

2026-27 FTC / BIOBUZZ

Build the robot, one assembly at a time.

A student-friendly companion for the REV DUO FTC Starter Bot using the FTC Starter Kit V3.1. Seven assemblies, 38 staged tasks, and a pause-and-check question at every stage.

Use REV's official PDF for every exact bracket direction, hole, shaft stack, and fastener placement. This booklet summarizes the work; it does not replace the manufacturer guide or competition rules.

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Before cutting, machining, powering, or firing: work with a mentor. Isolate power for adjustments, guard moving parts, use a clear lane and backstop, and confirm Driver Station STOP.

[Open the official REV 2026-27 build guide PDF](#)

ASSEMBLY 01 / REV PAGES 2-40

Prepare the parts

Prepare the shared parts first. Put each completed subassembly in a labeled tray so the three crews can work without losing its spacers or fasteners.

01 / Sort the real kit

Parts: Starter Kit V3.1, Control Bundle, 2 mm grid polycarbonate, bins or trays

1. Match the delivered labels against the official bill of materials. Separate the drive, pusher, intake, feeder, and launcher parts.
2. Set aside the Control Hub, battery, switch, and servos for the assemblies that need them. Mark any missing or different part before continuing.

Pause and check: Can another crew identify each tray without guessing?

[REV diagram - PDF page 2 - open source](#)

02 / Prepare extrusion and shafts

Parts: 15 mm extrusion, 5 mm hex shaft, measuring tools, clamps, adult-approved cutting tools

1. A mentor uses the cut list to prepare the specified lengths. The guide calls for 323, 278.5, 248, 83, 70, 63, and 218 mm extrusion pieces in different quantities.
2. Prepare two 308 mm intake shafts and two 252 mm shafts for the launcher and feeder. Label each cut piece by length and destination.

Pause and check: Are the cut ends safe, lengths labeled, and every piece matched to the PDF cut list?

[REV diagram - PDF page 3 - open source](#)

03 / Prepare the four polycarbonate shapes

Parts: 2 mm, 8 mm-grid polycarbonate sheet and the printed cutting layout

1. With a mentor, cut the launcher floor, intake lid, intake side, and intake floor to the guide shapes. Preserve the indicated holes and notches.
2. Keep the protective covering on until assembly if practical. Smooth sharp edges before students handle or mount the pieces.

Pause and check: Do the holes and bends match the guide before attaching any sheet?

[REV diagram - PDF page 4 - open source](#)

04 / Pre-load the brackets

Parts: 90 degrees, inside-corner, lap-corner, motion, servo, switch, and gearbox brackets; M3 screws and nyloc nuts

1. Finger-start the screws and nuts shown on PDF pages 5-9. The screw heads go on the ribbed side of REV's 90 degrees plastic brackets.
2. Group each bracket type separately. Leave the sliding connections movable until its assembly page tells you to tighten them.

Pause and check: Can each bracket slide into the intended channel without taking it apart?

[REV diagram - PDF page 5 - open source](#)

05 / Build the motor and gearbox groups

Parts: HD Hex motors, UltraPlanetary cartridges, motor plates, outputs, and mounting brackets

1. Follow pages 10-17 for the two 20:1 drive motor/gearbox groups and the 1:1 launcher group. Keep the groups labeled.
2. Check the cartridge order, output orientation, mounting bracket, and fastener lengths against each diagram. A mentor reviews any threadlocker use and tightening.

Pause and check: Are both drive outputs assembled alike, with the launcher motor clearly separate?

[REV diagram - PDF page 10 - open source](#)

06 / Stack the drive shafts

Parts: 90 mm 5 mm hex shafts, omni wheels, bearings, spacers, shaft collars, 10-tooth sprockets

1. Use pages 18-34 to make two drive shafts, two single-sprocket shafts, and two double-sprocket shafts. Keep the bearing, spacer, and sprocket order shown for each type.
2. Some drive-shaft parts are used temporarily to establish spacing and reinstalled later. Keep them with the same shaft in a labeled tray.

Pause and check: Do both left and right sets spin freely and retain the intended spacing?

[REV diagram - PDF page 18 - open source](#)

07 / Make the chain loops

Parts: #25 chain and the kit chain tool

1. Read the chain-tool sequence on pages 35-39 with a mentor. The guide calls for one 54-link intake loop and four 56-link drive loops on page 40.
2. Count the links before closing each loop. Avoid pushing a pin all the way out unless you have the correct master-link plan.

Pause and check: Are the one short loop and four drive loops separately labeled and free of twisted links?

