

# FIRST® LEGO® League Challenge BIOGLOW™ Building Instructions

## Mission 1: Drone Survey

This build is 154 pieces, and 47 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, els 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 bags labeled 1-2 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.

#### Mission 1: Drone Survey

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 1 (2 groups of bricks)

##### Main Build

Group 1 contains the pieces for steps 1-8.

Group 2 contains the pieces for steps 9-20. Include two black 32L axles from bag 0.

#### Bag 2 (4 groups of bricks)

Group 3 contains the pieces for steps 21-23.

Group 4 contains the pieces for steps 24-35. Include two black 32L axles from bag 0.

Group 5 contains the pieces for steps 36-42.

Group 6 contains the pieces for steps 43-47..

#### Building Instructions:

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

#### Mission 1: Drone Survey

##### Main Build

1.1. We'll start by building the base of the assembly! Place a red 4x6 plate, horizontally, in front of you.

1.2. Place a red 2x2 slope brick, with the slope on the left, on the left two columns of the previous piece so the back sides are even.

2. Place another red 2x2 slope brick, with the slope on the left, in front of the previous piece.

3. Place a red 2x2 brick, centered vertically, to the right of the previous two pieces.

4.1. Place a red 1x2 brick with a hole, horizontally, in front of the previous piece. Repeat symmetrically on the back side.

4.2. Push a yellow 2L pin, from the front, into the hole on the front piece from the previous step so the pin extends 1L to the front. Repeat symmetrically on the back side. These pins do not have friction ridges and will spin freely.

5. Place a red 2x4 brick, vertically, on the rightmost two columns of the base.

6. Keeping it horizontal with the slopes on the left, flip the base assembly upside down. Place a red 2x2 round plate with a rounded bottom, upside down, on the second and third columns of anti-stud from the right end of the base so the front sides are even. Place another to the left of the first, then place two more behind the first two. You'll place a total of four pieces in this step and the leftmost and rightmost columns of anti-stud will be free.

7.1. Keeping the slopes on the left, flip the base right side up. Place a red 1x4 brick, vertically, on the rightmost column.

7.2. Place a red 2x4 brick, vertically, to the left of the previous piece.

8. Place the left column of a red 2x4 tile, vertically, on the right column of the previous piece. The right side will be even with the right side of the base.

## Group 2.

9.1. Next, we'll make a cable. Set the base aside for now. Place a black 32L axle, horizontally, in front of you.

9.2. Find a black axle and pin connector #1. This piece has a 1L axle connector on one side, and a perpendicular pin hole on the other. Push the axle connector of this piece, with the pin hole on the left facing front and back, onto the left side of the previous piece. Repeat symmetrically on the right side.

9.3. Place the base in front of you, with the pins at the front and back and the slopes on the left. Push the hole on the left side of the cable onto the pin on the back side of the base.

10.1. Next, we'll make a middle assembly. Set the base and cable aside for now. Place a transparent blue 2x4 plate, horizontally, in front of you.

10.2. Place the front row of a black 1x2 plate with a 1x2 inverted curved slope on one side, centered horizontally with the curved slope at the back, on the back row of the previous piece.

11. Repeat the previous step symmetrically on the front side.

12. Place a red 2x2 brick, centered vertically and horizontally, on the previous two pieces.

13.1. Find a dark gray 1x2 brick with a large socket joint on one side. This piece looks like a normal 1x2 brick with a large circle on one side. Place this, vertically with the socket on the left, to the left of the previous piece. Repeat symmetrically on the right side.

13.2. Push a red 1L pin with a stud on one side, horizontally with the stud on the left, into the hole on the left side of the left piece from the previous step. Repeat symmetrically on the right side.

13.3. Place a transparent black 1x1 round tile on the studs of each of the previous two pieces.

14. Place a white 2x8 plate, horizontally and centered horizontally and vertically, on top of the assembly. The left and right columns will overhang.

15.1. Place a white 1x2 brick with a hole, horizontally and centered horizontally, in front of the previous piece. Repeat symmetrically on the back side.

