

NASA Mars Rover Perseverance & Space Hoverbike

Written by Daniel Turner and tested by Matthew Shifrin.

- Embark on an interplanetary adventure with this exciting miniaturized model of the iconic Perseverance rover, capturing the spirit of NASA's Mars exploration missions in a compact and collectible LEGO Technic set.
- 83 LEGO pieces: Perfect for a quick and satisfying build, ideal for on-the-go space explorers or expanding your LEGO Technic collection.
- Authentic details: Capture the essence of Perseverance with its six wheels, articulated suspension, rotating drill, and even a deployable Mars sample collection arm.

Some cool facts about the rover:

- Perseverance is based on the design of a previous rover, Curiosity, and they are both really big compared to previous designs. Previous rovers ranged from about the size of a small dog (the rover Sojourner) to roughly the size of a big washing machine or dryer (Spirit and Opportunity). Curiosity and Perseverance are about the size of a small SUV.
- The size of Curiosity and Perseverance meant it wasn't possible to land them using a combination of parachutes and airbags like previous designs used. Mars does not have much of an atmosphere, so the parachutes wouldn't slow the larger rovers down enough to land them safely. To avoid turning the rover into a bunch of tiny pieces spread over the surface of Mars, NASA developed a rocket powered Skycrane to slow down the rover and then lower it to the surface!
- No one had ever attempted that sort of design before because it was so complicated and risky, and Mars is so far away that if there was an issue NASA would have only found out 15 minutes after anything had happened.
- The large white cylinder at the back of the rover is for a radionuclide generator, often just called the RNG. This uses the heat generated by the decay of a radioactive "fuel" to power the rover. Previous rovers used batteries and solar panels, but it was found that the sun is too far away and there is too much dust on Mars for solar panels to power Perseverance throughout its mission. The RNG will provide power for years without stopping!
- The big mast on the rover is for cameras and a system called ChemCam. ChemCam basically shoots powerful lasers at rocks and then looks at the flash produced to identify elements. I am not exaggerating there, someone found out how to identify rocks by shooting lasers at them.
- Perseverance also brought along a little drone (Ingenuity) that became the first craft to fly on another planet!

Measurements:

- This set measures approximately 6 in. (15.25 cm) long, 3.5 in. (9 cm) wide, and 3 in. (7.5 cm) tall once complete.

An introduction to engineering

- LEGO® Technic buildable model sets feature realistic movement and mechanisms that introduce young LEGO builders to the universe of engineering

The front of the bag shows a white rover with black wheels and white and grey equipment. A mast with various sensors on top is pointed towards the viewer. A large white cylinder that covers the rover's power source is sticking up and outwards at a diagonal from the back of the rover. The front left wheel of the rover is articulated as though it is passing over a rock. The rest of the wheels are resting on the ground. The drill and sampling arm of the rover are facing to the left as though sampling from a rock on the surface of Mars. The background shows the rocky, barren, red-orange surface of the planet Mars. The sky is a very light light red-orange from the dust of the planet. The rocky hills of the planet Mars are in the background of the bag.

The build is 83 pieces and there are 19 steps to the build.

Welcome to Text-Based Building Instructions from Bricks for the Blind. Here is some helpful information on how to best use screen readers and browsers: bricksfortheblind.org/help-with-screen-readers. Before you start building, here are some terms we will 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: with the longest side going from front to back
- Horizontally: with the longest side going from left to right.
- Upright: pointing up towards the ceiling.
- 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.
- That one/ppp: previously placed piece.
- Plate: piece with studs.
- Tile: smooth piece without studs (unless otherwise specified)
- A jumper plate is a 1x2 plate with a single stud on top, or a 1x3 plate with only two studs on top.
- “Anti-stud” is a term for the portion of a LEGO piece which accepts studs, like the bottom of a plate or brick.
- 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 piece
- Centered-horizontally: even amount of space left and right of 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).

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, PDF versions are always online at [\[30682 LEGO Technic Mars Rover Polybag\]](http://30682.LEGO.Technic.Mars.Rover.Polybag). 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. 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.

Technic brick - a brick which contains one or more holes which accept technic pins.

