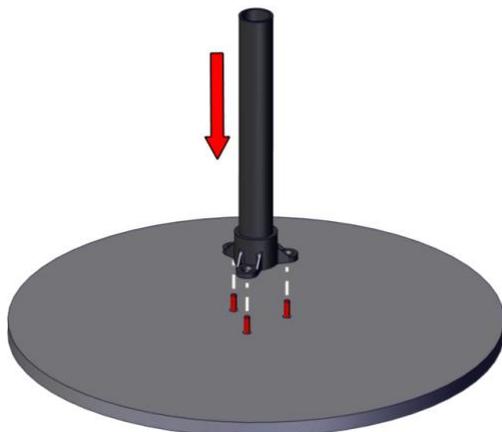
1. Locate the Carousel Platform (am-4497) and insert Carousel Screws (am-1324) into each of the three center holes.



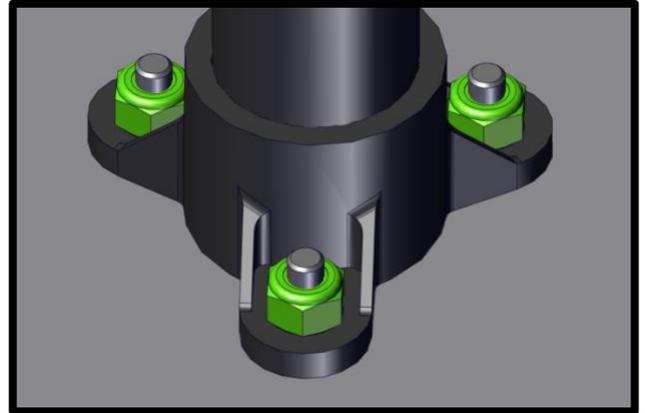
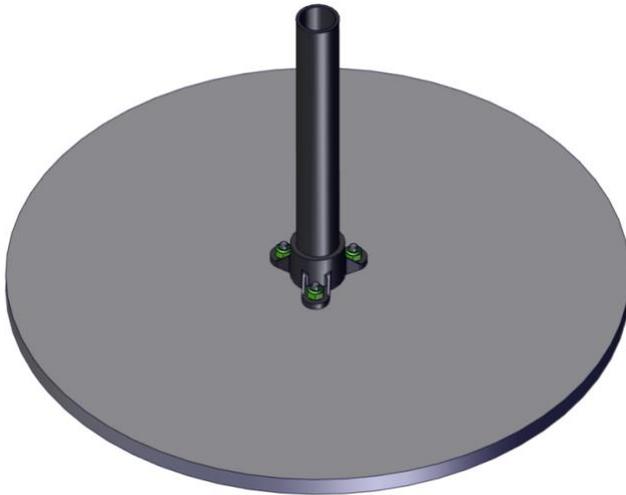
2. Flip the assembly over.



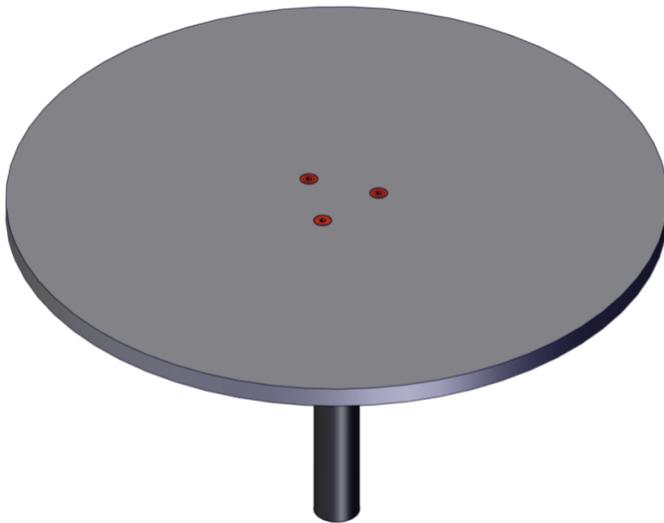
3. Locate the Carousel Axle and align with the screws.



4. Secure the Carousel Axle with Carousel Nuts.

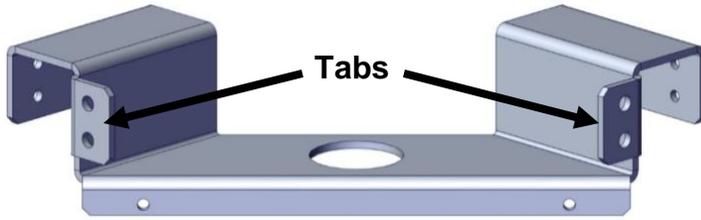


5. Tighten the Carousel Screws and Nuts until snug. Tighten just enough so that the flat heads of the screws sit flush with the top surface of the Platform.

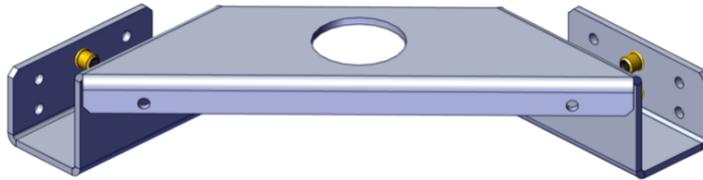


**Note: DO NOT
overtighten screws as
they may pull into and
damage the top surface
of the platform.**

6. Identify the Top and Bottom Carousel Support Brackets. The Top Bracket has additional mounting tabs and the Bottom Bracket does not.

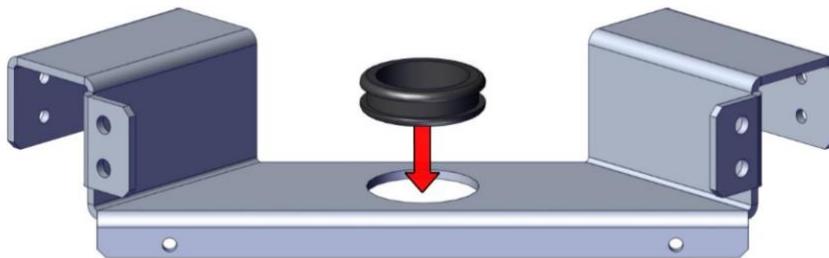


Top Bracket

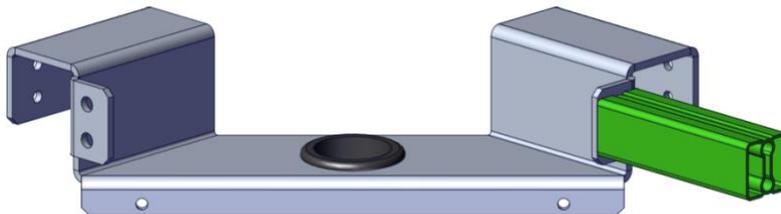


Bottom Bracket

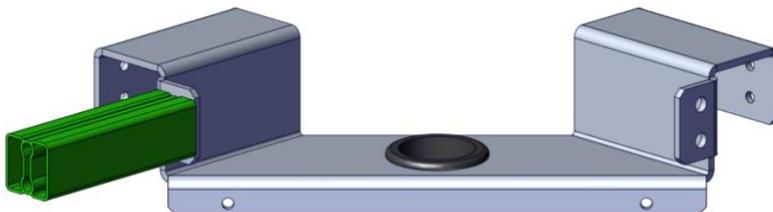
7. Insert a Grommet into the center hole in the Top Carousel Support Bracket.