15.2. Push a tan 3L pin, vertically with the stop near the back, from the front into the hole of the front piece from the previous step. Repeat symmetrically on the back side. These pins do not have friction ridges and will spin freely.

16. Place the back row of a white 3x3 corner plate with a rounded corner, with the rounded corner at the back right, on the front row of the 2x6 plate so the left sides are even. Place another symmetrically to the right of the first. Repeat these two pieces symmetrically behind the first two. The top of the assembly should look like a plus sign.

17. Each of the four arms of the plus sign should have two rows of two studs. Place a black 2x2 round tile with a hole on each of these sets of studs. You'll place four pieces in this step.

18. Stack two transparent blue 2x2 bricks and place the stack, centered vertically and horizontally, under the 2x4 plate at the bottom of the assembly.

19. Now we'll attach the middle assembly to the cable and base. Place the base and cable, with the base at the left and the cable at the back, in front of you. Connect the hole on the right side of the cable to the pin on the back side of the middle assembly. Push the pin as far in as it will go so the pin extends 1L behind the cable.

20.1. Next, we'll make another cable. Set the rest of the assembly aside for now. Place a black 32L axle, horizontally, in front of you.

20.2. Push the axle connector of a black axle and pin connector #1, with the pin hole on the left facing front and back, onto the left side of the previous piece. Repeat symmetrically on the right side.

20.3. Place the rest of the assembly in front of you, horizontally with the base on the left and the middle assembly on the right. Push the hole on the left side of the cable onto the pin on the front side of the base. Push the right hole on the cable onto the pin on the front side of the middle assembly. Push it all the way back so the pin extends 1L in front of the cable.

Bag 2.

Group 3.

21. Next, we'll make a minifigure. Set the rest of the assembly aside. Assemble the minifigure by placing the torso on the legs and the head on the torso. The minifigure wears teal pants with lots of pockets, a red and white striped tanktop, and a brown vest. He has a big smile.

22. Assemble his helmet by clipping a black visor onto a white helmet and placing the helmet on his head.

23. Place a black video game controller into the minifigure's hands.

Group 4.

24.1. Next, we'll make another cable. Set the minifigure aside for now. Place a black 32L axle, horizontally, in front of you.

24.2. Push the axle connector of a black axle and pin connector #1, with the pin hole on the left facing front and back, onto the left side of the previous piece. Repeat symmetrically on the right side.

24.3. Place the entire assembly, horizontally with the base on the left, in front of you. Push the hole on the left side of the cable onto the free pin on the back side of the assembly.

25.1. Next, we'll make an assembly with a chair. Set the entire assembly aside for now. Place a light gray 6x6 round plate in front of you.

25.2. Place a light green 2x4 plate, vertically and centered vertically and horizontally, on the previous piece.

26.1. Place a light gray 2x2 round plate, centered vertically, to the right of the previous piece.

26.2. Place a dark gray 2x2 round tile with a single stud on the previous piece.

27. Place a light gray 1x2 plate, horizontally, on the front row of the 2x4 plate. Repeat symmetrically on the back side.

28.1. Place a light gray 1x2 brick with a hole, horizontally, in front of the front piece from the previous step. Repeat symmetrically on the back side.

28.2. Push a yellow 2L pin, from the front, into the hole on the front piece from the previous step. Repeat symmetrically on the back side. These pins do not have friction ridges and will spin freely.

29. Place a dark gray 2x2 curved slope tile, centered vertically with the tall side at the front, on the front two rows of the chair assembly. This piece will attach to the front 1x2 plate and 1x2 brick with a hole. Repeat symmetrically on the back side.

30. Push the long side of a black 5L L-shaped bar, upright with the short bar on top and pointing to the front, into the hollow stud of the 2x2 round tile with a single stud from step 26.2.

31. Place a lime green chair, with the column of studs on the left, centered vertically between the two 2x2 curved slope tiles.

32.1.1. Next, we'll make an assembly that looks like a radar dish. Place a gold telescope, with the stud on top, in front of you.

32.1.2. Place a gold 1x1 round plate with a hollow stud on the previous piece.

32.2. Place a transparent clear 3x3 dish on the previous piece.

32.3. Rotate the dish assembly so it's sideways with the telescope at the front. Push the short bar of the 5L L-shaped bar on the chair assembly through the hollow stud in the dish. Push the dish on as far as it will go.