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, 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 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

Sorting the pieces:

To begin a successful build, it helps to sort the pieces into groups, bags or small containers. Have a sighted friend or family member do this in advance following the instructions below. You will see that the pieces should be sorted into groups according to the building steps in the set. Doing this in advance makes locating the pieces easier. See below on how to sort the pieces to correspond to the steps in this set. Number the containers using letters A-Z, numbers or meaningful names. The parts will be collected into a small number of steps in the instructions. Example: Steps 1-3 means collect all the parts used in steps 1, 2 and 3, and put them in one container.

The 1st group contains the pieces for steps 1-4.

The 2nd group contains the pieces for steps 5-6.

The third group contains pieces for steps 7-9.

The 4th group contains the pieces for steps 10-11.

The 5th group contains the pieces for steps 12-13.

The 6th group contains the pieces for steps 14-15.

The 7th group contains the pieces for steps 16-17.

The 8th group contains the pieces for steps 18-19.

Now, let's get building!

Start Building

Step 1

First we will be building one side of the rover, with the back of the rover facing to the right and the front of the rover to the left. Find the white 1X3 cross block with axle holes and place it so the axle holes are to the front and back and the pin hole points towards the ceiling. A cross block is an oval 1x3 piece with two axle holes with a perpendicular pin hole in between them. Push the red 4L axle from the front into the cross-blocks left axle-hole until it protrudes completely to the back. The whole thing will make an L shape, you'll want to orient it so that the red axle is making the long part of the L and the open axle hole (the right one) on the cross block is closer to you.

Step 2

Take the thin white 4L beam, line up its left axle hole with the red 4L axle, and then slide the beam down the red 4L axle until it is flush with the cross block. The beam should be upright horizontally and the rightmost axle-hole will overhang to the right. Line up the grey 7L axle with the axle hole at the right end of the thin white 4L beam and slide it through the hole until there is an equal length of axle on each side of the thin white beam. The final result should look like a misshapen lower-case H in print.

Step 3

Take two of the dark grey 2L bars with stop rings, a white 1X2 brick with axle hole, and one medium grey rounded 1X2 plates. Put one end of each of the two 2L bars in the open studs of the white 1X2 brick so that they both stick straight up out of the white brick. Then line up the medium grey rounded plate so that the holes in the center of each stud on the plate are aligned with the two bars on top of the brick and with the bottom of the plate facing the top of the white brick. Slide the medium grey rounded plate down the two bars until it is flush with the stops in the middle of each bar. Line up the axle hole of the white 1X2 brick with the grey 7L axle and slide it on from the back, without changing the brick's orientation. The 1x2 rounded plate still points towards the ceiling. The whole thing at this point is arranged in the following order from front to back: cross block, thin white beam, white brick.

Step 4

Take the black 2l beam with angled bar, and hold it horizontally upright, so its bar points diagonally to the left towards the floor and slide the right hole of the beam onto the red 4L axle from the back. It will rotate freely for now, so don't worry about that for the time being.

Step 5

Slide the second thin white 4L beam, upright horizontally from the back, onto the red and grey axles. Then slide the second white 1X3 cross block symmetrically to the front cross block onto the red axle. Lay this build aside for a minute while we build another part of the rover.

Step 6

Make a part: take the white 2X4 bent beam. Hold it upright horizontally so the bent part is on the right with the bend facing up and the straight end is on the left. Insert the pin end of the 2L black axle with pin into the third hole from the left of the white 2X4 beam. The axle end of the 2L black axle will be pointed towards you. Align an axle hole of a thin white 1X4 beam with the axle side of the black 2L axle and then slide the thin white beam down the black axle until it is flush with the white bent beam. The 4l white beam will be upright horizontally with its left axle-hole overhanging the build to the left. Slide a red 4L axle through the axle hole of the third hole from the left of the thin white beam until the end of the red axle is flush with the opposite side of the white 2X4 bent beam. The beam will be upright horizontally with its left axle-hole overhanging the build to the left. The red 4L axle will go into the axle hole of the thin white beam's left end. Slide a second red 4L axle through the hole to the right of the previous piece, into the axle hole on the left side of the bent white beam until it is flush with the other side of the bent white beam. The arrangement should be in the following order (from left to right): a red 4L axle through the axle hole of a thin white beam, red 4L axle through the hole of the thin beam and the axle hole of the bent white beam, an empty hole, the black 2L axle with the pin end in the hole of the bent beam and through the axle hole of the thin white beam, and then the bent end of the bent white beam. All axles should be flush with the back of the bent beam. Turn the build 180 degrees so that the axles are at the back. Slide the far right 4L red axle of the structure you made here in Group 2 in between the two pins of the structure made in Group 1 and underneath the rounded white plate. You'll also want to slide the black axle in the Group 2 structure through the top hole of the black beam with angled bar. This will pin that black beam in place. The bar will now be angle to the left.