8. Align the Underneath Sweeper Arm (3.5" long) with the holes in the corresponding brackets. There are two tabs on each Top Bracket. Only one tab on each Top Bracket will be used. The Blue Carousel will use the Right Bracket, and the Red Carousel will use the Left Bracket.

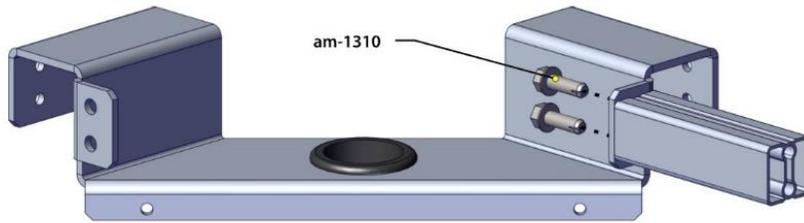


**Blue
Carousel**

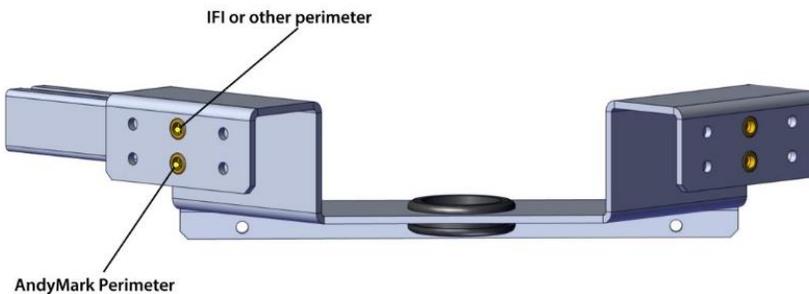


Red Carousel

9. Using two Sweeper Screws, attach the Underneath Sweeper Arm Top to one of the tabs. These are thread forming screws and will carve threads into the Sweeper arm as they are installed.



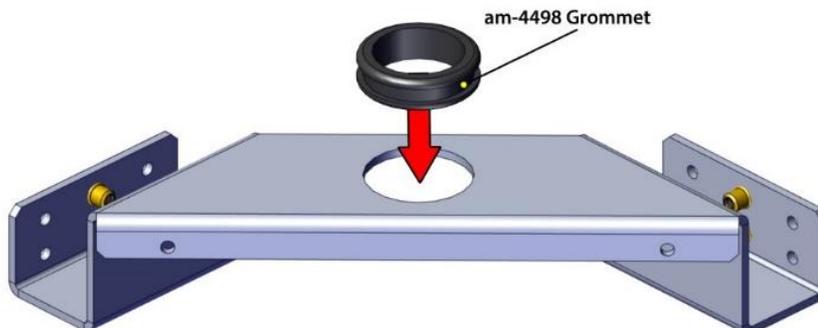
10. There are two rivnut threaded inserts in the center holes on each side of the Bracket. When the Bracket is oriented flat side DOWN, the lower hole is used for attaching to AndyMark Perimeters. For other perimeters, the upper hole is used.



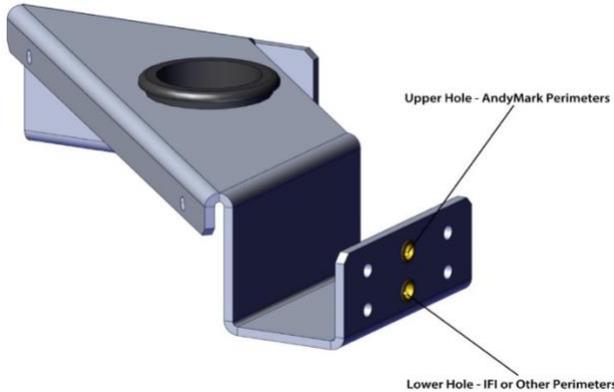
11. Install a pair of thumbscrews into the holes that correspond to the field perimeter type that you are using.



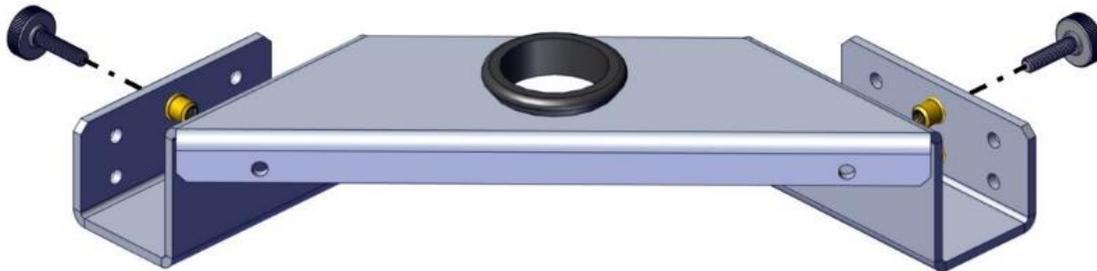
12. Insert a Grommet into the center hole in the Bottom Carousel Support Bracket.



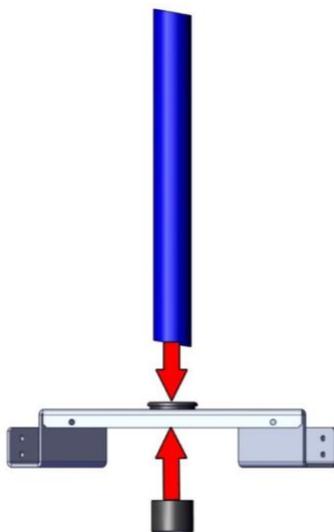
13. There are two rivnut threaded inserts in the center holes on each side of the Bracket. When the Bracket is oriented flat side UP, the upper hole is used for attaching to AndyMark Perimeters. For other perimeters, the lower hole is used.



