

# FIRST® LEGO® League Challenge SUBMERGED<sup>SM</sup> Building Instructions

## Build 7: Artificial Habitat

This build is 163 pieces, and 41 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 the pieces:

This LEGO set comes in the bags labeled 14-15. 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 7 (7 groups of bricks)

Group A is empty for this build.

Group B contains all of the blue 3L pins from this bag. These pins have friction ridges.

Group C is empty for this build.

Group 1 contains the pieces for steps 1-10.

Group 2 contains the pieces for steps 11-16, not including the two light gray 5L axles from step 16.

Group 3 contains the pieces for steps 17-19, including the two light gray 5L axles from step 16.

Group 4 contains the pieces for steps 20-27, not including the two light gray 5L axles from step 27.

Group 5 contains the pieces for steps 28-35, including the two light gray 5L axles from step 27.

Group 6 contains the pieces for steps 36-41.

Building Instructions:

Main build.

Open groups B, and 1. You will use the pins from group B throughout the build.

1.1. The habitat is a long box with a square cross section. It has a hinged door at one end. We'll start the build by making the door. Place a blue 5L liftarm in front of you, horizontally with the holes facing the front.

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 all the way to the front so it extends 1L to the front and back. This pin does not have friction ridges so it should spin easily.

2. Push two blue 3L pins from group B, with the stop rings at the back, from the back, one into the hole to the right of the previous piece and one into the second hole from the right on the 5L liftarm. Push them all the way to the front so they extend 1L to the front and back.

3. Find two orange 2L pin connectors. These pieces look like smooth cylinders which are 2L long and have a small notch in the middle. Push one, with the holes facing front and back, from the front onto the leftmost pin. Repeat this symmetrically on the back side.

4. Push a blue 5L liftarm, horizontally with the holes facing the front, on the two free pins on the front of the assembly. Repeat this symmetrically on the back side. These two liftarms should extend 1L past the middle liftarm.

5. Push two blue 3L pins from group B, with the stop rings at the back, from the front into the second and fourth holes from the right on the front liftarm. These should extend 2L to the front. Repeat these symmetrically on the back.

6. Push a blue 5L liftarm, horizontally with the holes facing the front, onto the two front pins from the previous step, so that the sides are even with the liftarm behind it. Push this liftarm all the way back. Repeat this symmetrically on the back side.

7. Repeat the previous step with two more blue 5L liftarms. There should be no more free pins.

8.1. Find an orange axle and pin connector #1. This piece has a 1L axle connector on one side, and a perpendicular pin hole on the other. Place this piece, with the pin hole on the right with the hole facing the front, in front of you.

8.2. Push a tan 3L pin, with the stop ring at the back, from the back into the pin hole of the previous piece. Push it all the way to the front so it extends 1L to the front and back. This pin does not have friction ridges so it should spin easily.

8.3. Push a light gray 5L axle, horizontally, from the left into the axle hole of the orange axle and pin connector #1.

8.4. Keeping the axle at the left, push the front pin of this assembly, from the back into the back 2L pin connector on the door assembly.

9.1. Place an orange axle and pin connector #1 in front of you, with the pin hole on the right with the hole facing the front.

9.2. Push a light gray 2L pin, from the back into the pin hole of the previous piece. This pin does not have friction ridges so it should spin easily.

9.3. Push a light gray 5L axle, horizontally, from the left into the axle hole of the orange axle and pin connector #1.

9.4. Keeping the axle at the left, push the back pin of this assembly, from the front into the front 2L pin connector on the door assembly.

10.1. Place a light gray 7L liftarm in front of you, horizontally with the holes facing the front.

10.2. Push two blue 3L pins from group B, with the stop rings at the back, from the front into the second holes from the left and right ends of the previous piece. These should extend 2L to the front.

10.3. Push a light gray 7L liftarm, horizontally with the holes facing the front, onto the two front pins from the previous step, so that the sides are even with the liftarm behind it. Push this liftarm all the way back.

10.4. Keeping the two 7L liftarms horizontal with the pins at the front, push this assembly onto the backside of the door assembly so that the left hole of the front 7L liftarm attaches to the pin on the back left side of the door assembly.

Open group 2.

11.1. Now we'll start building the rest of the habitat. Set the door aside for now. Place a light gray 7L liftarm in front of you, vertically with the holes facing up.

11.2. Push two blue 3L pins from group B, with the stop rings at the top, from the top into the front and back holes of the previous piece. Push them all the way in so they extend 1L above and below the liftarm.

12. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the bottom onto the front pin from the previous piece. Repeat this with the back pin.

13. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the top onto the front pin on the assembly. Repeat this with the back pin. The liftarms should look like a capital letter I.

14.1. Find a red crab. Push the hollow stud of a red 1L pin with a hollow stud on one side, with the stud on top, up into the anti-stud on the bottom of the crab.

14.2. Push a dark gray 3L bar up into the bottom of the pin on the bottom of the crab. Push this all the way up until it stops.

