

FIRST® LEGO® League Challenge SUBMERGEDSM Building Instructions

Build 2: Coral Reef

This build is 110 pieces, and 37 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 3 and 4. Additional pieces are in the unlabeled bag. 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 2 (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.

Sub build:

Group 1 contains the pieces for steps 1-2 of the sub build.

Group 2 contains the pieces for step 3 of the sub build.

Main build:

Group 3 contains the pieces for steps 1-8 of the main build. This includes the dark gray 11x15 hollow frame from the unlabeled bag.

Group 4 contains the pieces for steps 9-11.

Group 5 contains the pieces for steps 12-19.

Group 6 contains the pieces for steps 20-24 and the two orange flowers from step 25.

Group 7 contains the pieces for steps 25-33.

Group 8 contains the pieces for steps 34-37.

Building Instructions:

Sub-build: Coral colonies

Open bags 3 and 4.

Open group 1.

1.1. First we will build three small coral colonies. Each is growing on a conical rock. Start by placing a transparent blue 2x2 round plate with a rounded bottom in front of you.

1.2. Place a dark gray 3x3x2 tall cone, centered vertically and horizontally, on the previous piece.

1.3. Place a dark tan 2x2 round plate with a single hollow stud on the previous piece.

1.4. Find a dark green seaweed frond. This has four individual fronds pointing upwards, and a short bar at the bottom. Push the short bar of this piece, with the fronds pointing up, down into the hollow stud of the previous piece. This completes the first coral colony.

2.1. Repeat steps 1.1-1.3 to build the second rock.

2.2. Find a purple coral frond. This looks kind of like a letter Y with a number of extra arms poking off of it. If you lay it flat on the table, it will have three studs facing up and three facing down. There is also one stud on one arm of the Y shape. Rotate the coral frond so that this stud points up and the three studs face away from you. The arm with the top stud should be on the left. Push the bar on the bottom part of the Y through the hollow stud of the back 1x1 flower plate.

Open group 2.

3. Repeat steps 2.1-2.2 to build the third rock. The coral frond for this rock is pink instead of purple.

Main build 2.

Open groups A, B and 3. You will use the pins from groups A and B throughout the build.

1.1. The first part we'll build is the base of the coral reef. Find a dark gray 11x15 hollow frame. This looks like two 15L liftarms connected by two 9L liftarms, forming an open rectangle. Place this piece horizontally in front of you.

1.2. Push four black 2L pins from group A, from the right into the front four holes on the right side of the previous piece so they extend 1L to the right.

2. Push a red 1L pin with a hollow stud on one side, with the stud on top, down through the front right corner hole on the top of the 11x15 frame. Push another, in the same orientation, down through the second hole from the back on the right column of the 11x15 frame. These pins have friction ridges and should not spin easily in the holes.

3. Push two black 2L pins from group A, from the back into the left two holes on the back side of the 11x15 frame.

4.1. Now we'll build the first of two upright supports. Place a green 3x5 L-shaped liftarm, lying flat with the short leg vertically on the left and the long leg horizontally at the front pointing to the right, in front of you.

4.2. Push a black 2L pin from group A, down into the rightmost hole on the piece from the previous step. Push another down through the second hole from the left on the piece from the previous step. There should be two free holes between these pins.

4.3. Push a green 9L liftarm, horizontally with the hole facing up, onto the pins from the previous step, placing the leftmost hole onto the left pin so the 9L liftarm overhangs the L-shaped liftarm by five holes to the right.

4.4. Push a black 2L pin up into the rightmost hole of the piece from the previous step. Push another up into the hole to the right of the L-shaped liftarm.

4.5. Rotate this assembly so it stands upright, with the short leg of the L-shaped liftarm pointing to the back and the two pins from the previous step free at the top right. Push the assembly from the right onto the back two pins on the right side of the 11x15 frame.

5.1. Now we'll make the second upright, which is a mirrored version of the first. Place a green 3x5 L-shaped liftarm, lying flat with the short leg vertically on the left and the long leg horizontally at the back pointing to the right, in front of you.

5.2. Push a black 2L pin from group A, down into the rightmost hole on the piece from the previous step. Push another down through the second hole from the left on the piece from the previous step. There should be two free holes between these pins.

5.3. Push a green 9L liftarm, horizontally with the hole facing up, onto the pins from the previous step, placing the leftmost hole onto the left pin so the 9L liftarm overhangs the L-shaped liftarm by five holes to the right.

5.4. Push a black 2L pin from group A, up into the rightmost hole of the piece from the previous step. Push another up into the hole to the right of the L-shaped liftarm.