14. Install a pair of thumbscrews into the holes that correspond to the field perimeter type that you are using.



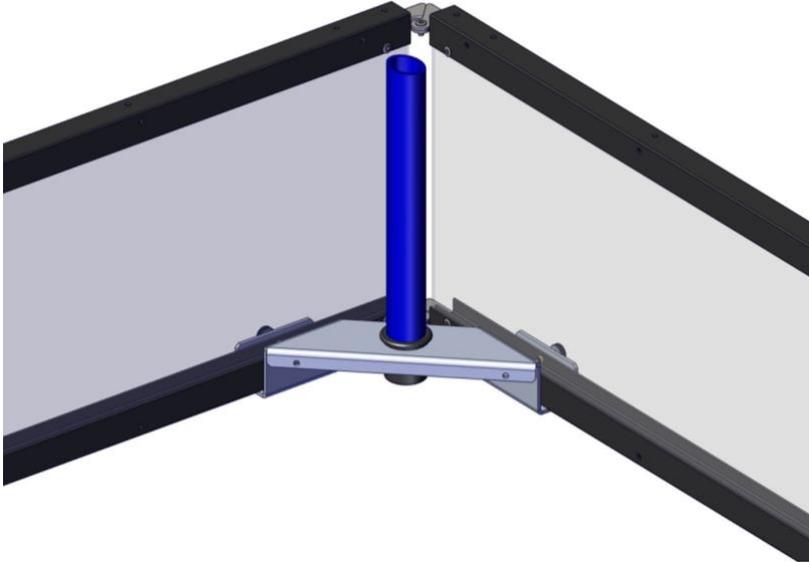
15. Locate the one Pipe Sleeve (Red or Blue) and a Pipe Bottom Cap (black). Push the Pipe Sleeve through the Bottom Carousel Support Bracket. Place the Bottom Cap underneath the Bracket and onto the Pipe Sleeve. Make sure the Bottom Cap is pushed all the way onto the bottom of the pipe. The Bottom Cap sits on the floor.



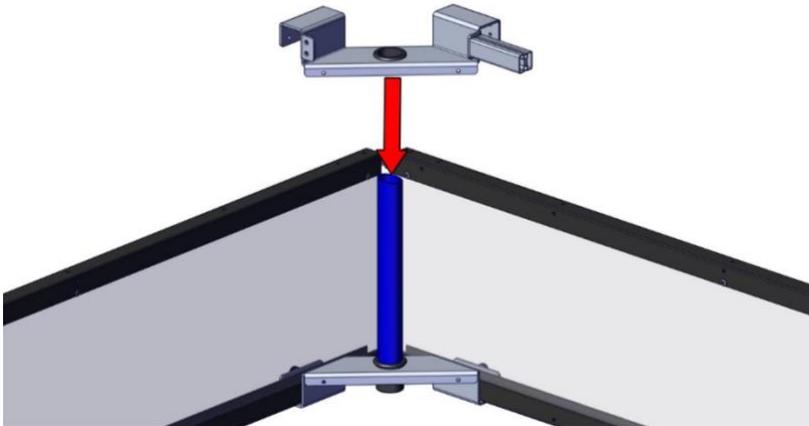
Note: The pipes are tightly held by the grommet and may need to be twisted in order to get them through.

The following steps require use of a Field Perimeter to complete the assembly.

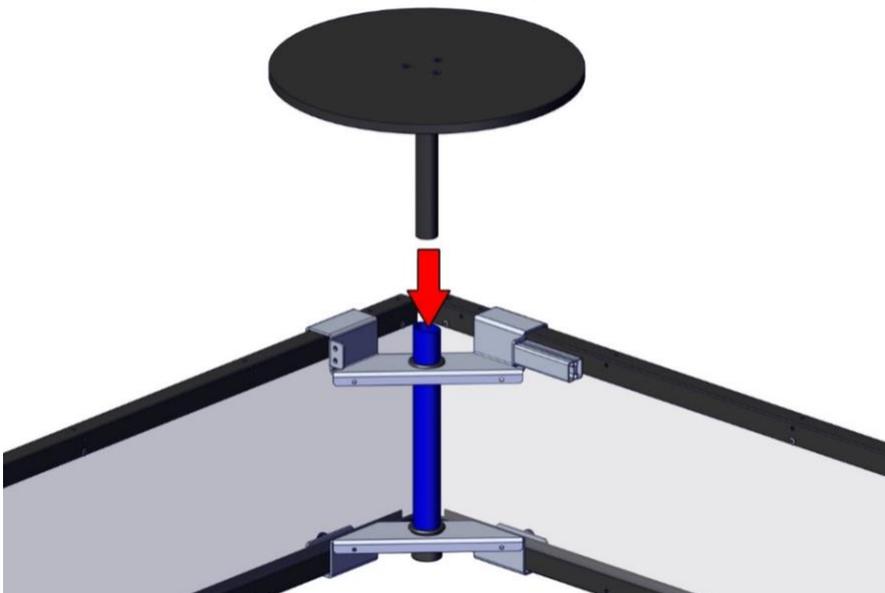
16. Take the Bottom Bracket Assembly and place it underneath the Field Perimeter. Secure to the field perimeter using the Bracket Hardware (thumb screws).



17. Using a twisting motion, slide the Top Bracket Assembly over the top of the Field Perimeter and onto the pipe. Secure to the field perimeter using the Bracket Hardware (thumb screws).



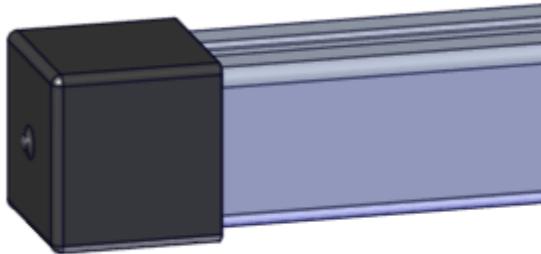
18. Insert the Carousel Platform Assembly into the open pipe.



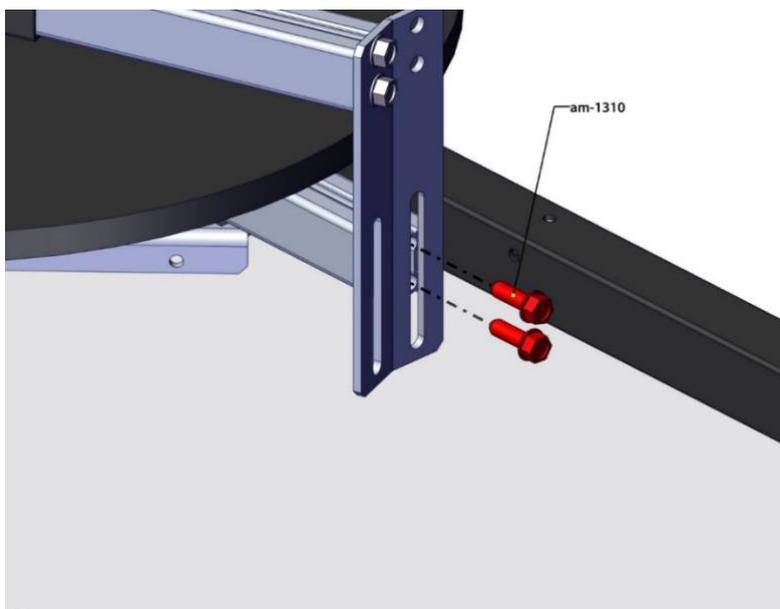
19. Attach the Sweeper Bracket to the Top Sweeper Arm using two Sweeper Screws. The Blue Carousel will use the Left set of holes and the Red Carousel will use the Right set of holes.



