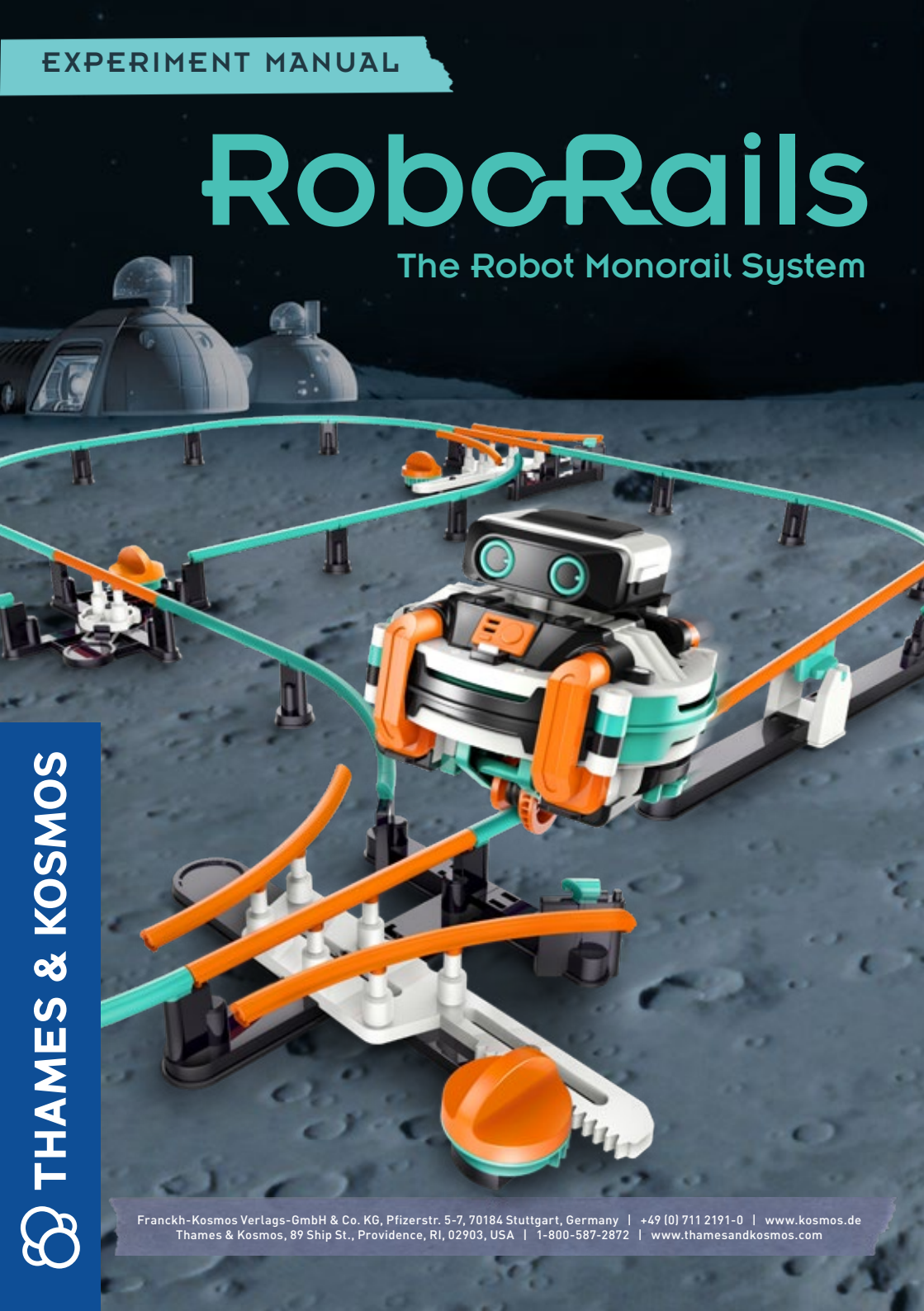
EXPERIMENT MANUAL

RoboRails

The Robot Monorail System



THAMES & KOSMOS

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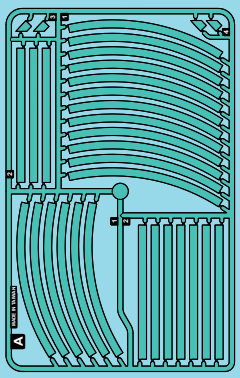
Thames & Kosmos, 89 Ship St., Providence, RI, 02903, USA | 1-800-587-2872 | www.thamesandkosmos.com

KIT CONTENTS

Good to know!

Do you have any questions or are you missing any parts? Our tech support team will be happy to help!
US: 1-800-587-2872

What's in your experiment kit: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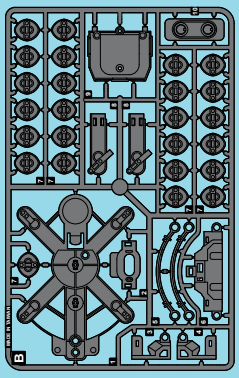
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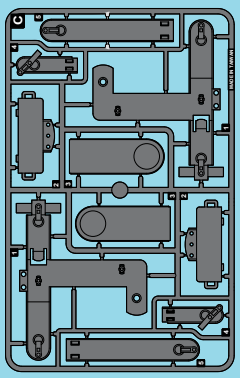
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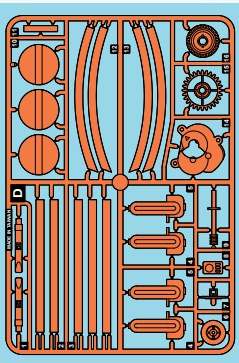
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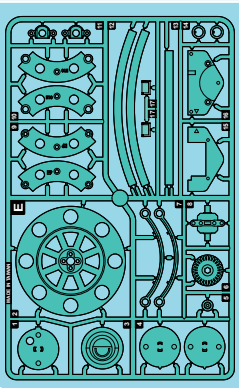
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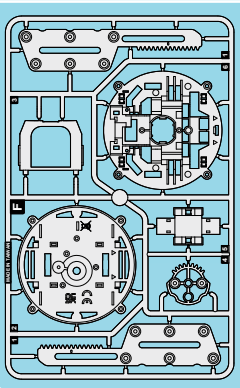
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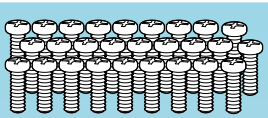
P1


P2


P3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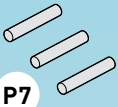
P5


P6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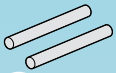
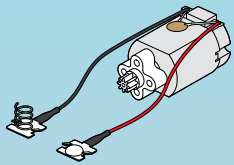

P8


x8
P9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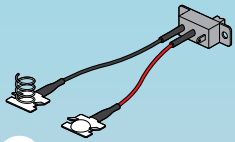
P12


P10


P13

Oil the parts as instructed.

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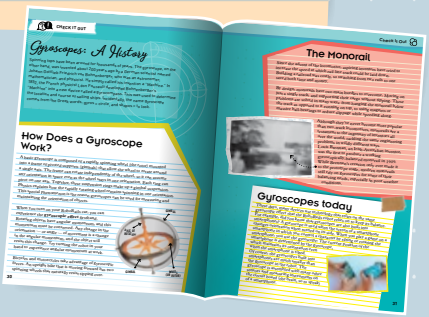
TIP

YOU WILL FIND ADDITIONAL INFORMATION IN THE CHECK IT OUT SECTIONS ON PAGES 30 AND 31.



✓	No.	Description	Quantity	Item No.
○	A	Frame A with parts A1 – A4	1	620400-A
○	B	Frame B with parts B1 – B10	1	620400-B
○	C	Frame C with parts C1 – C5	1	620400-C
○	D	Frame D with parts D1 – D16	1	620400-D
○	E	Frame E with parts E1 – E17	1	620400-E
○	F	Frame F with parts F1 – F6	1	620400-F
○	P1	Gear 40T/10T, pink	1	620400-1
○	P2	Gear 36T/14T, green	1	620400-2
○	P3	Gear 36T/10T, yellow	1	620400-3
○	P4	Screw	27	620400-4
○	P5	Wide head screw, small	1	620400-5
○	P6	Wide head screw, large	2	620400-6
○	P7	Metal rod, short	3	620400-7
○	P8	Metal rod, long	2	620400-8
○	P9	Metal ball	8	620400-9
○	P10	Gasket	1	620400-10
○	P11	Motor with wires	1	620400-11
○	P12	Switch with wires	1	620400-12
○	P13	Lubricant packet	1	620400-13

YOU WILL ALSO NEED:
Diagonal cutters or scissors and nail file, Phillips-head screwdriver (PH1 size recommended), 2 AA batteries (1.5-volt, type LR6)

Wow! **That's a lot of parts!**

SAFETY 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: This toy is only intended for use by children over the age of 8 years, due to accessible electronic components. Instructions for parents or caregivers are included and shall be followed.

Warning. To be used under the direct supervision of an adult. Keep the toy out of reach of children under 8 years old.

Keep packaging and instructions as they contain important information.

Assembly must be performed under adult supervision.

Do not pick up the robot during operation.

Keep hands, hair, and clothing away from the moving parts when the robot is powered on.

Avoid hitting people, animals, and household furniture with the robot.

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 two AA batteries (1.5-volt, type LR6), 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 (+ and -). Press them gently into the battery compartment. See page 18. This page shows how the batteries are inserted, removed, and changed.
- Always close battery compartments with the lid.
- Non-rechargeable batteries are not to be recharged. They could explode!
- 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.
- Avoid deforming the batteries.
- The toy is not to be connected to more than the recommended number of power supplies.
- 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 device compartments.

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.

IMPORTANT INFORMATION

Dear Parents and Supervising Adults,

Children want to be amazed, understand, and create new things. They want to try everything out and do it for themselves. They want to know! They can do all of this with Thames & Kosmos experiment kits. We hope you and your child have a lot of fun experimenting with RoboRails: The Robot Monorail System.

— Before building and experimenting, read the instructions together with your child and discuss the safety information together. Stand by to assist your child with any challenging steps of assembly or usage.

— If your child is working on a table top, give them something to work on to prevent damage to the furniture.

— Particular care must be taken when cutting the plastic parts out of the frames, as sharp points can be created. These can be removed with the help of diagonal cutters or scissors and a nail file. Please supervise your child whenever they are using scissors or diagonal cutters until you feel they are ready to use the tools independently.

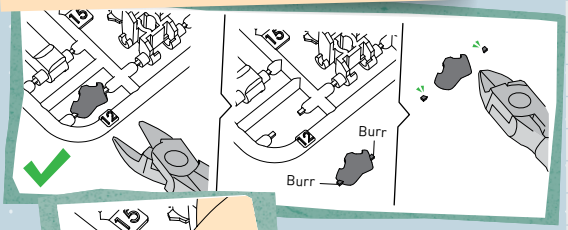
— The robot should not be grabbed or picked up while it is moving. Hands, hair, and clothing should be kept away from moving parts. Avoid hitting people, animals, and household furniture with the robot.

— And most importantly: Have fun!

TIP

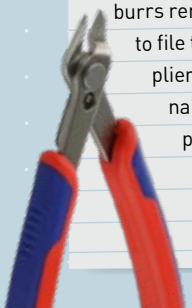
IMPORTANT:

REMOVE THE PARTS FROM THE FRAMES ONLY WHEN THEY ARE NEEDED. REMOVE EXCESS MATERIAL (BURRS) BEFORE ASSEMBLY USING A DIAGONAL CUTTER OR A NAIL FILE.



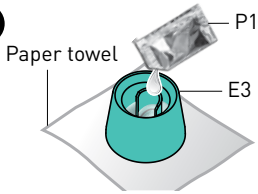
THE RIGHT TOOL

The right tool can make assembling your model much easier and it can also make your model work better in the end. It is best to cut the plastic parts out of their frames with a small diagonal cutter (such as those used for electronics work) or model pliers. Using these tools, the parts can be precisely cut so that no burrs remain on the parts and there is no need to file them down. If you don't have these pliers at home, you can use scissors and a nail file. Normal scissors do not cut as precisely as a diagonal cutter, so you may have to file some of the rough edges down with the nail file.

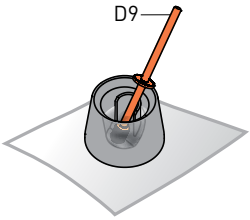


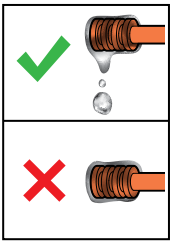
ASSEMBLING THE LOWER BODY

1

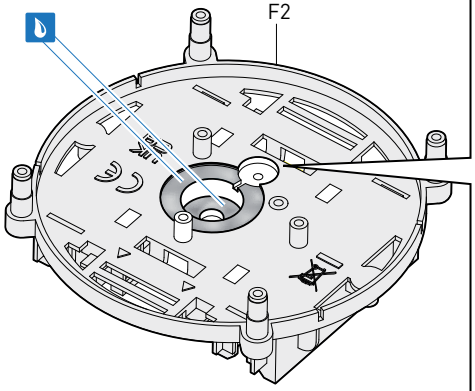


Be careful not to spill oil from the E3 oil well.

