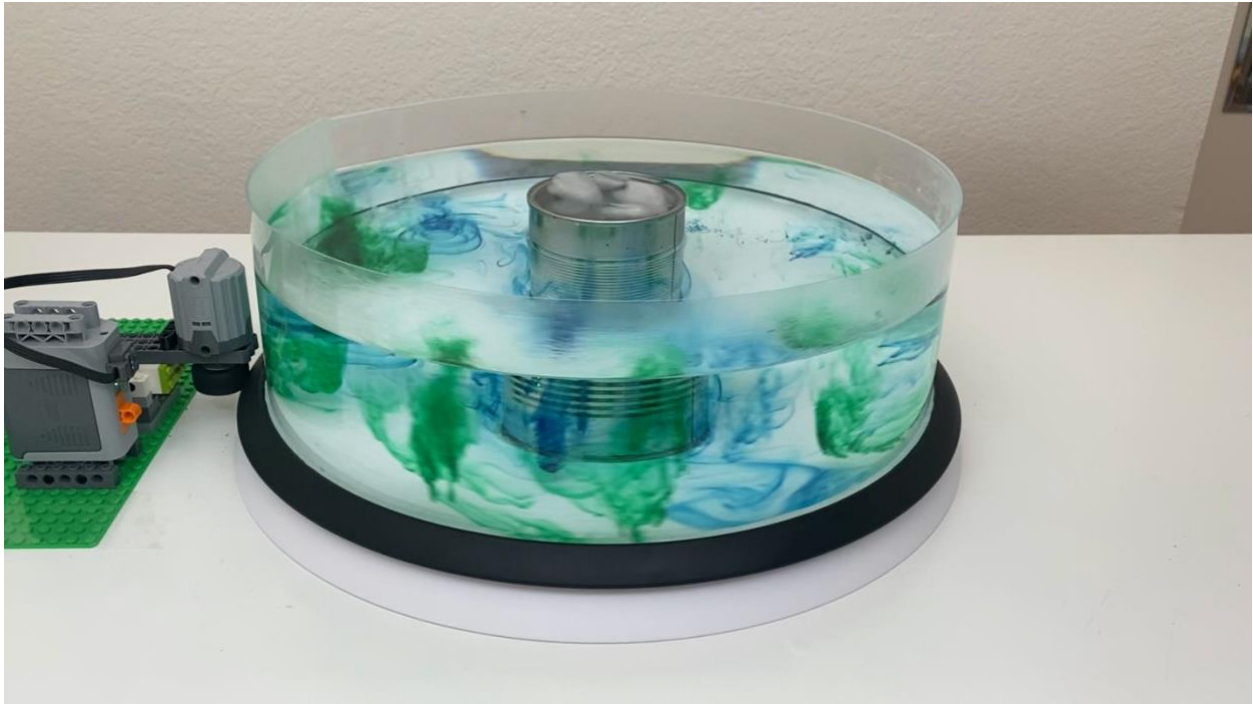


Building the DIY Sidewall Tank



The DIY Sidewall Tank provides an affordable yet effective large cylindrical tank for the DIYnamics LEGO-Based Tables. The DIY Sidewall Tank presents an alternative to the Sidewall Tank. Both approaches affix an acrylic cylinder onto a lazy susan to create an integrated rotating tank platform. The tanks offer greater diameter and height than the default option thus expanding the experimental possibilities of the model.

The Sidewall Tank utilizes a purpose-built acrylic cylinder cast as a single piece. At the time of writing, the component costs in excess of \$100 thus undermining its accessibility. To this end, we introduce the DIY Sidewall Tank! The design utilizes a homemade acrylic cylinder created by bending an acrylic sheet into a cylindrical shape then fastening the ends together. The acrylic cylinder is affixed to the lazy susan creating an integrated rotating tank platform.

Compared to the Sidewall Tank, the DIY Sidewall Tank offers similar dimensions at a fraction of the cost – core components can be purchased for \$40. Note that the Sidewall Tank's sidewall is thicker than that of the DIY Sidewall Tank. As a result, the Sidewall Tank can support equipment such as cameras on its sidewall whilst the DIY Sidewall Tank cannot. Nevertheless, with tools such as [DIYrotate](#), there are options to capture stunning results!

The DIY Sidewall Tank is perfect for experiments that benefit from a large fluid body – e.g. baroclinic instability. Learn how to build the DIY Sidewall Tank [here!](#)

====Read Before Building the DIY Sidewall Tank====

Safety


Follow safety precautions during all steps in building the DIY Sidewall Tank. The process will necessitate using a blade to cut acrylic and handling sealant that emits fumes. Goggles and masks should be worn at all times to prevent small acrylic pieces from reaching your eyes and nose respectively. Wear gloves whilst sanding acrylic to protect your hands. Allow the sealant to cure in a well-ventilated area away from others. Building the DIY Sidewall Tank with a partner will both help maintain safe conditions and facilitate the construction.






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Components

Note that personal protective equipment including goggles, gloves and a mask is not included in the parts list. Household items including a Tape Measure (or ruler long enough to measure 48”), Sharpie, Duct Tape, Scotch Tape and a Table with a Cardboard Cover are assumed to be already available.

