EXPERIMENT MANUAL

ROBOTICS

SMART MACHINES

ROVERS & VEHICLES



THAMES & KOSMOS

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Safety Information

WARNING. Only for use by children aged 8 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep packaging and instructions as they contain important information.

WARNING. Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.
Store the experiment material and assembled models out of the reach of small children.

WARNING. Do not aim at eyes or face.
Never launch heavy, sharp-pointed, or sharp-edged objects.

Safety for Experiments with Batteries

››› The wires are not to be inserted into socket-outlets. Never perform experiments using household current! The high voltage can be extremely dangerous or fatal!

››› To operate the models, you will need three AA batteries (1.5-volt, type AA/LR6) or three AA rechargeable batteries (1.2-volt, type AA, HR6/KR6), which could not be included in the kit due to their limited shelf life.

››› The supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.

››› Different types of batteries or new and used batteries are not to be mixed.

››› Do not mix old and new batteries.

››› Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.

››› Batteries are to be inserted with the correct polarity. Press them gently into the battery compartment. See page 2.

››› Always close battery compartments with the lid.

››› Non-rechargeable batteries are not to be recharged. They could explode!

››› Rechargeable batteries are only to be charged under adult supervision.

››› Rechargeable batteries are to be removed from the toy before being charged.

››› Exhausted batteries are to be removed from the toy.

››› Dispose of used batteries in accordance with environmental provisions, not in the household trash.

››› Be sure not to bring batteries into contact with coins, keys, or other metal objects.

››› Avoid deforming the batteries.

As all of the experiments use batteries, have an adult check the experiments or models before use to make sure they are assembled properly. Always operate the motorized models under adult supervision.
After you are done experimenting, remove the batteries from the battery compartments. Note the safety information accompanying the individual experiments or models!

Notes on Disposal of Electrical and Electronic Components

The electronic components of this product are recyclable. For the sake of the environment, do not throw them into the household trash at the end of their lifespan. They must be delivered to a collection location for electronic waste, as indicated by the following symbol:



Please contact your local authorities for the appropriate disposal location.

Dear Parents,

Before starting the experiments, read through the instruction manual together with your child and discuss the safety information. Check to make sure the models have been assembled correctly, and assist your child with the experiments. **We hope you and your child have a lot of fun with the experiments!**

FCC Part 15 Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, maybe cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different form that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC RF Exposure Statement

To comply with the FCC RF exposure compliance requirements, this device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with an accessory that contains no metal and that positions the device a minimum of 5 mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.



Kosmos Quality and Safety

More than one hundred years of expertise in publishing science experiment kits stand behind every product that bears the Kosmos name. Kosmos experiment kits are designed by an experienced team of specialists and tested with the utmost care during development and production. With regard to product safety, these experiment kits follow European and US safety standards, as well as our own refined proprietary safety guidelines. By working closely with our manufacturing partners and safety testing labs, we are able to control all stages of production. While the majority of our products are made in Germany, all of our products, regardless of origin, follow the same rigid quality standards.

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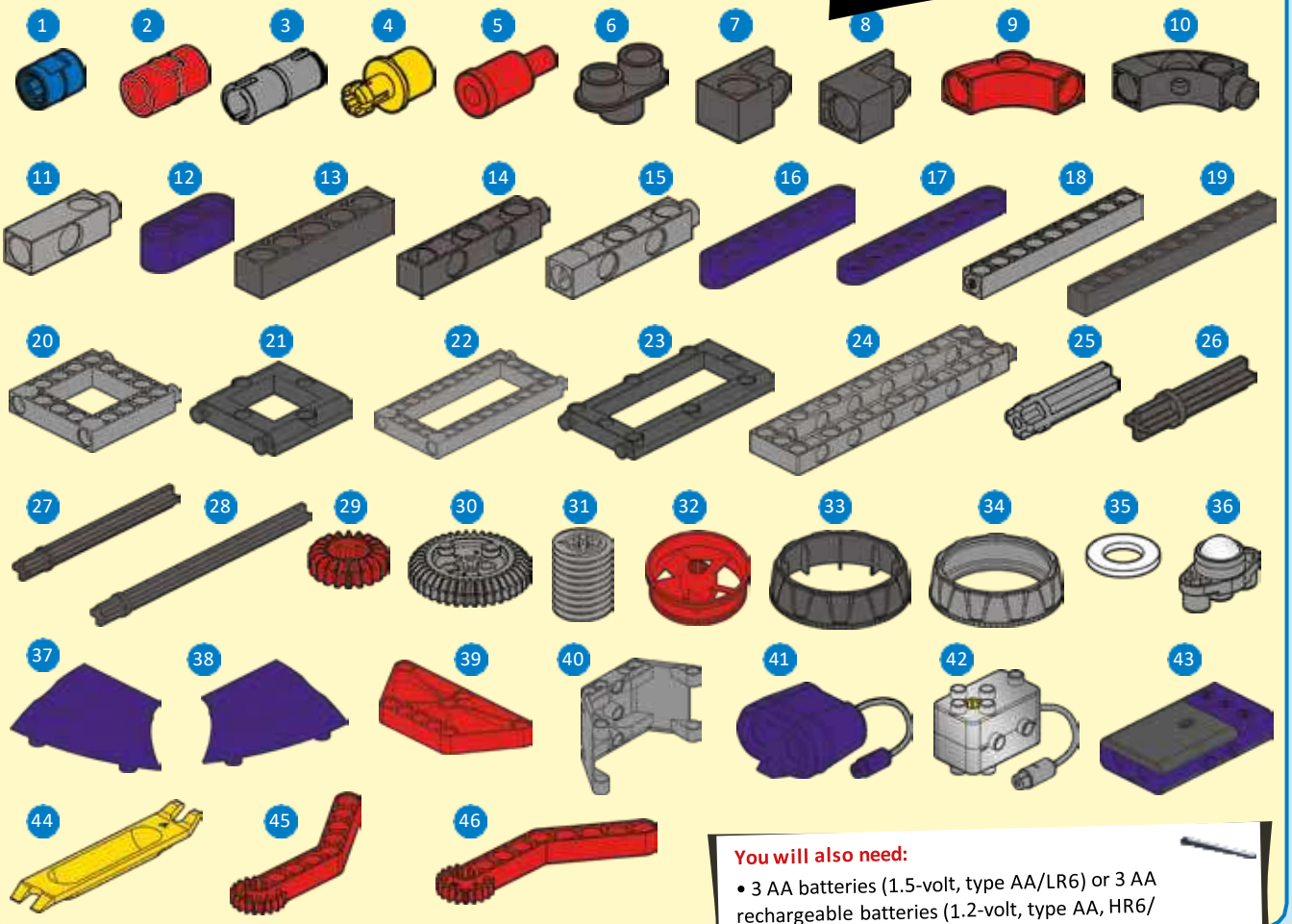
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What's inside your experiment kit:



You will also need:

- 3 AA batteries (1.5-volt, type AA/LR6) or 3 AA rechargeable batteries (1.2-volt, type AA, HR6/KR6) and a tablet or smartphone running iOS or Android (see page 7 for hardware requirements)

Checklist: Find – Inspect – Check off

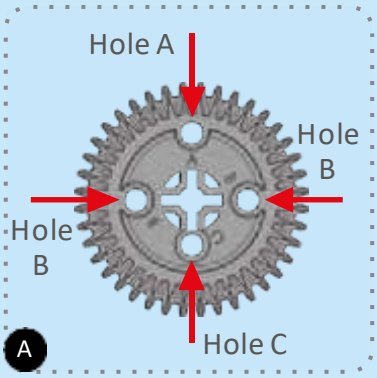
✔	No.	Description	Qty.	Item No.
○	1	Short anchor pin, blue	50	7344-W10-C2B
○	2	Anchor pin, red	28	7061-W10-C1R
○	3	Joint pin, gray	10	1156-W10-A1S1
○	4	Shaft plug	5	7026-W10-H1Y
○	5	Shaft pin	8	7026-W10-J3R
○	6	Two-to-one converter	4	7061-W10-G1D
○	7	90-degree converter X, black	2	7061-W10-J1D
○	8	90-degree converter Y, black	4	7061-W10-J2D
○	9	Rounded curved rod	2	3941-W10-C1R
○	10	Curved rod, black	6	7061-W10-V1D
○	11	3-hole dual rod, gray	4	7061-W10-R1S2
○	12	3-hole wide rounded rod, purple	7	7404-W10-C1P
○	13	5-hole rod, black	4	7413-W10-K2D
○	14	5-hole dual rod C, black	3	7026-W10-S2D
○	15	5-hole dual rod B, gray	3	7026-W10-S3S2
○	16	7-hole wide rounded rod, purple	7	7404-W10-C2P
○	17	7-hole flat rounded rod, purple	7	7404-W10-C3P
○	18	9-hole rod	3	7407-W10-C1S
○	19	11-hole rod	3	7413-W10-P1D
○	20	Square frame	7	7413-W10-Q1S1
○	21	Rounded square frame	2	7411-W10-F1D
○	22	Short frame	3	7413-W10-I1S1
○	23	Rounded short frame	2	7411-W10-E1D

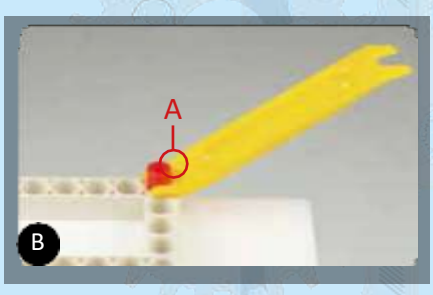
✔	No.	Description	Qty.	Item No.
○	24	3x13 dual frame	2	7406-W10-A1S
○	25	Motor shaft (27-mm axle)	6	7026-W10-L1S1
○	26	35-mm axle	2	7413-W10-O1D
○	27	70-mm axle	5	7061-W10-Q1D
○	28	100-mm axle	1	7413-W10-L2D
○	29	Small gear, red	7	7026-W10-D2R
○	30	Medium gear, gray	10	7346-W10-C1S
○	31	Worm gear	1	7344-W10-A1S1
○	32	Wheel, red	4	7392-W10-H1R
○	33	Tire, hard plastic	2	7392-W10-G1D
○	34	Tire, rubbery plastic	2	7413-W10-D1S
○	35	Washer	4	R12#3620
○	36	Ball roller	1	1247-W85-C1S
○	37	Body plate left, purple	1	7392-W10-L1P
○	38	Body plate right, purple	1	7392-W10-L2P
○	39	Trapezoidal plate	1	7408-W10-A1R
○	40	Trapezoidal cover	2	7408-W10-B1S
○	41	Ultrasonic sensor, purple	1	7416-W85-B-1
○	42	Motor (40x motor)	2	7400-W85-A1
○	43	Bluetooth battery box, purple	1	7416-W85-G-TK-1
○	44	Anchor pin lever	1	7061-W10-B1Y
○	45	Crankshaft gear A, red	1	7411-W10-C1R
○	46	Crankshaft gear B, red	1	7411-W10-C2R

Here are a few tips for assembling and using the models. Read them carefully before starting.

A. Pay attention to the hole alignment!

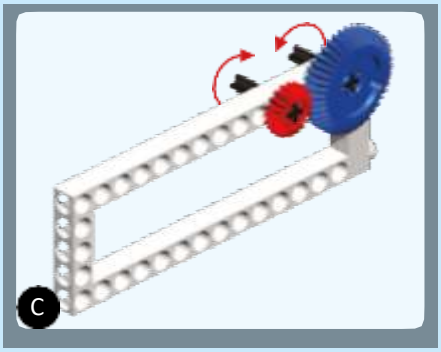
It is very important that you pay close attention to the alignment of the holes in the gear wheels. Make sure that you insert the shaft pins into the correct holes and that the gears are oriented exactly as shown in relation to each other and to the model. Otherwise, the robots will not move properly.





B. The part separator tool

In the box, you will find a little yellow tool called the anchor pin lever. End A of the part separator tool makes it easy to remove anchor pins from the frames.

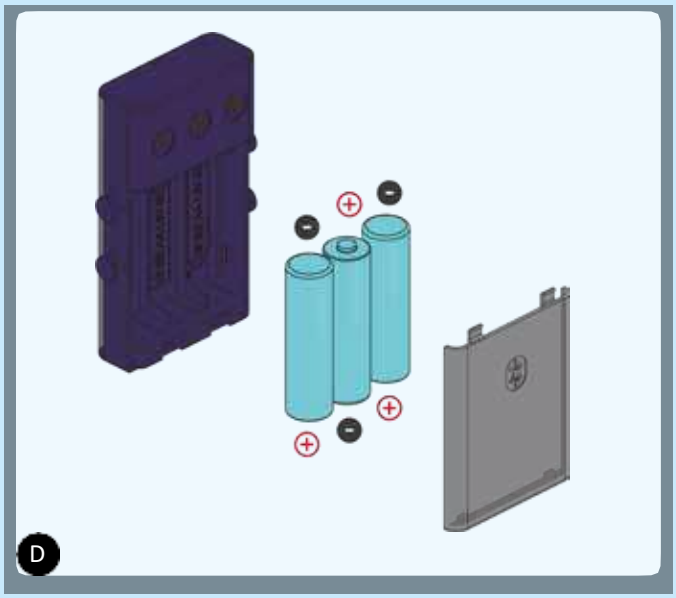


C. Gear wheels

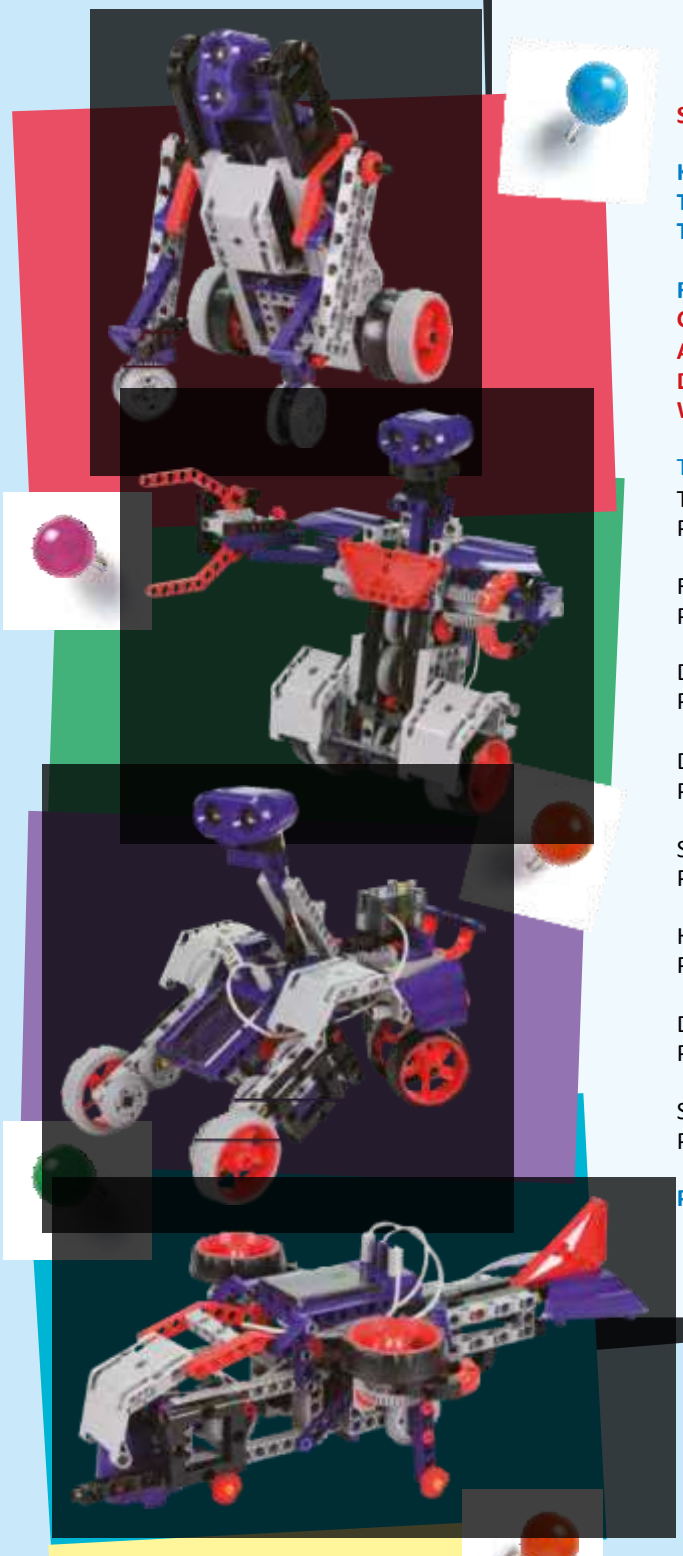
The models will often have several gear wheels installed in a row. In order for the models to work well, these gears will have to mesh well. Otherwise, the force from one gear wheel won't be properly transferred to the next.

D. Installing batteries in the Bluetooth battery box

Slide the transparent cover open. Insert the batteries according to the indicated plus-minus polarity. Close the compartment by sliding the cover back on.



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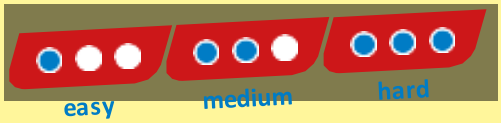
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Publisher's information .....Inside back cover

TIP!

Above each set of assembly instructions, you will find a red bar:

››› It shows you the difficulty level for the model's assembly:



Robots: Sensing, Thinking Machines

Robots are mechanical agents controlled by computer programs. They can be programmed to perform all sorts of tasks and movements. Robots can assemble cars, play soccer, vacuum floors, deliver packages, map terrain, climb mountains, entertain people, cook dinner — the list goes on and on. With this kit, you can build robots that use an ultrasonic sensor to sense their environment. With the app, you can program the robots' motors to behave in different ways depending on the data coming from the ultrasonic sensor. In this way, you can create different robots that perform different tasks!



GETTING STARTED

There are four primary types of functional components in this kit that enable the robots to work:

A. The Bluetooth battery box connects to the app on your tablet or smartphone via a wireless Bluetooth connection, and provides power to the motor units via wires.

B. The motor units connect to axles and motor shafts to turn gears and wheels, activating your models. They are powered by the batterybox.

C. The ultrasonic sensor sends out ultrasound waves and "listens" for them to bounce off of objects. It gives this information to the app.

D. The app is the "brain" of your robotic models. It uses the feedback from the ultrasonic sensor and program instructions to control the models.

These four elements, in combination with all the mechanical parts — rods, gears, axles, frames, and so on — allow you to build and program mechanical robots that can sense their surrounding using sound waves.

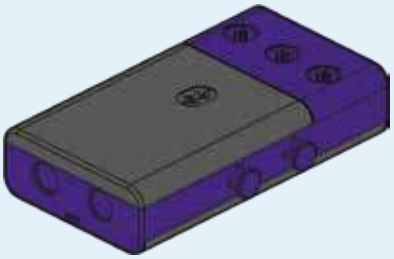
First, follow the assembly instructions starting on page 13 to build one ofthe models.

Make sure you have inserted the batteries correctly according to the battery information on page 2.

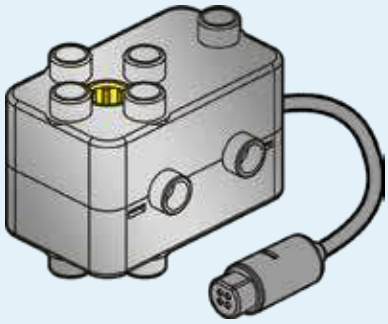
Shake the model until the blue light on the Bluetooth battery box turns on, indicating that the module is on. The module automatically turns off after about a minute of inactivity to save battery power. You simply have to jiggle the model when you want to turn it on again. It's a movement-activated on-off switch!

Now you can connect the tablet or smartphone to the model via the free app. Instructions to download and use the app start on page 7.

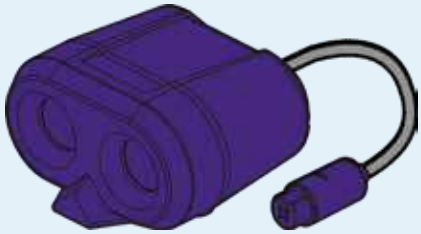
A



B



C



D

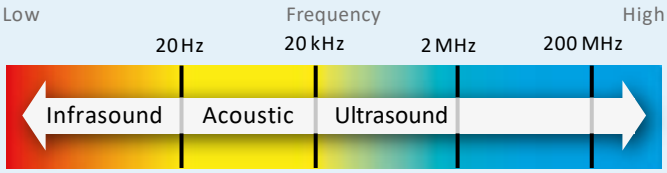


Robotics

ABOUT ULTRASOUND

Ultrasound is a sound pressure wave that moves through substances (gases, liquids, and solids) and has a frequency greater than that which humans can hear.

Frequency is simply the number of waves in a given period of time. Humans can hear sound waves in the frequency range of 20 hertz (which means cycles per second) to 20,000 hertz (20 kilohertz).

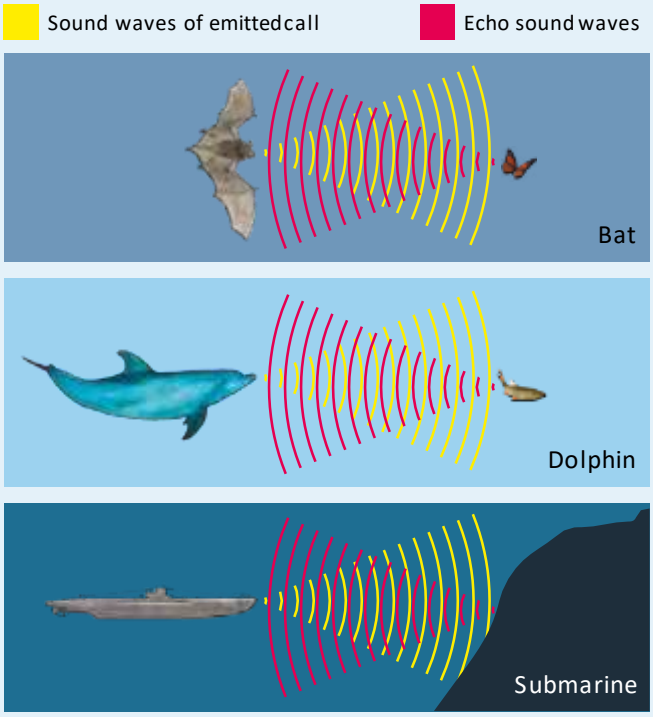


ANIMAL SONAR

In the natural world, bats, whales, and some birds use sound waves to detect objects around them. This is especially useful in the darkness of night or underwater, where seeing visible light is difficult or impossible.

This type of sensing is called **echolocation,** or biosonar. It works like this: The animal emits sound waves that move outward in all directions around it. When the sound waves hit an object, they bounce off of it and travel back to the animal's ears. The sound waves reach each of the animal's two ears at slightly different times. The animal can interpret this time difference to perceive the size, direction of movement, and speed of objects.

Animals use echolocation to hunt prey in the dark of night. They can also navigate and find their way around without normal eyesight.

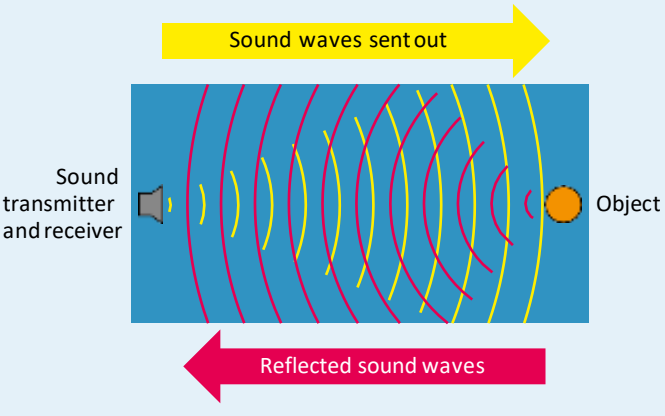


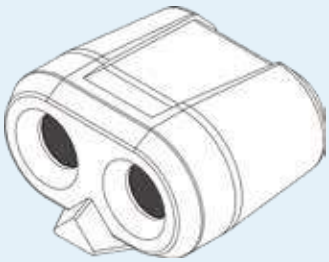
ACTIVE SONAR

Humans have developed a technology to replicate echolocation, which is called **sonar.** Sonar is an acronym for **SO**und **N**avigation **A**nd **R**anging. Sonar is used for navigation in submarines, ships, and airplanes. A similar technology using electromagnetic radio waves instead of sound waves is called **radar** (**RA**dio **D**etection **A**nd **R**anging).

With sonar and radar, airplane pilots are able to find their way and avoid collision with other planes, even in complete darkness or in thick clouds. Police use radar to detect speeding cars.

Your ultrasonic sensor also sends out sound waves. You can't hear them because they are ultrasonic! One "eye" on the sensor head is a transmitter and the other is a receiver. The transmitter sends out ultrasonic waves, like a speaker, and the receiver senses the waves that bounce back, like a microphone. In this way, the sensor is able to sense objects in front of it, even in the dark.





The ultrasonic sensor has one transmitter and one receiver.

DOWNLOADING AND USING THE APP

DOWNLOAD THE APP

You can download the free app for iOS devices from the iOS App Store, or for Android devices from Google Play.

- iOS devices must support Bluetooth 4.0 and must be running iOS 8.0 or later.
- Android devices must support Bluetooth 4.0 and must be running Android 4.4 or later.

To get the app:

1. Turn on your tablet or smartphone.
2. If you have a QR code reader installed, you can scan one of the QR codes to right to take you directly to the app download page for your device.
3. Alternatively, you can search for the "Robotics: Smart Machines" app or follow one of these links:
   iOS: www.thamesandkosmos.com/apps/620375/ios
   Android: www.thamesandkosmos.com/apps/620375/android
4. Follow the steps on the download page to download and install the app on your device.
5. Open the app and the remote control screen will appear.

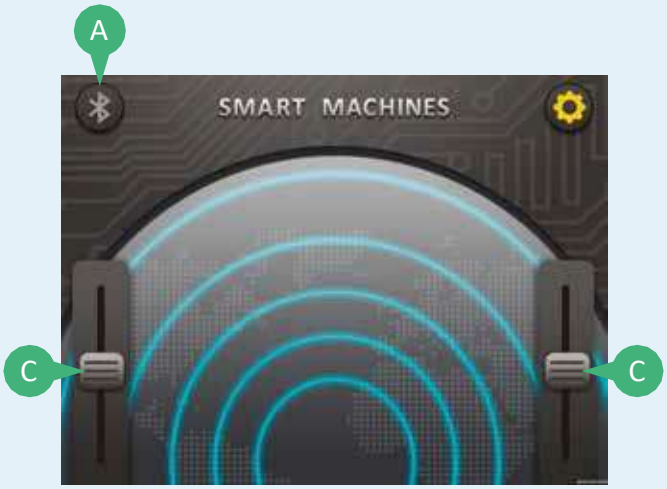
KOSMOS Robotics

iOS app

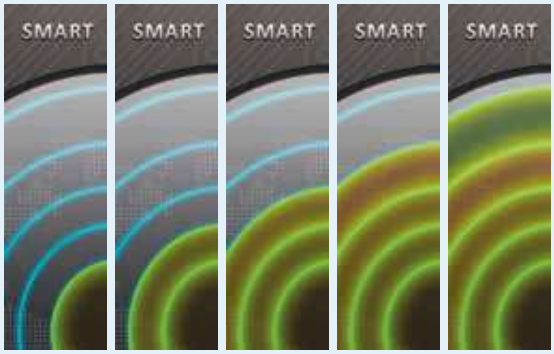
Android app

REMOTE CONTROL MODE

1. Connect the app to your model by pressing the Bluetooth button in the upper left corner (A).
2. When the connection has been made, the Bluetooth symbol will change color (B) and, if a motor is connected, the motor will drive for a second to indicate the connection has been made.
3. The ultrasonic functionality will now be available if the ultrasonic sensor is connected properly. The concentric circular rings indicate the relative distance to an object in front of the sensor. The ring lights up when an object is detected. Closer objects light up the inner rings; objects that are farther away light up the outer rings. Test it out by moving an object in front of the sensor.
5. You can use the two slider controls (C) to directly control the two motors on your models. Slide the slider up or down with your finger to make the motor spin clockwise or counterclockwise.







Object Near

Object Far

PROGRAMMING MODE

Press the gear icon (D) to enter the programming mode. When you press the icon, a list of programs appears. You can save up to sixteen programs. The app comes with demo programs preloaded in Programs 1-16. You will be using programs 9-16 in this kit.

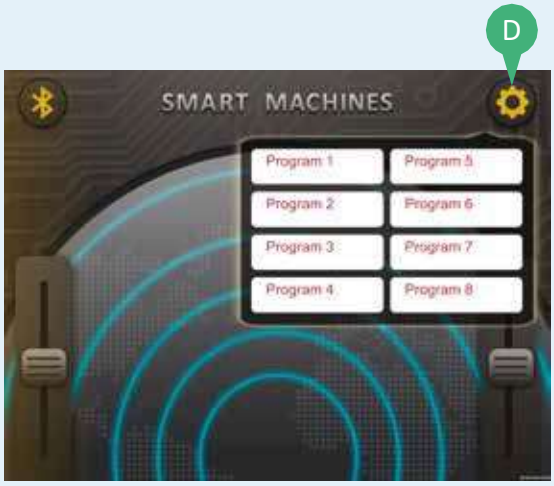
UNDERSTANDING THE ULTRASONIC DETECTION INTERVALS

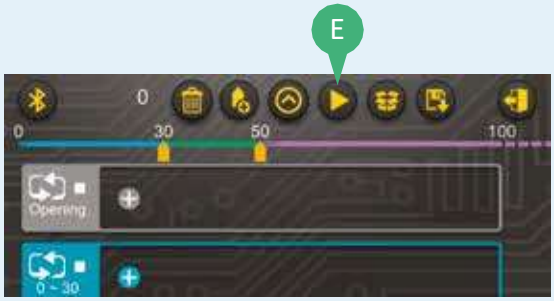
1. Enter Program 8 (the blank program). The programming screen appears.
2. The Go button (E) runs the program. When it is pressed, the number in the upper left (F) will start indicating the distance to the object that the sensor is detecting.
3. After you press the Go button, it becomes a Stop button (G) and the program runs. You can see in this example that the sensor is reading a distance of "21." This equates roughly to a distance of 21 centimeters. Press the Stop button.
4. The sensor distance indicator line (H) has adjustable ranges. Different program segments can run in each of these ranges. By default, there are three ranges. The first range marker (I) is set at 30 and the second marker (J) at 50. This means there are four program segments by default:

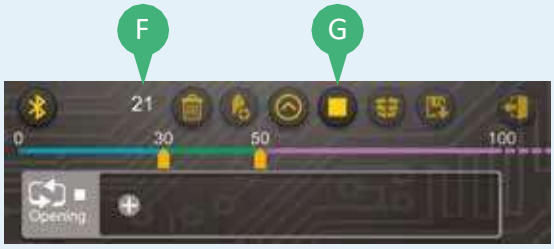
- The "Opening" program segment (K) runs once at the beginning when the Go button is pressed.
- When an object is detected between 0 and 30, the blue 0-30 segment (L) runs.
- When an object is detected between 30 and 50, the green 31-50 segment (M) runs.
- When an object is detected between 50 and 100, the purple >51 segment (N) runs.

You can slide the range markers to change the distance ranges. You can also increase the number of distance range segments by pressing the add range marker button (O). You can delete a segment with the delete button (P).

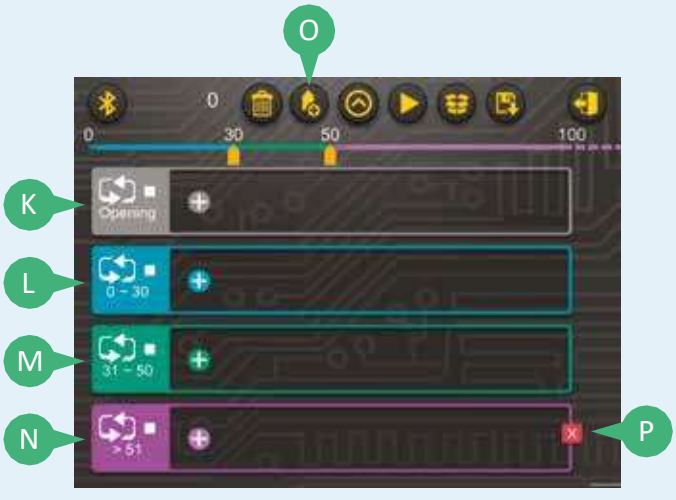
Range markers must be a minimum of 5 distance units apart. You cannot add a new range marker if there is another marker at 90 or higher.







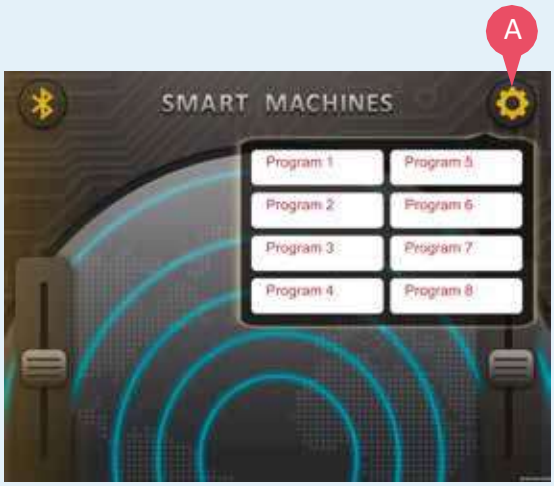






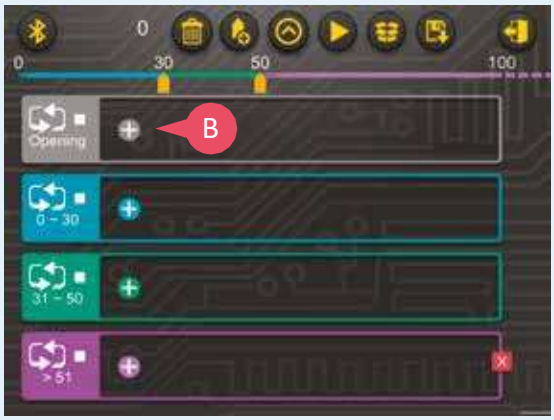
WRITING A PROGRAM

1. Now you are ready to write your first program. Click the gear button (A) to enter the programming mode. Choose a blank program (Program 8 starts out blank).



2. The programming screen appears.

3. Press the plus sign "+" button (B) in one of the program segments to add a command.



4. The commands menu (C) pops up. You can select between three types of commands:

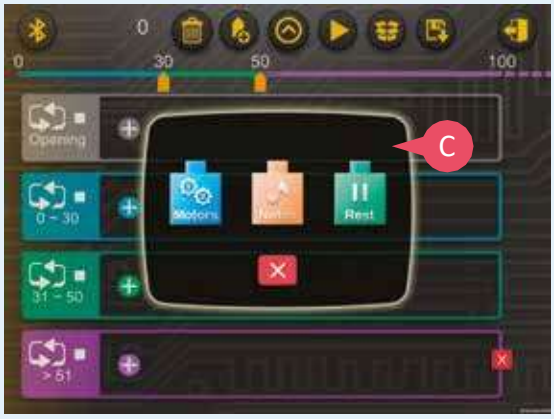
   • Choose Motors to add motor commands.

   • Choose Notes to add sound commands.

   • Choose Rest to add a pause command.

   Or press the red X button to exit the commands menu.

Continued on next page >>>



TROUBLESHOOTING THE SENSOR CONNECTION

If the sensor connection isn't working:

››› Disconnect and then reestablish the Bluetooth connection.

››› Make sure the sensor cable is securely plugged into the battery box.

››› Exit the program you are in and relaunch it.

PROGRAMMING MOTORS

1. Press the motors command icon and the motor programming window appears (D).

2. In the motor programming window, you can create a command to control motor one (blue) and/or motor two (red) to turn forward or backward. You can choose a relative speed from -4 (fastest in one direction) to 4 (fastest in the other direction).

Note: A positive speed (1-4) in the motor command doesn't always mean your model will move forward! You will have to test which direction results in the desired output direction on your specific models, because the orientation of the motor and the gearing will change the direction.

3. With the time slider (E), you can also set the duration for which the motor(s) will turn, from 0.5 to 5.0 seconds.

4. When you are satisfied with your selections, press the green check mark button and the motor block (F) appears in the program segment.

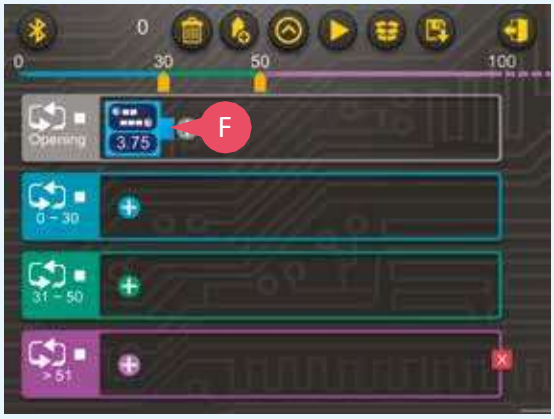
   The blocks show which motor(s) (G) the command will turn, and at what speed and in what direction (H) each motor will turn. Below that, it shows how long the motor(s) will turn (I).

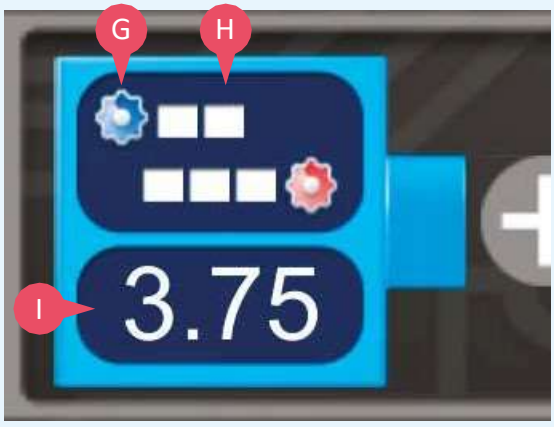
   The blue gear wheel represents motor one and the red gear wheel represents motor two.

