FIRST® LEGO® League Challenge BIOGLOW™ Building Instructions

Mission 10: Fragile Microhabitats

This build is 64 pieces, and 23 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.

Liftarms - A liftarm 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. liftarms come in a variety of lengths, including a 1x1 liftarm which looks like a cylinder. Thick liftarms are as wide as a LEGO brick, and thin liftarms are half as wide as a LEGO brick, but not the same thickness as a LEGO plate! The holes in a liftarm 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 liftarms, 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 16. 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 10: Fragile Microhabitats
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 16 (3 groups of bricks)
Main Build

Group 1 contains the pieces for steps 1-8.
Group 2 contains the pieces for steps 9-14.
Group 3 contains the pieces for steps 15-23.

Building Instructions:

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

Mission 10: Fragile Microhabitats

Main Build

1.1. Let’s start by building a frame. Place a lime green 2L thick liftarm with one axle hole and one pin hole, horizontally with the pin hole on the left and the pin hole facing front and back, in front of you.

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

1.3. Push the axle side of a blue 2L axle/pin combo from group C, with the pin side at the front, into the axle hole to the right of the previous piece.

2. Push the left two holes on the bottom row of a green 3x5 L-shaped liftarm, with the 3L liftarm horizontally at the bottom pointing to the left and the 5L liftarm upright on the right pointing up, onto the front side of the previous two pieces.

3. Push a blue 3L pin from group B, with the stop ring at the back, from the front into each of the top two holes on the front side of the previous piece.

4.1. 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 piece so the 7L liftarm is upright at the bottom and the 3L liftarm is on top pointing to the right. The holes will be facing the front and back. Push the second and third holes from the bottom onto the front side of the previous two pieces. Push it all the way back so the pins extend 1L in front of it.

4.2. Push the axle side of a blue 2L axle/pin combo from group C, with the pin side at the front, into the top axle hole of the previous piece so it extends 1L to the front.

5.1.1. Now we'll make another small assembly. Place a lime green 2L thick liftarm with one axle hole and one pin hole, horizontally with the pin hole on the right and the holes facing front and back, in front of you.

5.1.2. Push a blue 3L pin from group B, with the stop ring at the back, from the front into the right hole on the front side of the previous piece.

5.2. Push a black 4L axle, from the front, into the hole to the left of the previous piece. Push it back until it extends 1L behind the 2L liftarm.

5.3. Push the left two holes on the bottom row of a green 3x5 L-shaped liftarm, with the 3L liftarm horizontally at the bottom pointing to the right and the 5L liftarm upright on the left pointing up, onto the front side of the previous two pieces.

5.4. Push the top two holes of the previous piece onto the bottom two pins on the front side of the rest of the frame assembly. The back side of the axle should go through the corner hole of the L-shaped liftarm on the rest of the frame.

6. Push a lime green 2L thick liftarm with one axle hole and one pin hole, horizontally with the pin hole on the right and the holes facing front and back, onto the axle and pin on the front side of the assembly at the bottom.

7.1. Push the pin side of a blue 2L axle/pin combo from group C, with the axle side at the front, from the front into the corner hole of the upright bent liftarm.

7.2. Push the leftmost axle hole of a brown 7x3 bent liftarm, with the 7L liftarm horizontally pointing to the right and the 3L liftarm on the left pointing down, from the front onto the axle side of the previous piece. The corner hole will attach to a pin.

8.1. Push a light gray 2L pin, from the back, into the leftmost free hole on the back side of the previous piece. There should be five free holes to the right of this piece. This piece does not have friction ridges and it will spin freely.

8.2. Push the top hole of a brown 3L thick liftarm, upright with the holes facing front and back, onto the back side of the previous piece.

Group 2.

9.1.1. Next, we'll build a grid of liftarms, so set the rest of the frame aside for now. Place a white 9L thick liftarm, horizontally with the holes facing up and down, in front of you. It will have a spider in the middle later on.

9.1.2. Push a tan 3L pin, upright with the stop ring at the bottom, from the top into the leftmost hole of the previous piece. This pin does not have friction ridges and will spin freely.

9.2. Push a light gray 2L pin, from the top, into the middle and rightmost holes of the 9L liftarm. These pins do not have friction ridges and will spin freely.

9.3. Push the front hole of a white 9L thick liftarm, vertically, from the top onto the leftmost pin on the assembly. Push the liftarm all the way down so the pin extends 1L above it.

9.4.1. Place a white 9L thick liftarm, horizontally with the holes facing up and down, in front of you.

9.4.2. Push a light gray 2L pin, from the top, into the leftmost, middle and rightmost holes of the 9L liftarm. These pins do not have friction ridges and will spin freely.

9.4.3. Repeat steps 9.4.1-9.4.2.

9.4.4. Push the leftmost pin on one of the 9L liftarms, from the bottom, into the center hole on the vertical 9L liftarm. Push the leftmost pin on the other 9L liftarm, from the bottom, into the back hole on the vertical 9L liftarm.

9.5. Push a white 9L thick liftarm, vertically with the holes facing up and down, onto the middle three pins on the assembly. Place another on the right three pins.

9.6. Push a red 1L pin with a stud on one side, with the stud on top, from the top into the third free hole from the back on the left piece from the previous step. This pin goes into the hole behind the center hole.