20. Press the Sweeper Arm Cap onto the open end of the Top Sweeper Arm.

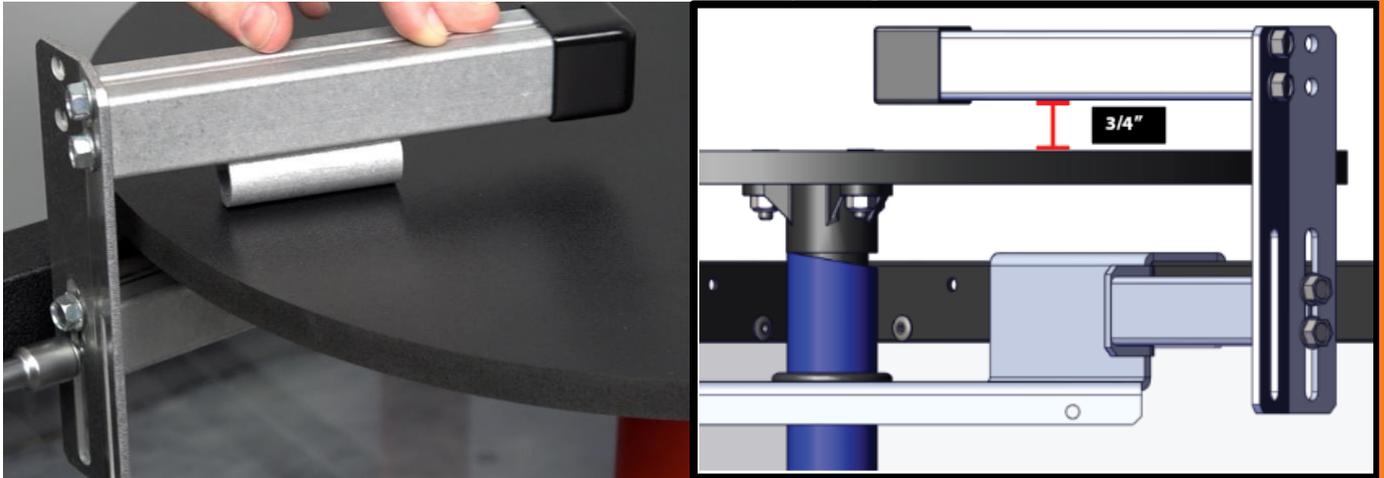


21. Locate the Top Sweeper Bracket Assembly with the Carousel as shown. **Don't tighten the screws yet.** The two Sweeper Screws should be placed through the slot opposite the existing screws (they'll be closest to the wall) so that the Top Sweeper Arm points away from the perimeter wall.

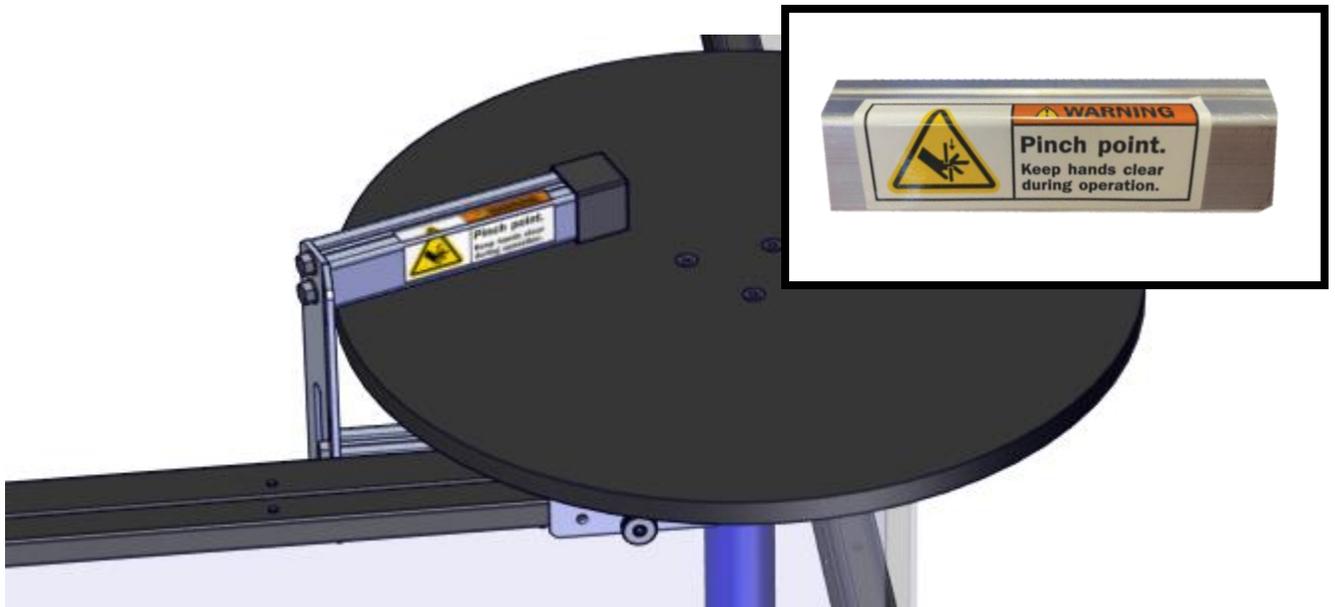


Note: These screws will need to be removed in order to disassemble the Carousel for transport and storage.

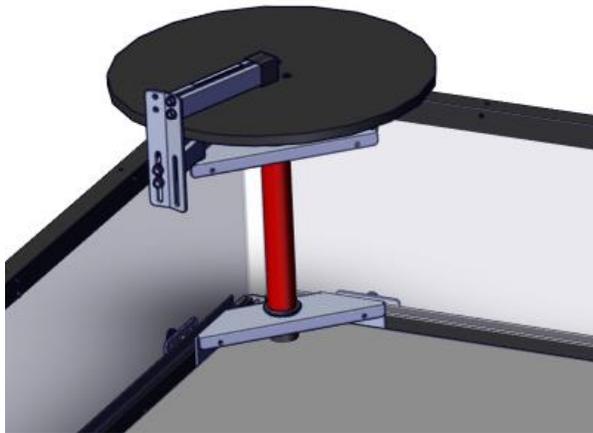
22. Use the Height Spacer to align the Top Sweeper Arm approximately $\frac{3}{4}$ " above the top surface of the Carousel Platform. Tighten the screws once the spacing is confirmed.



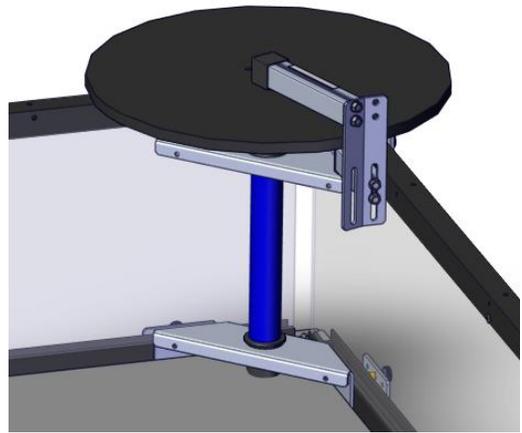
23. Add a Pinch Point Sticker to the Top Sweeper Arm by aligning the bottom of the sticker with the bottom of the Arm. Wrap the warning orange box onto the top surface. The text on the sticker should be viewable to the drive team in their respective red or blue alliance stations.