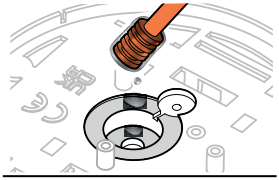




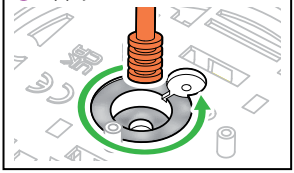
= Oil When you see this symbol in the instructions oil the component indicated.



1 Drop a little bit of oil.



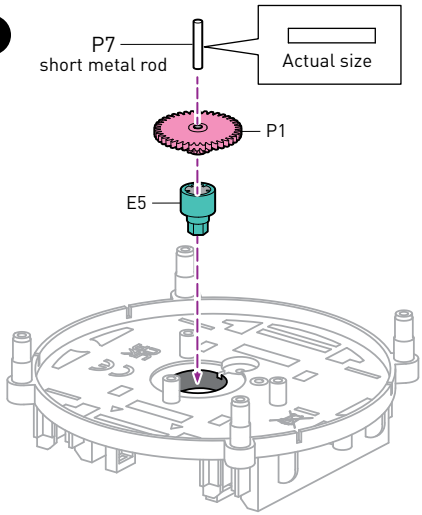
2 Apply oil as shown.

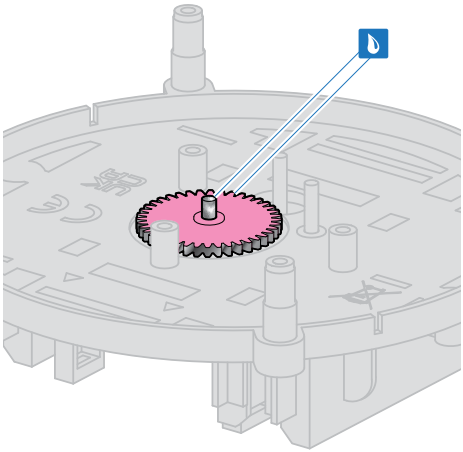


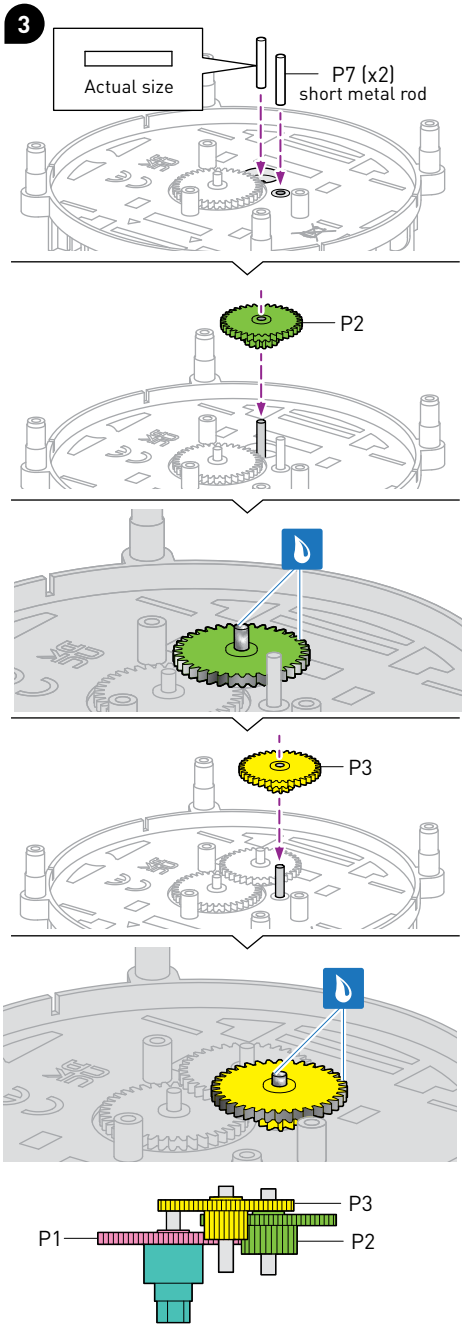
ASSEMBLY VIDEO

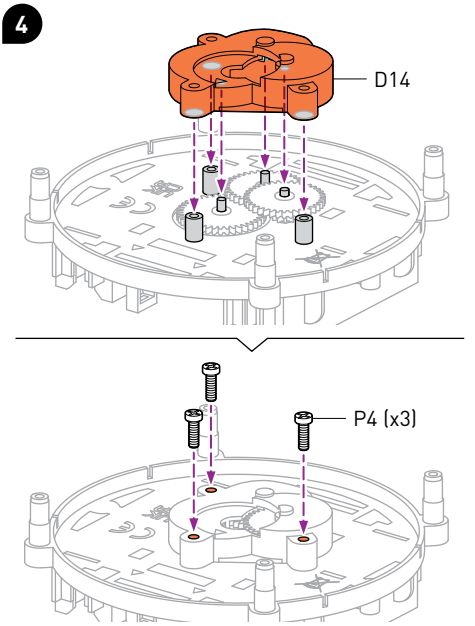
Scan this QR code for a step-by-step assembly video.

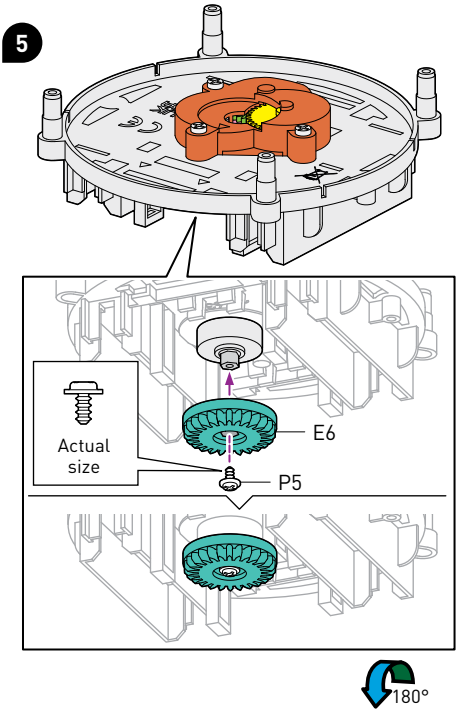
2





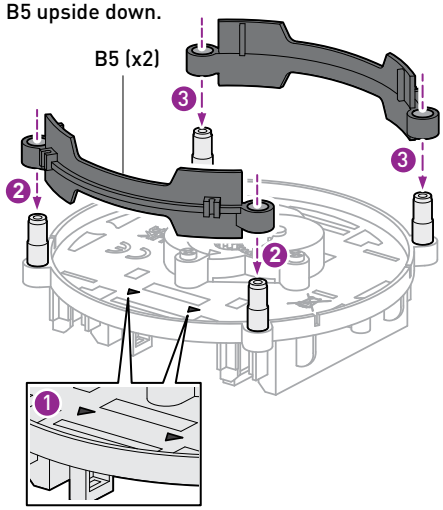

3
Actual size
P7 (x2)
short metal rod
P2
P3
P1
P3
P2


4
D14
P4 (x3)

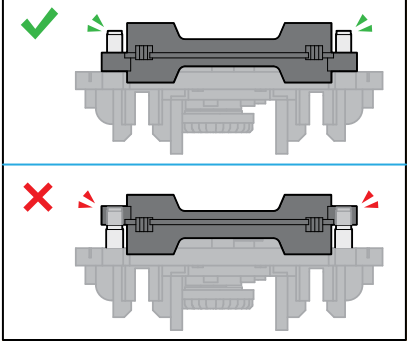

5
Actual size
E6
P5
180°

6

Please pay attention to the arrow placement while assembling B5. Meanwhile, do not place B5 upside down.



Make sure you can see the top of white stubs at two sides.



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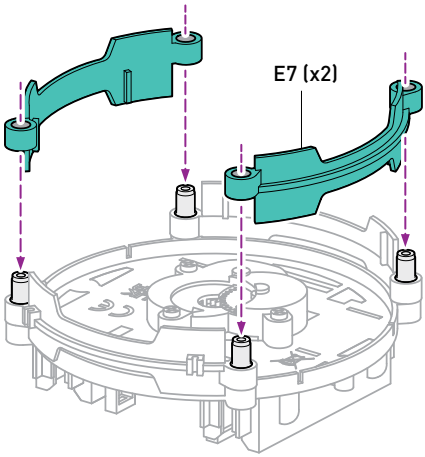
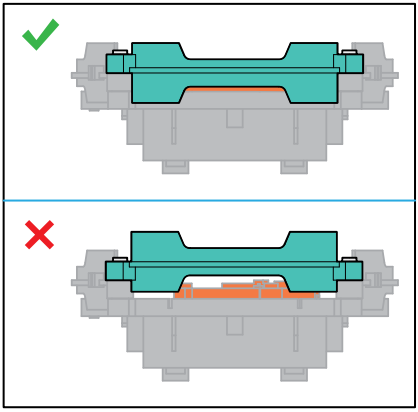
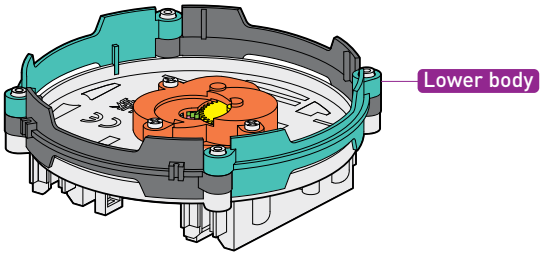
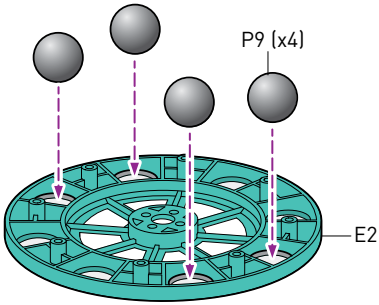


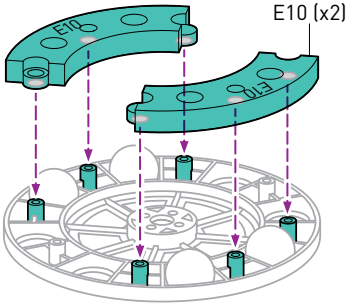


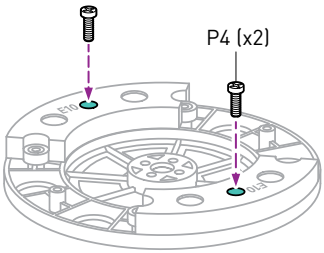


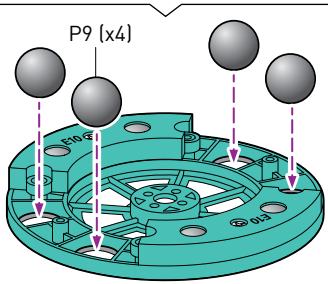
ASSEMBLING THE ROTOR

1









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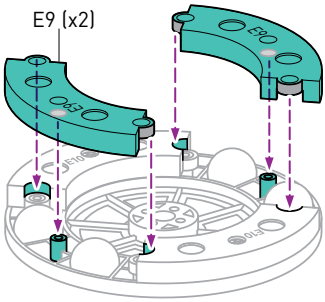

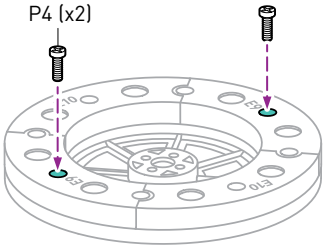

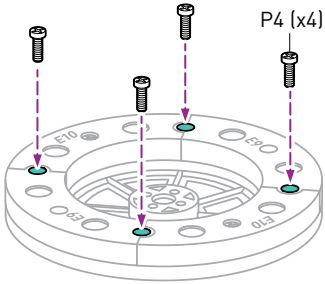

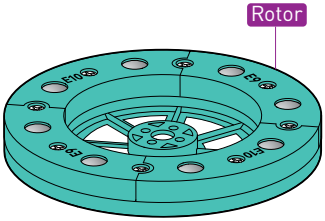

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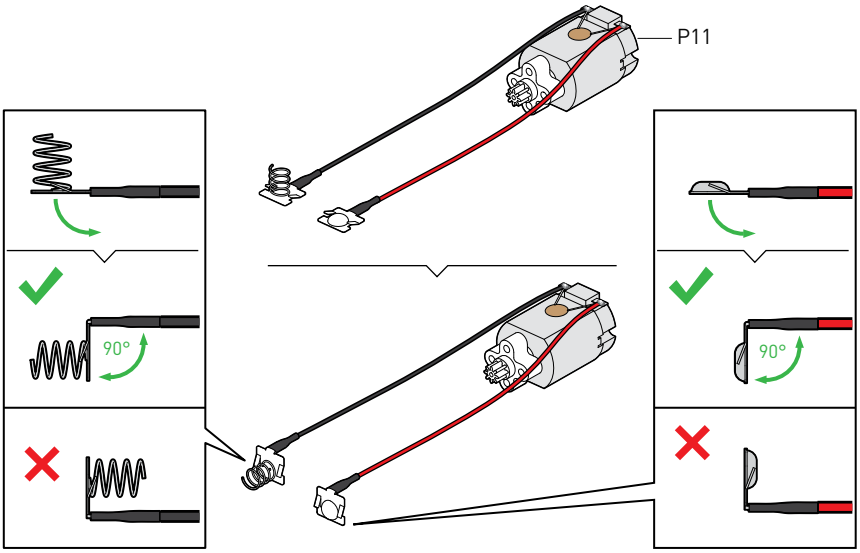