Core Components in italics refer to parts that are key to the DIY Sidewall Tank and should not be replaced. Only switch out *Core Components* if an alternative of similar specifications is available. Meanwhile, the remainder of parts can be replaced with household items already on hand that fill a similar role.

| Picture | Part Name | Link and ETA | Quantity |
|---|-----------------------|--|--------------------|
|  | <i>Plastic Cutter</i> | https://www.amazon.com/Fletcher-05-111-Scoremate-Plastic-Cutter/dp/B000LNJYNA/ (ETA <1 week) | 1 (\$6.50 each) |

| | | | |
|---|---|---|---------------------|
|  | 12" x 48" x 1/16" Acrylic Sheet * | https://www.homedepot.com/p/Falke-n-Design-12-in-x-48-in-x-1-16-in-Thick-Acrylic-Clear-Sheet-Falke-Design-ACRYLIC-CL-1-16-1248/308669974 (ETA 1 week) | 1 (\$19.99 each) |
|  | Silicone | https://www.homedepot.com/p/GE-Advanced-Silicone-2-2-8-oz-Clear-Kitchen-and-Bath-Caulk-2709136/100004845 (ETA 1 week) | 1 (\$4.27 each) |
|  | Waterproof Tape | https://www.homedepot.com/p/Gorilla-a-1-88-in-x-9-yds-Crystal-Clear-Tape-60270/204593167 (ETA 1 week) | 1 (\$7.97 each) |
|  | Painters Tape ** | https://www.homedepot.com/p/3M-ScotchBlue-1-41-in-x-60-yds-Original-Multi-Surface-Painter-s-Tape-2090-36AP/202077779 (ETA 1 week) | 1 (\$5.97 each) |
|  | 220 Grit Sandpaper ** | https://www.homedepot.com/p/3M-Pro-Grade-Precision-9-in-x-11-in-220-Grit-Fine-Advanced-Sanding-Sheets-4-Pack-26220PGP-4/205415923 (ETA 1 week) | 1 (\$4.97 each) |

| | | | |
|---|---------------------------------|---|------------------------|
|  | Metal Straight Edge ** | https://www.homedepot.com/p/Empire-48-in-Aluminum-Straight-Edge-Ruler-4004/100118266 (ETA 1 week) | 1 (\$10.97 each) |
| Total Cost | | | \$60.64 |
| Core Components Cost | | | \$38.73 |

* The 12" x 48" x 1/16" Acrylic Sheet features enough material for 2 DIY Sidewall Tanks.

** Alternatives can be used for the Painters Tape, 220 Grit Sandpaper and Metal Straight Edge.

- The Painters Tape temporarily fixes components in place and can be replaced by a strong yet removable tape such as Masking Tape.
- Only a hand sized patch of the 220 Grit Sandpaper is required and other objects for sanding down an edge can be used in its place.
- The Metal Straight Edge provides a guide for cutting and can be replaced by another straight beam.

Note that we recommend the listed parts for the remainder of components.

Instructions

Building the DIY Sidewall Tank can be performed with 1 person. However, the process features steps that are streamlined with 2 people. The steps will be marked with ***.

Step 1: Fix the acrylic sheet onto a table. This involves

- I. Duct taping a cardboard sheet onto the table to prevent scratches during scoring.
- II. Add painters tape to points of attachment on the acrylic sheet to prevent sticker duct tape from directly contacting the acrylic sheet.
- III. Duct taping the acrylic sheet at the points to attachment to the cardboard sheet.

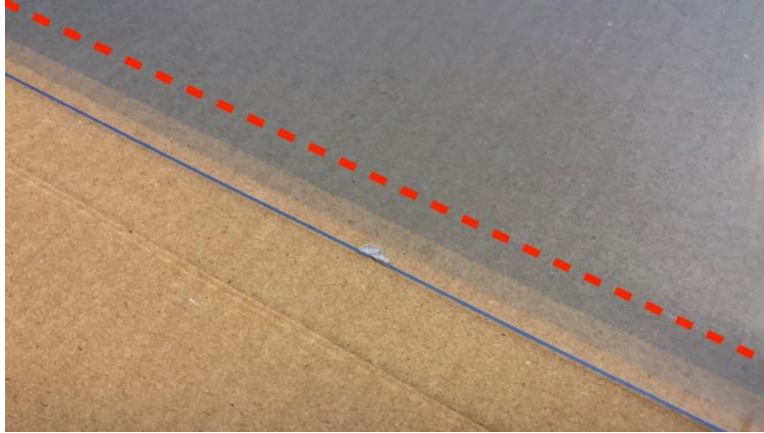


Notice the layering. The acrylic sheet and table are separated by a cardboard sheet to protect the table. The duct tape and acrylic sheet are separated by painters tape to protect the acrylic sheet. Make sure that each layer is firmly in place – shifting during cutting acrylic presents a safety risk.