24. Repeat steps 1-23 of the other color for the opposite corner when assembling a full field.



Red
Carousel

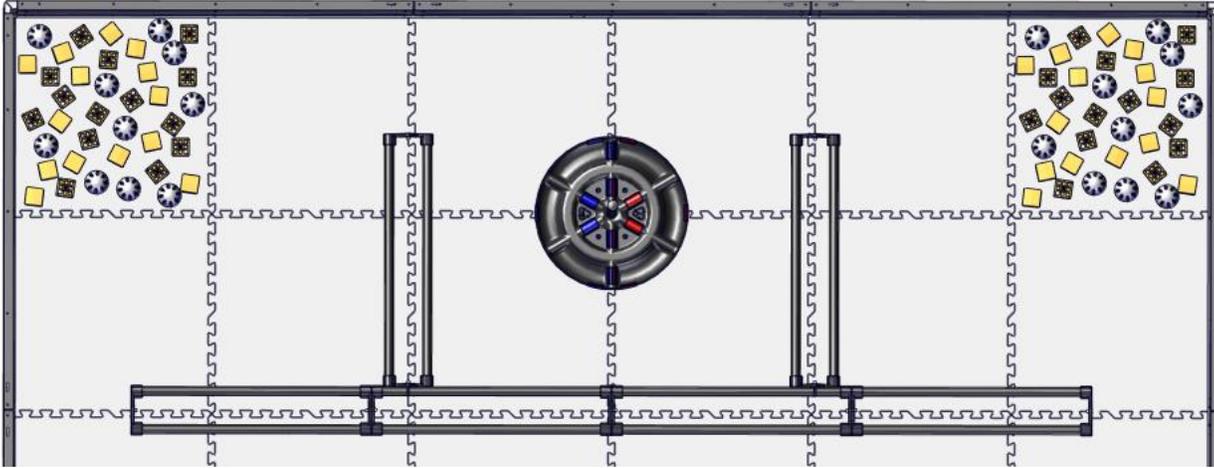


Blue
Carousel

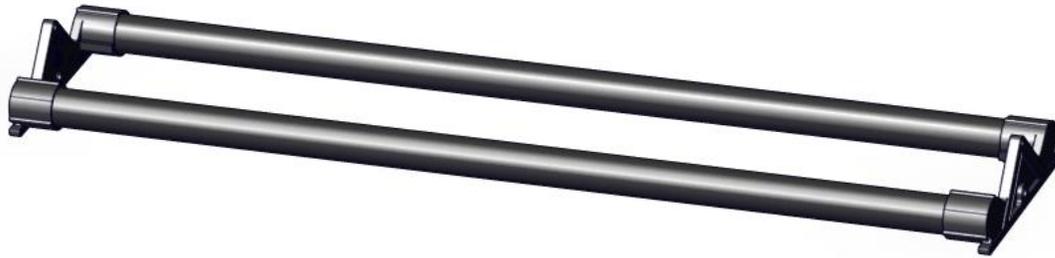
Note: The Sweeper Arm and Bracket Assembly will need to be removed in order to disassemble the Carousel for transport and storage.

Barrier Assembly Instructions

The barrier is made out of two types of pipe assemblies: Vertical and Horizontal. The Vertical Assemblies are longer (29.5 inches) and the Horizontal Assemblies are shorter (28 inches) with respect to the front and back perimeter walls.



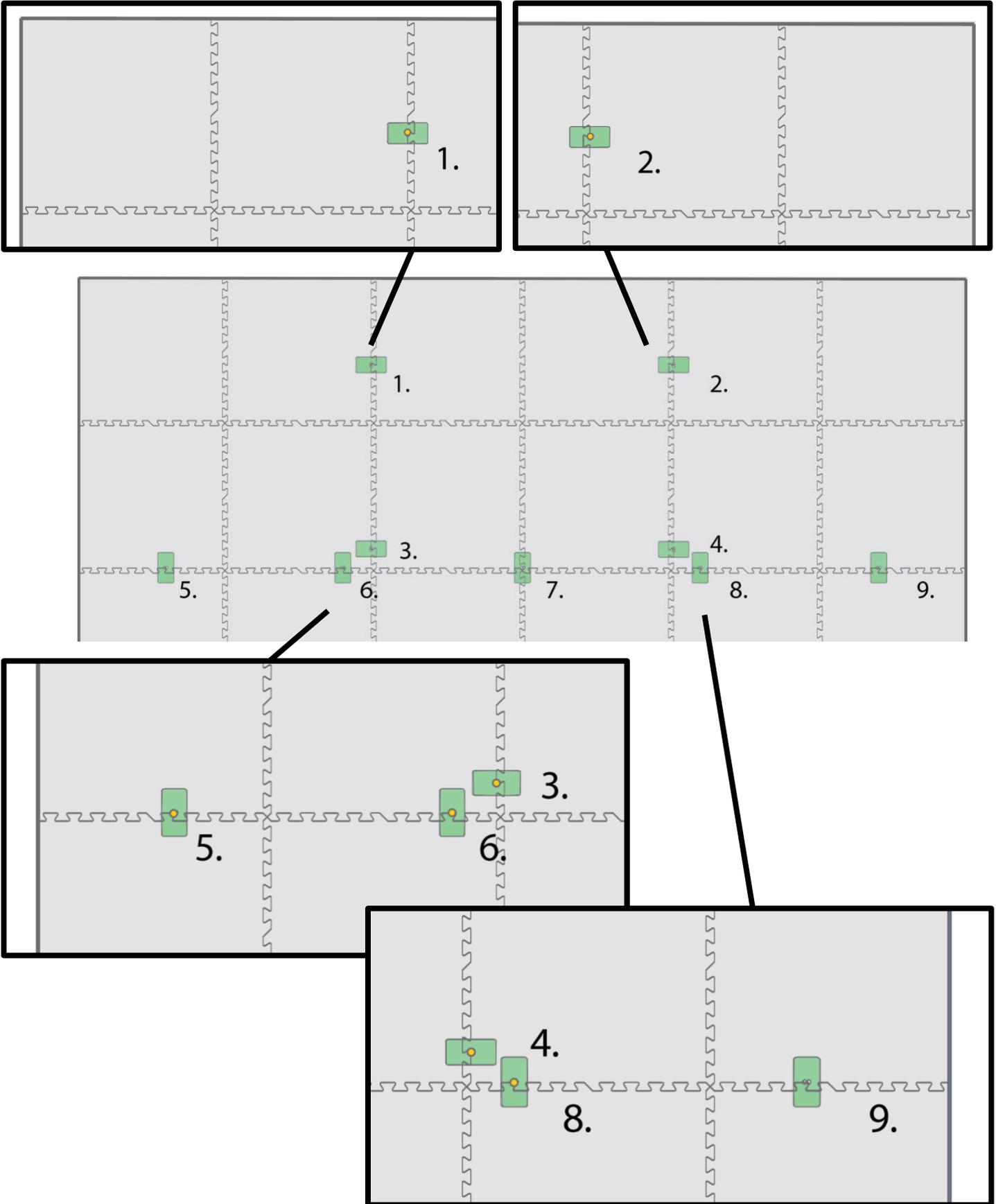
1. Select two pipes of the same length. Press a Barrier Pipe Anchor onto each end to make an assembly. A full field will have 3 Horizontal Barrier Assemblies and 2 Vertical Barrier Assemblies. Repeat this step for all 5 assemblies and set aside.