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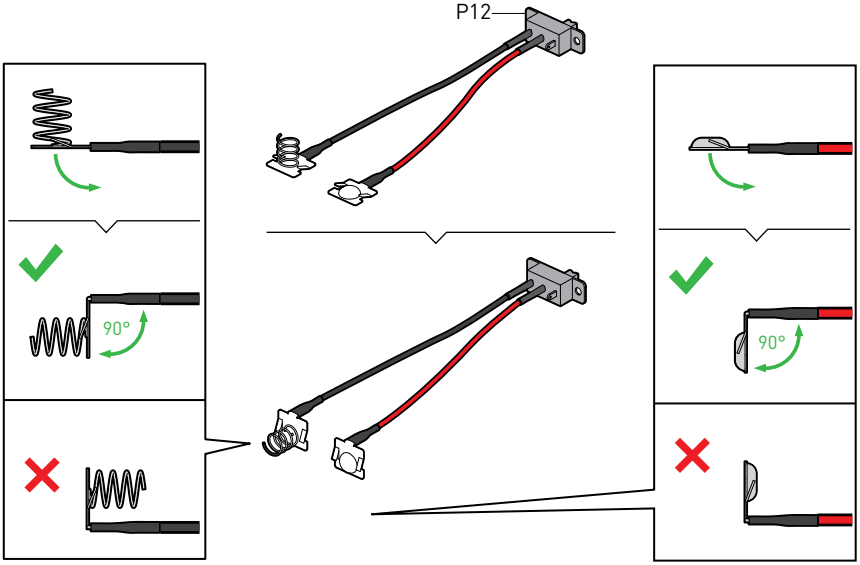

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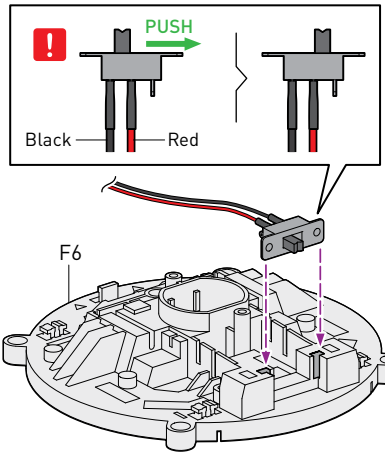

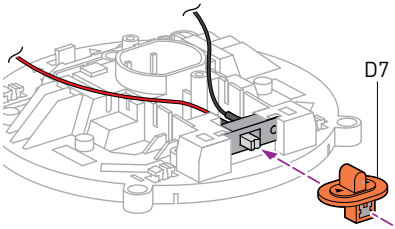

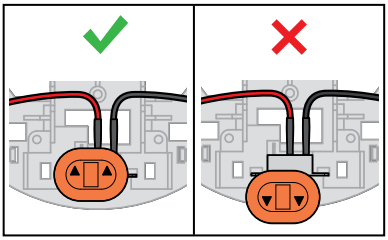

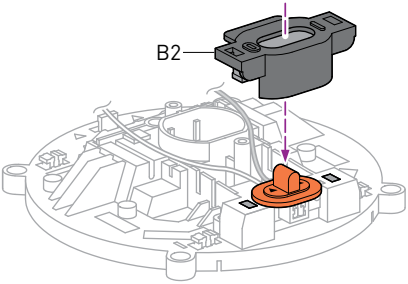

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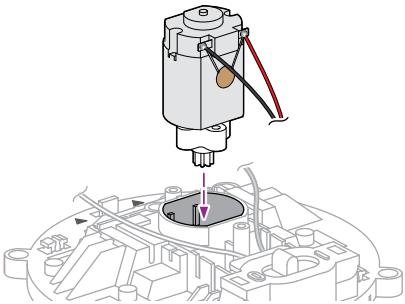
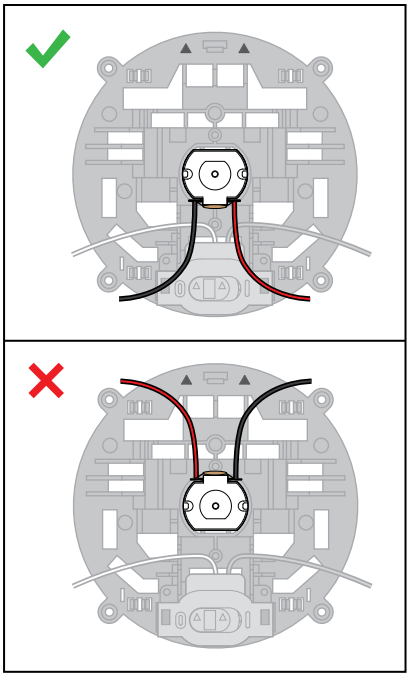
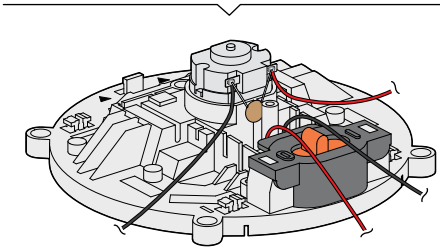
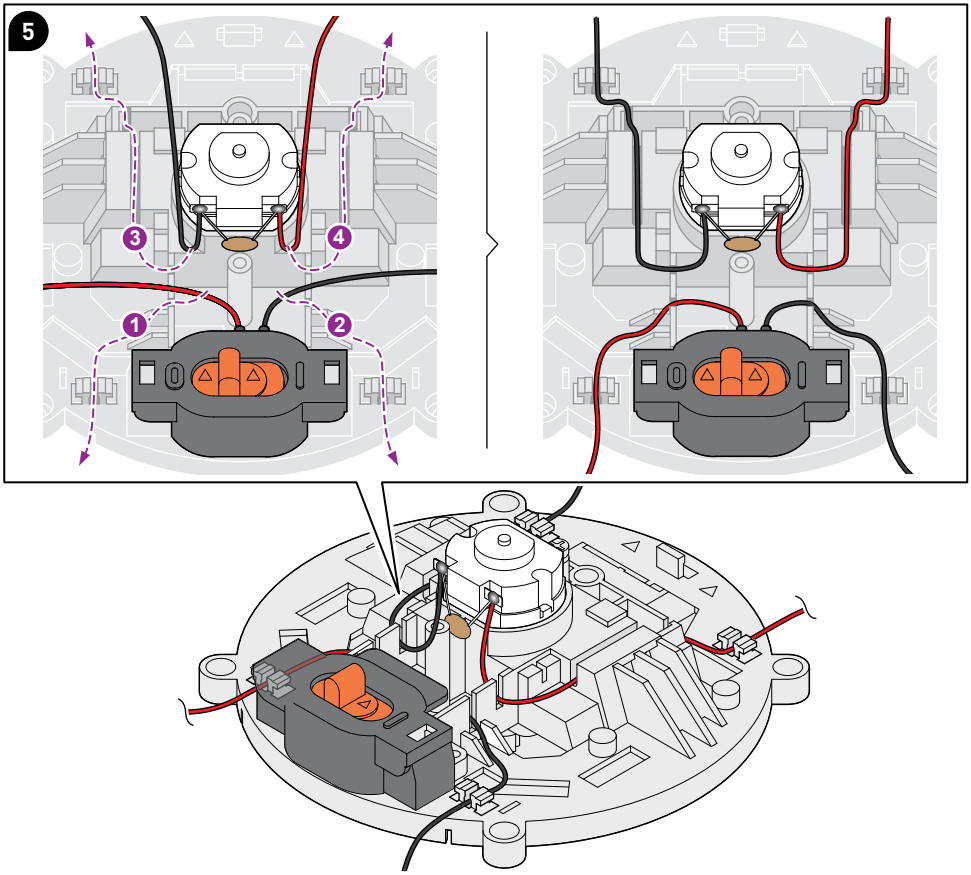
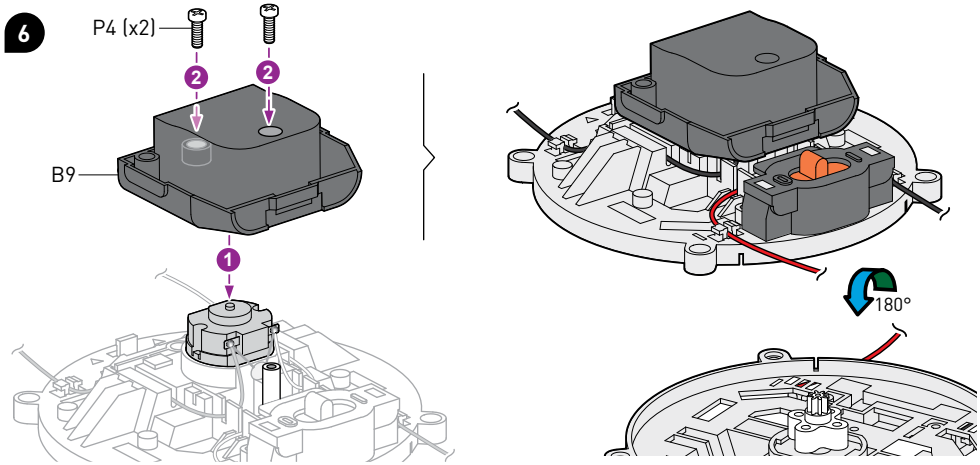


