FIRST® LEGO® League Challenge UNEARTHED™ Building Instructions

Build 5: Surface Brushing

This build is 157 pieces, and 44 building steps.

Welcome to text-based instructions from Bricks for the Blind. Before you start building, here are some terms we'll be using:
- In Front of/Front: towards you.
- Behind/Back: away from you.
- Up: towards the ceiling.
- Down: towards the floor.
- Stud: the bump on a LEGO brick. Example: A 2x1 brick has two studs on it.
- Vertically: going from front to behind.
- Horizontally: going from left to right.
- Upright: pointing up towards the ceiling.
- That one/ppp: previously placed piece.
- Plate: piece with studs.
- Tile: smooth piece without studs (unless otherwise specified)
- Symmetrically: a mirror image. Example: If you place a 2x1 brick with technic connector on the front wall at the right, connector to the front, and then place another such piece symmetrically on the back wall, at the right, the technic connector of the second piece should point to the back, since it will be placed symmetrically.
- Centered-vertically: even amount of space in front of and behind the piece
- Centered-horizontally: even amount of space left and right of the piece.
- Row: studs lined up horizontally (left to right/side to side).
- Column: studs lined up upright or vertically (top to bottom/back to front).
- Standing upright: the piece is perpendicular to the ground, like a wall.
- Lying flat: the piece is parallel to the ground, like a piece of toast which fell off the table.
- Anti-stud: the portion of a piece which accepts studs, like the bottom of a plate.
- Jumper plate: a 1x2 plate with a single stud on top, or a 1x3 plate with only two studs on top.

A note on LEGO Technic™ part names. These parts are somewhat different from regular LEGO bricks. Here are some definitions in case the builder or helper is not familiar with LEGO Technic™.

Axles - An axle is a connector which has an X shaped cross-section. Because their cross section is not round, anything connected to an axle using an axle-hole will rotate with that axle. Axles are longer than they are wide, and the length of an axle corresponds with how many bricks long it is. Aka a 3L axle is three bricks long. Axles come in a variety of lengths, with a 2L axle being the shortest available. They may be combined with pins, or have circular stops on them. A stop prevents the axle from sliding through an axle-hole at a specific point on the axle.

Pins - A pin is a connector which has a circular cross section and a flanged notch out of one or both ends. This flanged notch allows them to click into bricks with a pin-hole. Pins come with and without friction ridges, which are small bumps on the pin which prevent them from rotating freely. For standard pins, black is a high friction pin, and gray is a low friction pin. A standard length pin is two brick lengths long, with a stop in the middle. This prevents a brick from being pushed from one side of the pin to the other. A 1L pin is one brick long and still retains the stop, however it also includes a hollow stud at the other end. A 3L pin is three bricks long, and only contains a stop at one side, allowing two bricks to be pushed onto the other side of the pin. Pins may also have one side which is an axle.

Lift-arms - A lift-arm is a basic structural element, similar to a brick or a plate, but usually without any studs. It is a beam with rounded ends and with holes in it, with the same spacing as the studs on a LEGO brick. lift-arms come in a variety of lengths, including a 1x1 lift-arm which looks like a cylinder. Thick lift-arms are as wide as a LEGO brick, and thin lift-arms are half as wide as a LEGO brick, but not the same thickness as a LEGO plate! The holes in a lift-arm arm may accept axles or pins. They also come in a variety of shapes, including tees, ells and triangles.

Gears - A gear is a functional element. They are typically discs with teeth on the outside, there are also worm gears which look like a spiraling cylinder! Gears connected by axles transmit or even transform rotational motion!

Axle and Pin Connectors - These elements are typically smaller than lift-arms and are used to connect some combination of pins or axles. They might have pins or axles, as well as axle or pin-holes. They have a lot of different angle combinations! The simplest just connects two axles or pins together in a straight line.

Bushes/Bushings - LEGO Technic™ uses bushes largely as spacers, but they also can reduce friction between rotating parts, or can form useful elements such as handles. Bushes are typically light gray, generally cylindrical, and have an axle-hole running through the middle. They have a flange at the front and back to make them easier to pull on and off.

Technic™ Bricks and Plates – There are also regular bricks and plates that are adapted for use with Technic™ elements. Technic™ bricks have holes for either pins or axles on the sides and are only one brick wide. One of the most common of these is a 1x2 brick with a single pin hole. Most often, these bricks have pin holes, not axle holes. Technic™ plates have holes on the flat surface between the studs and are a minimum of two bricks wide. The holes in these plates can accept pins or can allow an axle to pass through and still spin.