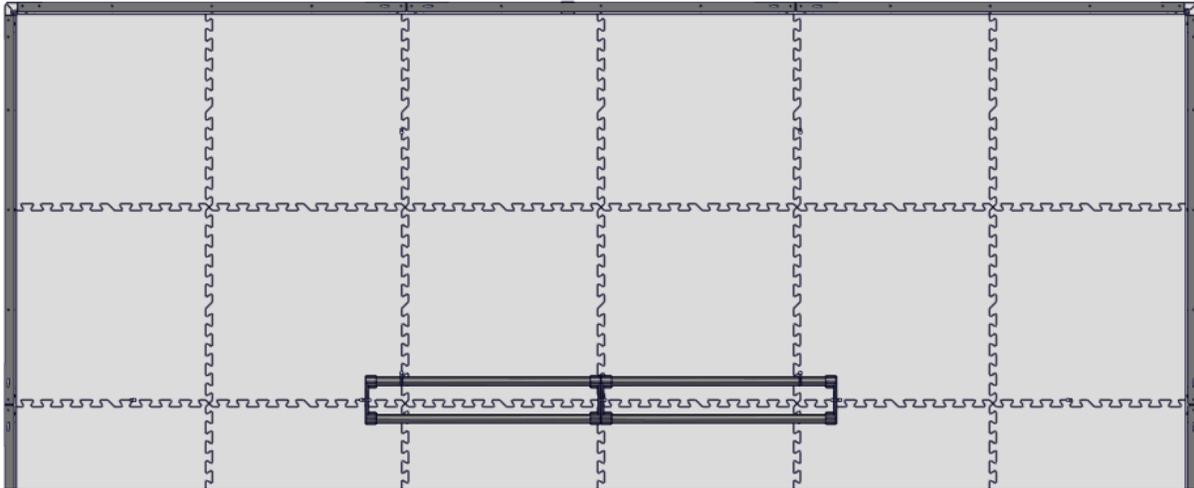
2. A full field uses 9 Under Tile Plates. Prepare the plate by routing a cable tie through the holes as shown. Repeat until 9 plate assemblies are complete.



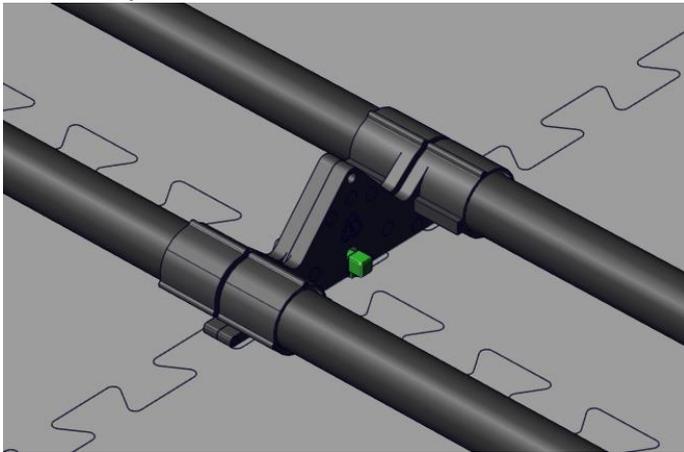
3. Locate the Under Tile Plates between the breaks in the tile with the ends of the cable tie sticking up through the tile. Slide each plate under the tile in the locations as shown.



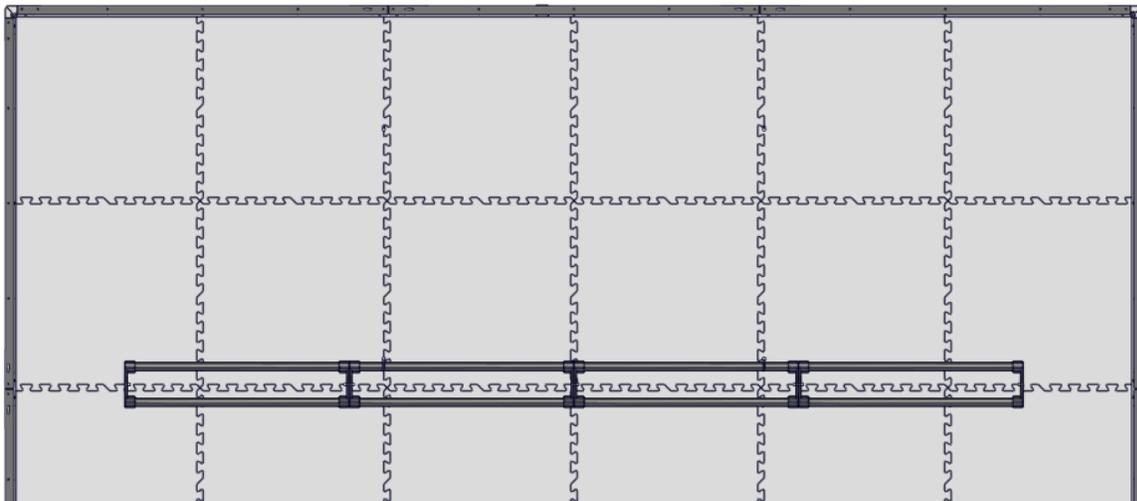
4. Start by laying out the two shorter length Horizontal Barrier Assemblies in the locations as shown. Each end should align with an Under Tile Plate.



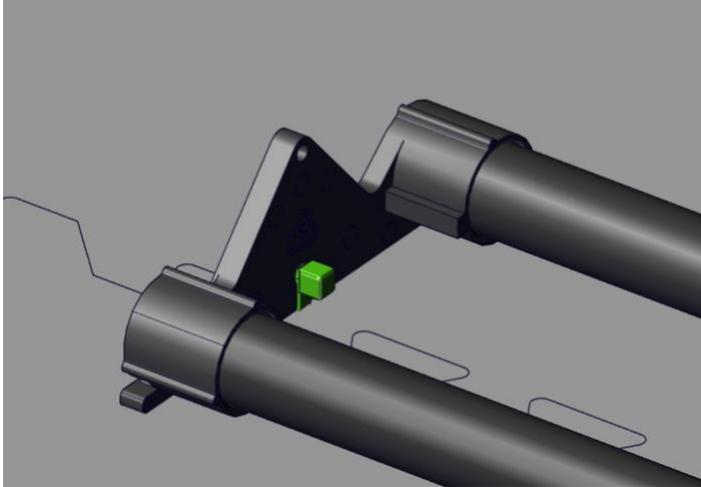
5. **Loosely** route the cable tie from the Under Tile Plate (#7) through the hole in the center Barrier Pipe Anchor.