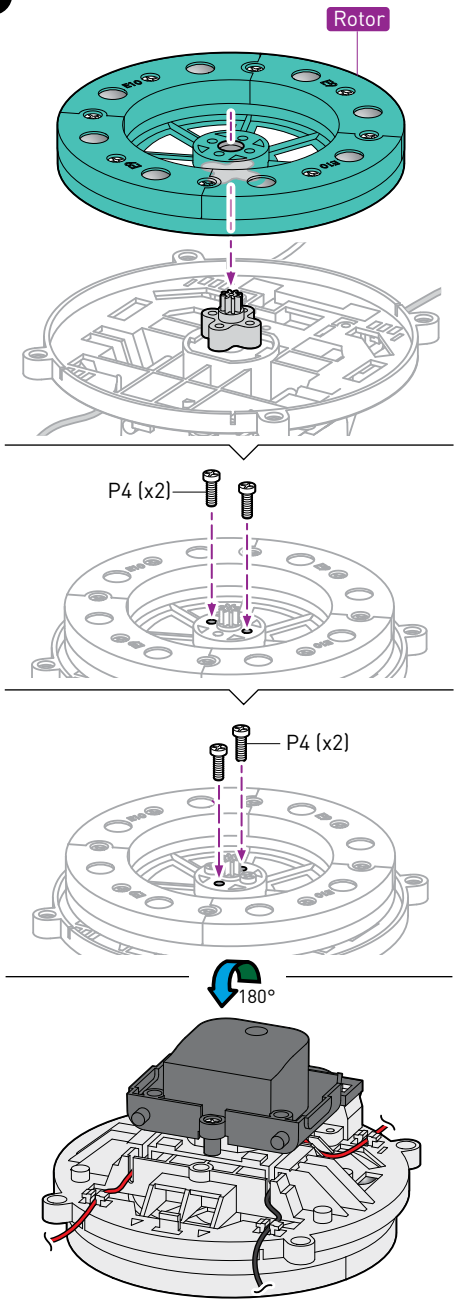




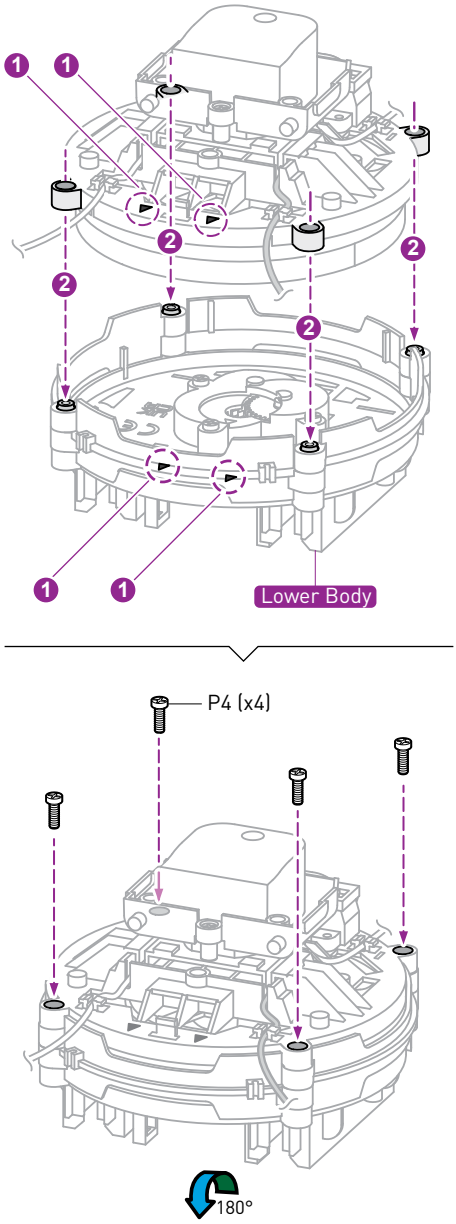

5
3
4
1
2


6
P4 (x2)
2
2
B9
1
180°

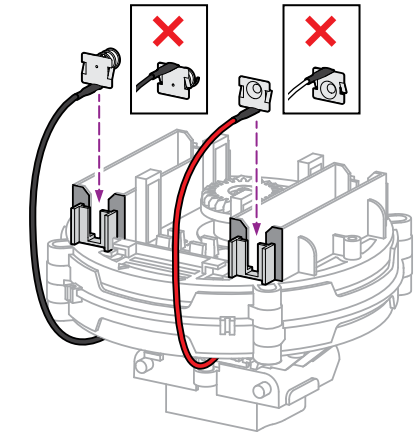
7

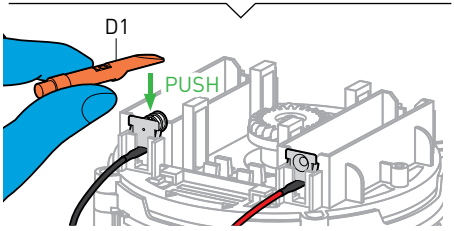


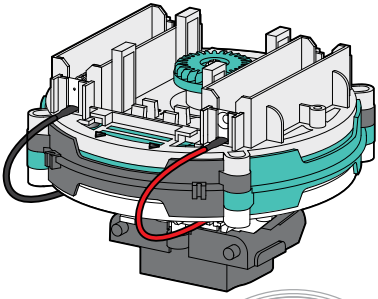
8 Please align the directional arrows when combining it to the lower body.

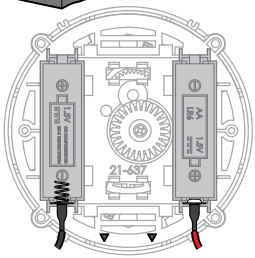


9

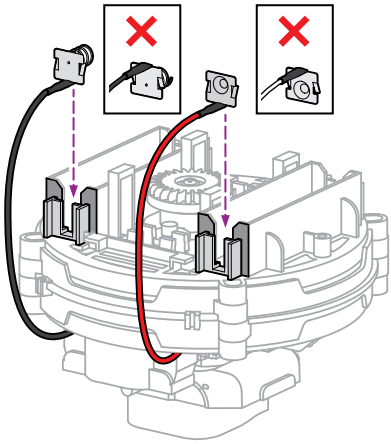


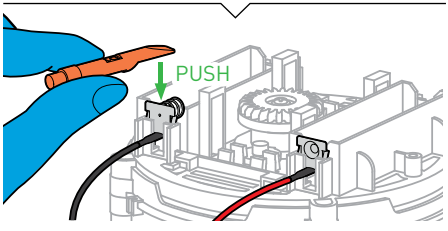


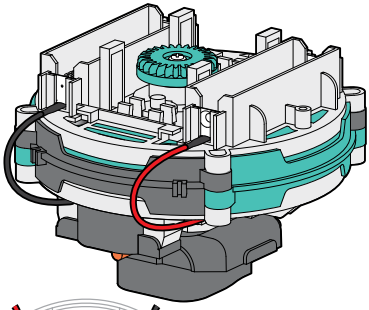


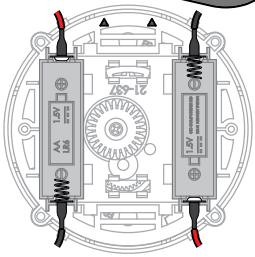


10



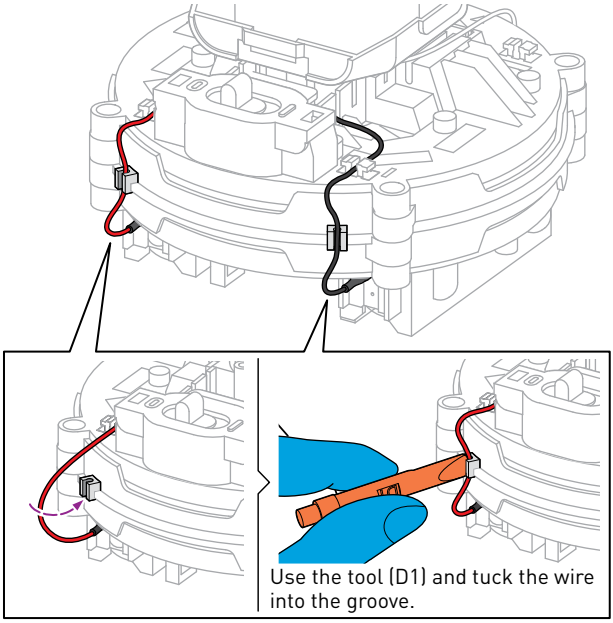




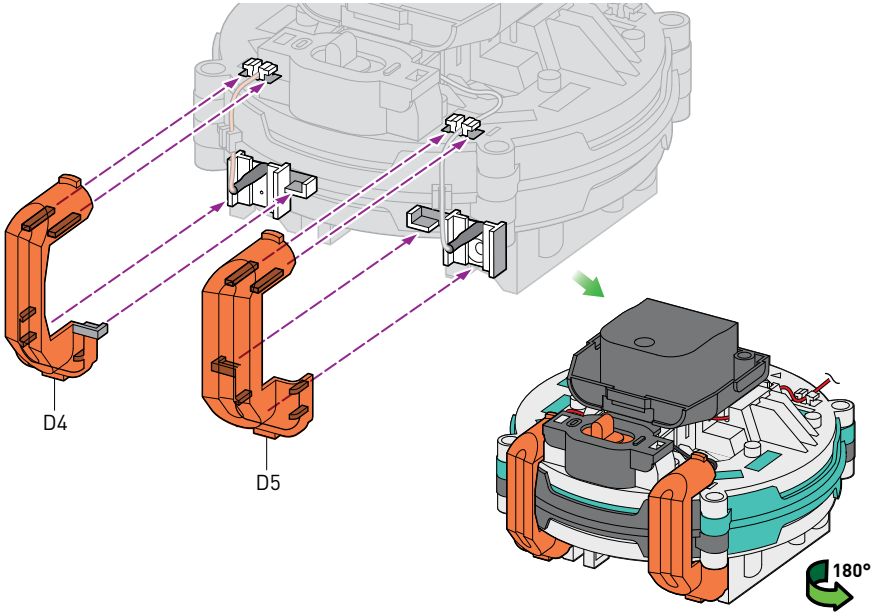


If you install the battery contacts incorrectly, see page 32.

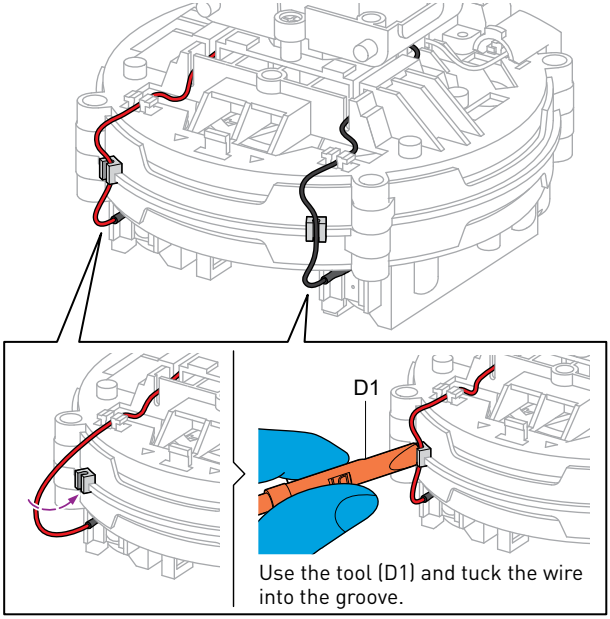
11



12

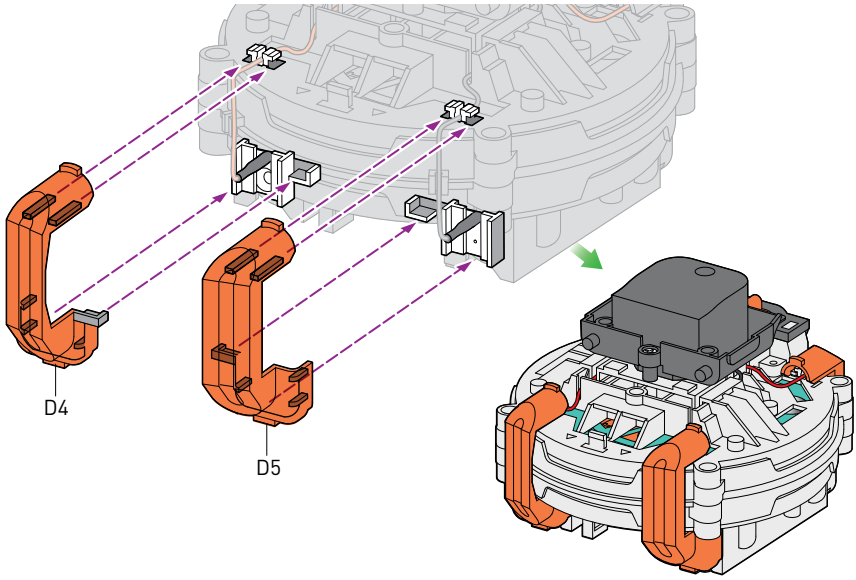


13



Use the tool (D1) and tuck the wire into the groove.

14



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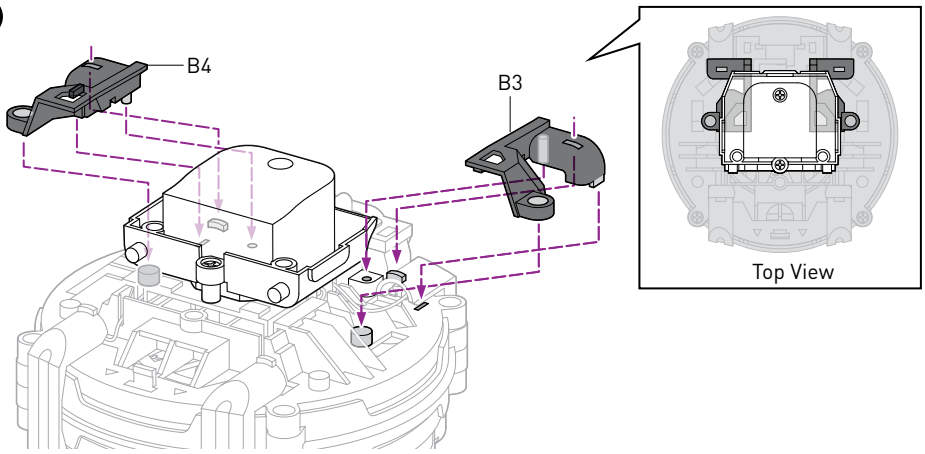
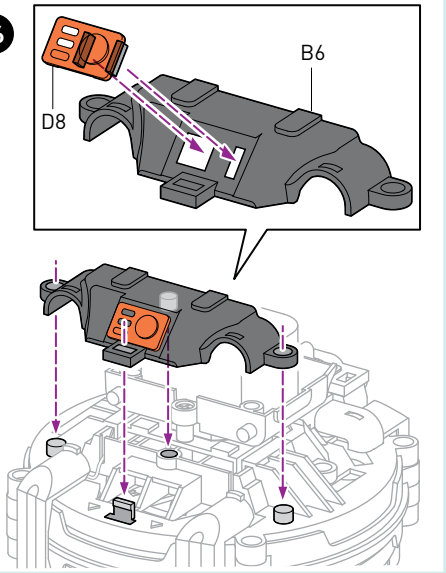
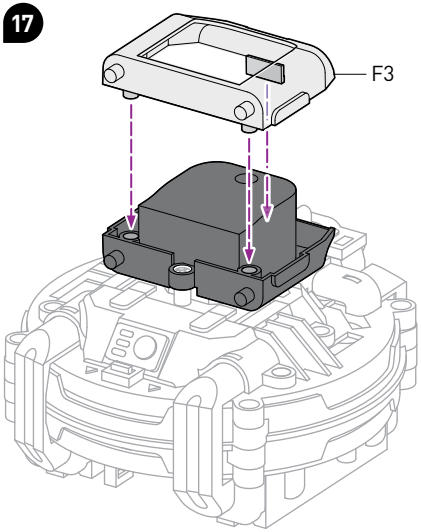