For builders with low vision, or a sighted building partner who may want to follow along with the printed visual instructions that come with each set. As low vision users may benefit from viewing the instructions on a personal device where they can zoom in on content and use assistive technologies to enhance the visuals.

Sorting Instructions:

This LEGO set comes in the bag labeled 7 and some large pieces from bag 0. Sort the pieces into groups as described below. Note that where there are multiple colors of the same brick in a step, the colors will be split across two groups to make telling the difference easier for the builder! LEGO includes a few spare parts in case you lose something. Set these into their own group away from the rest, in case you need them later.

Build 5 (10 groups of bricks)
Group A contains all of the black 2L pins from this bag. These pins have friction ridges.
Group B contains all of the blue 3L pins from this bag. These pins have friction ridges.
Group C contains all of the blue 2L axle/pin combos from this bag. These pins have friction ridges.

Bag 7 (7 groups of bricks)
Main Build: Surface Brushing
Group 1 contains the pieces for steps 1-7.
Group 2 contains the pieces for steps 8-15.
Group 3 contains the pieces for steps 16-18.
Group 4 contains the pieces for steps 19-22.
Group 5 contains the pieces for steps 23-26.
Group 6 contains the pieces for steps 27-35.

Sub-build: Brush

Group 7 contains the pieces for steps 36-44.

Building Instructions:

Groups A, B, C and 1. You will use the pins from groups A, B and C throughout the build.

Main Build

1.1. We'll start by building the base of a digsite. Find a black 7x11 hollow frame. This looks like two 11L liftarms connected by two 7L liftarms, forming an open rectangle. Place this in front of you with the 11L liftarm sides at the front and back and the 7L liftarms on the left and right.

1.2. Push a blue 3L pin from group B, with the stop ring at the front, from the front into the leftmost and rightmost holes on the front side of the previous piece. Push these all the way back so they extend 1L to the front and back. Repeat symmetrically on the back side.

2.1. Find a dark gray 3L axle/pin combo which has a 2L pin side, and a 1L axle side. Push the pin side of this piece, from the front with the axle at the front, into the hole to the right of the front left previous piece. Push it all the way back until it extends 1L to the front and back. Repeat symmetrically on the right side.

2.2. Repeat step 2.1 symmetrically on the back side of the hollow frame.

3. Push a light gray 3L liftarm, horizontally with the holes facing the front and back, from the back onto each pair of pins on the back side of the front 11L liftarm of the hollow frame. The center hole of these liftarms is an axle hole instead of the usual pin hole.

4.1. Place a light gray 3L liftarm, horizontally with the holes facing the front and back, in front of you. Find a dark gray 3L axle/pin combo which has a 2L pin side, and a 1L axle side. Push the axle side of this piece, from the front with the axle at the back, into the center hole of the previous piece. It will extend 2L to the front.

4.2. Push a dark gray 1L liftarm, from the front, onto the previous piece. Push it all the way back so it touches the 3L liftarm.

4.3. Find a dark gray 7L liftarm with perpendicular holes. This looks like a normal 7L liftarm, except that every hole is perpendicular to its neighbors. Rotate this so it is horizontal with the smooth sides at the top and bottom. Push the rightmost hole onto the pin that extends from the front of the 3L liftarm.

4.4. Repeat steps 4.1-4.2 to create another 3L liftarm assembly, and push the pin, from the back, into the leftmost hole of the 7L liftarm with perpendicular holes.

4.5. Push this assembly, from the front, onto the four pins on the front side of the back 11L liftarm on the hollow frame.

5.1. Now we'll place an artifact. Place a dark gray 1x2 brick with an axle hole, horizontally, in front of you. Push the axle side of a blue 2L axle/pin combo from group C, with the axle at the front, from the back into the axle hole of the previous piece.

5.2. Place a light gray 1x1 plate with a horizontal clip on one side, with the clip on the left, on the left stud of the 1x2 brick with an axle hole. Place a light gray 1x1 plate with a perpendicular double stud on one side, with the double stud on the right, to the right of the previous piece.

5.3. Place a light blue 1x2 tile, horizontally on top of the artifact. Clip a light gray lightsaber handle, upright, into the clip on the left side of the artifact.