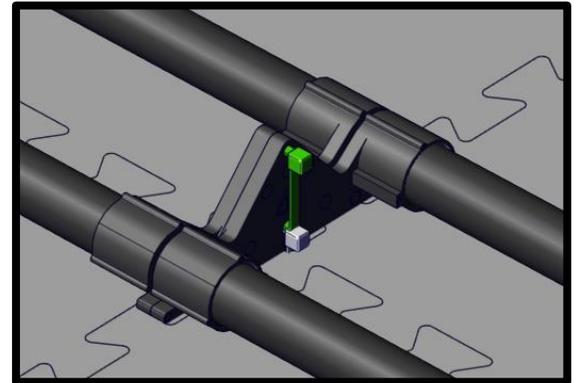
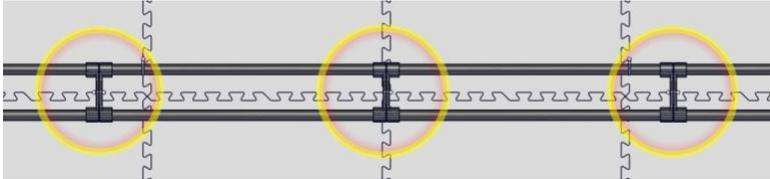
6. Layout a Horizontal Barrier Assembly on each end of the barrier. Each end should align with an Under Tile Plate.



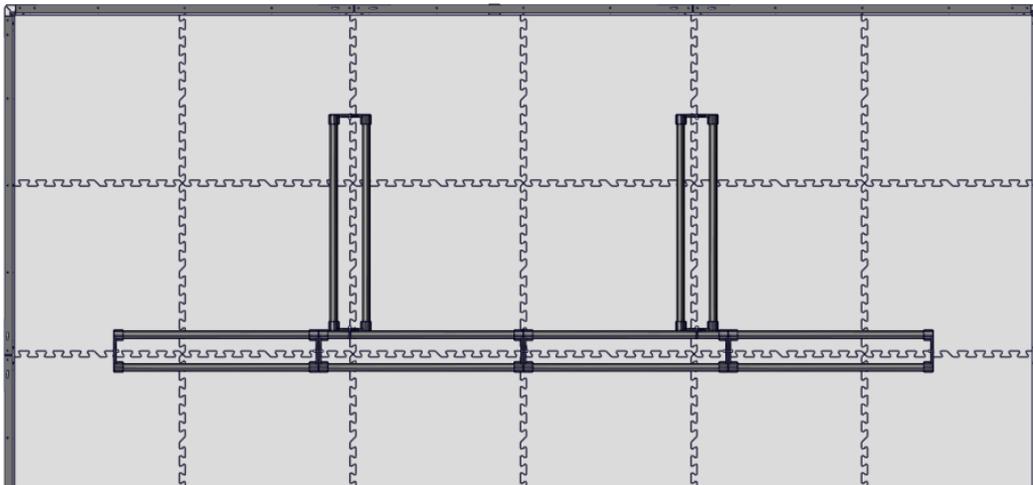
7. Loosely Route the cable ties from the corresponding Under Tile Plates (#5,6,8,9) through the aligned Barrier Pipe Anchors.



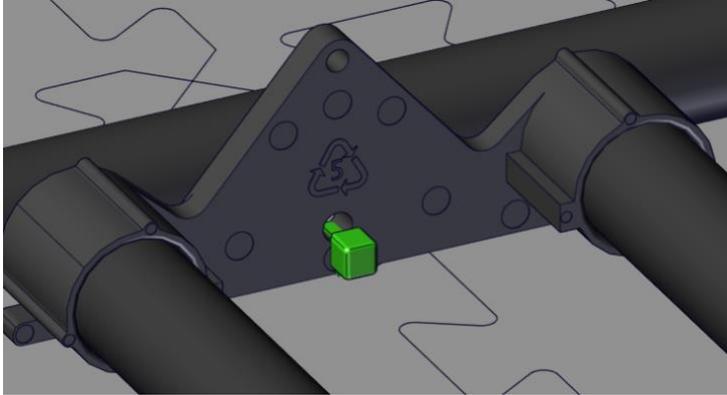
8. Add three additional cable ties to connect adjacent Anchors together.



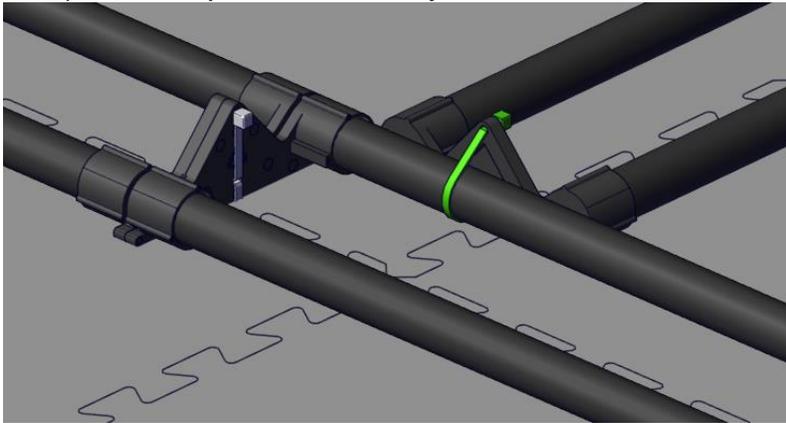
9. Layout the two Vertical Barrier Sections as shown. The anchor should be up against the horizontal pipe.



10. **Loosely** attach the cable ties on the Under Tile Plate (#1,2,3,4) to the adjacent Anchors on the Vertical Barrier Assemblies.

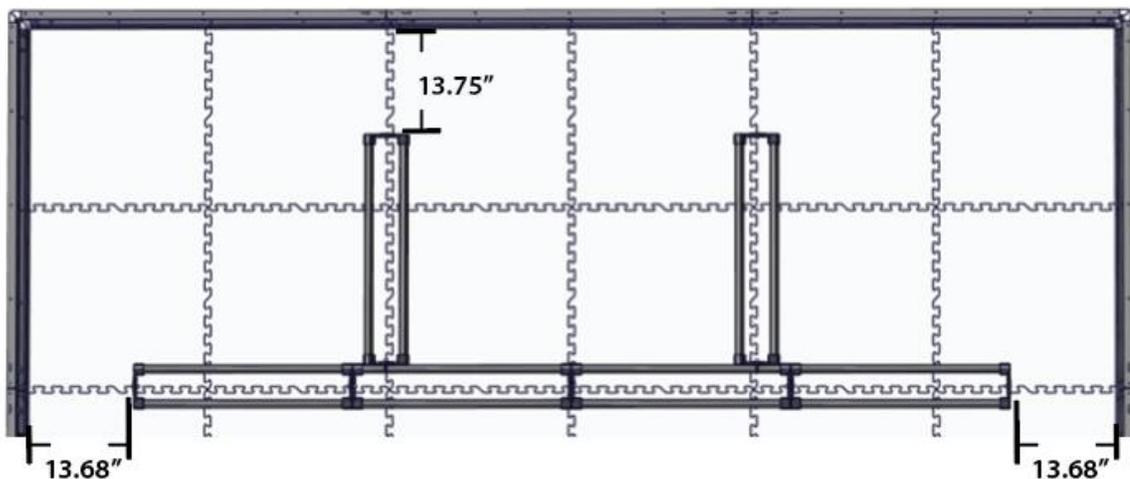


11. **Loosely** add a cable tie from the top hole of the Anchor on the Vertical Barriers (Locations #3,4) and wrap around the adjacent Horizontal Barrier Pipe.