[REV diagram - PDF page 35 - open source](#)

Finished-piece checks

[] Our kit model is recorded.

[] We checked missing parts, guards, battery, and switch.

[] A mentor completed or supervised tool preparation.

ASSEMBLY 02 / REV PAGES 41-49

Add the flower pusher

The flower pusher is part of REV's 2026-27 reference robot. Bench-build it before installing it on the drive rail.

01 / Make the sliding arm structure

Parts: 120, 63, and 83 mm extrusion; inside-corner, lap-corner, 90 degrees, and 30 degrees brackets

1. Use pages 41-46 to arrange the three extrusion lengths and pre-loaded brackets. Leave the intended gaps between brackets before tightening.
2. Compare the two 30 degrees bracket orientations carefully; their pre-loaded screws occupy opposite holes.

Pause and check: Does the arm geometry match the guide and leave room for the servo?

[REV diagram](#) - [PDF page 41](#) - [open source](#)

02 / Mount the pusher servo

Parts: Smart Robot Servo V2, bent metal servo bracket, M3 mounting hardware

1. Fasten the servo in the bracket in the orientation shown on page 47. Keep its lead clear of the arm path.
2. Pre-load the aluminum double servo arm and attach it to the servo with the correct central fastener.

Pause and check: Is the servo retained firmly without pinching its wire?

[REV diagram](#) - [PDF page 47](#) - [open source](#)

03 / Secure the arm and check travel

Parts: Aluminum double servo arm and prepared extrusion arm

1. Slide the arm extrusion into the servo arm and secure both side nuts as shown through page 49.
2. Move the linkage gently by hand with power disconnected. If it collides, recheck the bracket spacing before installing it on the chassis.

Pause and check: Does the pusher move freely between its expected positions?

[REV diagram](#) - [PDF page 48](#) - [open source](#)

04 / Hand it to the drivetrain crew

Parts: Completed pusher assembly and the second drive rail

1. The drive crew places the pusher servo bracket on the rail during the chassis build. Agree on an accessible wire route.
2. After mechanical assembly, the controls crew must verify the actual servo configuration and safe travel limits before powered movement.

Pause and check: Can all three crews explain what the pusher must clear?

[REV diagram](#) - [PDF page 74](#) - [open source](#)

Finished-piece checks

- [] The linkage moves freely with power off.
- [] Physical travel limits and pinch points were reviewed.
- [] Our pusher retrieves a ball without damaging it.

Build the drive base

Two matching drive rails become the base. Leave room for the pusher, Control Hub, battery, and the upright mounts that later carry the launcher.

01 / Build the first motor rail

Parts: 20:1 drive motor group, 408 mm C channel, endcap, 120 mm extrusion, lap brackets, four 40 mm standoffs

1. Fasten the gearbox output at the fourth hole from the end of the C channel, using the diagram on page 52 for orientation. Add the endcap and the small upright extrusion.
2. Place the lap brackets and four standoffs as shown through page 58. Leave the brackets that must accept later cross pieces adjustable.

Pause and check: Does the motor output line up with the future drive shaft, without binding?

[REV diagram - PDF page 52 - open source](#)

02 / Install the first chain drive

Parts: Drive shaft, single and double sprocket shafts, two 56-link chains, collars, tensioning bushings

1. Loop the two chains around the three matching sprockets and place the drive shaft into the motor output. Route each loop around its standoffs as shown.
2. Retain the other shafts with collars, add the tensioning bushings, and close the rail with the second 408 mm C channel. Turn the system by hand with power disconnected.

Pause and check: Do both chains stay on their sprockets without rubbing the channel?

[REV diagram - PDF page 59 - open source](#)

03 / Mirror the second rail

Parts: Second 20:1 drive motor, C channels, remaining drive shafts, two 56-link chains, standoffs, collars

1. Build the opposite rail from pages 64-73. Mirror its orientation; do not assume that the motor and bracket directions are identical to the first rail.
2. Check the chain path and hand rotation before tightening the adjustable brackets.

Pause and check: Do the two rails form a left/right pair with the same free motion?

[REV diagram - PDF page 64 - open source](#)

04 / Install the prepared flower pusher

Parts: Completed pusher from assembly 02 and its servo bracket

1. Slide the servo bracket onto the indicated second drive rail before closing the full base. The guide places its arm next to the endcap.
2. With power isolated, move the arm through its intended path and adjust the bracket if the arm catches on the extrusion.