33.1. Now we'll build the base for the chair. Place a light gray 8x8 round plate in front of you.

33.2. Place a black 4x4 turntable back, centered vertically and horizontally, on the previous piece. This piece looks like a 4x4 tile with a large circle on top.

33.3. Push the rest of the chair assembly, centered vertically and horizontally, down onto the previous piece until it clicks. The top of the chair assembly should spin freely on the base.

34. Now we'll attach the chair assembly to the rest of the assembly. Place the entire assembly, horizontally with the base on the left, in front of you. Push the pin on the back side of the chair assembly onto the hole on the rightmost cable.

35.1. Next, we'll make another cable. Set the entire assembly aside for now. Place a black 32L axle, horizontally, in front of you.

35.2. Push the axle connector of a black axle and pin connector #1, with the pin hole on the left facing front and back, onto the left side of the previous piece. Repeat symmetrically on the right side.

35.3. Place the entire assembly, horizontally with the base on the left, in front of you. Push the hole on the left side of the cable onto the free pin on the front side of the middle part of the assembly, and the hole on the right side of the cable onto the hole on the front side of the chair assembly.

#### Group 5.

36.1. Next, we'll build a stand. Set the entire assembly aside for now. Find a light gray 4x6 hollow brick with holes on four sides. This piece has three holes on four sides, and a rectangular 2x4 hole in the center. Place this piece, horizontally, in front of you.

36.2. Place a green 2x6 plate with two rounded corners, horizontally with the row of four studs at the back, on the back two rows of the previous piece.

37.1. Place a light brown 2x2 tile, centered horizontally, in front of the previous piece.

37.2. Place a green 1x2 plate with rounded ends, horizontally, to the left of the previous piece and in front of the 2x6 plate with rounded corners. Repeat symmetrically on the right side.

38.1. Place the front stud of a green 1x2 plate with rounded ends, vertically, on the left stud of the left piece from the previous step.

38.2. Place a green 1x3 plate with rounded ends, vertically, to the right of the previous piece so the front sides are even.

38.3. Place a red 1x1 round tile to the right of the middle stud of the previous piece.

39.1. Place the front stud of a green 1x2 plate with rounded ends, vertically, to the right of the previous piece.

39.2. Place the back row of a green 2x2 round plate to the right of the front stud of the previous piece.

40.1. Next, we'll attach some supports to the stand. Push a black 2L pin from group A, from the left, into the front hole on the left side of the stand. Repeat symmetrically on the right side.

40.2. Push the pin side of a blue 2L axle/pin combo from group B, with the axle side on the right, into the back hole on the left side of the stand. Repeat symmetrically on the right side.

40.3. Find a light gray 4x4 bent liftarm. This is two 4L liftarms connected at a 135 degree angle. The holes at each end are axle holes. Rotate this so it's vertical with the holes facing left and right and the front half of the liftarm sloping down. Push the back axle hole onto the axle on the left side of the stand. The third hole from the back will attach to a pin. Repeat symmetrically on the right side.

41. Push the axle side of a tan 2L axle/pin combo, with the pin on the left, from the left into the front axle hole on the left piece from the previous step. Repeat symmetrically on the right side. The pin side of this piece does not have friction ridges.

42.1. Place a light gray 2L pin connector, horizontally, in front of you. This piece looks like a cylinder with a pin hole on each end.

42.2. Push a yellow 2L pin, from the left, into the left side of the previous piece so the pin extends 1L to the left. This pin does not have friction ridges and will spin freely.

42.3. Repeat steps 42.1-42.2.

42.4. Take one of the assemblies we just made, with the pin on the left, and push it into the second hole from the front on the left 4x4 bent liftarm on the stand. Repeat symmetrically on the right side.

Group 6.

43.1.1. Next, we'll build a base for the stand. Set the stand aside for now. Place a dark gray 5x5 L-shaped brick with three holes on each leg, with the corner at the front right, in front of you.