9.7. Place a black spider on the stud of the previous piece.

9.8. Now we'll attach the spiderweb, the grid we've just made, to the rest of the frame. Place the rest of the frame, with a 1x2 thick liftarm horizontally at the bottom and with the bent liftarms overhanging to the right, in front of you. Rotate the spiderweb so it's upright, with the pin on the front at the bottom left corner. Push this pin, from the back, into the rightmost hole on the bottom side of the frame assembly.

Sub-Build: Worm

10.1. Now we'll build an object that looks kind of like a worm. Place a light gray 4x4 bent liftarm, with one 4L liftarm horizontally on the bottom pointing to the left and the other on the right pointing up, in front of you. The holes will be facing front and back.

10.2. Push a yellow 3L axle, from the front, into the leftmost and rightmost axle holes on the previous piece. Push these in until the back sides are even with the back of the liftarm.

11. Push a light gray 2L pin from the back, into the second free hole from the left on the back side of the bent liftarm. This piece will be to the left of the corner hole of the bent liftarm. This piece does not have friction ridges and will spin freely.

12.1. Place a dark gray 5L thick liftarm, horizontally with the holes facing front and back, in front of you.

12.2. Push a blue 3L pin from group B, with the stop ring at the front, into the rightmost hole of the previous piece. Push it all the way back so it extends 1L in front and behind the liftarm.

12.3. Push the back side of the previous piece into the corner hole of the 4x4 bent liftarm. The left axle will slide through the second hole from the left on the 5L liftarm.

13. Place the leftmost axle hole of a brown 7x3 bent liftarm, with the 3L liftarm horizontally pointing to the right and the 7L liftarm on the left pointing down, onto the front side of the right 3L axle. Push it all the way to the back so the axle extends 1L in front of it.

14.1. Push a light gray 4x4 bent liftarm, with one 4L liftarm horizontally on the bottom pointing to the left and the other on the right pointing up, onto the two axles and one pin on the front side of the worm assembly.

14.2. Push a light gray 2L pin from the front, into the second free hole from the left on the front side of the bent liftarm. This piece will be to the left of the corner hole of the bent liftarm. This piece does not have friction ridges and will spin freely.

Group 3.

15.1. Now we'll make the neck of the worm. Set the rest of the worm aside. Place a lime green 7x3 bent liftarm, with the 7L liftarm horizontally pointing to the left and the 3L liftarm on the right pointing down, in front of you.

15.2. Push a yellow 3L axle into the leftmost axle hole of the previous piece so it extends 1L in front and behind the liftarm.

16. Find a dark gray cam. This piece is about 2x3 in size, is flat with no studs or gear teeth and is shaped like a tear drop. It has four axle holes in a line. Rotate this piece so the pointed side is at the left and push the rightmost hole onto the front side of the previous piece. Push it back until it touches the bent liftarm. Push another in front of the first. Repeat these two pieces on the back side of the axle. You'll place four pieces in this step.

17. Push the axle side of a tan 2L axle/pin combo, with the pin side at the front, into the leftmost hole on the front pair of cams. Repeat symmetrically on the back side.

18.1. Place a black 2L thin liftarm with two axle holes, horizontally with the holes facing up and down, in front of you.

18.2. Push a red 2L axle, from the top, into the leftmost hole of the previous piece so the back side is even with the back of the thin liftarm.

18.3. Rotate the previous two pieces so the axle is at the front and slide it through the corner hole of the bent liftarm and so the 2L liftarm is upright. The front side of the axle will extend just in front of the liftarm.

18.4. Push the bottom hole of a black 2L thin liftarm with two axle holes, upright with the holes facing front and back, onto the front side of the axle. The liftarm should point up and to the right.

19.1. Find an orange 3L axle and pin connector with two perpendicular pin holes. This looks like a 3L liftarm, except that the hole on one end is an axle hole that is perpendicular to the two pin holes. Rotate this piece so the axle hole is on the left with the holes facing left and right and so it is parallel with the 3L side of the bent liftarm. Line the axle hole up with the top axle holes of the two 2L thin liftarms.

19.2. Push a white 4L bar through the top holes of the two thin 2L liftarms. Push it through until it's centered front to back. It will also go through the axle hole of the previous piece.

19.3. Push a red 1L pin with a stud on one side, with the stud on top, from the top into the rightmost hole of the 3L axle and pin connector with perpendicular holes.

19.4. Push the stem of a gold T-shaped bar, with the stem at the bottom and the arms at the front and back, into the hollow stud of the previous piece.

20.1. Next, we'll make the worm's eyes. Place a lime green 1x1 round plate with a hollow stud in front of you.

20.2. Place a yellow 3L dish on the previous piece.

20.3. Repeat steps 20.1-20.2.

20.4. Find the bar on the front side of the worm. Rotate one eye so the stud is at the front and push the hollow anti-stud on the eye onto the front side of the bar. Repeat symmetrically on the back side with the other eye.

21. Push the rightmost hole of a brown 3L thick liftarm, horizontally with the holes facing front and back, from the back onto the leftmost pin on the worm.

22. Place the rest of the worm, with the single 7x3 liftarm pointing up and to the right, in front of you. The two 4x4 bent liftarms will be at the left on the bottom. Lift the neck of the worm and let the previous piece hang upright. Push the bottom hole of this liftarm, from the back, onto the pin on the back side of the rest of the worm at the bottom.

23. Push a brown 3L thick liftarm, upright with the holes facing front and back, from the front, onto the two pins on the front side of the worm near the bottom.

Congratulations! Now this build is complete!