Step 2: Mark pieces to cut on the acrylic sheet. The goal is to create a single piece that will wrap around to form the sidewall. Thus, the piece must feature a length of the lazy susan circumference and height of the sidewall height. For the OXO Lazy Susan, the circumference is 44.75 in (113.67 cm). We choose a sidewall height of 5 in (12.7 cm) as a compromise – a tall sidewall increases the tank's volume whilst a short sidewall improves the tank's stability. This involves:

- I. If you are using an alternative to the OXO Lazy Susan, calculate the circumference of your lazy susan.
- II. Check for any chips on the edge of the acrylic sheet. Avoid including chips in the piece forming the sidewall – the cracks may propagate once the piece is bent. Options for handling chips include using another or cutting off the edge of the acrylic sheet.
- III. Choose a lengthwise edge of the acrylic sheet to serve as the “clean” edge. The edge is “clean” because it will likely be factory cut thus featuring few imperfections. In turn, we will cut the “rough” edge. Mark a line in sharpie 5 in (12.7 cm) from the “clean” edge down the entire acrylic sheet. Both lengthwise edges will serve as rims of the sidewall.
- IV. Analogous to the lengthwise edges, choose a heightwise edge of the acrylic sheet to serve as the “clean” edge. Within the 5 in (12.7 cm) wide region previously demarcated, mark a line in sharpie the length of the circumference from the “clean” edge.

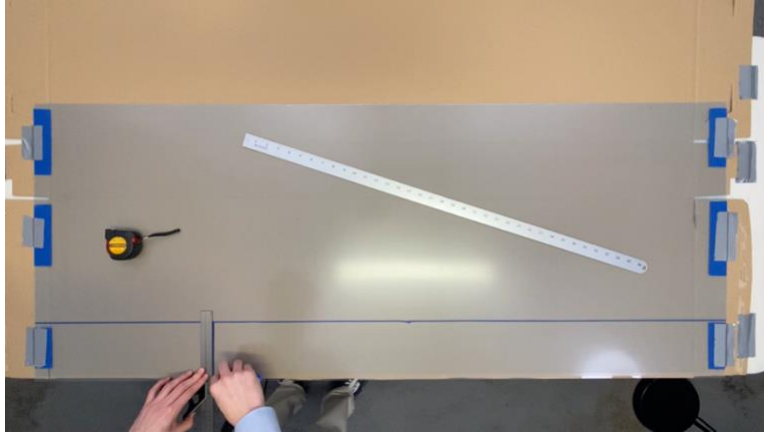
The piece forming the sidewall will feature a length of the lazy susan circumference and height of the sidewall height. If the markings are slightly too large, the piece can always be cut down once you have a better idea of its fit with the lazy susan.



Example of a chip on the edge of the acrylic sheet. Avoid the chip by choosing another edge or cutting to create a new edge slightly inwards – e.g. at the dotted red line. Notice that the acrylic sheet features a protective plastic layer with a blue tint. This is beneficial because sharpie will not be applied directly on the acrylic sheet. If a protective plastic layer is missing, add painters tape on your acrylic sheet before you mark in sharpie.



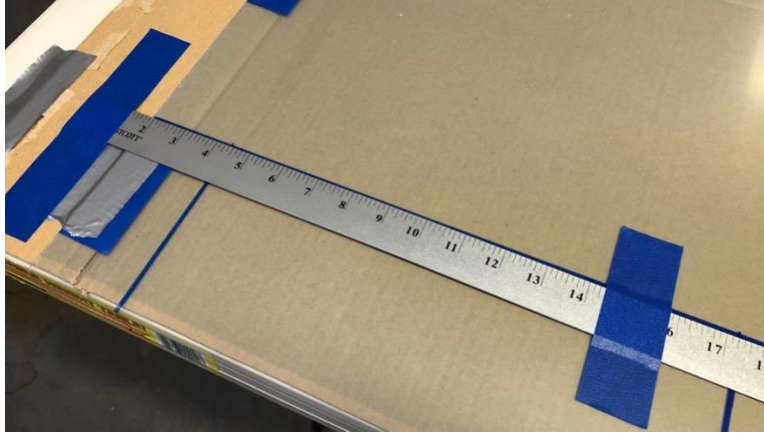
To mark a line parallel to the “clean” lengthwise edge, use a right angle to place guide points exactly 5 in (12.7 cm) into the acrylic sheet. A crooked line will yield a sidewall of uneven height.



The lengthwise and heightwise lines demarcate the piece forming the sidewall. A metal straight edge is useful for creating straight lines and a tape measure is useful for measuring out the circumference of the lazy susan. Note that the acrylic sheet pictured is much larger than but features the same thickness as the option in the parts list.

Step 3: Cut out the piece forming the sidewall from the acrylic sheet. Proceed by 1) performing a lengthwise cut to extract the 5 in (12.7 cm) wide region then 2) performing a heightwise cut to extract the lazy susan circumference length region from 1). This involves:

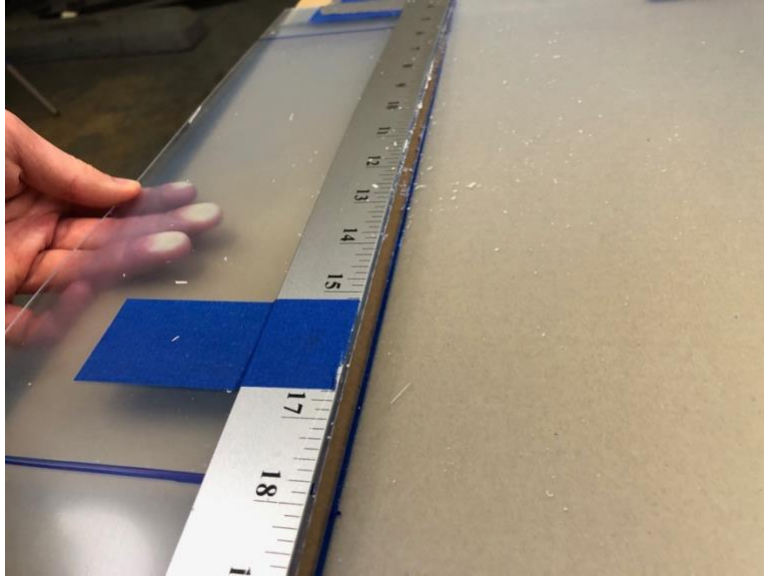
- I. Start from an end of the lengthwise line. Align the metal straight edge with an edge of the line – not to the middle of the sharpie markings. Make sure that the metal straight edge is located between the line and yourself. Fix the metal straight edge in place with painters tape onto the table or acrylic sheet.
- II. Use the plastic cutter to score or repetitively slice along the metal straight edge until entirely through the acrylic sheet. This process will require on the order of 100 scores per cut. When scoring, to maintain safety, be sure to never place your hand in the path of the blade or prospective path if it were to slip. In addition, make sure the ergonomic situation is comfortable before committing to making the cut. Furthermore, wear a mask to prevent accidental inhalation of particles.
- III. The metal straight edge may be shorter than the lengthwise line. To complete the cut, repeat I. and II. for the remainder of the lengthwise line.
- IV. Remove the extra material (region of the acrylic sheet outside of the prospective sidewall) from your workspace. Fix the 5 in (12.7 cm) wide region in place and perform I. and II. for the heightwise line.



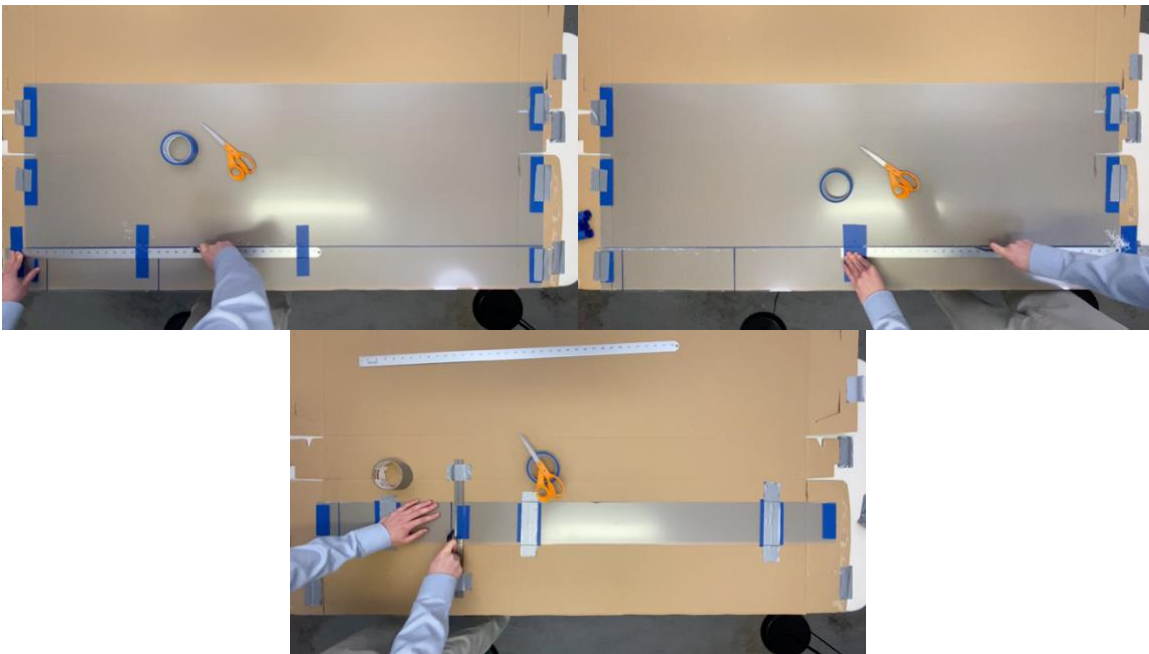
Starting from an end, align the metal straight edge to an edge of the line. This ensures that the cut remains parallel, rather than at an angle, to the “clean” edge. Use painters tape to fix the metal straight edge in place.



Scoring consists of dragging the plastic cutter along the metal straight edge and applying pressure to carve material from the acrylic sheet. In the direction comfortable for you, pull the blade back repetitively. Note that your hand should always be ahead or out of the potential path of the blade.



Continue scoring until you have cut entirely through the acrylic sheet.