Step 7

Slide the axle hole of a thin white beam through the far right red 4L axle so that the hole to the right of the axle hole goes over the second red 4L axle and the black axle goes into the axle hole at the end of the thin white beam. From the back slide the axle hole of a white 1X4 bent beam over the right red 4L axle. This is the red axle that is not in between the pins. The bent end of the 1X4 bent beam will be facing up on the left. You have built the body of the rover!

Step 8

Stack two white 2X2 round bricks. Slide the center hole of the bottom 2X2 round brick onto the angled bar of the black beam that's part of Group 2. The two round white 2X2 bricks will be pointed up and to the left of the rover body and represent the rover's engine.

Step 9

Take two white Technic fork blocks. They look like open staples, or the print letter C, and put them on the table horizontally with the upright openings to the right. Slide a red 2L axle into one of the axle holes of each fork block. Make sure you slide that axle through until the end of the red 2L axle is flush with the inside face of the fork, not all the way in. Put a white 1X3 cross block into the forks so that the axle hole is aligned with the red axles. The cross-block's pinhole should face the ceiling. Then slide the red 2L axles all the way through the axle holes until each end of the two red 2L axles is flush with the outside of the two fork blocks. These are your two Group 3 assemblies. Keeping them upright, turn them so the cross blocks are to the right and slide the holes of one Group 3 assembly you just made onto the red axle and grey axle on the right side at the front of the rover. Put the second Group 3 assembly on the right side at the back. This will leave you with two "arms" sticking out from what will be the rover's front. To make things easier, it helps to rotate this whole rover body so these two arms are facing towards you.

Step 10

Put a grey axle into one axle hole of a thin white beam and a red 2L axle into the other axle hole. Both axles should be flush with the bottom of the thin white beam, and the thin white beam should be horizontally on the table. This is the Group 4 assembly. Align the grey axle with the axle hole on the left arm, the red 2L axle with the axle hole on the right arm, and the thin white beam is on the bottom side of the two arms. Slide both axles through the axle holes of each arm until the thin white beam is flush with the bottom of each arm.

Step 11

Put the grey worm gear in between the two arms and slide the reddish brown 5L axle with stop through the two holes in each arm until the stop on the reddish-brown axle is flush with the right arm. The gear will be placed horizontally upright. The reddish brown 5L axle will be poking through the hole on the left side, the side with the grey axle running through the axle hole of the left arm.

Step 12

Slide a white axle connector onto the end of the reddish-brown axle sticking out of the left side. Align a thin white 4x1 beam with the two axles pointing up through the axle holes of each arm so that the axle holes on each end of the thin white bar are in line with each axle.

Step 13

Slide a pearl gold 1X3 bar into a white axle connector. Clip two white clip bars onto the gold bar, one on top of the other, and then slide the axle hole of a white 2x1 brick with axle hole over the gold bar. This makes the mast of the rover. Then slide the open end of the white connector that makes up the bottom of the mast onto the grey axle.

Step 14

Put the dark grey thick eight tooth gear in between the two thin white 4x1 beams on the top and bottom of the arms, with the axle hole of the gear in line with the right-side hole of each thin white beam. Place a bent white 4x2 beam so that the holes are perpendicular to the surface of where you're building, like a Braille letter D. Insert the pin end of a black 2L axle with pin into the second hole from the left end of a bent white beam (the corner hole) so that the axle end is facing up. The long part of it will overhang to the front but that's ok. Insert the axle through the right-side hole of the thin white beam, the grey thick eight tooth gear, and through the right side hole of the thin white beam until the top side of the white bent beam is flush with the thin white bottom beam.