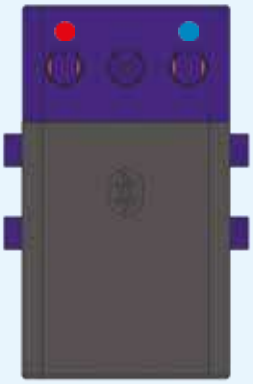
Tip! Add red and blue dots or stickers to the battery box and motors so you can easily keep track of which motor you are programming.

5. You can add more command blocks to the same segment by pressing the "+" button (B) again.









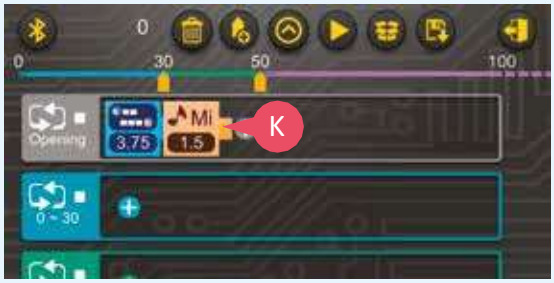
Motor indicator dots

PROGRAMMING SOUNDS

1. Press the notes command icon and the sound programming window appears (J).
2. In the sound programming window, you can create a command to make sounds. You can choose the pitch (Do, Re, Mi, Fa, Sol, La, Si, and Do) and the duration (0.5 to 5 seconds) for each note command.
3. Press the green check mark button and the note block (K) appears in the program segment.

   In this way, you can program a simple melody with multiple note blocks that will play when the program segment runs.





PROGRAMMING PAUSES

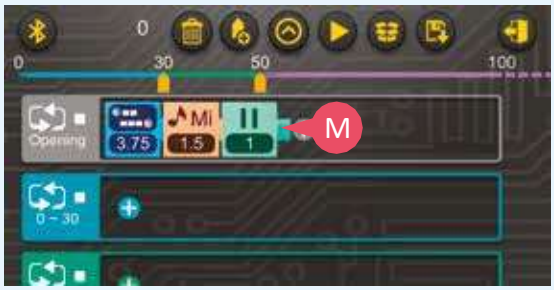
1. The last command option is to add a pause, or rest, to the program. Press the rest command icon and the rest programming window appears (L). You can choose the duration (0.5 to 5 seconds) of the pause in the program. Press the green check mark button and the rest block (M) is added to the program segment.



WRITING A COMPLETE PROGRAM

Following the previous instructions for adding commands, you can now go and write programs for all of the segments. You can think of the different actions you want your robot to perform when the ultrasonic sensor reads objects at different distances in front ofit.

Don't be afraid to try a lot of different ideas and play around with different combinations of command blocks in different distance range segments.



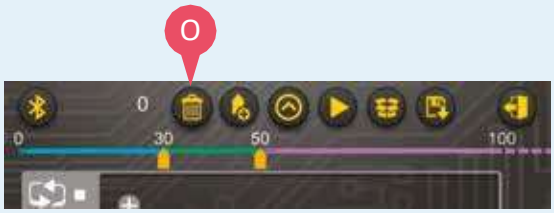
DELETING COMMANDS

To delete a command block, press the block you want to delete to open its programming window. Then press the trash button (N) in the bottom corner.



DELETE ALL

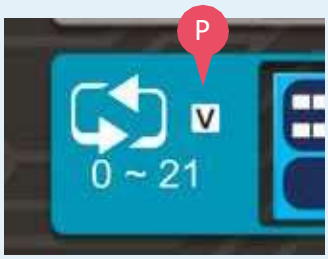
To clear an entire program and set it back to the default blank program mode, press the trash can button (O) in the menu bar. This also resets the range markers to the default settings.



LOOP CHECKBOX

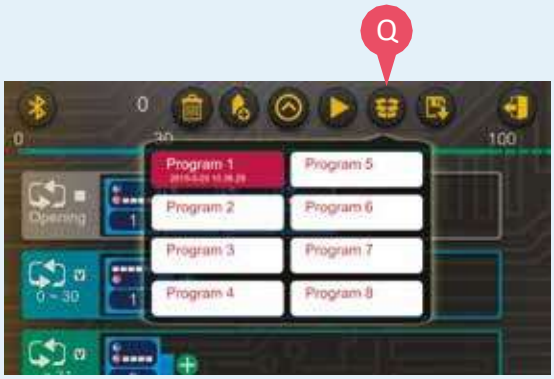
When the loop checkbox (P) is checked, the program segment will run in a continuous loop, over and over again, when the program segment is active.

When the loop checkbox is unchecked, the program segment will run just once when the program segment is triggered.



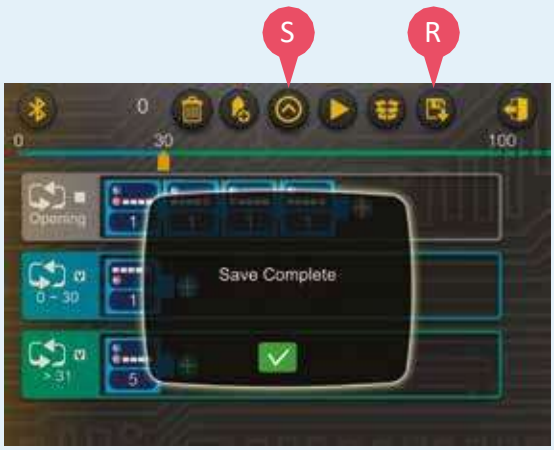
SWITCHING BETWEEN PROGRAMS

If you want to move to a different program, click the storage box button (Q) and select which program you want to open.



SAVING PROGRAMS

When you want to save a program you have written, press the disk button (R). The program script will immediately be saved inside the program (1-6) you are currently in. A confirmation screen will appear.



REVERT TO SAVED

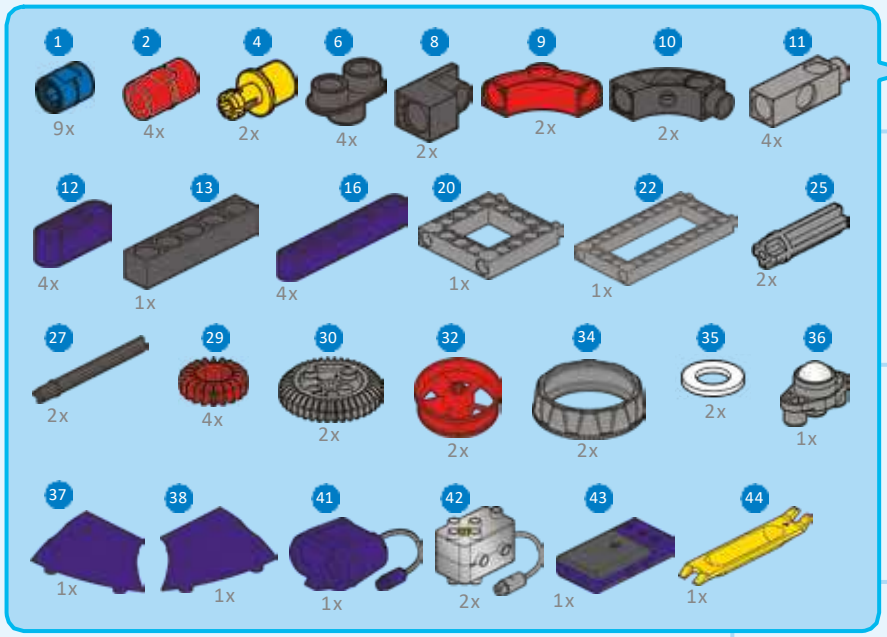
To revert to the last saved version of the program and erase all unsaved changes, press the revert to saved button (S).

EXITING PROGRAMMING MODE

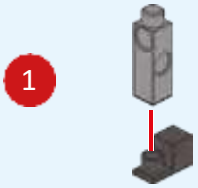
When you want to leave the programming screen, press the door button (T). A window will pop up asking if you are sure you want to leave the programming screen. Press the green check mark button to go back to the main remote screen.



TURTLE ROBOT

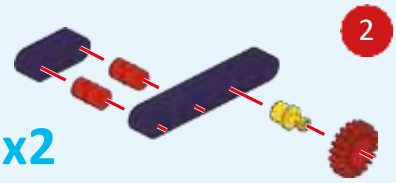


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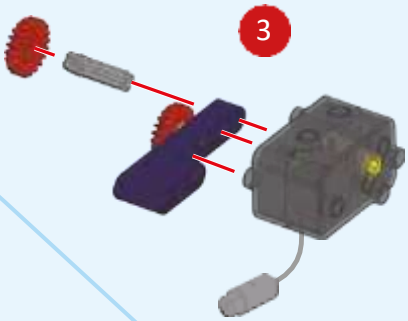
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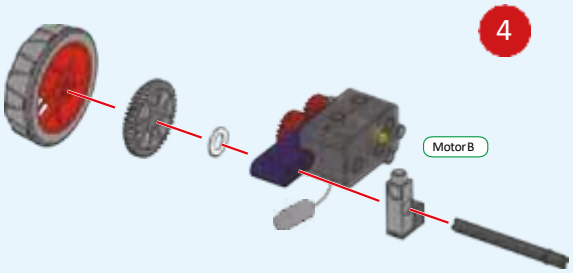


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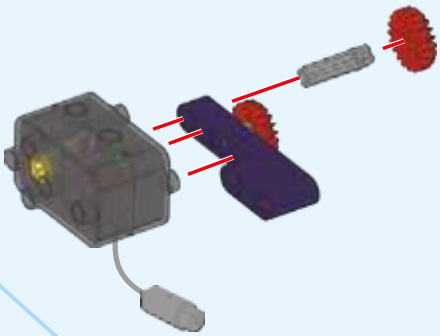
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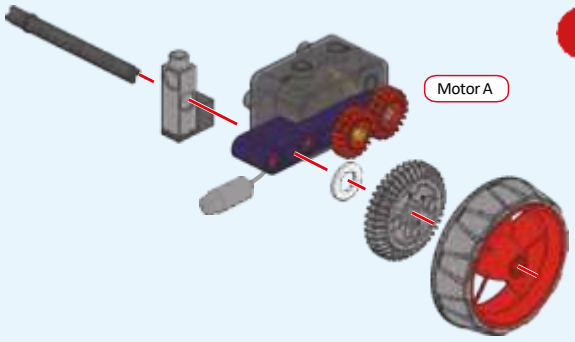
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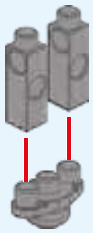
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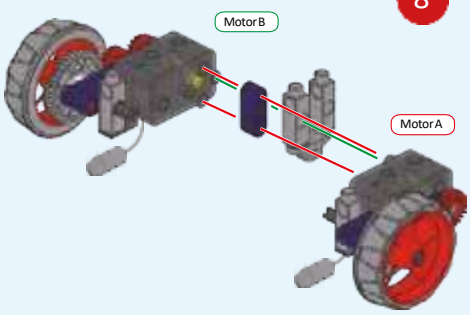
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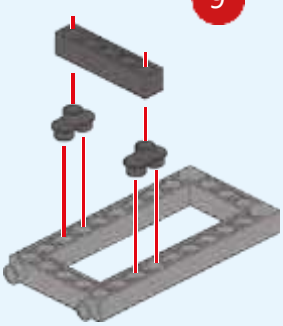
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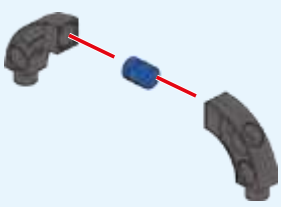
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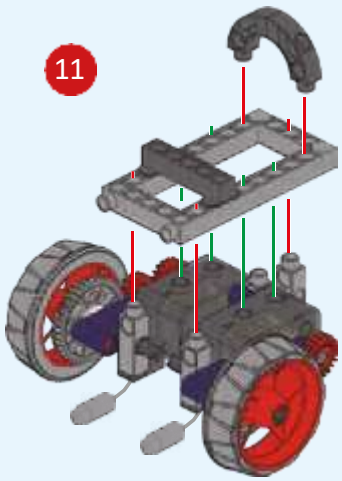
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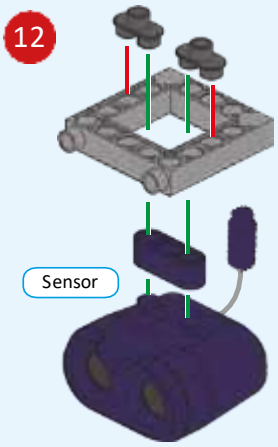
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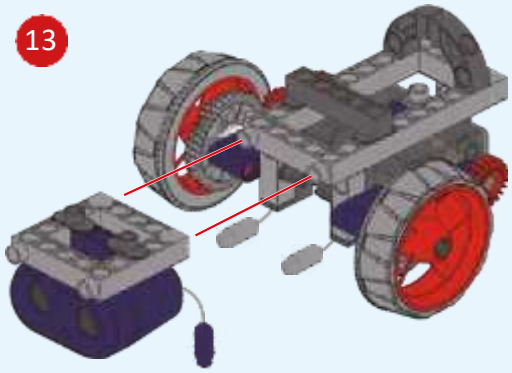
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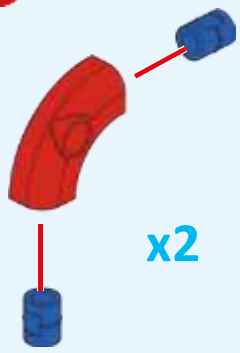
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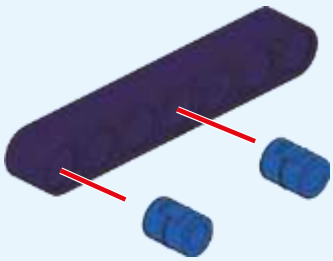
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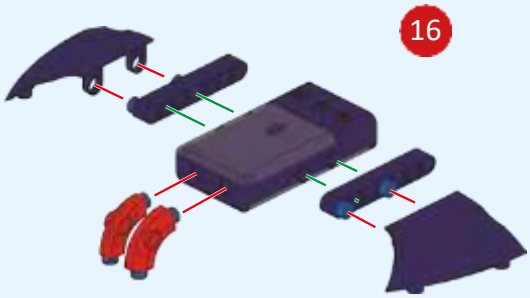
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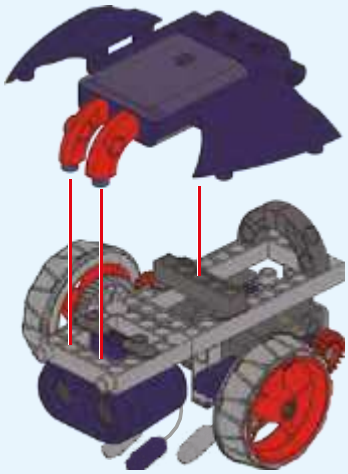
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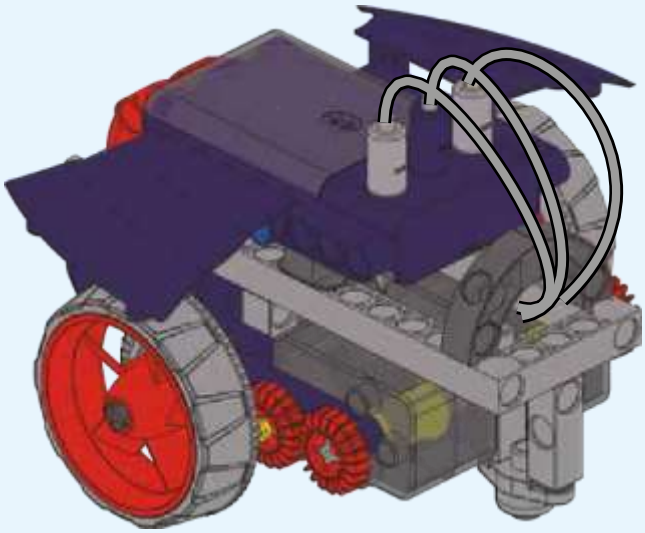
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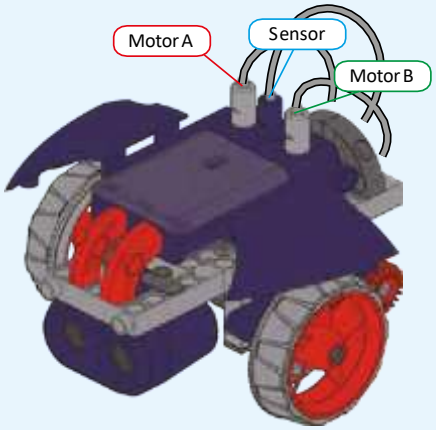
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18



Done!



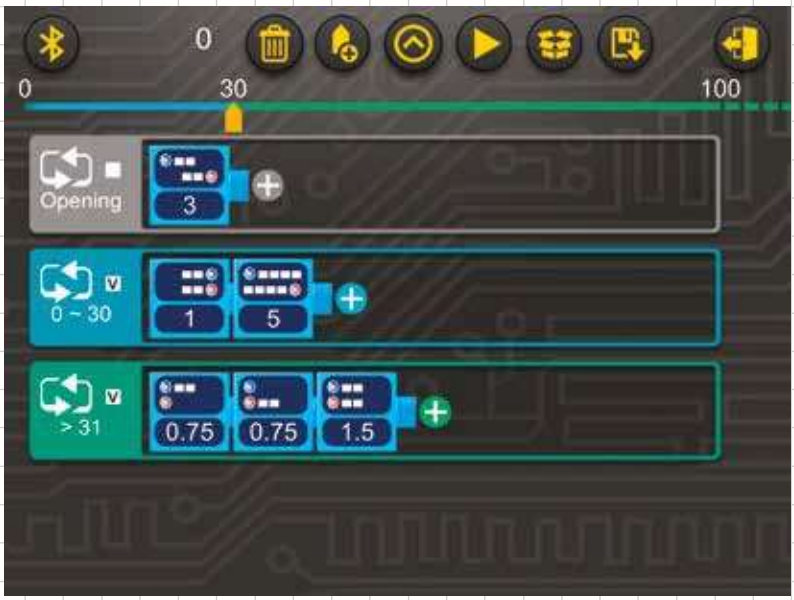
PROGRAMMING



SAMPLE PROGRAM FOR THE TURTLE ROBOT

The turtle robot is very timid! It will quickly move to avoid any object that is in front of it. When this program runs, the turtle robot will move forward until it detects an object with the ultrasonic sensor. The turtle robot will back away, turn, and then move forward in a new direction.

This program is preloaded in the app under Program 9. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 9

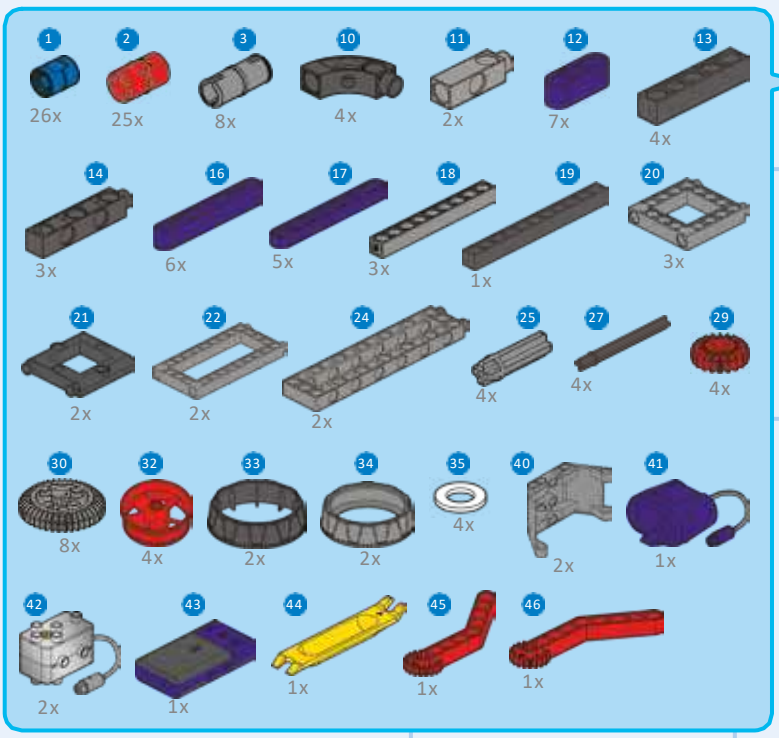
OPENING SEGMENT:

SEGMENT 0-30:

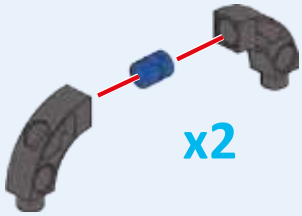
SEGMENT >31:

PROGRAMMING NOTES

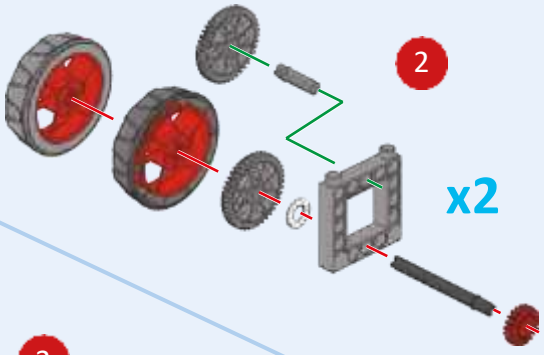
ROVER BOT



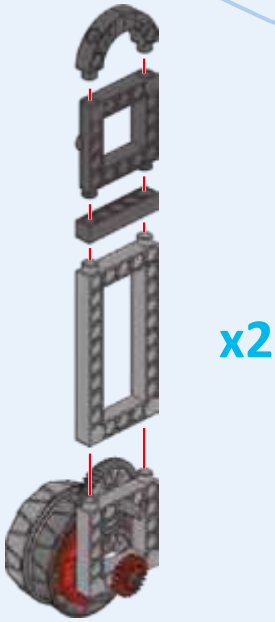
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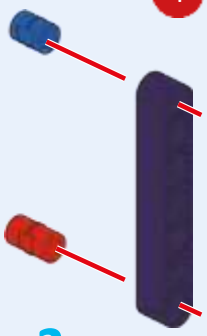
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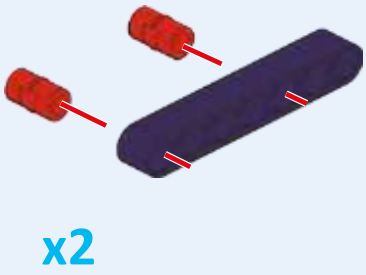
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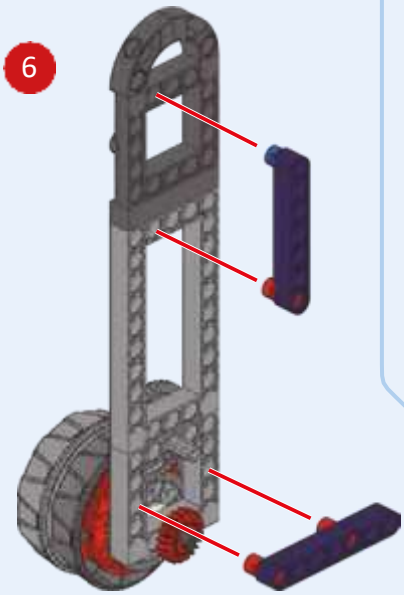
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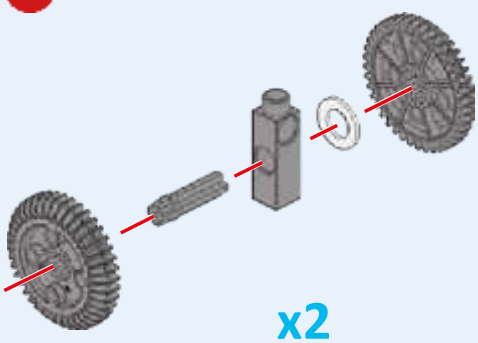
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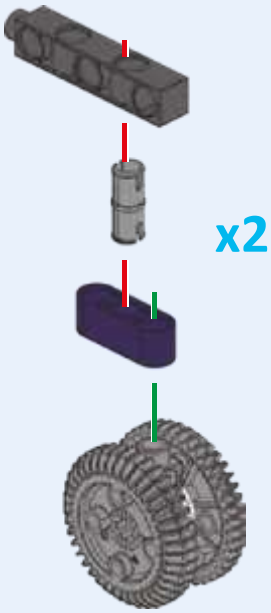
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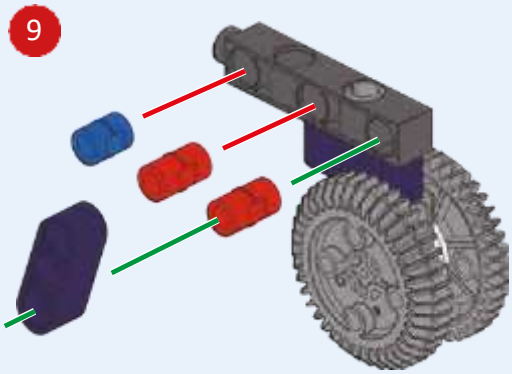
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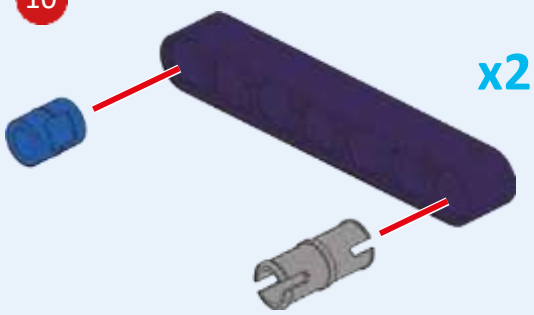
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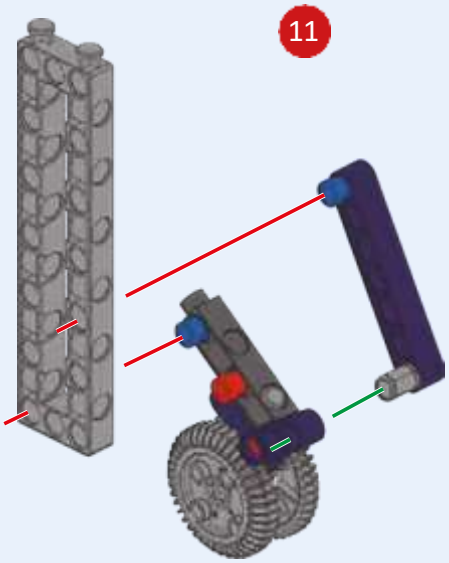
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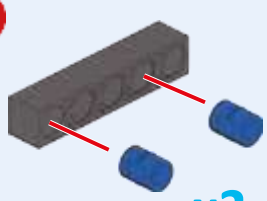
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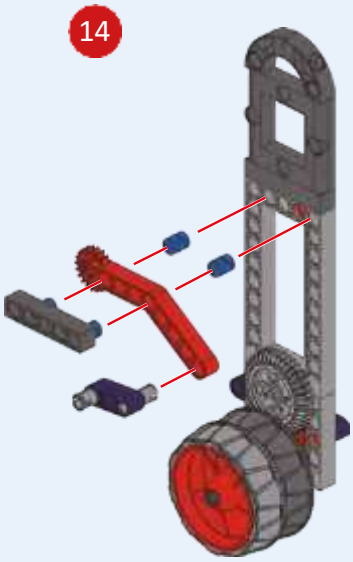
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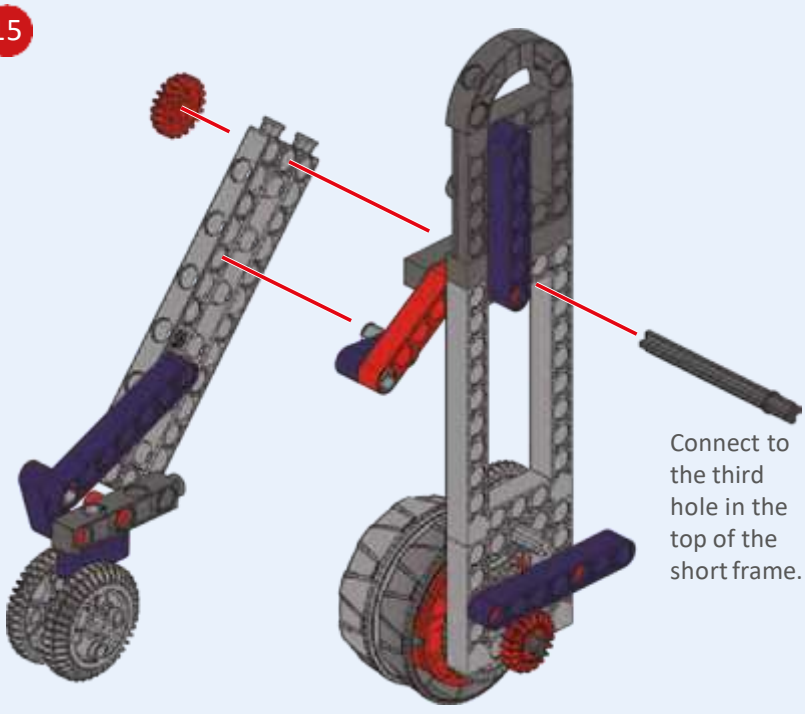
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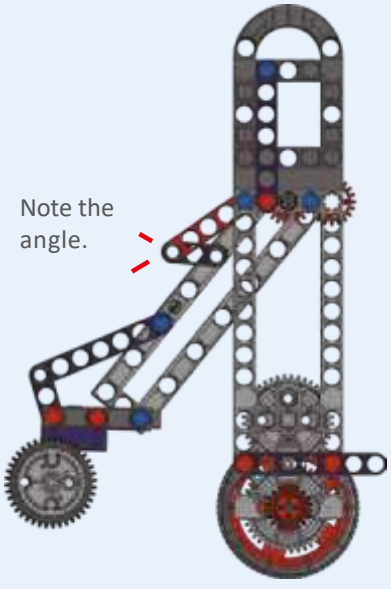


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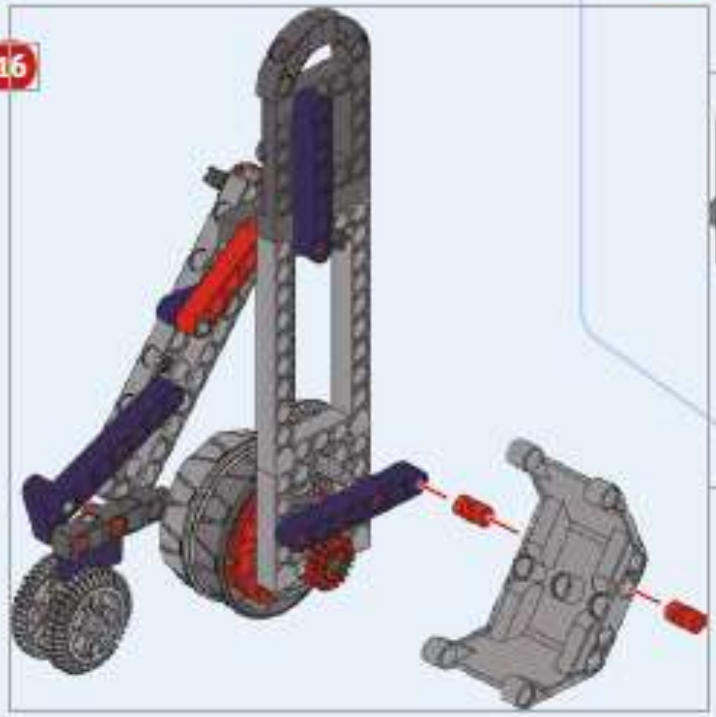


Connect to the third hole in the top of the short frame.

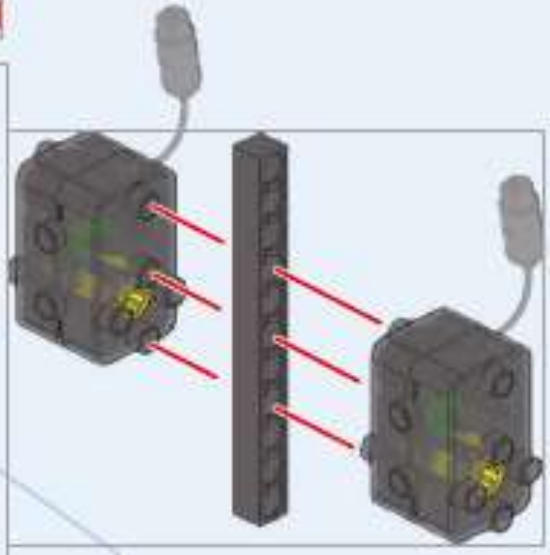
Note the angle.



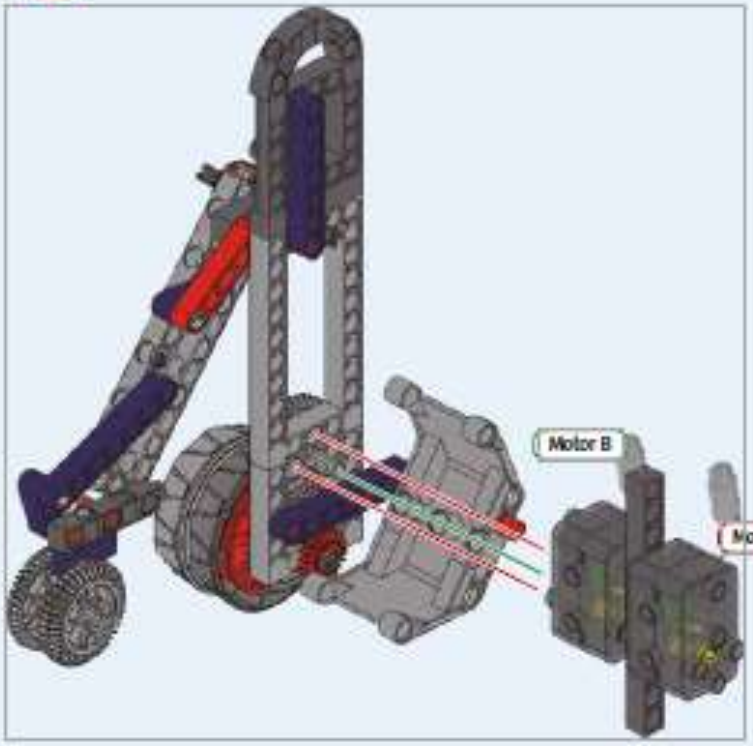
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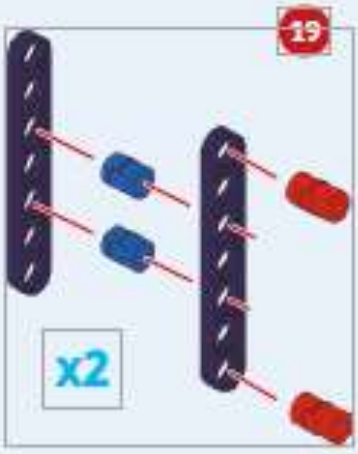
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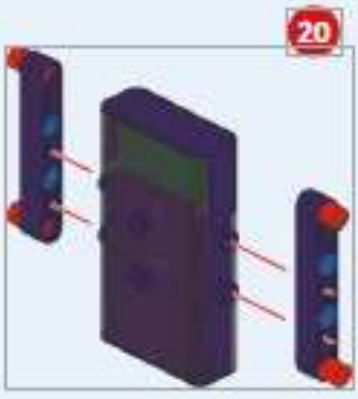
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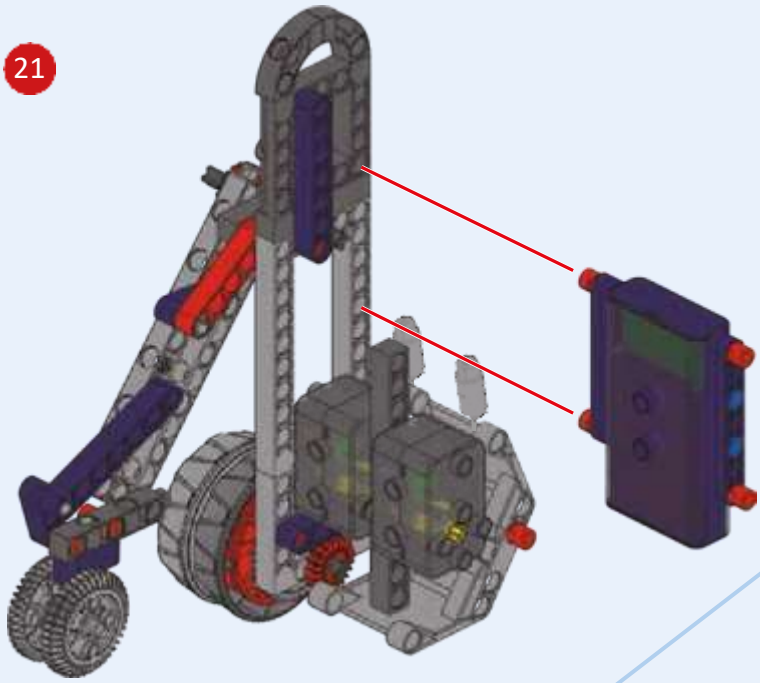
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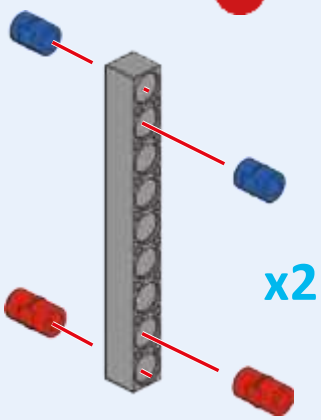
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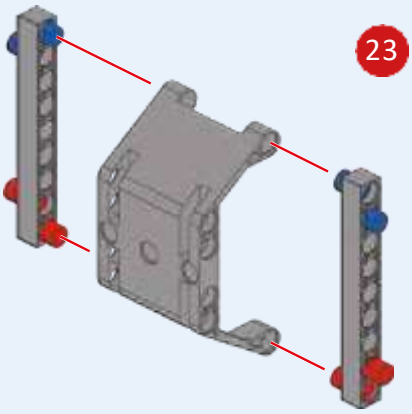
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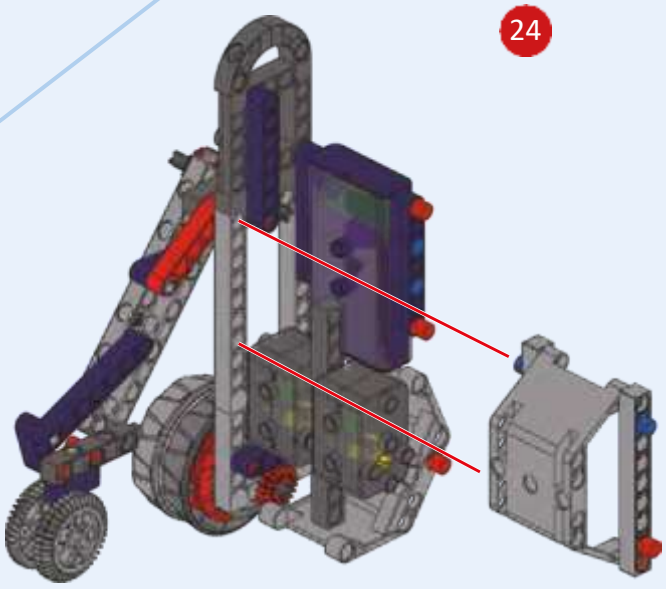
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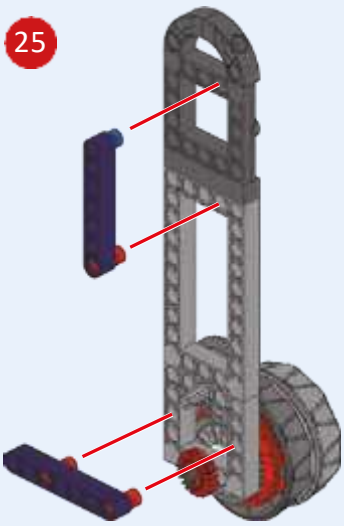
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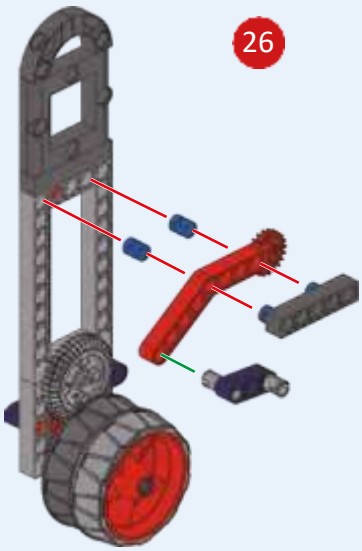
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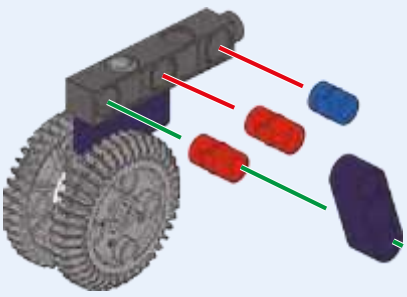
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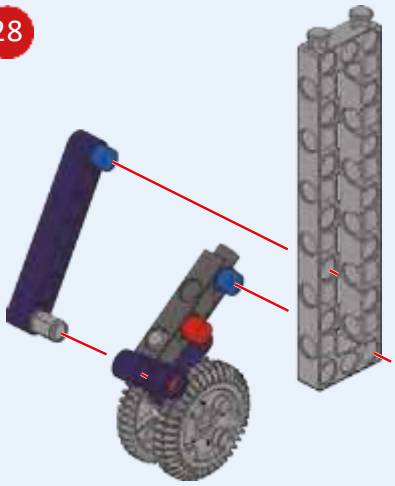
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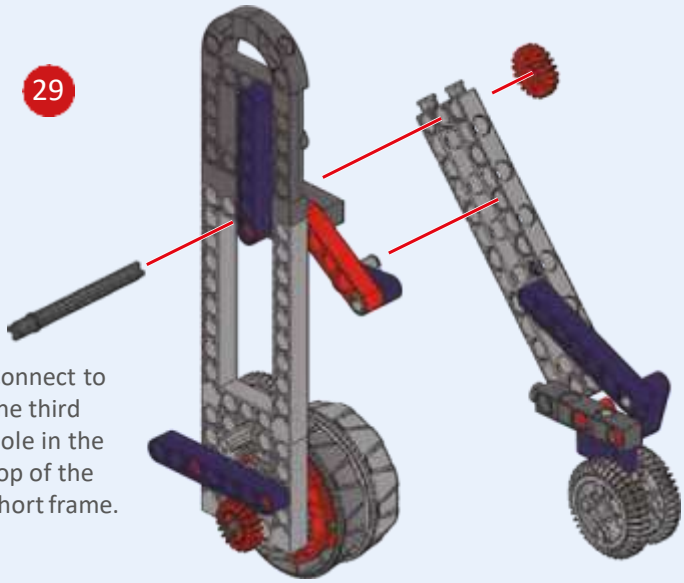
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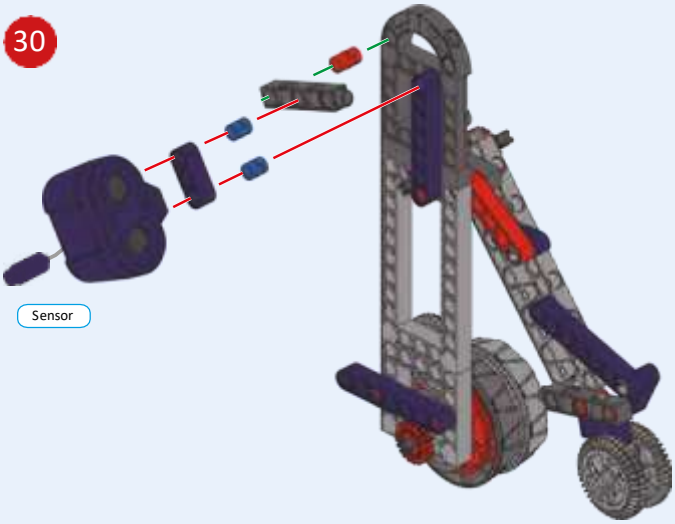