Pause and check: Can the arm travel without striking the rail, wheel, or a cable?

[REV diagram - PDF page 74 - open source](#)

05 / Join and square the chassis

Parts: 248 mm C channels and extrusion crossmembers, corner brackets, both completed rails

1. Add the 248 mm cross pieces as shown on pages 76-82. Bring the rails together and align the brackets before final tightening.
2. Stand the open rail ends on a flat surface or check with a square. Fix any twist now; a skewed base will affect wheel contact and straight-line driving.

Pause and check: Are both rails parallel and the frame square?

[REV diagram - PDF page 76 - open source](#)

06 / Mount power and controls

Parts: Battery holder, hook-and-loop restraint, Control Hub, 16 mm mounting screws, switch bracket

1. Mount the battery holder between the rails, make a secure removable battery restraint, then take the battery back out during the rest of assembly.
2. Attach the Control Hub and the two 420 mm cross extrusions as shown on pages 78-83. Put the switch where a driver or mentor can reach it quickly.

Pause and check: Can the battery be removed, wires be routed safely, and the main switch still be reached?

[REV diagram - PDF page 77 - open source](#)

07 / Fit wheels and future mounts

Parts: Omni, grip, and traction wheels, through-bore bearings, collars, four 70 mm mounting extrusions

1. Fit the omni wheel on each drive shaft and the grip and traction wheels on the remaining shafts using the bearing and collar order on pages 83-84.
2. Add the four upright mounting pieces from pages 84-86. These will support later assemblies, so compare their orientation to REV's pictures.

Pause and check: Do all wheels turn freely, and are the upright mounts positioned as matched pairs?

[REV diagram - PDF page 83 - open source](#)

Finished-piece checks

[] Wheels and frame are secure.

[] Wires cannot reach moving wheels.

[] A mentor observed forward, reverse, and stop.

ASSEMBLY 04 / REV PAGES 87-96, 108-113

Build the feed path

Build the ball-supporting floors first, then the roller and servo that deliver one ball toward the flywheel.

01 / Frame the launcher floor

Parts: Two 278.5 mm rails, 218 and 83 mm pieces, lap and corner brackets, cut launcher-floor polycarbonate

1. Slide the prepared brackets onto both long rails. Attach the cut sheet at the holes shown on pages 88-89.
2. Form the polycarbonate into the guide shape and add the short framing pieces on pages 90-93. Match the PDF hole pattern before tightening.

Pause and check: Is the shaped floor supported and clear of any moving shaft?

[REV diagram](#) - [PDF page 87](#) - [open source](#)

02 / Seat both floor pieces on the chassis

Parts: Launcher-floor assembly, cut intake floor, 3 mm spacers, M3 screws and nuts

1. Place the launcher floor over the four upright mounts with the spacers and nuts shown on pages 94-95.
2. Position the intake floor at the fourth and seventh hole positions indicated on page 96, with its standoff cutouts between the rails.

Pause and check: Do the intake and launcher floors meet cleanly without a step that traps a ball?

[REV diagram](#) - [PDF page 94](#) - [open source](#)

03 / Assemble the feeder roller

Parts: 252 mm hex shaft, four 1-inch soft grip wheels, 60-tooth gear, bearings, collars, pillow blocks

1. Group the four small wheels between collars on the shaft, leaving the exposed length specified on pages 109-110.
2. Fit the bearings, pillow blocks, gear, and spacer in the pictured order. Spin it by hand and check for side rub.

Pause and check: Is the roller retained and centered under the future ball path?

[REV diagram](#) - [PDF page 108](#) - [open source](#)

04 / Assemble the feeder servo

Parts: Smart Robot Servo V2, bent servo bracket, aluminum horn, 60-tooth gear, 3 mm spacers

1. Mount the horn and servo in its bracket. Page 113 spaces the gear off the horn with six small spacers and screws.
2. Do not guess powered servo endpoints from the drawing. The controls crew will set and verify travel on the real robot.

Pause and check: Does the gear turn without rubbing the bracket?

[REV diagram](#) - [PDF page 111](#) - [open source](#)

05 / Set up a single-ball handoff

Parts: Feeder roller, feeder servo, launcher frame, one practice POLLEN

1. During launcher-frame assembly, position the feeder roller and servo on the 323 mm uprights; leave them adjustable until the gears and ball path line up.
2. With power disconnected, trace one ball from intake floor to feeder to flywheel. Ask a mentor to review pinch points before any powered trial.

Pause and check: Can the mechanism hold, then advance just one ball without a pinch or jam?