5.4. Find a light gray T-shaped tube. Push the tube that's like the stem of the T, with the arms of the T horizontal at the top, down into the hollow stud on top of the previous piece.

5.5. Keeping the lightsaber handle on the left, rotate the artifact 90 degrees away from you so it lays flat with the tile at the back. Push the pin down into the center hole of the 7L liftarm with perpendicular holes from step 4.3. Set the base aside.

6.1. Next we'll start building the sides of the dig site. Place a dark gray 1x14 technic brick, horizontally, in front of you.

6.2. Place a tan 1x2 plate, horizontally, on the leftmost and rightmost two studs of the previous piece.

7.1. Place a brown 1x2x2 tall slope brick, horizontally with the slope on the right, to the right of the left piece from the previous step.

7.2. Place a brown 1x4 brick, horizontally, to the right of the previous piece.

7.3. Place a dark gray 1x2x3 tall slope brick, horizontally with the slope on the left, to the right of the previous piece.

7.4. Place a tan 1x2 slope brick, horizontally with the slope on the left, to the right of the previous piece.

Group 2.

8.1. Place a brown 1x2 inverted slope brick, horizontally with the slope on the left, on the previous piece.

8.2. Place a tan 1x4 brick, horizontally, on the brown 1x4 brick from step 7.2.

9.1. Place a tan 1x4 brick, horizontally, on the previous piece.

9.2. Place a tan 1x2 technic brick, horizontally, to the left of the previous piece. This piece will only be attached by one stud.

9.3. Place a tan 1x2 technic brick, horizontally, on the third and fourth studs from the right. This is on the 1x2 inverted slope brick from step 8.1.

10.1. Place a dark gray 1x2x3 tall slope brick, horizontally with the slope on the left, on the leftmost two studs. Repeat symmetrically on the right side.

10.2. Place a tan 1x4 plate, horizontally, to the right of the left previous piece.

10.3. Place a dark gray 1x6 plate, horizontally, to the right of the previous piece.

11. Place two dark gray 1x6 technic bricks, horizontally, on top of the side assembly.

12.1. Place a green 1x2 plate, horizontally, on the leftmost two studs on the left previous piece. Repeat symmetrically on the right side.

12.2. Place a green 1x8 plate, horizontally, between the previous two pieces.

13. Place a pink 1x1 round plate with a flower petal pattern on the fourth stud from the right on the side assembly.

14. Push a black 2L pin from group A, from the front, into the fourth holes from the left and right on the top row of pin holes.

15. Find a black 1x3x5 liftarm with a slot cut out from one side. This piece is a rectangle with two holes on the front and back, five holes on the bottom, and four holes on the top. There is also a slot on the top. Rotate this piece so the five hole side is at the bottom, the smooth side is at the front, and the slot is on top. Push the holes on the back side, from the front, onto the pins from the previous step.

Group 3.

16.1. We'll make a couple of spacers now. Place a tan 2L axle/pin combo, horizontally with the pin side on the left, in front of you.

16.2. Find a light gray 2L pin with a bushing on one side. Push the bushing side, with the pin on the right, from the right onto the axle side of the previous piece.

16.3. Push a dark gray 1L liftarm, from the right, onto the pin side of the previous piece. Push it all the way to the left until it touches the bushing.

16.4. Repeat steps 16.1-16.3.

16.5. Rotate the spacers 90 degrees clockwise so the pin of the 2L axle/pin is at the back. Push this pin, from the front, into the holes to the left and right of the 1x3x5 liftarm with a slot from step 15. There should be two free holes to the left of the left assembly and to the right of the right assembly. The tan 2L axle/pin combos do not have friction ridges, so the spacers should spin freely.

17. Push a tan 3L pin, with the stop ring at the back, from the front into the leftmost and rightmost holes in the bottom row of pin holes on the side assembly. These pins do not have friction ridges and should spin freely. These pins will extend 2L past the front of the side assembly.

18. Set the base in front of you, horizontally with the artifact closer to the back. Push the four pins on the back side of the base into the bottom row of pin holes on the side assembly. The two tan 3L pins from the previous step should be on either side of the base.

Group 4.

19.1. Now we'll make two identical ground assemblies. Set the combined base and side assembly aside for now. Place a green 7L liftarm, horizontally with the holes facing the front and back, in front of you. Push a blue 3L pin from group B, with the stop ring at the back, into the second holes from the left and right on the previous piece. These pins will extend 2L to the front.