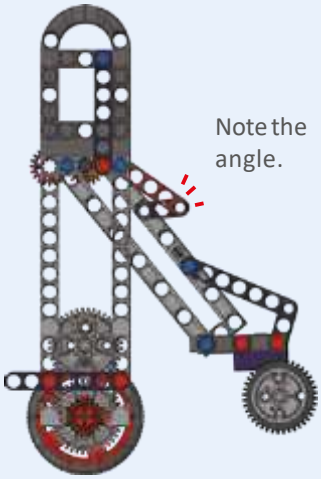
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Connect to the third hole in the top of the short frame.

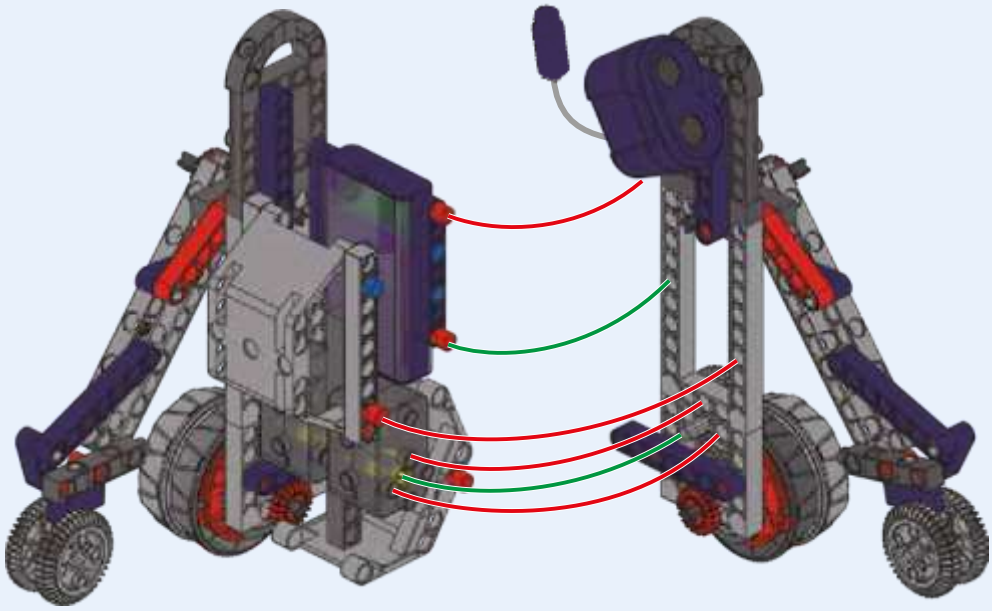
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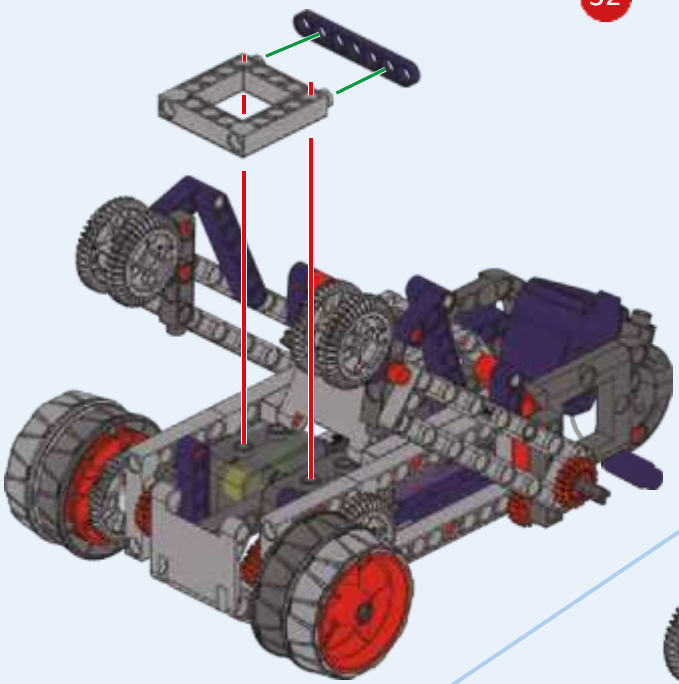


Note the angle.

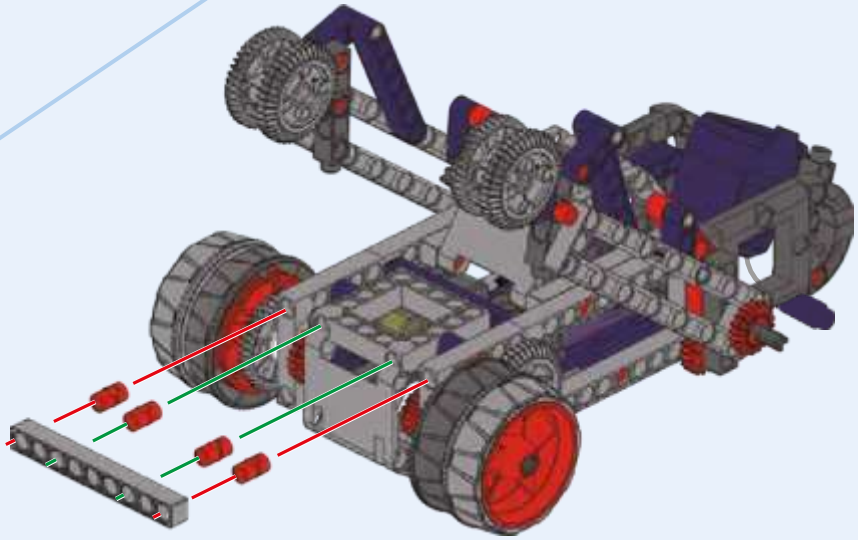
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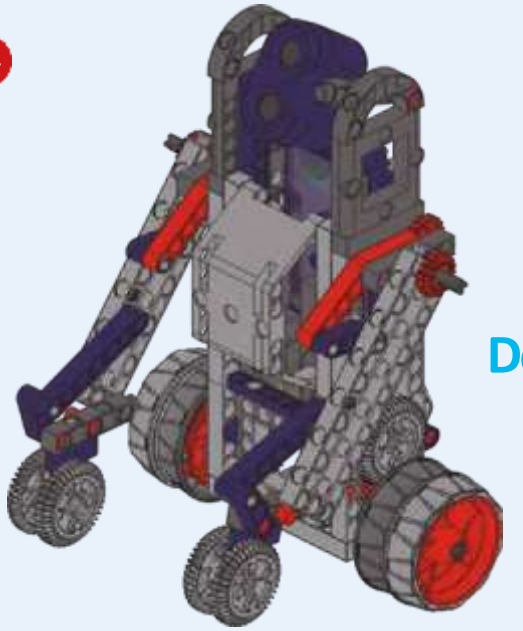
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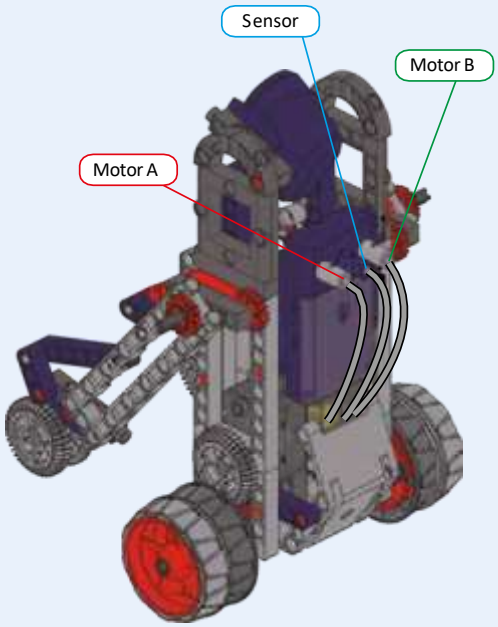
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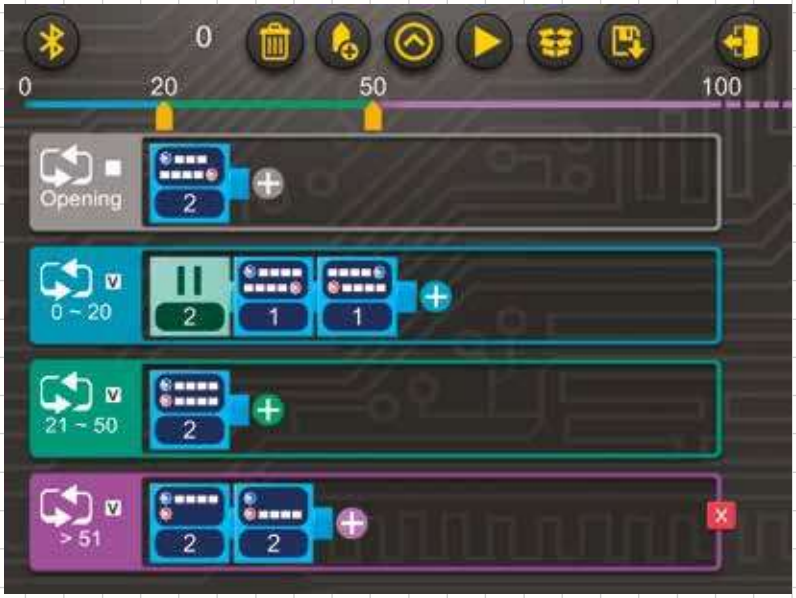
Done!



SAMPLE PROGRAM FOR THE ROVER BOT

Enter this program to make the rover bot follow you around after it has detected you. Place the rover bot a few feet away from any objects and point the ultrasonic detector away from you. The rover bot will move the ultrasonic sensor left and right searching for you. You may have to move closer for the rover bot to detect you, but once it has, it will move towards you and follow you around.

This program is preloaded in the app under Program 10. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 10

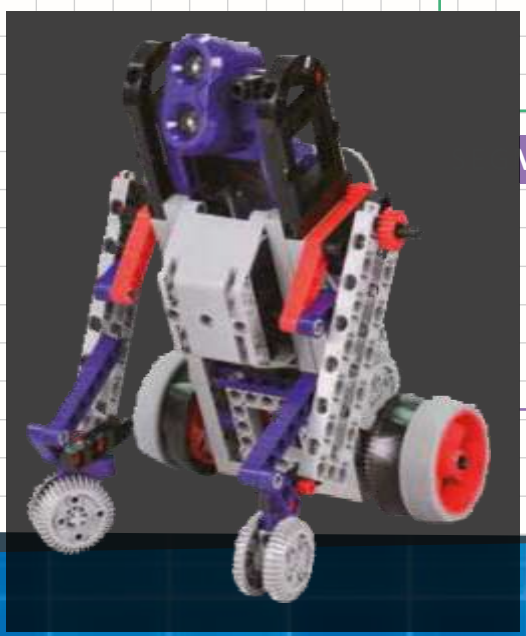
OPENING SEGMENT:

SEGMENT 0-20:

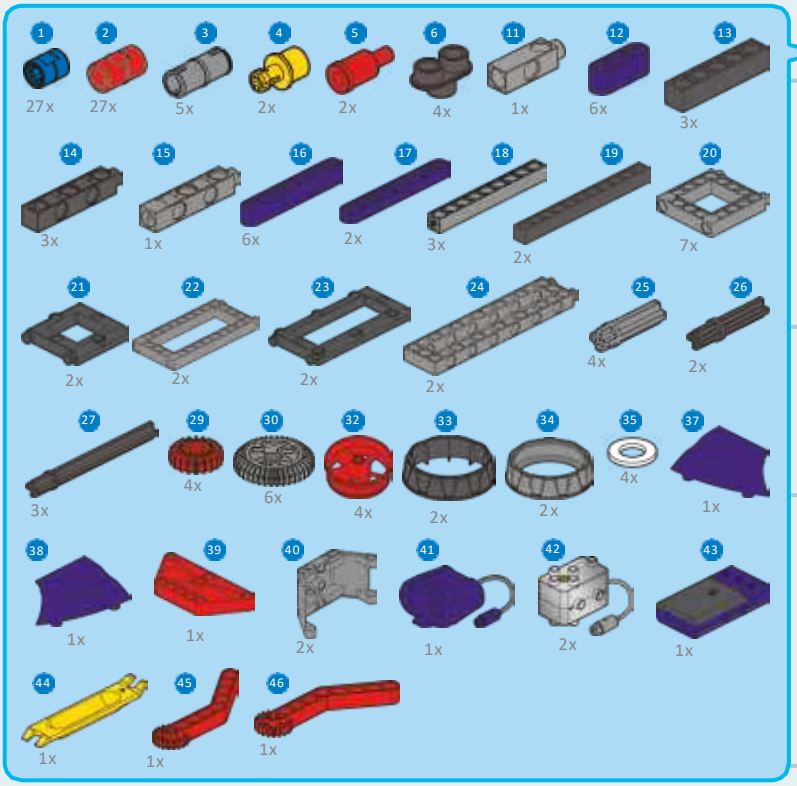
SEGMENT 21-50:

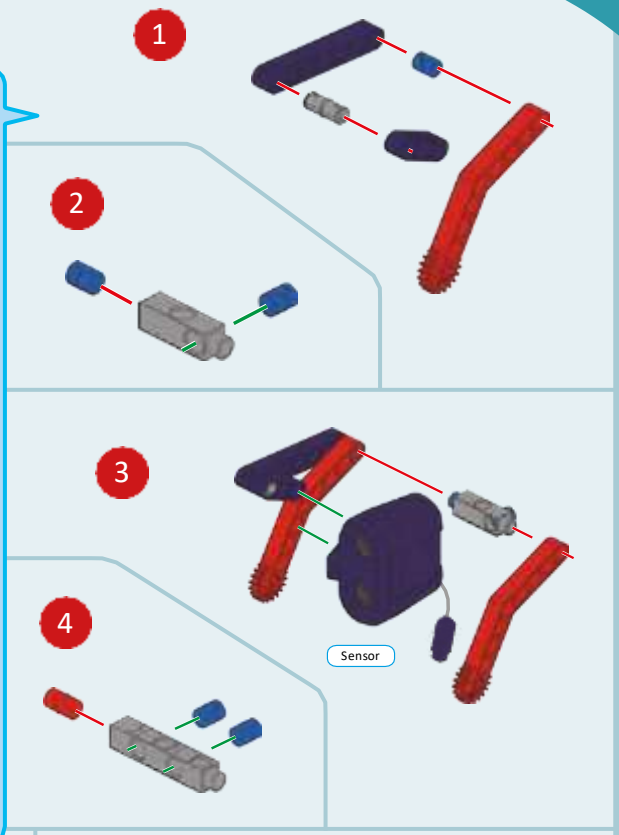
MENT >51:

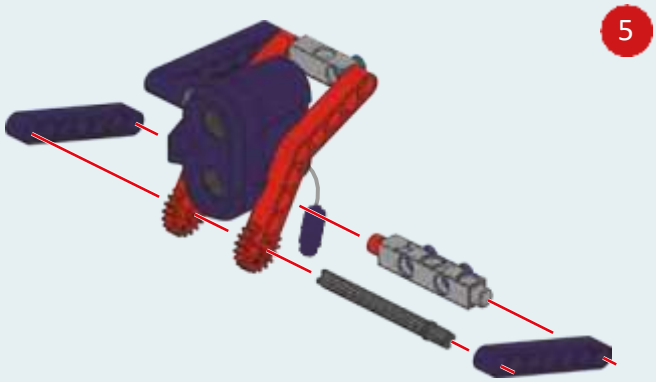
PROGRAMMING NOTES

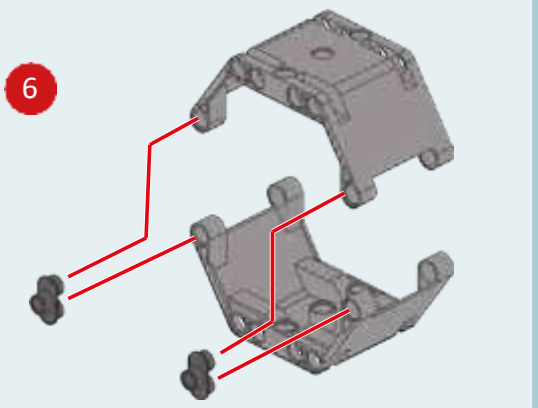


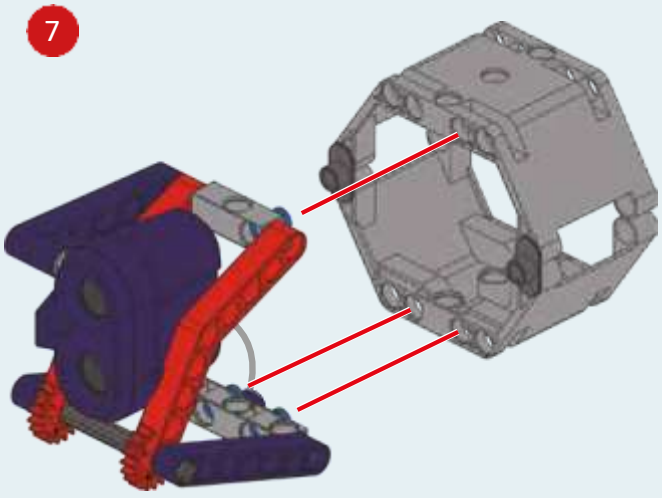
DESERT EXPLORER

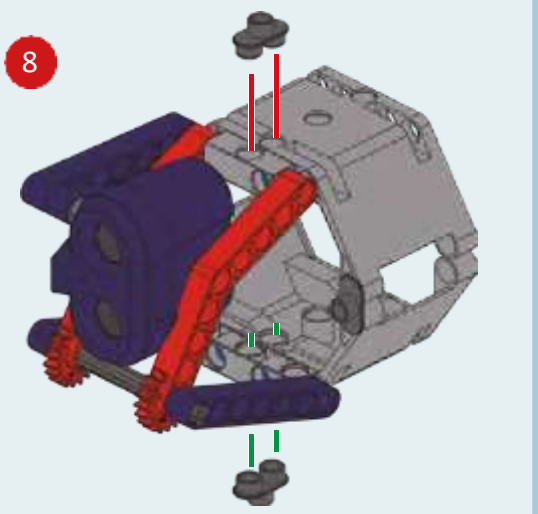




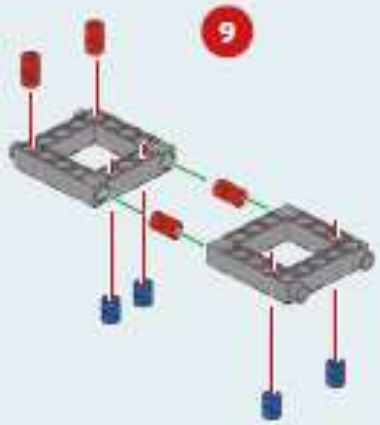




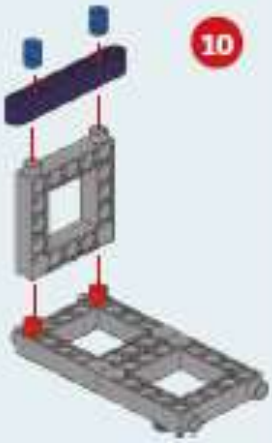




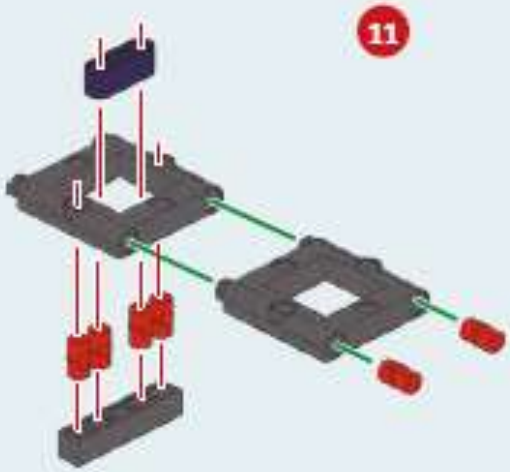
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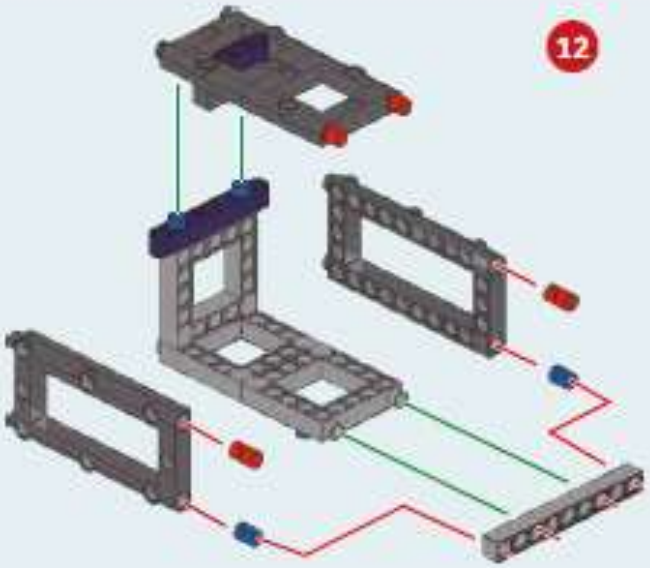
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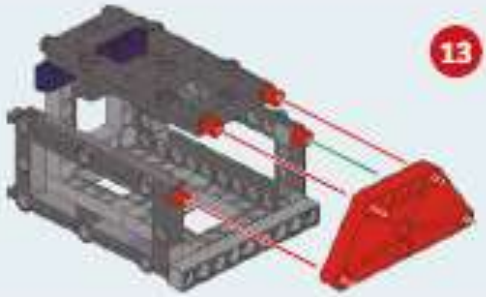
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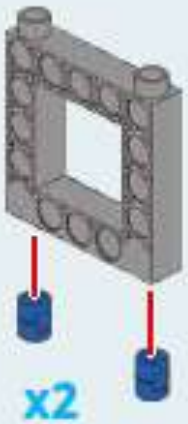
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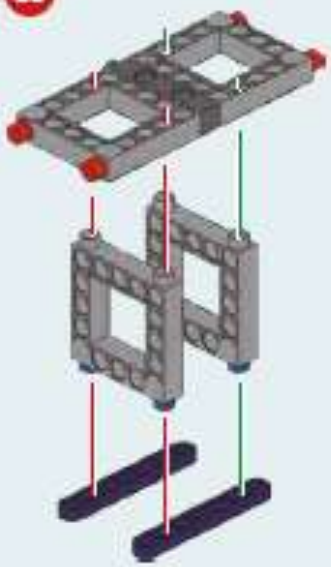
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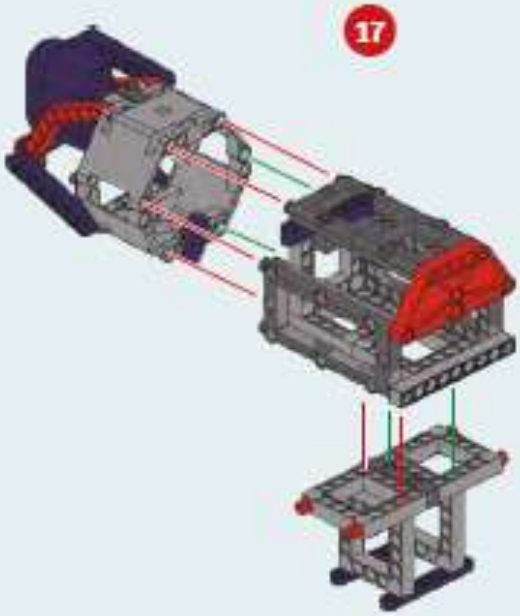
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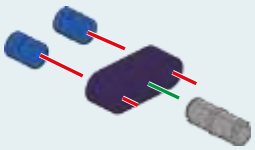
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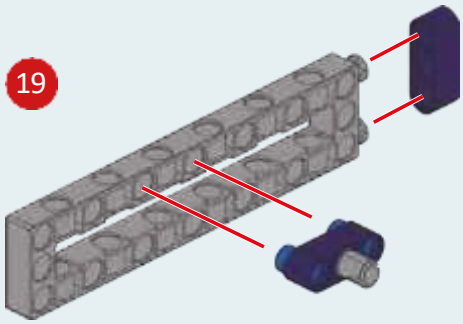


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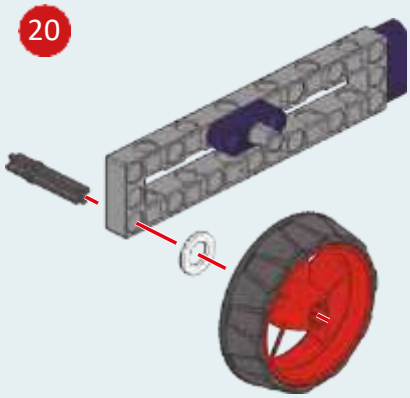


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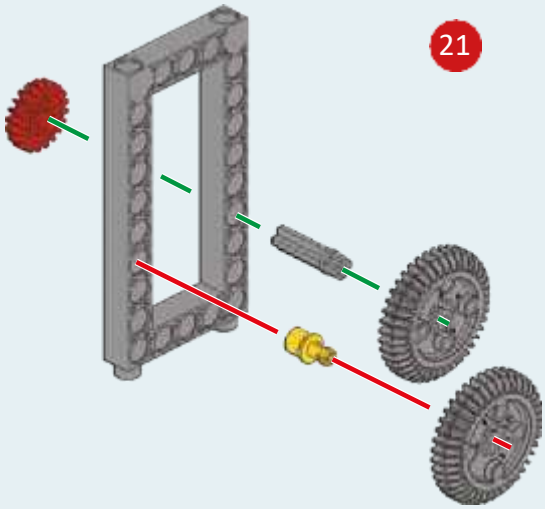
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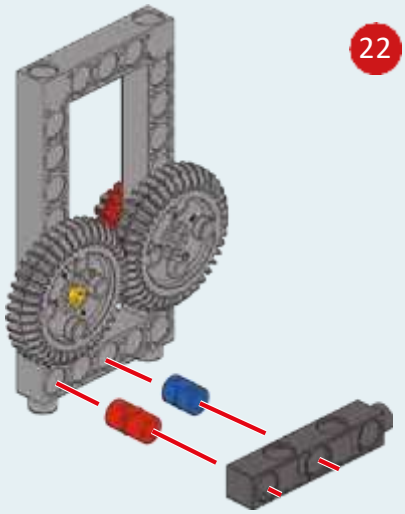
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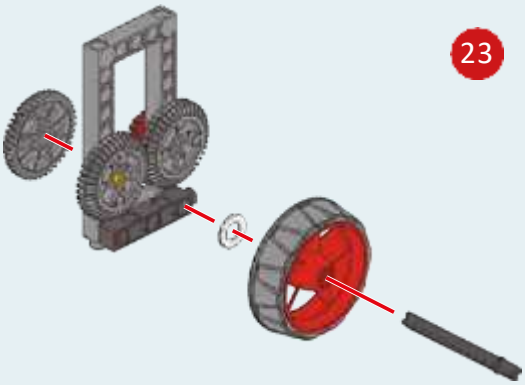
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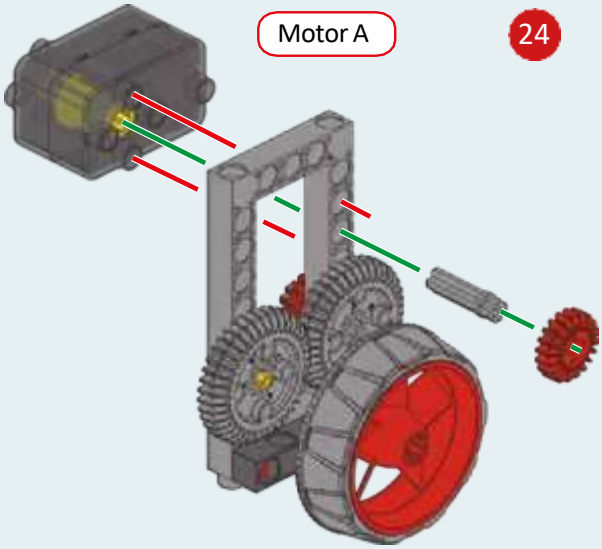


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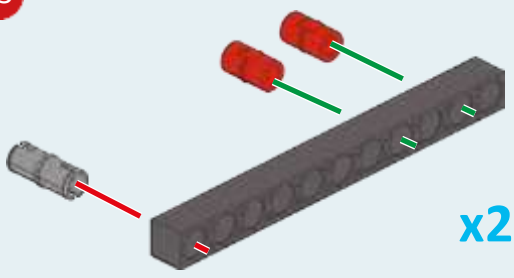


Motor A

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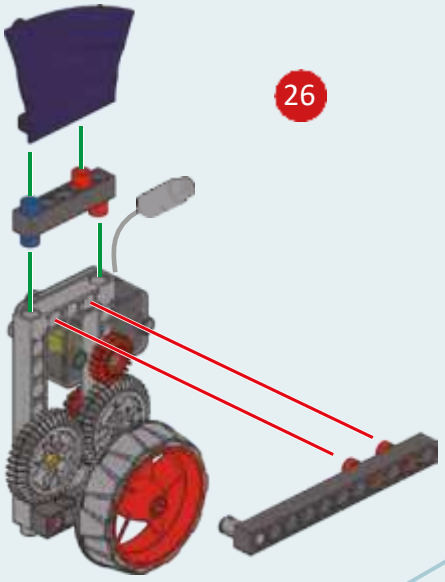


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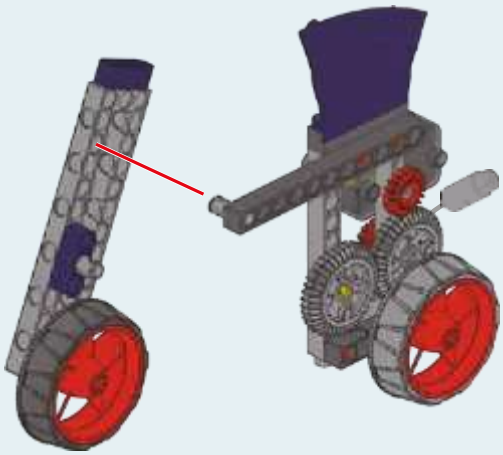


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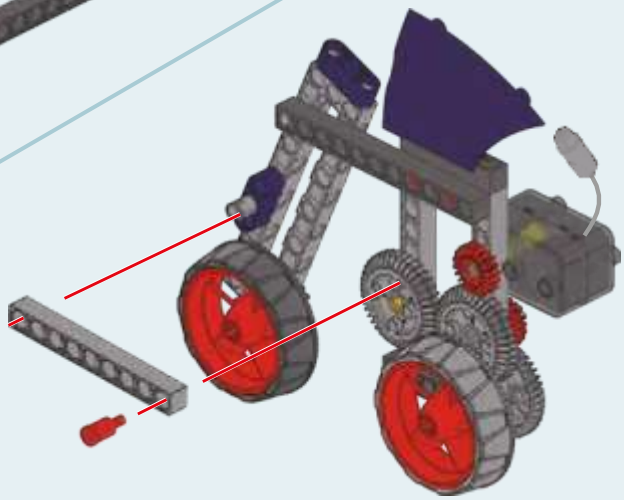
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27