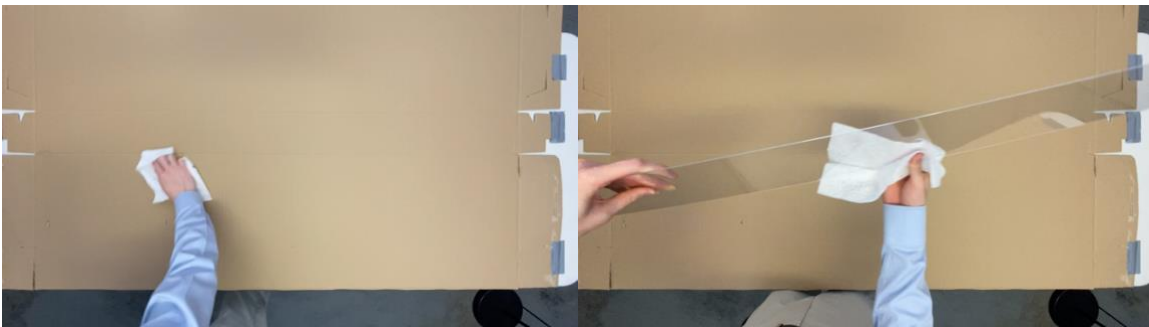
Extract the piece forming the sidewall by cutting lengthwise then heightwise regions. For the lengthwise cut, note that it runs along the entire acrylic sheet rather than the length of the circumference. This prevents scratches or other damage to the extra material for future use. For the heightwise cut, a smaller metal straight edge may be useful.

Step 4: Sand (with 220 grit sandpaper) the “rough” edges of the piece forming the sidewall for a smooth and safe finish. Else, the recently cut edges may remain sharp posing safety issues during handling. To maintain safety, wear gloves and a mask to protect against the sharp acrylic edge and acrylic particles in the air respectively.



Before sanding the piece forming the sidewall, remove the protective plastic layer and any other coverings – e.g. tape. Use a hand sized patch of 220 grid sandpaper to sand the “rough” or recently cut edges of the sidewall piece until dull.

Step 5: Clean up your workspace and the sidewall piece to remove as much waste acrylic as possible. Particles on the surface of the sidewall piece will become stuck under the waterproof taping. This may disrupt the connection thus undermining the waterproof seal. Further checks will be made down the line to ensure that the sidewall piece is clean.



Use a Swiffer sweeper or microfiber cloth to wipe both the workspace and sidewall piece as best as possible.

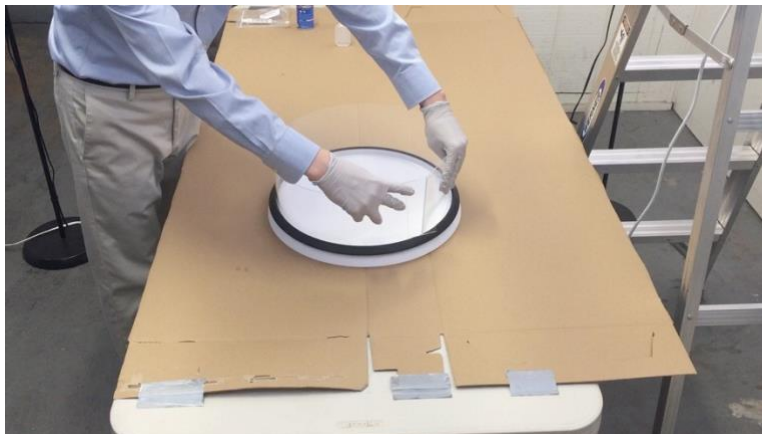
Step 6: Bend then place the sidewall piece into the lazy susan. Check the fit of the sidewall piece with the lazy susan for any last-minute changes before waterproof tape and silicone are applied. The goal is for the sidewall piece to match the lazy susan circumference as close as possible whilst remaining able to close the loop within. This will help the homemade acrylic cylinder retain a cylindrical rather than teardrop shape. This involves:

- I. The sidewall piece, consisting of sheet acrylic, is bendable along its length. Using your hands, bend the sidewall piece such that the ends are only several inches away from each other. The sidewall piece is now in a “C” shape.

- II. Slot the “C” shaped sidewall piece into the lazy susan starting from the curved middle. Specifically, place the curved middle within the rim of the lazy susan and gradually continue bringing in the sidewall piece along both sides until you reach the ends.
 - III. Complete the loop by placing the ends of the sidewall piece within the lazy susan rim. Check the contact. If there is an overlap, use a sharpie to mark the region and follow step 3. to cut excess material.
- Remove the sidewall piece after fitting.



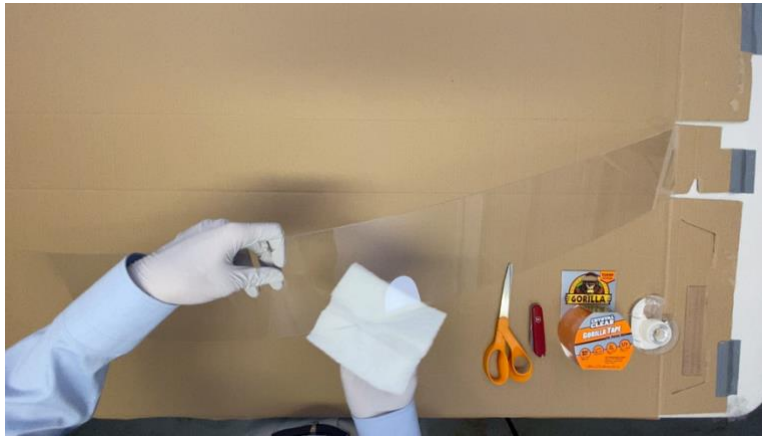
The sidewall piece is thin enough to bend into the shape of the lazy susan. We bend then place the sidewall piece into the lazy susan to gauge its fit before connections are made. The sidewall piece is fixed within the lazy susan because the latter features a raised rim. Nevertheless, until its ends are connected with waterproof tape, do not allow the sidewall piece to rest inside the lazy susan without support.



