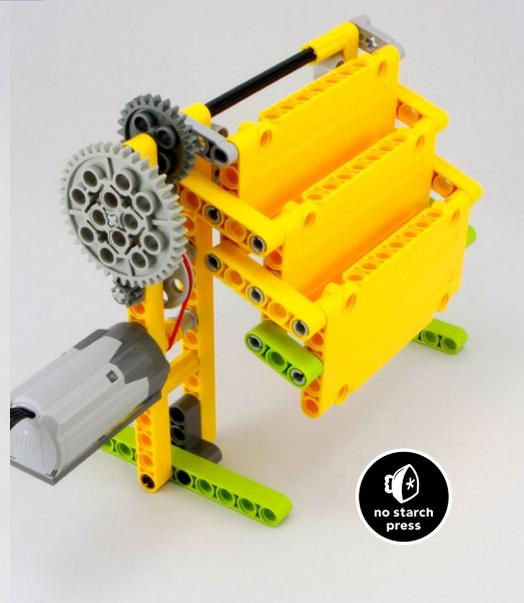
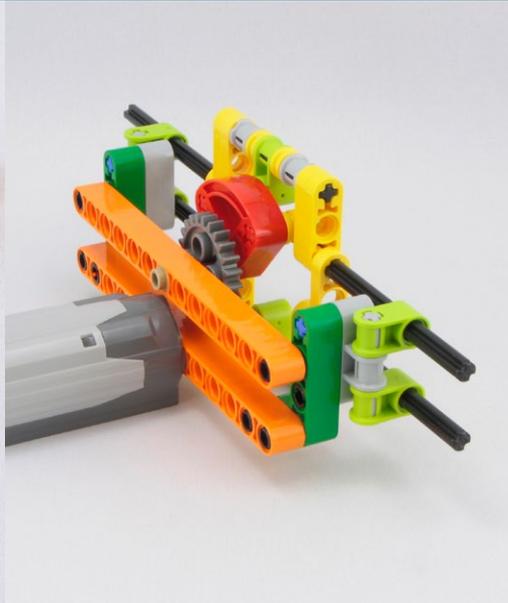
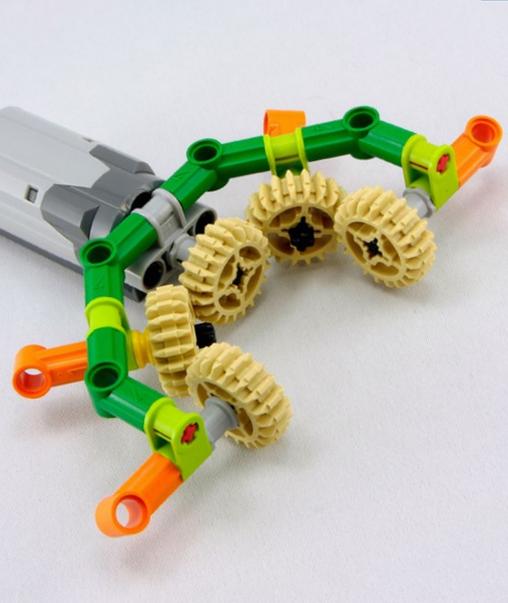


THE LEGO®
POWER
FUNCTIONS
IDEA BOOK
MACHINES AND
MECHANISMS
YOSHIHITO ISOGAWA



THE LEGO® POWER FUNCTIONS IDEA BOOK
MACHINES AND MECHANISMS

VOLUME 1

**THE LEGO®
POWER
FUNCTIONS
IDEA BOOK**

**MACHINES AND
MECHANISMS**

Y O S H I H I T O I S O G A W A



The LEGO® Power Functions Idea Book, Volume 1: Machines and Mechanisms.

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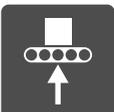
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Introduction

This is an idea book, offering hundreds of projects and mechanisms you can build with LEGO Technic parts. The book especially focuses on LEGO Power Functions, which is the latest version of the Technic system of motors, lights, and other electric building elements.

Where Are the Words?

Other than this brief introduction and the table of contents, this book has almost no words. Instead, you'll find a series of photographs of increasingly complex models, each designed to demonstrate a mechanical principle or building technique.

While the book lists the pieces needed to build each model, it does not include step-by-step building instructions. Look at the photographs taken from various angles and try to reproduce the model. Building in this way is something like putting together a puzzle. You'll get the hang of it after a little practice.

The Use of Color

The examples in this book are made with parts of various colors to make it easier for you to see the individual bricks' shapes. But you don't need to use the colors I've chosen in your models; use whichever colors you want to make the projects your own.

Substituting Parts

The parts used in this book were selected from among the easily obtainable ones as much as possible, but you'll probably still be missing a few.

Try to build as many models as possible using the parts that you already own. If you find that you're missing parts, try to think of ways to substitute other parts for the ones that you're missing.

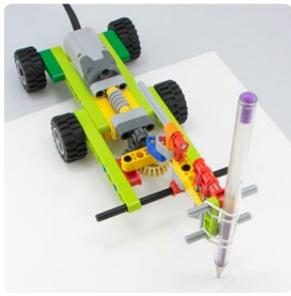
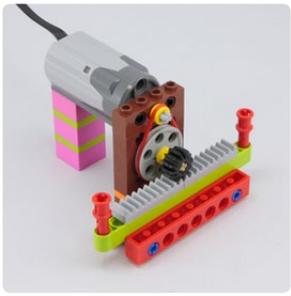
For example, there are many types of LEGO tires. If you don't have the tires shown in a particular project, try using any tires you have that are a similar size. Also, there are several types of Power Functions motors. In this book, the commonly available Medium (M) motors are used most frequently. It's relatively easy to replace the M motor with the Large (L) motor or older motors from earlier systems, so use whatever you have available.

The Parts List in the back of the book will help you find the pieces you need.

You Are the Creator

Look at the models you build closely. By thinking about how they move and why they are designed that way, you will greatly improve your building skills.

This is an idea book; it's about imagination. It is my sincere hope that you make these projects your own, combine them, and evolve them into something even better—your own original models.



PART 1

Basic Mechanisms



4



52



90



114



154



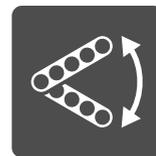
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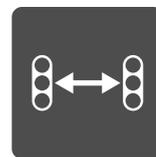
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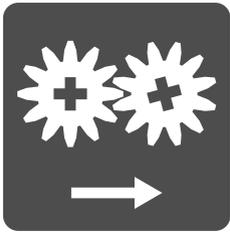
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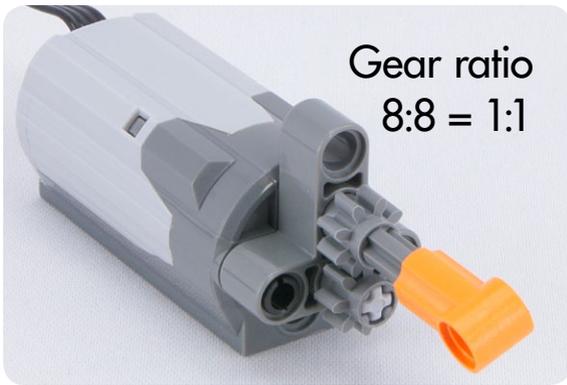
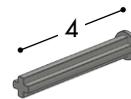


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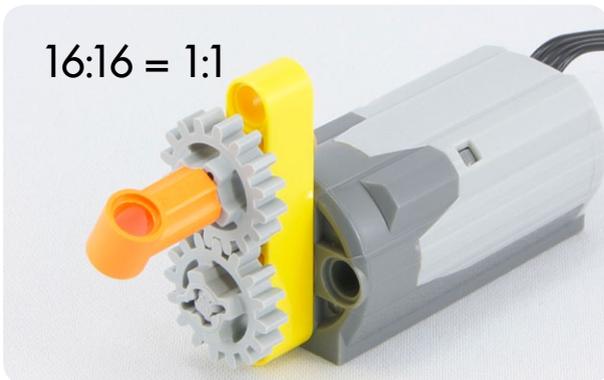
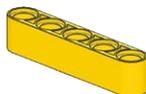


Transmitting rotation

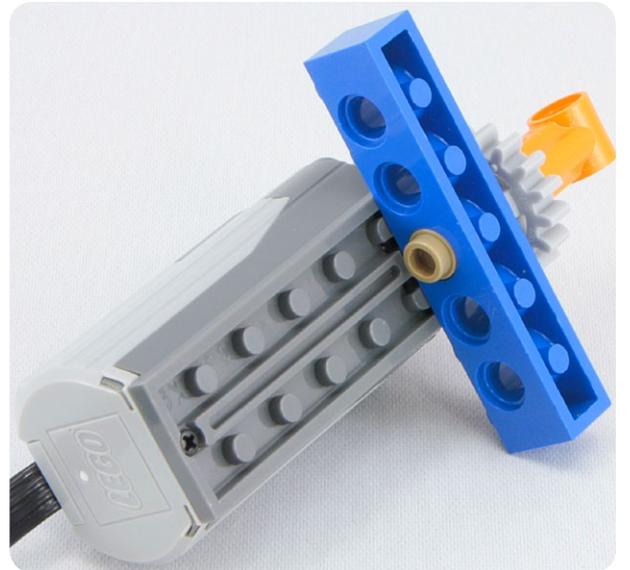
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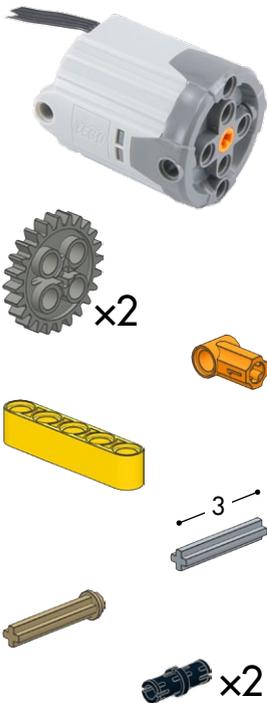
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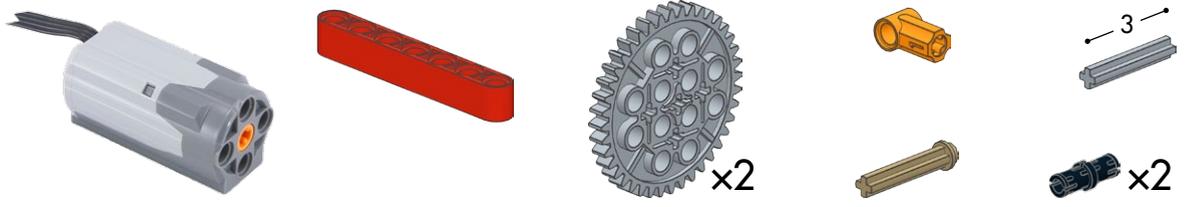
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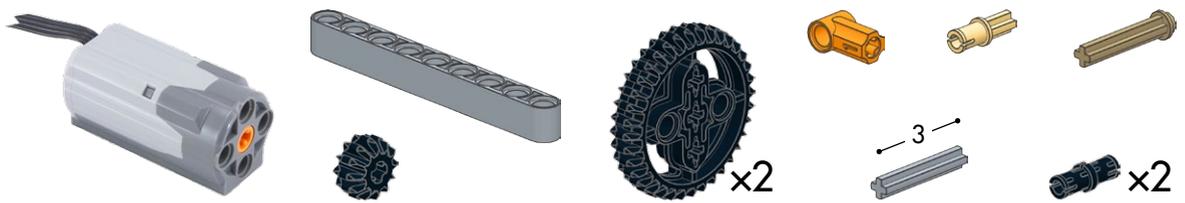
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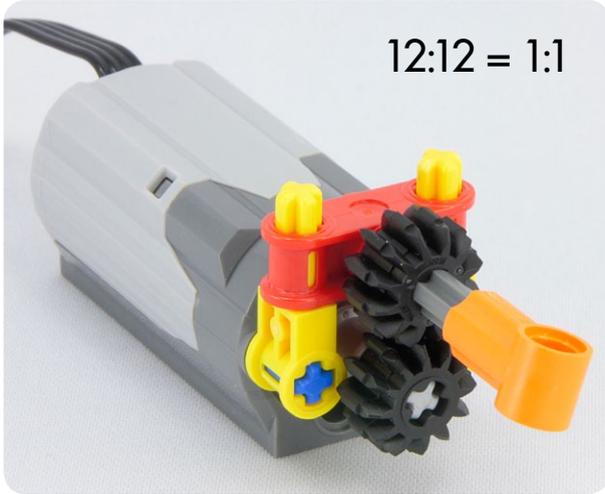
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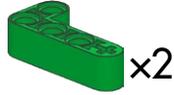
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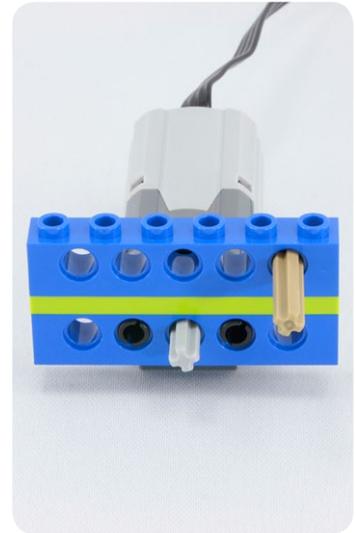
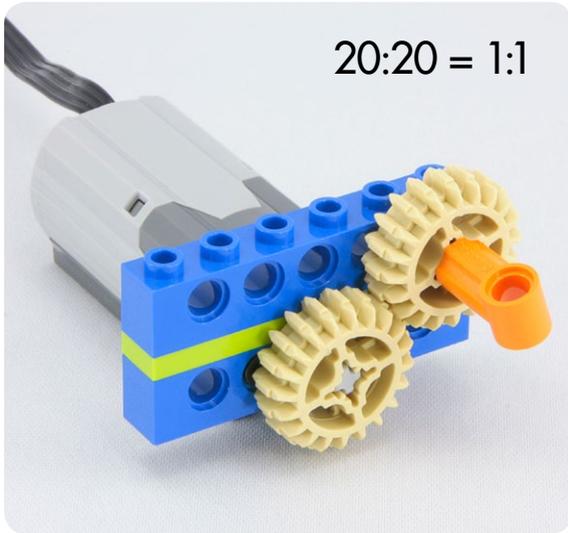
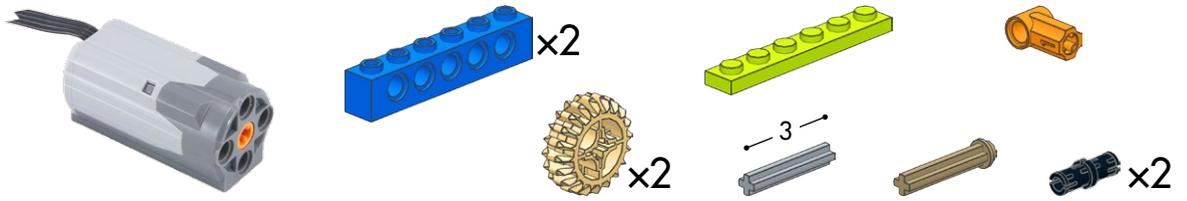
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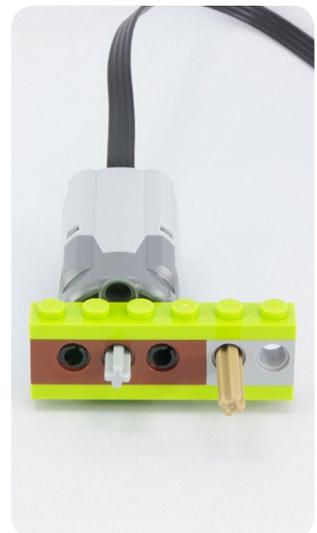
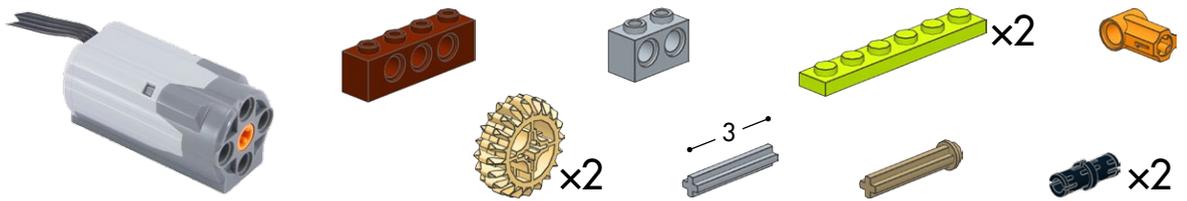
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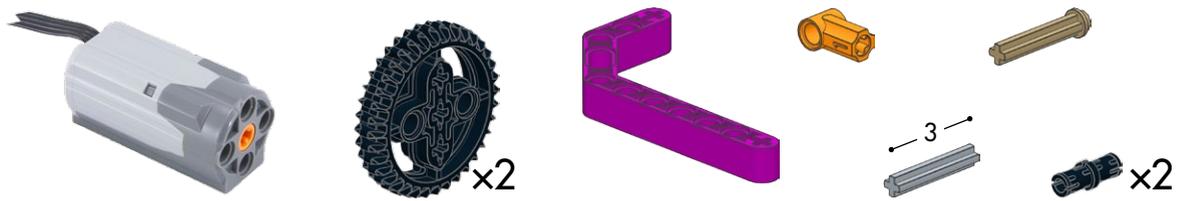
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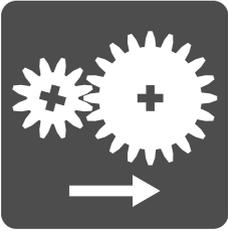


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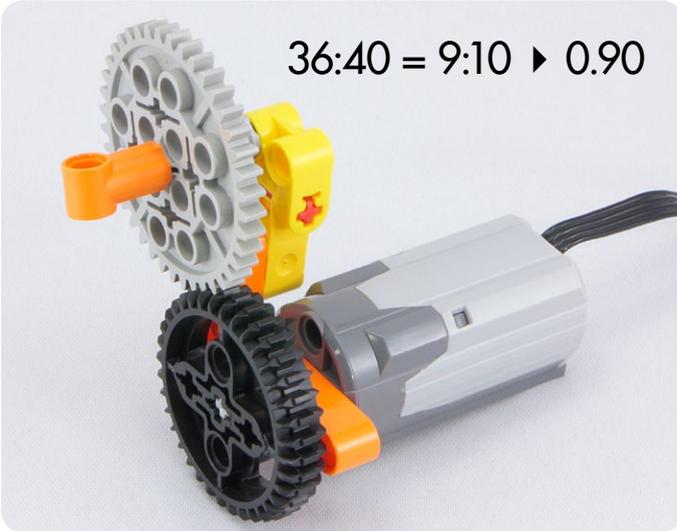
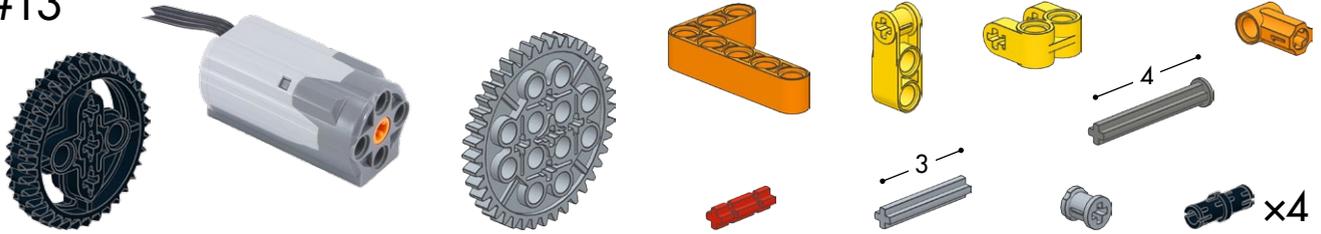
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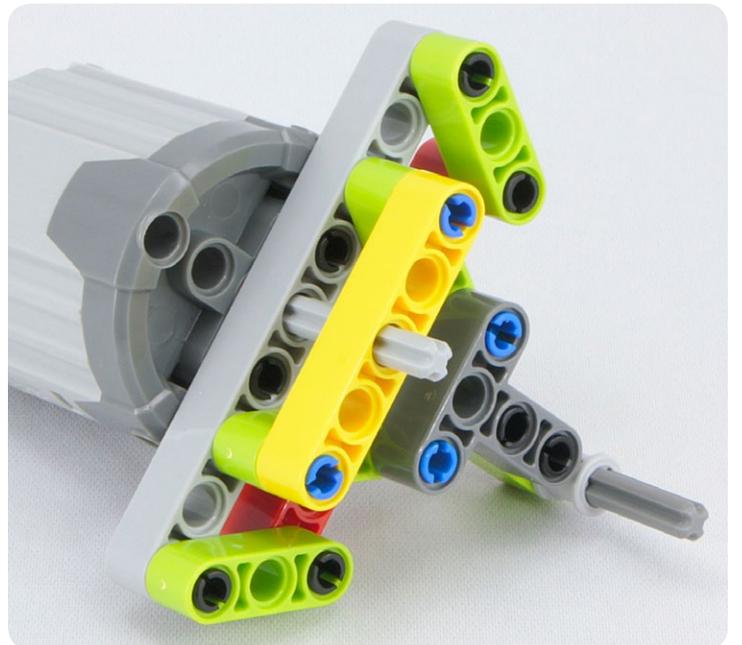
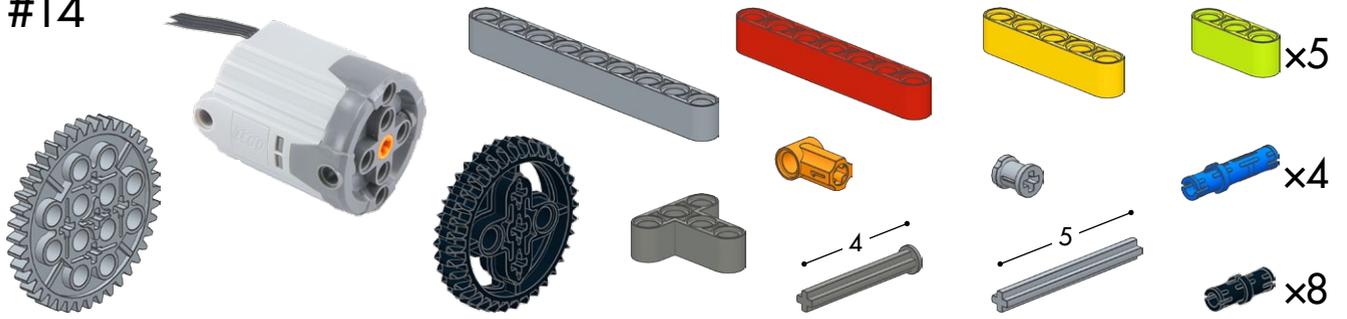