28



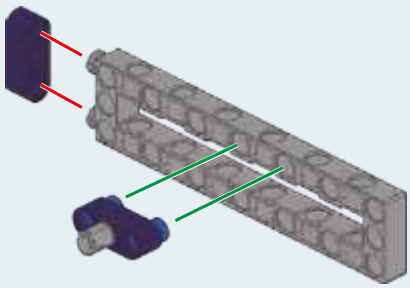
Side view



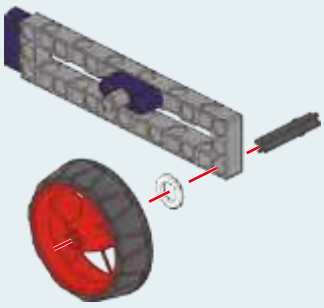


Hole B

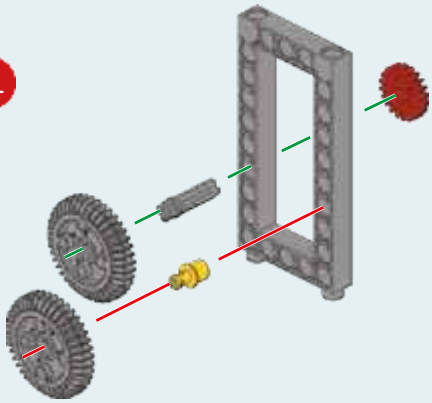
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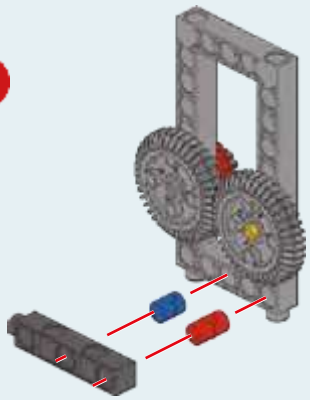
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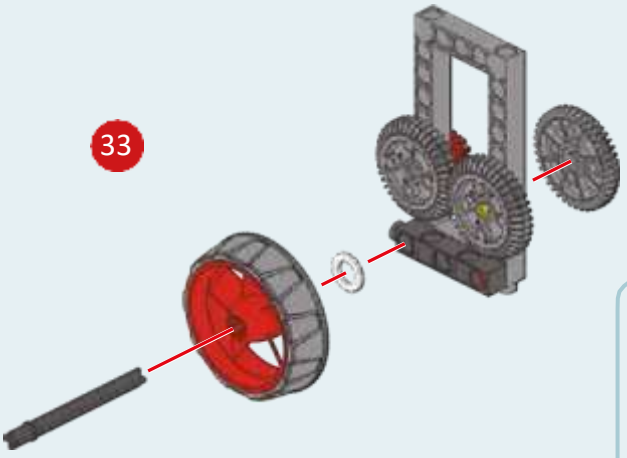
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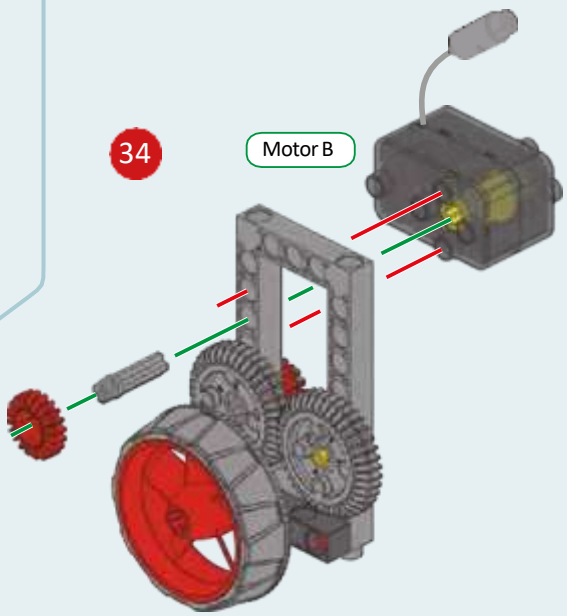


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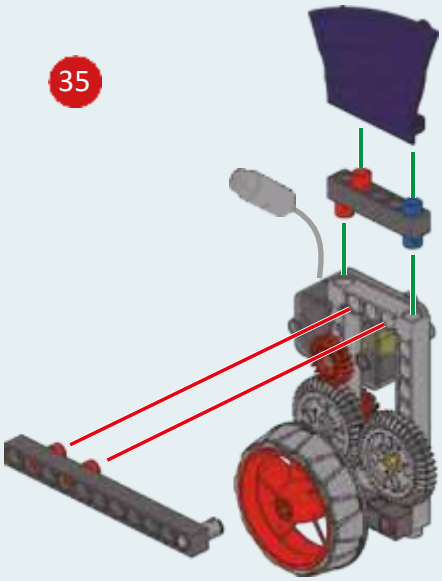


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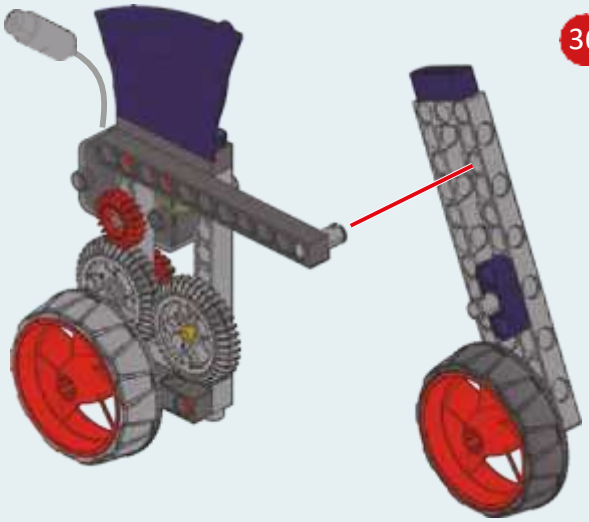
Motor B



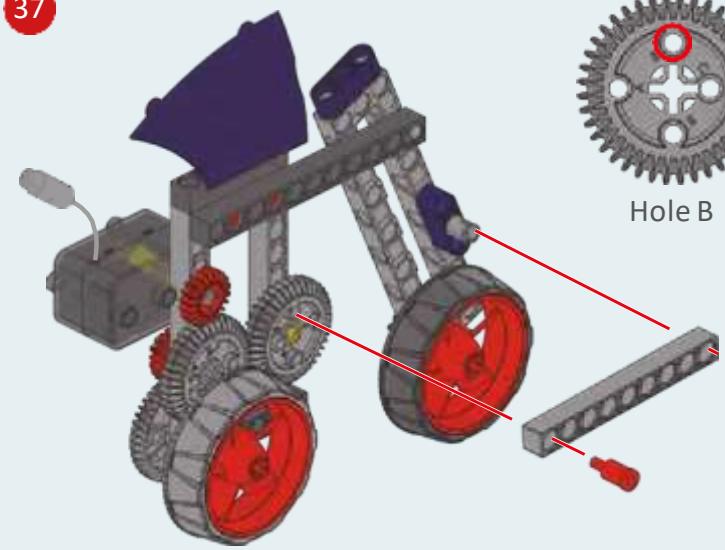
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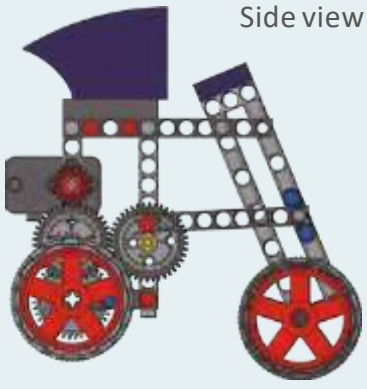


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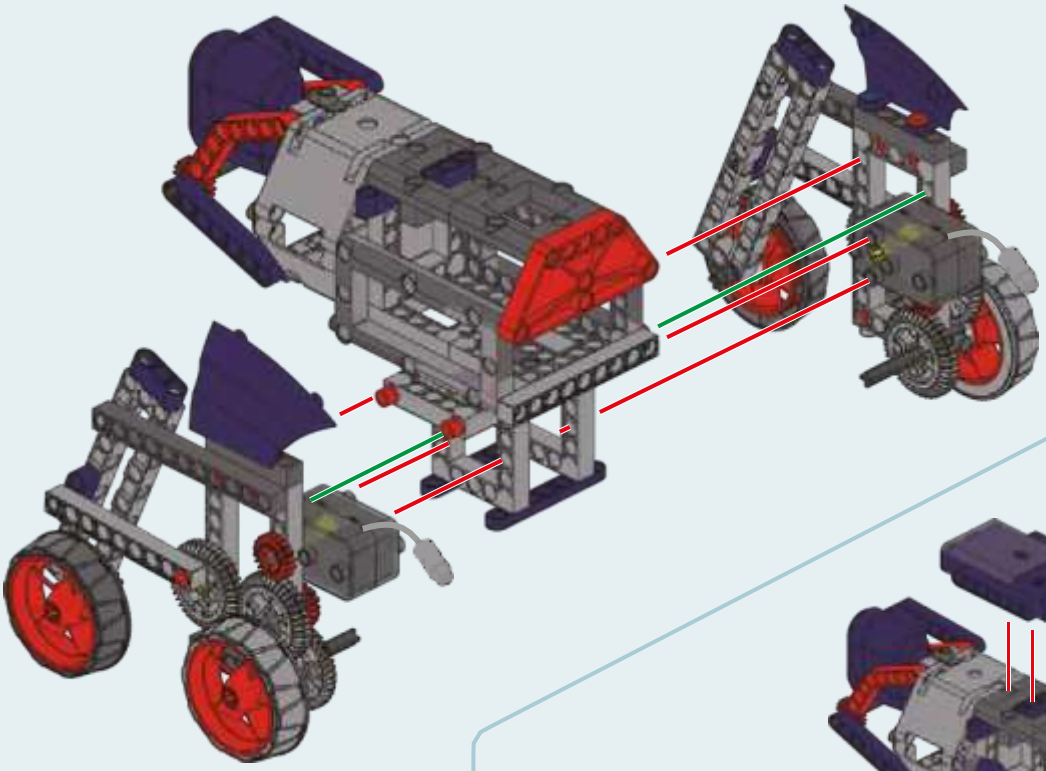


Hole B

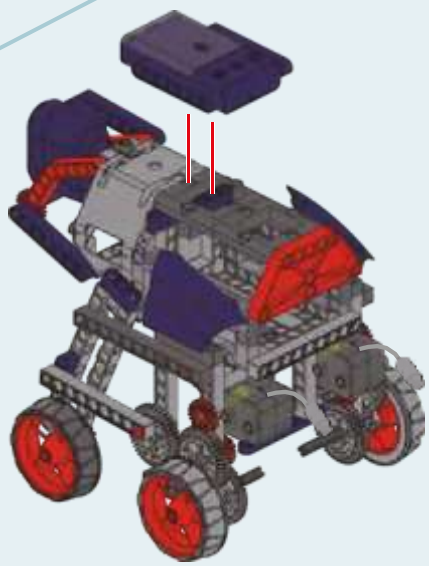
Side view



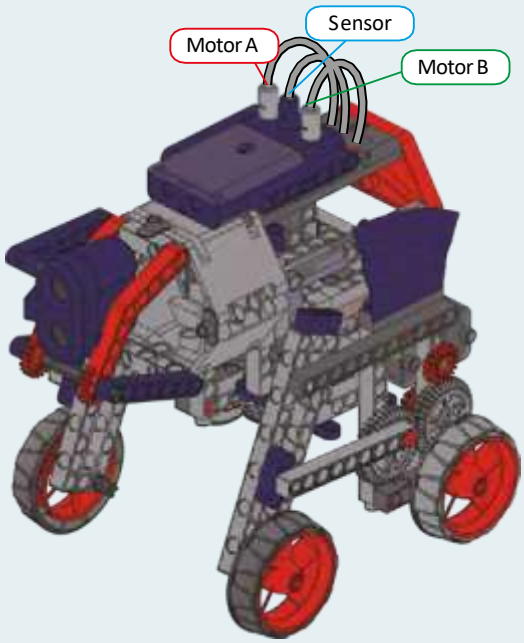
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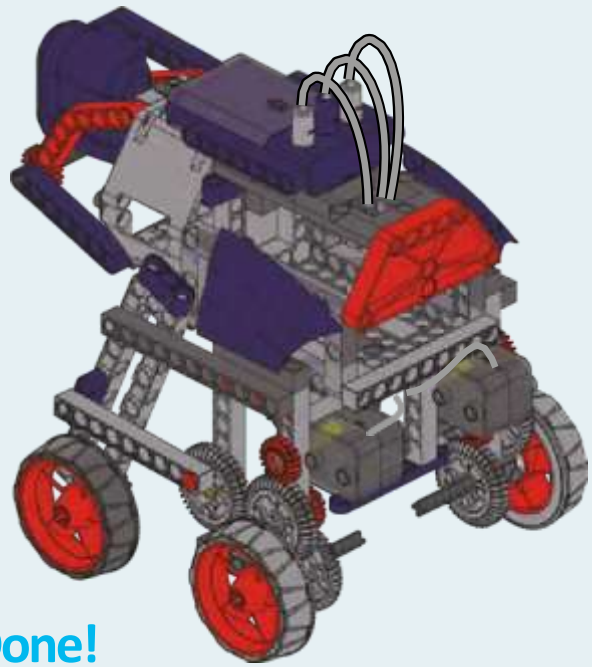


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Done!

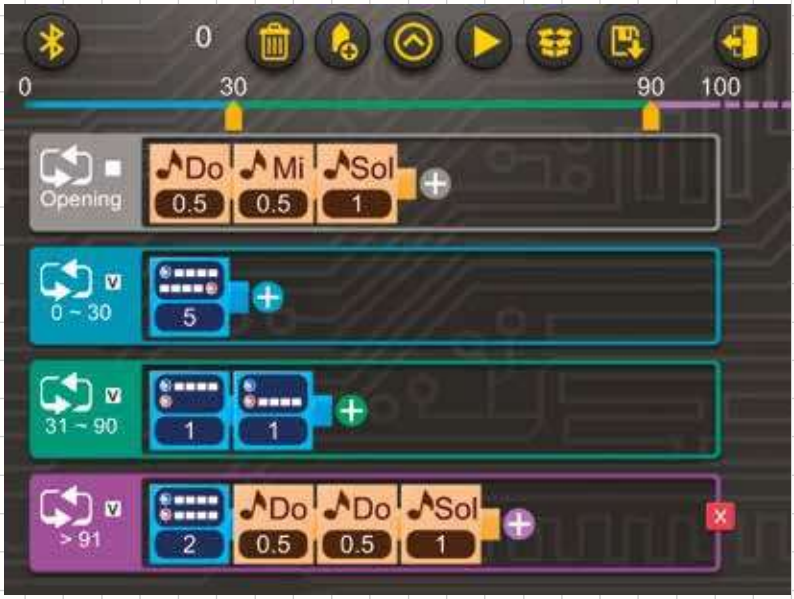
PROGRAMMING



SAMPLE PROGRAM FOR THE DESERT EXPLORER

The desert explorer has two modes of movement based on its proximity to objects. When the desert explorer is far away from objects, it will move quickly. But once it has detected an object with the ultrasonic sensor, it will "walk" slowly towards the object.

This program is preloaded in the app under Program 11. Test it out and write down how the robot behaves for each program segment below.



PROGRAMMING NOTES

DEMO PROGRAM:

Program 11

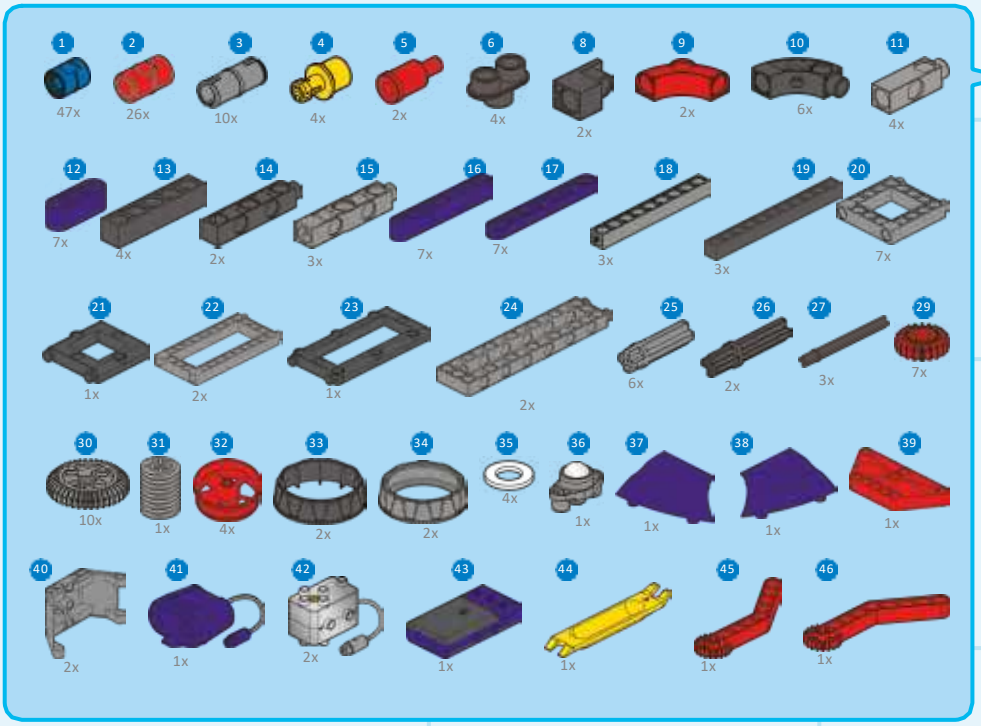
OPENING SEGMENT:

SEGMENT 0-30:

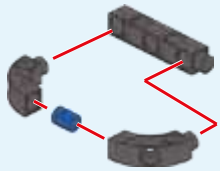
SEGMENT 31-90:

SEGMENT >91:

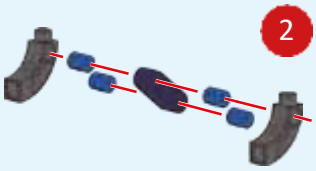
DANCING ROBOT



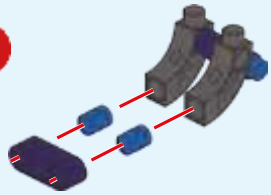
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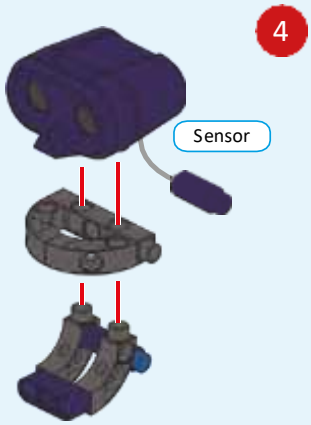
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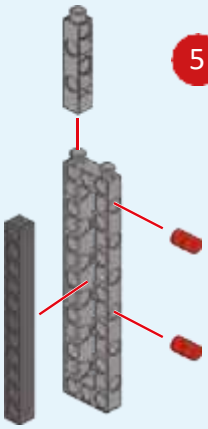
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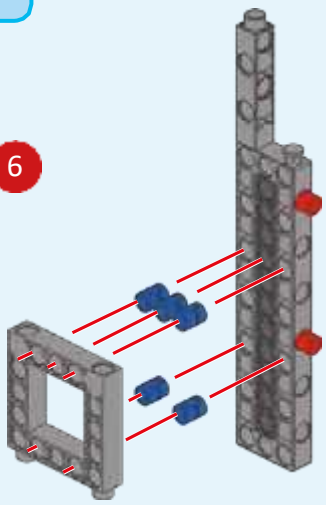
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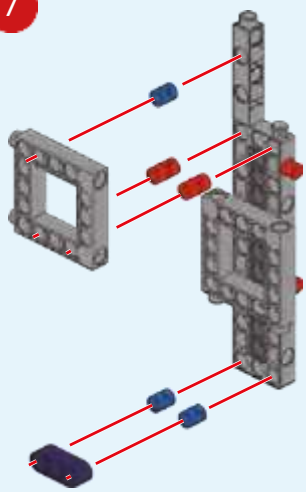
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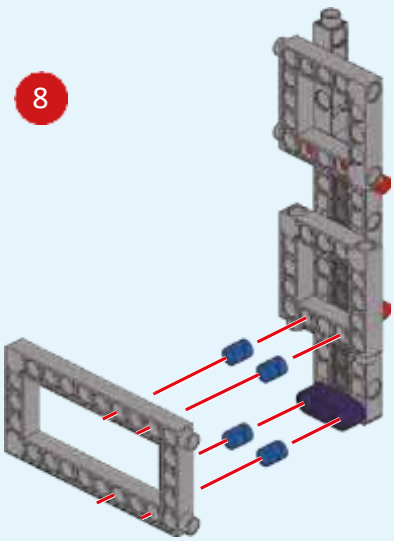
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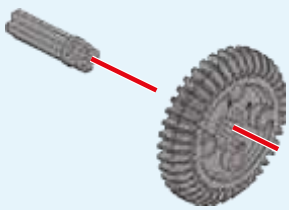
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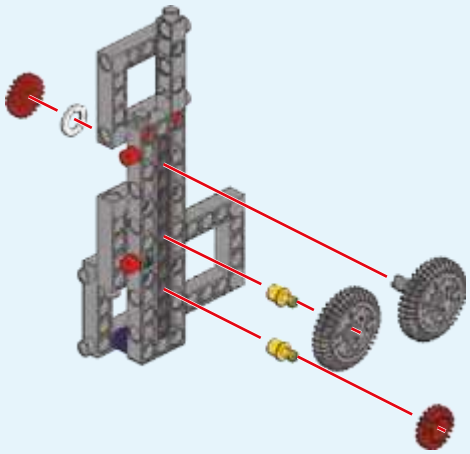


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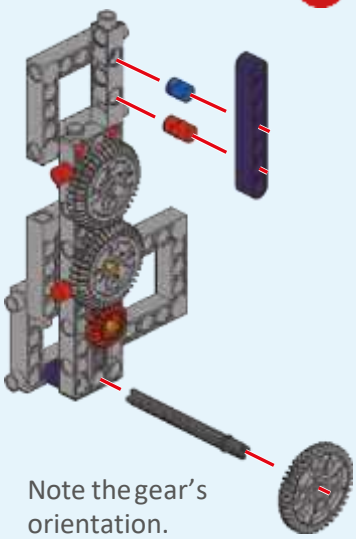


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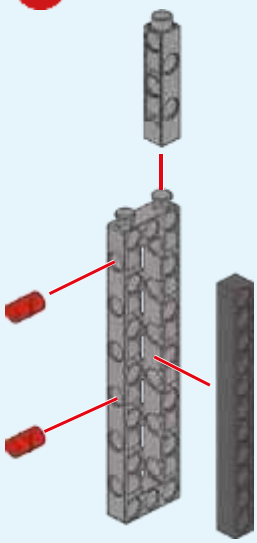


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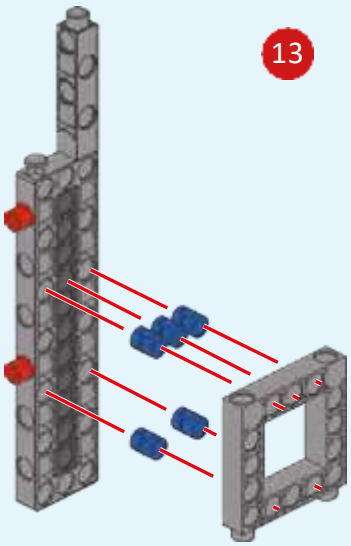


Note the gear's orientation.

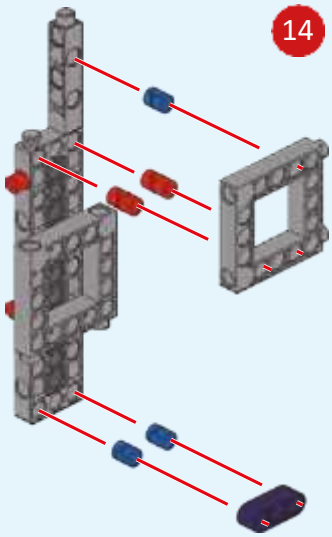
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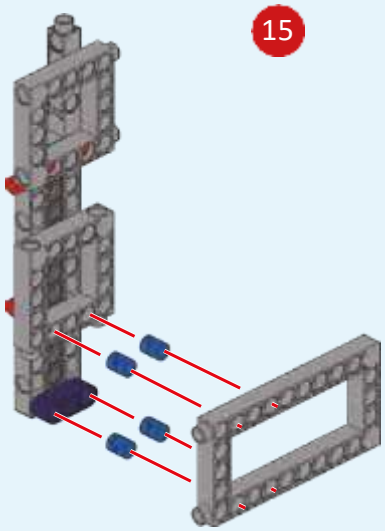
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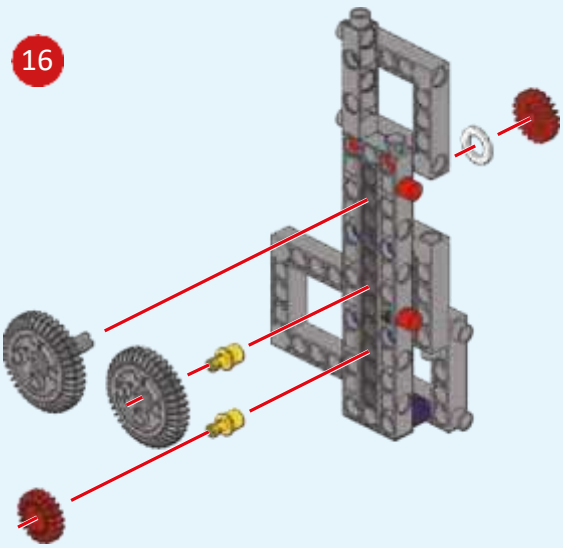
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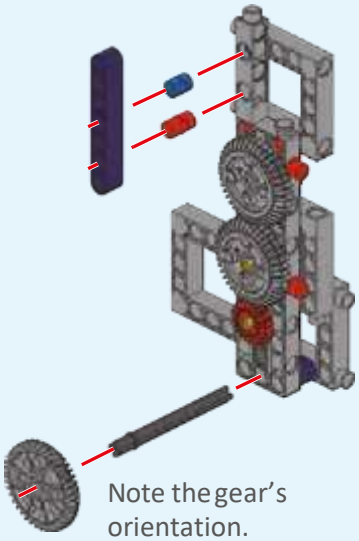
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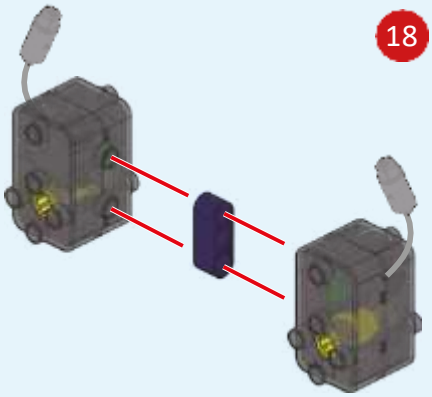


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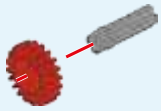
Note the gear's orientation.

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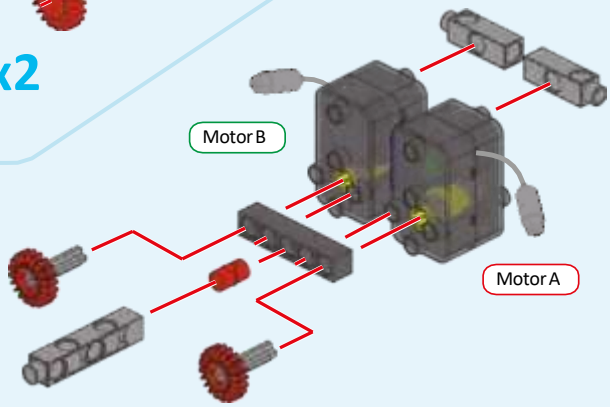


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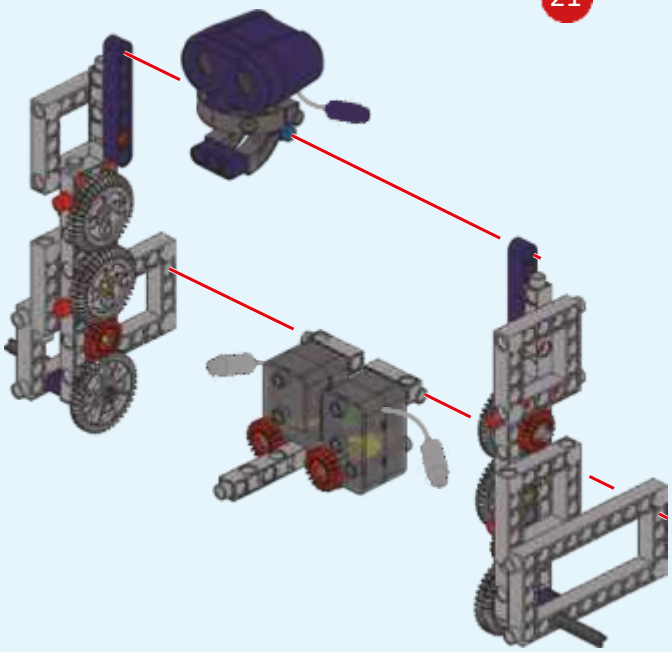
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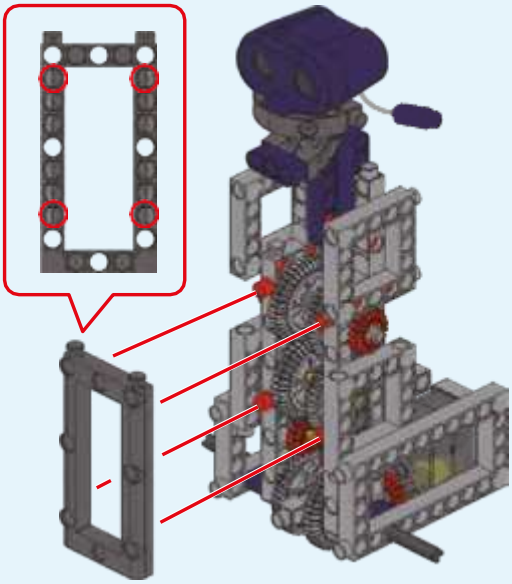
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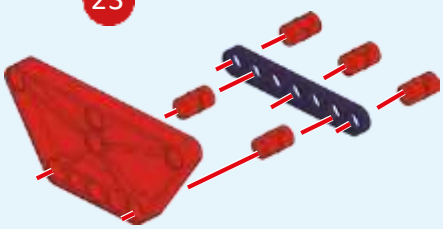
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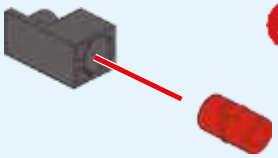


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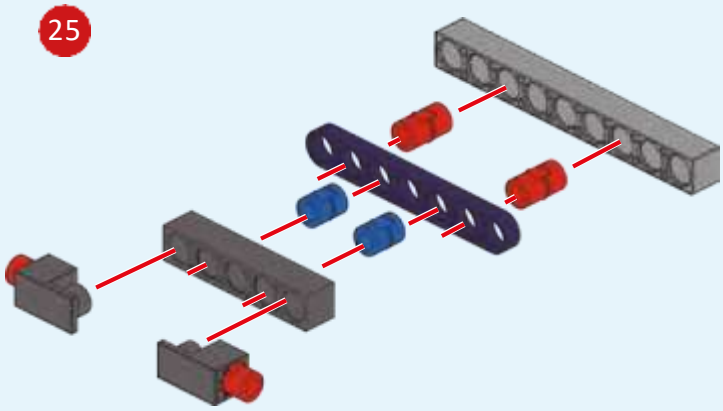


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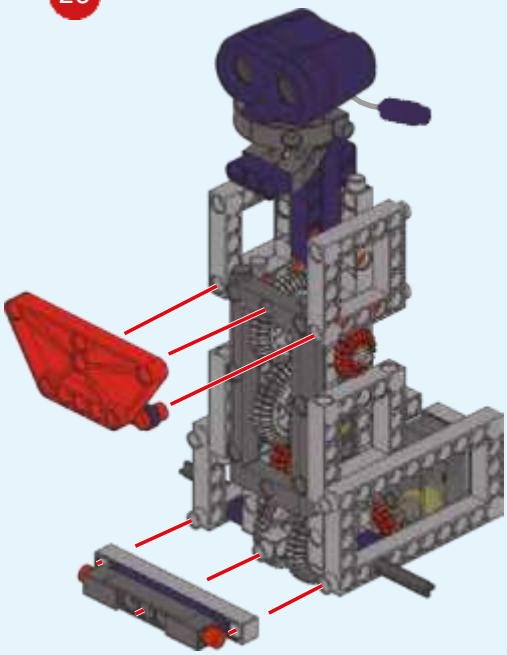
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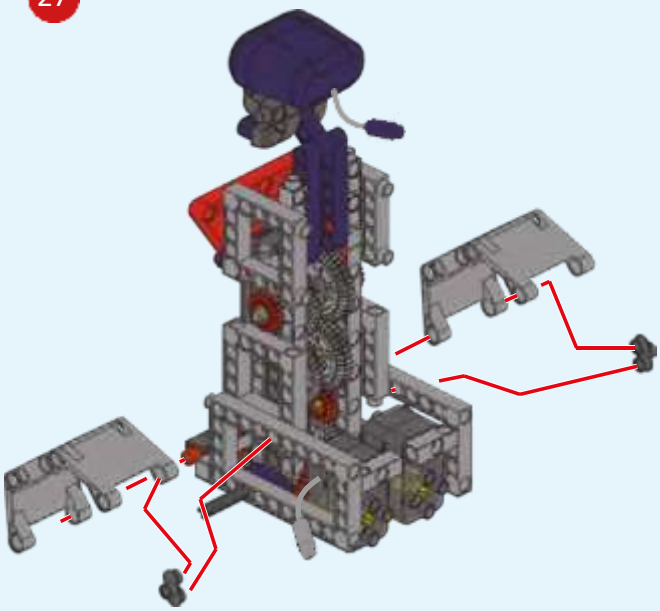
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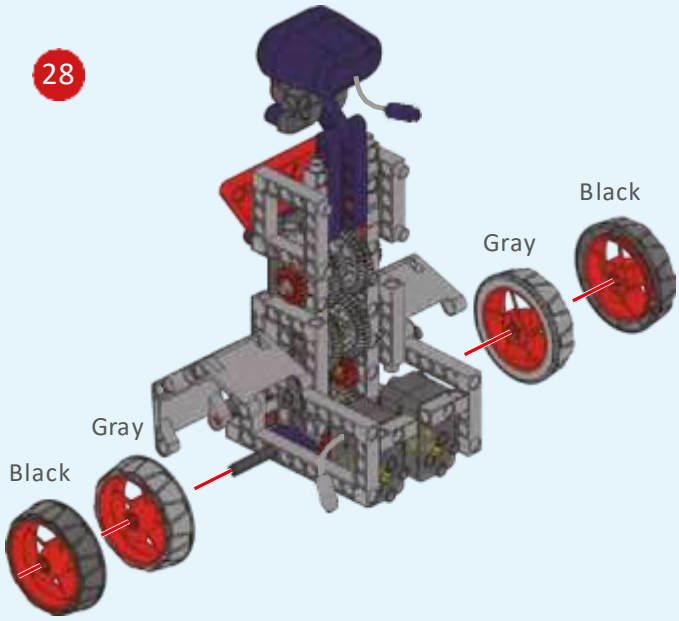
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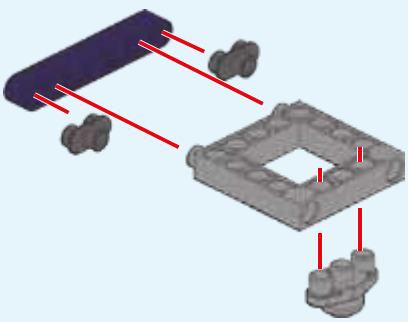
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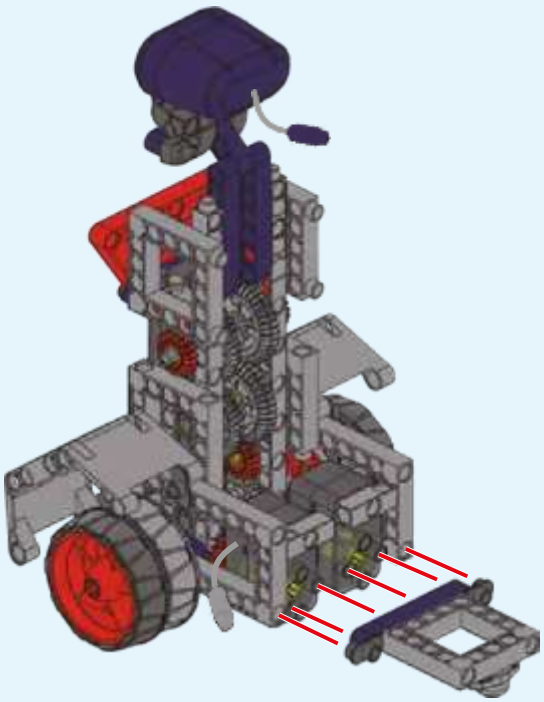
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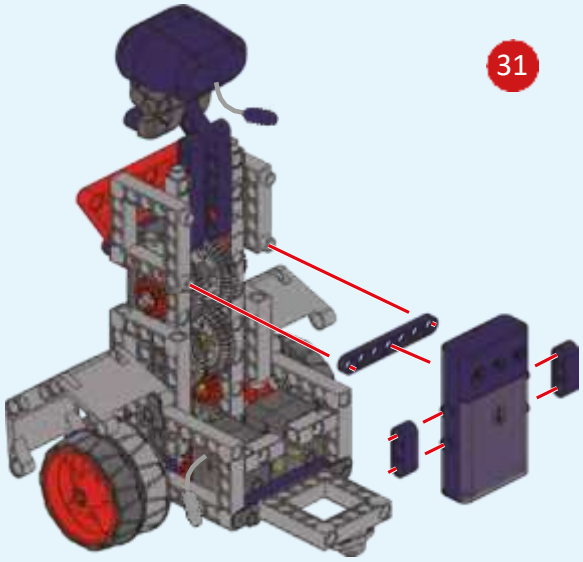
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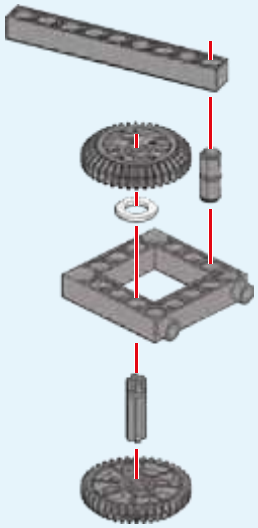
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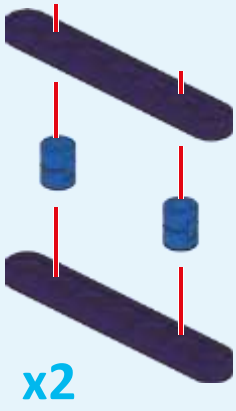
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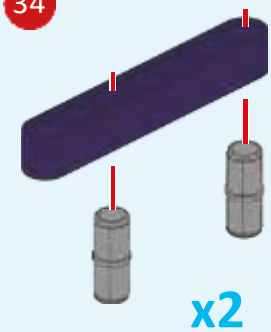