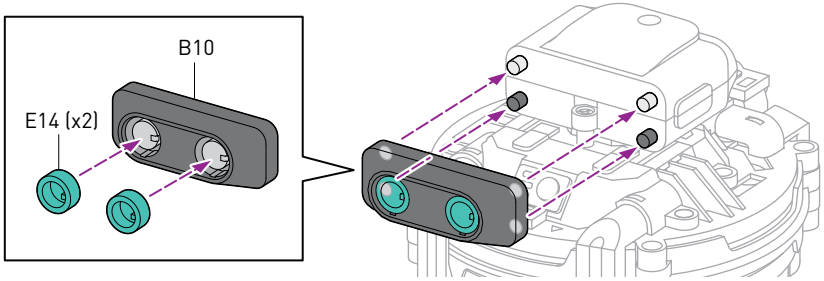
16



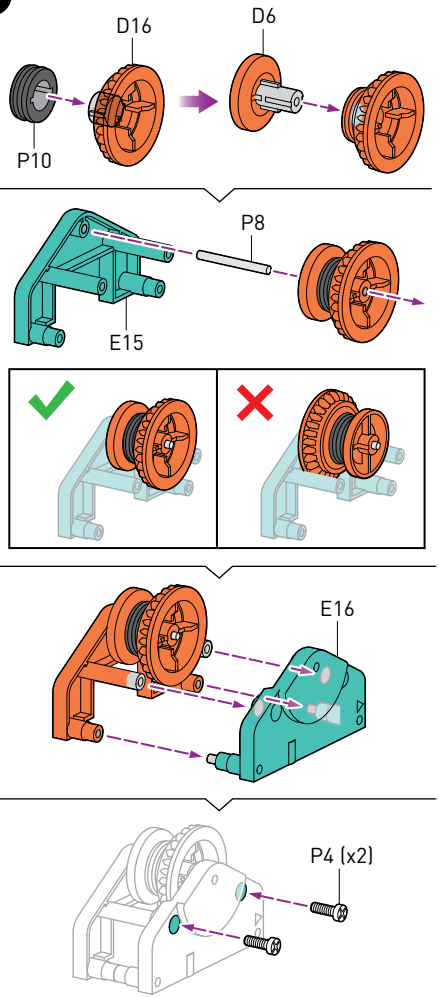
17



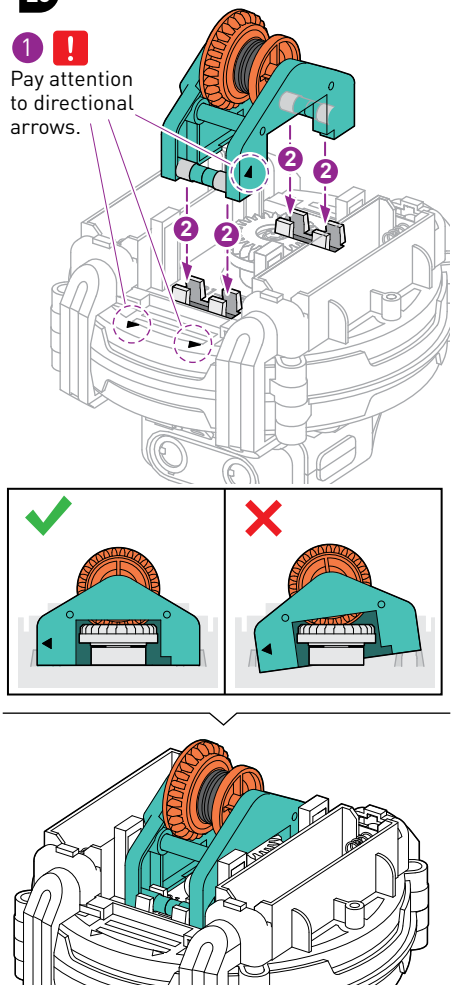
18



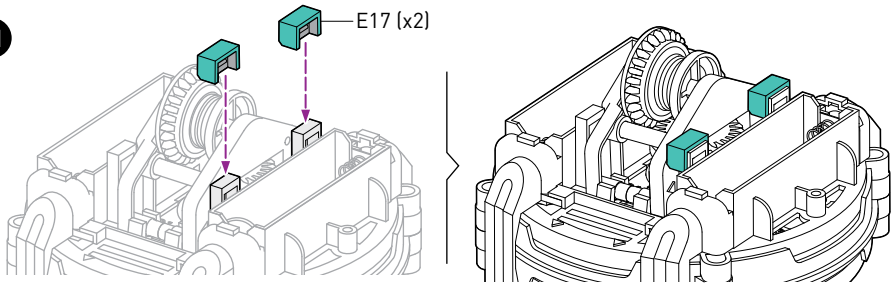
19


D16
D6
P10
P8
E15
E16
P4 (x2)

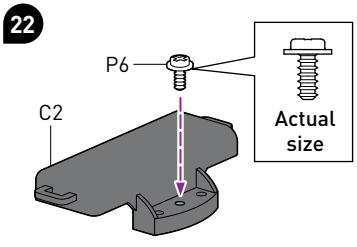
20

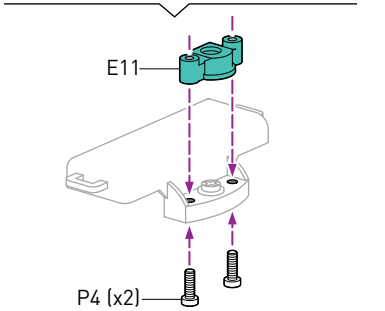

1
Pay attention to directional arrows.
2
2
2
2

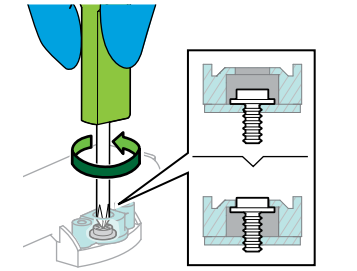
21

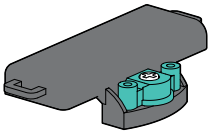

E17 (x2)

22

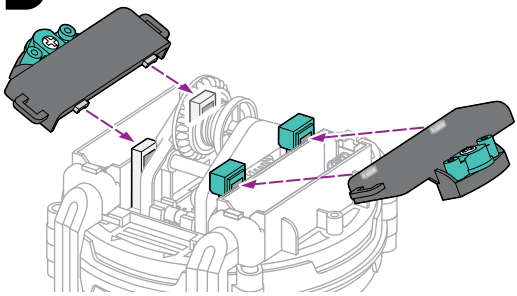


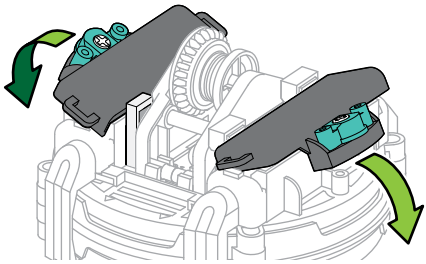


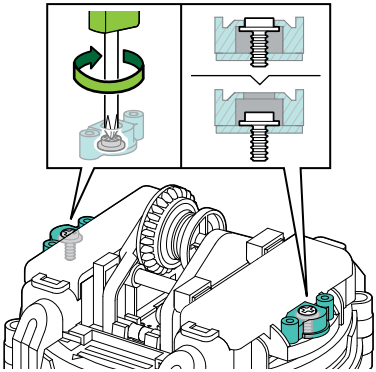




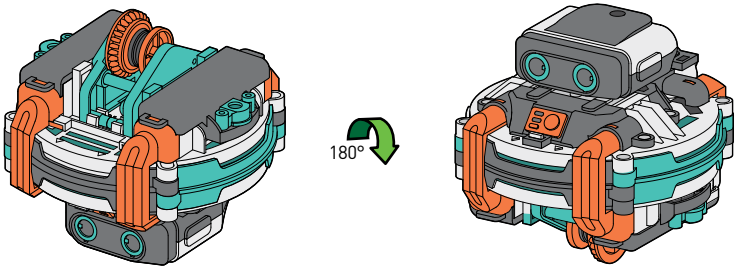
23





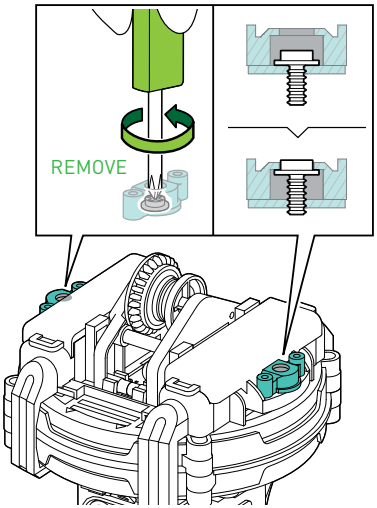


24

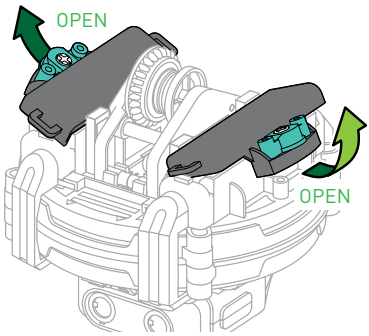


INSTALLING THE BATTERIES

1



2



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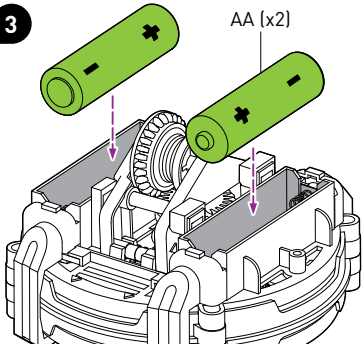
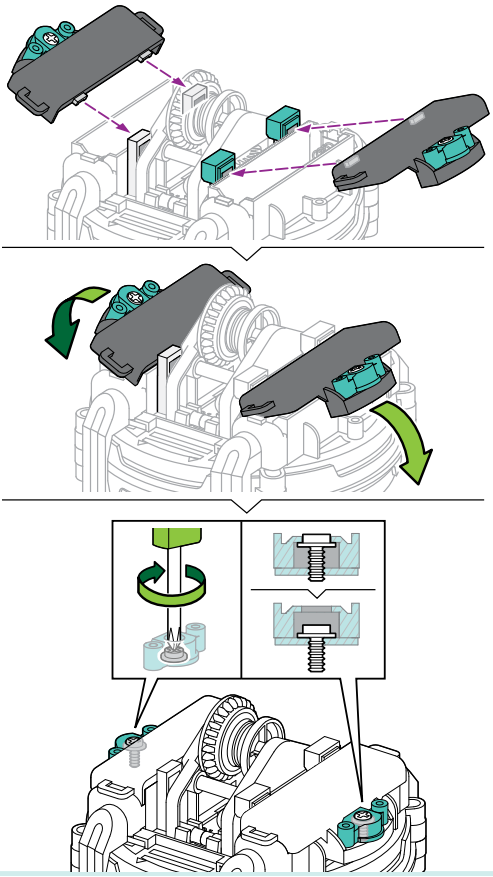


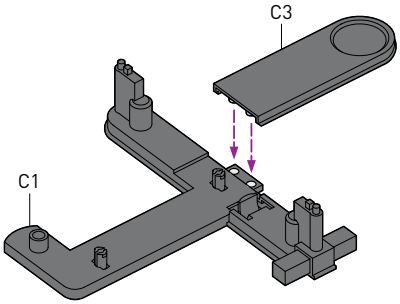
4



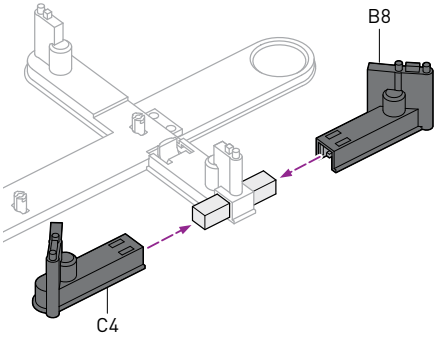
- Removal and replacement of batteries should be carried out by adults or under adult supervision.
- Avoid short circuiting the contacts in the battery compartment or the battery terminals.
- Remove exhausted batteries from the product to avoid leakage.
- Do not mix used batteries and new batteries or batteries of different types.
- Do not mix alkaline, standard (carbon-zinc) , or rechargeable (nickel-cadmium) batteries.
- Batteries are to be inserted with the correct polarity.
- Do not attempt to recharge non-rechargeable batteries.
- Rechargeable batteries are only to be charged under adult supervision.
- Rechargeable batteries are to be removed from the toy before being charged.
- The toy is not to be connected to more than the recommended number of power supplies.