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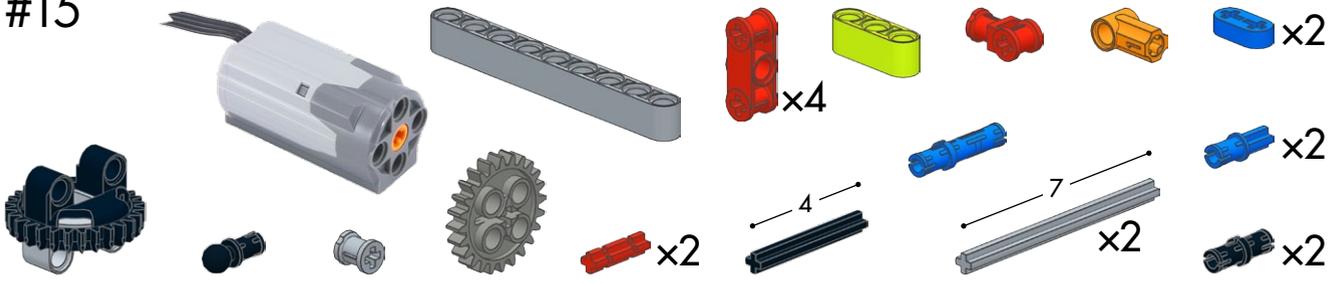
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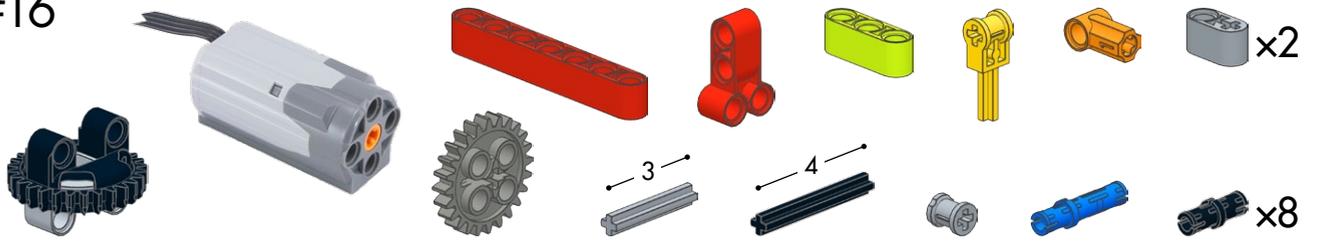
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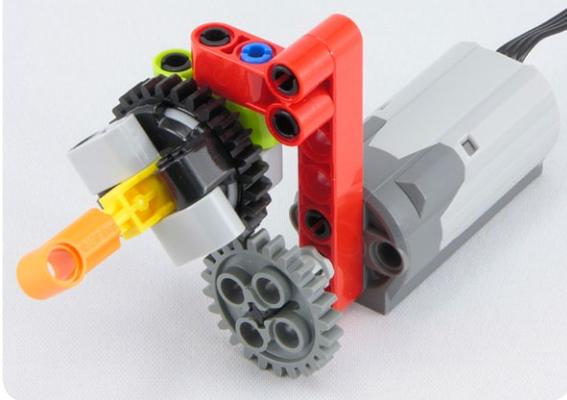
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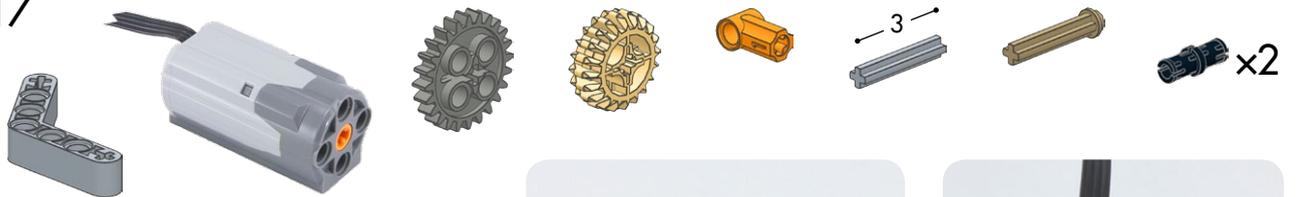
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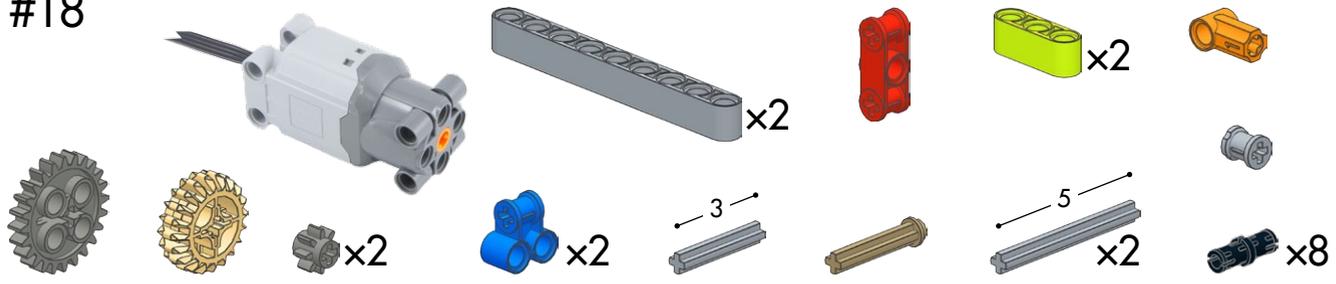
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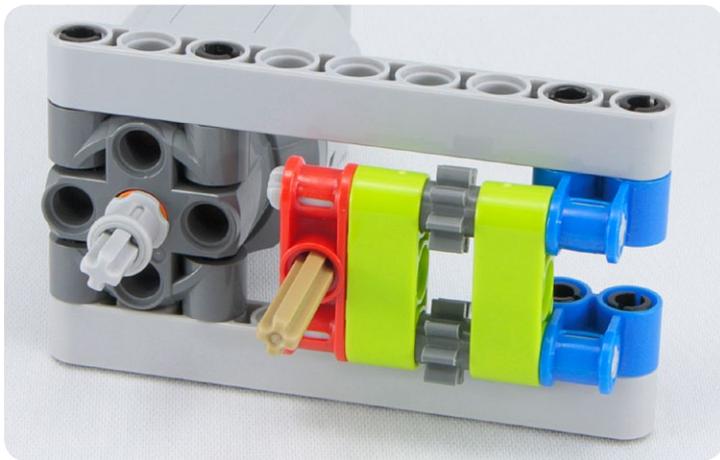
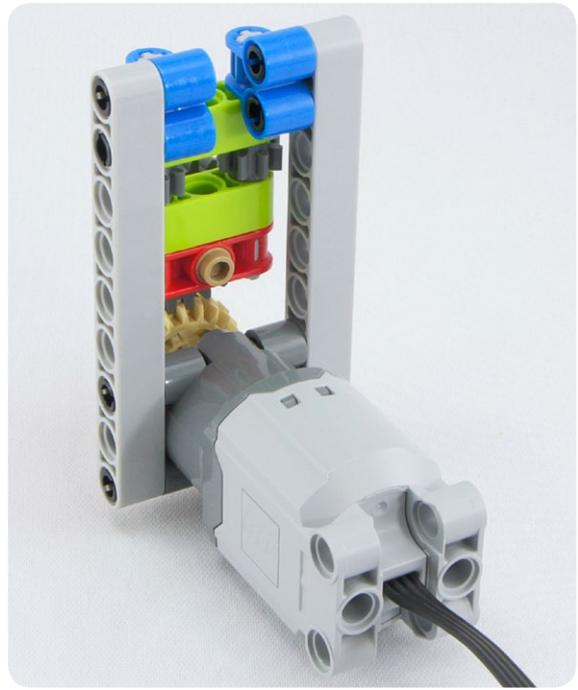
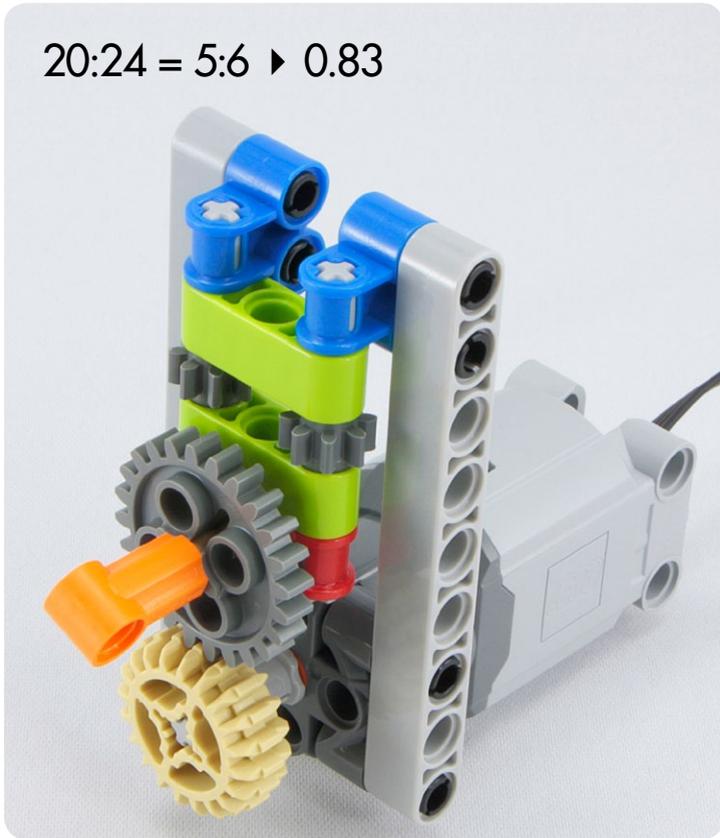
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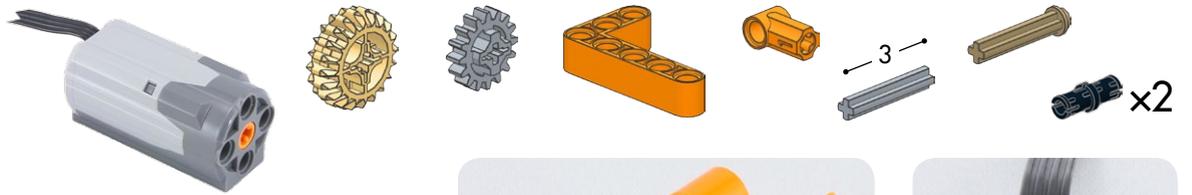
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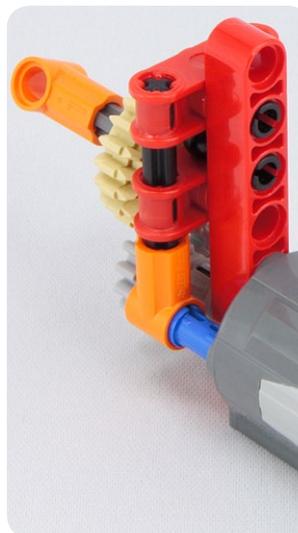
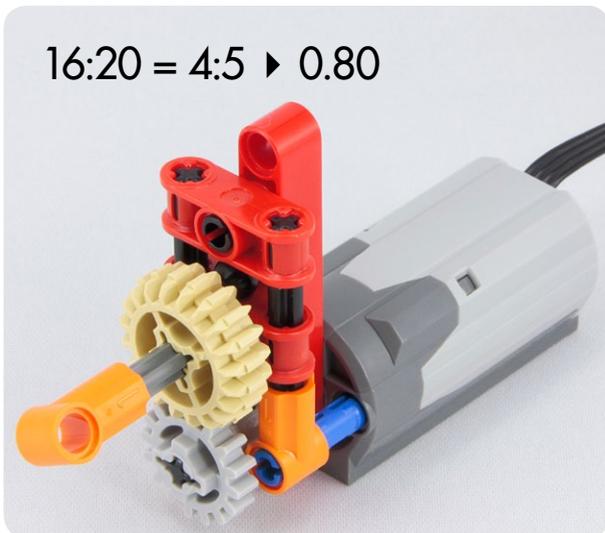
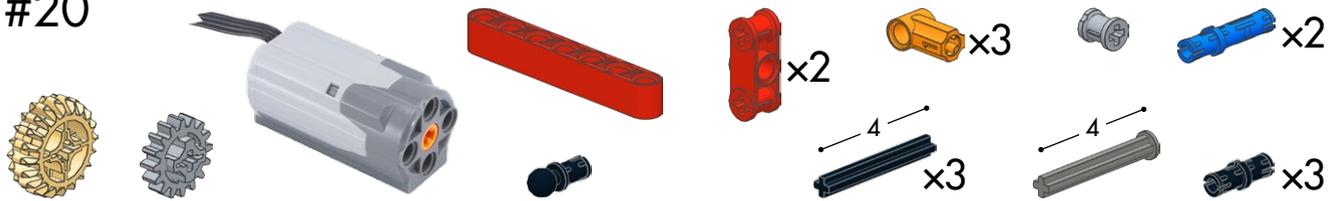
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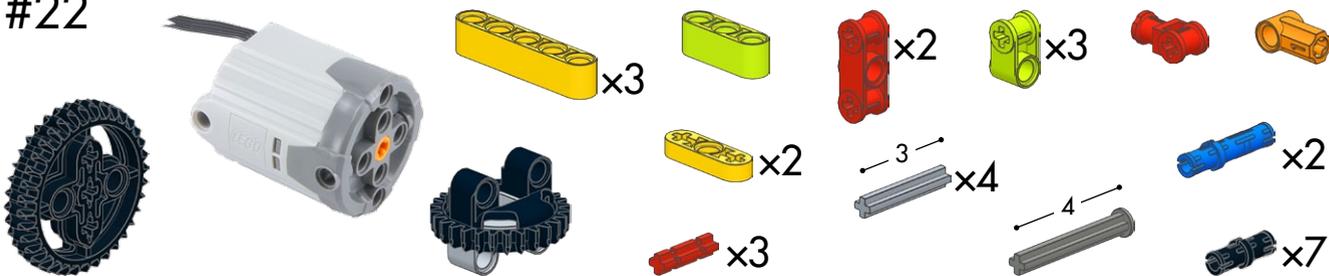
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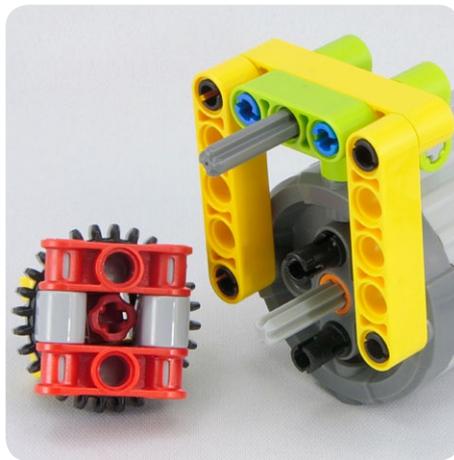
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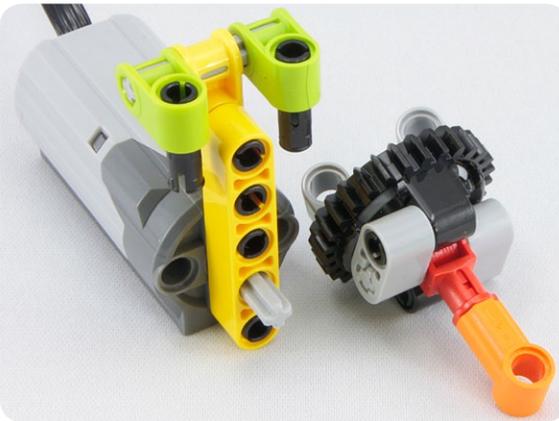
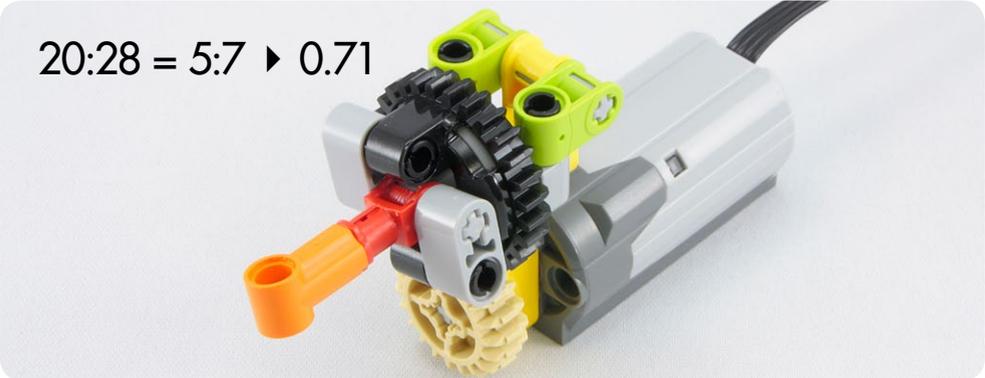
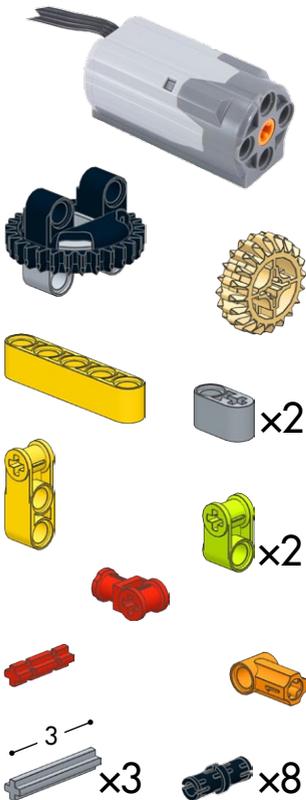
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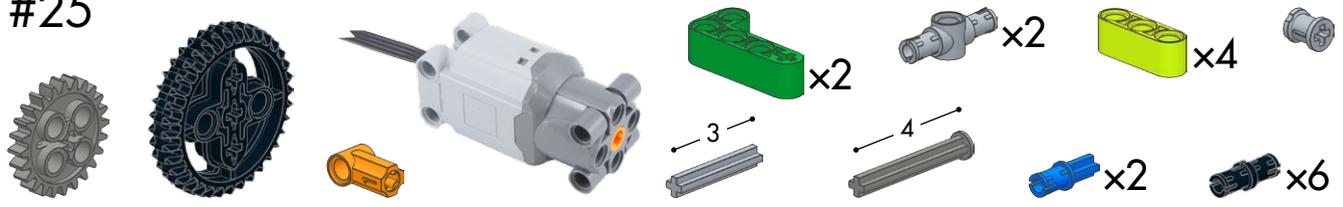
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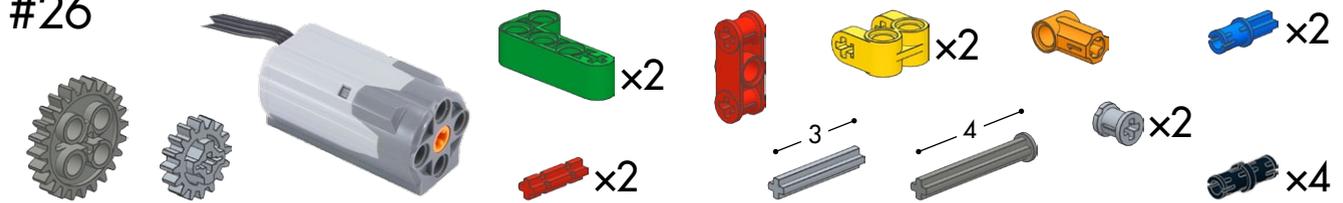
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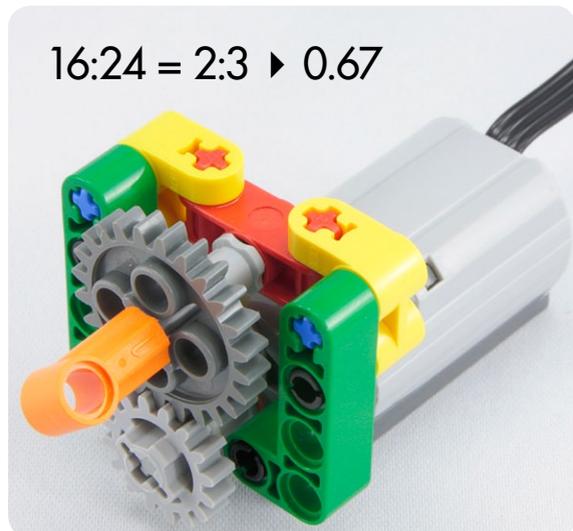
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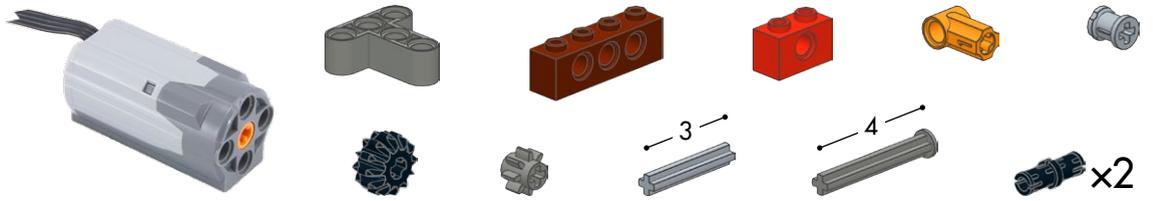
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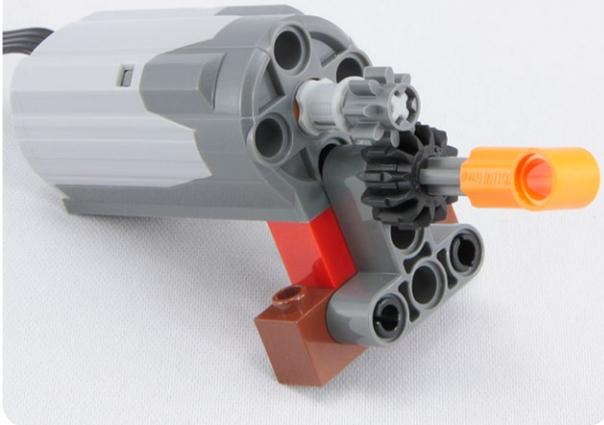
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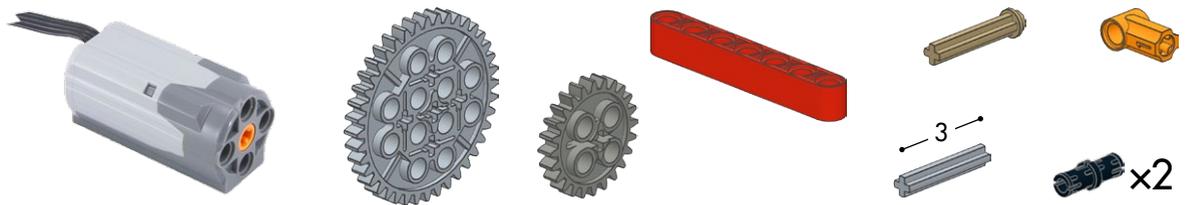
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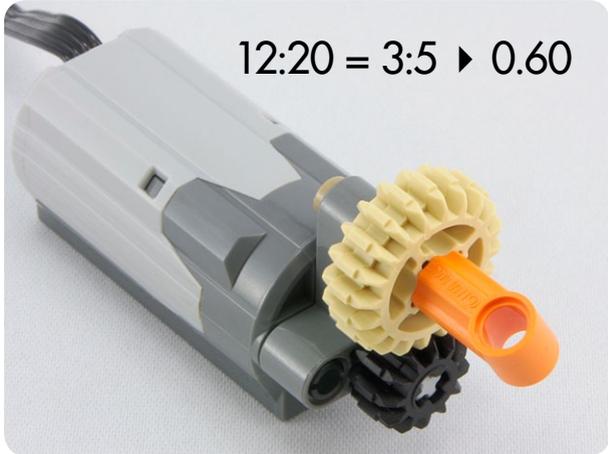
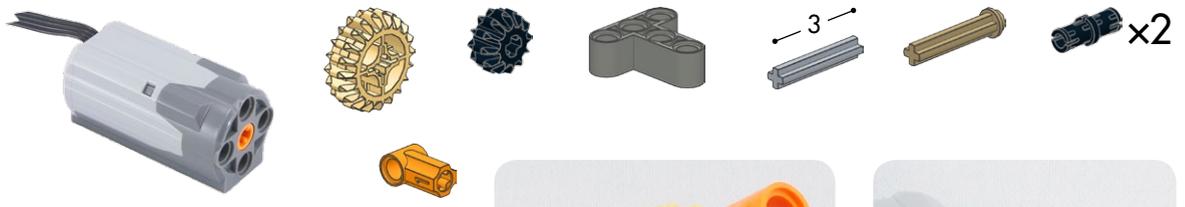
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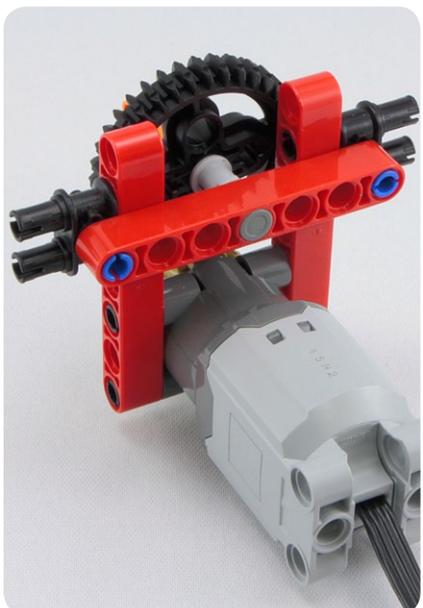
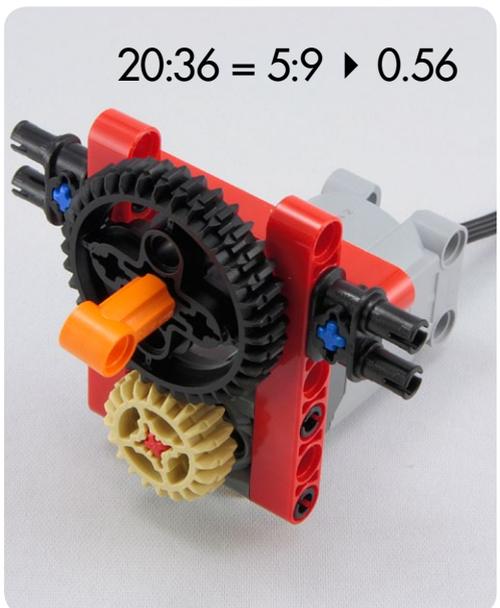
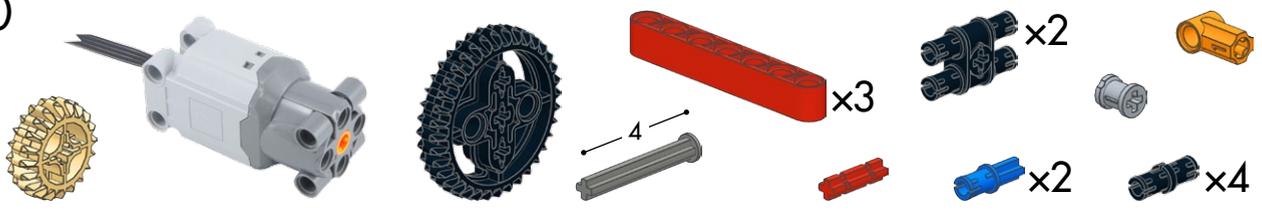
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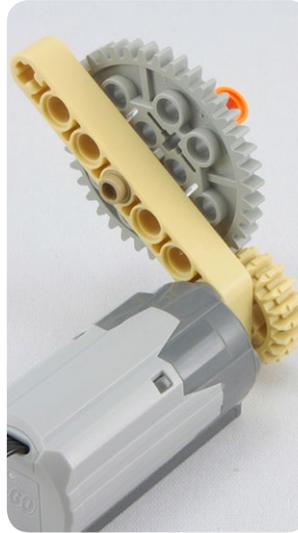
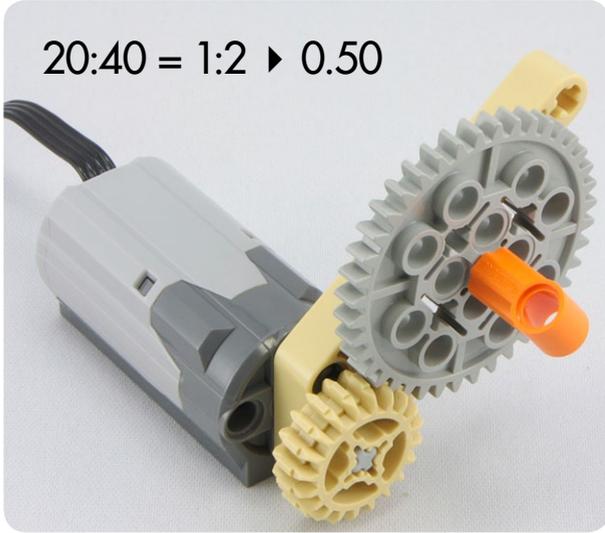
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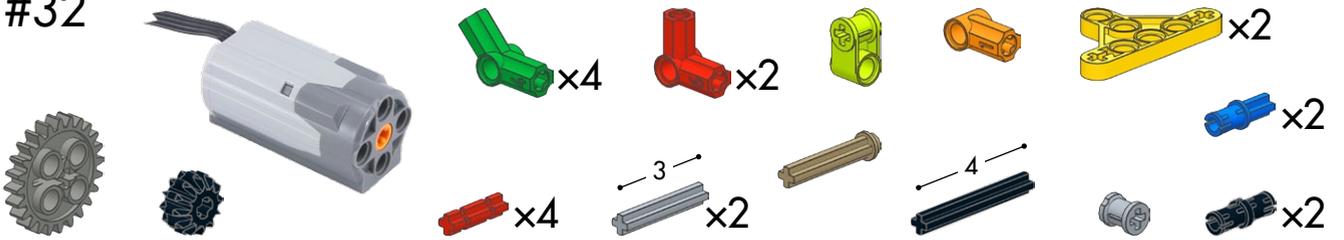
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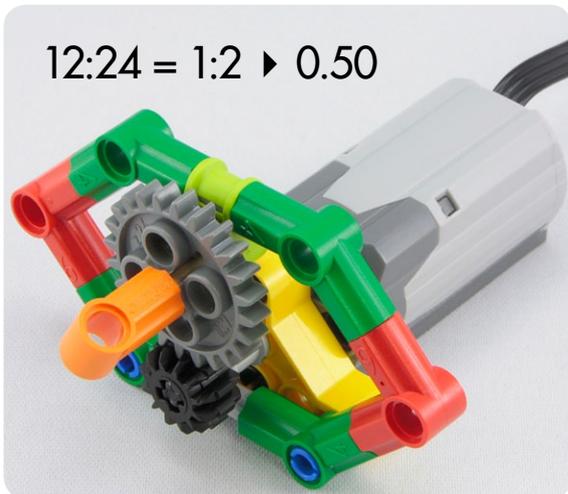
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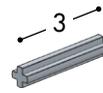
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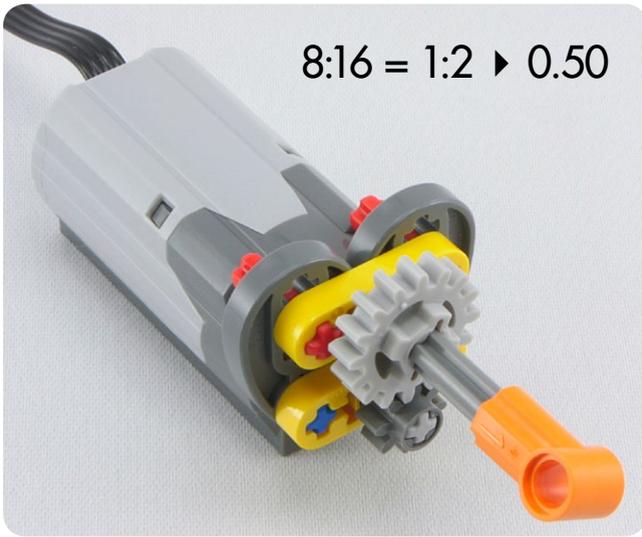
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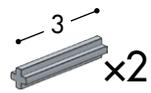
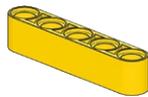
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8:16 = 1:2 ▶ 0.50