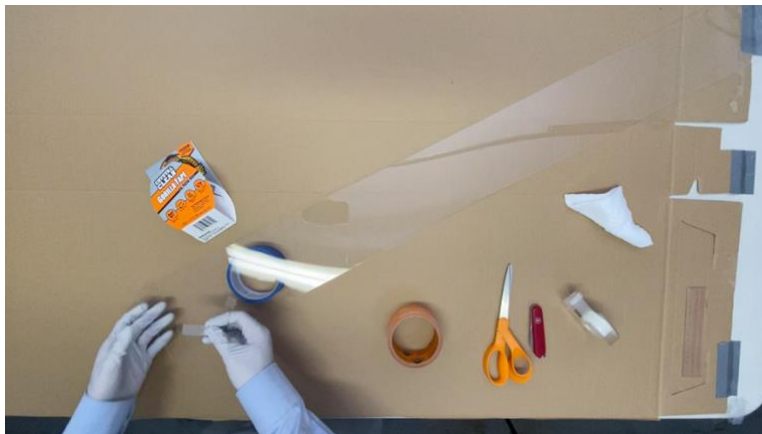
Once the loop is completed within the lazy susan, check for any overlap between sidewall piece ends. The ideal situation is for sidewall piece ends to continue along the same curve rather than overlapping (too long) or forming a teardrop shape (too short).

Step 7*:** Apply waterproof tape to tape both ends of the sidewall piece together from the outside. This will create a teardrop shaped loop that remains connected and can be slotted into the lazy susan – the homemade acrylic cylinder. This involves:

- I. Clean the sidewall piece again to minimize debris sticking on its surface. Debris is detrimental because it creates air pockets under the tape. The air pockets may allow water to collect or create air pockets in subsequent layers thus undermining the tape's connection.
- II. Use waterproof tape to connect both ends of the sidewall tank together from the outside. This seal will not directly contact water but will be key for maintaining the shape and integrity of the homemade acrylic cylinder. The goal is to establish as tight and robust of a connection as possible. A tight connection will help maintain shape because little sway ensures that the cylindrical loop does not develop a bow once placed in the lazy susan. A robust connection will help maintain integrity because the design relies on the outside tape to keep ends of the sidewall piece together – the inside tape is intended for waterproofing. Details on applying waterproof tape tightly and robustly can be found below.



Use a Swiffer sweeper or microfiber cloth to wipe the sidewall piece as best as possible.



Wiping the sidewall piece with a cloth can remove the majority of debris sticking on the surface. However, for a final check, tap the ends of the sidewall piece with scotch tape

before applying waterproof tape. The scotch tape, sticky yet removable, will capture remaining particles on the surface of the sidewall piece.

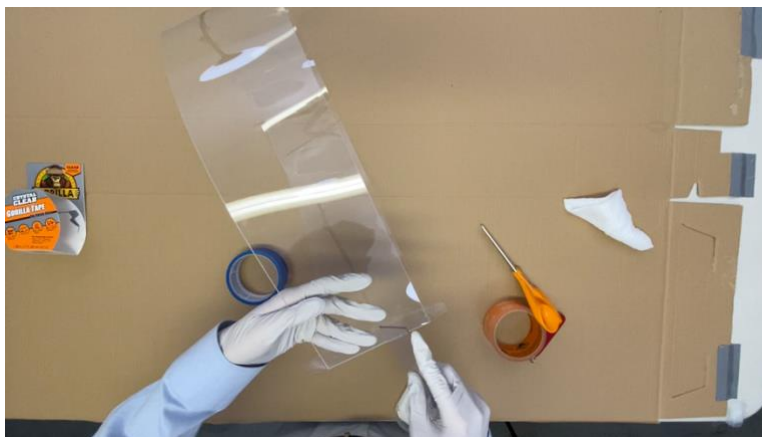


The goal of this step is to tightly and robustly tape the ends of the sidewall piece together to create a teardrop shaped loop. Establish a tight connection by holding then taping the ends of the sidewall piece together such that the joined acrylic sheet forms a gentle curve rather than an abrupt angle. This will minimize the tolerance thus providing little flexibility for the homemade acrylic cylinder to develop a bow shape. Note that this task is best performed with 2 people – one to hold the sheet acrylic in place and one to tape the connection. Establish a robust connection by applying waterproof tape in overlapping layers that alternatively span the connection and support the layers spanning the connection. The redundancy is intended to keep the ends of the sidewall piece together even if water begins leaking.





Here is the taping strategy adopted for the DIY Sidewall Tank prototype – each color represents a layer. Waterproof tape is applied in successive layers that either span the connection or support the layers spanning the connection. Note that the layer annotated in red is wrapped around both the outside and inside of the homemade acrylic cylinder.



