

FIRST® LEGO® League Challenge BIOGLOW™ Building Instructions

Mission 5: Reaching Rods

This build is 76 pieces, and 34 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.

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.

A note on LEGO Technic™ part names. These parts are somewhat different from regular LEGO bricks. I'll include 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.

Lifarms - A lifarm 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. lifarms come in a variety of lengths, including a 1x1 lifarm which looks like a cylinder. Thick lifarms are as wide as a LEGO brick, and thin lifarms are half as wide as a LEGO brick, but not the same thickness as a LEGO plate! The holes in a lifarm 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 lifarms, 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.

Sorting Instructions:

This LEGO set comes in the bag labeled 7. 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.

Mission 5: Reaching Rods

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 (4 groups of bricks)

Main Build

Group 1 contains the pieces for steps 1-6.

Group 2 contains the pieces for steps 7-13.

Group 3 contains the pieces for steps 14-23.

Group 4 contains the pieces for steps 24-34.

Building Instructions:

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

Main Build

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1.1. This build looks kind of like a tree! Let's start at the bottom. Find a light gray 5x7 hollow frame. This looks like two 7L lifarms connected by two 3L lifarms on the ends, forming an open rectangle. Place this, upright and vertically with the 7L lifarms upright, in front of you.

1.2. Push a black 2L pin from group A, from the top, into the middle hole on the top side of the bottom lifarm.

2. Push a black 2L pin from group A, from the left, into the bottom two holes on the left side of the front liftarm on the hollow frame.

3. Find a dark gray 3x3x1 square liftarm. This piece is shaped like a square with five holes forming a cross on the flat sides. Two sides are rounded, and the other two sides have two holes each. Push the two holes on the right side, with the 3x3 square liftarm standing upright and horizontally with the rounded sides on the top and bottom, from the left onto the previous two pieces.

4. Push a black 2L pin from group A, from the left, into the two holes on the left side of the previous piece.

5.1. Let's start adding parts of the tree trunk! Find a brown 7x3 bent liftarm. This is a 7L liftarm connected to a 3L liftarm at a 135 degree angle. The holes at each end are axle holes. Rotate this so it's vertical with the holes facing up and down, with the 7L liftarm at the front and the 3L liftarm pointing away from you and to the right.

5.2. Push the axle side of a blue 2L axle/pin combo from group C, with the pin on top, from the top into the front axle hole of the previous piece.

5.3. Skip one hole and then push a black 2L pin from group A, from the top, into the bent liftarm.

5.4. Rotate the bent liftarm so it's upright with the two pins on the right near the bottom. Push the two pins into the top two holes on the left side of the front liftarm on the hollow frame. The 3L liftarm should be on top and away from you.

6.1. Place a blue 3L pin from group B, horizontally with the stop ring on the left, in front of you.

6.2. Push a brown 1L liftarm, from the right, onto the right side of the previous piece. Push it all the way to the left so the pin extends 1L to the left and right of it.

6.2. Push the right side of the 3L pin, from the left, into the fourth hole from the bottom of the 7x3 bent liftarm.

Group 2.

7.1.1. Place a green 2L thick liftarm with one axle hole and one pin hole, vertically with the axle hole at the front facing left and right, in front of you.

7.1.2. Push a red 2L axle, from the left, into the front hole of the previous piece so it extends 1L to the left.

7.1.3. Push the pin side of a blue 2L axle/pin combo from group C, with the axle side on the left, from the left, into the hole behind the previous piece.

7.2.1. Push the right axle hole of a light brown 3L axle connector, horizontally, onto the left side of the previous piece.

7.2.2. Push the axle side of a blue 2L axle/pin combo from group C, with the axle side on the right, from the left, into the left axle hole of the previous piece.

7.3. Push the left side of the 2L axle that's in the front hole of the 2L liftarm, from the right, into the top axle hole of the 7x3 bent liftarm so the 3L axle connector is below the bent liftarm.

8.1.1. Now we'll extend the trunk. Set the main assembly aside for now. Place a brown 5L thick liftarm, vertically with the holes facing left and right, in front of you.

8.1.2. Push a red 1L pin with a stud on one side, with the stud on the right, from the right into the back hole of the previous piece.

8.2. Place a pink 1x1 round plate with a flower petal pattern on the stud of the previous piece.

8.3. Push a black 2L pin from group A, from the left, into the front and second from the back holes on the 5L lifarm.

8.4. Push the corner hole of a brown 7x3 bent lifarm, vertically with the 7L lifarm at the front and the 3L lifarm pointing up at the back, onto the back hole from the previous piece. The front pin will go into the fourth hole from the front on the bent lifarm.