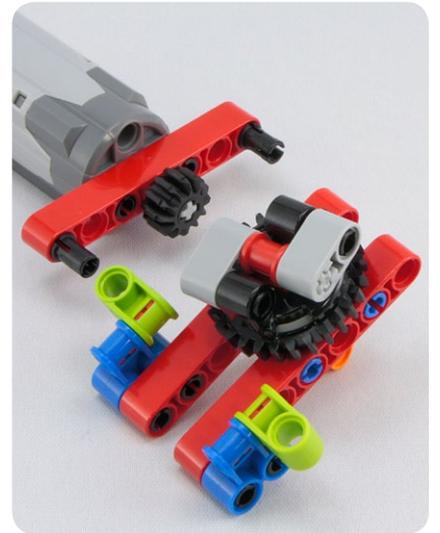
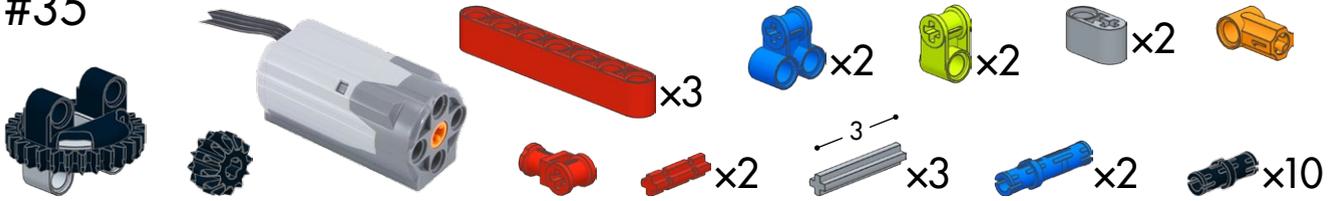
#34



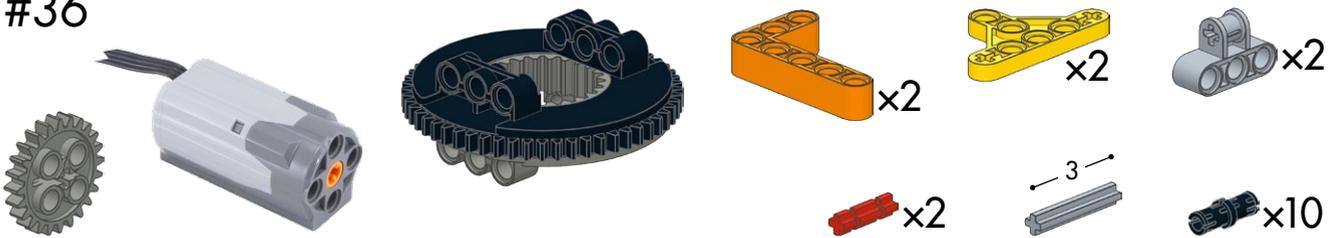
8:16 = 1:2 ▶ 0.50



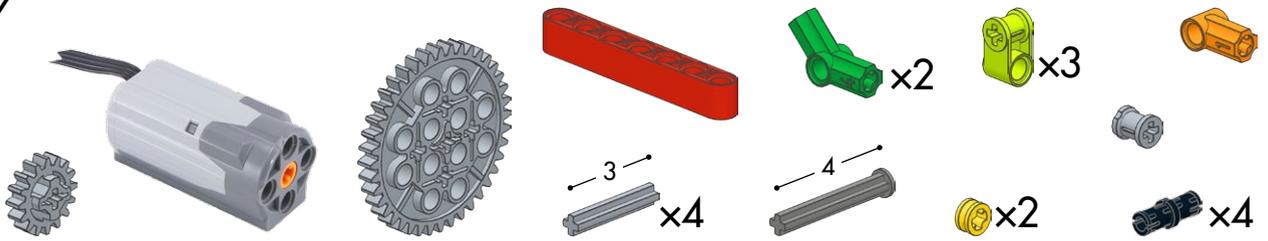
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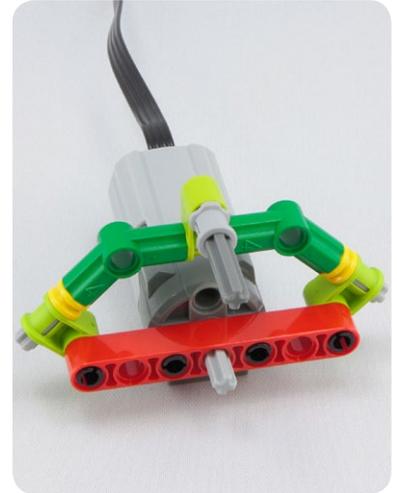
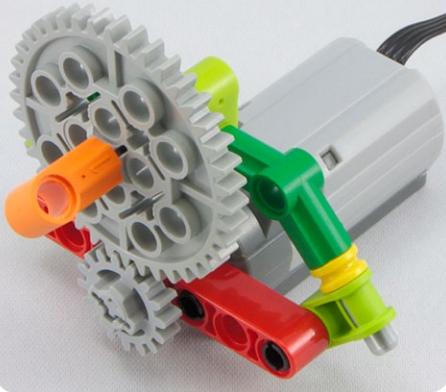
#36



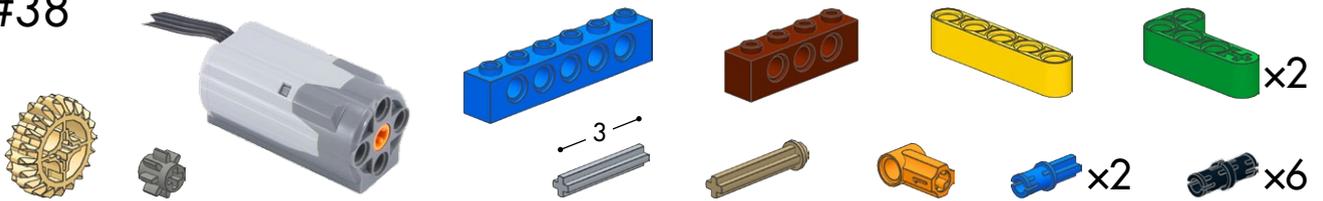
#37



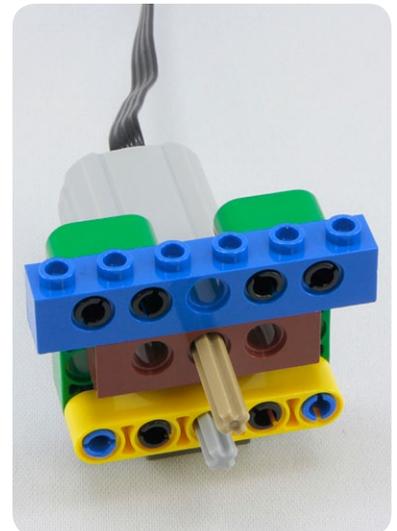
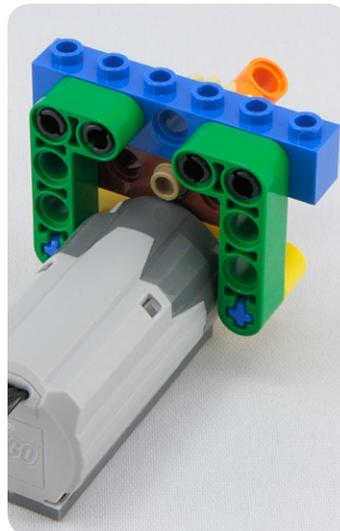
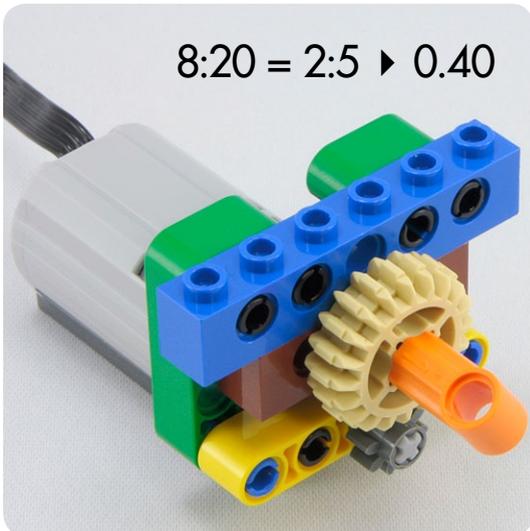
16:40 = 2:5 ▶ 0.40



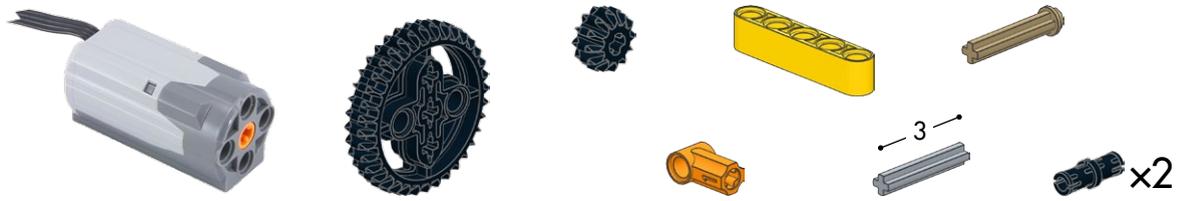
#38



8:20 = 2:5 ▶ 0.40



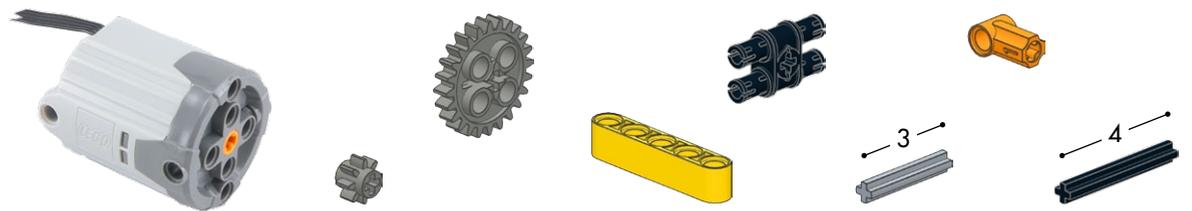
#39



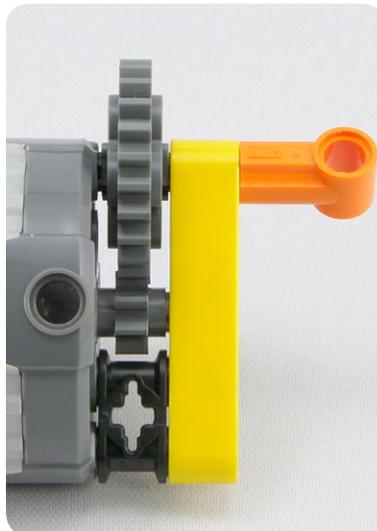
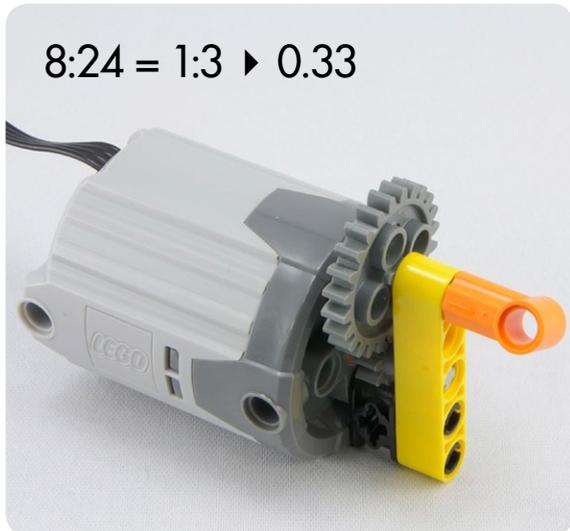
$12:36 = 1:3 \triangleright 0.33$



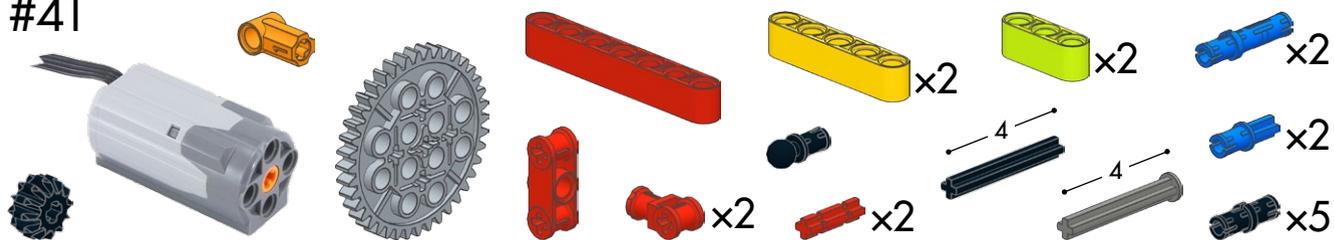
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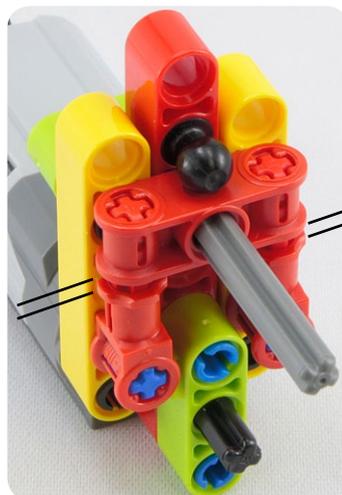
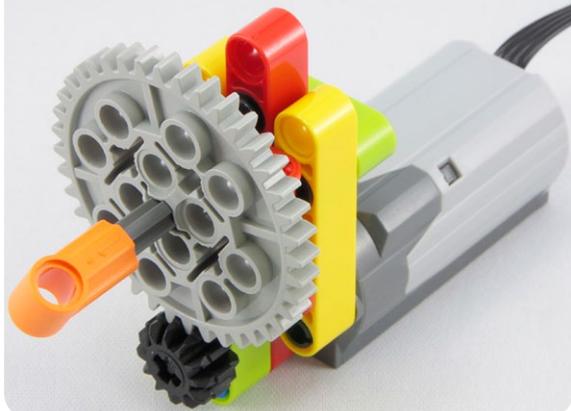
$8:24 = 1:3 \triangleright 0.33$



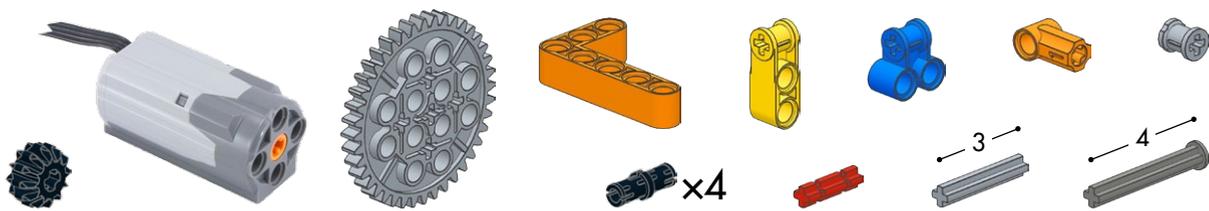
#41



12:40 = 3:10 ▶ 0.30



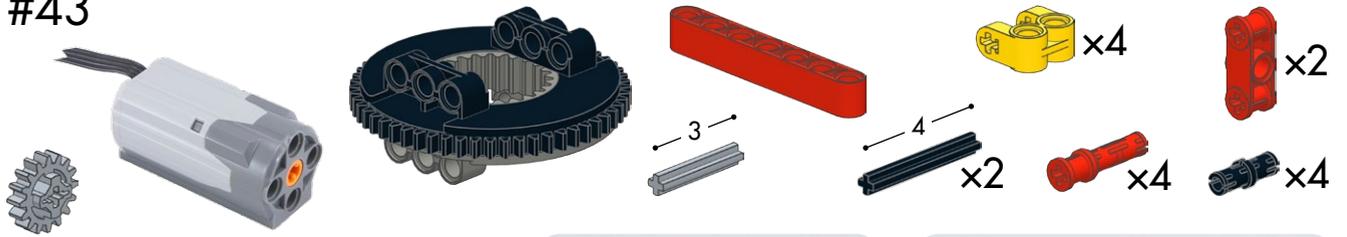
#42



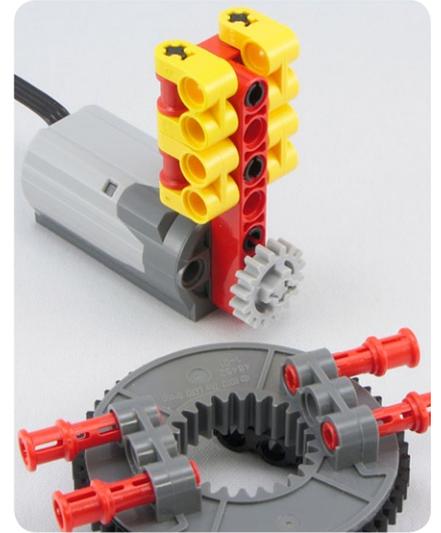
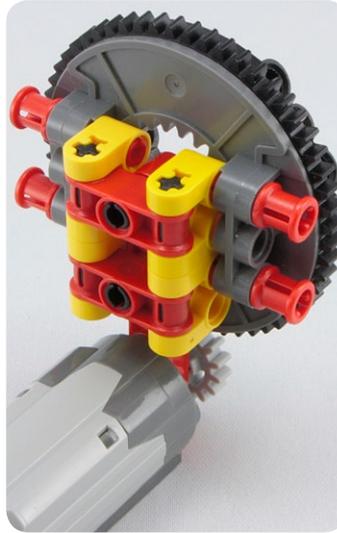
12:40 = 3:10 ▶ 0.30



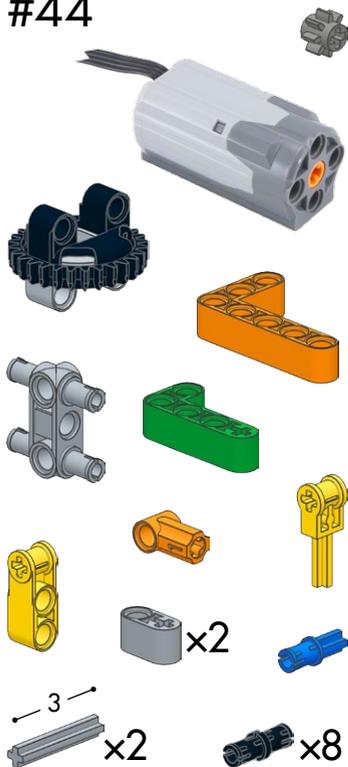
#43



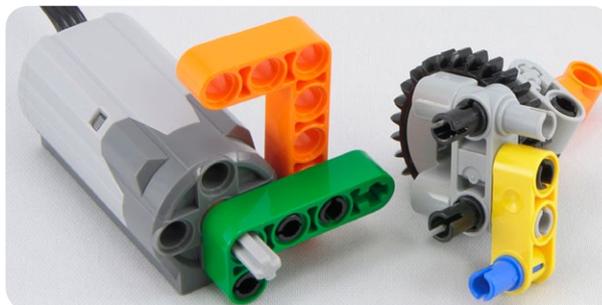
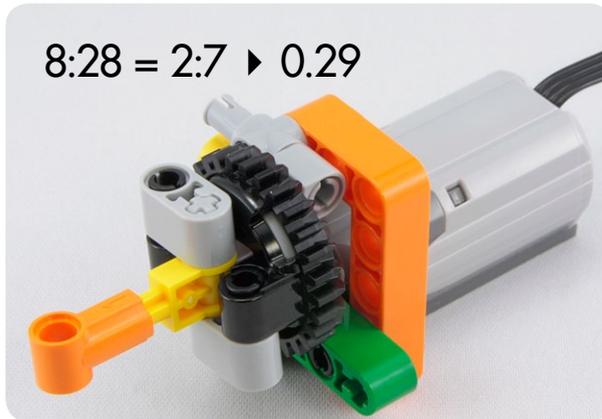
$16:56 = 4:14 \triangleright 0.29$



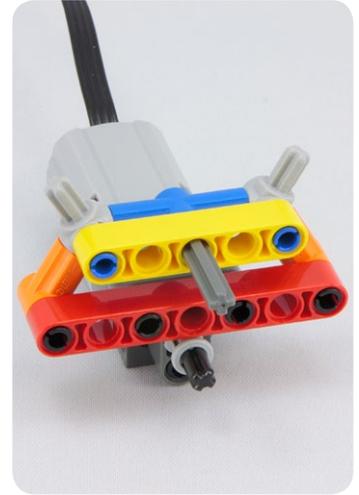
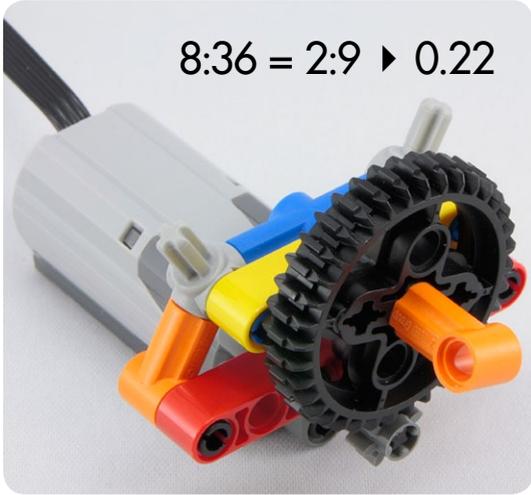
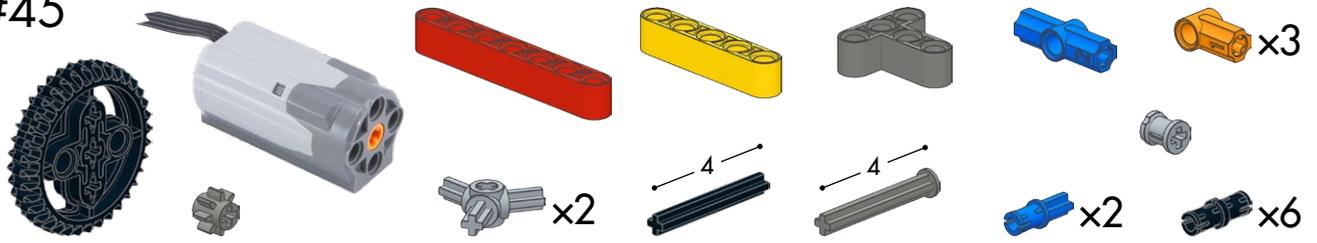
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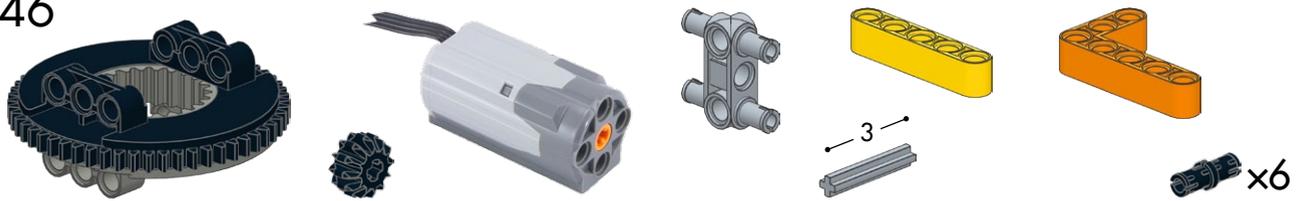
$8:28 = 2:7 \triangleright 0.29$