19.2. Push two green 7L liftarms, horizontally with the holes facing the front and back, onto the pins from the previous step so the pins are completely covered.

19.3. Push a blue 3L pin from group B, with the stop ring at the back, into the rightmost hole of the front previous piece. Repeat symmetrically on the left side with a tan 3L pin. Note that the left pin does not have friction ridges and will spin freely, while the right pin does have friction ridges and will not spin freely.

19.4. Find a lime green 3x5x3 curved panel. This looks kind of like a chair with no legs. It has two flat panels at an angle close to 90 degrees, with pin holes on two opposite sides. Rotate this so the long panel is laying flat on the right and the short panel is upright on the left. Push the right hole, from the front, onto the left pin from the previous step. Push it all the way to the back. This piece should spin freely. Push a dark gray 1L liftarm, from the front, onto the other pin and push it all the way to the back.

19.5. The two pins from step 19.3 should extend 1L to the front. Push a green 7L liftarm, horizontally with the holes facing the front and back, onto these pins.

19.6. Push a blue 3L pin from group B, with the stop ring at the back, into the second holes from the left and right on the previous piece. These pins will extend 2L to the front.

19.7. Push two green 7L liftarms, horizontally with the holes facing the front and back, onto the pins from the previous step so the pins are completely covered.

19.8. Repeat steps 19.1-19.7.

19.9. Place the base back in front of you, horizontally with the side wall at the back. Push the rightmost hole on the back of one of the ground assemblies, from the front, onto the tan left pin on the bottom row of the side wall. The curved panel should be on the left. Repeat symmetrically on the right side with the other ground assembly.

20.1. Place a tan 2L axle/pin combo, horizontally with the pin side on the left, in front of you.

20.2. Push a green 2L axle connector, from the right, onto the previous piece.

20.3. Push a light gray 5L axle, from the right, into the right axle hole of the previous piece.

20.4. Push a green 2L axle connector, from the right, onto the previous piece.

20.5. Repeat steps 20.1-20.4.

20.6. Find the two holes on the front side of the side wall which are below the top row of holes. These are centered below the second and third studs from the left and right sides of the back row of the side wall. Rotate the assemblies we just made 90 degrees clockwise so the pin is at the back. Push the pins into these holes. The tan 2L axle/pin combos do not have friction ridges, so these assemblies should spin freely. Set the base aside.

21.1. Next we'll build the other side of the dig site. Place a dark gray 1x14 technic brick, horizontally, in front of you.

21.2. Place a tan 1x2 plate, horizontally, on the leftmost and rightmost two studs of the previous piece.

22.1. Place a brown 1x2x2 tall slope brick, horizontally with the slope on the right, to the right of the left piece from the previous step.

22.2. Place a brown 1x4 brick, horizontally, to the right of the previous piece.

22.3. Place a dark gray 1x2x3 tall slope brick, horizontally with the slope on the left, to the right of the previous piece.

22.4. Place a tan 1x2 slope brick, horizontally with the slope on the left, to the right of the previous piece.

Group 5.

23.1. Place a brown 1x2 inverted slope brick, horizontally with the slope on the left, on the previous piece.

23.2. Place a tan 1x4 brick, horizontally, on the brown 1x4 brick from step 7.2.

24.1. Place a tan 1x4 brick, horizontally, on the previous piece.

24.2. Place a tan 1x2 technic brick, horizontally, to the left of the previous piece. This piece will only be attached by one stud.

24.3. Place a tan 1x2 technic brick, horizontally, on the third and fourth studs from the right. This is on the 1x2 inverted slope brick from step 23.1.

25.1. Place a dark gray 1x2x3 tall slope brick, horizontally with the slope on the left, on the leftmost two studs. Repeat symmetrically on the right side.

25.2. Place a tan 1x4 plate, horizontally, to the right of the left previous piece.

25.3. Place a dark gray 1x6 plate, horizontally, to the right of the previous piece.

26. Place two dark gray 1x6 technic bricks, horizontally, on top of the side assembly.

Group 6.

27.1. Place a green 1x2 plate, horizontally, on the leftmost two studs on the left previous piece. Repeat symmetrically on the right side.

27.2. Place a green 1x8 plate, horizontally, between the previous two pieces.

28.1. Place a green 1x1 round plate with three leaves, with the leaves pointing to the back, on the fourth stud from the right.