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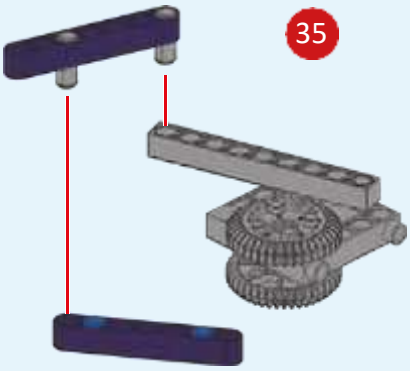
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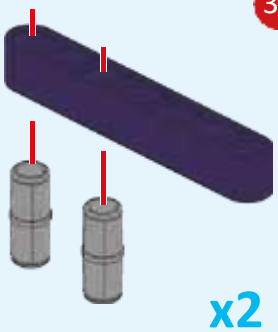


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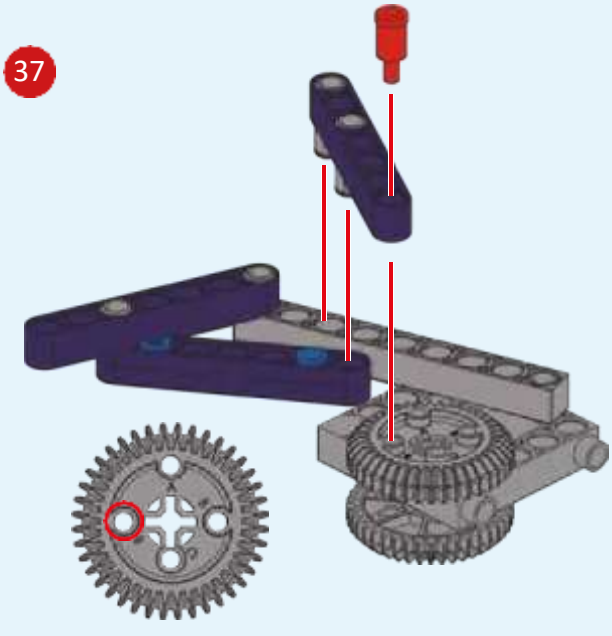


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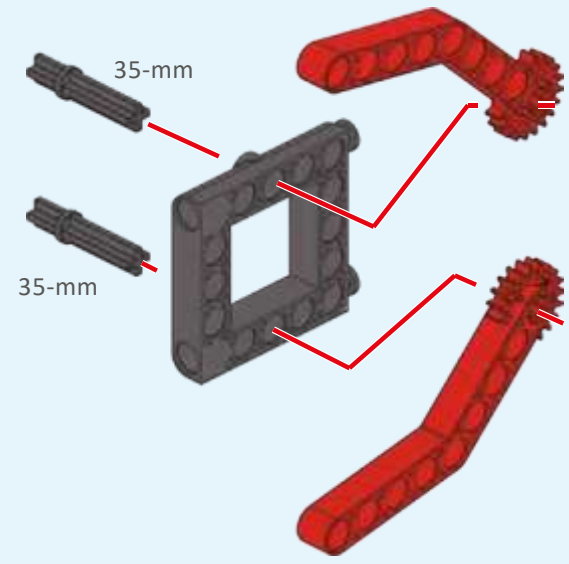
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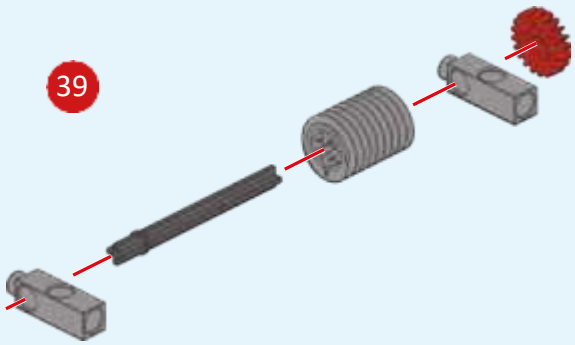


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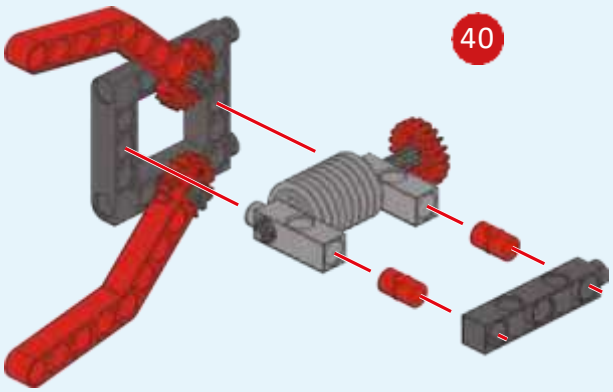
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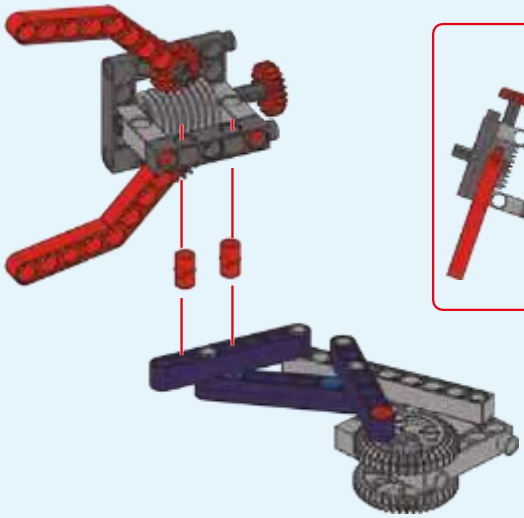
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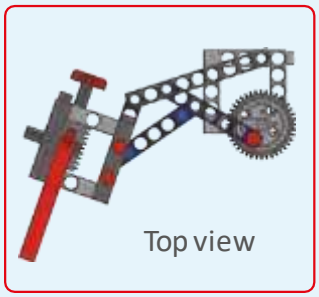


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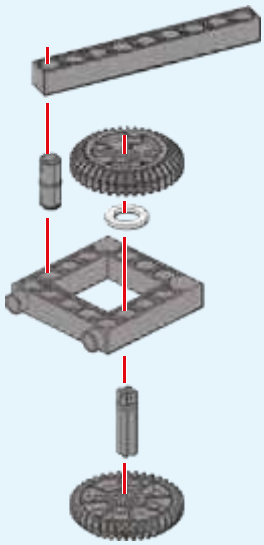
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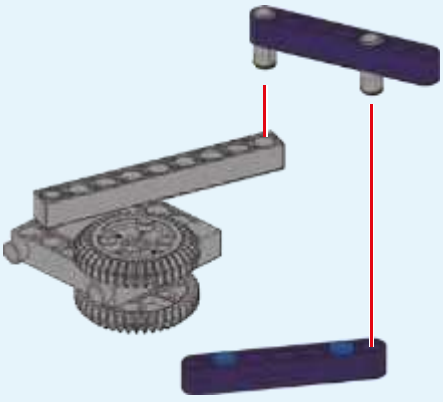


Top view

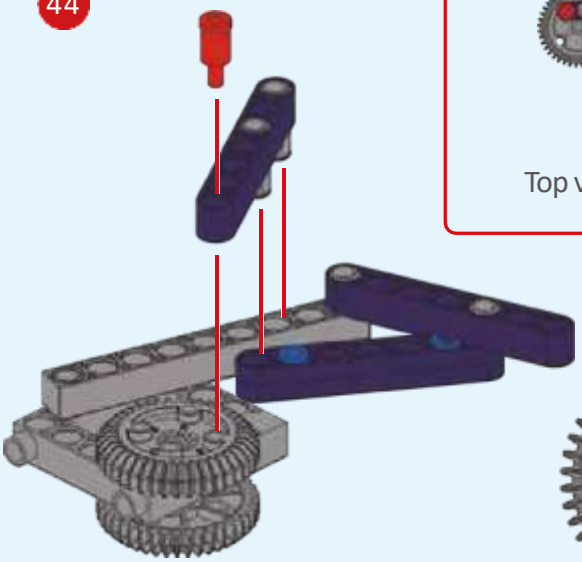
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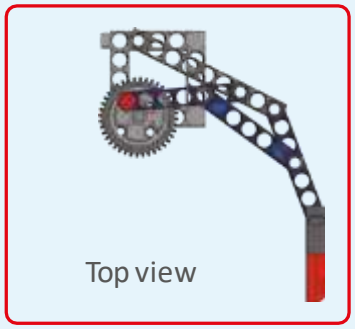


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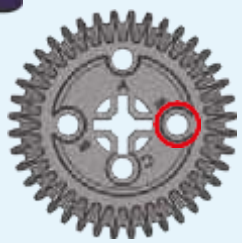


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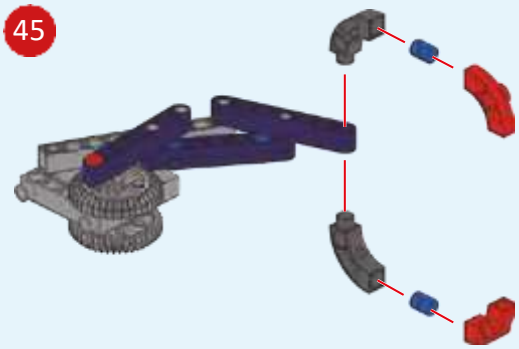


Top view

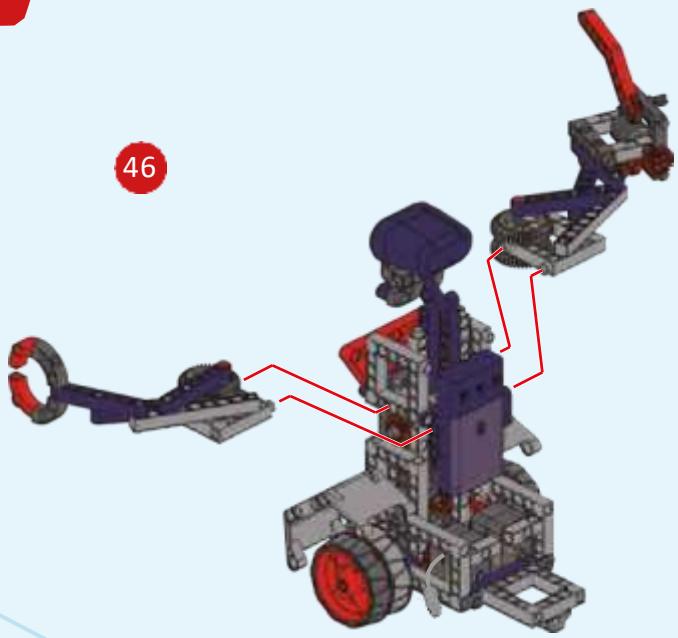


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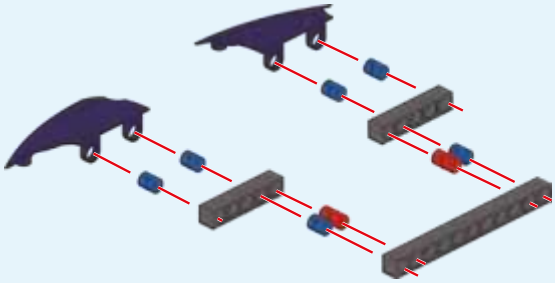
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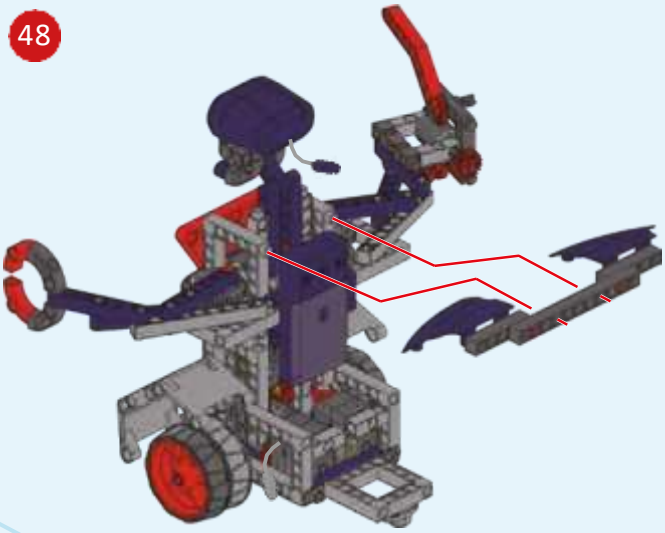
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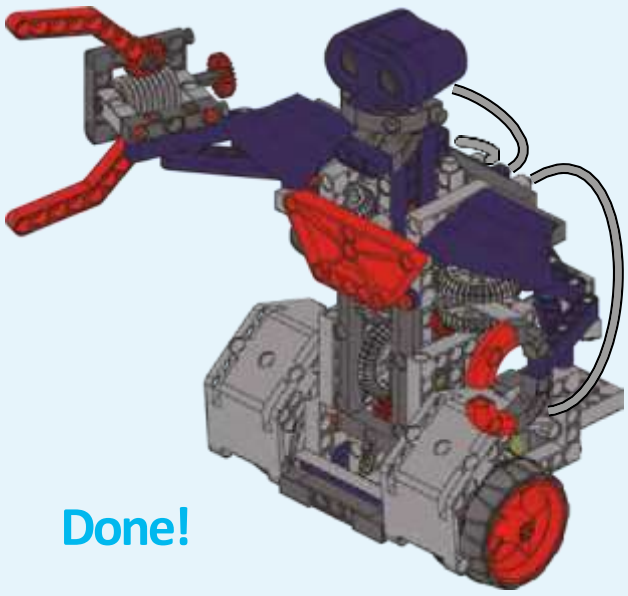
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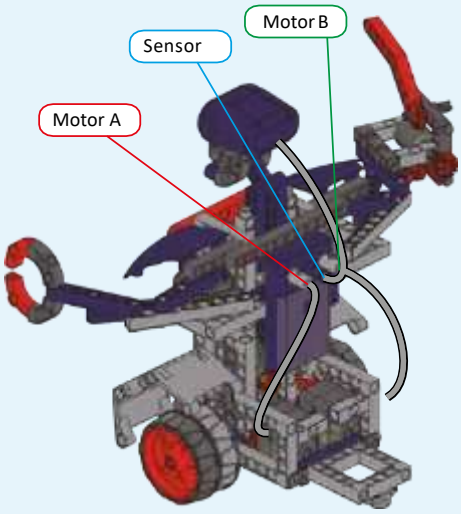
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49



Done!

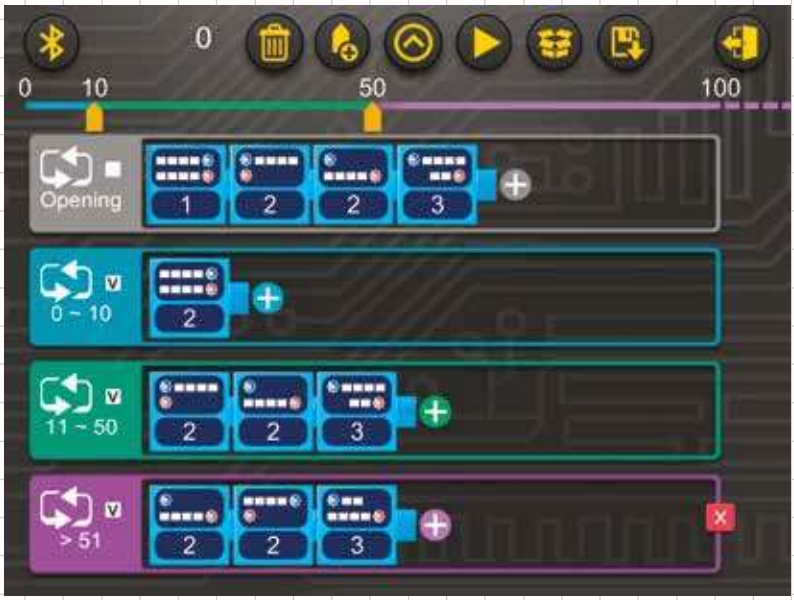


PROGRAMMING

SAMPLE PROGRAM FOR THE DANCING BOT

The dancing bot can be programmed to move and turn in time with a song. Modify this program so that the dancing bot moves to the beat when you play a song.

This program is preloaded in the app under Program 12. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 12

OPENING SEGMENT:

SEGMENT 0-10:

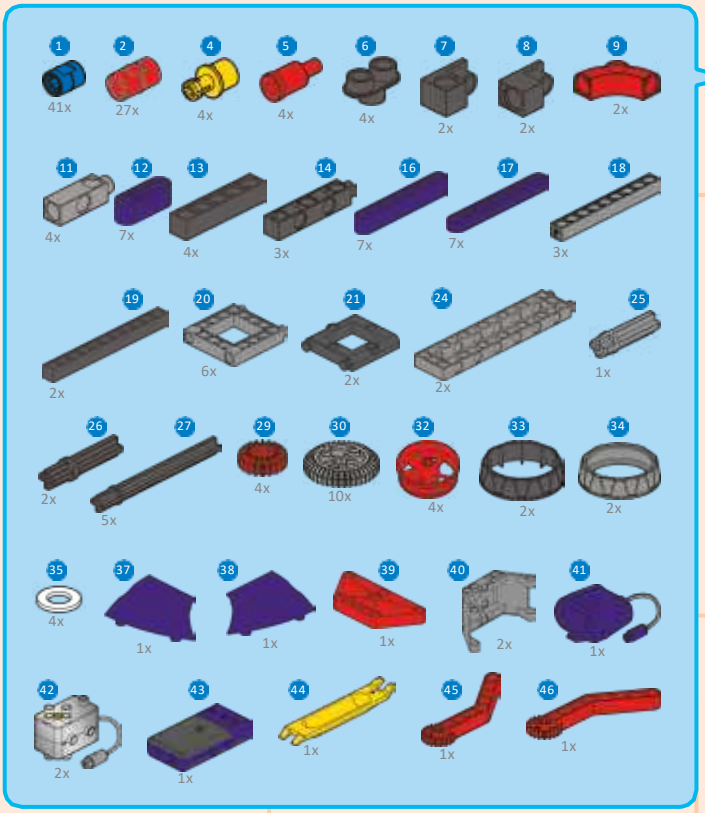
SEGMENT 11-50:

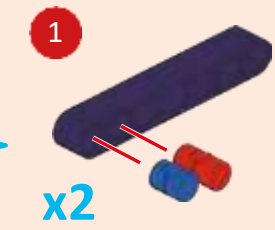
SEGMENT >51:

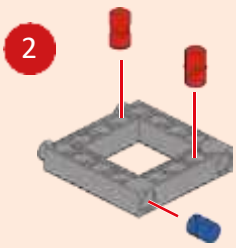
PROGRAMMING NOTES

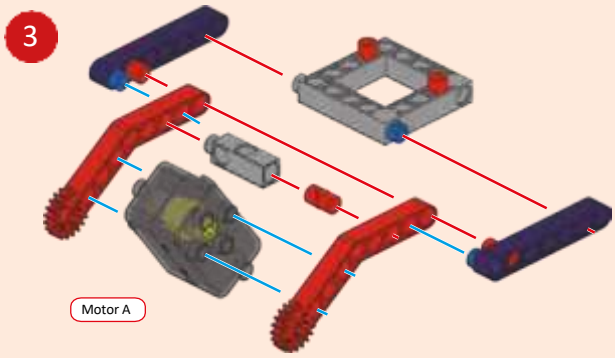


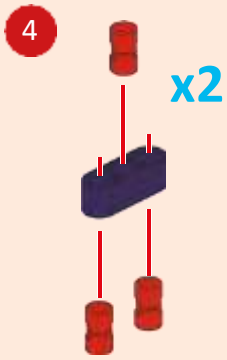
SCOUT ROVER

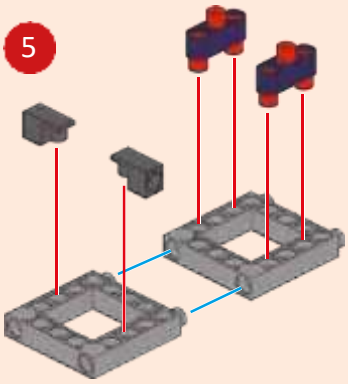

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2 27x
4 4x
5 4x
6 4x
7 2x
8 2x
9 2x
11 4x
12 7x
13 4x
14 3x
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17 7x
18 3x
19 2x
20 6x
21 2x
24 2x
25 1x
26 2x
27 5x
29 4x
30 10x
32 4x
33 2x
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44 1x
45 1x
46 1x

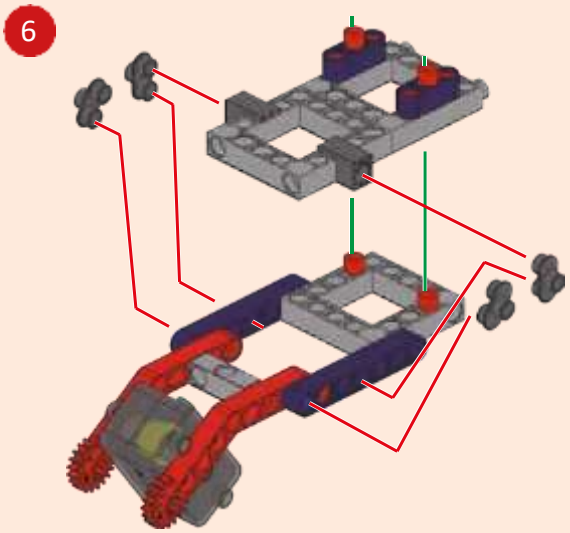

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x2

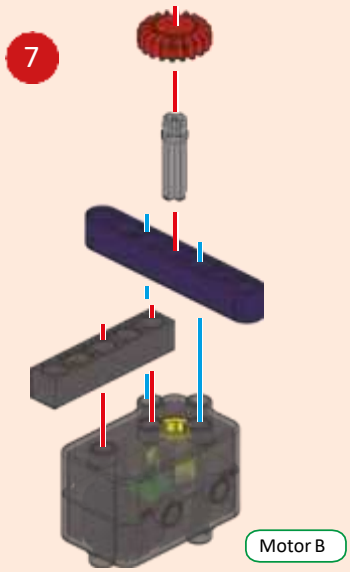

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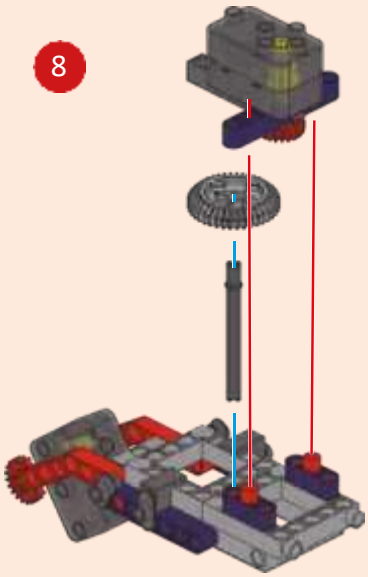

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Motor A

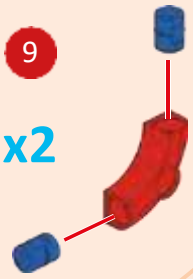

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x2

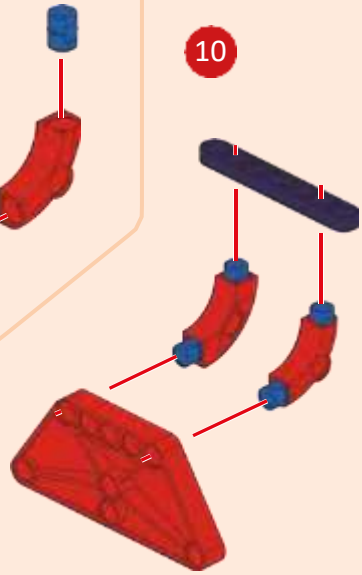

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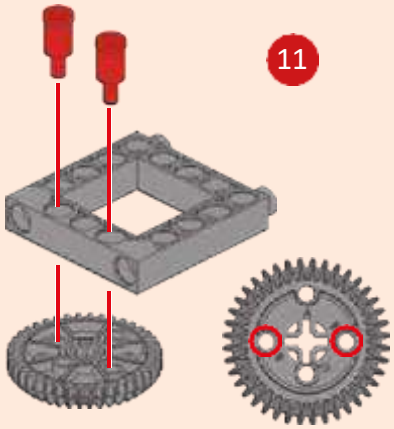

7
Motor B


8


9
x2

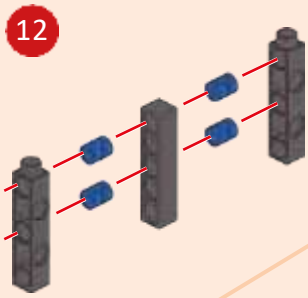

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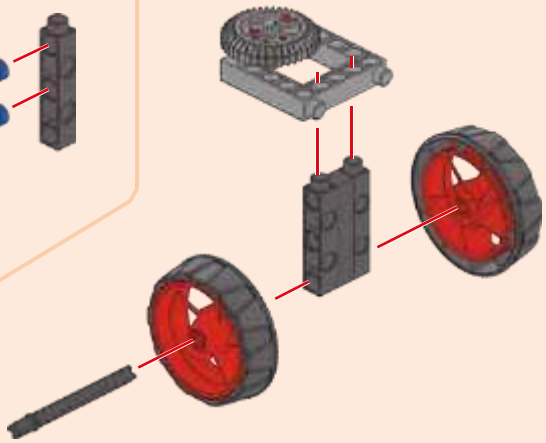


Connect to B holes.

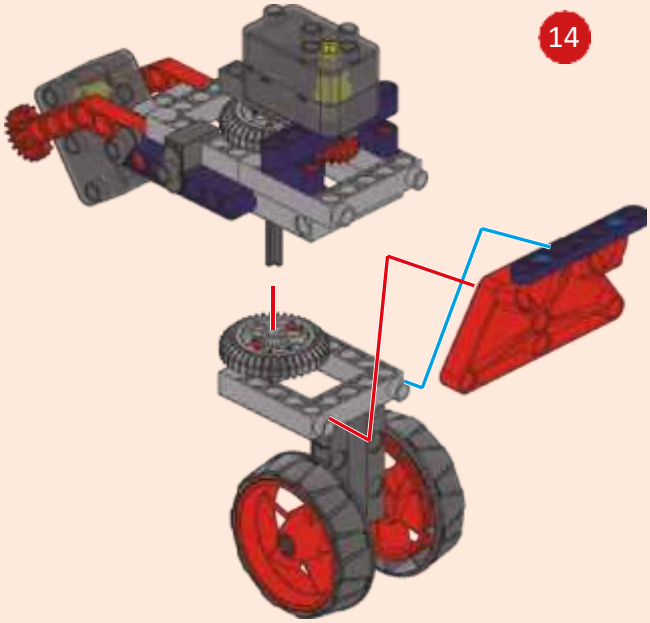
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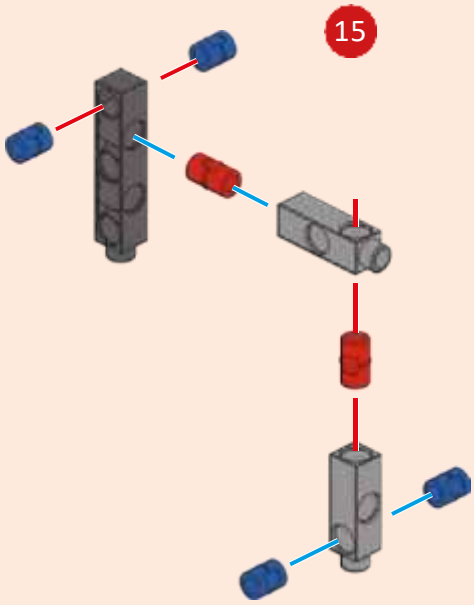
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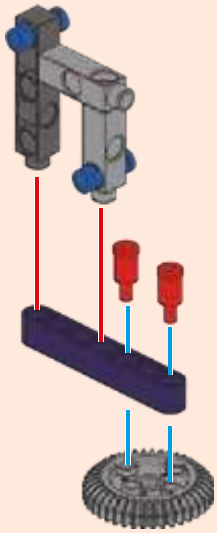
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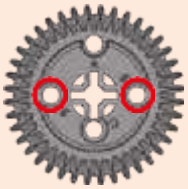


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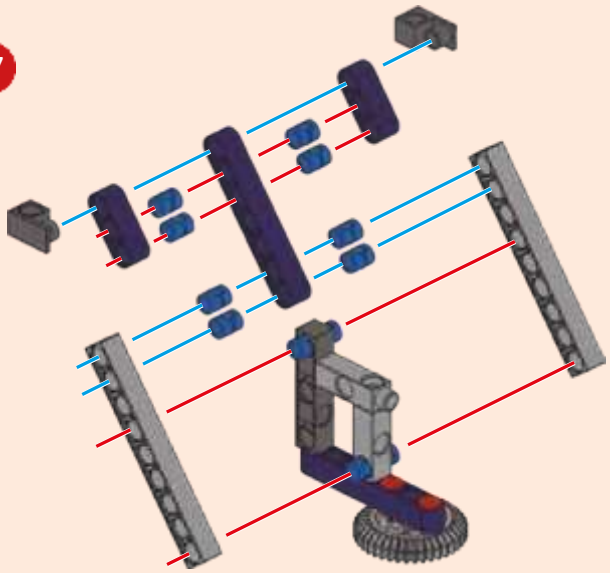
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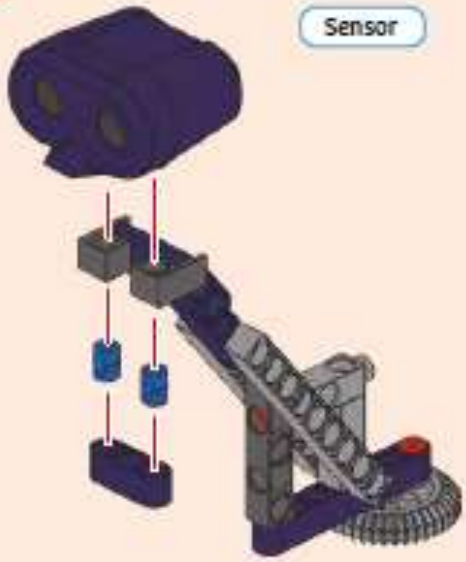


Connect to B holes.

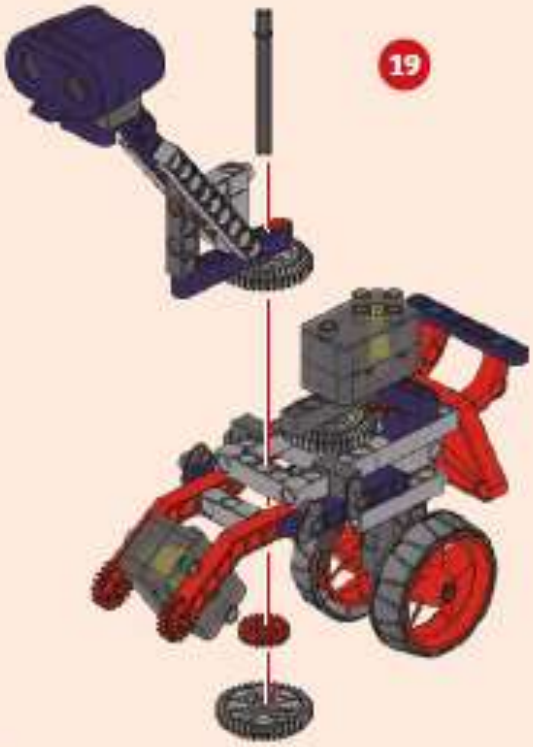
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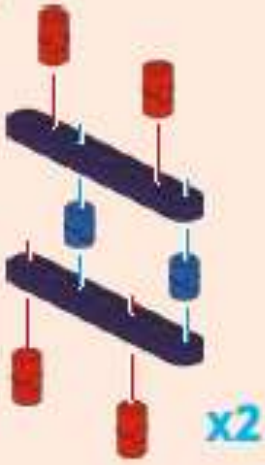
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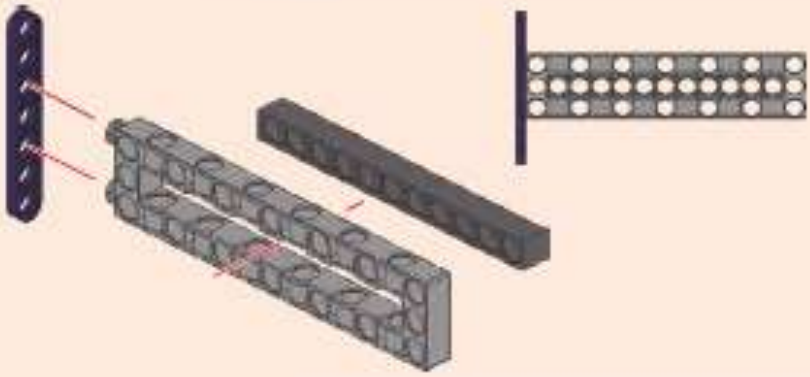
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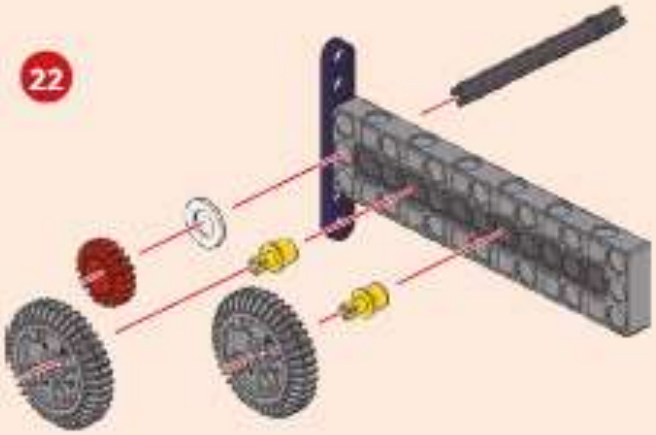
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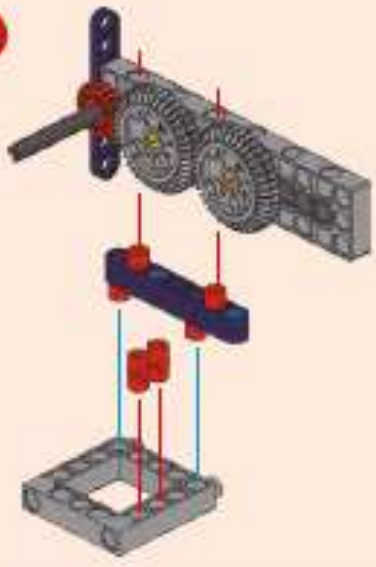
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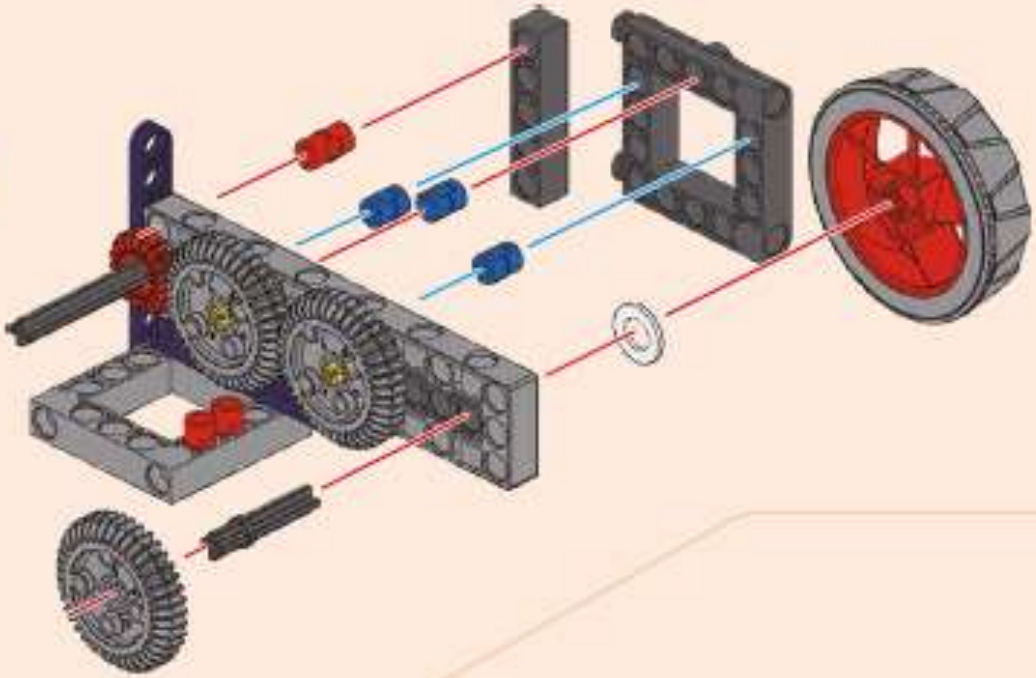
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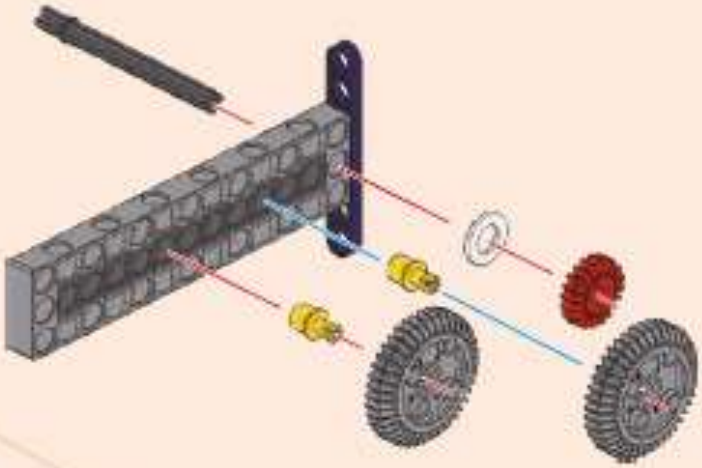
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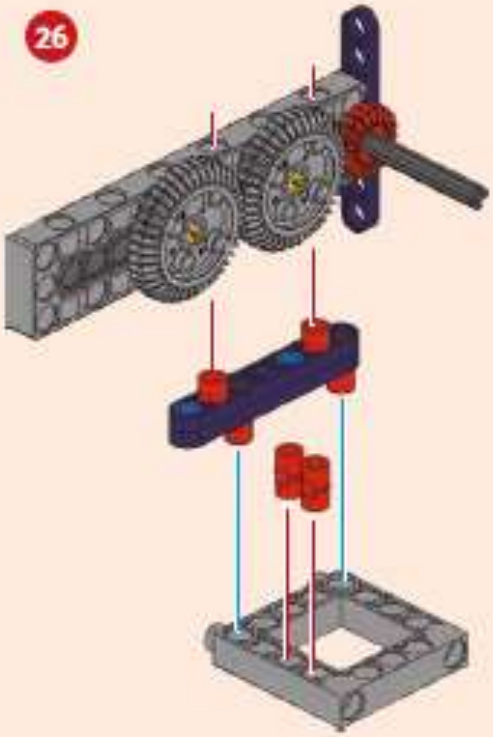
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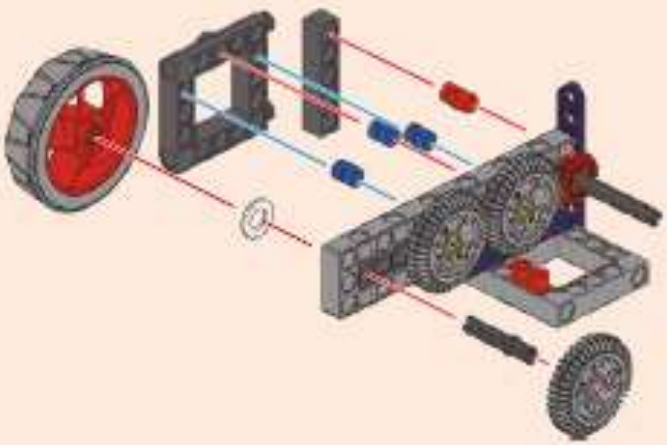
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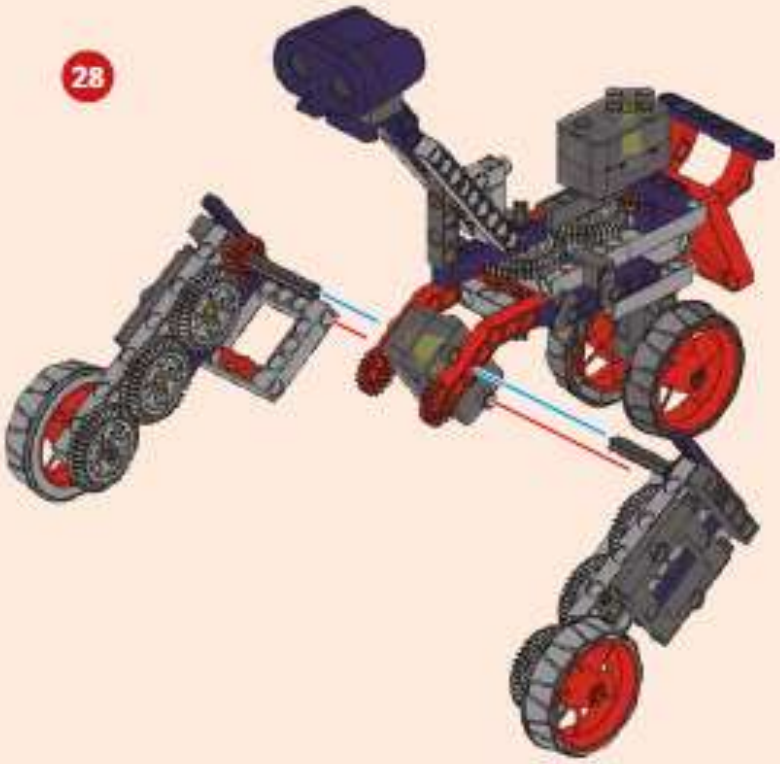
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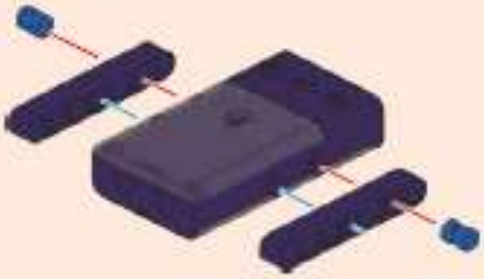
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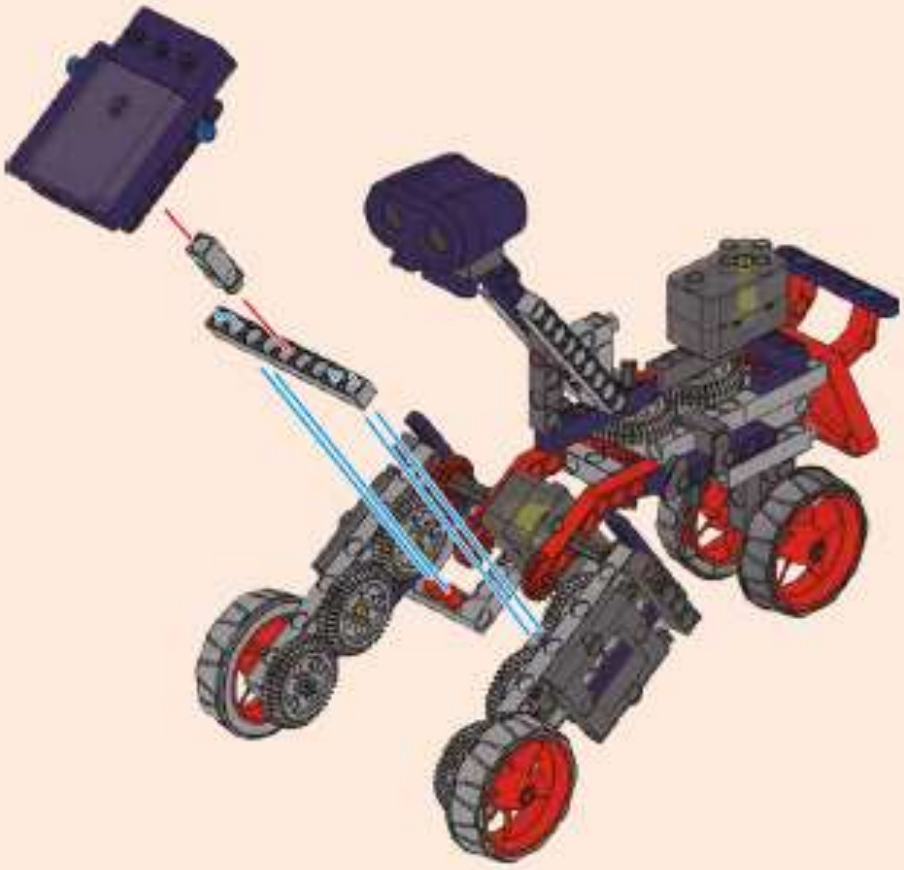
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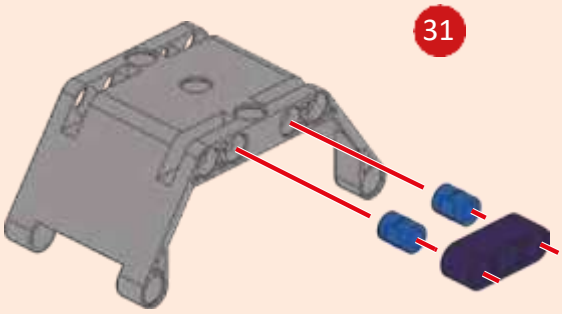