[REV diagram](#) - [PDF page 118](#) - [open source](#)

Finished-piece checks

- ☐ No sharp edge catches or damages a ball.
- ☐ The gate can hold a ball while the launcher is stopped.
- ☐ We can stop intake and feeding before exceeding four controlled balls.

Build the scoop + intake

The intake uses two flap-covered shafts and one Core Hex motor to move a POLLEN ball inward. Build the complete assembly on the bench before mounting.

01 / Build the powered intake shaft

Parts: Core Hex motor, motion bracket, 308 mm hex shaft, 20-tooth sprocket, spacers, bearings, collars

1. Attach the motor to its pre-loaded motion bracket, then build the first 308 mm shaft using the part order on pages 98-99.
2. Add four soft intake flaps with spacers between them. Turn the flaps to the stagger shown in the diagram so they do not line up as one wall.

Pause and check: Does the powered shaft spin without a flap hitting its bracket?

[REV diagram](#) - [PDF page 98](#) - [open source](#)

02 / Build the second intake shaft

Parts: Second 308 mm hex shaft, four intake flaps, 20-tooth sprocket, spacers, bearings, collars

1. Assemble the second shaft with the bearing, sprocket, spacer, and flap sequence on page 100. Keep its orientation distinct from the motor shaft.
2. Compare the two completed shafts side by side before mounting; the flap rows should be offset.

Pause and check: Are both sprockets aligned so one chain can drive both shafts?

[REV diagram](#) - [PDF page 100](#) - [open source](#)

03 / Make the intake frame

Parts: 248 mm cross extrusion, two 225 mm side extrusions, pre-loaded 90 degrees and rod-end brackets

1. Place four prepared 90 degrees brackets on the 248 mm cross piece and attach the two 225 mm side pieces.
2. Make mirrored rod-end brackets from pages 102-103. Leave their sliding nuts adjustable until the intake is mounted.

Pause and check: Are the side rails mirrored and wide enough for the ball path?

[REV diagram](#) - [PDF page 101](#) - [open source](#)

04 / Couple the two roller shafts

Parts: Both completed shafts and the 54-link #25 chain

1. Loop the 54-link chain over the two 20-tooth sprockets. Seat the shaft brackets on the frame following the upper/outside and lower/inside orientation shown in the PDF.
2. Rotate by hand with power isolated. Look for a twisted chain, rubbing flap, or sprocket out of line.

Pause and check: Does turning one shaft move the other without a tight spot?

[REV diagram](#) - [PDF page 103](#) - [open source](#)

05 / Add the intake lid

Parts: Cut intake lid polycarbonate and M3 fasteners

1. Pre-load the lid fasteners, then place the lid on the side extrusions as shown.
2. Check the opening using an actual POLLEN ball. Keep fingers away from the roller path during any later supervised test.

Pause and check: Can a ball enter without the lid scraping the rollers or pinching the ball?

[REV diagram](#) - [PDF page 104](#) - [open source](#)

Finished-piece checks

- ☐ A real ball fits through the narrowest opening.
- ☐ Rollers do not gouge or crush the ball.
- ☐ We tested five approaches and recorded misses too.

Build the launcher

The launcher joins a two-wheel flywheel to the feeder on a separate upright frame. A mentor must review guarding and the firing area.

01 / Build the flywheel shaft

Parts: 252 mm hex shaft, two 90 mm grip wheels, four 90-tooth gears, shaft collars

1. Stack the gears and two large wheels in the illustrated order between collars on page 106. Leave the specified exposed shaft length for its support bracket.
2. Secure the 5 mm hex bearing block to the bent mounting bracket, then add the spacers shown on page 107.

Pause and check: Are the wheels retained, centered, and free to turn without wobble?

[REV diagram](#) - [PDF page 105](#) - [open source](#)

02 / Attach the 1:1 launcher drive

Parts: Prepared flywheel shaft, bearing bracket, HD Hex motor with 1:1 UltraPlanetary output

1. Fit the flywheel shaft into the motor output using the page 107 diagram for direction and spacing.
2. Keep this 1:1 launcher group separate from the two 20:1 drive motors; swapping them changes the mechanism and code assumptions.

Pause and check: Is the shaft supported at both ends and free of bracket contact?

[REV diagram](#) - [PDF page 107](#) - [open source](#)

03 / Build the launcher frame

Parts: 218 mm cross extrusion, two 323 mm uprights, prepared 90 degrees brackets, M3 fasteners

1. Make the lower bracketed cross piece, then slide on the two long upright extrusions shown on pages 115-117.
2. Leave the indicated screws exposed for the floor and later mounting. Check that the left and right uprights are parallel.