5.5. Rotate this assembly so it stands upright, with the short leg of the L-shaped liftarm vertically at the front and the two pins from the previous step free at the top right. Push the assembly from the right onto the front two pins on the right side of the 11x15 frame.

6.1. Push two green 9L liftarms, standing upright with the holes at the left and right, from the right, one onto the two free pins on the right of each of the two uprights. The bottom holes of the 9L liftarms should attach to the bottom pins.

6.2. Push a black 2L pin from group A, from the left, into the top hole of each of the two pieces from the previous step. Push another black 2L liftarm, from the left, into the fourth hole from the top of each of the two pieces from the previous step.

7. Push two green 9L liftarms, standing upright with the holes at the left and right, from the left onto the two sets of pins from the previous step. The bottom holes of the 9L liftarms should attach to the bottom pins.

8.1. Next we'll connect the two uprights. Place a green 3L liftarm, horizontally with the holes at the front, in front of you.

8.2. Push a black 2L pin from group A, from the front into each of the holes of the previous piece.

8.3. Push a green 2L liftarm with one axle hole and one pin hole, standing up with the axle hole at the top, from the front onto the middle pin from the previous step.

8.4. Keeping the 3L liftarm lying flat, rotate this assembly 90 degrees counterclockwise so the 2L liftarm is at the back with the holes facing left and right. Push the remaining two free pins from this assembly into the second holes from the top on the two uprights. The 2L liftarm should go between the uprights and the tops of all three should be even.

Open group 4.

9.1. Find a light gray 3L axle and pin connector with a perpendicular pin hole. This looks like a 3L liftarm where the center hole is perpendicular to the two end holes. The end holes are both axle holes. Place this, vertically with the pin hole on the top, in front of you.

9.2. Find two red 3L axle/pin combos. These have a 2L pin side and a 1L axle side. Push these, with the axle side on the right, from the left into the two axle holes on the left side of the previous piece.

9.3. Push this assembly, from the right, into the front and back top holes on the uprights. Push it all the way until it stops so the 3L axle/pin combos extend 1L past the liftarms.

9.4. Push a green 3L liftarm, vertically and lying flat with the holes on the left and right, from the left onto the exposed part of the pins from the previous step.

10.1. Now we'll make a strand of kelp. Find a green plant stem with a bar, bar holder, and two leaves. This looks like a cylinder that is hollow on one side and has a bar sticking out of the opposite side. There are two leaves midway down the cylinder. Place one, with the hollow side on the right and the leaves curving away from you, in front of you. Push the bar of another, from the right, into the hollow side of the first. Offset the leaves of the second 90 degrees from the first so the leaves curve down. Push the bar of a third, from the right, into the hollow side of the second. Offset the leaves of the third 90 degrees from the second so the leaves curve away from you.

10.2. Rotate this strand of kelp so the short bar of the first piece from the previous step is at the bottom with the leaves curving to the left and push this bar down through the hollow stud on the 11x15 frame behind the upright.

10.3. Make another strand of kelp that is only two stems tall.

10.4. Push the second strand of kelp down into the hollow stud on the front right corner of the 11x15 frame, with the bottom leaves curving to the left.

11. Find the holes on the front row on the inside of the hollow frame. There are seven of them on the front row, and another seven on the back row. Push a blue 3L pin from group B, with the stop ring at the front, from the back into the third hole from the right on the inside of the front row. Push another blue 3L pin into the hole to the left of this one. Push these pins all the way in so they extend 2L to the rear. Repeat these two pieces symmetrically on the back row of the 11x15 frame.

Open group 5.

12. Push a dark gray 3L liftarm, horizontally with the holes at the front, from the back, onto the front pair of pins from the previous step. Repeat this symmetrically on the back pair of pins.

13. Push a dark gray 3x5 L-shaped liftarm, with the long leg standing upright on the left and the short leg horizontally on the bottom pointing to the right, from the back, from the back onto the pins behind the front piece from the previous step. Repeat this symmetrically on the back pair of pins.

14.1. Find two dark gray 1L liftarms. These look like hollow cylinders. Place these, with the holes facing up, in front of you.

14.2. Push two tan 3L pins, with the stop rings at the bottom, down into the previous pieces. These pins do not have friction ridges and should spin easily in the holes.

14.3. Take one of the assemblies from the previous step and rotate it so the 1L liftarm is at the back. Push it, from the back, through the top hole of the front 3x5 L-shaped liftarm, pushing all the way until the 1L liftarm touches the L-shaped liftarm. Repeat this symmetrically on the back side.