8.5. Push the axle side of a white 3L axle/pin combo with a 2L axle side, with the pin on the right, into the front axle hole of the previous piece. Push it all the way left so it extends 1L to the left and right of the bent lifarm.

8.6. Place the rest of the assembly, with the hollow frame upright on the right and the 3x3 square lifarm upright at the front, in front of you. Rotate the trunk extension so it's upright, with the previous piece at the bottom and so the 1x1 flower plate is on the right. Push the pin side of the previous piece into the corner hole of the bent lifarm on the main assembly. Rotate the top of the trunk extension away from you so it rests on a 3L axle connector.

9.1. Now we'll close in the left side of the trunk. Place a brown 7x3 bent lifarm in front of you, vertically with the 7L lifarm at the front and the 3L lifarm pointing away from you and to the left.

9.2. Push the axle side of a blue 2L axle/pin combo from group C, with the pin on top, from the top into the front axle hole of the previous piece.

9.3. Skip one hole and then push a black 2L pin from group A, from the top, into the bent lifarm.

9.4. Rotate the bent lifarm so it's upright with the two pins on the left near the bottom. Slide the corner hole onto the axle that's on the left side of the trunk. The pin on the left side of the trunk should attach to the fourth hole from the bottom of the bent lifarm we're adding now.

10.1. Push a red 2L axle, from the left, into the top axle hole of the 7x3 bent lifarm we just placed.

10.2. Push the top hole of a green 2L thick lifarm with one axle hole and one pin hole, upright with the axle hole at the top, onto the left side of the previous piece. The bottom hole will attach to the pin below and behind the axle.

11.1. Push the four pin holes on the front lifarm of a light gray 5x7 hollow frame, upright and vertically with the 7L lifarms upright, onto the four pins on the left side of the assembly.

11.2. Push a black 2L pin from group A, from the top, into the middle hole on the top side of the bottom lifarm.

12.1.1. Now we'll make an assembly to stabilize the two 5x7 hollow frames. Place a dark gray 3x3x1 square lifarm, laying flat with the rounded ends at the front and back, in front of you.

12.1.2. Push a black 2L pin from group A, from the top, into the leftmost hole on top of the previous piece. Repeat symmetrically on the right side.

12.2. Place a brown 5L thick lifarm, horizontally with the holes facing up and down, centered horizontally on the previous two pieces.

12.3. Find the pins that stick up from the bottom liftarms of each of the two 5x7 hollow frames. Push the left and right holes on the 5L liftarm from the previous step down onto these pins.

13.1. Now we'll add some studs to the front side of the tree assembly. Push a red 1L pin with a stud on one side, with the stud at the front, into each of the three holes on the front side of the rightmost 5x7 hollow frame.

13.2. Push a red 1L pin with a stud on one side, with the stud at the front, into the bottom hole on the front side of the leftmost 5x7 hollow frame.

13.3. Find the 3x3 cross of holes on the 3x3 square liftarm that's between the two 5x7 hollow frames. Push a red 1L pin with stud on one side, with the stud at the front, into the top and bottom holes on the front side of the cross.

Group 3.

14.1. Now we'll build some detail for the front of the tree. Set the tree assembly aside for now. Place a green 3x3 plate in front of you.

14.2. Place a brown 2x3 slope brick, vertically with the slope at the front, on the right two columns of the previous piece.

15. Place a brown 2x3 brick, horizontally, to the left of the previous piece so the back sides are even. The left two columns will overhang.

16. Place the back two rows of a brown 2x3 plate, vertically, under the overhanging two columns of the previous piece.

17. Place a brown 1x2 brick, horizontally, on the back row of the 2x3 brick so the left sides are even.

18. Place the left stud of a brown 1x4x2 curved slope tile, horizontally with the tall side on the left, on the right stud of the previous piece.

19. Place a green 1x2 slope tile, horizontally with the tall side at the back, centered horizontally on the front row. Place another on the brick behind the first.

20. Find a brown 1x5x4 inverted half arch. This piece has only two studs, is curved on top, and is stepped on the bottom. Rotate it so it's vertical with the tall side at the back and place it on the leftmost column of the assembly so the back sides are even. The front two studs will overhang.

21. Place the back two studs of a brown 1x3 plate, vertically, under the front two overhanging studs of the previous piece.