Pause and check: Can the frame accept the flywheel and feeder without forcing either bracket?

[REV diagram](#) - [PDF page 114](#) - [open source](#)

04 / Seat flywheel, feeder, and servo

Parts: Completed flywheel, feeder roller, feeder servo, remaining frame brackets

1. Slide the flywheel brackets onto the uprights, then the feeder pillow blocks and servo bracket as pages 118-119 show. Keep their mounts adjustable for alignment.
2. Check gear mesh, roller spacing, and ball clearance by hand with power disconnected; final tightening follows the physical fit.

Pause and check: Does one ball have a clear path through the feeder into the flywheel?

[REV diagram - PDF page 118 - open source](#)

05 / Review launch guarding

Parts: Completed launcher assembly, guards, clear practice lane and backstop

1. Ask the mentor to check rotating wheels, fasteners, cable clearance, and a safe backstop before energizing any output.
2. Agree which tested control requests one feed, how readiness is determined, and how Driver Station STOP shuts down the flywheel and feeder.

Pause and check: Can every student describe the stop procedure and stay clear of the firing path?

[REV diagram - PDF page 119 - open source](#)

Finished-piece checks

- ☐ A mentor checked guarding, fasteners, and the test area.
- ☐ Our feed remains closed until the launcher is ready.
- ☐ We recorded real shots and verified an immediate safe stop.

Integrate + prove it

Bring the bench-built systems onto the chassis. Finish mechanical fit and safety checks before any staged electrical or driving test.

01 / Mount the launcher frame

Parts: Complete launcher-and-feeder assembly and the chassis uprights

1. Lower the six frame brackets onto the matching upright extrusions and tighten them after checking that the assembly is square.
2. Bring the launcher floor back onto its two prepared screws and secure it as page 121 shows.

Pause and check: Is the launcher fixed without forcing the floor or narrowing the feed path?

[REV diagram](#) - [PDF page 121](#) - [open source](#)

02 / Fit the intake to the front

Parts: Completed intake, rod-end brackets, prepared chassis screws

1. Seat the intake rod ends onto their mounting brackets, then lower the intake onto the prepared chassis screws.
2. Align the intake lid just above the feeder wheels, as the PDF shows. Check that the opening, floor, and roller path stay clear before tightening.

Pause and check: Can a ball travel from the intake to the feeder with no sharp edge or trapped gap?

[REV diagram](#) - [PDF page 122](#) - [open source](#)

03 / Secure the rails and side panel

Parts: U-channel endcaps, intake-side polycarbonate, lap bracket, M3 screws and nuts

1. Finish the remaining chassis fasteners and endcaps. Mount the side panel in the order on pages 124-125.
2. Use an unpowered ball to check the funnel and any adjustable sign holders. Keep the main switch visible and reachable.

Pause and check: Are all guards, side panels, wheels, and chain paths secure?

[REV diagram](#) - [PDF page 123](#) - [open source](#)

04 / Map the actual electronics

Parts: Control Hub, battery, switch, drive, intake, feeder, pusher, and launcher leads

1. With power isolated, label each real device and trace its controller port to the Java hardware name. REV's reference map uses leftDrive 0, rightDrive 1, intakeMotor 2, flywheel 3, crServo 0, and pollenServo 1. Verify your real wiring before choosing its configuration.
2. Secure cables away from chain, wheels, shafts, flaps, and the flywheel. The mentor checks strain relief, connectors, and battery restraint.

Pause and check: Can the controls crew read back the exact port, type, name, and safe stop for every output?

[REV wiring, configuration and OnBot Java - open source](#)

05 / Prove motion in safe stages

Parts: Mentor-approved supported robot, driver station, clear lane, backstop, measured trial area

1. This is a Pathfinder practice sequence after REV's mechanical assembly: test supported drive direction and STOP, then guarded intake and feed, then launcher readiness and one ball at a time. Leave untested outputs disabled.
2. Record real outcomes and missed shots. Change one variable at a time, stop on unexpected motion or a jam, and isolate power before adjustments.

Pause and check: Did a mentor observe STOP, the ball path, and a repeatable result on the actual robot?

[REV configuration and driver controls - open source](#)

Finished-piece checks

- [] We measured start size and physically constrained expansion.
- [] The main switch and driver stop are accessible and tested.
- [] Our team can explain and safely stop the entire sequence.