28.2. Place an orange 1x1 round plate with a flower petal pattern on the previous piece.

29. Push a black 2L pin from group A, from the front, into the fourth holes from the left and right on the top row of pin holes.

30. Push the back holes of a black 1x3x5 liftarm with a slot cut out from one side, with the five hole side at the bottom, the smooth side is at the front, and the slot on top, from the front, onto the pins from the previous step.

31.1. Place a tan 2L axle/pin combo, horizontally with the pin side on the left, in front of you.

31.2. Find a light gray 2L pin with a bushing on one side. Push the bushing side, with the pin on the right, from the right onto the axle side of the previous piece.

31.3. Push a dark gray 1L liftarm, from the right, onto the pin side of the previous piece. Push it all the way to the left until it touches the bushing.

31.4. Repeat steps 31.1-31.3.

31.5. Rotate the assemblies we made 90 degrees clockwise so the pin of the 2L axle/pin is at the back. Push this pin, from the front, into the holes to the left and right of the 1x3x5 liftarm with a slot from step 30. There should be two free holes to the left of the left assembly and to the right of the right assembly. The tan 2L axle/pin combos do not have friction ridges, so these assemblies should spin freely.

32.1. Rotate the side wall 180 degrees so the previous assemblies point to the back.

32.2. Set the base in front of you, horizontally with the first side wall at the back. Push the four pins on the front side of the base into the bottom row of pin holes on the second side wall.

33. There are two full rows of pin holes on the front side of the dig site, one on top and one on the bottom. Push a light gray 3L pin with a stop on one side, with the stop at the front, into the leftmost and rightmost holes on the 1x14 technic brick on the bottom row of the front side. Push these all the way back.

34.1. Push a light gray thick bushing onto a brown 3L axle with a stop on one side. Push the bushing all the way up to the stop. Repeat.

34.2. Rotate one of these assemblies so the axle is at the back. Find the two pin holes below the top row of holes on the front side of the dig site. Push the axle side of the assembly through the left pin hole. Push it all the way back so it attaches to the 2L axle connector from step 20.4. Repeat with the other assembly in the right hole.

35. Now we'll close up the sides! Take the hinged set of six liftarms with a 3x5x3 curved panel on the left side of the dig site and rotate it clockwise until the liftarms stand upright, then continue rotating the curved panel clockwise until it stops. It should rest on some of the pins inside of the build. Repeat symmetrically on the right side. The two curved panels should almost meet in the middle.

Sub-build: Brush

Group 7.

36.1. Now we'll build a brush! Set the dig site aside for now. Place a red 8L axle horizontally in front of you.

36.2. Push a light gray 2L axle connector onto the right side of the previous piece.

37. Push the center hole of a light gray 3L liftarm, horizontally with the holes facing the left and right, from the left onto the 8L axle. Push it all the way to the right until it touches the axle connector. The center hole of these liftarms is an axle hole instead of the usual pin hole.

38.1. Now we'll make the bristles of the brush. Push a black 2L pin from group A into one of the holes of a light gray 2L pin connector. Repeat.

38.2. Push the pin of one of the bristles, with the pin on the left, into each of the free holes on the right side of the 3L liftarm. The pin connectors and the axle connector from step 36.2 are the bristles of the brush.

39. Find a black axle connector with two perpendicular bar holders. This looks like a 1L cylinder with an axle hole through it. There are two perpendicular hollow cylinders extending from either side of the axle hole which are bar holders. Push the axle hole of this piece, with the bar holders at the front and back, from the left onto the 8L axle. Push it all the way to the right until it stops.

40. Push a black 4L bar into the bar holders on the front and back sides of the previous piece.

41. Push a light gray thick bushing, from the front, onto the front previous piece. Push it all the way to the back. Repeat symmetrically on the back side.

42. Push a light gray thin bushing, from the front, onto the front 4L bar from step 40. Push it all the way to the back. Repeat symmetrically on the back side.

43. Push a red ball onto the left end of the 8L axle.

44. Set the dig site in front of you, so the rows of studs on the top are at the front and back. Rotate the brush so the ball is on top and so the bristles and 4L bars are vertical. Set the bristles between the two 3x5x3 curved panels. The ball and handle of the brush should stand upright in the dig site.

Congratulations! Now this build is complete!

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