15.1. Now we're going to build a rocking frame which holds some coral. Set the coral reef base aside for now. Find a light gray 11L liftarm with perpendicular holes. This looks like a normal 11L liftarm, except that every hole is perpendicular to its neighbors. Place this piece, horizontally with the smooth side on top, in front of you. The left and rightmost holes should be facing the front.

15.2. Push a yellow 2L pin from the front into the leftmost hole of the previous piece. This pin does not have friction ridges and should spin easily in the hole.

15.3. Push a black 2L pin from group A, from the front into the rightmost hole of the 11L liftarm. This pin does have friction ridges and should not spin easily in the hole.

16. Push a tan 3L pin, with the stop ring at the back, from the back into the hole to the left of the previous piece on the back side of the 11L liftarm, pushing it all the way until it stops. The rightmost hole on top of the liftarm should be between these two pins. This pin does not have friction ridges and should spin easily in the hole.

17. Find a yellow 3x7 panel. This piece has three pin holes on each short end, three pin holes on each long side, and four pin holes on the top and bottom, one near each corner. One side is flat, and one side has a gap between the two long rows of pin holes. Push this piece, vertically with the flat side at the top, from the front onto the two pins on the right side of the 11L liftarm.

18. Push two black 2L pins from group A, from the front, one into the left and the other into the right holes, on the front of the previous piece.

19. Now we'll attach the rocking frame to the rest of the coral reef. Place the coral reef base, with the uprights on the right, in front of you. Place the rocking frame in front of you, with the 11L liftarm at the back and the 3x7 panel on the right, from the front. Find the first front facing hole on the 11L liftarm to the left of the 3x7 panel. Attach the rocking frame by pushing that hole onto the pin extending from the back of the back L-shaped liftarm on the base.

Open group 6.

20.1. Now we'll build a coral tray which attaches to the rocking frame. Set the rocking frame aside for now. Place a dark gray 3x3 T-shaped liftarm, standing up with the flat part on the bottom and the holes facing left and right in front of you.

20.2. Find a light gray 3L pin connector with four pins. This looks like a 3L liftarm where the middle pin hole is perpendicular to the end holes. There are also two pins extending parallel to the middle pin hole from each end. When viewed from the front, it looks kind of like a capital letter I. Push this, oriented like a capital letter I with the pins pointing left and right, from the right into the front and back bottom holes of the previous piece.

21. 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 this, lying flat with the rounded sides at the front and back, from the right onto the two pins on the right side of the previous piece.

22. Push a light gray 3L pin connector with four pins, oriented like a capital letter I with the pins pointing left and right, from the right into the front and back holes on the right side of the previous piece.

23. Next, we will place five red 1L pins with a hollow stud on one side. Push them all, with the hollow stud on top, down into the assembly. Push one into each of the three holes on the front row of the assembly. Push two into the right and middle holes on the second row from the front on the 3x3x1 square liftarm.

24.1. Push a dark gray 3x3 T-shaped liftarm, standing up with the flat part on the bottom and the holes facing left and right, from the right onto the two pins on the right side of the assembly.

24.2. Push a yellow 2L pin from the right into the top hole of the previous piece. This pin does not have friction ridges and should spin easily in the hole. You should have two flowers with a bar on one side left over. These are orange ones which you'll use in the next step.

Open group 7.

25.1. Now we will add some flowers to the top of this assembly. Push an orange flower with a bar, with the bar on the bottom, down through the left hollow stud on the front row of the assembly. Push another orange flower down through the right hollow stud on the second row of the assembly.

25.2. Push a pink flower with a bar, with the bar on the bottom, down through the middle hollow stud on the front row of the assembly. This should be diagonally in front of the last flower from the previous step.

26.1. Find a reddish brown plant flower stem with a bar and six stems. This has a short bar on one side and six long stems. Push the short bar down through the hollow stud to the left of the flower in the second row.

26.2. Push a green bar with three leaves, with the leaves on top, down through the right hollow stud on the front row of the assembly.

27. Place the coral reef base back in front of you, with the upright on the right. Rotate the coral tray assembly so it is vertical, with the row of flowers on the left. The front 3x3 T-shaped liftarm should have a pin, and the back one should not. Push the top hole of the back T-shaped liftarm onto the pin on the left side of the rocking frame.

28. Push a light gray 11L liftarm with perpendicular holes, horizontally with the smooth side on top, from the front onto the pins on the front of the rocking frame. It should be in the same orientation as the back 11L liftarm with perpendicular holes. The rocker plate is held on by pins without friction ridges, so it will naturally tilt down towards the coral tray. This is ok.