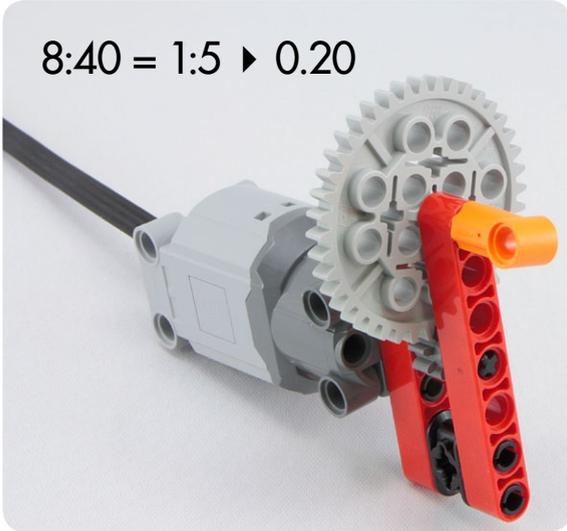
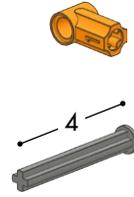
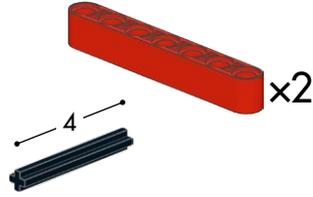
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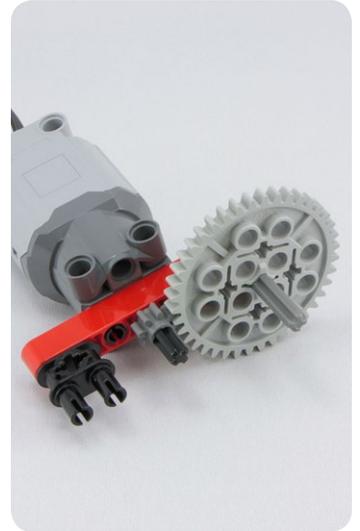
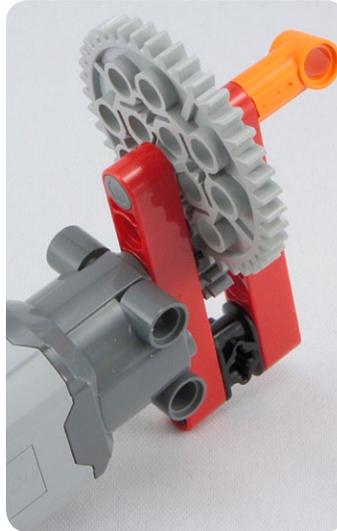
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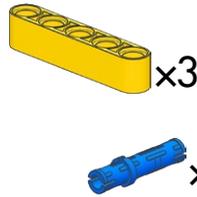
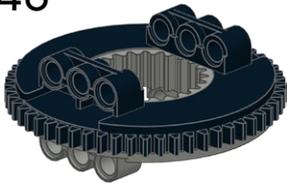
#47



8:40 = 1:5 ▶ 0.20

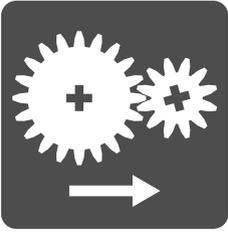


#48



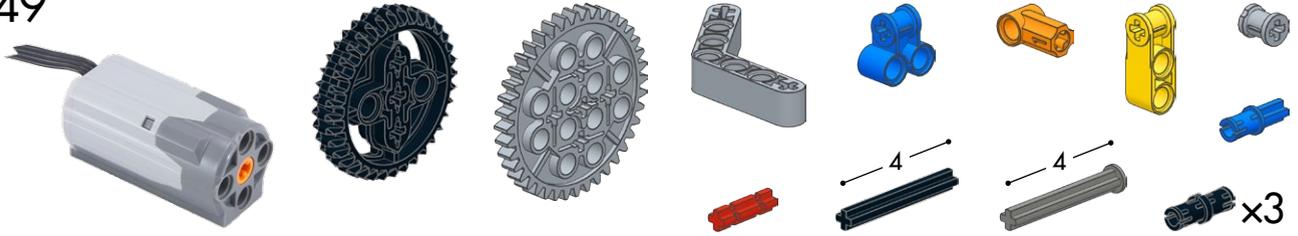
8:56 = 1:7 ▶ 0.14



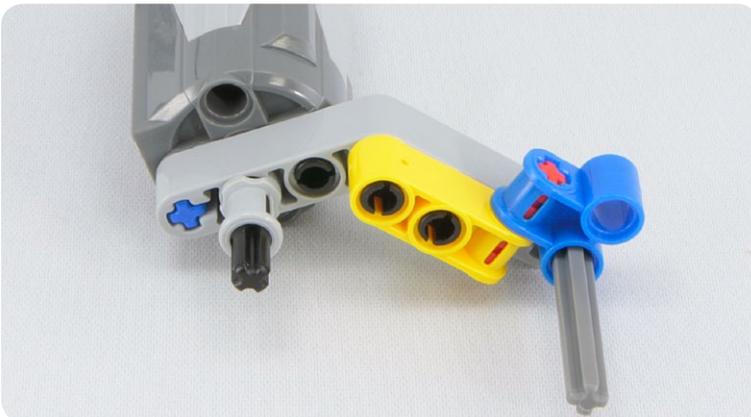


Gearing up (speeding up)

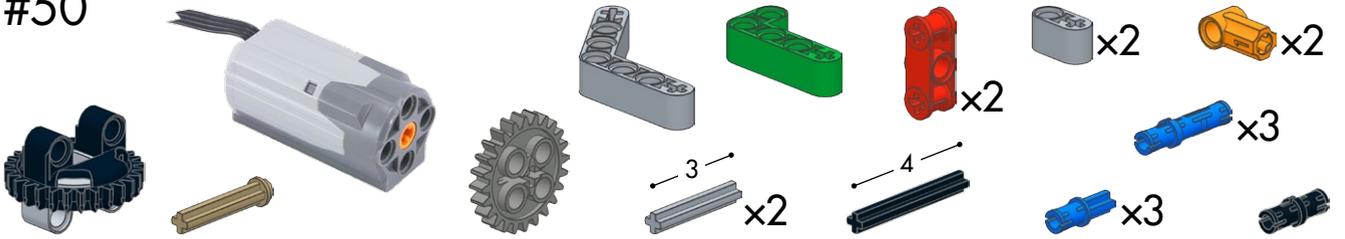
#49



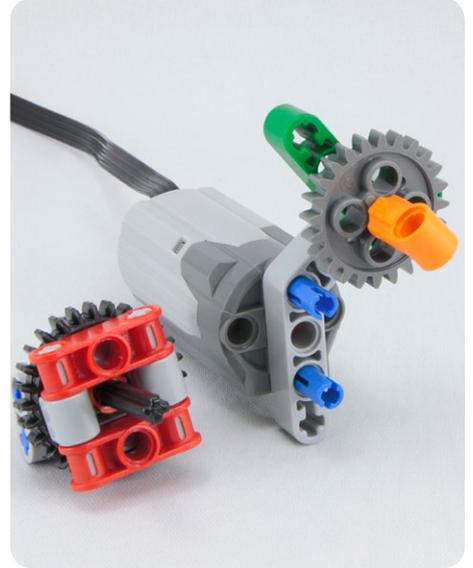
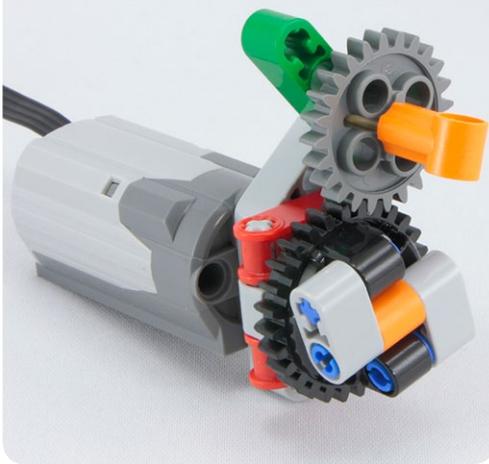
$40:36 = 10:9 \triangleright 1.11$



#50



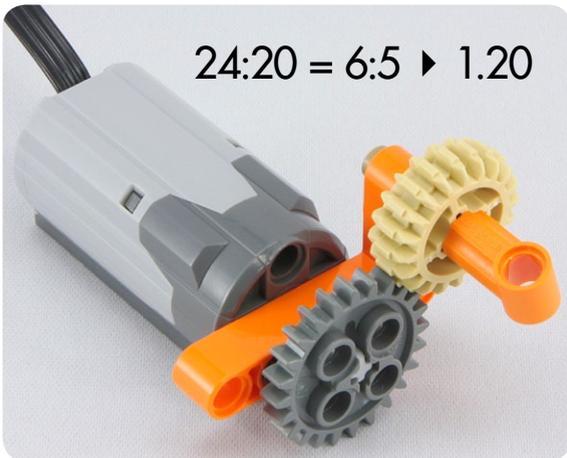
$28:24 = 7:6 \triangleright 1.17$



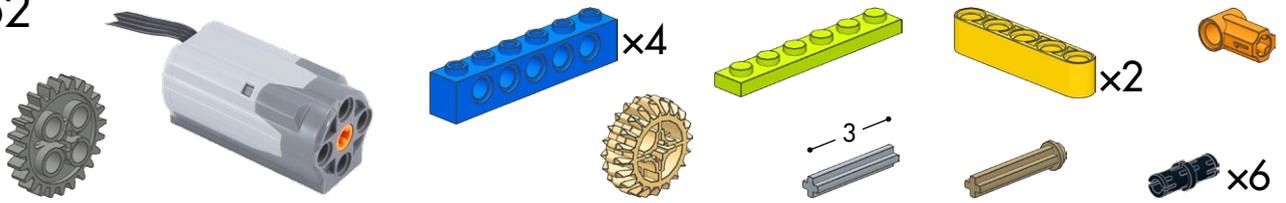
#51



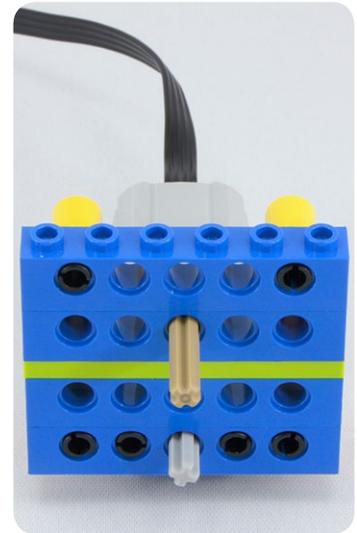
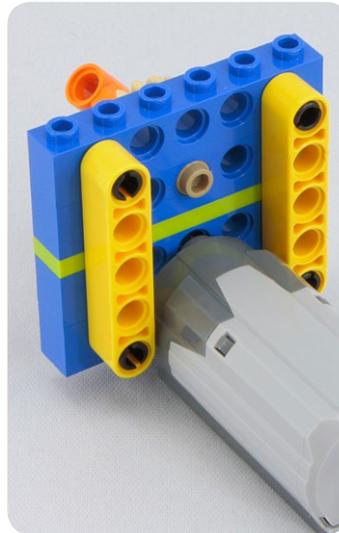
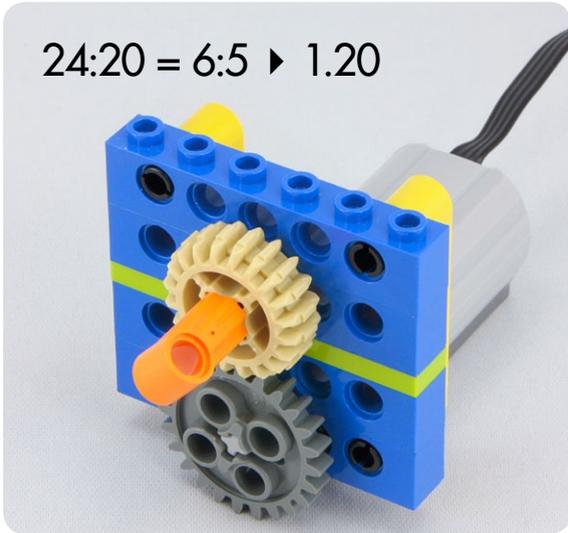
$24:20 = 6:5 \triangleright 1.20$



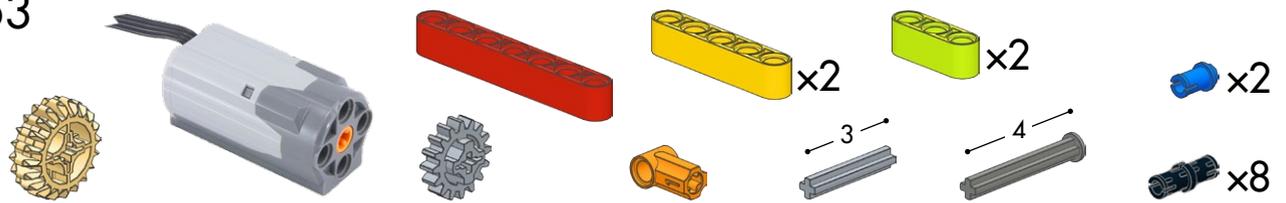
#52



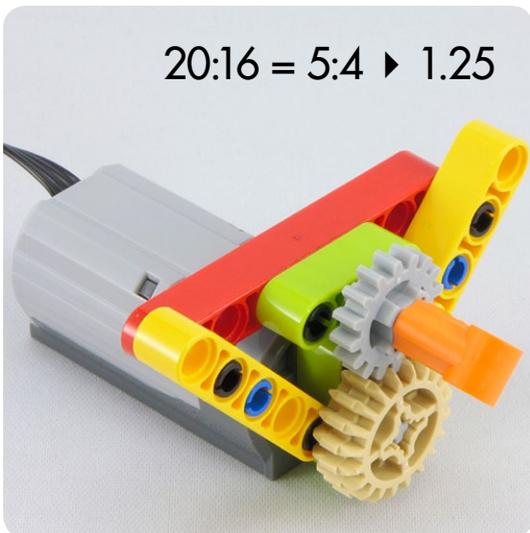
24:20 = 6:5 ▶ 1.20



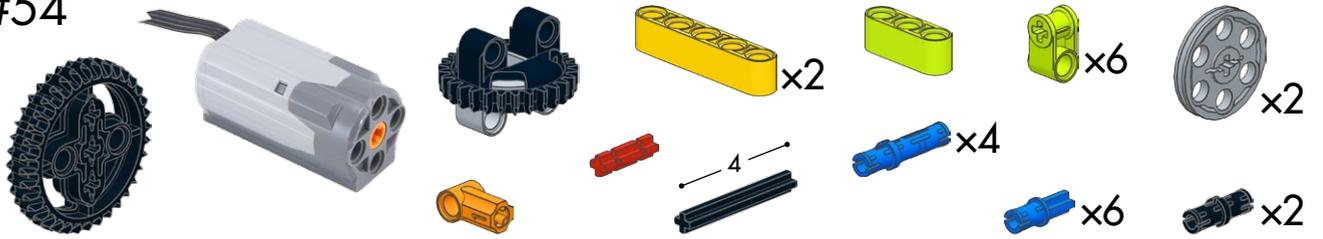
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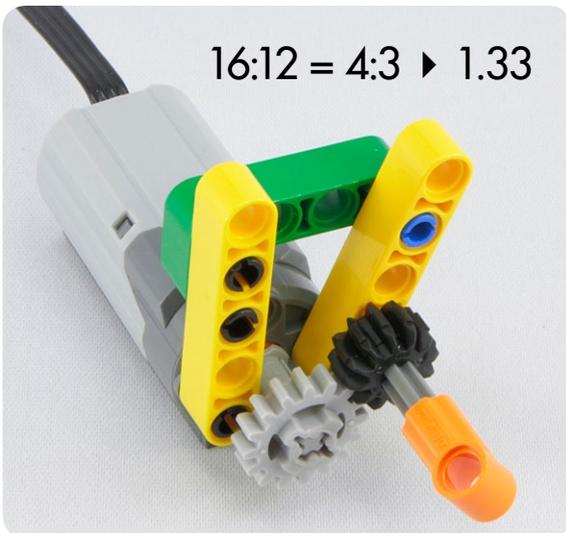
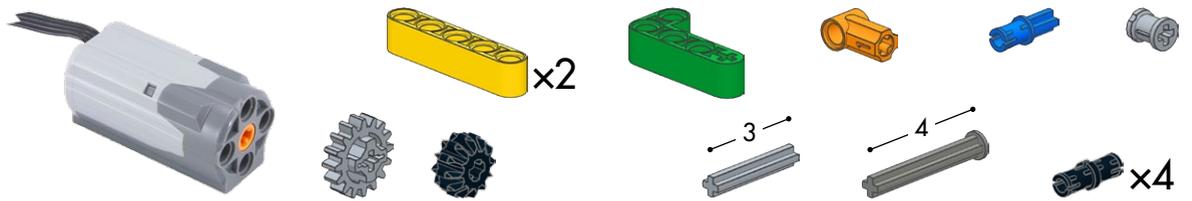
20:16 = 5:4 ▶ 1.25



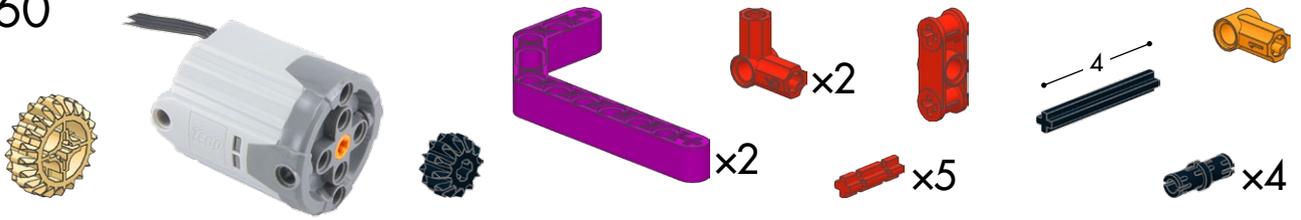
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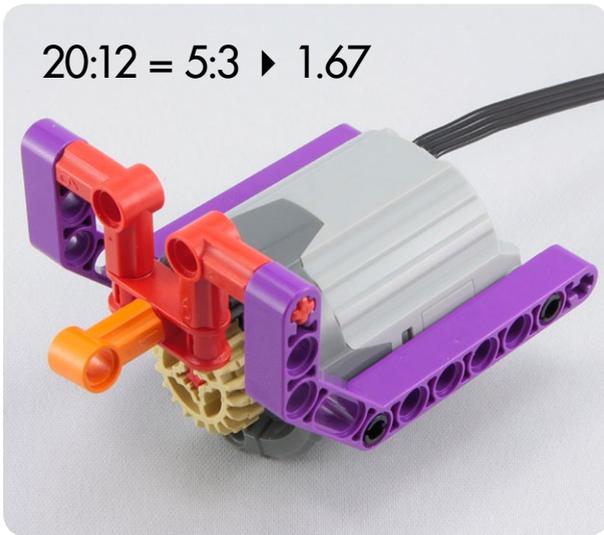
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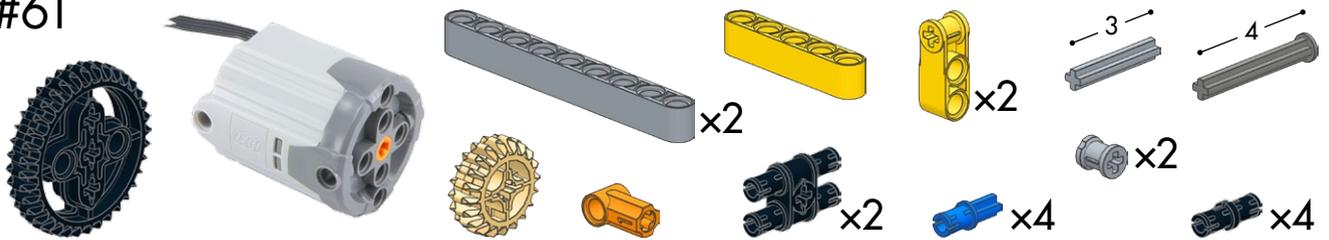
#60



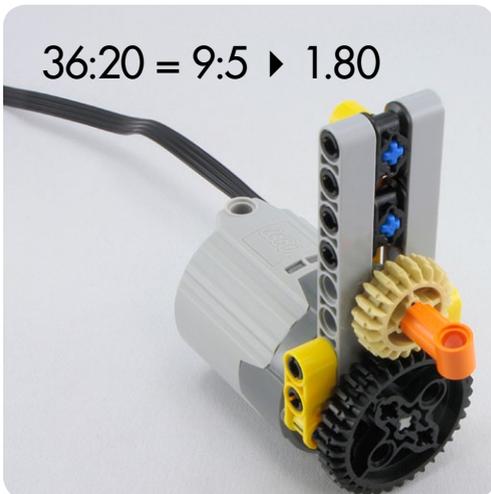
$20:12 = 5:3 \triangleright 1.67$



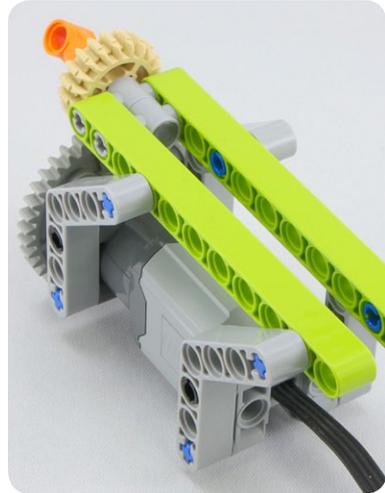
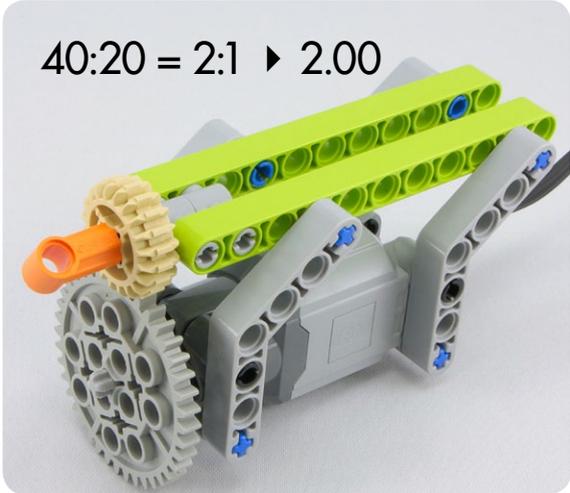
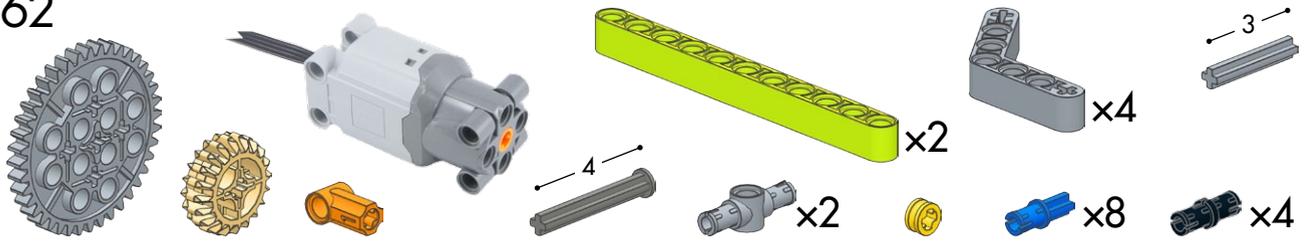
#61



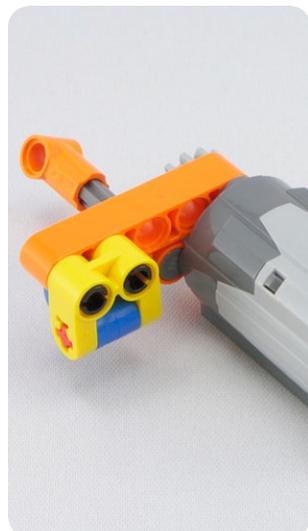
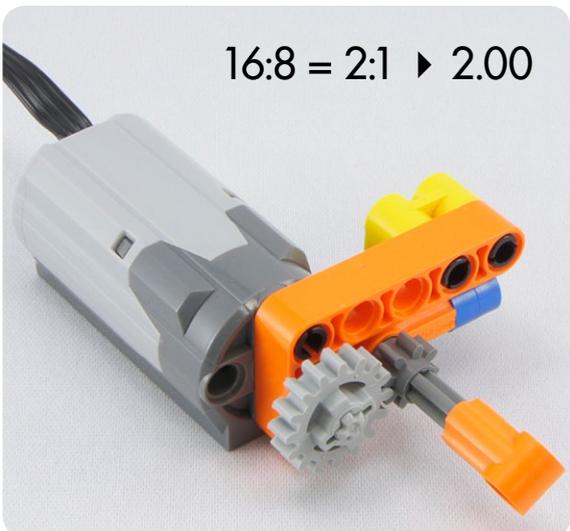
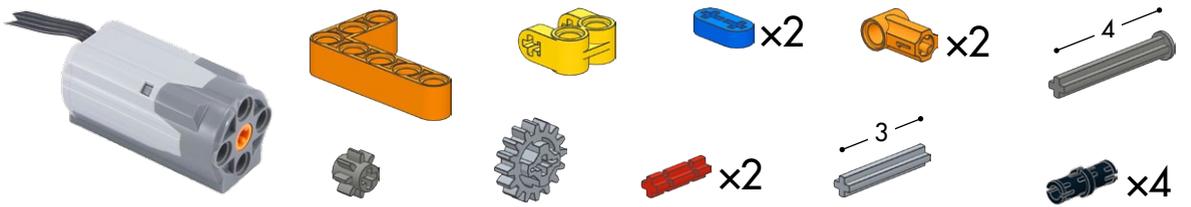
$36:20 = 9:5 \triangleright 1.80$



