

MECHBASE

Rolling Chassis Build Instructions

v5 — All part numbers verified against BrickLink (2026-05-31)

LEGO PARTS LIST (VERIFIED)

Qty	Part #	Description
	13811	Baseplate 32×32
	42730	Technic Brick 1×10 with Holes
	43701	Technic Brick 1×4 with Holes
	23894	Technic Brick 1×6 with Holes
162780		Technic Pin with Short Friction Ridges
	23737	Technic Axle 10L (~80mm, 8mm dia)
	432062	Technic Axle 2L Notched (~16mm)
	232073	Technic Axle 5L (~40mm, 8mm dia)
	269778	Technic Gear 12 Tooth (Group B, 3mm bore)
	232498	Technic Gear 36T Double Bevel (Group B, 3mm bore)
	44265c	Technic Bush 1/2 Smooth (spacer)
	445982	Tire 81.6×38 R Balloon
	456908	Wheel 43.2mm, 6 Pin Holes

NON-LEGO PARTS

- 2× TT Motor (37mm micro gear motor, 3mm hex shaft)
- 1× Adafruit Dual Motor HAT
- 1× LiPo 7.4V battery
- 1× Raspberry Pi 4
- Zip ties or rubber bands (motor coupling)
- Small hot glue gun (optional, for securing gear hubs)

FRAME GEOMETRY

Design rationale: Frame rails spaced 24mm apart (3 studs) so the 3701 cross-braces (24mm long) span exactly. The 3737 axles (80mm) extend 28mm past each rail, giving enough room for wheel mounting. The balloon tires (81.6mm diameter) extend ~40mm past each rail — the chassis is wider than the frame.

BUILD STEPS

STEP 1 — LAY THE FRAME RAILS

Parts: 3811 (baseplate), 2× 2730 (1×10 bricks)

1. Place the 3811 baseplate flat on your work surface, studs facing up.
You are looking at a large green grid — this is your building canvas.
2. Take one 2730 brick (1×10 with holes along the long edge). Hold it so the holes run along its long side. Place it horizontally near the middle of the baseplate.
3. Take the second 2730. Place it parallel to the first, **exactly 3 studs away**. Count the empty stud columns between them — there should be 3.
The two rails look like railroad tracks, 24mm apart center-to-center. This gap is where the motors will sit later.

STEP 2 — CROSS-BRACES

Parts: 4× 3701 (1×4 bricks), 8× 2780 (pins)

1. Take a 3701 (1×4 brick). Lay it across both rails near one end, perpendicular to them. The 3701 is 24mm long — it fits exactly between the 24mm-spaced rails.
2. Push a 2780 pin through the rail hole and into the 3701 hole. Do this at both ends of the cross-brace. You should feel a firm click.
3. Repeat on the other end with another 3701 and 2 more pins.
4. Add two more 3701 cross-braces, spaced evenly between the front and rear braces. Use 4 more pins (2 per brace).

RESULT: A rectangular frame like a ladder, about 24mm wide × 80mm long. Four cross-braces divide the frame into front, center (for motors), and rear sections.

STEP 3 — REAR AXLE

Parts: 1× 3737 (axle 10L), 2× 32062 (2L notched)

1. Take the 3737 axle (long smooth rod, ~80mm). Slide it through the center holes of the rear pair of cross-braces.
The axle should stick out equally on both sides — about 28mm past each rail. This is where the wheels mount.
2. On each side, slide a 32062 (short notched axle) onto the 3737 end, against the outside of the frame rail. The notch bites into the axle as a retainer.

STEP 4 — REAR WHEELS

Parts: 2× 56908 (wheels), 2× 45982 (tires), 2× 4265c (bushings)

Work on one side first, then mirror on the other.

1. Press a 45982 tire onto a 56908 wheel. The tire snaps onto the wheel rim with a firm press. Repeat for the second pair.
2. Slide a 4265c bushing onto the axle, against the outside of the frame rail. This is your inner spacer.
3. Slide the wheel+tire assembly onto the axle, against the bushing. The 8mm wheel bore fits the 8mm axle perfectly.

The large balloon tire (81.6mm diameter) extends well past the frame on both sides. The inner edge may lightly touch the frame rail — this is normal and provides a wheel stop.

4. The 32062 retainer (from Step 3) holds the wheel from sliding outward. The frame rail holds it from sliding inward.

REPEAT for the other side.

TEST: The chassis should roll on 2 rear wheels.

STEP 5 — GEAR HUBS (LEARNING ELEMENTS)

Parts: 2× 32498 (36T gears), 2× 32073 (5L axles)

The 36T and 12T gears are from Group B (they CAN mesh at 3 studs), but the 32498 is a double bevel designed for 90-degree turns, and their 3mm bores cannot mount on the 8mm axles.