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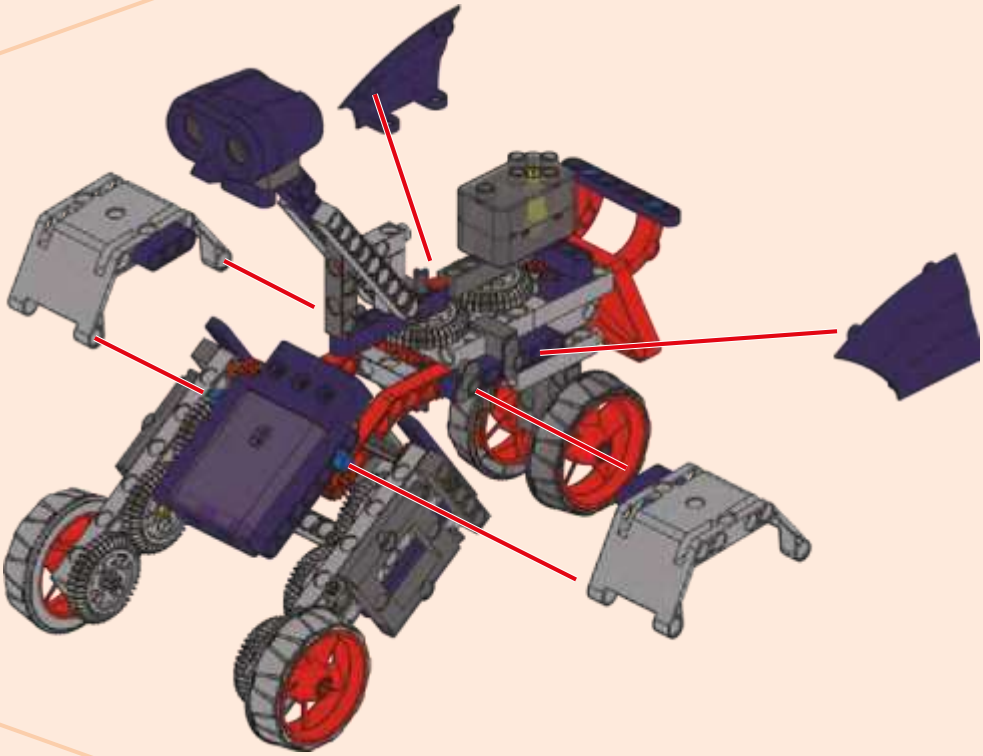


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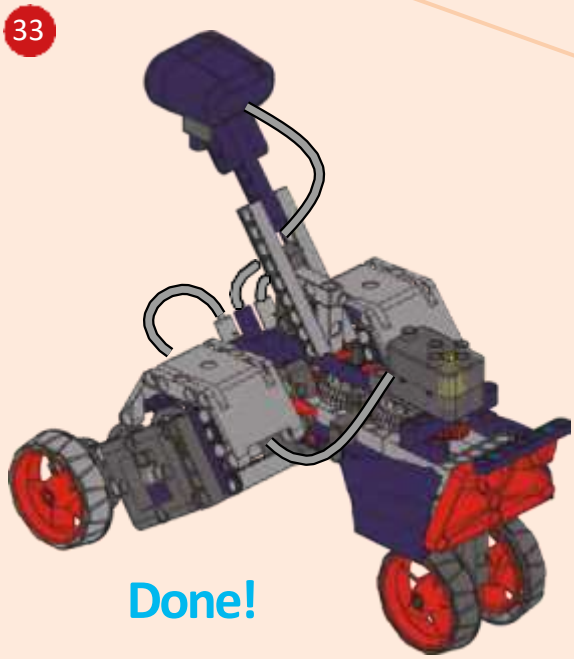
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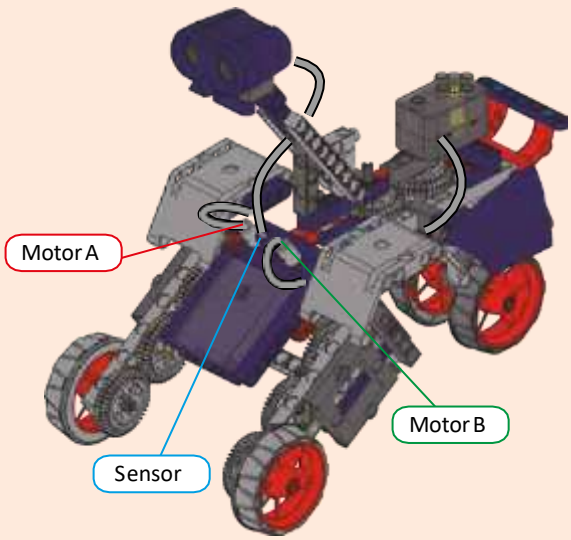
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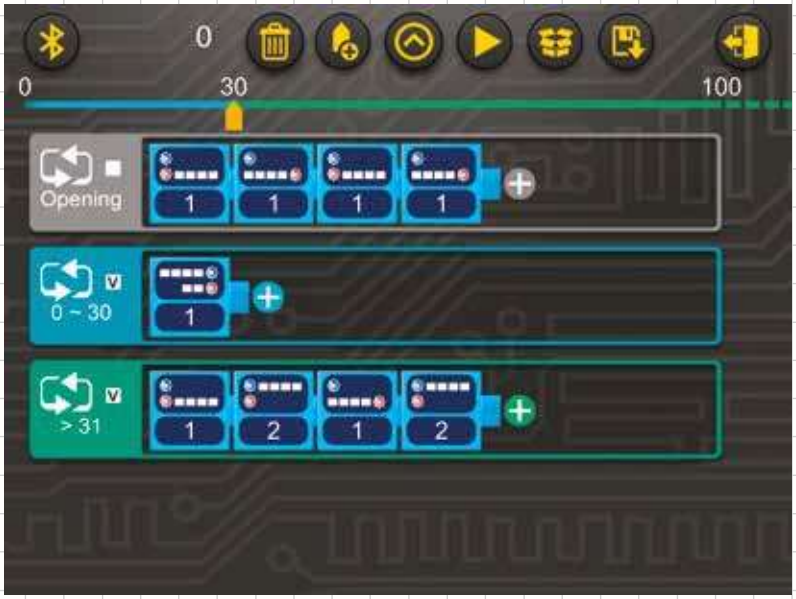
Done!



SAMPLE PROGRAM FOR THE SCOUT ROVER

First, place several large objects along a corridor or hallway. When you run this program, the scout rover will be able to navigate these obstacles. First, the scout rover will move the ultrasonic sensor left and right searching for any objects that are nearby. If no objects are detected the scout rover will move forward. When an object is within range of the scout rover, it will back away and turn its wheels. Then the scout rover will continue to move forward again in a new direction until it detects another object.

This program is preloaded in the app under Program 13. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 13

OPENING SEGMENT:

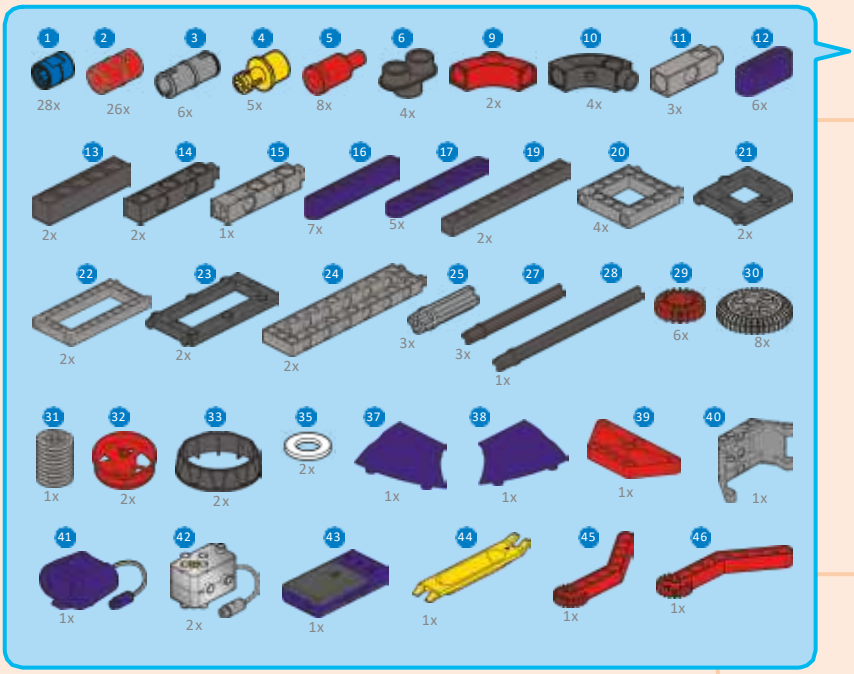
SEGMENT 0-30:

SEGMENT >31:

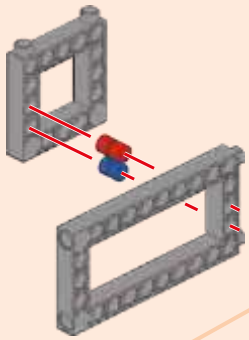
PROGRAMMING NOTES

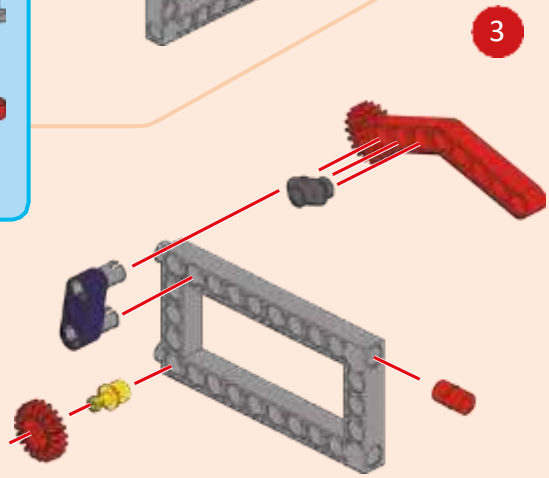


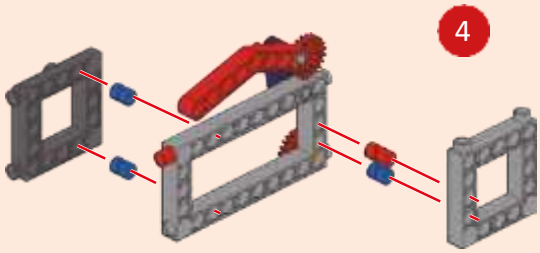
HELICOPTER

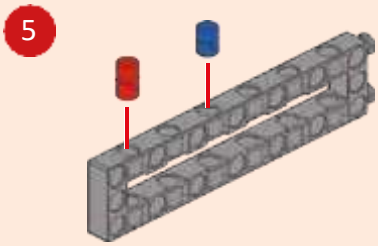

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6 4x
9 2x
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11 3x
12 6x
13 2x
14 2x
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16 7x
17 5x
19 2x
20 4x
21 2x
22 2x
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24 2x
25 3x
27 3x
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29 6x
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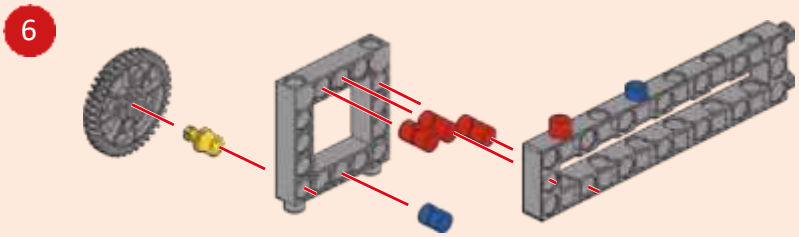

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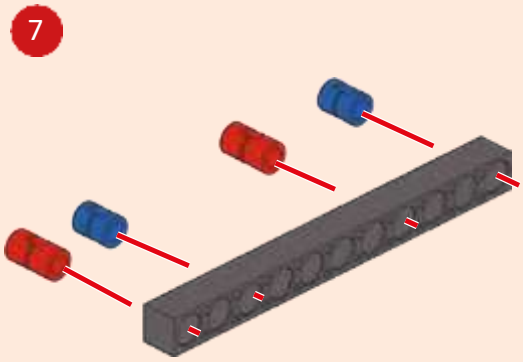

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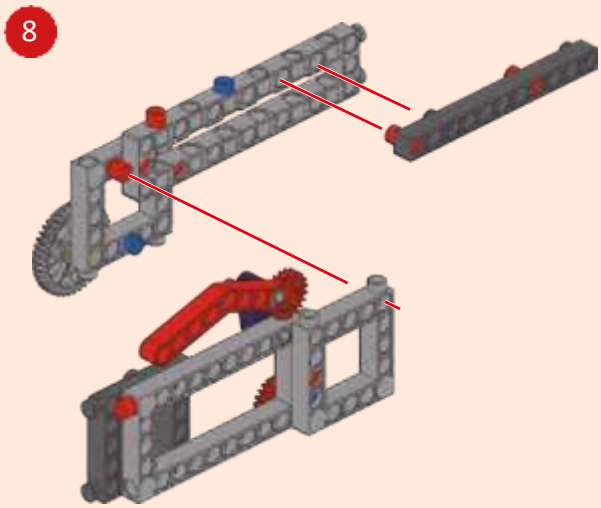

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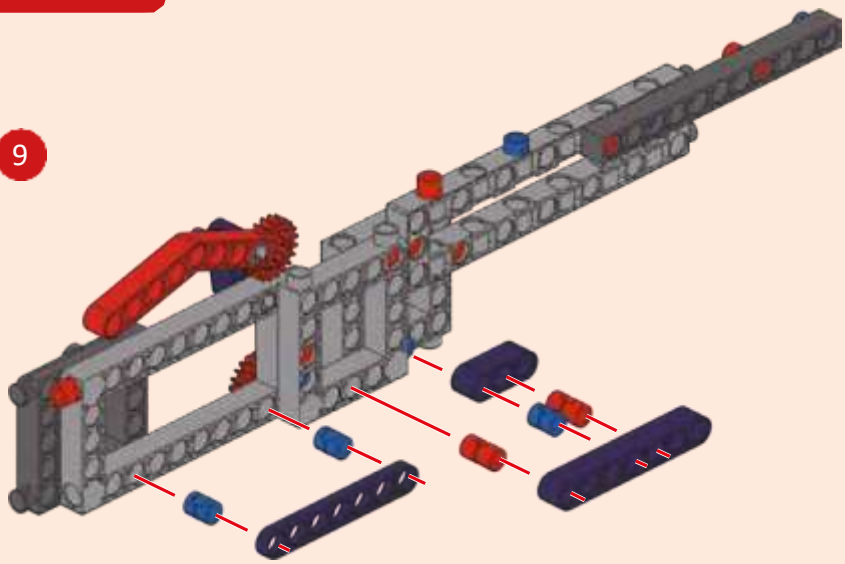

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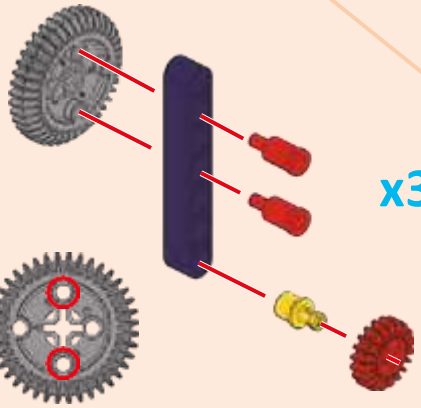

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8

9

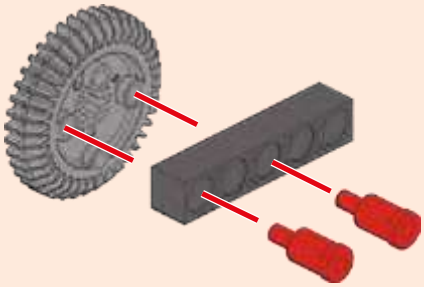


10



Connect to Hole B

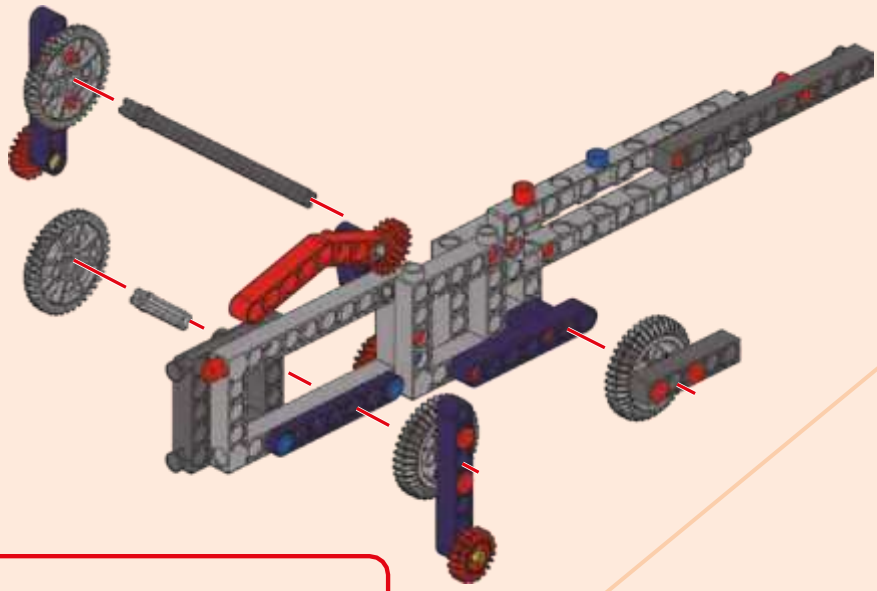
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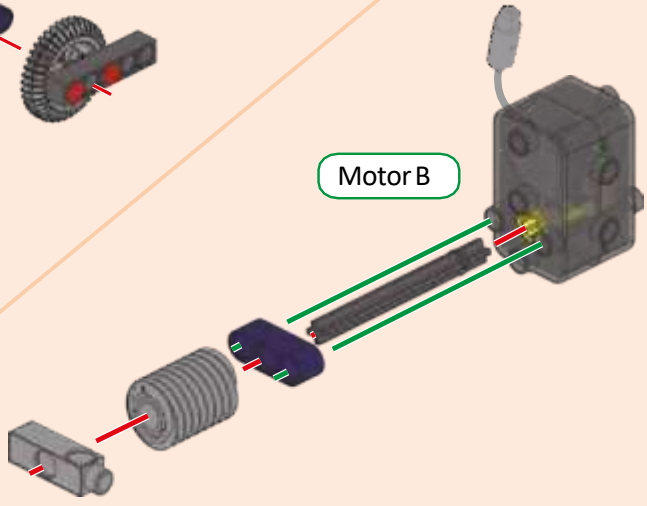


Connect to Hole B

12



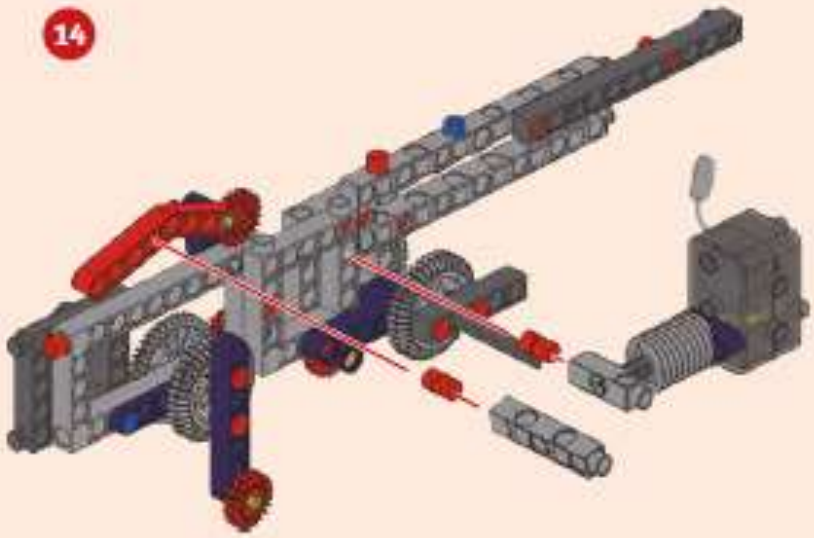
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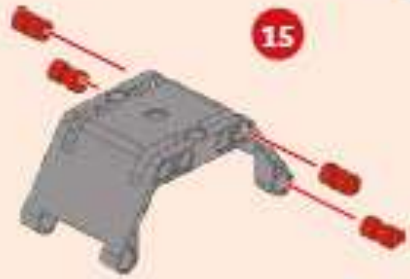


Side view

14



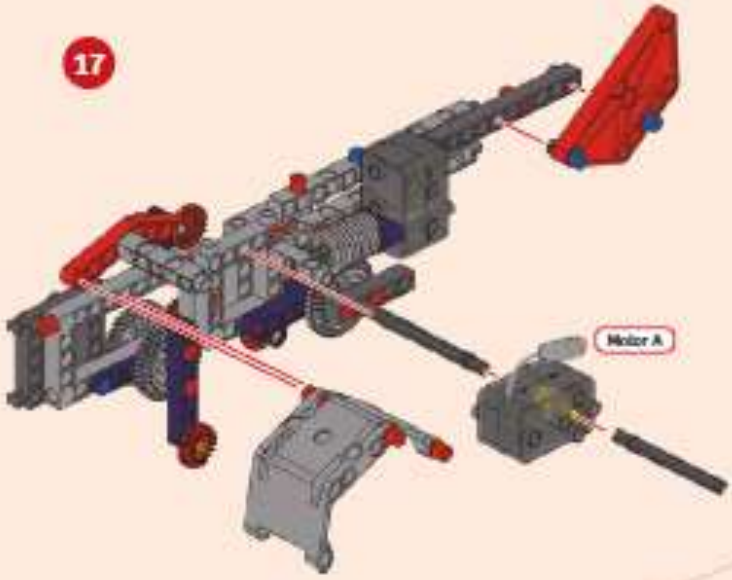
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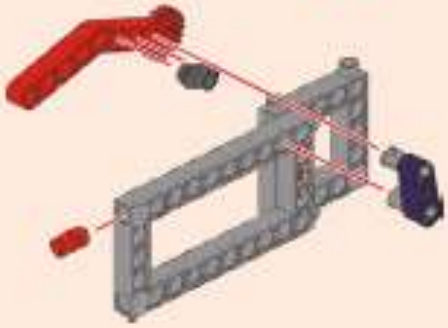
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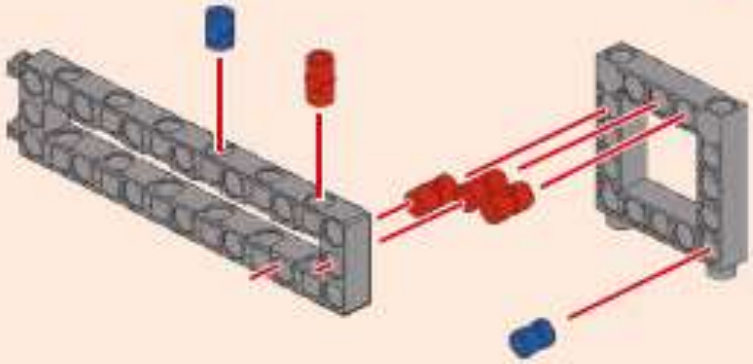
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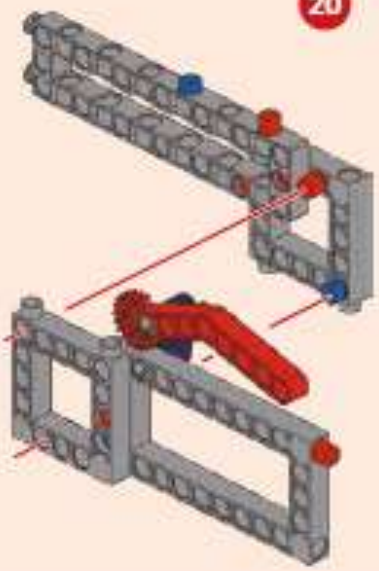
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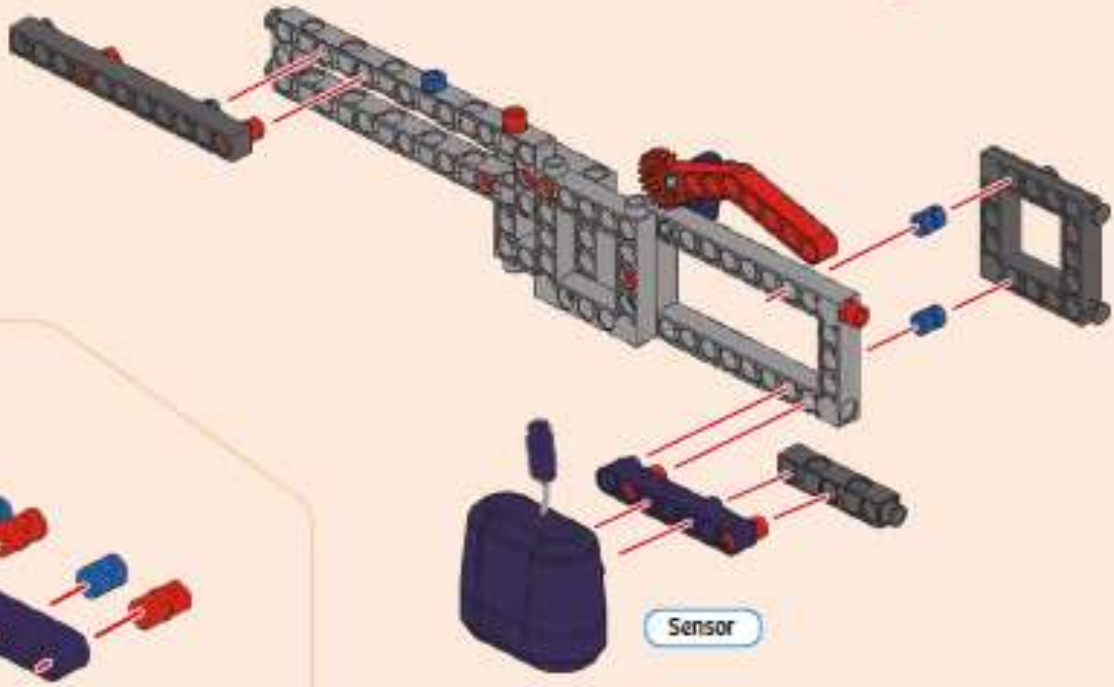
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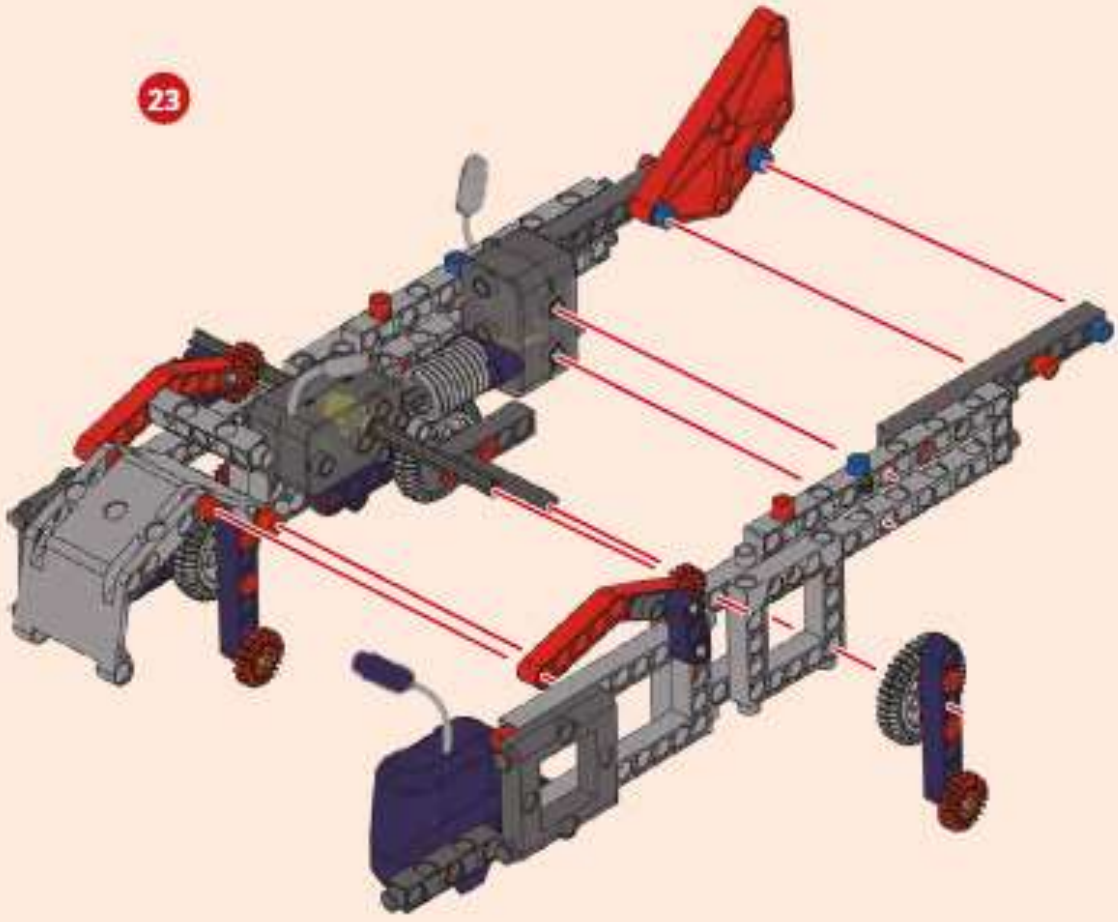


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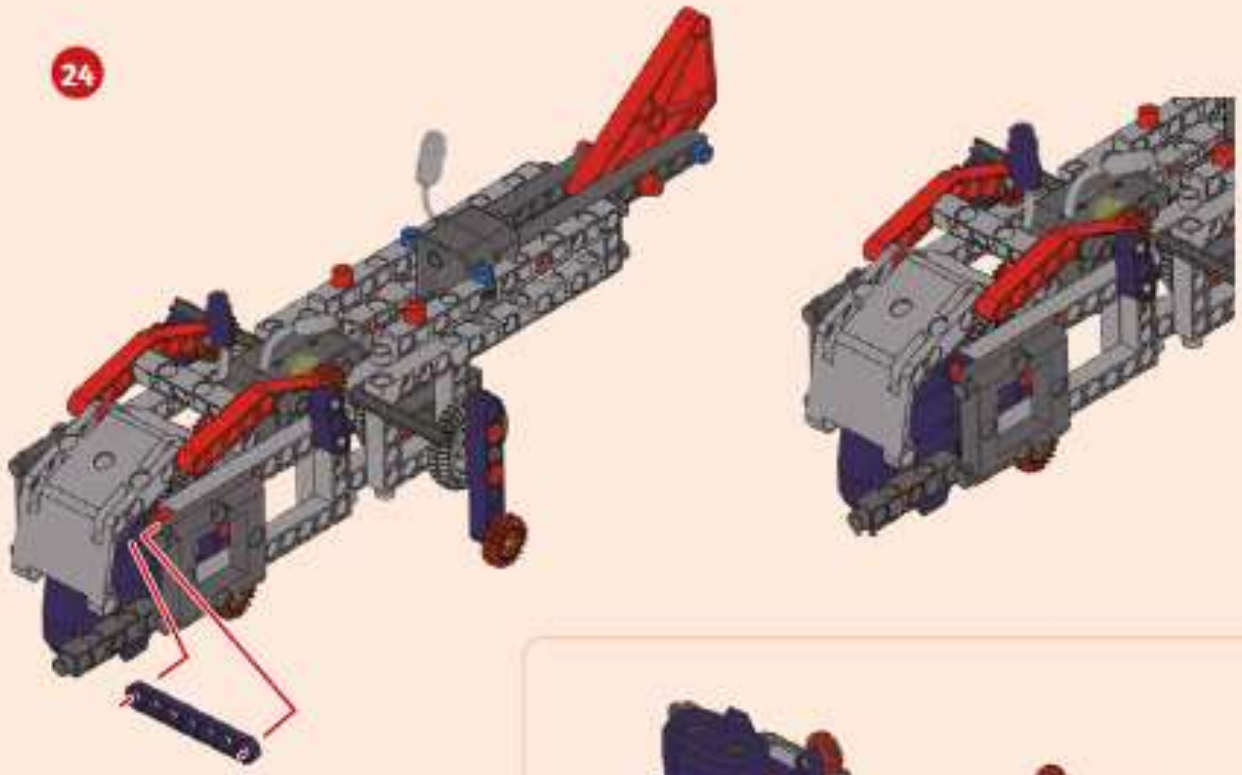