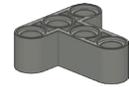
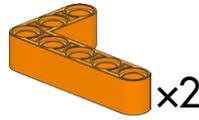
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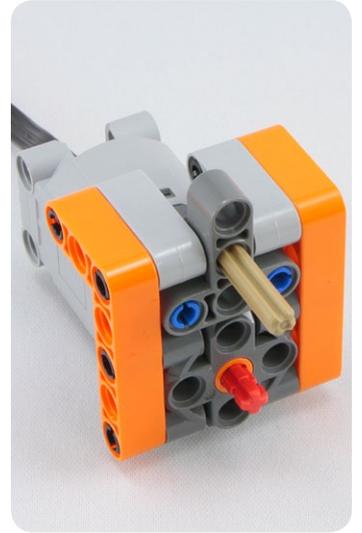
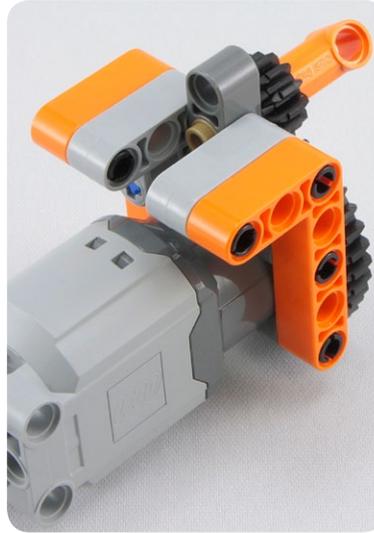
#63



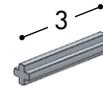
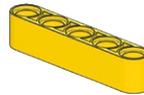
#66



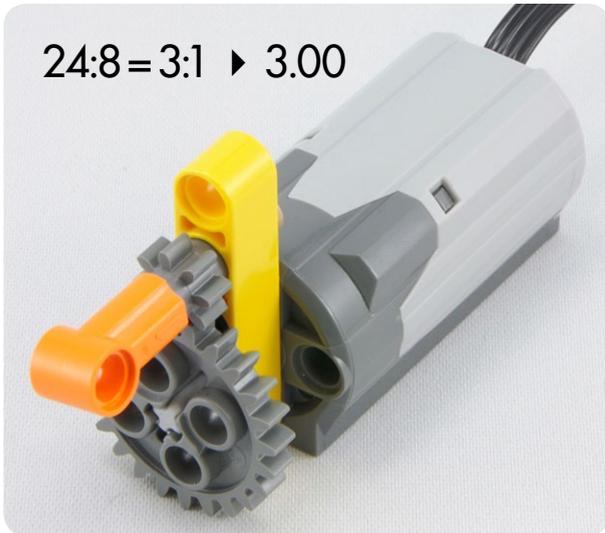
$36:12 = 3:1 \blacktriangleright 3.00$



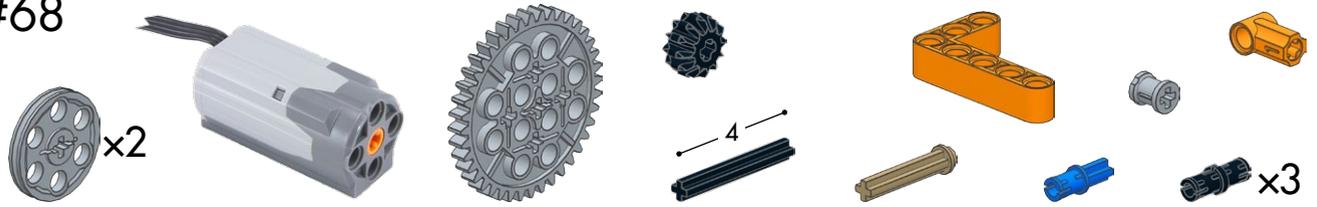
#67



$24:8 = 3:1 \blacktriangleright 3.00$



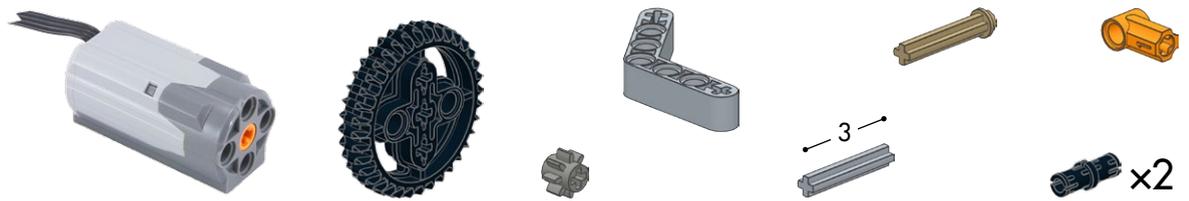
#68



$40:12 = 10:3 \triangleright 3.33$



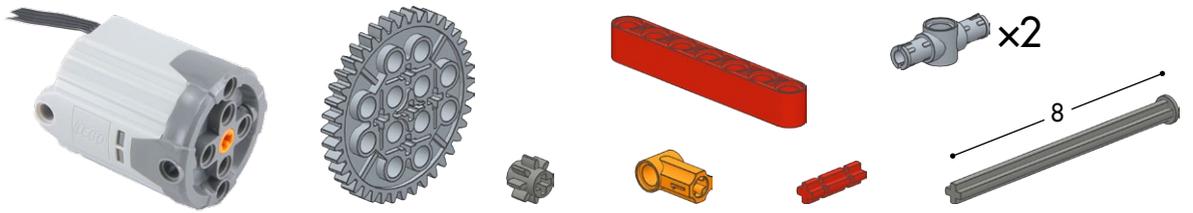
#69



$36:8 = 9:2 \triangleright 4.50$



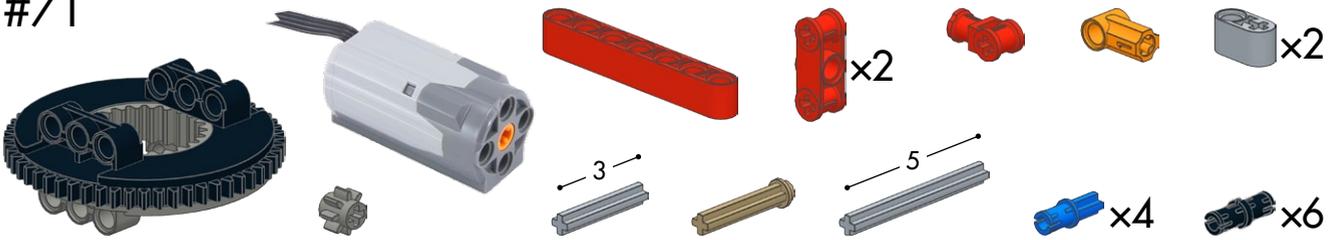
#70



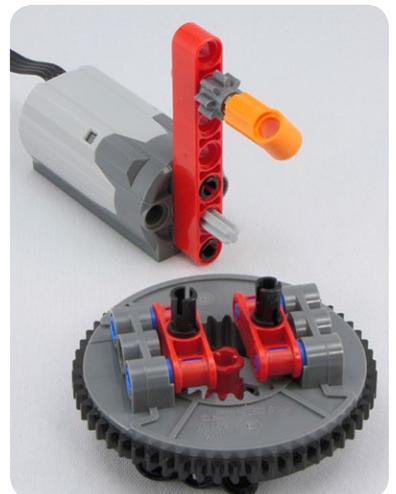
$40:8 = 5:1 \triangleright 5.00$

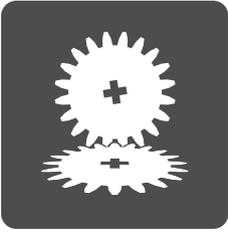


#71



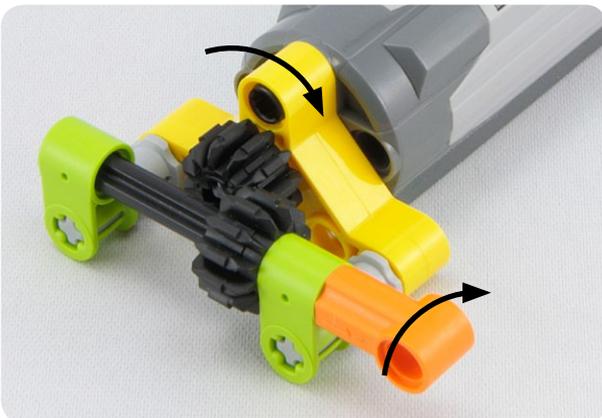
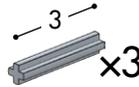
$56:8 = 7:1 \triangleright 7.00$



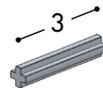
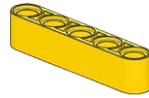
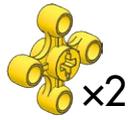


Changing the angle of rotation

#72



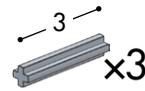
#73



4:4 = 1:1



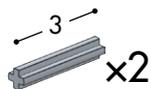
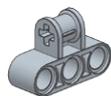
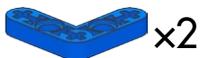
#74



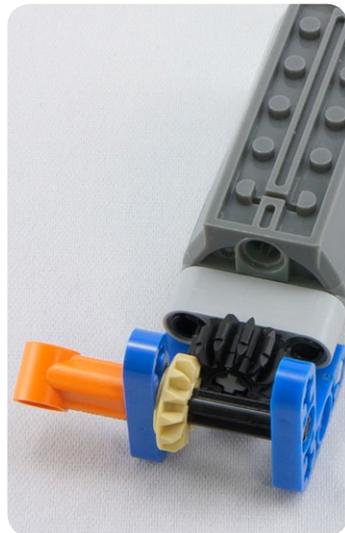
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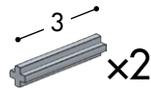
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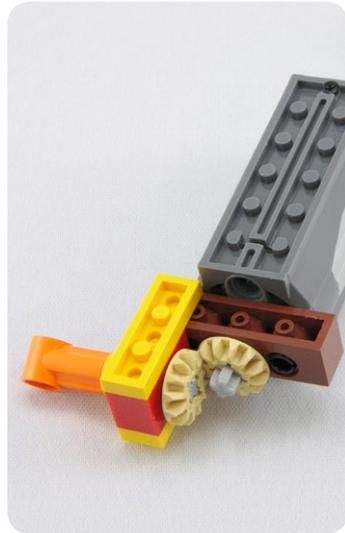
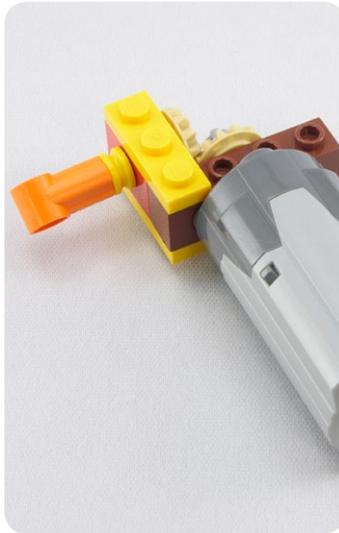
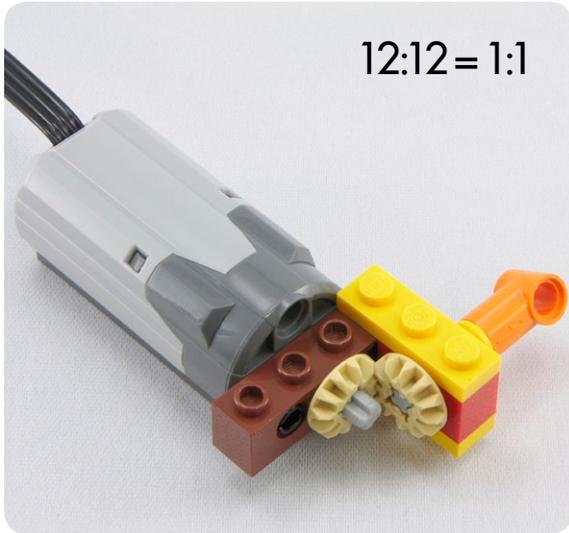
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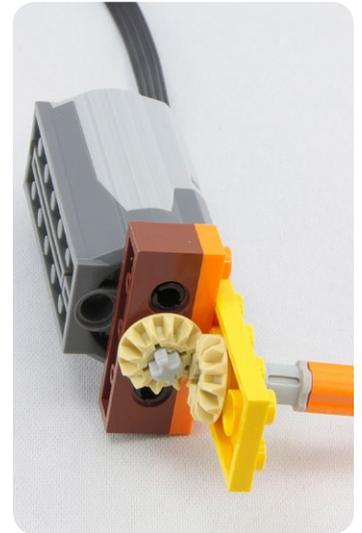
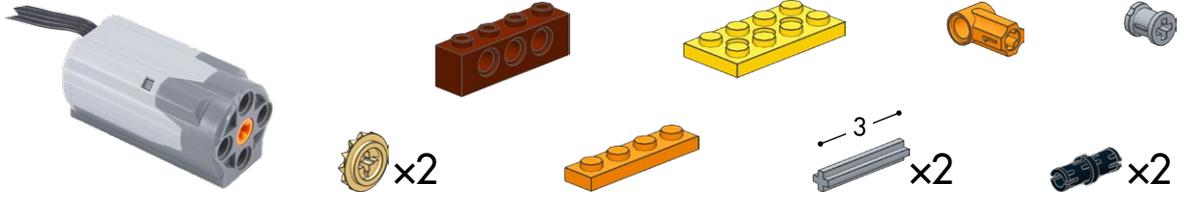
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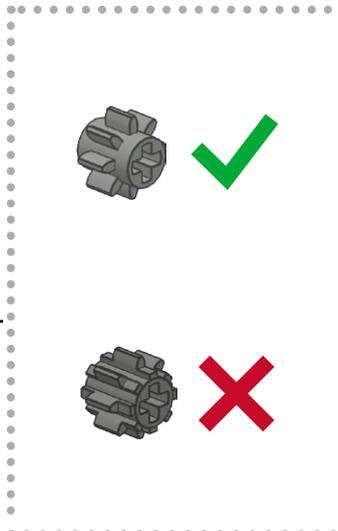
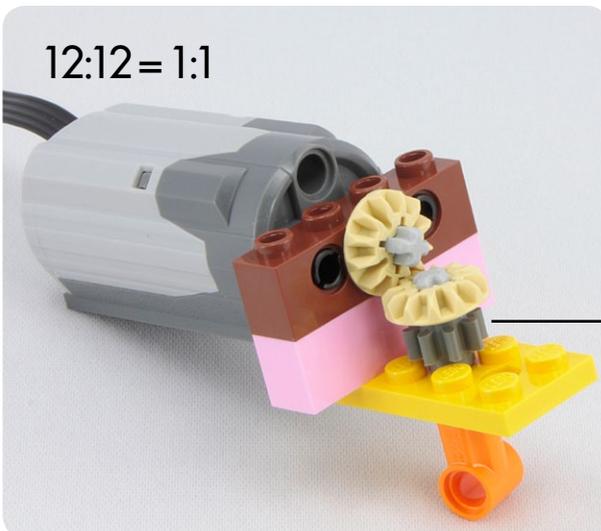
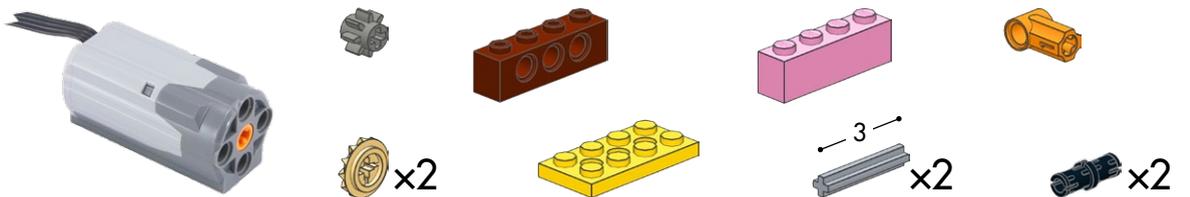
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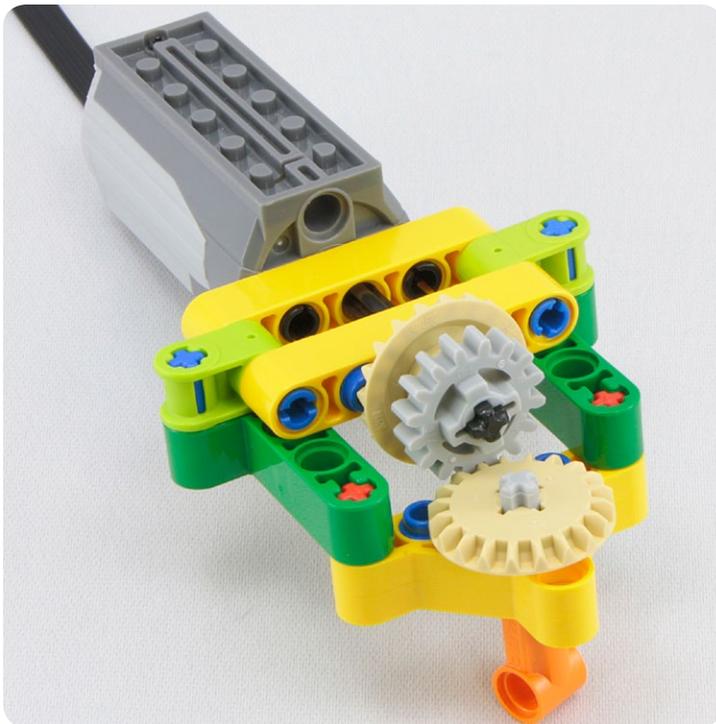
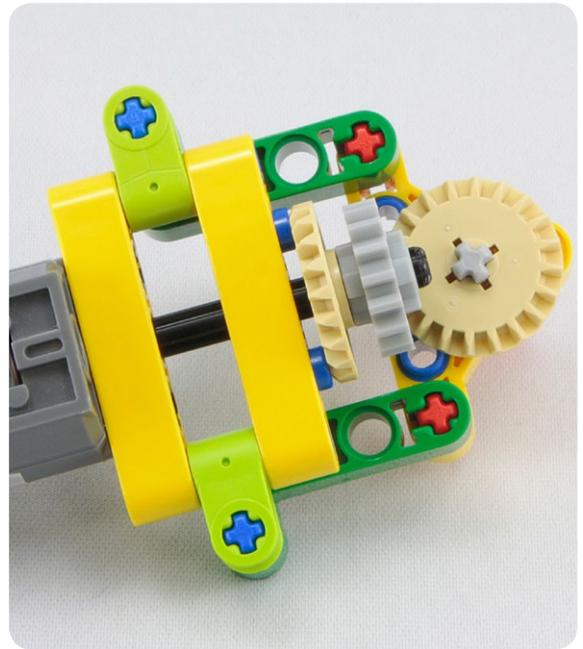
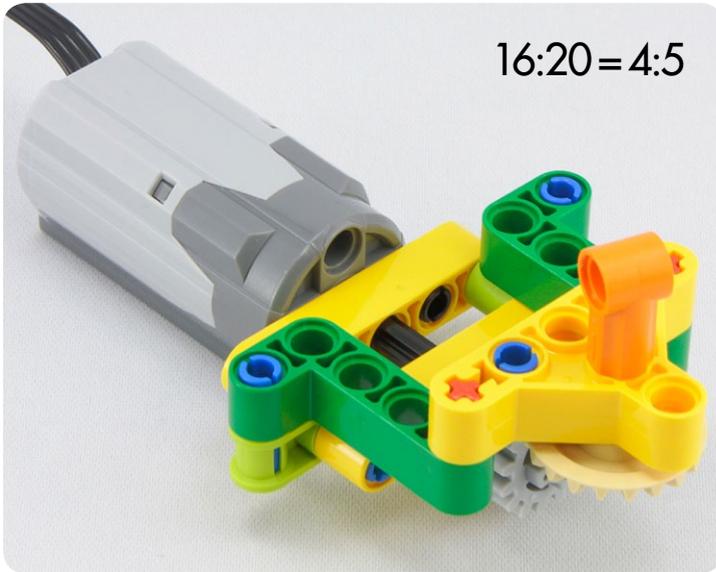
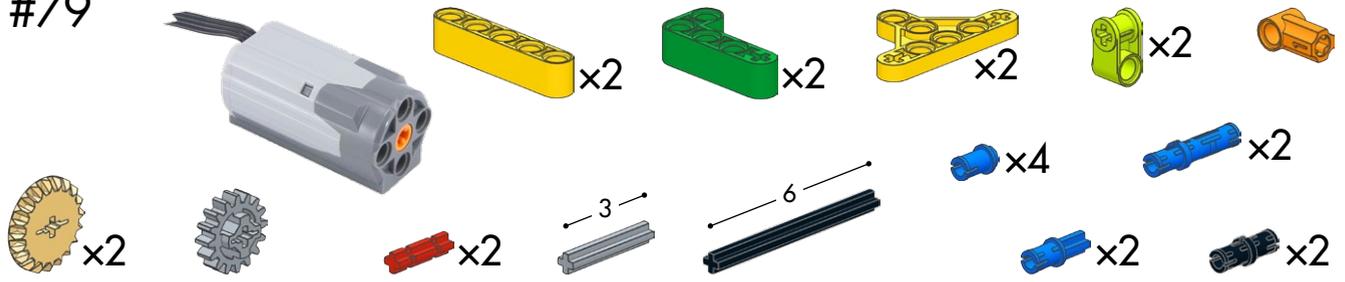
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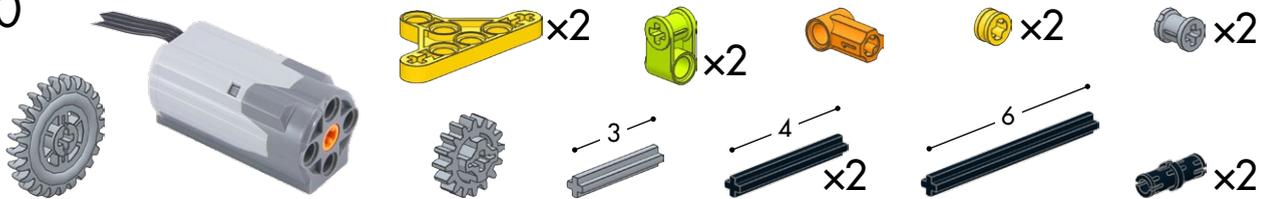
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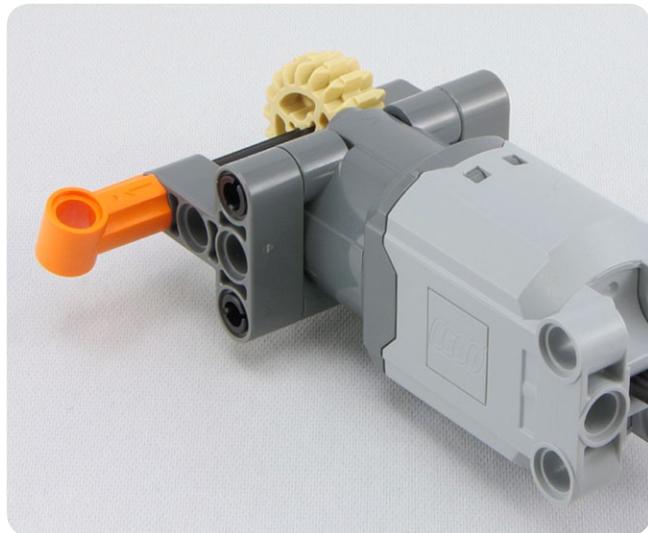
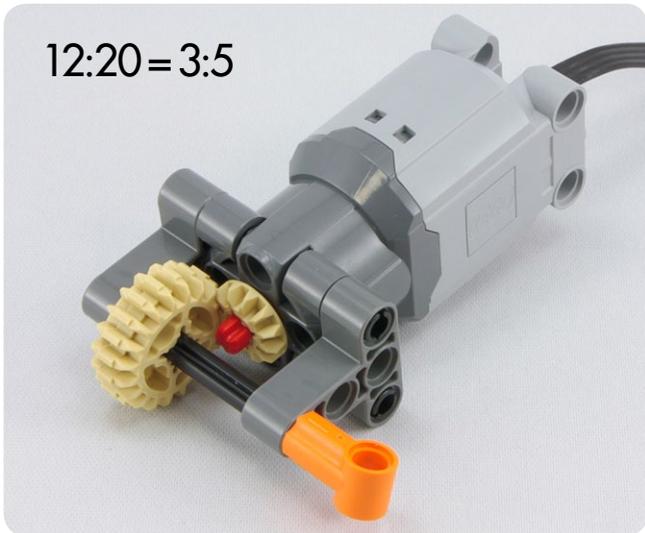
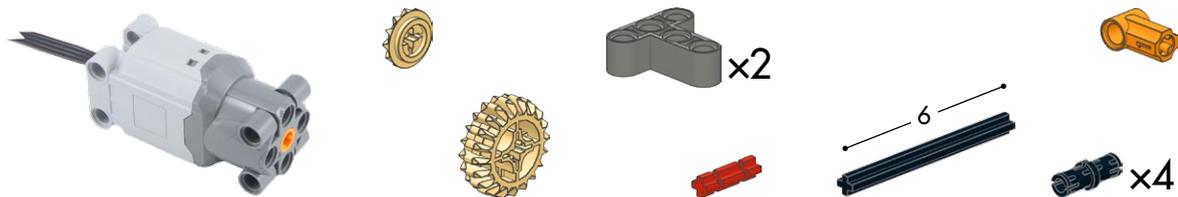
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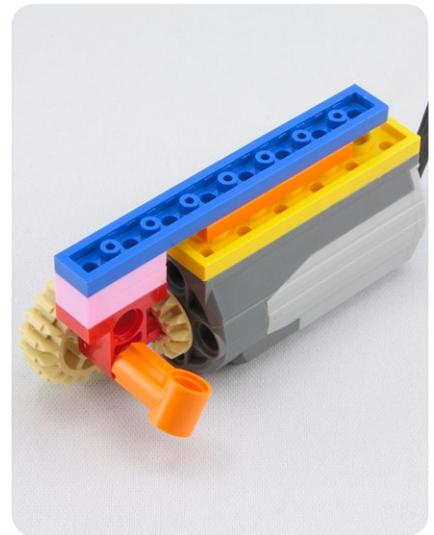
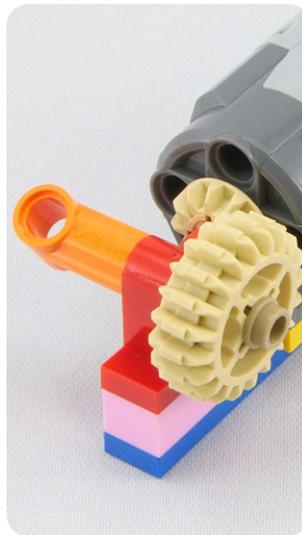
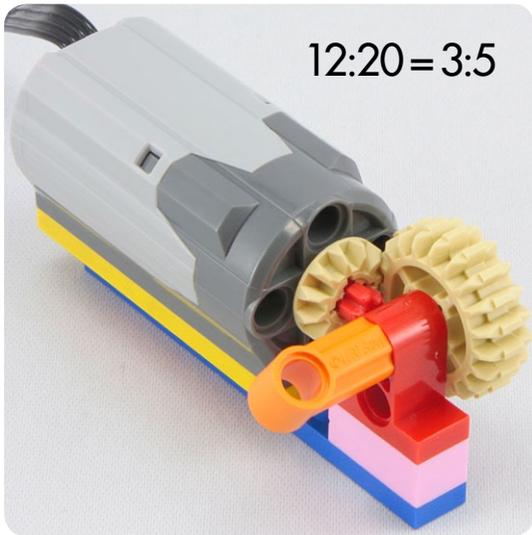
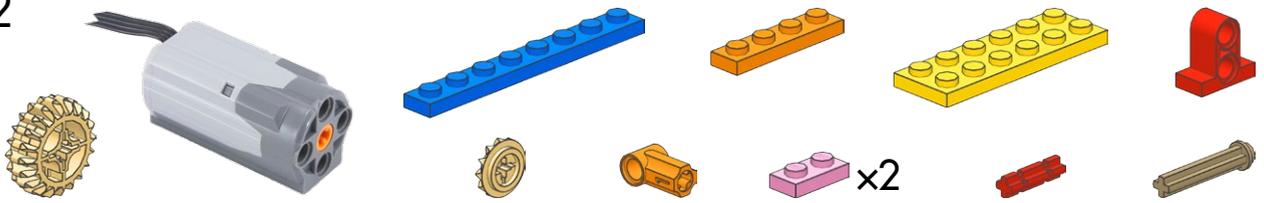
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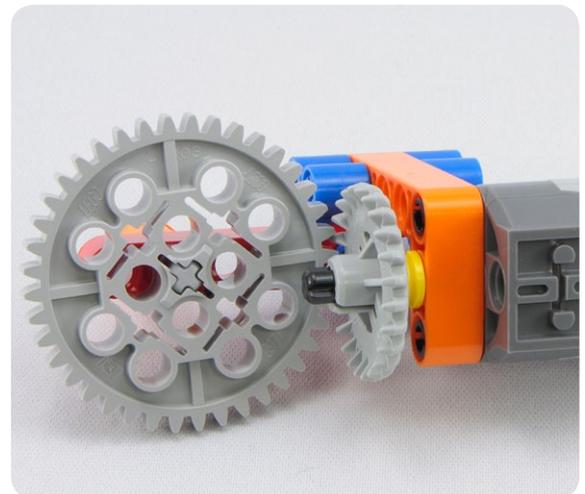
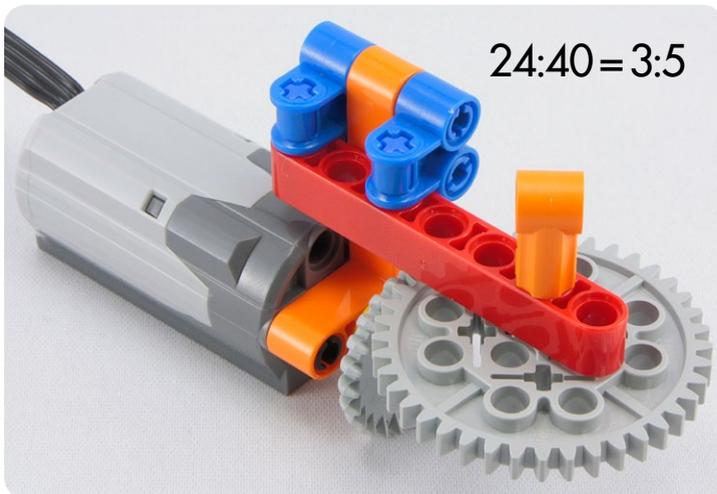
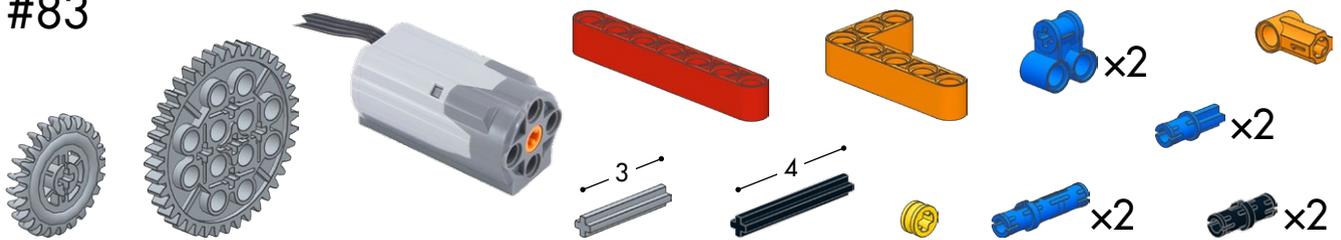
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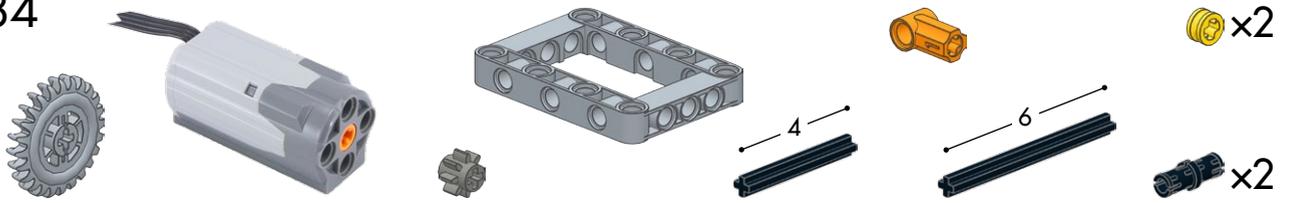
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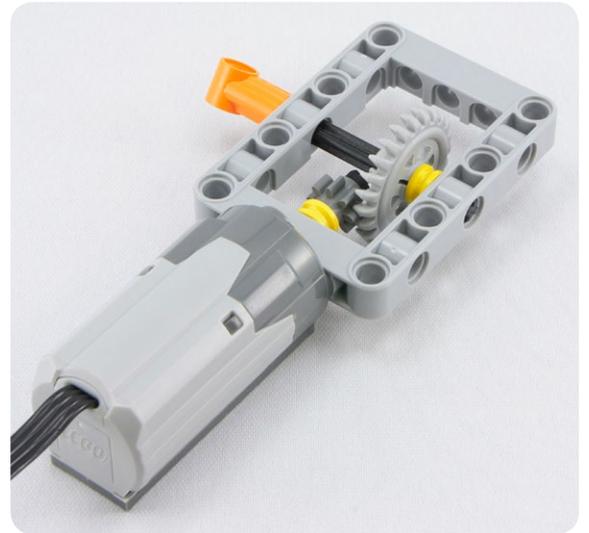
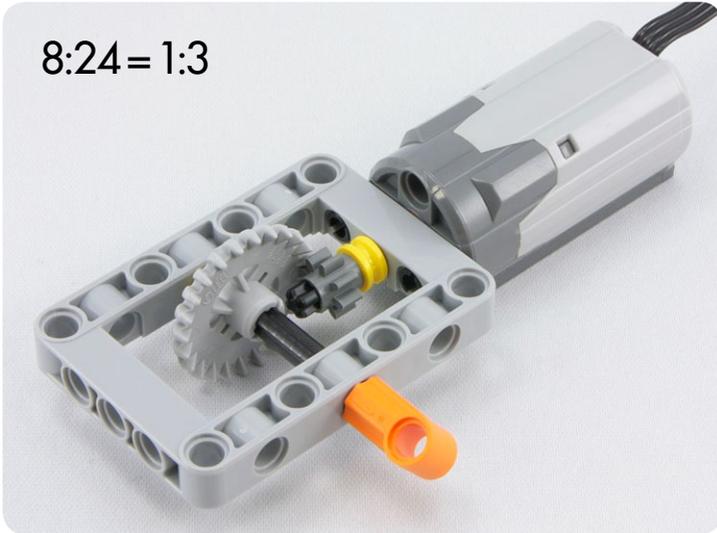
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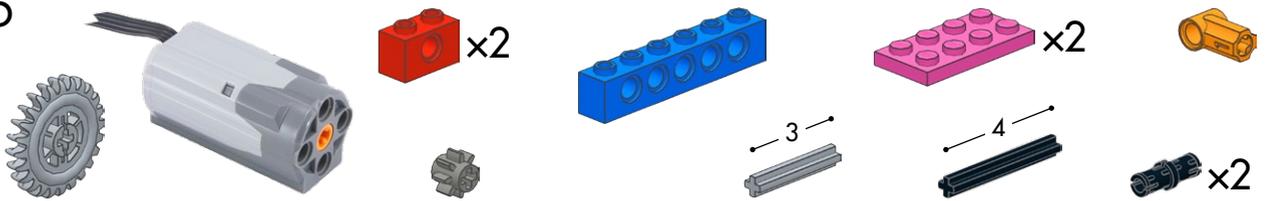
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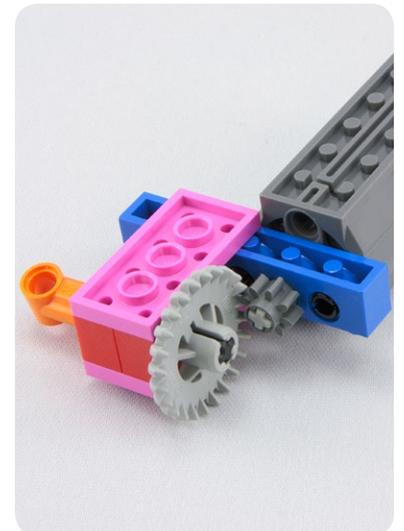
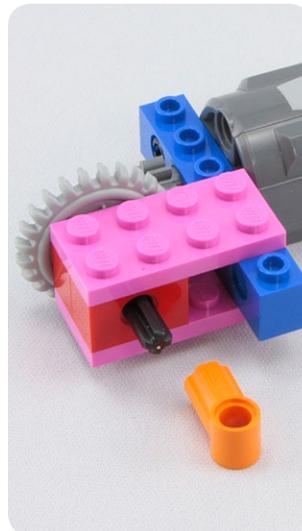
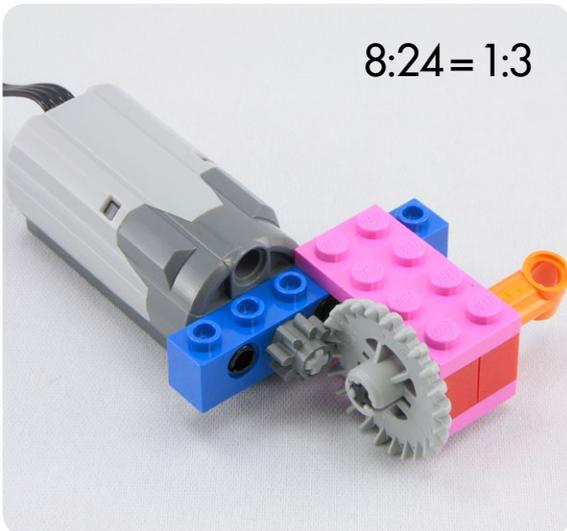
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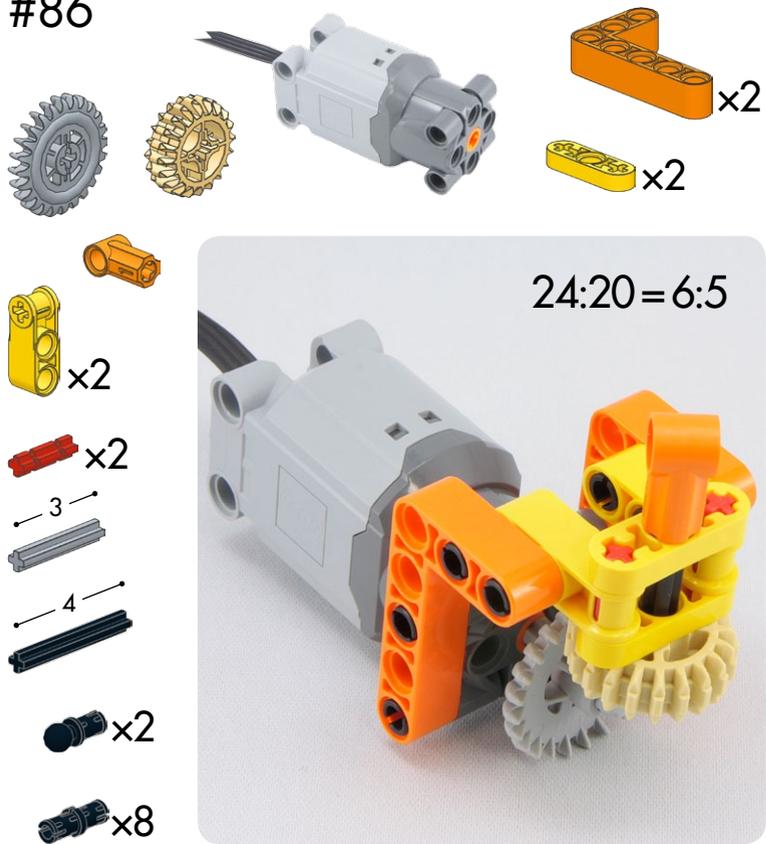
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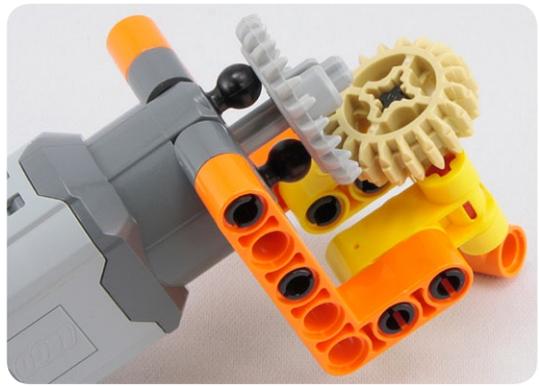
#86