THREE-WAY SPLITTER ASSEMBLY

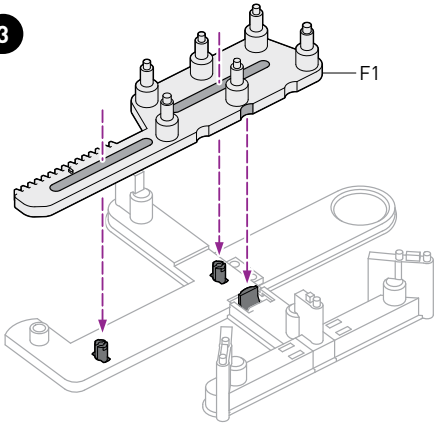
1

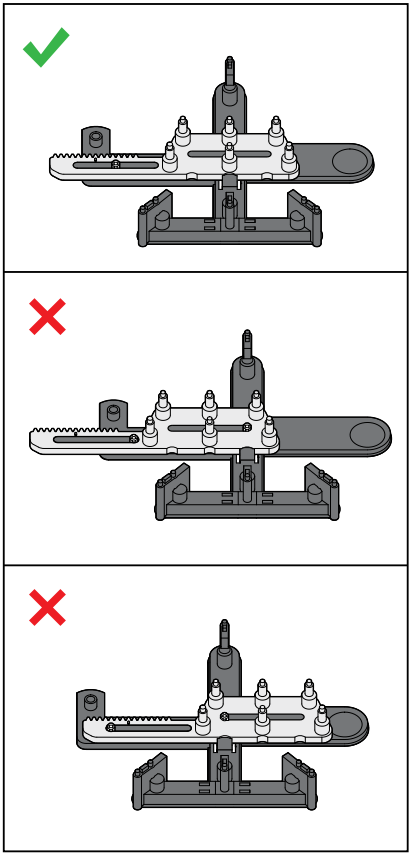


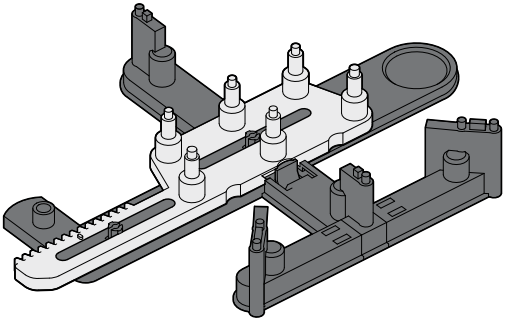
2



3







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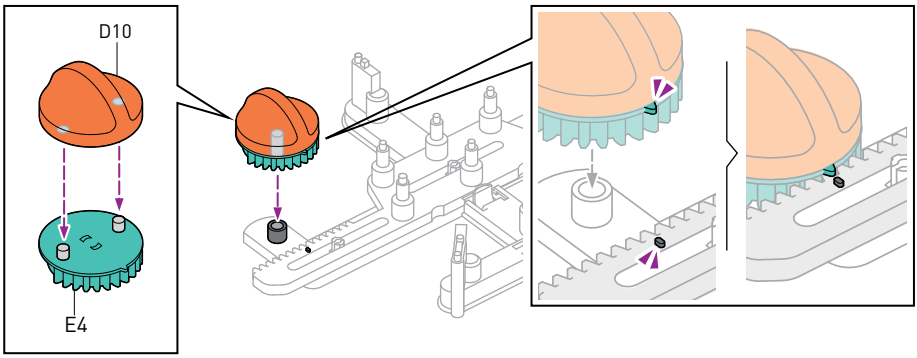

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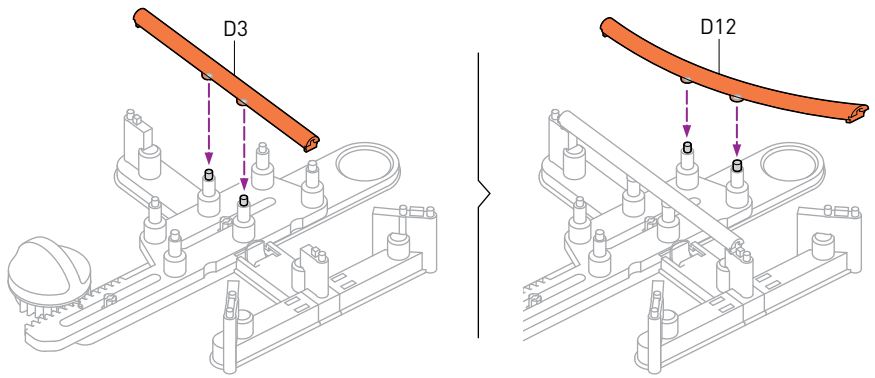
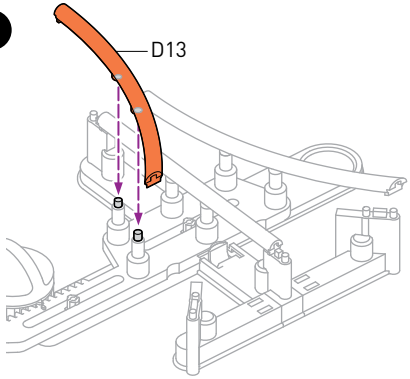
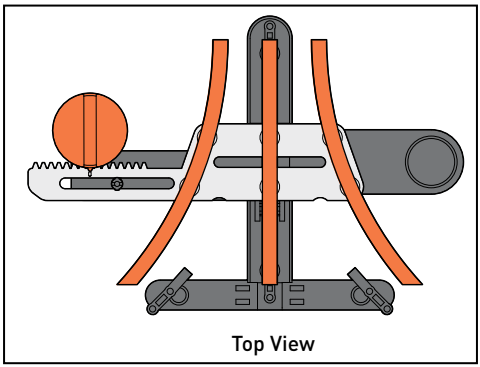
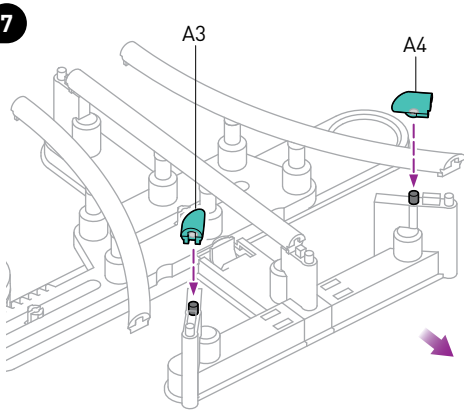


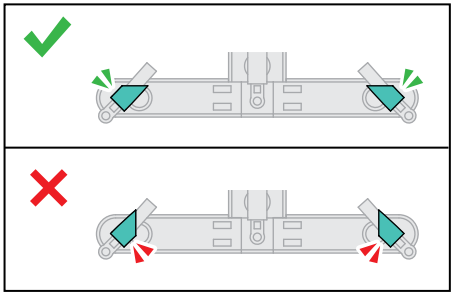
6

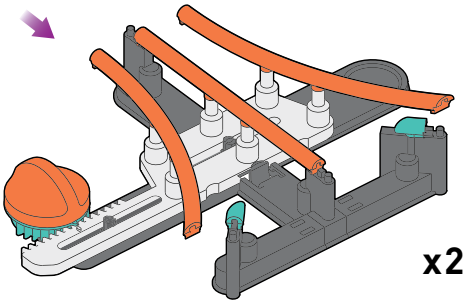




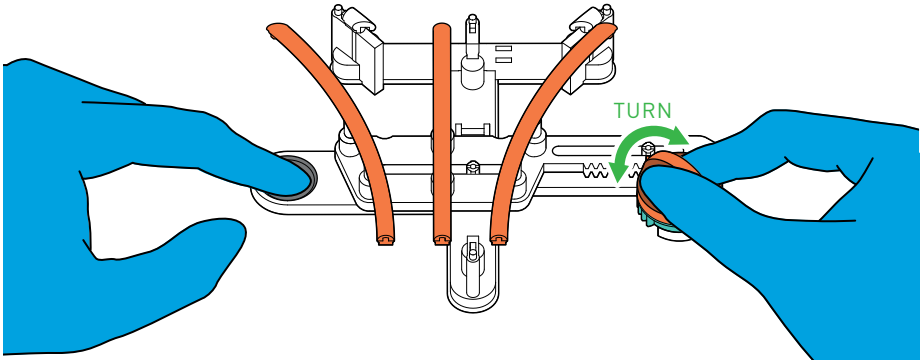
7

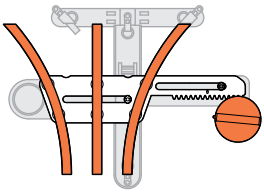


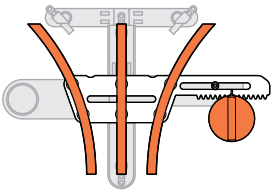


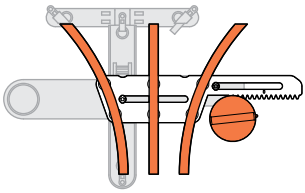


TEST THREE-WAY SPLITTER



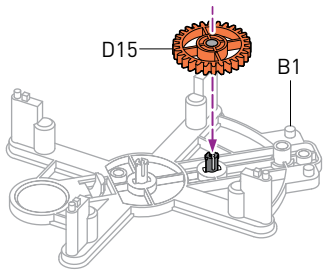

right


middle

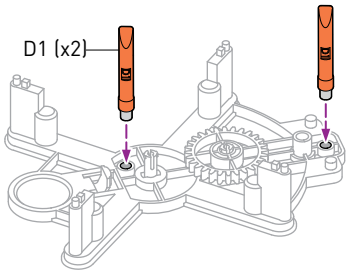

left

CROSS SWITCH ASSEMBLY

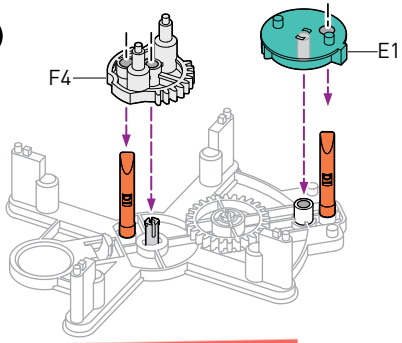
1



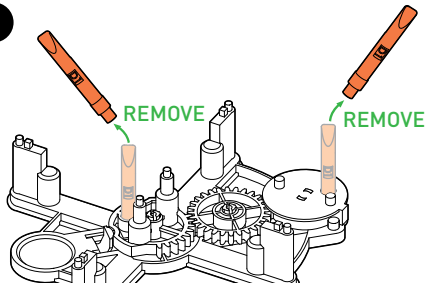
2



3

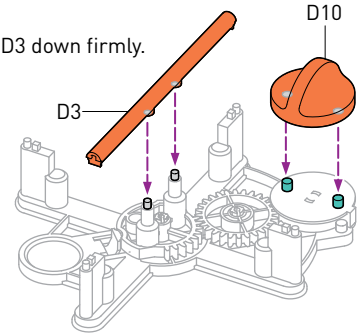


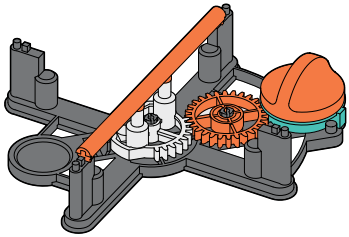
4



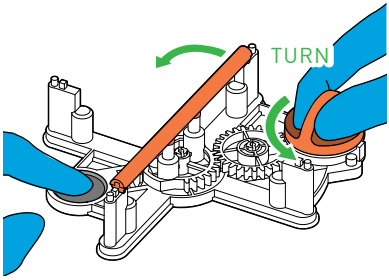
5

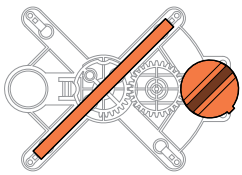
Press D3 down firmly.