12. **Check the Barrier.** Ensure the Barrier is completely flat on the floor, is aligned straight and parallel to perimeter walls, and evenly spaced between the perimeter walls.

- The distance from the edge of the Vertical Barrier to the edge of the back perimeter wall should measure 13.75" (13 ³/₄").
- The distance from each end of the Horizontal Barrier to the edge of the tiles should measure 13.68" (~13 ¹¹/₁₆")

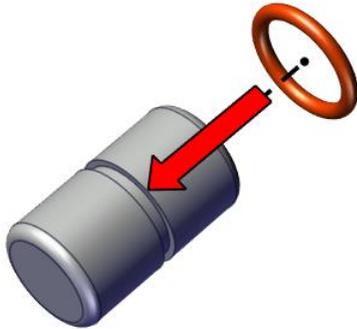


13. Tighten all the cable ties to secure and trim ends.

Making Blocks into Boxes:

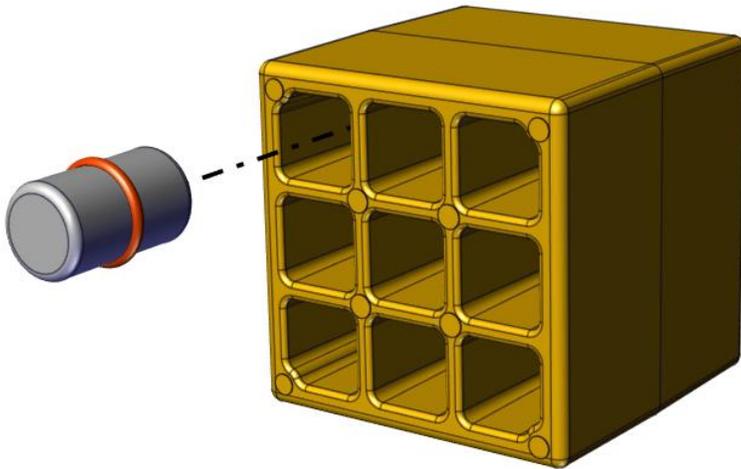
The playing field has 4 types of boxes. Pre-load, Light, Medium, and Heavy. The Medium and Heavy Boxes have weights added to them as shown in the chart below.

Add O-Rings to Weights: Take an O-ring and roll it onto the weight. Ensure the O-ring is well seated in the groove.



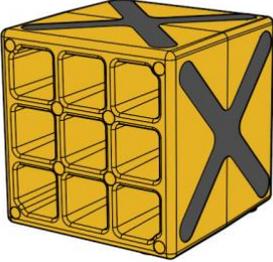
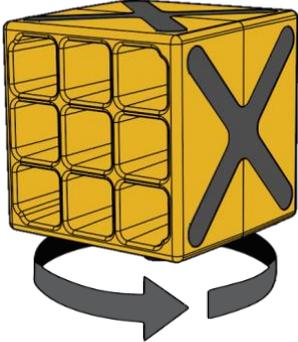
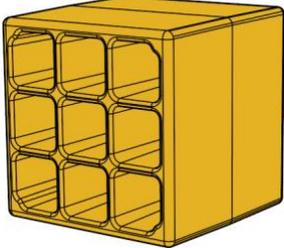
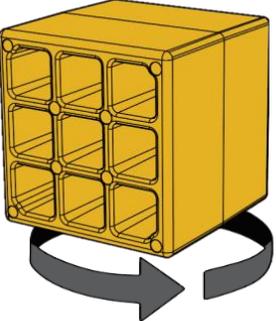
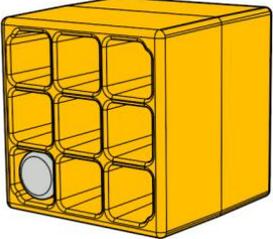
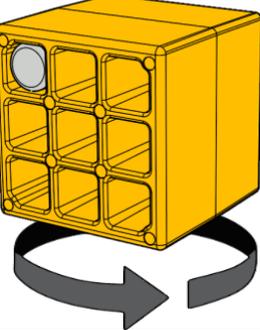
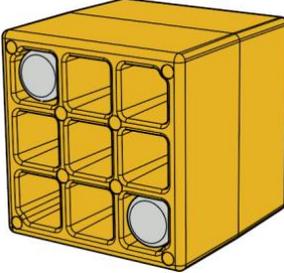
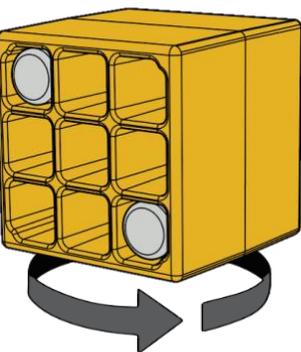
Note: Use your fingernail to press the O-ring into the groove to ensure it stays in place during gameplay.

Carefully press the Weight and O-ring into the block cavity. Ensure the O-ring stays in place in the groove when inserting the weight.



Note: Twisting the weight may be helpful during insertion.

Use the chart to build up enough boxes for gameplay.

Name	QTY per Field	Modification	FRONT	BACK
Pre-load Boxes	4	<ul style="list-style-type: none"> Using a permanent marker, draw two lines from corner to corner to make an X on each of the 4 flat block faces. Leave all cavities empty. A pre-load block marker tool STL file is available for download at: https://www.firstinspires.org/resource-library/ftc/game-and-season-info 		
Light Boxes	26	<ul style="list-style-type: none"> Leave all cavities empty and make no markings on the faces. 		
Medium Boxes	20	<ul style="list-style-type: none"> Place one weight with O-ring in the bottom left corner of the front side. Rotate the block, and place one weight with O-ring in the top left corner of the back side. <p><i>Weights should be in the corners farthest away from each other to balance the weight. There are two weights in each Medium Box.</i></p>		
Heavy Boxes	10	<ul style="list-style-type: none"> Place one weight with O-ring in the bottom right corner, and top left of the front side. Rotate the block and place one weight with O-ring in the bottom right corner, and top left of the back side. <p><i>Weights should be in the corners farthest away from each other to balance the weight. There are four weights in each Heavy Box.</i></p>		

NOTE: The weights can be removed with a small narrow & rigid tool like a small allen wrench.