22.1. Place the front stud of a green 1x2 curved slope tile, vertically with the tall side at the back, on the front stud of the previous piece.

22.2. Place a brown 1x1 slope tile, with the tall side at the back, on the 1x5x4 inverted half arch that's at the back left corner of the assembly.

23. Place the tree assembly, with the 5x7 hollow frames on the left and right and the six studs at the front. Rotate the assembly we just made so the anti-studs are at the back and so the 1x5x4 inverted half arch is upright on the right. Place this assembly on the studs on the front side of the tree assembly so the left, right, and bottom sides are even.

Group 4.

24.1. Next, we'll make an assembly to extend the tree some more. Set the rest of the tree aside for now. Place a green 7L thick liftarm, horizontally with the holes facing front and back, in front of you.

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

25. Push a brown 1L liftarm, from the front, onto each of the previous two pieces. Push them all the way back.

26.1.1. Place a brown 5L thick liftarm, horizontally with the holes facing front and back, in front of you.

26.1.2. Push a tan 3L pin, with the stop ring at the back, from the back into the leftmost hole of the previous piece. Push it as far forward as you can so it extends 1L to the front and back. This pin does not have friction ridges and will spin freely.

26.1.3. Push the pin side of a dark gray 3L axle/pin combo with a 2L pin side, with the axle side at the back, from the back into the rightmost hole of the 5L liftarm. Push it as far forward as you can so it extends 1L to the front and back. This pin has friction ridges and will not spin freely.

26.2. Push a black 2L pin from group A, from the front, into the hole to the left of the previous piece.

26.3. Rotate the 5L liftarm so it's upright with the dark gray 3L axle/pin combo at the top. The axle side of this piece should extend to the back. Push the back side of the pin on the bottom of the 5L liftarm, from the front into the 7L liftarm and to the right of the left 3L pin with a 1L liftarm on it. This pin goes into the third hole from the right on the 7L liftarm. Rotate the 5L liftarm clockwise until it rests on the right 3L pin with a 1L liftarm.

27. Push a green 7L thick liftarm, horizontally, onto the bottom three pins on the front side of the assembly so the right and left sides are even.

28.1. Find the axle that's on the back side of the 5L liftarm, at the top. Push a red 3L axle connector, from the back, onto this axle.

28.2. Push a yellow 3L axle, from the back, into the hole on the back of the previous piece.

29.1. Push a red thick bushing, from the back, onto the previous piece. Push it as far forward as you can so the axle extends 1L behind it.

29.2. Push the axle hole of a red ball onto the axle behind the previous piece.

30. Find a green pin and perpendicular axle connector. This piece looks like a 2L liftarm with bushing on one side. The sides are rounded, instead of smooth like a normal liftarm. The bushing is parallel to the long axis of the liftarm. Push the pin holes on this piece, with the bushing on top with its axle holes facing left and right, from the front onto the two pins on the front side of the 5L liftarm.

31.1.1. Push a red 2L axle, from the right, into the axle hole on the bushing of the previous piece.

31.1.2. Find a brown 90 degree tube. This looks exactly like a macaroni noodle, except that it's green and it probably won't taste very good if you cook it! Rotate this piece so the holes are at the left and top. Push the left hole onto the right side of the previous piece.

31.2. Push a red 2L axle, from the top, into the top hole of the previous piece.

32.1. Push the anti-stud of a brown 1x1 cone, from the top, onto the previous piece. The bottom of this piece is shaped like an axle hole so it will attach to an axle.

32.2. Push the short bar on the bottom of a brown claw, with the claw curving up, into the hollow anti-stud of the previous piece.

33. Now we'll add this assembly to the rest of the tree. Place the rest of the tree, with the 5x7 hollow frames on the left and right and the sloped details at the front, in front of you. Find the top of the top bent liftarm on the tree. Rotate the assembly we just made so it's vertical with the 7L liftarms on the left and right and the 5L liftarm on top at the back. Place the front holes of the two 7L liftarms around the top hole on the tree assembly. Push a black 4L axle, from the left, through these holes to attach the two assemblies. Push it in until the left side extends 1L.

34.1.1. Push a red 3L axle connector, from the left, onto the free side of the previous piece.

34.1.2. Push a red 2L axle, from the left, into the left hole of the previous piece.

34.2. Push the axle hole of a red ball, from the left, onto the free side of the previous piece.

Congratulations! Now this build is complete!

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