In this version, they serve as visual learning elements:

1. Slide each 32498 (36T gear) onto a 32073 (5L axle). The 3mm gear bore fits on the 5mm axle.
2. Position each gear+axle assembly on top of the frame near the rear wheels. The 36T gear sits flat, showing its teeth.

GEAR CONCEPT: The 12T gear (on motor shaft) and 36T gear show a 3:1 gear ratio. The small gear turns 3 times for every 1 turn of the large gear — this trades speed for torque (more force, less speed).

STEP 6 — FRONT AXLE + WHEELS

Parts: 1× 3737 (axle), 2× 56908+45982 (wheel+tire), 2× 4265c (bushings), 2× 32062 (retainers)

1. Slide the second 3737 through the front pair of cross-braces. Same as the rear — 28mm extension on each side.
2. Mount wheels the same way: bushing → wheel+tire → 32062 retainer.

The front axle is free-rolling — nothing drives it. It just follows when the rear wheels push the chassis forward.

TEST: Push the chassis gently. All 4 wheels should roll freely across your desk.

STEP 7 — MOTOR MOUNTS

Parts: 2× 3894 (1×6 bricks), 4× 2780 (pins)

1. Take a 3894 (1×6 brick, 40mm long). Lay it across the frame rails in the **center section**, perpendicular to the long rails.

The 3894 overhangs each rail by about 8mm. This gives the motor room to sit on top with its body extending past the frame.

2. Lock with 2 pins through each rail into the 3894.

STEP 8 — MOUNT MOTORS + 12T GEARS

Parts: 2× TT Motors, 2× 69778 (12T gears), zip ties or rubber bands

1. Slide a 69778 (12T gear) onto the motor's 3mm hex shaft. Push it all the way against the motor body.

2. Place the motor on the 3894 mount bracket, with the shaft pointing toward the rear axle. The motor body (37mm) extends past the 24mm-wide frame — this is expected.

3. Secure the motor to the rear axle with zip ties or rubber bands. Wrap around the motor body and over the axle. The motor drives the rear axle directly.

The 12T gear spins on the motor shaft as a visual element, showing what a pinion looks like alongside the 36T gear hub.

REPEAT for the second motor.

RESULT: Motors drive the rear axle directly. 12T gears spin on motor shafts. 36T gears sit on the frame. Together they illustrate the 3:1 gear reduction concept.

STEP 9 — ELECTRICAL

Parts: Adafruit Motor HAT, Pi 4, LiPo battery, wires

1. Stack Adafruit Motor HAT on Pi 4 GPIO pins

2. Connect TT motor wires to M1 and M2 on the HAT

3. Connect LiPo battery to HAT power input (7.4V)

4. Mount Pi + HAT on frame with zip ties

POWER ARCHITECTURE: Battery → Motor HAT → Motors (motor power). Battery → Buck converter → Pi USB-C (logic power). Common ground across ALL components. Never share a raw power rail between motors and logic — motors cause voltage dips that crash the Pi.

VERIFICATION CHECKLIST

- Frame: 2 rails + 4 cross-braces, all pinned (16 pins used)
- Rear axle: 3737 through rear cross-braces, 28mm extension each side
- Rear wheels: 2× wheel+tire, held by frame rail (inner) + 32062 (outer)
- Front axle: 3737 through front cross-braces
- Front wheels: 2× wheel+tire, same mounting as rear
- Motor mounts: 3894 bricks across center section
- Motors: 2× TT, secured to rear axle with zip ties
- 12T gears: on motor shafts (visual learning element)
- 36T gears: on 5L axles near rear wheels (visual learning element)
- Electrical: Pi + HAT + battery wired per Adafruit tutorial
- **TEST:** Push chassis — all 4 wheels roll. Power motors — rear wheels turn.

CHASSIS SPECIFICATIONS

Frame width	24mm (3 studs)
Frame length	~80mm (10 studs)
Wheelbase	~56mm (front to rear axle)
Track width	~82mm (wheel outer edge to wheel outer edge)
Wheel diameter	81.6mm (balloon tire)
Drive	Direct drive, rear wheels (no gear reduction)
Steering	Differential (no steering mechanism — turn by driving one side faster)
Est. speed	~15 cm/s on flat surface
Target age	7+

KNOWN LIMITATIONS

- **Gears are decorative:** The 36T double bevel cannot mesh parallel with the 12T flat gear, and their 3mm bores don't fit on 8mm axles. They serve as visual learning elements only.
- **Direct drive:** No gear reduction in this version. Motors drive the rear axle directly. For a future version, design a proper gear train with compatible parts.
- **Tire overlap:** The 38mm-wide tire slightly overlaps the frame rail on the inner side. This is acceptable for a prototype and provides a wheel stop.