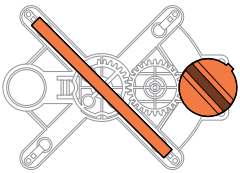




TEST CROSS SWITCH







SEESAW ASSEMBLY

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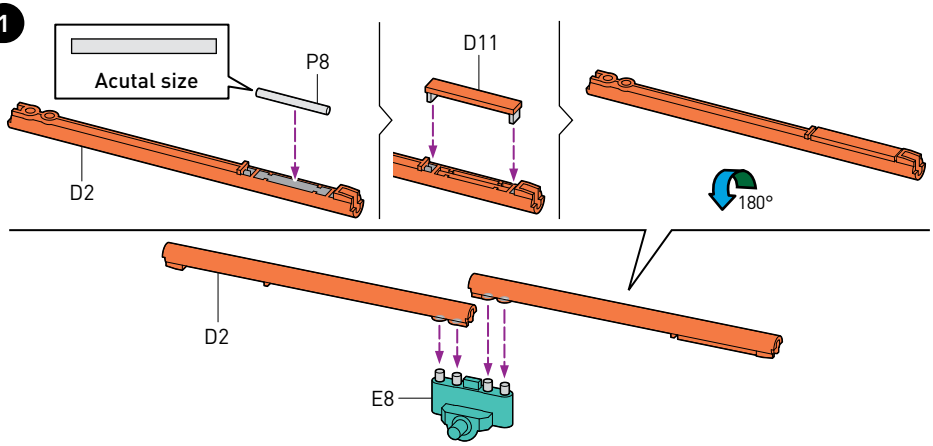

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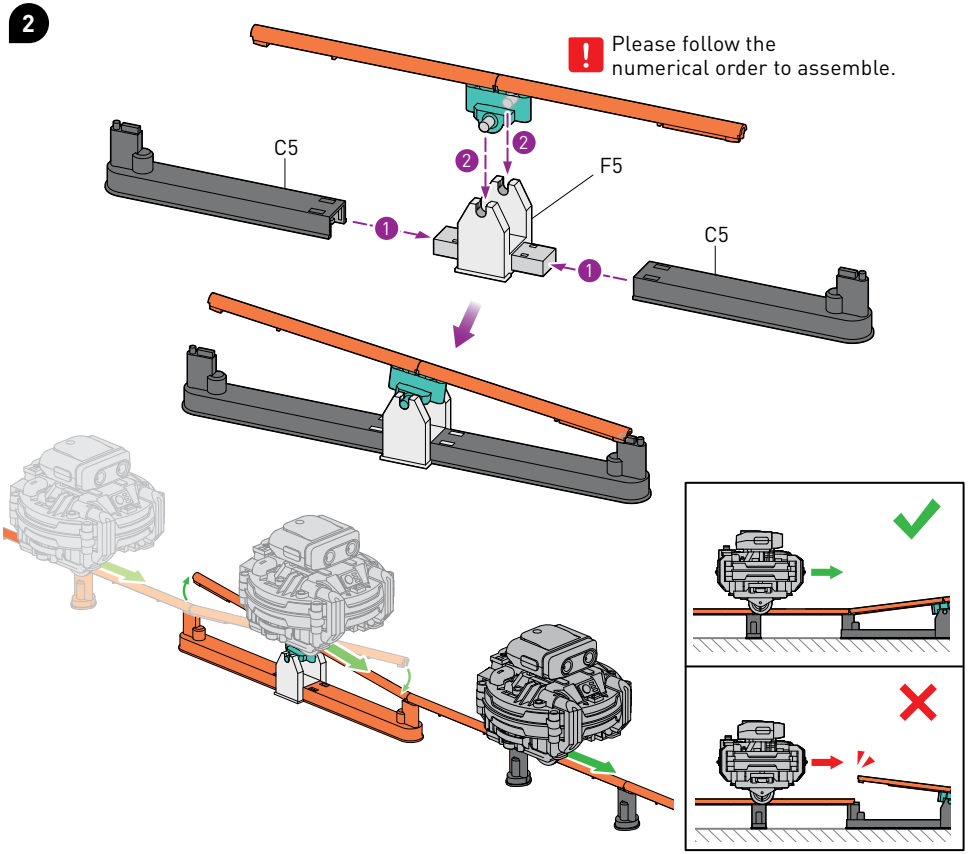
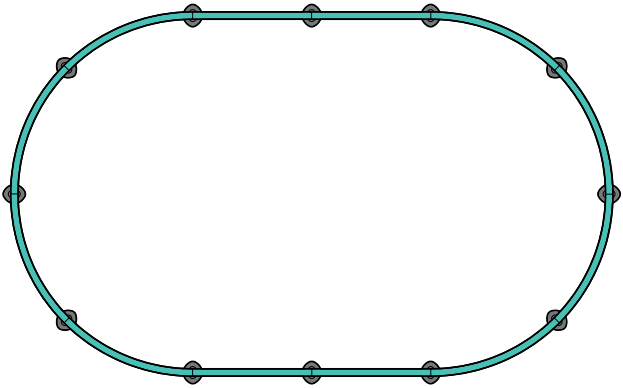
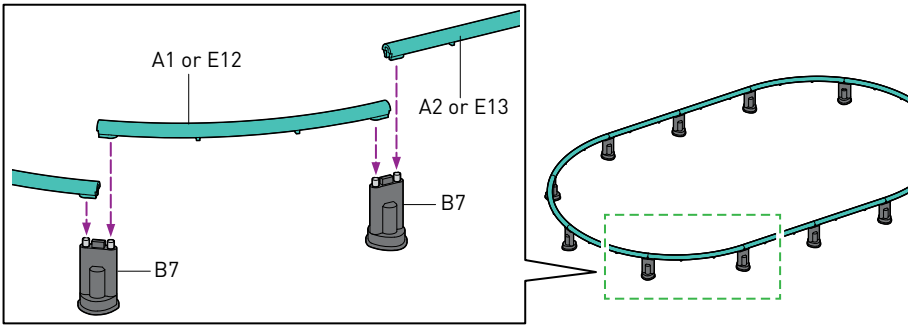
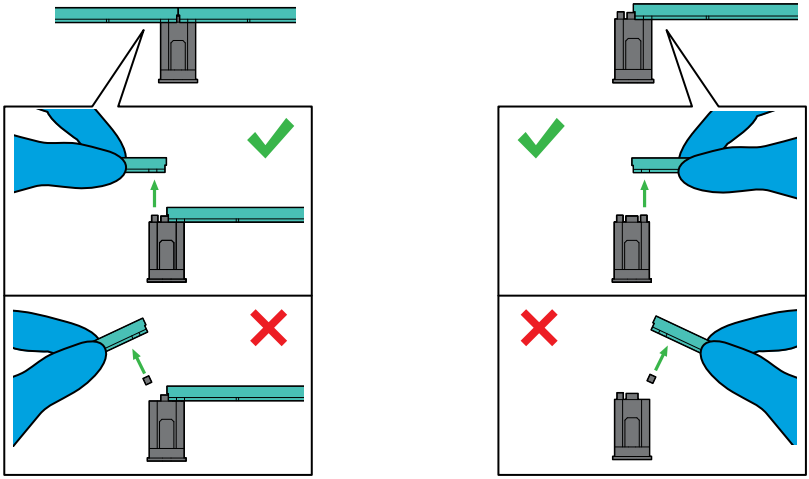


TRACK ASSEMBLY



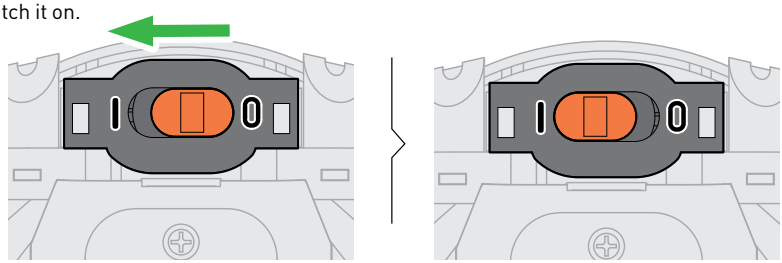


DISASSEMBLE THE TRACK

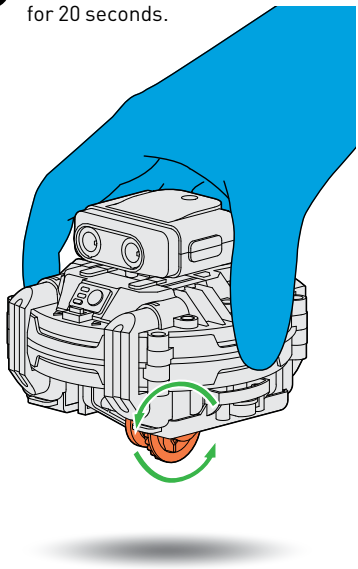


OPERATING TIPS

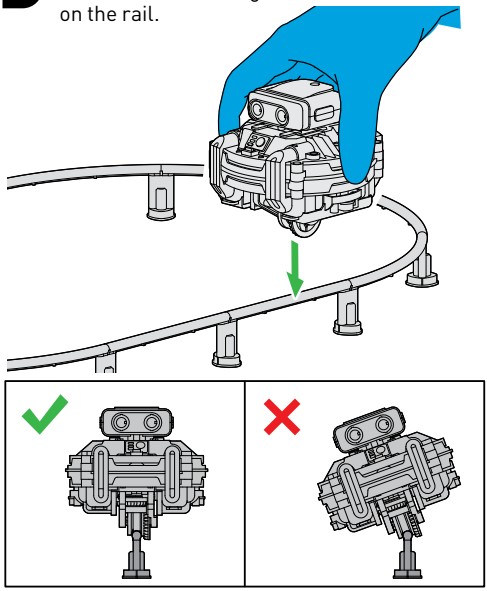
1 Switch it on.



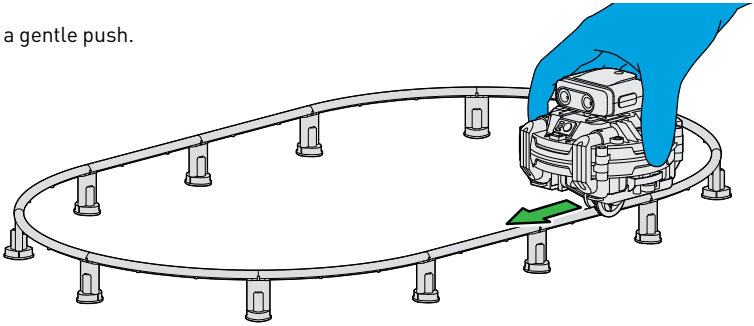
2 Allow the motor to run for 20 seconds.



3 Place the robot straight on the rail.



4 Give it a gentle push.



TRACK CONFIGURATIONS

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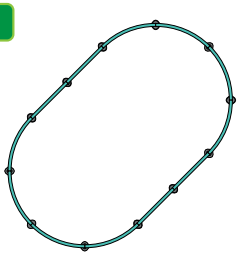

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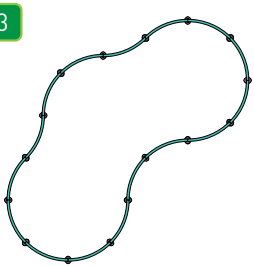

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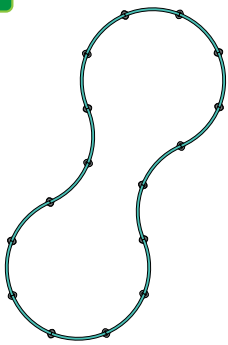

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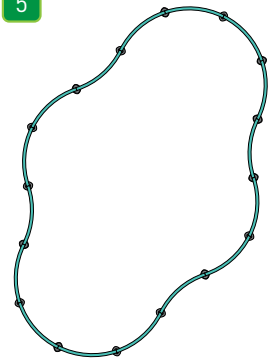

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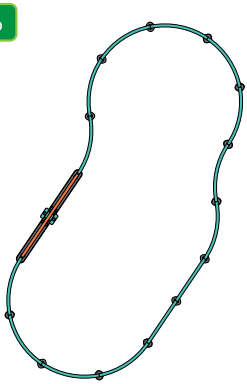

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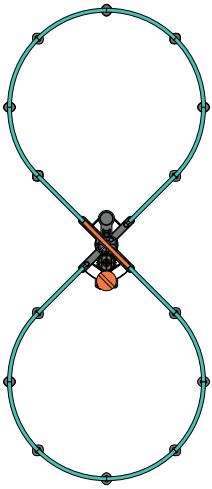

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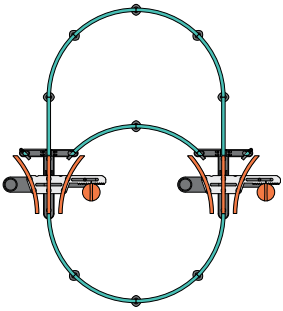

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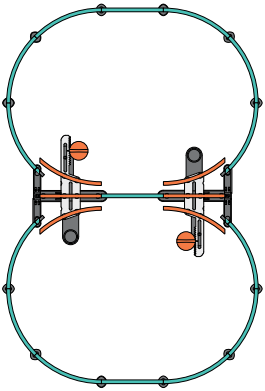

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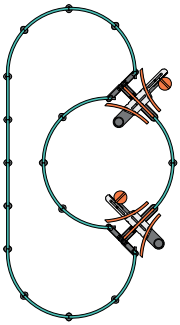

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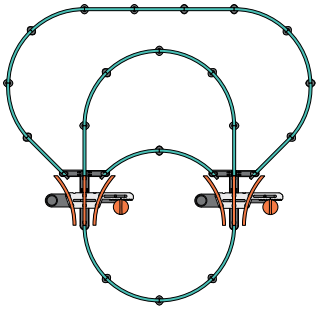

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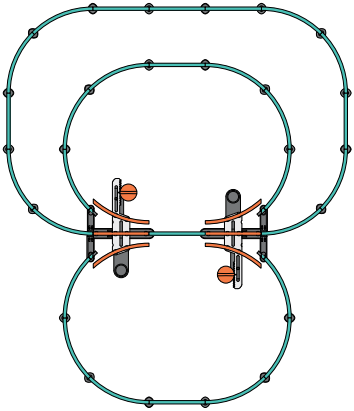

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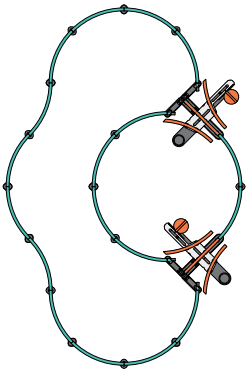