Step 15

Make a part: Take the two triangular three axle connectors and orient the two pieces so that the pinhole is pointing towards the ceiling, one axle connector points toward the left, the other points to the front right, and the third one points to the back right. Place a medium grey axle with ball in the left connector of each of the two three axle connectors. Place a stone-grey beam with axle in each of the front right connectors of the two three axle connectors. Place a grey 3L axle in the back right connector of each of the two three axle connectors and then place the axle connector end of a black angle connector #1 onto each of the two axles. These two parts make up the suspension assemblies of the rover and will be referred to as such going forwards. Slide the center hole of each part of the suspension assembly on the grey axles on each side of the rover, with the axle with ball end part of each assembly pointing up and the black angle connector end of each three axle connector pointing down and towards you. Attach the grey 6L link with stoppers (this looks like a 6l axle with pinholes on each end,) to the ball connectors on each side. The ball connectors should be on the top of the suspension.

Step 16

Make a part: Take a dark grey beam with perpendicular axles and orient it so one axle faces down and to the right, the other axle faces down and towards the left, and the hole is perpendicular to where you're building, like a Braille letter F. Insert a grey pin into the hole of the dark grey beam and a black angle connector #1 with the hole perpendicular to the surface of where you're building on the right hand axle. Place two black 1x2 thin beams upright onto the other axle, oriented so that the top axle hole of the beams is on top and the bottom axle holes are on the axle of the dark grey beam. The top axle holes of each beam should be facing in the same direction as the grey pin. Insert the grey pin of this structure into the hole connector on the back left side of the rover (Facing towards the front of the rover) the two black beams should be facing down and back.

Step 17

Make a part: Take a dark grey beam with perpendicular axles and orient it so one axle faces down and to the right, the other axle faces down and towards the left, and the hole is perpendicular to where you're building, like the Braille letter H. Insert a grey pin into the hole of the dark grey beam and a black angle connector #1 with the hole perpendicular to the surface of where you're building on the left hand axle. Place two black 1x2 thin beams onto the other axle, oriented so that the top axle hole of the beams is on top and the bottom axle holes are on the axle. Insert the grey pin of this structure into the hole connector on the back right side of the rover facing towards the front of the rover) the two black beams should be facing down and back.

Step 18

Make a part: Insert a black 2L pin into the hole of a grey beam with axle. Attach a white axle connector to the axle. Attach the axle end of a black 2L axle with pin into the other end of the white axle connector. Attach a grey beam with axle to the black Technic pin from the beginning of this step and orient it so that the axle is facing downwards. Insert the hole of a 180 degree angle connector onto the pin of the 2L axle and insert a dark grey bar into one axle hole of the 180 degree connector. Insert the axle at the end of the grey beam into the axle hole of the white beam at the front of the rover, the one that can move left and right. This will complete the rover's drill and sampling arm!

Step 19

To finish up, take 4 of the black wheels and insert a medium grey pin in the center hole. This pin will spin easily when inserted into a wheel. Put the other end of the pin in one of the four holes at the end of the rover's suspension arms and repeat until there are two wheels on each side. Specifically, you should have the front and middle wheels on at this point. The wheels should be facing outwards, away from the center of the rover. Take the two tan pins with axles and insert the pins into the remaining two wheels. Attach the axle end of the two pins into the axle connector end of the two dark grey 1.5L axles with perpendicular connectors. This step can be a bit fiddly, so don't worry if you have some trouble with it. You need to insert the axle end of each of the dark grey 1.5L axles with connectors you just attached the wheels to into the free axle holes of the two black half beams on each side. They're at the back of the rover, facing down. Make sure the wheel is oriented outwards. If you don't remember these, they were made in steps 16 and 17.

Congrats! You have a completed Perseverance rover! Now you're ready to roam the red planet! If you twist the white axle connector sticking out of the left side of the rover (if you were facing towards the front), you can swing the sample arm back and forth.

Thank you so much for building this set!

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