14.3. With the crab on top with its arms facing the right, push this assembly down through the middle hole of the vertical 7L liftarm.

15. Now, place the door in front of you with the two axles at the left and the two longest liftarms at the back. Rotate the I-shaped assembly we just made 90 degrees so the holes all face left and right and the four horizontal 7L liftarms are standing upright. The crab should be on the left. Slide the bottom holes on the upright liftarms onto the axles on the left side of the door assembly. Because these are axles in pin holes they will not be rigid.

16.1. Now we'll build the top frame on the right side of the habitat. Place a yellow 5L axle vertically in front of you.

16.2. Find two yellow axle and yellow pin connectors #6. These pieces have two 1L axle connectors which form a right angle, and a perpendicular pin hole between them. Push this piece, with one axle connector facing the back and one facing left, from the front onto the previous piece. Place the other symmetrically at the back side.

Open group 3.

16.3. Push two light gray 5L axles, horizontally, from the left into the previous pieces.

16.4. Slide the two previous pieces from the right through the top two holes on the upright liftarms on the habitat. There should now be four axles extending 1L to the left of the habitat, one from each corner hole.

17.1. Now we will make end caps to connect the axles to the habitat frame. Place two light gray 5L axles vertically in front of you.

17.2. Push two light gray axle and pin connectors #6, with the axle connectors facing the back and the right, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

17.3. Stand one of these end caps upright with the axle holes at the right and push it onto the front two axles on the habitat assembly. Repeat this on the back with the other end cap.

18.1. Place two dark gray 2L liftarms in front of you, horizontally with the holes facing the front.

18.2. Push two light gray 2L pins, from the front into the holes of each of these (for a total of four pins).

18.3. Find the hole facing front and back on the top left corner of the front side of the habitat. Push the right pin of one of the 2L liftarms, from the back, into this hole. Repeat this symmetrically on the back. The two 2L liftarms should extend to the left.

19.1. Now we'll make some connectors to extend the habitat to the left. Place two light gray 5L axles vertically in front of you.

19.2. Push two light gray axle and pin connectors #6, with the axle connectors facing the back and the left, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

19.3. Push two light gray 5L axles, horizontally, from the left into each of the previous pieces (for a total of four).

19.4. Stand one of these extensions upright with the axles at the left and push the top right pin hole onto the top left pin on the habitat. Repeat this on the back with the other extension.

Open group 4.

20. Now we'll build another internal wall of the habitat, complete with crab. Set the rest of the habitat aside for now. Place a light gray 7L liftarm in front of you, vertically with the holes facing up.

21. Push two blue 3L pins from group B, with the stop rings at the top, from the top into the front and back holes of the previous piece. Push them all the way in so they extend 1L above and below the liftarm.

21. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the bottom onto the front pin from the previous piece. Repeat this with the back pin.

22. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the top onto the front pin on the assembly. Repeat this with the back pin. The liftarms should look like a capital letter I.

23.1. Find a red crab. Push the hollow stud of a red 1L pin with a hollow stud on one side, with the stud on top, up into the anti-stud on the bottom of the crab.

23.2. Push a dark gray 3L bar up into the bottom of the pin on the bottom of the crab. Push this all the way up until it stops.

23.3. With the crab on top with its arms facing the left, push this assembly down through the middle hole of the vertical 7L liftarm.

24. Now, place the habitat in front of you with door at the bottom on the right and the four axles at the left. Rotate the I-shaped assembly we just made 90 degrees so the holes all face left and right and the four horizontal 7L liftarms are standing upright. The crab should be on the right. Slide the top and bottom holes on the upright liftarms onto the axles on the left side of the habitat. Because these are axles in pin holes they will not be rigid.

25.1. Now we'll build the end caps for the left side of the habitat. Place two yellow 5L axles vertically in front of you.

25.2. Find two yellow axle and yellow pin connectors #6, with the axle connectors facing the back and the right, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

25.3. Keeping the axle vertical and the axle connectors on the right, push one end cap onto the bottom two axles on the habitat. Repeat this with the top end cap.

26.1. Place two dark gray 2L liftarms in front of you, horizontally with the holes facing up.

26.2. Push two light gray 2L pins, from the top into the holes of each of these (for a total of four pins).

26.3. Find the hole facing up on the front left corner of the top of the habitat. This is on the top end cap we just placed. Push the right pin of one of the 2L liftarms, from the bottom into this hole. Repeat this symmetrically on the bottom. The two 2L liftarms should extend to the left. We'll use these to attach the other half of the habitat.

27.1. Now we'll start building the other half of the habitat, starting with two end caps. Place the two yellow 5L axles vertically in front of you.

27.2. Find two yellow axle and yellow pin connectors #6, with the axle connectors facing the back and the left, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

Open group 5.