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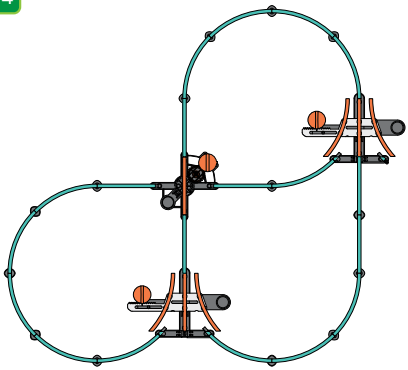

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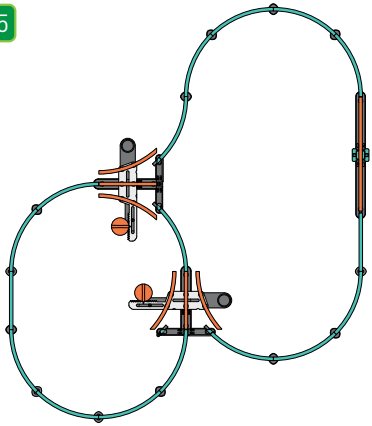

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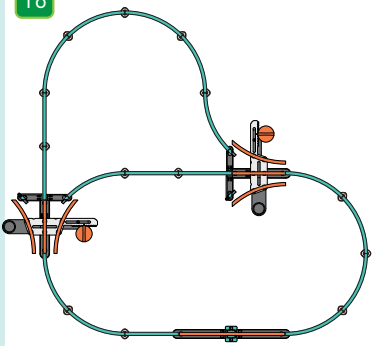

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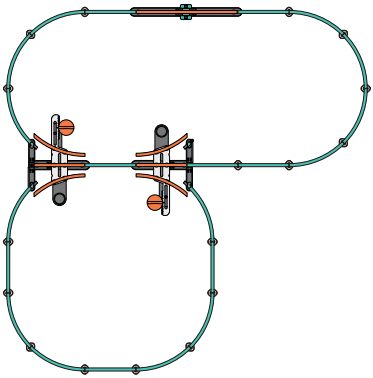

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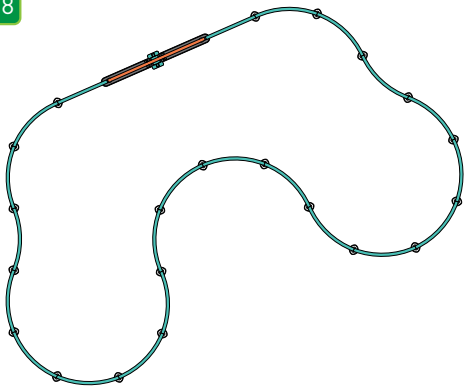

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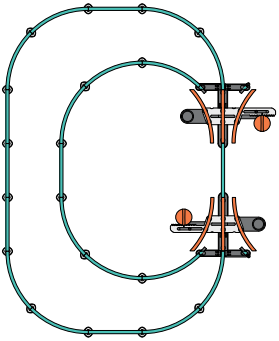

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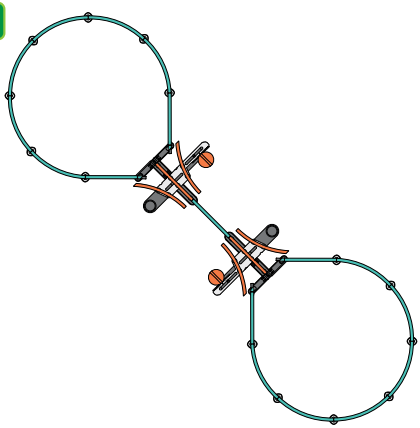

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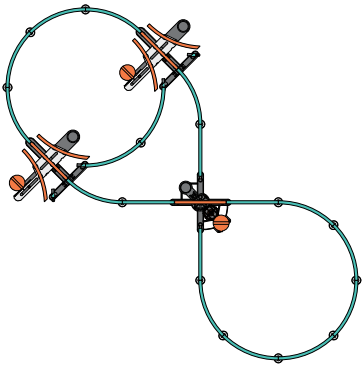

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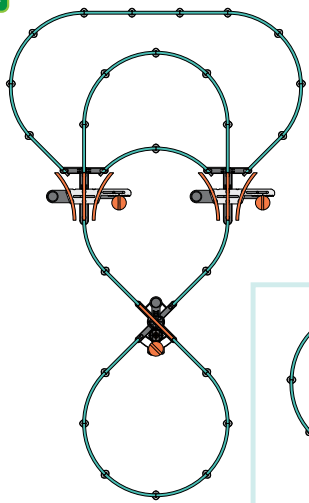

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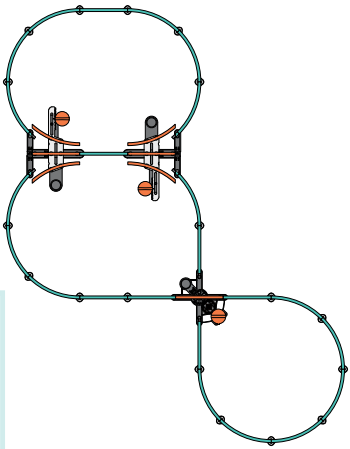

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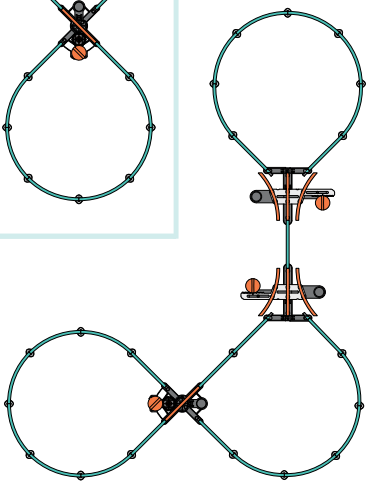

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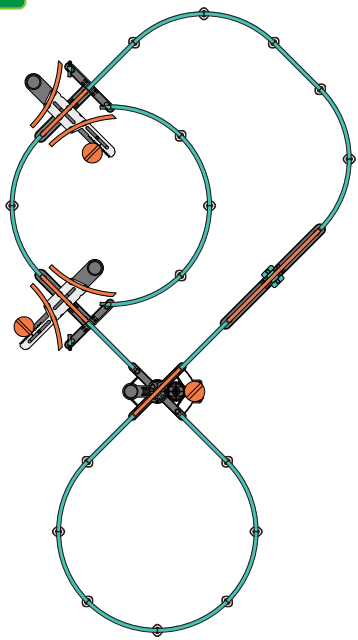

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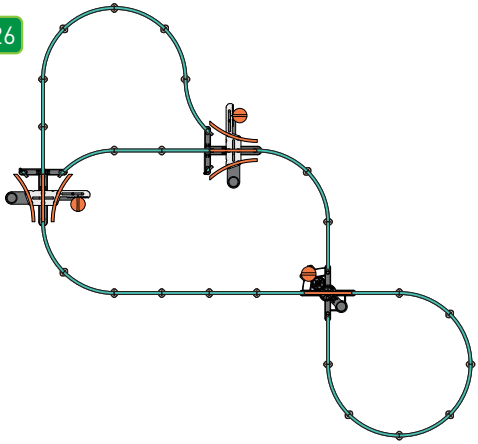


CHECK IT OUT

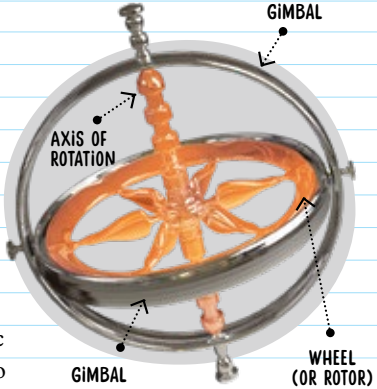
Gyroscopes: A History

Spinning tops have been around for thousands of years. The gyroscope, on the other hand, was invented about 200 years ago by a German scientist named Johann Gottlieb Friedrich von Bohnenberger, who was an astronomer, mathematician, and physicist. He simply called his invention a "Machine." In 1852, the French physicist Léon Foucault developed Bohnenberger's "Machine" into a new device called a gyrocompass. This was used to determine the location and course of sailing ships. Incidentally, the name gyroscope comes from the Greek words: gyros = circle, and skopos = to look.

How Does a Gyroscope Work?

A basic gyroscope is composed of a rapidly spinning wheel (the rotor) mounted into a frame of pivoted supports (gimbals) that allow the wheel to rotate around a single axis. The frame can rotate independently of the wheel, so it can assume any orientation in space even as the wheel stays in one orientation. Each ring can pivot on one axis. Together, these suspension rings make up a gimbal suspension. Physics explains how the rapidly rotating wheel remains spinning in one orientation. This special phenomenon is the reason gyroscopes can be used for measuring and maintaining the orientation of objects.

When you turn on your RoboRails car, you can experience the **gyroscopic effect** firsthand. Rotating objects have angular momentum, and this momentum must be conserved. Any change in the orientation — or angle — of movement is a change in the angular momentum, and the object will resist this change. Try turning the robot in your hand to experience angular momentum at work.

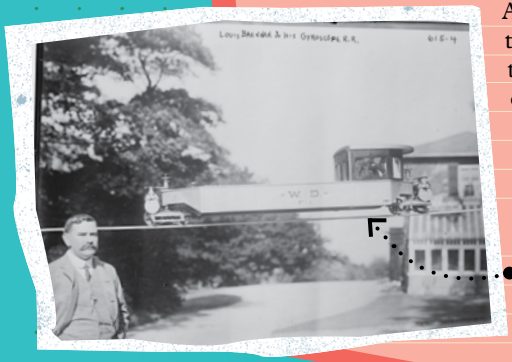


Bicycles and motorcycles take advantage of gyroscopic forces. An upright bike that is moving forward has two spinning wheels that naturally resist tipping over.

The Monorail

Since the advent of the locomotive, aspiring inventors have tried to increase the speed at which rail line track could be laid down. Building a railroad was costly, so switching from two rails to one saved both time and money.

By design, monorails have two main hurdles to overcome: Moving on just a single track, and supporting their cargo without tipping. These problems are solved in many ways: from hanging the monorail below the track as opposed to it running on top, to using magnets or massive ball-bearings to reduce slippage while speeding along.



Although they've never become more popular than two-track locomotives, monorails are a testament to the ingenuity of inventors all over the world, tackling the same engineering problems in wildly different ways.

Louis Brennan, an Irish-Australian inventor, was the first to produce a working gyroscopically-balanced monorail in 1909. While Brennan's creation only ever made it to the prototype stage, modern monorails still rely on gyroscopes for some of their balancing needs, especially in poor weather conditions.

Gyroscopes today

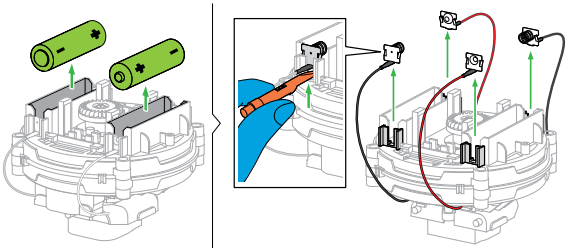
These days, many devices use technology that relies on the same gyroscopic effect that the RoboRails robot relies on to keep its balance. For example, did you know that gyroscopes are also built into smartphones? A gyroscope is used when the screen of a smartphone changes orientation when turned on its side. When you play a game on a smartphone in which you control a character by tilting or rotating the smartphone, you use the gyroscope: The current position of the smartphone is determined by the gyroscope, which maintains its orientation even when the smartphone is tilted. Of course, the gyroscopes built into smartphones are much smaller than the gyroscope in the robot. The gyroscope is assembled with many other sensors and measuring instruments on the circuit board (the brain, so to speak) of a smartphone.

PROBLEM

What should I do if the robot doesn't respond after I switch it on?

SOLUTION

1. Check to make sure that the batteries were installed correctly, with the correct polarity (+ and -). See page 18, step 3.
2. Make sure that all battery contacts are properly installed. See page 12, steps 9 and 10. To disassemble the battery contacts, remove the batteries, then use part D1.



PROBLEM

What should I do if the robot fails to balance on the rails after the batteries are replaced?

SOLUTION

1. Give the robot a boost. Turn it off, then on, and allow it to run for 20 seconds in your hand before placing it straight on the rail. See page 25, steps 2 through 4.
2. Make sure E17 was installed correctly. Check page 16, step 21.

PROBLEM

What should I do if the robot makes a loud sound after being activated?

SOLUTION

Oil the gears. See page 4, steps 1 through 3. Follow the disassembly step above to remove the batteries and the battery contacts.

PROBLEM

What should I do if the robot shakes violently after being activated?

SOLUTION

1. Make sure B9 is attached tightly with screws. See page 10, step 6.
2. Make sure the screws on the rotor are tightened all the way. See page 7, and follow disassembly step above.
3. Make sure that the rotor is securely attached. See page 11, step 7.

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