Parts list for step #86:

- 1 grey motor
- 1 grey gear (24 teeth)
- 1 yellow gear (20 teeth)
- 2 orange L-shaped Technic bricks
- 2 yellow Technic pins
- 2 yellow Technic pins with holes
- 2 red Technic pins
- 3 grey Technic pins
- 4 black Technic pins
- 2 black Technic pins with holes
- 8 black Technic pins with holes

$24:20 = 6:5$

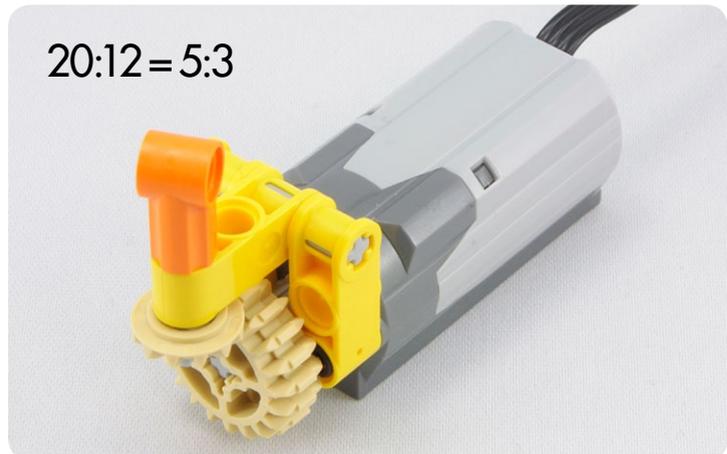


#87

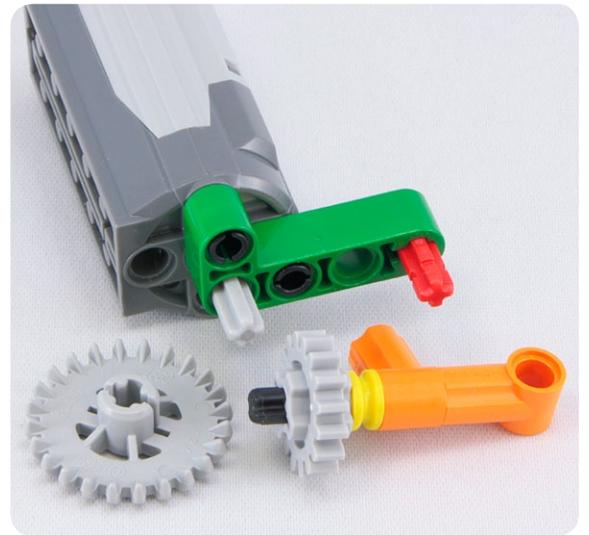
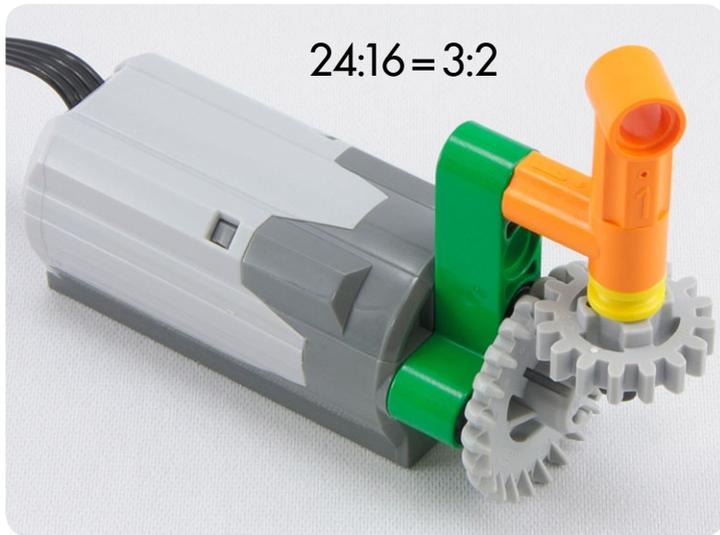
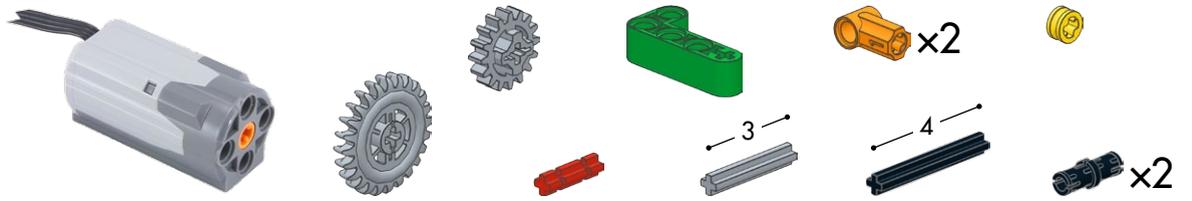


Parts list for step #87:

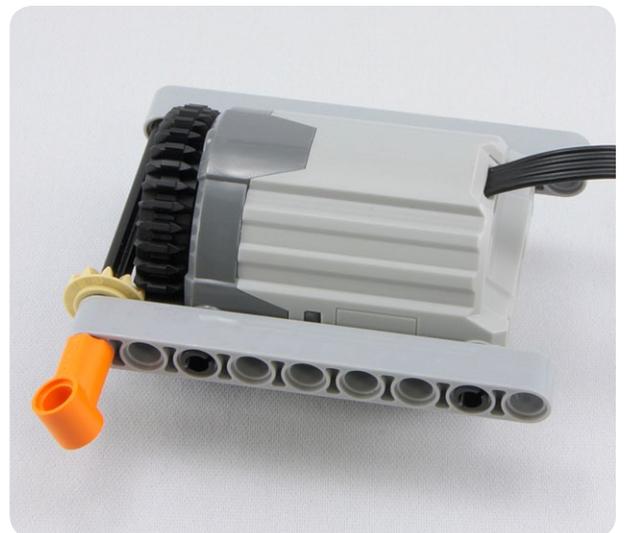
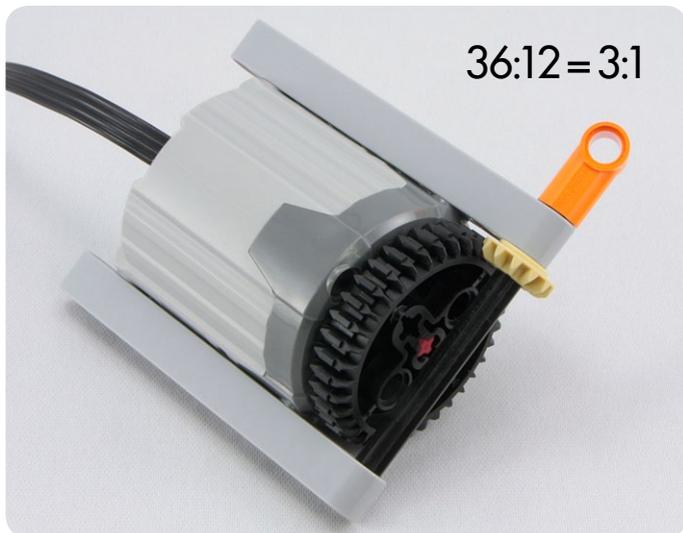
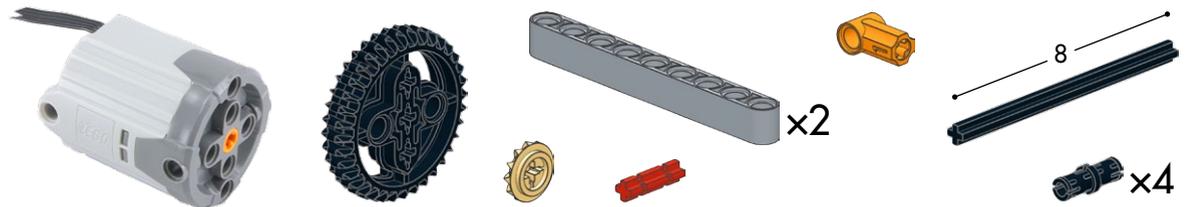
- 1 grey motor
- 1 yellow gear (20 teeth)
- 1 grey gear (12 teeth)
- 3 yellow Technic pins with holes
- 1 orange Technic pin
- 3 grey Technic pins
- 1 grey Technic pin with hole
- 2 black Technic pins with holes



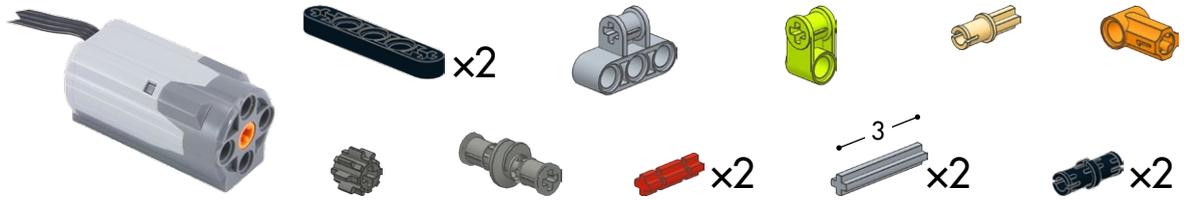
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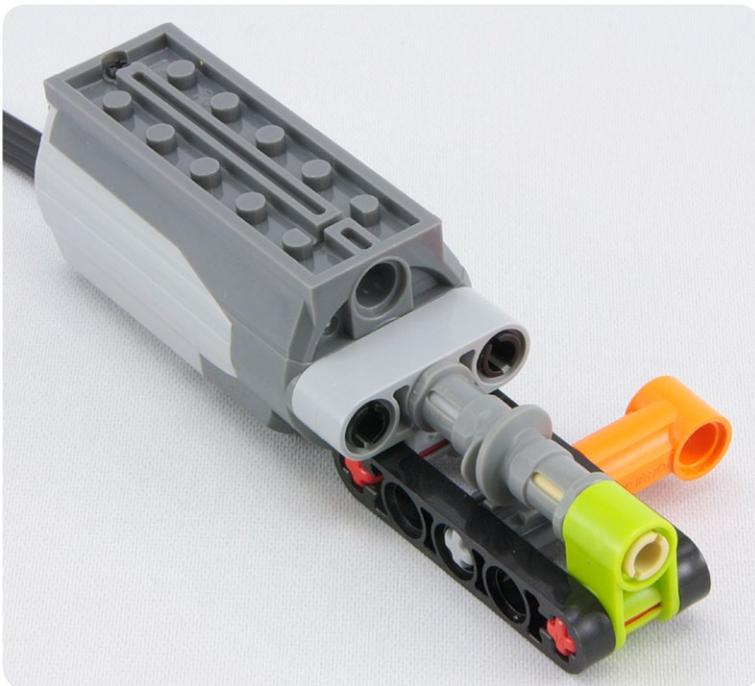
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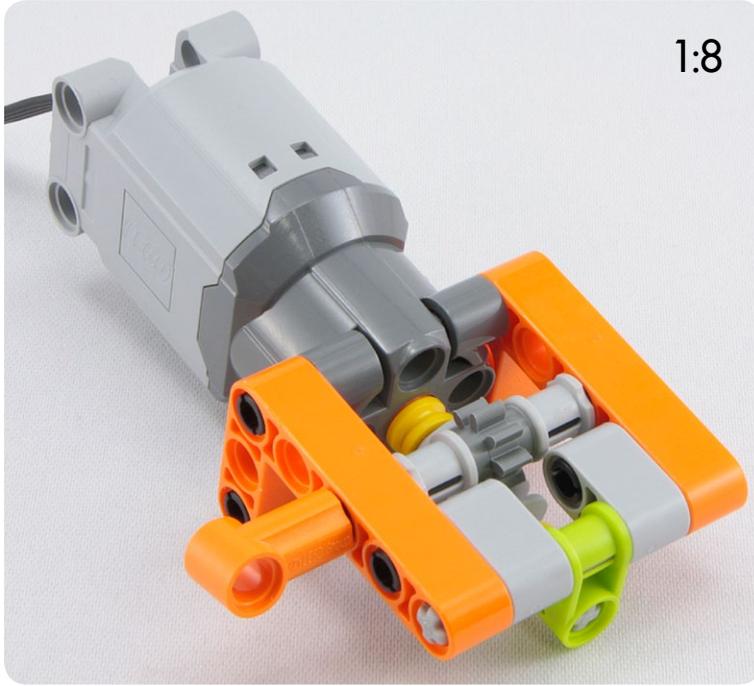
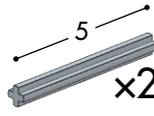
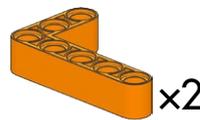
#91