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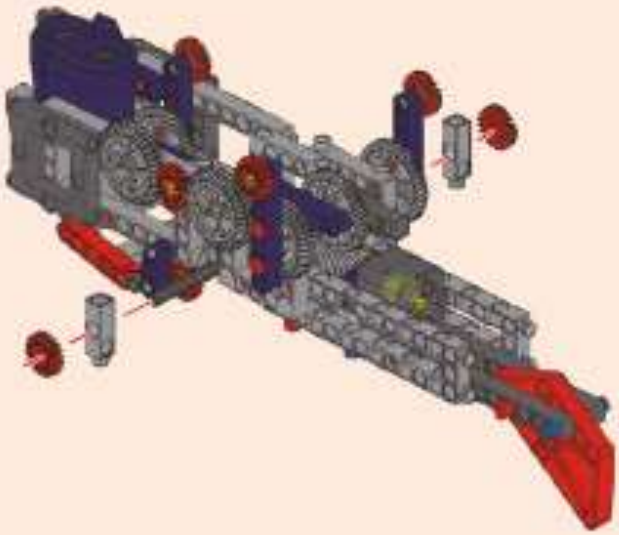
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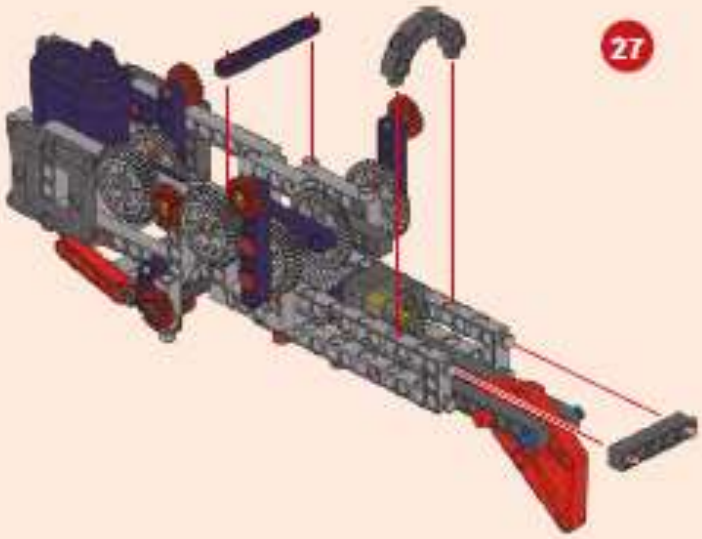
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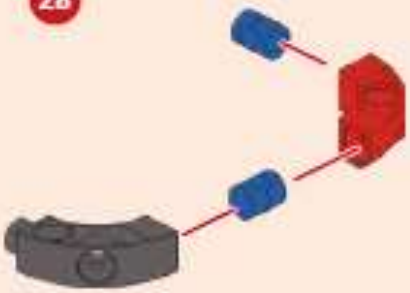
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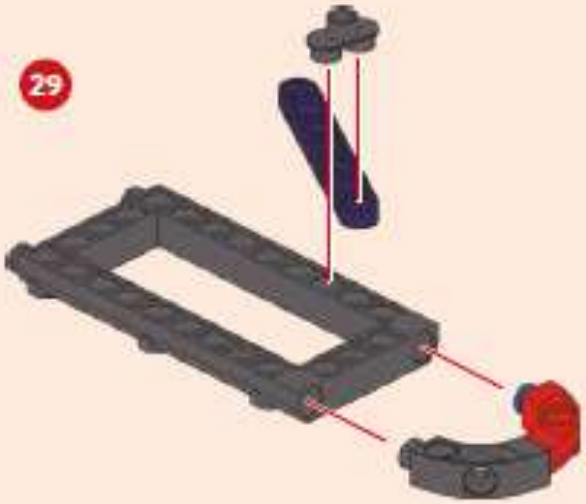
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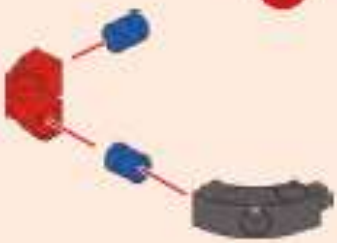
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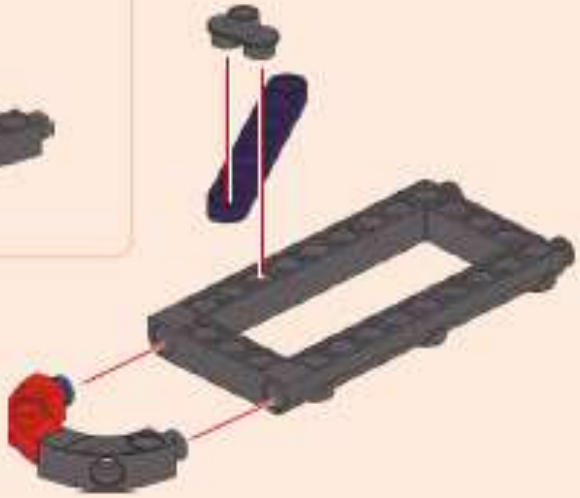
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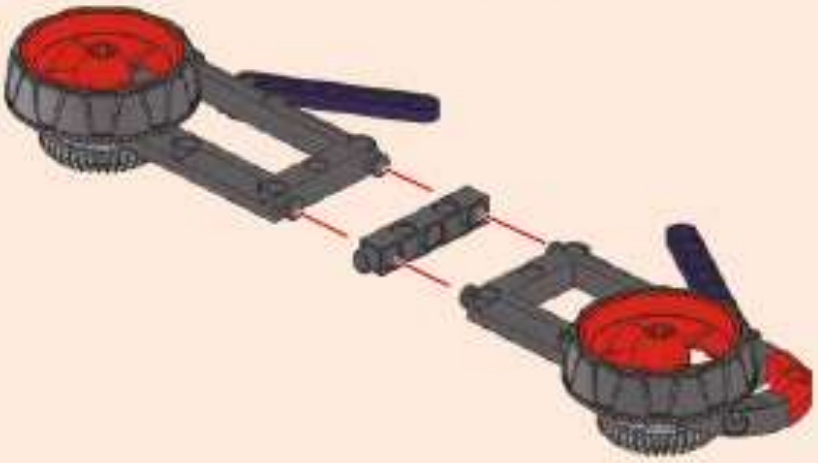
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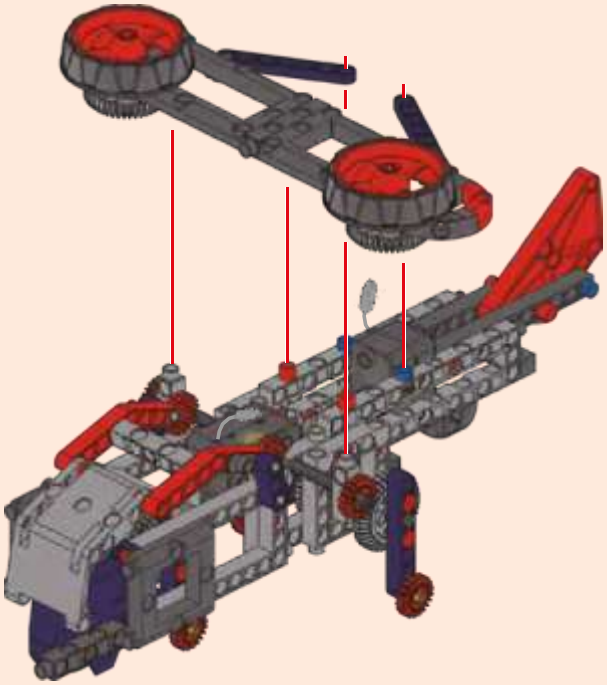
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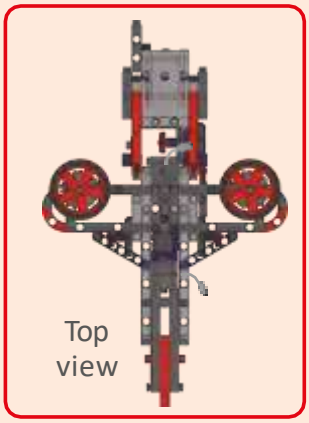


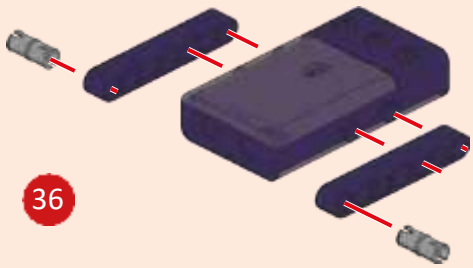
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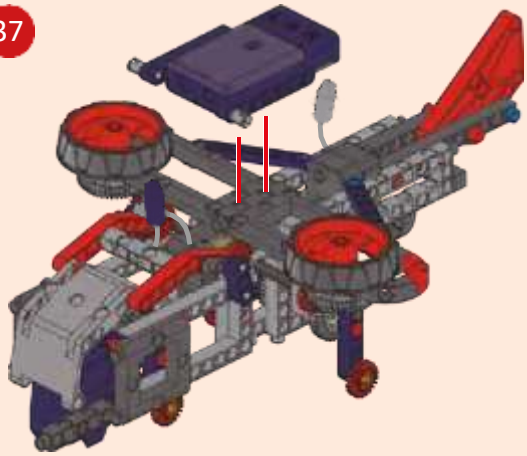




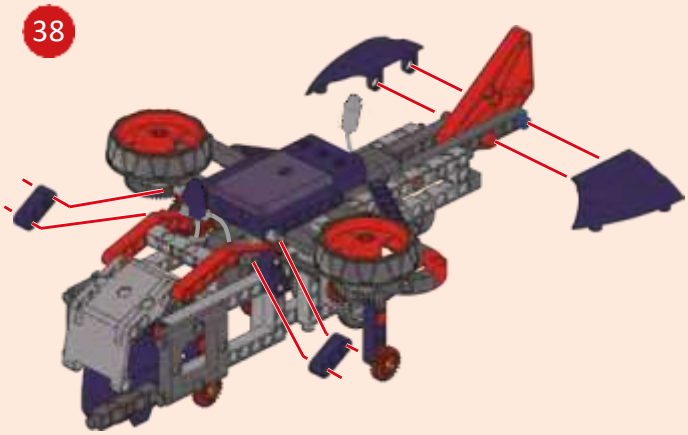


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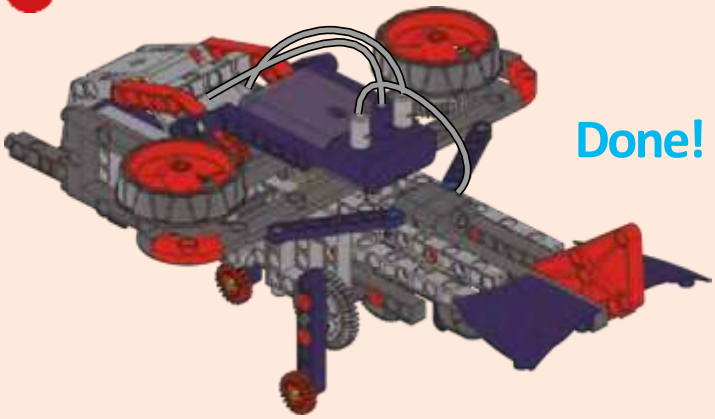
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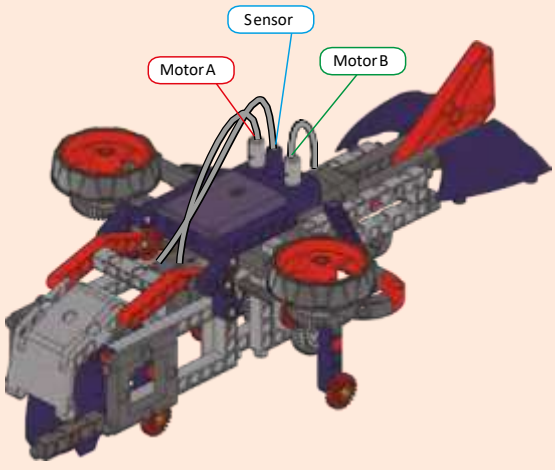
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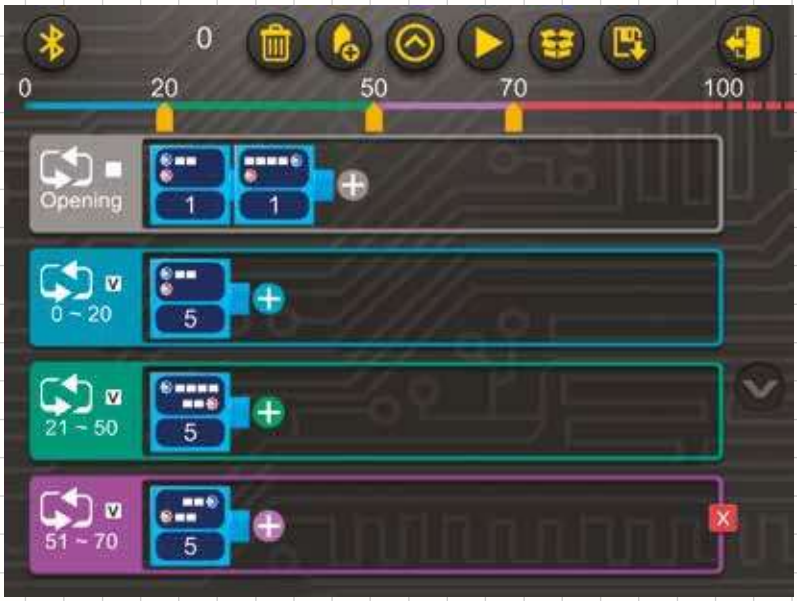
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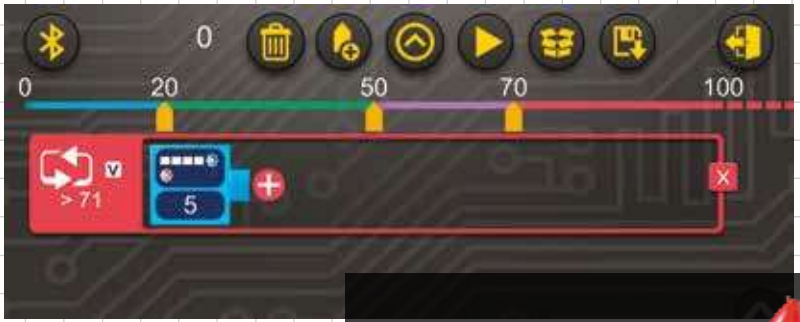


SAMPLE PROGRAM FOR THE HELICOPTER

Start by placing the helicopter on a table. Run the program. First, the program turns motor B on, which spins the rotor blades. Then, lift the helicopter up off the table with your hand. Once the model is several centimeters from the table surface, the ultrasonic sensor detects the absence of the table. The program then tells motor A to retract the landing gear. Now you can pretend the model is flying around. When it's time to land, slowly bring the helicopter close to the tabletop again. The sensor will tell motor A to swivel back into landing mode, and the landing gear will extend so the helicopter can land.

This program is preloaded in the app under Program 14. Test it out and write down how the robot behaves for each program segment below.







DEMO PROGRAM:

Program 14

OPENING SEGMENT:

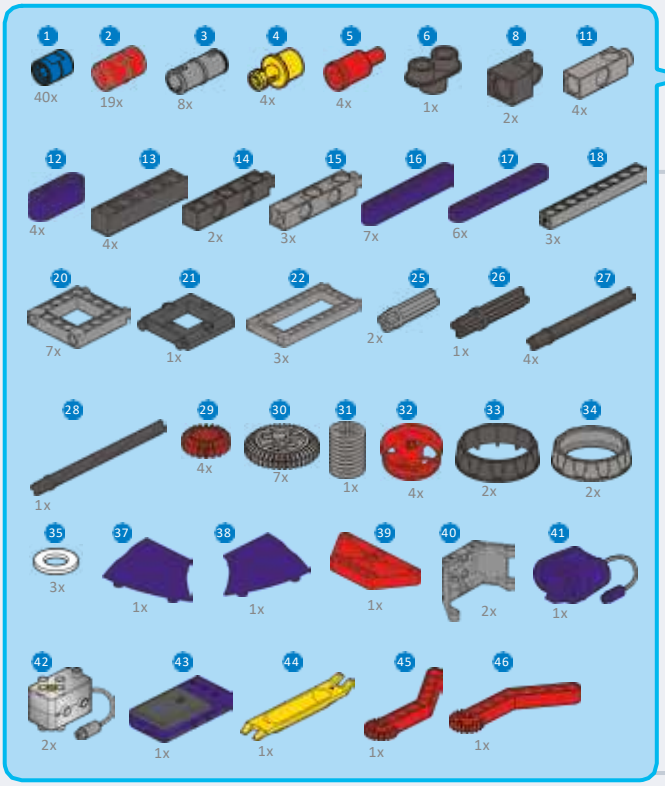
SEGMENT 0-20:

SEGMENT 21-50:

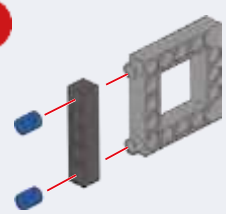
SEGMENT 51-70:

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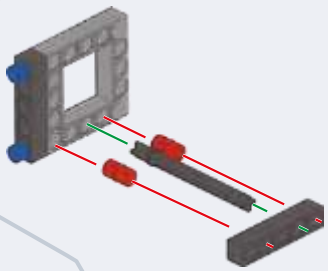
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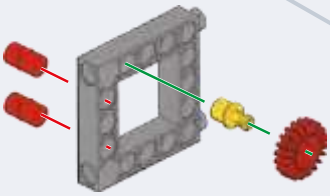


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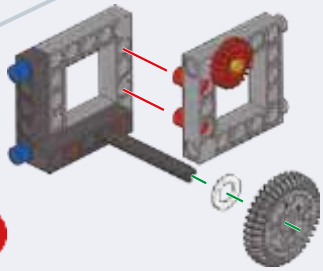
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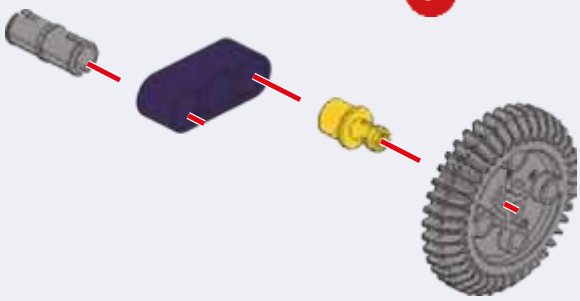


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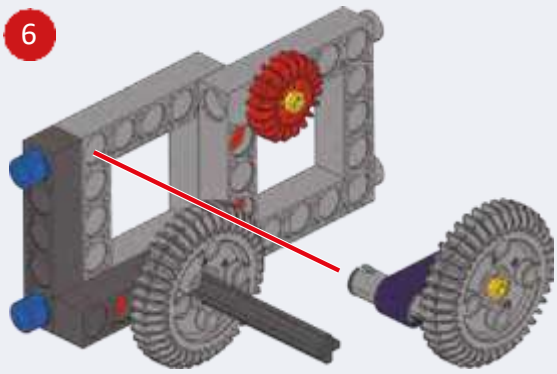
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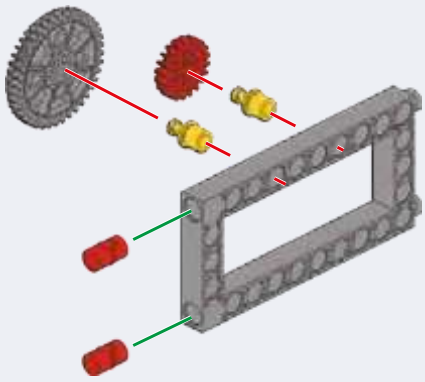
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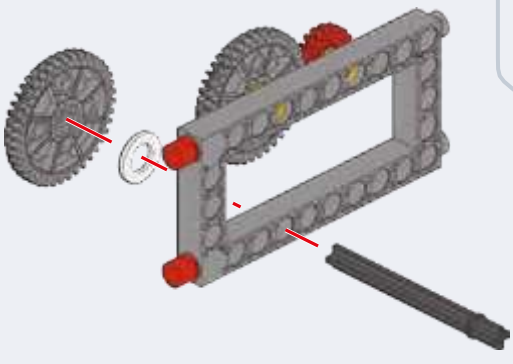
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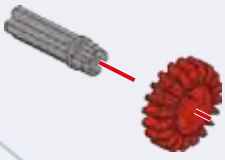
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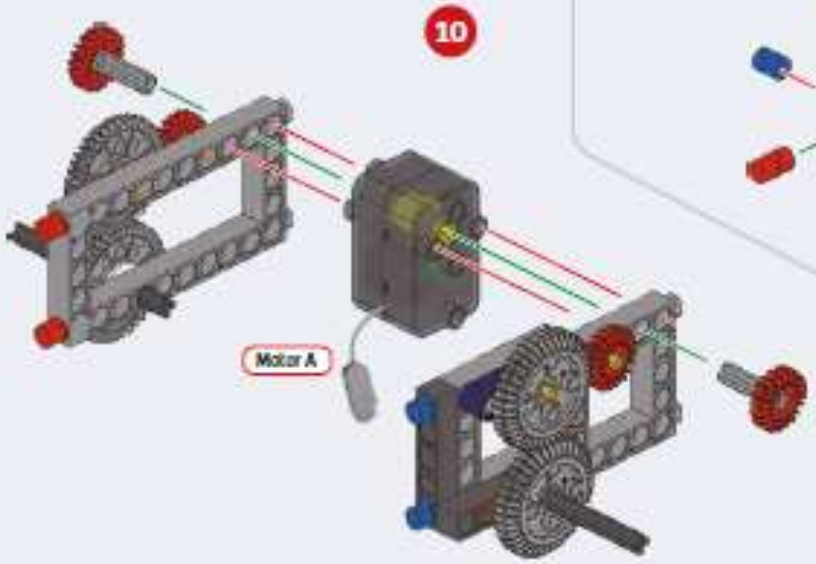


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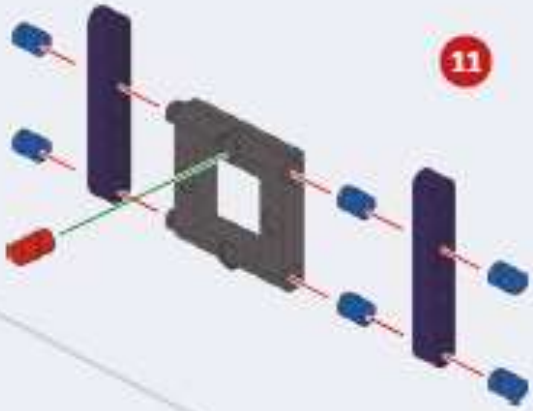


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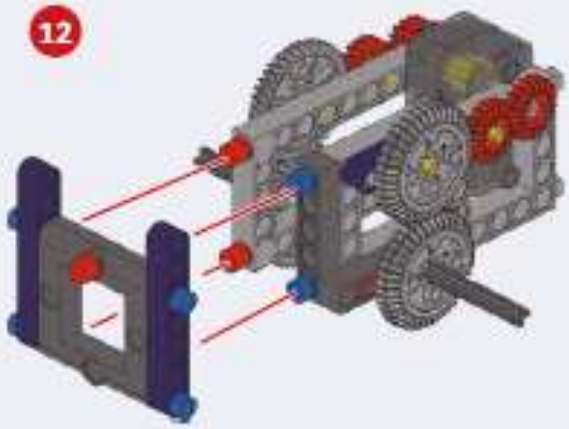
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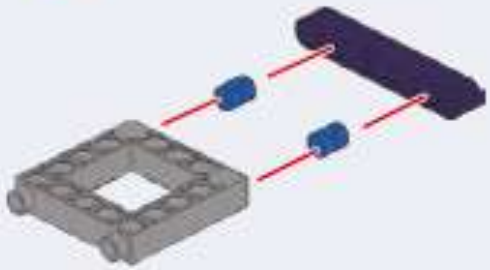
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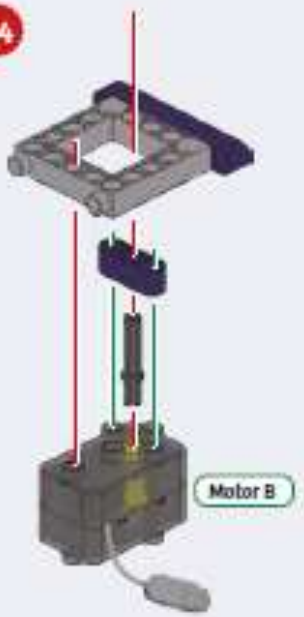
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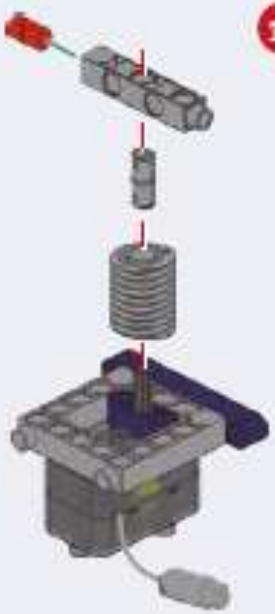
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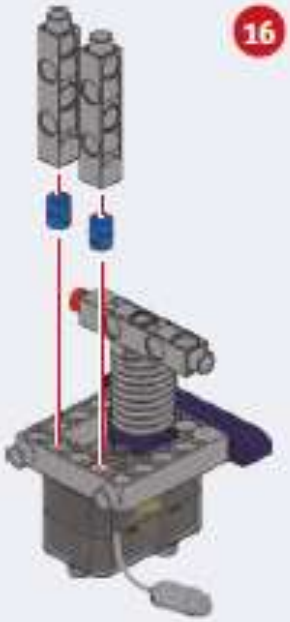
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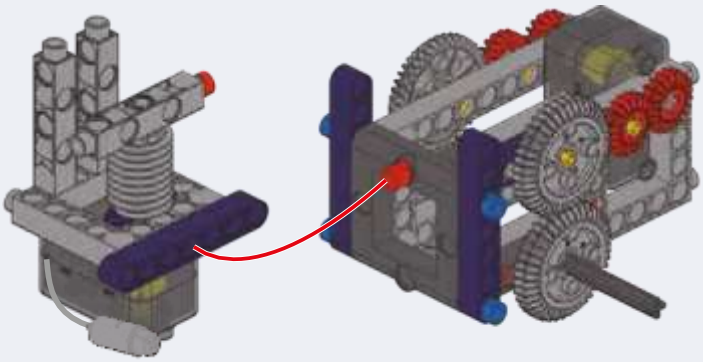
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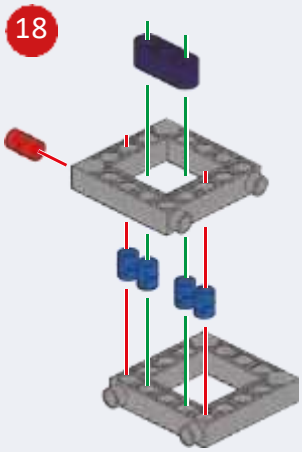
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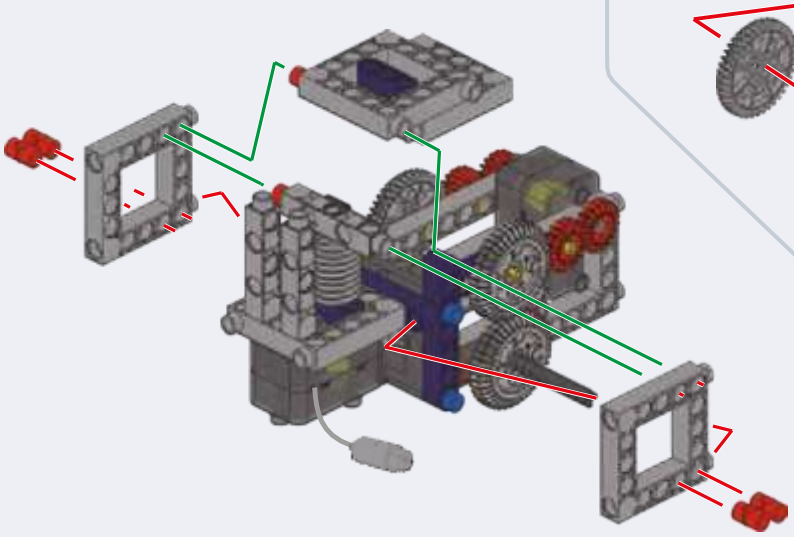
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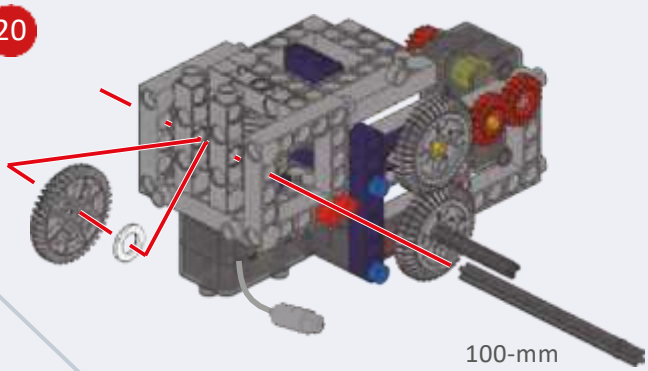
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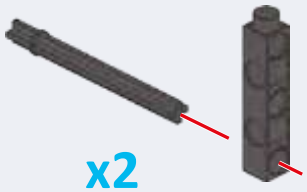


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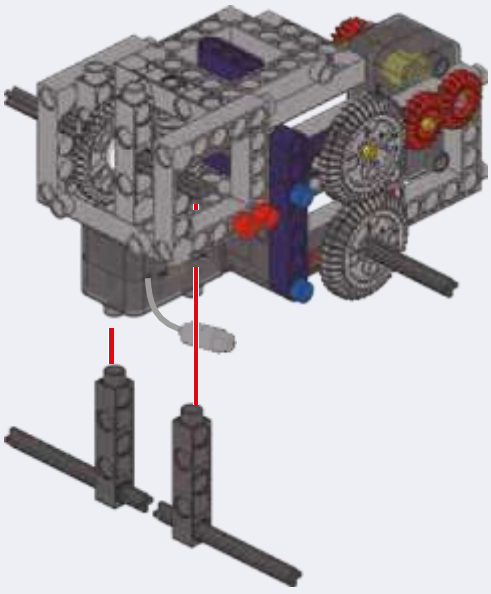
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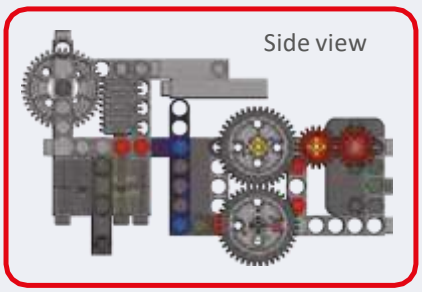
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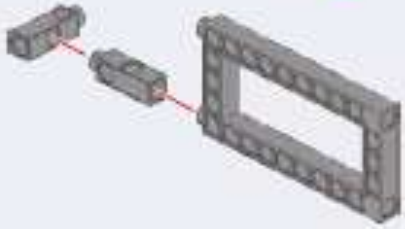
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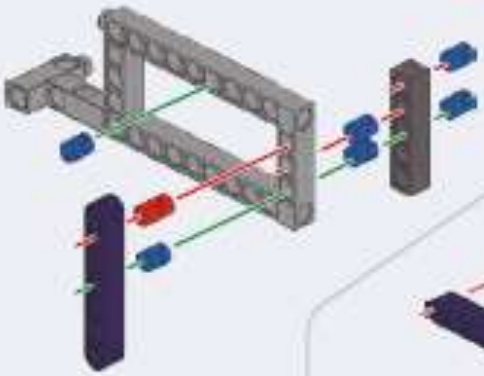




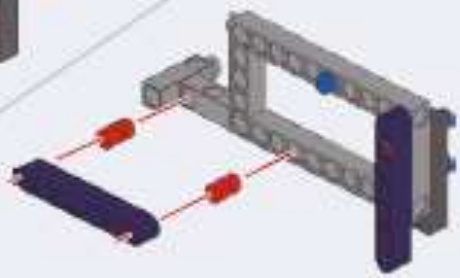
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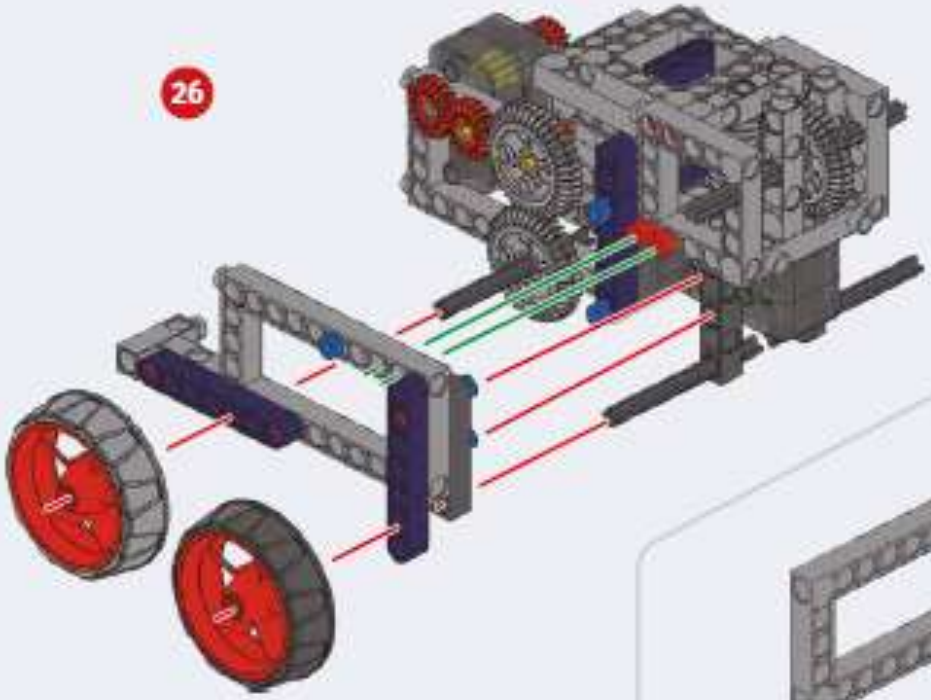
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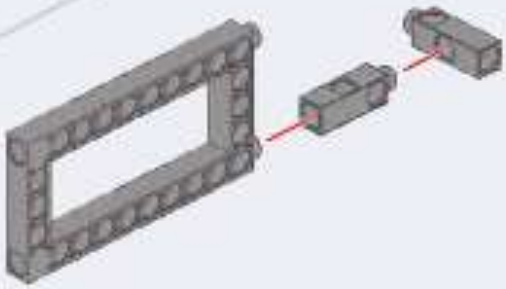
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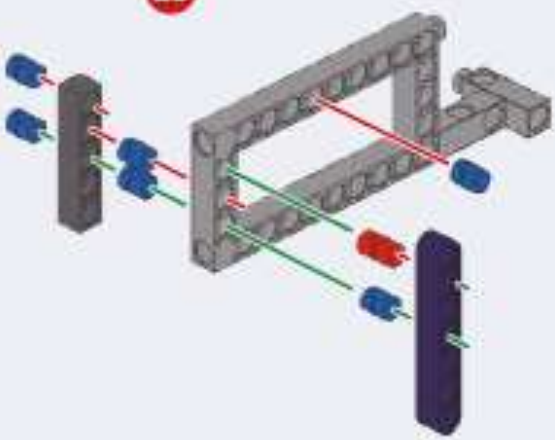
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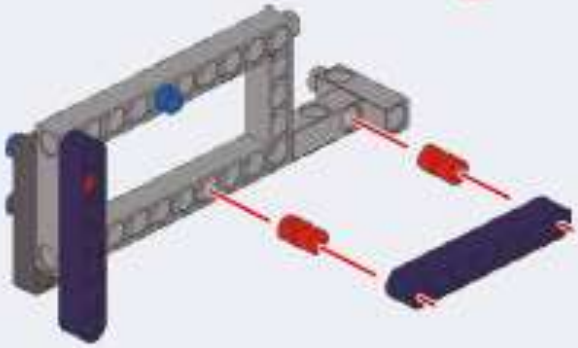
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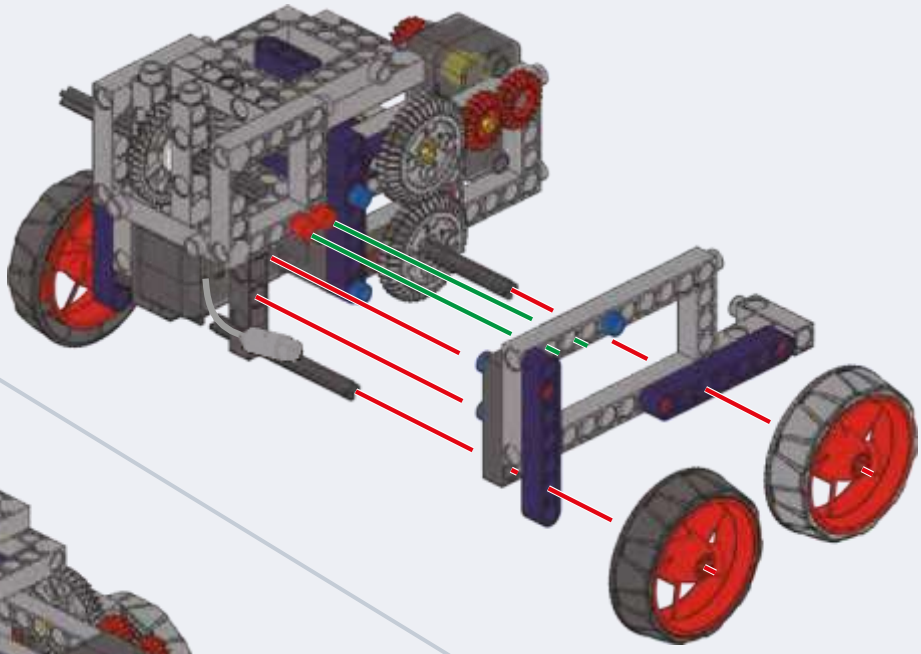
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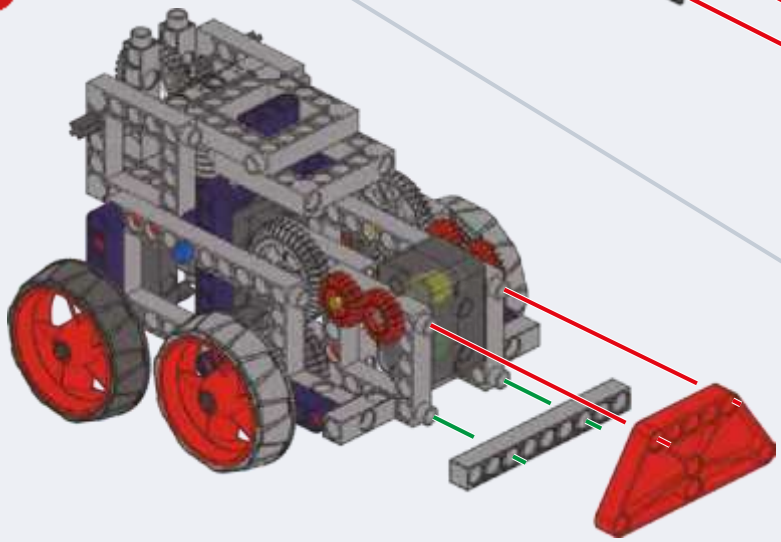
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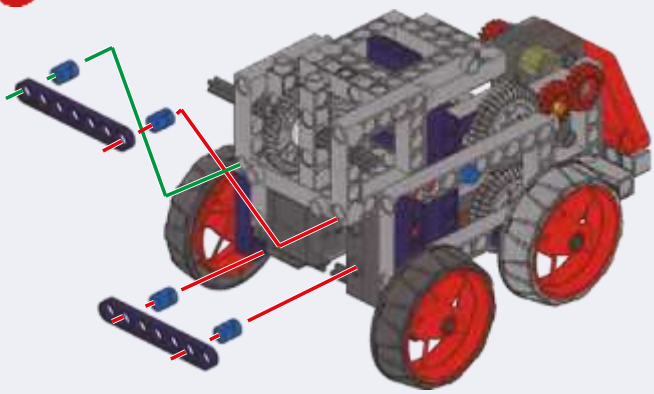
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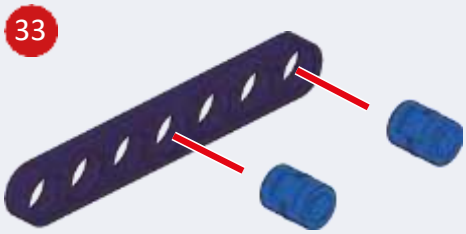
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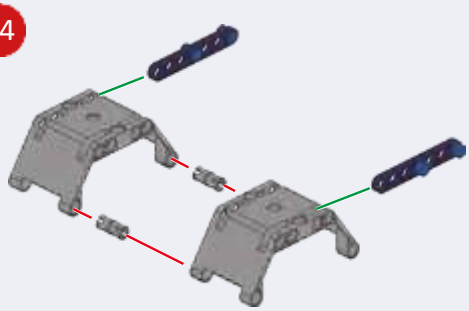