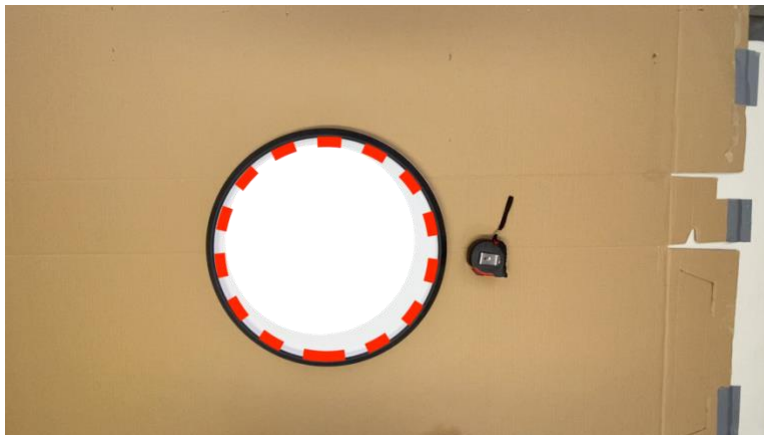
When working with layers of waterproof tape, air pockets below propagate upward. After each application of waterproof tape, use a straight edge (e.g. ruler) to smooth and push out any air pockets in the layer. Some air pockets will be impossible to remove but address as many as possible.

Note: Be ready to perform steps 8 through 11 in succession. The silicone will remain pliable for approximately 5 to 10 minutes and will cure over several hours. Nevertheless, it is best to work with the sealant when fresh. Wear a mask and work in a well-ventilated area to mitigate silicone fumes.

Step 8: Apply a ring of silicone on the floor of the lazy susan along its rim. This serves to establish a bond between the rim of the lazy susan and the outer side of the homemade acrylic cylinder. The silicone should form a consistent stream at least a drinking straw in diameter. Note that excess silicone is better than not enough silicone.



Silicone is packaged in squeeze tubes amongst other containers. Prepare the squeeze tube by cutting off the tip of the applicator.



Silicone will be applied twice to form redundant seals – outer and inner. Here, we bond the rim of the lazy susan to the outer side of the homemade acrylic cylinder. Follow the edge between the rim and floor of the lazy susan – marked in red. Later, we bond the inner side of the homemade acrylic cylinder to the floor of the lazy susan. Note that the prototype DIY Sidewall Tank omits the prior silicone application.

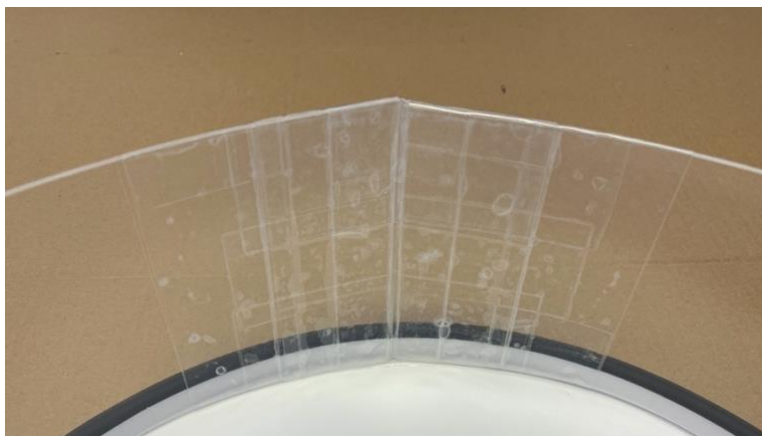
Step 9: Slot the homemade acrylic cylinder into the lazy susan. In a manner similar to step 6, slide in the teardrop shaped loop by starting from the curved middle then gradually bringing in both sides until completely in. Proceed with the “clean” edge down – the factory cut will be straight thus minimizing gaps between the homemade acrylic cylinder and lazy susan. Press down to ensure that both components are flush.



After prior calibration, the homemade acrylic cylinder should fit snugly. Ideally, the teardrop shaped loop will fill the lazy susan such that the prior's outer side is flush with the latter's rim – the ends of the sidewall piece may be slightly inwards. Note that the green ring marks the upcoming bond between the inner side of the homemade acrylic cylinder and floor of the lazy susan.

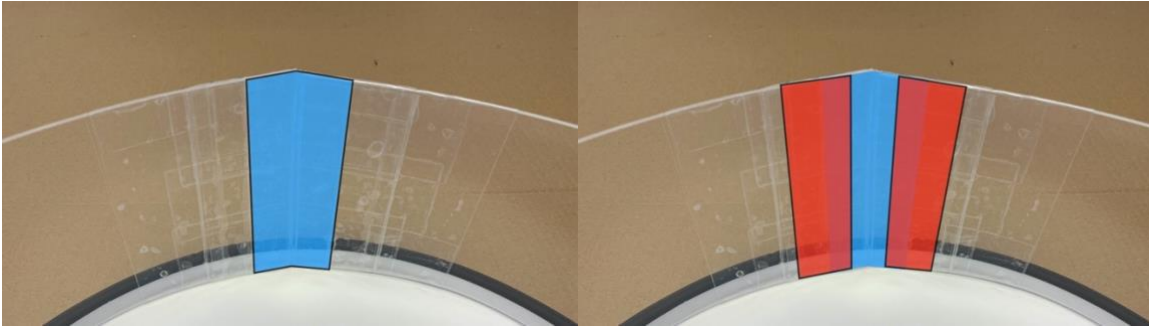
Observe the bowing in the overhead view. The slight distortion occurs because the lazy susan rim holds the teardrop shaped loop in a cylinder at its bottom but not its top. Check out the Follow Up and Troubleshooting section for potential solutions to mitigate bowing.