1:8



#92



#93



x4

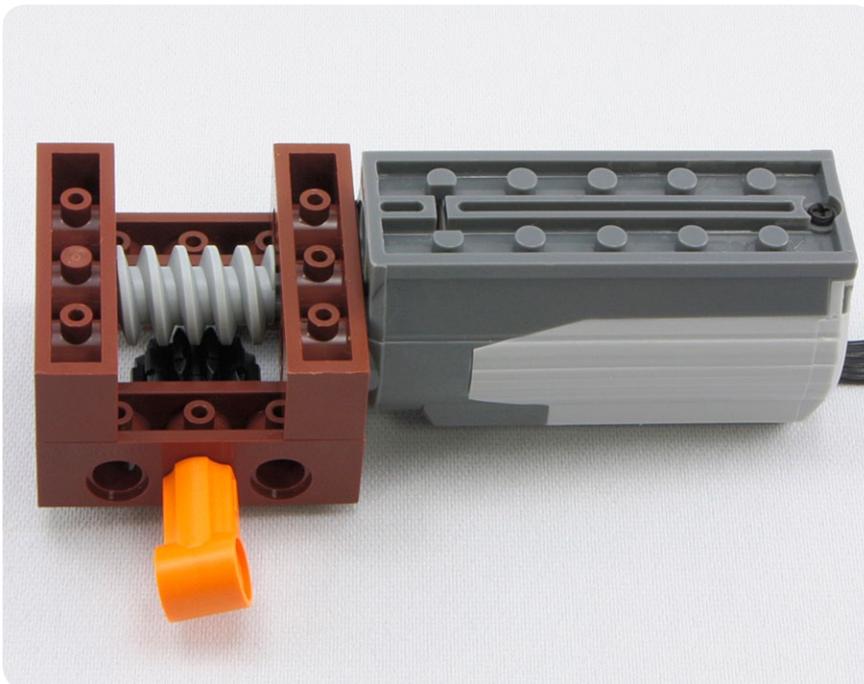
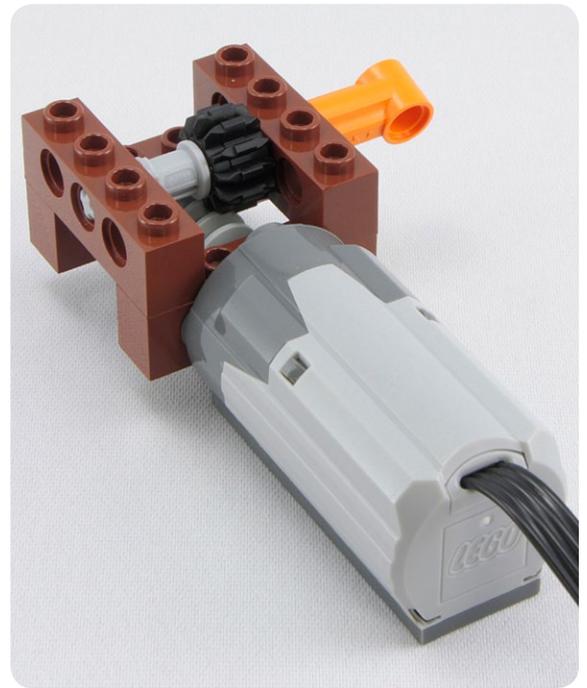
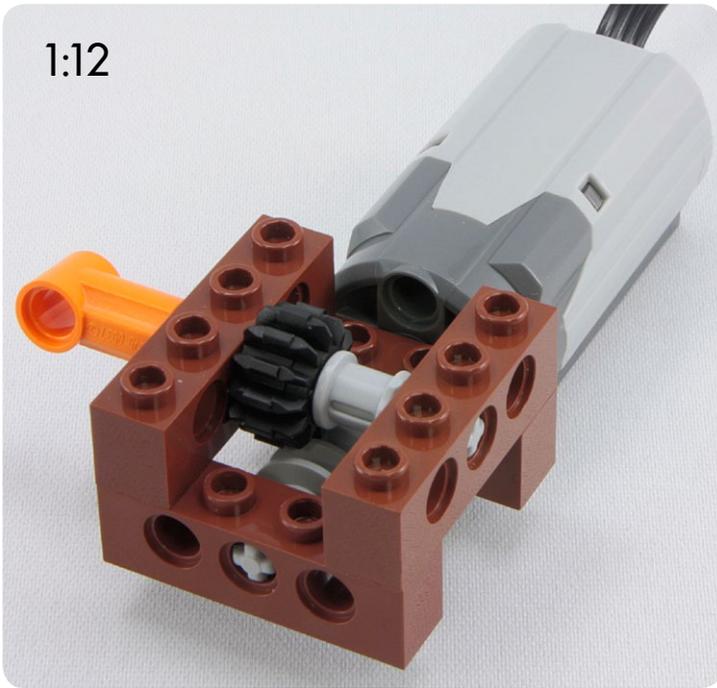


x2

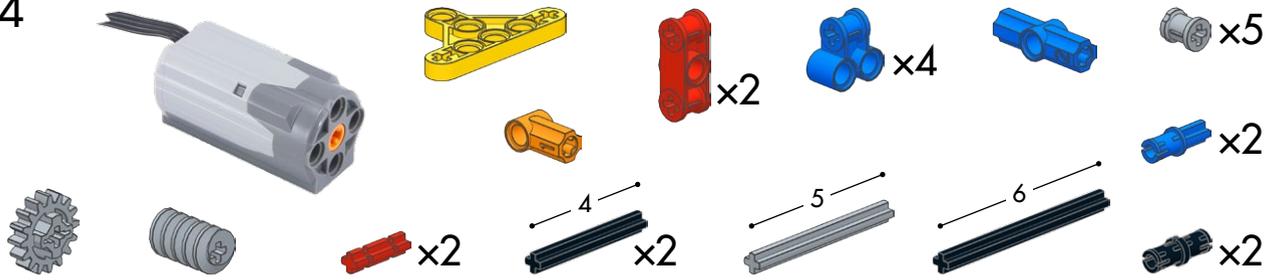


x2

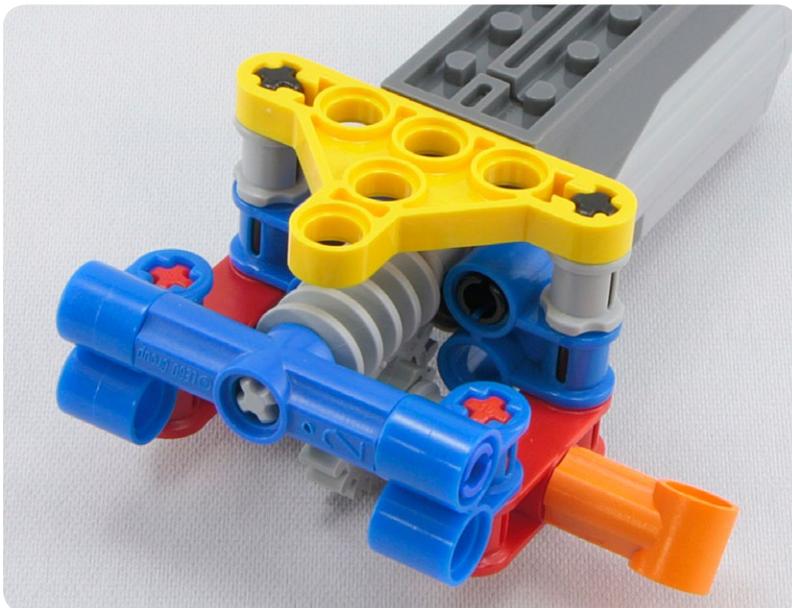
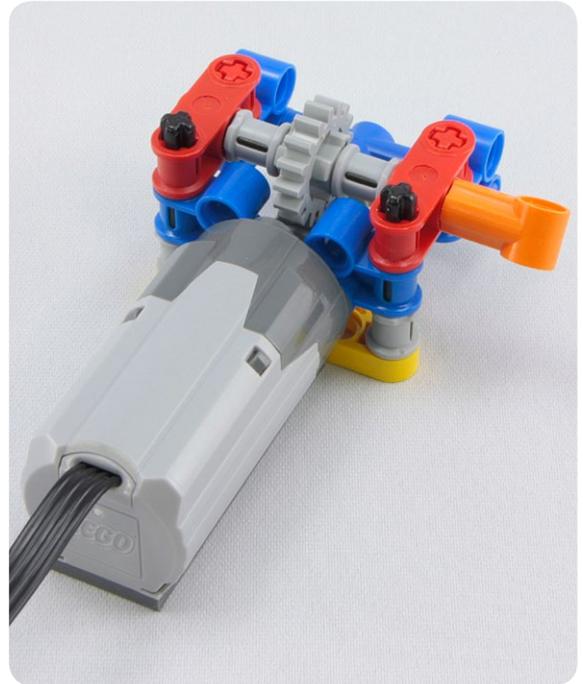
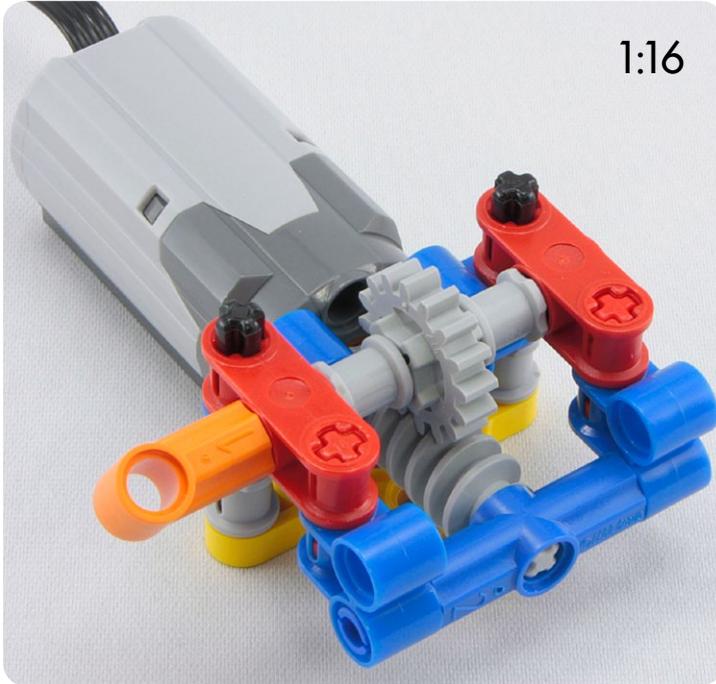
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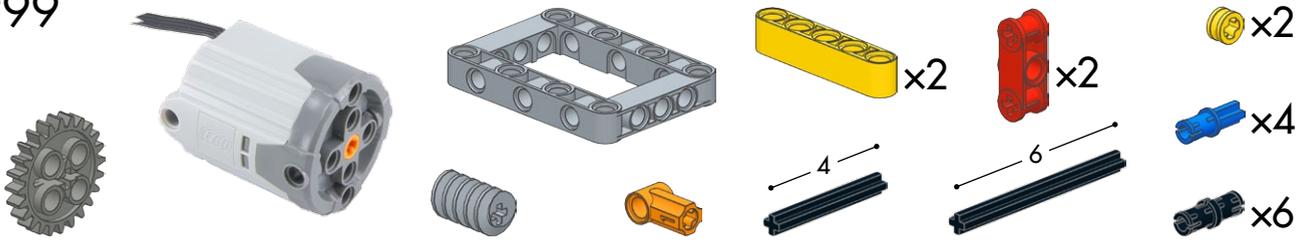
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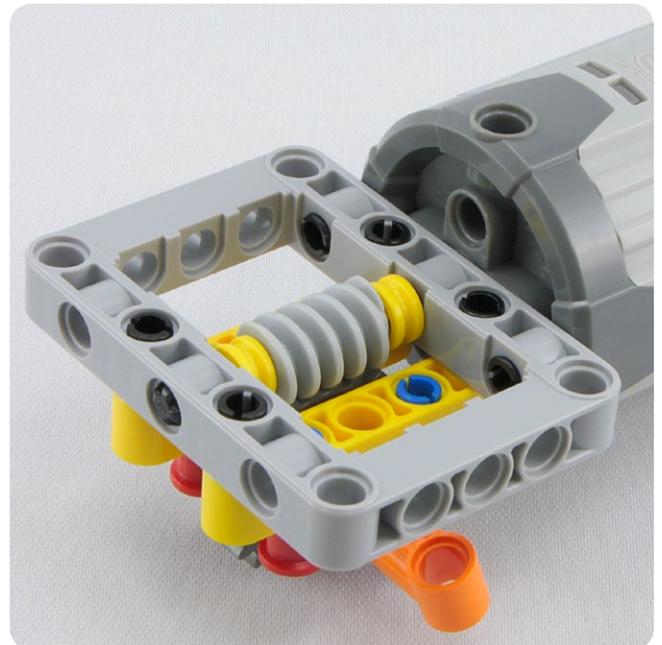
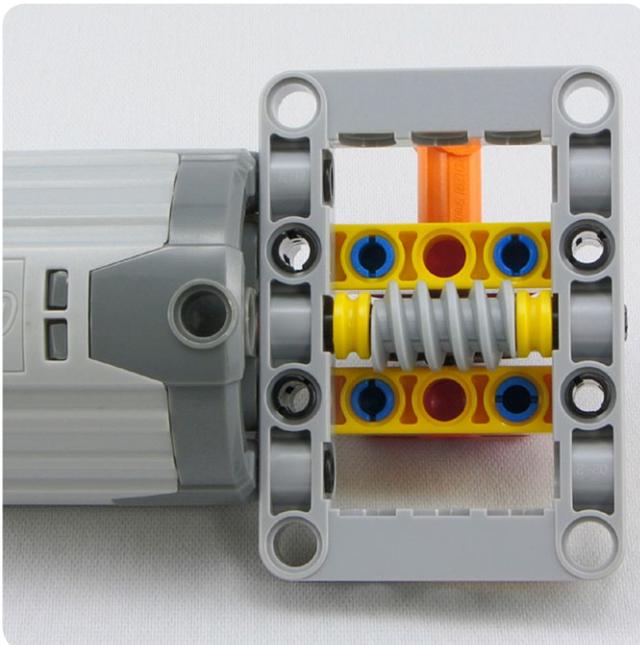
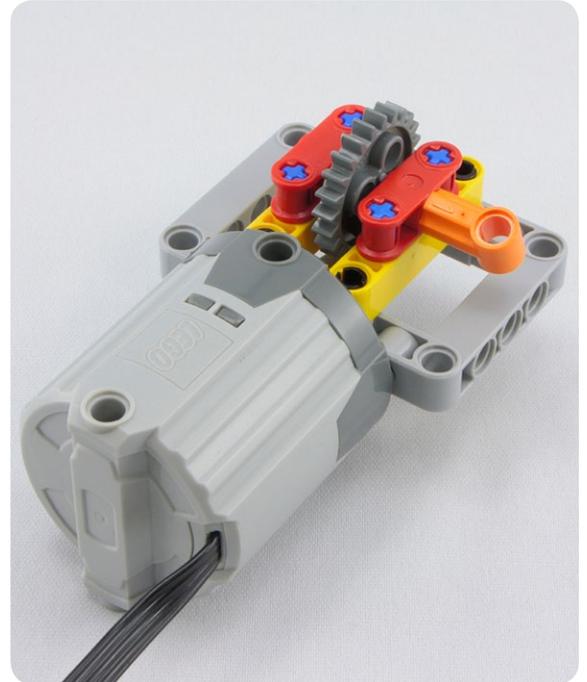
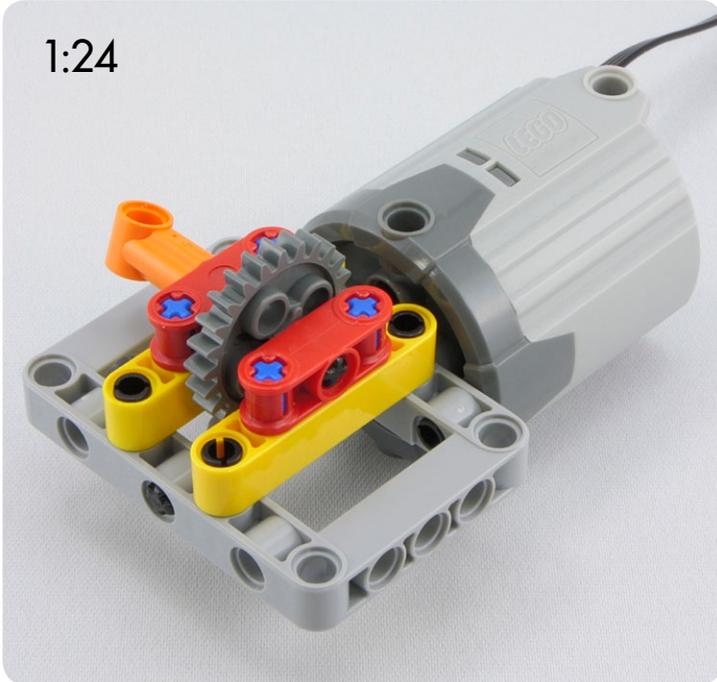
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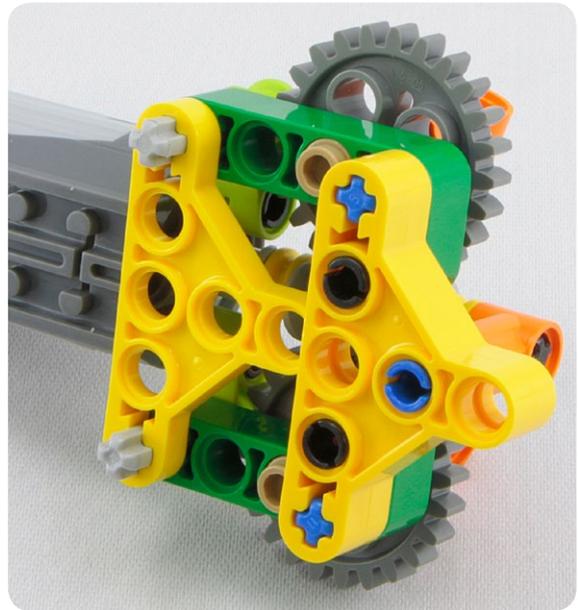
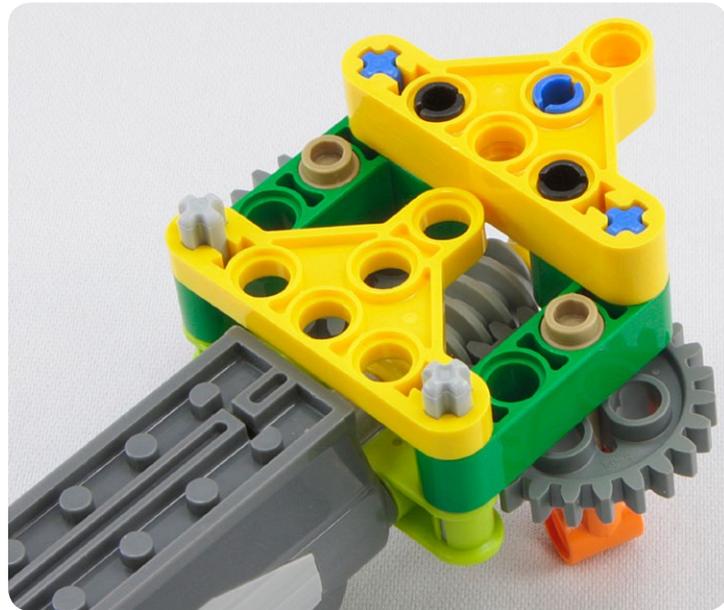
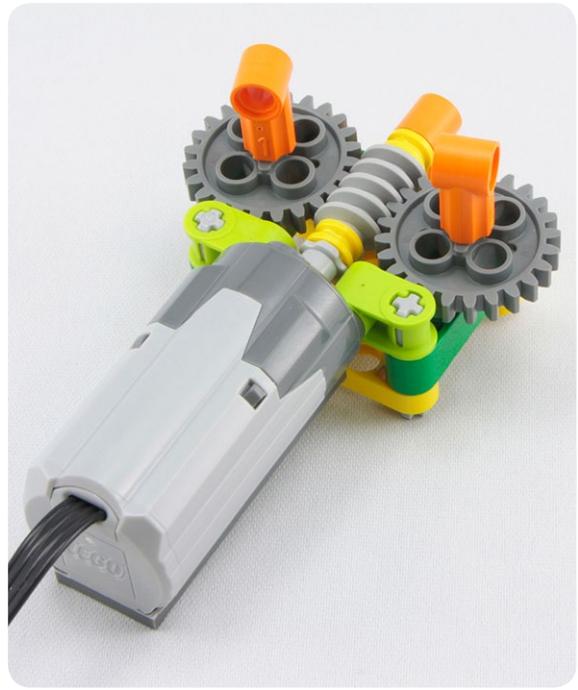
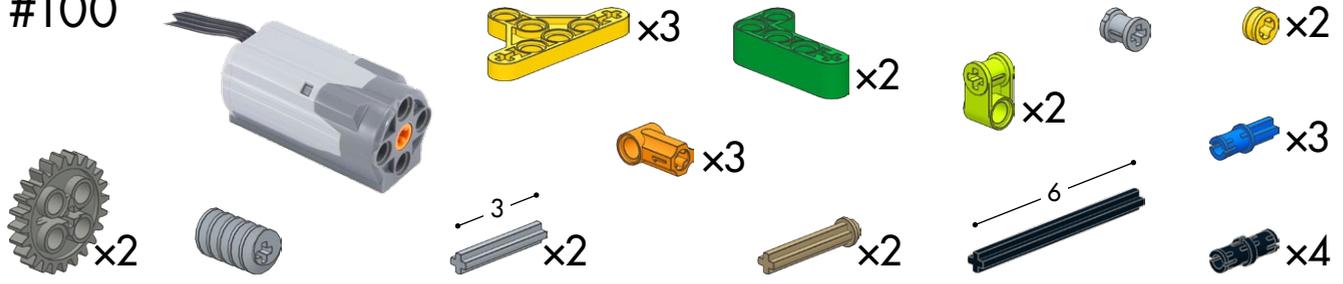
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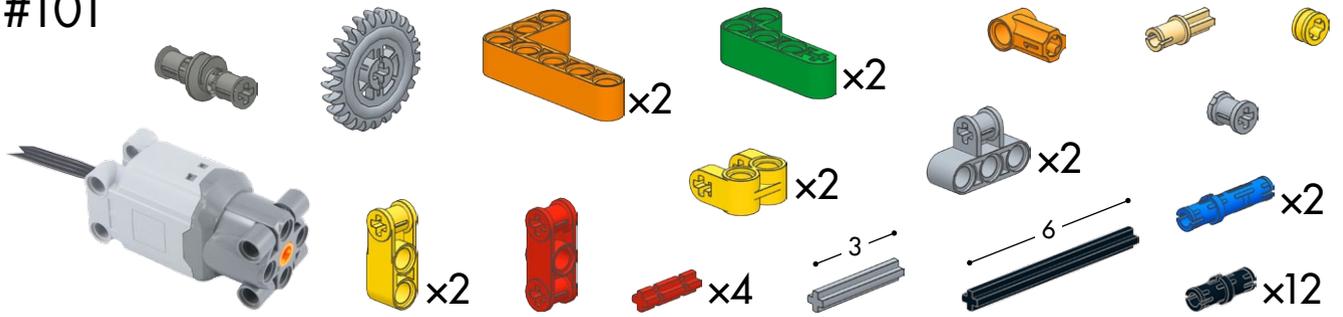
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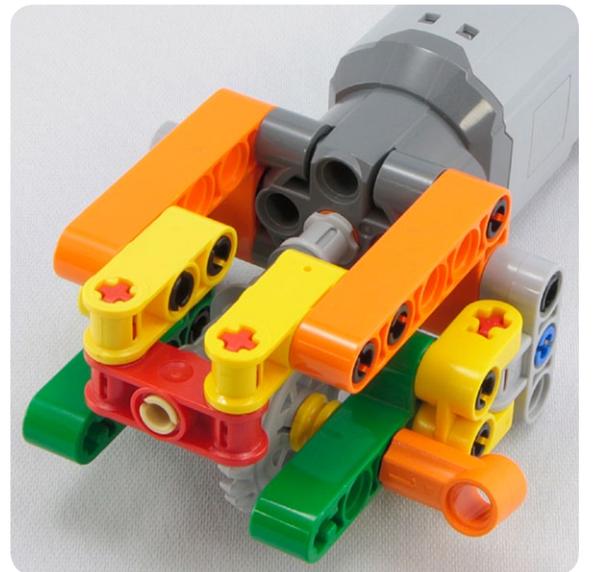
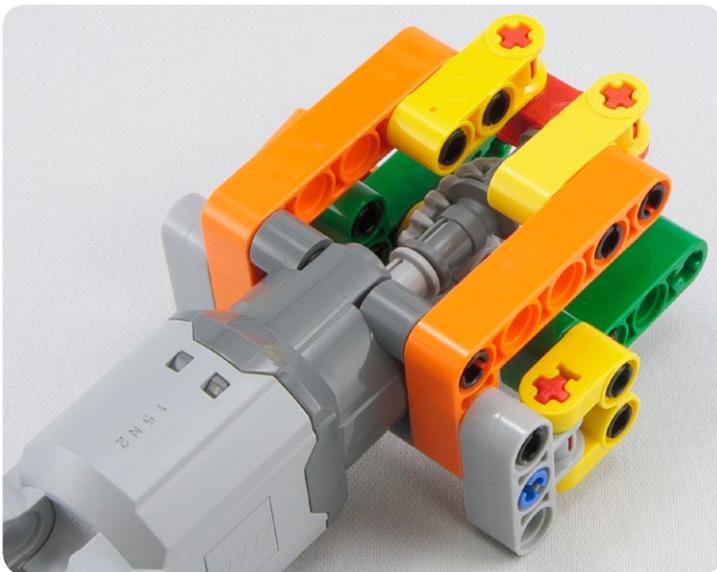
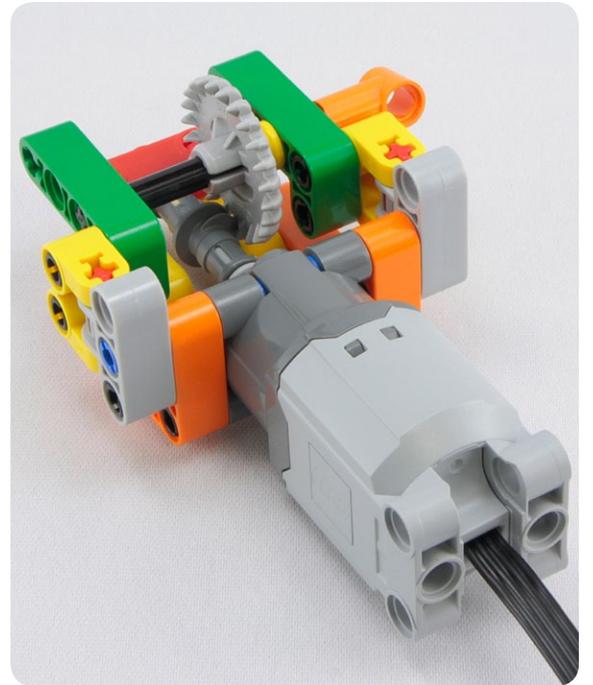
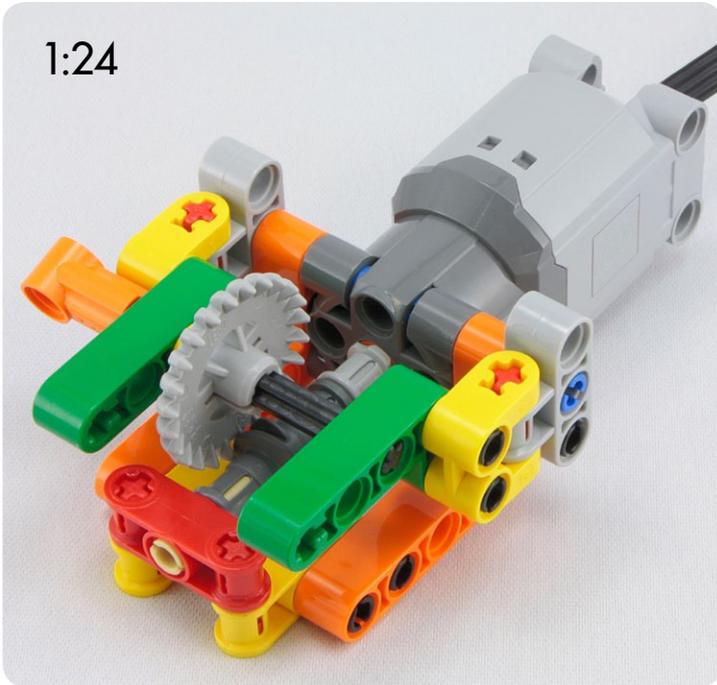
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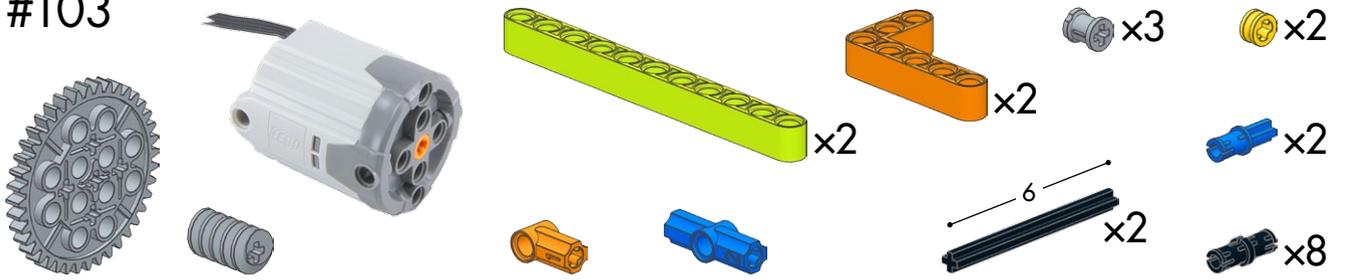
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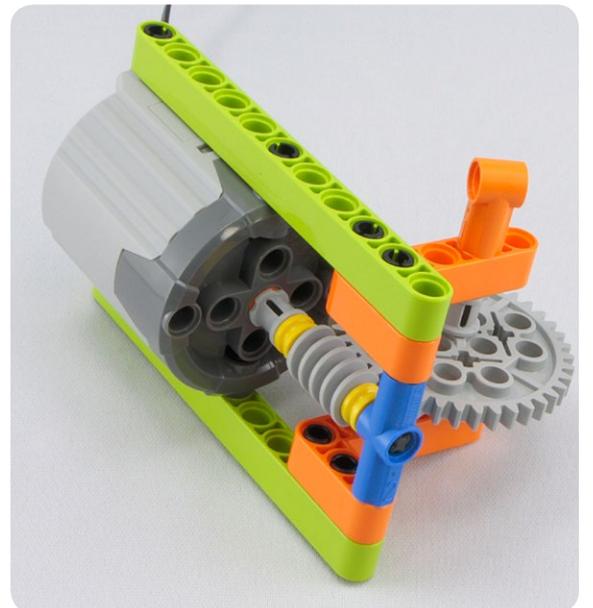
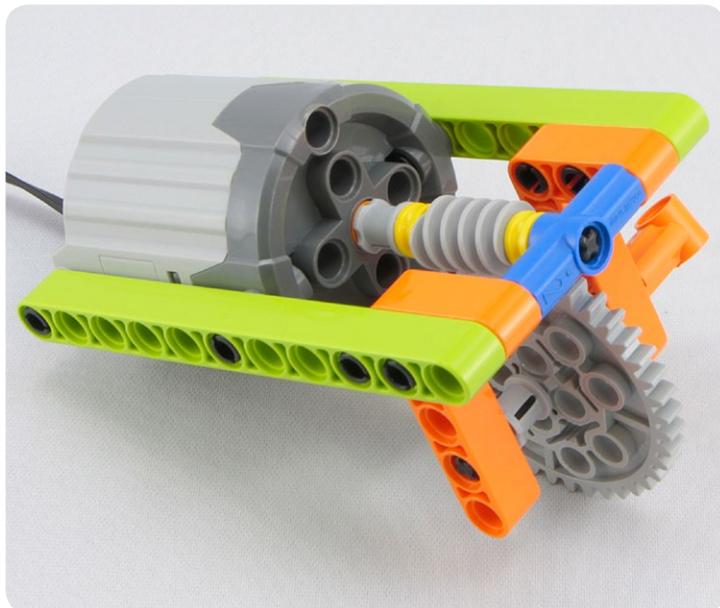
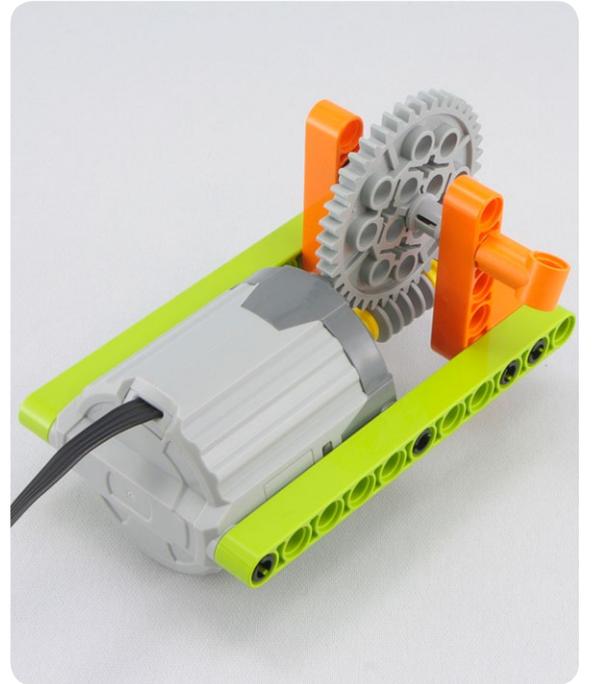
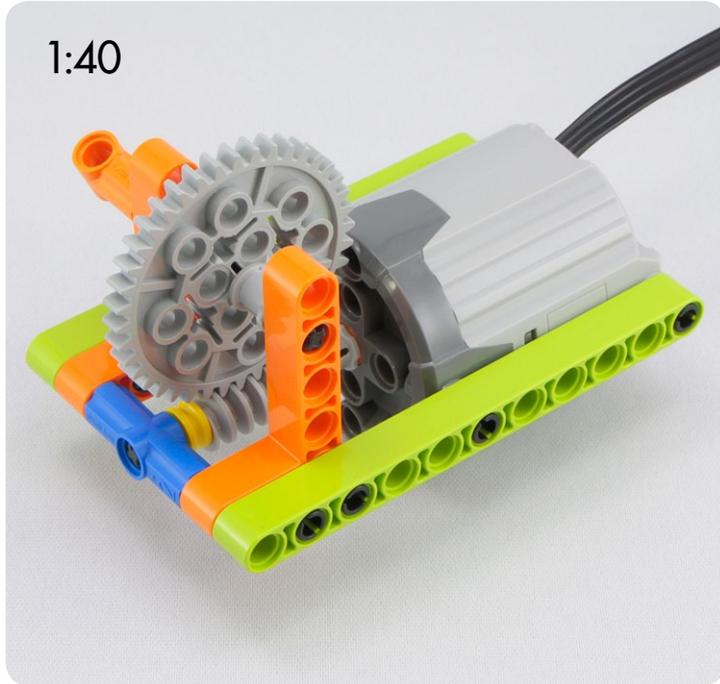
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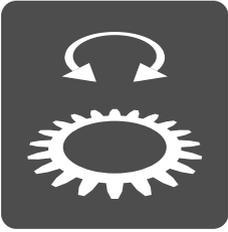