29. Push a black 2L pin from group A, down into the middle hole on top of the previous piece. There should be two free pin holes on either side of this piece. Repeat this with the 11L liftarm on the back side of the rocking frame.

30. Push a green 9L liftarm, vertically with the holes facing up, from the top onto the two pins from the previous step.

31.1. Keeping the base flat, rotate the entire coral reef 180 degrees so the upright is on the left. Find the front facing pin on the front 11L liftarm of the rocking frame. Push the top hole of a dark gray 3L liftarm, standing upright with the holes facing the front, from the front onto this pin. This is attached to a pin without friction ridges so it will naturally hang straight down.

31.2. Push a yellow 2L pin from the front into the bottom hole of the previous piece. This pin does not have friction ridges and should spin easily in the hole.

32.1. Now we will make a mount for the mechanism which rocks the coral reef. Place a dark gray 7L liftarm in front of you, horizontally with the holes facing the front.

32.2. Push a tan 3L pin, with the stop at the back, from the front into the leftmost hole of the previous piece. Push it all the way in so it extends 2L to the front. This pin does not have friction ridges and should spin easily in the hole.

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

32.3. Push a dark gray 2L liftarm, horizontally with the holes facing forward, from the front onto the two previous pieces, pushing it all the way back until it touches the 7L liftarm.

32.4. Rotate the 7L liftarm so that it is horizontal with the 2L liftarm at the back right. The tan 3L pin should extend 1L to the back from the right hole. Now push this assembly from the front onto the two pins on the front side of the coral reef base so that there is no space between the base and the 2L liftarm.

33.1. Now we will make a linkage for the rocking mechanism. Place a dark gray 3x5 L-shaped liftarm in front of you lying flat with the short leg vertically on the left and the long leg horizontally at the back pointing to the right.

33.2. Push a dark gray 1L pin with a bar with a ball on it, with the ball on top, down into the third hole from the right on the previous piece. Including the ball, this piece is almost 3L long.

33.4. Push a yellow 2L pin down into the frontmost hole on the short leg of the L-shaped liftarm. This pin does not have friction ridges and should spin easily in the hole.

33.5. Push the back hole of a dark gray 2L liftarm, vertically with the holes facing up, from the top onto the previous piece. It should overhang 1L to the front of the L-shaped liftarm. This piece is not held on by a pin with friction ridges, so it will naturally spin when you move the assembly. This is ok.

33.6. Push a yellow 2L pin down into the frontmost hole of the previous piece. This pin does not have friction ridges and should spin easily in the hole.

33.7. Find the tan pin which faces to the back on the base. This is on the back of the 7L liftarm at the front right corner of the base. Rotate the linkage assembly so it is standing upright, with the short-leg of the L-shaped liftarm on top and the long leg on the right pointing down. The 2L liftarm should be at the top left, there should be a pin facing you on the top left, and a ball facing you on the right side. Push the bottom hole of the L-shaped liftarm onto the pin facing back which we just identified. Now, rotate the L-shaped liftarm counterclockwise until it touches the base. You may have to tilt the rocking frame counterclockwise so the liftarm can fit under it. The L-shaped liftarm will sit at an angle. Now, rotate the 2L liftarm on the left side of the L-shaped liftarm counterclockwise until it lays on the base pointing to the left.

Open group 8.

34. Find the 3L liftarm hanging down on the front of the rocking frame. Push a dark gray 7L liftarm, horizontally with the holes facing forward, from the front onto this pin and the pin on the 2L liftarm from the previous step. The 7L liftarm will need to be at a slight diagonal for this to work, and you may need to pull the 3L and 2L liftarms a little bit to get them to connect. If you push down on the left side of this liftarm, the coral tray will rock back and forth!

35. Keeping the bottom of the base flat on the ground, rotate the coral reef assembly 180 degrees so the uprights are on the right. 3. Push two black 2L pins from group A, from the front into the first and third holes on the left side of the front-facing holes on the bottom of the coral reef.

36. Push a dark gray 7L liftarm, horizontally with the holes at the front, from the front onto the previous two pins so that the left edge is even with the left edge of the coral reef.

37.1. Now we'll build an arm which extends off of the upright. Find a yellow 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 left with the hole pointing up, in front of you.

37.2. Push a black 1L pin with a ball on one side, with the ball on top, down into the pin hole of the previous piece.

37.3. Push a yellow 11L axle from the right into the axle connector on the axle and pin connector #1.

37.4. Push the axle of the arm assembly, with the ball facing up, from the left into the center hole on the top row of the upright. It should overhang the rocking frame.

Congratulations! Now this build is complete!

Thank you so much for building this set!

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