Step 10: Apply waterproof tape to tape both ends of the sidewall piece together from the inside. This will create a waterproof seal that prevents the tank's contents from reaching the multiple layers of waterproof tape that support the homemade acrylic cylinder from the outside. Follow the procedure highlighted in step 7 of cleaning then taping.



The goal of this step is to ensure that the inner side of the homemade acrylic cylinder is contiguous. Waterproof tape applied to the outer side is effective for maintaining shape and strength. However, the connection features gaps in the inner side. This

disjointedness exposes adhesive to the tank's contents leading to eventual failure. Thus, we add waterproof tape to close the gaps from the inner side.



Here is the taping strategy adopted for the DIY Sidewall Tank prototype – each color represents a layer. Layering is employed to provide additional support. Note that the waterproof tape is applied from the bottom to the top of the homemade acrylic cylinder – the waterproof seal must extend the entire height. When taping the connection between ends of the sidewall piece, proceed by completely taping one lengthwise half of the piece to one end then carefully taping the other half to the other end. This helps ensure that the waterproof tape covers the gaps as closely as possible.

Step 11: Apply a ring of silicone along the contact between the inner side of the homemade acrylic cylinder and the floor of the lazy susan. Use a finishing tool to smooth the silicone such that the corner gently transitions from the homemade acrylic cylinder to lazy susan faces – a la caulking around sinks. Note that the [Sidewall Tank video guide](#) features an informative overview of using silicone.



The bond is responsible for preventing the tank's contents, potentially 3.5 gal (13.25 L) of liquid, from leaking through the bottom. Thus, be generous when applying silicone to ensure that the entire contact is covered – the DIY Sidewall Tank prototype features a pencil diameter stream of sealant.



The silicone is extruded from the squeeze tube in blobs. Thus, the stream may protrude or fail to entirely cover the contact. A finishing tool refers to a panel that features a patterned corner to shape silicone or other like substances. The end of the silicone squeeze tube may already include a finishing tool and you can easily create one yourself. Use a finishing tool to smooth out the imperfections and form a clean transition between the homemade acrylic cylinder and lazy susan. The process has the added benefit of pushing silicone into the contact thus improving the seal. Check out the Sidewall Tank video guide for further details on finishing.

Step 12: Allow the silicone to cure. Although the silicone squeeze tube mentions that the product is water ready in 30 min, we recommend leaving the silicone for several hours (ideally overnight) due to the copious amounts applied and the importance of a strong bond. To avoid breathing in silicone fumes, set aside the DIY Sidewall Tank away from others.

Step 13: The DIY Sidewall Tank is now ready to use! The DIY Sidewall Tank greatly expands the capabilities of the DIYnamics LEGO-Based Tables by offering large diameter and height. This is beneficial for many fluid dynamics experiments because fluid structures become clearly visible and less constrained. Learn more about potential experiments on our [YouTube channel](#)!

Follow Up and Troubleshooting

Generating Rotating Frame Results: Assuming the rotating frame, or perspective of an observer rotating with a system, is ideal for studying geophysical fluid dynamics. The perspective abstracts away rotational movement thus isolating fluid motions of interest. In contrast, the stationary frame refers to the perspective of an observer fixed as the system rotates.

The sidewall of the DIY Sidewall Tank is too thin to support equipment such as the [Gooseneck Camera Clamp](#) for mounting cameras. Nevertheless, a convenient option for generating rotating frame results is to capture stationary frame footage then apply [DIYrotate](#) to programmatically remove rotational movement. Learn more about the DIYrotate workflow [here](#)!

Reducing Bowing: As seen in the above overhead views, the cylindrical DIY Sidewall Tank may warp and develop a bow. This occurs because the homemade acrylic cylinder is unequally supported at its bottom and top – the lazy susan compresses the teardrop shaped loop into a cylindrical shape at its bottom whilst the top is unconstrained. We believe that bowing can be reduced by adding support to the top. Snugly wrap a daisy chained link of [zip ties](#) or a [band clamp](#) around the top. Both options will act as a belt compressing the homemade acrylic cylinder to help retain its cylindrical shape. Another potential option is to warp the connection between ends of the sidewall piece into shape using a hair dryer or heat gun.

Removing Silicone: Silicone is convenient because the sealant holds yet is entirely removable if needed. Remove silicone by using a knife to slice into the stream then peel away. Any remaining silicone can be rubbed off with a paper towel.

Fixing Leaks: Water bubbling between the outer side of the homemade acrylic cylinder and the rim of the lazy susan is a telltale sign of a leak. Patching the gap in the contact is the only option for fixing leaks. To find the leak, it may be helpful to fill then drain the tank with dyed water. The coloring will remain trapped in the gap in the contact. Mitigate leaks by allowing the DIY Sidewall Tank to dry then applying more silicone to the source.