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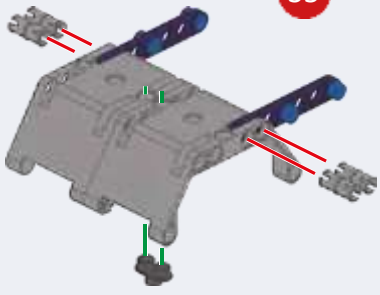


x2

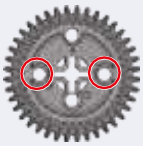
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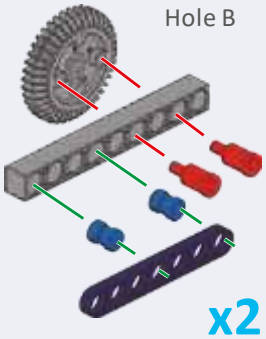
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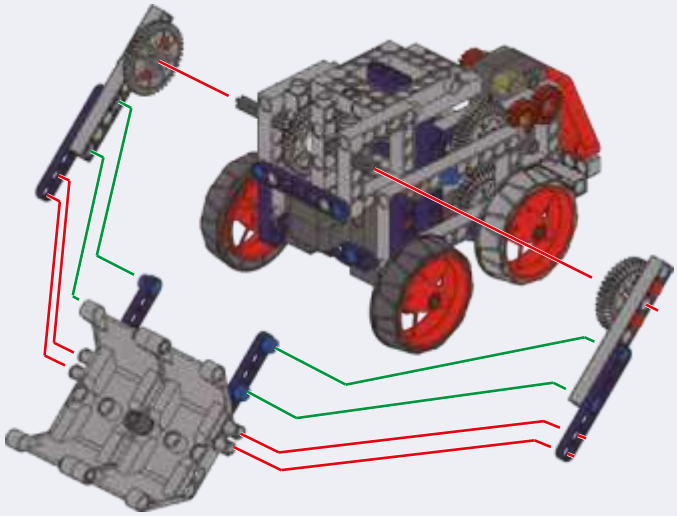


Connect to Hole B

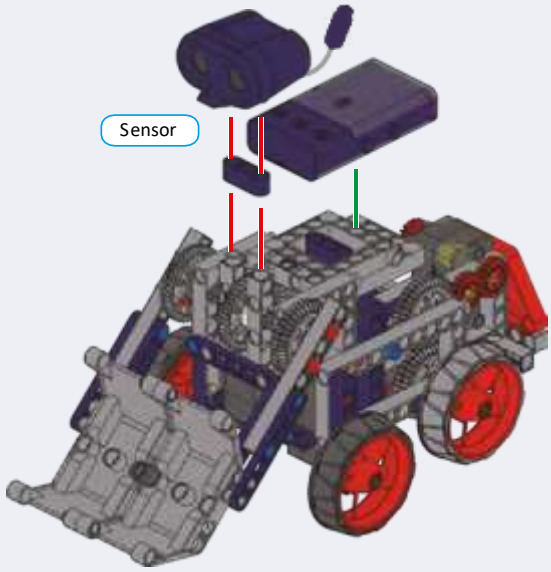


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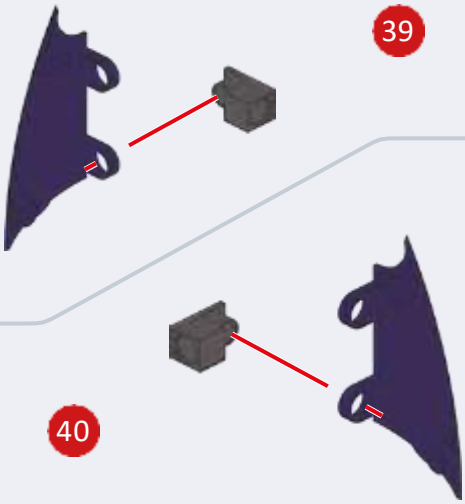
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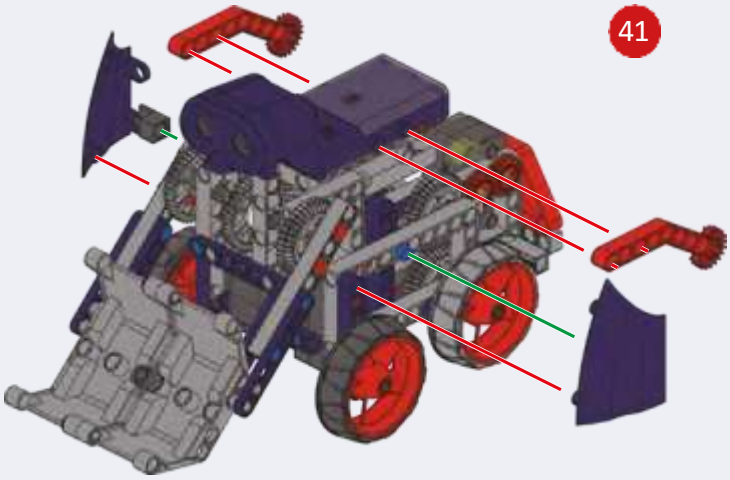


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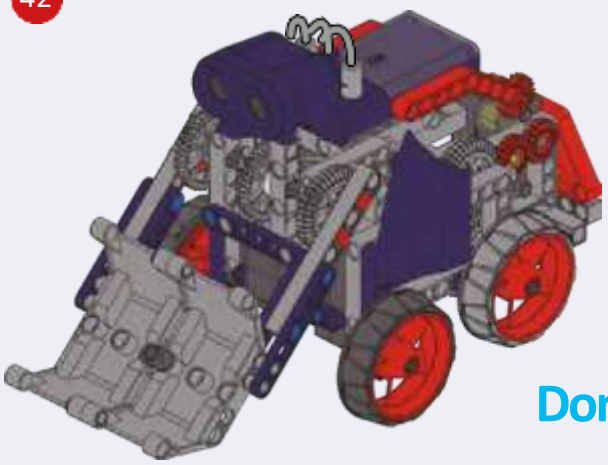


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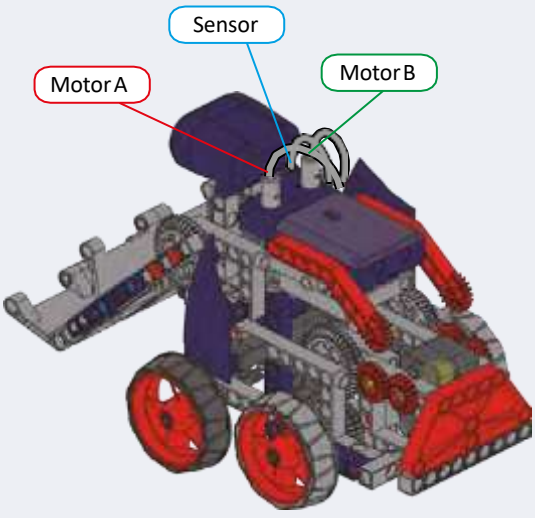
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42



Done!

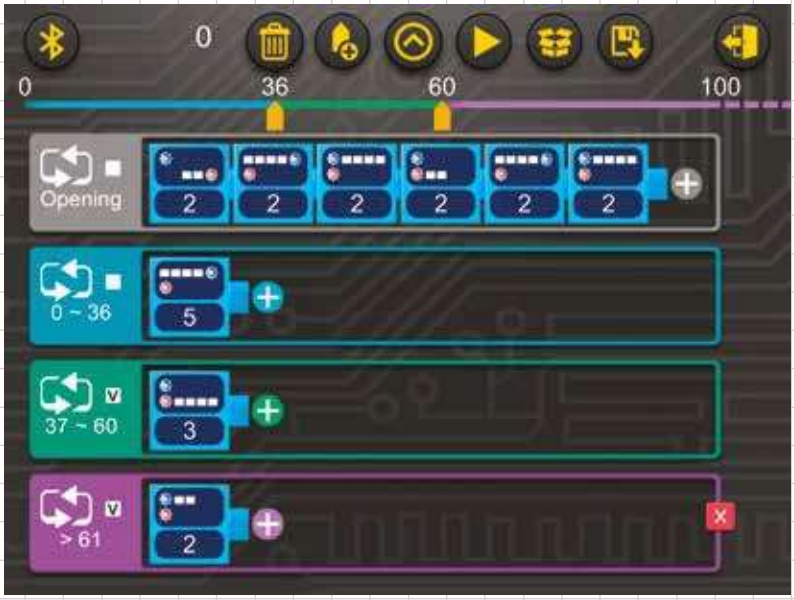


PROGRAMMING

SAMPLE PROGRAM FOR THE DOZER BOT

The dozer bot is able to pick up and push small objects around with the blade on its front end. Run this program and the dozer bot will move forward with its blade down until it detects an object. The dozer robot will then raise its blade until it is horizontal, and then move backwards.

This program is preloaded in the app under Program 15. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 15

OPENING SEGMENT:

SEGMENT 0-36:

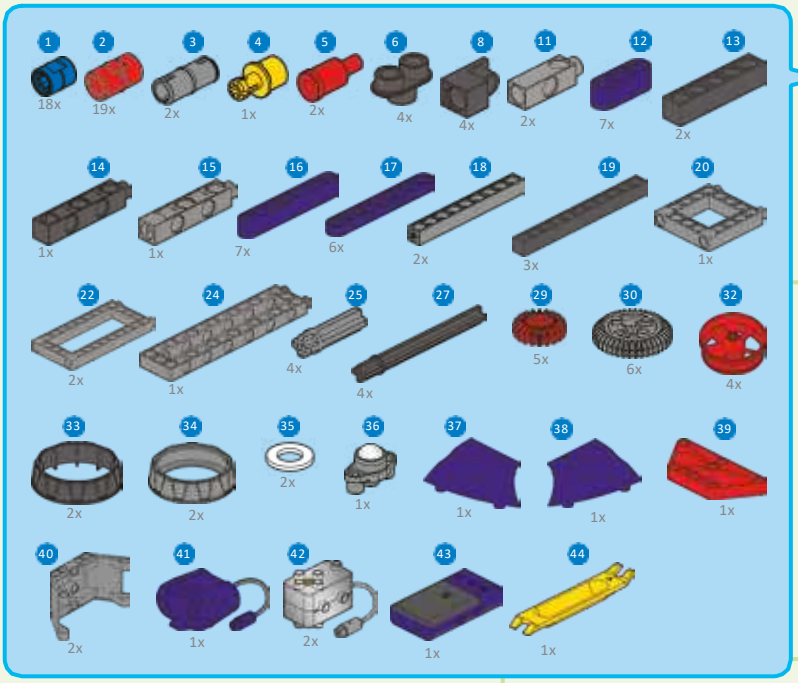
SEGMENT 37-60:

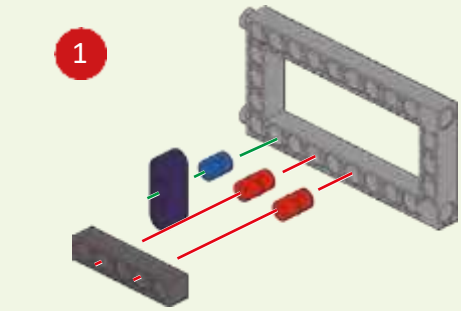
SEGMENT >61:

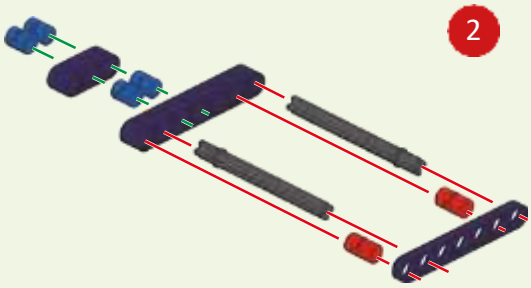
PROGRAMMING NOTES

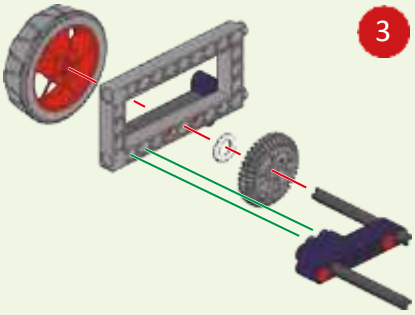


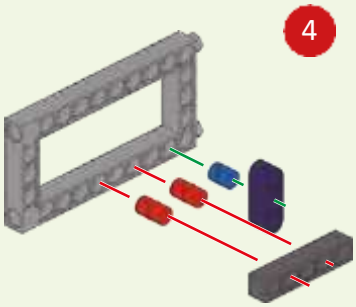
SCORPION ROBOT

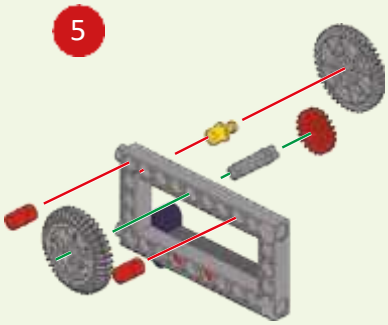


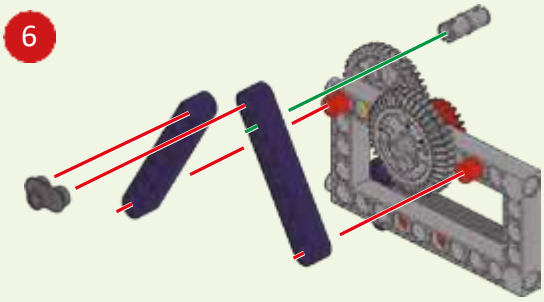


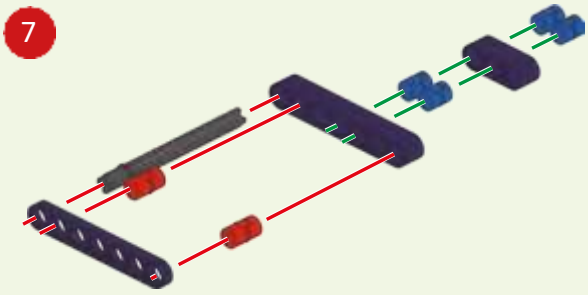


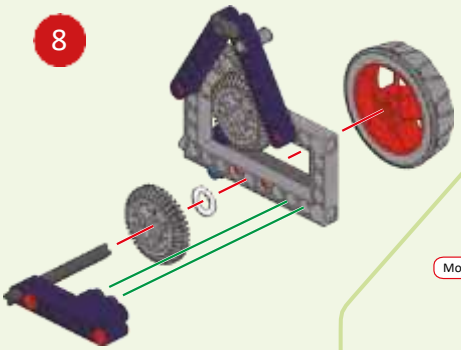


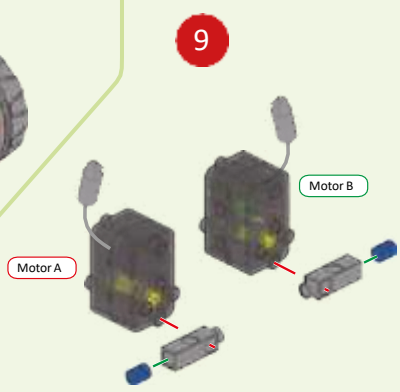


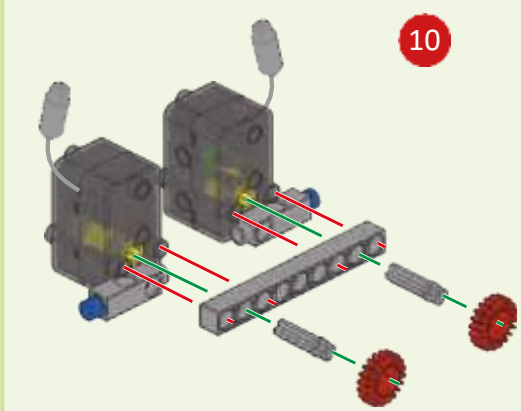




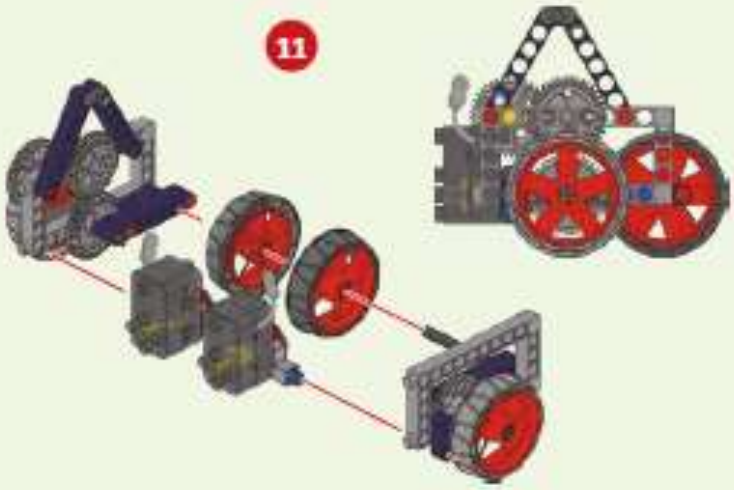




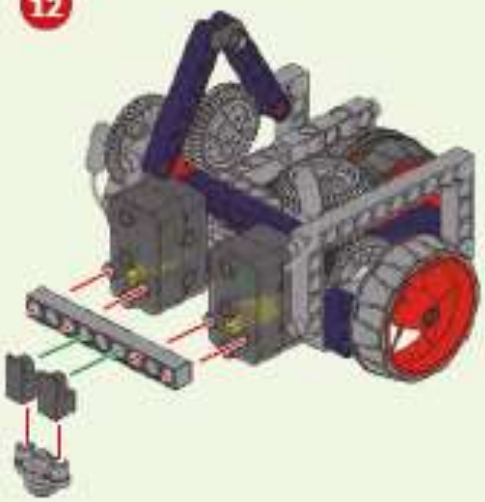




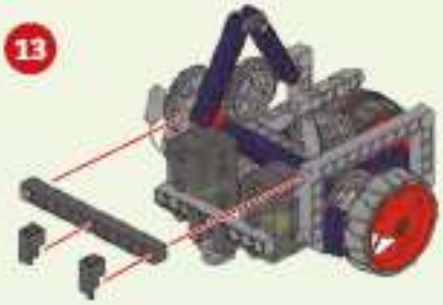
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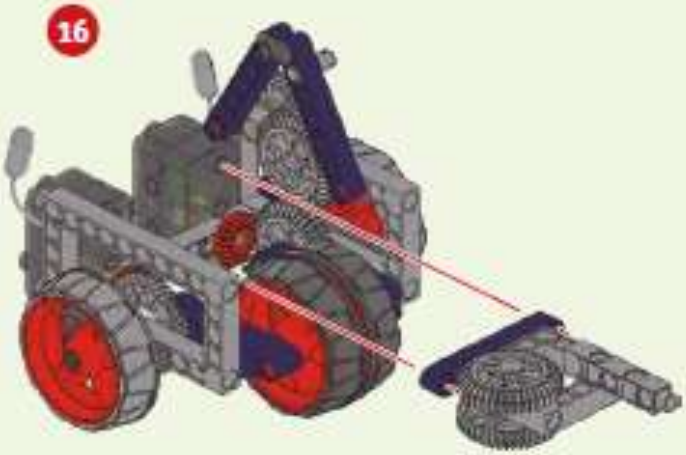
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13



16



14



15

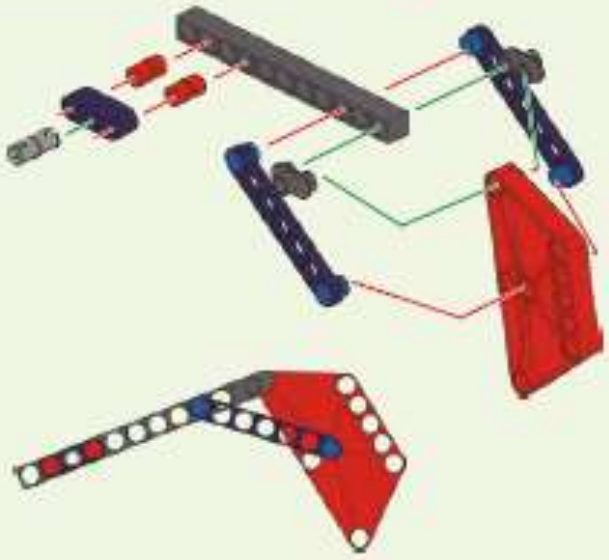


17



x2

18



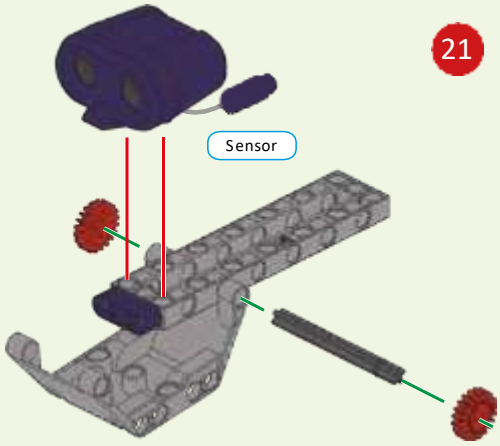
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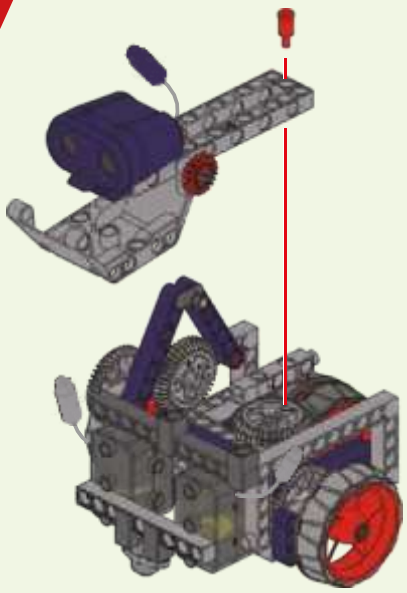
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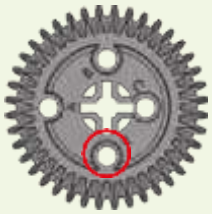


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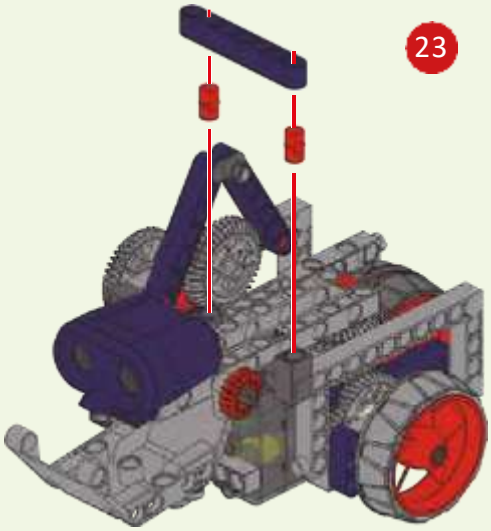
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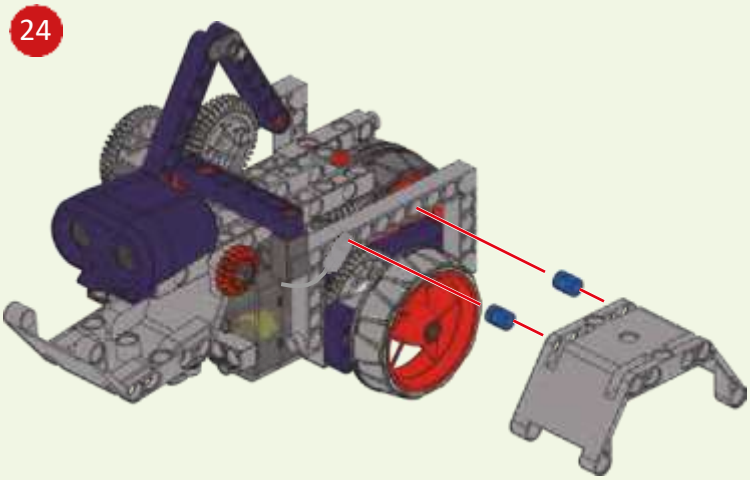


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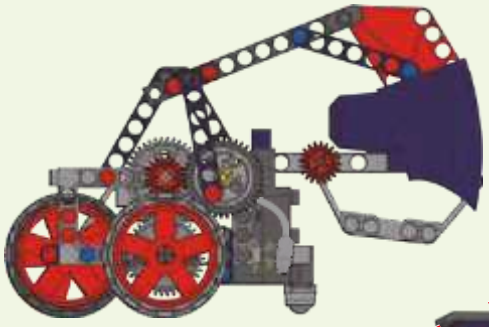
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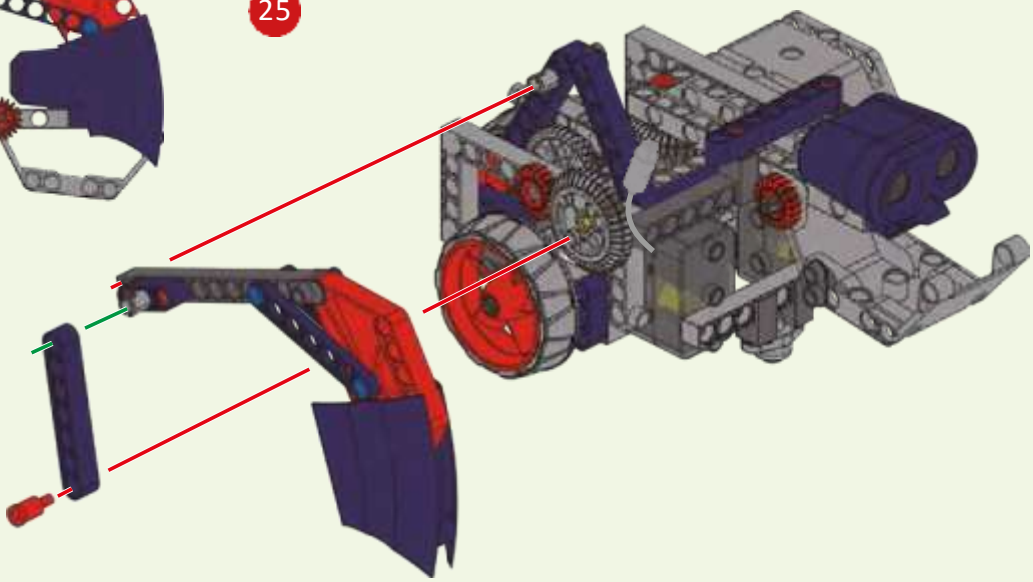


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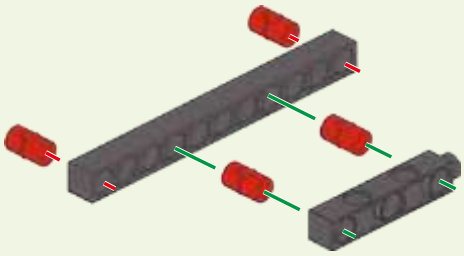




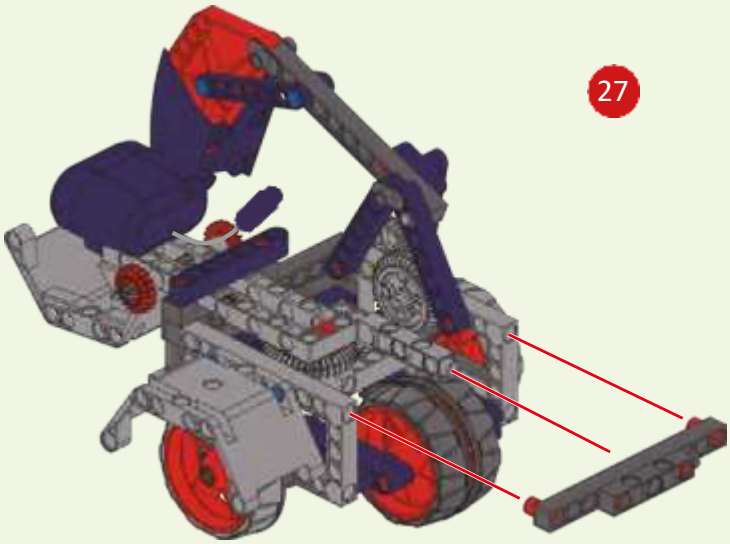
Connect to hole B.



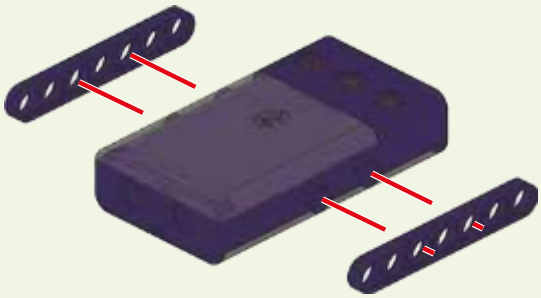
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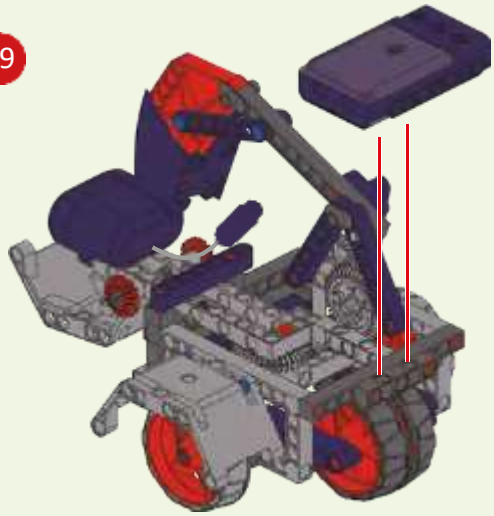
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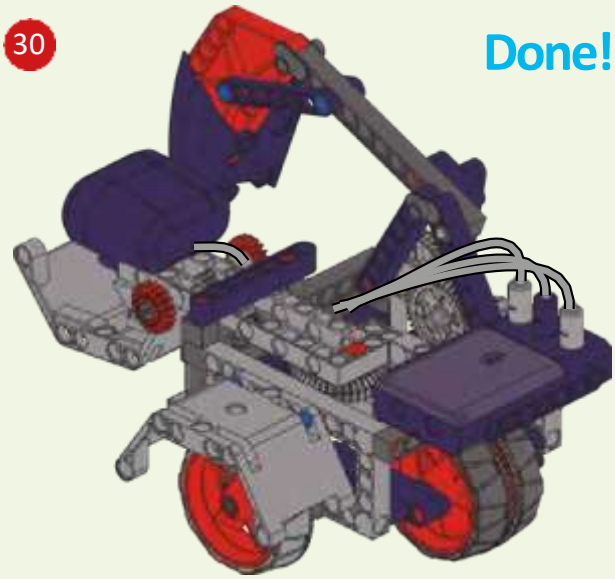
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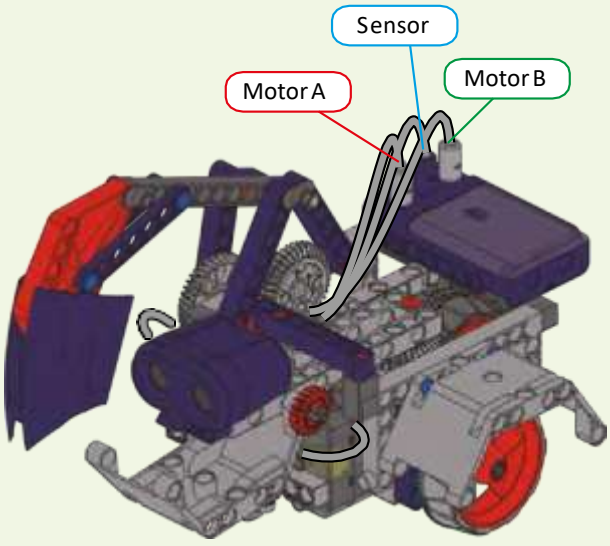
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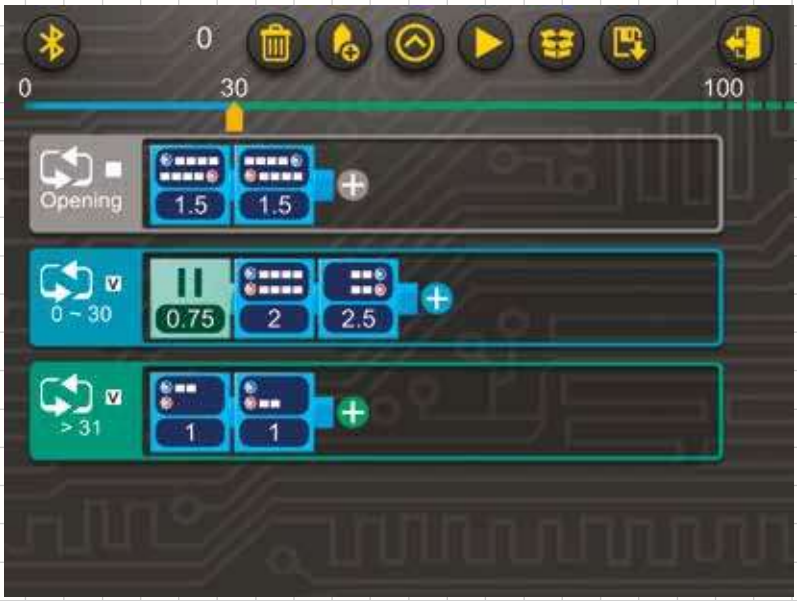
Done!



SAMPLE PROGRAM FOR THE SCORPION ROBOT

Unlike the turtle bot, the scorpion robot will charge toward any object it detects. First, the scorpion robot will move forward while moving the ultrasonic sensor left and right and its tail up and down. When an object is in range, the scorpion robot will quickly charge forward and raise its tail.

This program is preloaded in the app under Program 16. Test it out and write down how the robot behaves for each program segment below.



DEMO PROGRAM:

Program 16

OPENING SEGMENT:

SEGMENT 0-30:

SEGMENT >31:

PROGRAMMING NOTES



WHAT ELSE CAN YOU BUILD?

Now that you have built the eight robotic machines in this kit, can you design your own robots and write your own programs to control them? Use your imagination to think up a cool robot that uses the ultrasonic sensor to respond to its environment.



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