43.1.2. Place a light gray 1x2 plate, horizontally, under the left two studs on the front row of the previous piece.

43.2.1. Place the back row of a dark gray 2x2 plate with two studs on one side, with the side studs at the front, to the right of the previous piece.

43.2.2. Place the left column of a dark gray 2x2 plate with two studs on one side, with the side studs on the right, under the third and fourth studs from the back of the L-shaped brick. The right column will stick out.

43.3.1. Place a light gray 1x2 plate, vertically, on the right column of the previous piece. Do not place this on the side studs.

43.3.2. Place another light gray 1x2 plate, horizontally, on the front row of the 2x2 plate with two studs that extends past the front row of the L-shaped brick. Do not place this on the side studs.

43.4.1. Place the front row of a dark gray 2x2 curved slope tile, with the tall side at the back, on the previous piece.

43.4.2. Place the right column of a dark gray 2x2 curved slope tile, with the tall side on the left, on the vertical 1x2 plate that's to the right of the L-shaped brick.

43.5. This is the first half of the base. Rotate this assembly 180 degrees so the curved slope tiles are at the back and right. Place the stand in front of you so it's horizontal with the studs on top and the pins in the liftarms at the front. Push the pin on the right side of the stand, from the left, into the back hole on the right column of the base. You may need to stand the base upright to do this.

44.1. Now we'll build the other half of the base! Set the stand and first half of the base aside for now. Place a dark gray 5x5 L-shaped brick with three holes on each leg, with the corner at the front left, in front of you.

44.1.2. Place a light gray 1x2 plate, horizontally, under the right two studs on the front row of the previous piece.

44.2.1. Place the back row of a dark gray 2x2 plate with two studs on one side, with the side studs at the front, to the left of the previous piece.

44.2.2. Place the right column of a dark gray 2x2 plate with two studs on one side, with the side studs on the left, under the third and fourth studs from the back of the L-shaped brick. The left column will stick out.

44.3.1. Place a light gray 1x2 plate, vertically, on the left column of the previous piece. Do not place this on the side studs.

44.3.2. Place another light gray 1x2 plate, horizontally, on the front row of the 2x2 plate with two studs that extends past the front row of the L-shaped brick. Do not place this on the side studs.

44.4.1. Place the front row of a dark gray 2x2 curved slope tile, with the tall side at the back, on the previous piece.

44.4.2. Place the left column of a dark gray 2x2 curved slope tile, with the tall side on the right, on the vertical 1x2 plate that's to the left of the L-shaped brick.

44.5. Rotate this assembly 180 degrees so the curved slope tiles are at the back and left. Place the stand and first half of the base in front of you, horizontally with the first half of the base on the right. There will be a pin on the left side of the stand near the bottom. Push this pin, from the right, into the back hole on the left column of the second half of the base.

45. Keeping the base and stand horizontal, rotate the stand forward as far forward as it will go. Place a light gray 1x4 plate, horizontally, under the second row from the back of the base. This will attach the two halves of the base.

46. Place a dark gray 1x4 tile, horizontally, on the second row from the back of the base. This will be directly above the previous piece.

47.1.1. Now, we'll add a small dish assembly to the stand. Set the stand aside for now. Place a black 1x2 plate with a short bar sticking up from one long side, horizontally with the bar at the front, in front of you.

47.1.2. Push the hollow stud of a white 2x2 dish, with the stud at the bottom, down over the bar of the previous piece. Push it down as far as it will go.

47.2. Place a gold 1x1 round plate with a hollow stud, upside down, on the previous piece. The bar should go into the hollow stud of this piece.

47.3. Place a gold telescope, with the stud at the bottom, on the previous piece.

47.4. Place the stand, horizontally with the open side of the base at the front, in front of you. Rotate the main part of the stand so it's upright, if you haven't already done that. Rotate the dish assembly so the dish is on top and the anti-studs are on the right. Place the 1x2 plate on the two side studs on the left side of the stand assembly.

47.5. Place the rest of the assembly, horizontally with the chair on the right, in front of you. Place the minifigure, with his legs bent so he's sitting, in the chair.

Congratulations! Now this build is complete!

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