27.3. Push two light gray 5L axles, horizontally, from the left into each of the previous pieces (for a total of four).

27.4. With the door of the habitat at the right, push the front hole of one end cap, with the two light gray axles at the left, down into the top hole on the left front corner of the habitat. Repeat this symmetrically at the bottom.

28.1. Now we'll build another internal wall of the habitat, complete with crab. Set the rest of the habitat aside for now. Place a light gray 7L liftarm in front of you, vertically with the holes facing up.

28.2. Push two blue 3L pins from group B, with the stop rings at the top, from the top into the front and back holes of the previous piece. Push them all the way in so they extend 1L above and below the liftarm.

29. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the bottom onto the front pin from the previous piece. Repeat this with the back pin.

30. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the top onto the front pin on the assembly. Repeat this with the back pin. The liftarms should look like a capital letter I.

31.1. Find a red crab. Push the hollow stud of a red 1L pin with a hollow stud on one side, with the stud on top, up into the anti-stud on the bottom of the crab.

31.2. Push a dark gray 3L bar up into the bottom of the pin on the bottom of the crab. Push this all the way up until it stops.

31.3. With the crab on top with its arms facing the right, push this assembly down through the middle hole of the vertical 7L liffarm.

32. Now, place the habitat in front of you with the door at the bottom on the right and the four axles at the left. Rotate the I-shaped assembly we just made 90 degrees so the holes all face left and right and the four horizontal 7L liffarm are standing upright. The crab should be on the left. Slide the top and bottom holes on the upright liffarm onto the axles on the left side of the habitat. Because these are axles in pin holes they will not be rigid.

33.1. Now we will make end caps to connect the axles to the habitat frame. Place two light gray 5L axles vertically in front of you.

33.2. Push two light gray axle and pin connectors #6, with the axle connectors facing the back and the right, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

33.3. Stand one of these end caps upright with the axle holes at the right and push it onto the front two axles on the habitat assembly. Repeat this on the back with the other end cap.

34.1. Place two dark gray 2L liffarm in front of you, horizontally with the holes facing the front.

34.2. Push two light gray 2L pins, from the front into the holes of each of these (for a total of four pins).

34.3. Find the hole facing front and back on the bottom left corner of the front side of the habitat. Push the right pin of one of the 2L liffarm, from the back, into this hole. Repeat this symmetrically on the back. The two 2L liffarm should extend to the left.

35. Now we'll make some connectors to extend the habitat to the left. Place two light gray 5L axles vertically in front of you.

35.2. Push two light gray axle and pin connectors #6, with the axle connectors facing the back and the left, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

35.3. Push two light gray 5L axles, horizontally, from the left into each of the previous pieces (for a total of four).

35.4. Stand one of these extensions upright with the axles at the left and push the bottom right pin hole onto the bottom left pin on the habitat. Repeat this on the back with the other extension.

Open group 6.

36.1. Now we'll build another internal wall of the habitat, complete with crab. Set the rest of the habitat aside for now. Place a light gray 7L liffarm in front of you, vertically with the holes facing up.

36.2. Push two blue 3L pins from group B, with the stop rings at the top, from the top into the front and back holes of the previous piece. Push them all the way in so they extend 1L above and below the liffarm.

37. Push the middle hole of a light gray 7L liffarm, horizontally with the holes facing up, from the bottom onto the front pin from the previous piece. Repeat this with the back pin.

38. Push the middle hole of a light gray 7L liftarm, horizontally with the holes facing up, from the top onto the front pin on the assembly. Repeat this with the back pin. The liftarms should look like a capital letter I.

39.1. Find a red crab. Push the hollow stud of a red 1L pin with a hollow stud on one side, with the stud on top, up into the anti-stud on the bottom of the crab.

39.2. Push a dark gray 3L bar up into the bottom of the pin on the bottom of the crab. Push this all the way up until it stops.

39.3. With the crab on top with its arms facing the left, push this assembly down through the middle hole of the vertical 7L liftarm.

40. Now, place the habitat in front of you with the door at the bottom on the right and the four axles at the left. Rotate the I-shaped assembly we just made 90 degrees so the holes all face left and right and the four horizontal 7L liftarms are standing upright. The crab should be on the left. Slide the top and bottom holes on the upright liftarms onto the axles on the left side of the habitat. Because these are axles in pin holes they will not be rigid.

41.1. Now we'll build the end caps for the left side of the habitat. Place two yellow 5L axles vertically in front of you.

41.2. Push two yellow axle and pin connectors #6, with the axle connectors facing the back and the right, from the front onto each of the previous pieces. Repeat this symmetrically on the back side of the axle.

41.3. Keeping the axle vertical and the axle connectors on the right, push one end cap onto the bottom two axles on the habitat. Repeat this with the top end cap.

Congratulations! Now this build is complete!

Thank you so much for building this set!

Visit [bricksfortheblind.org](https://bricksfortheblind.org) for more accessible instructions and follow us on [Facebook](#) and [Instagram](#) to be the first to know when new instructions are available!

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