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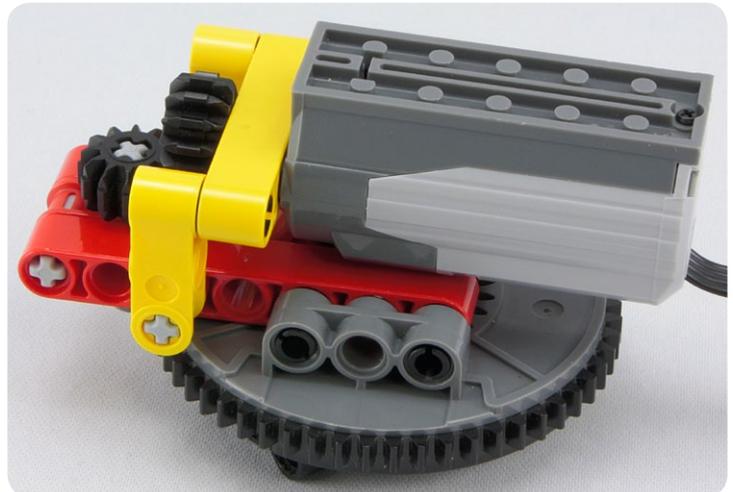
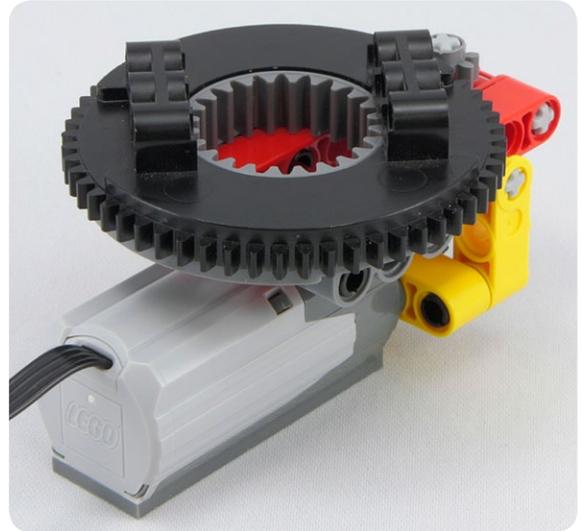
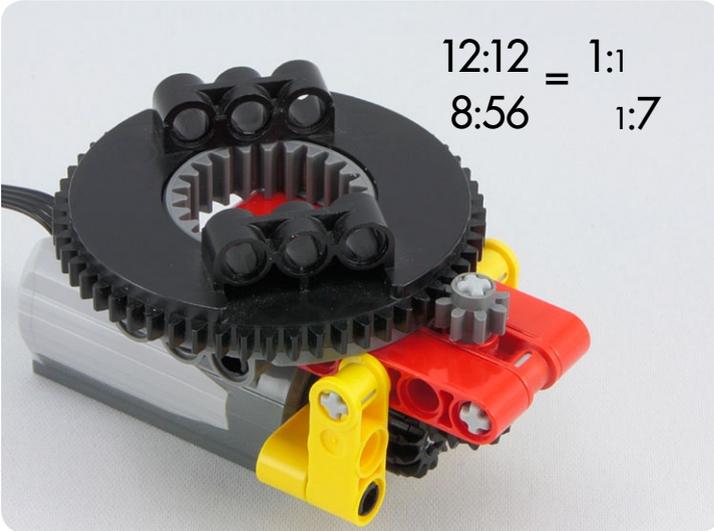
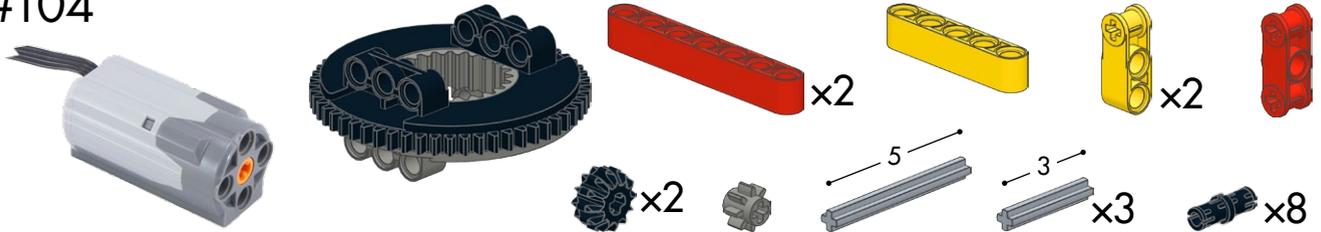
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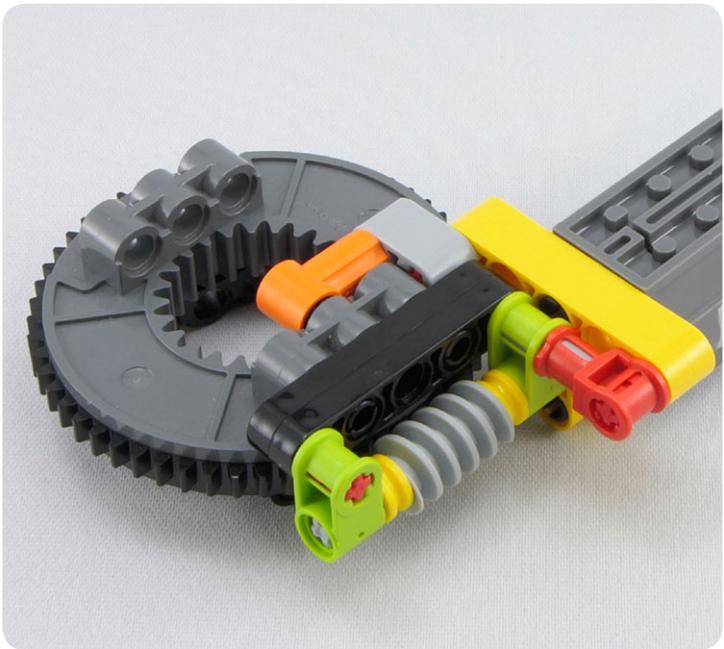
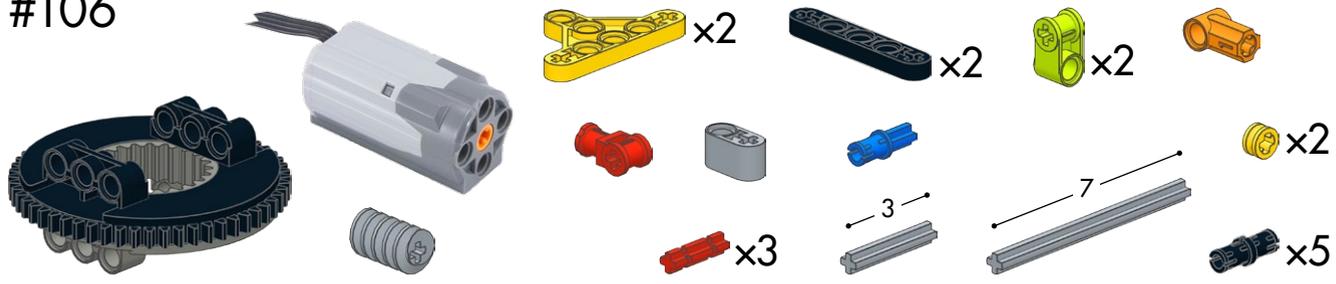


Using turntables

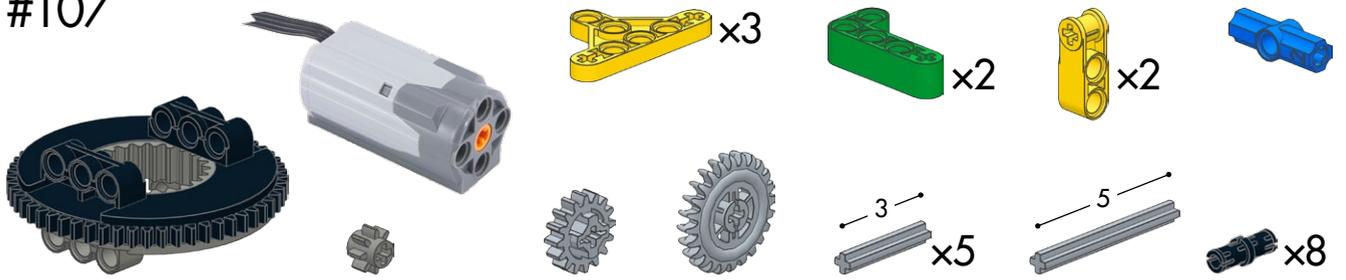
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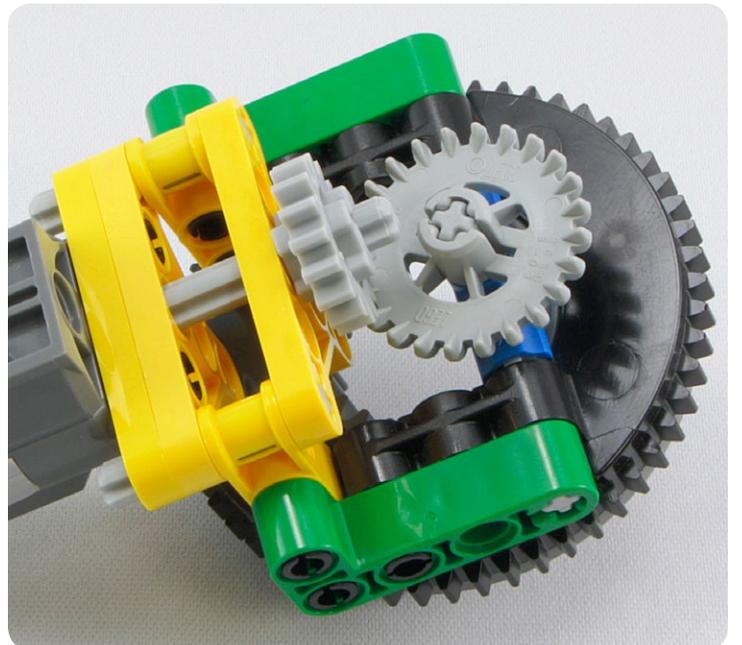
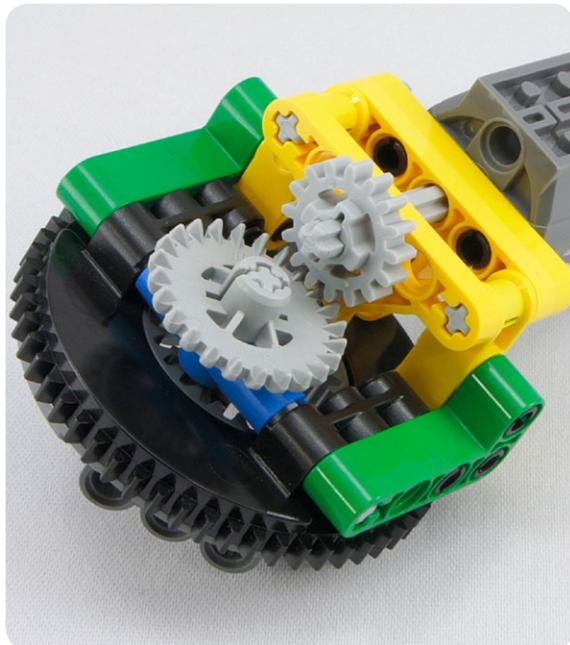
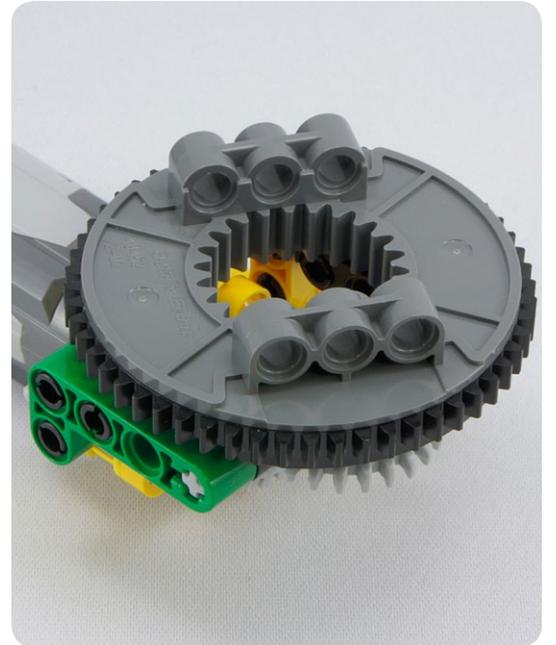
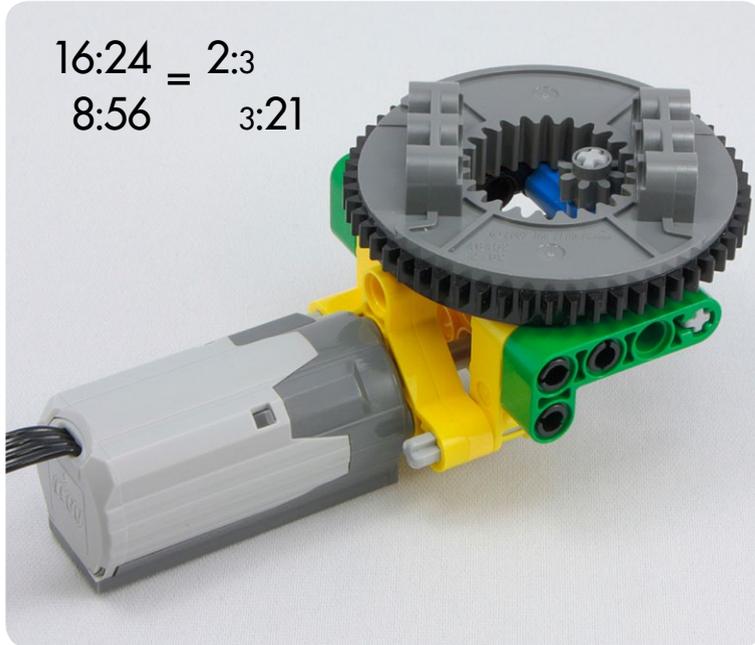
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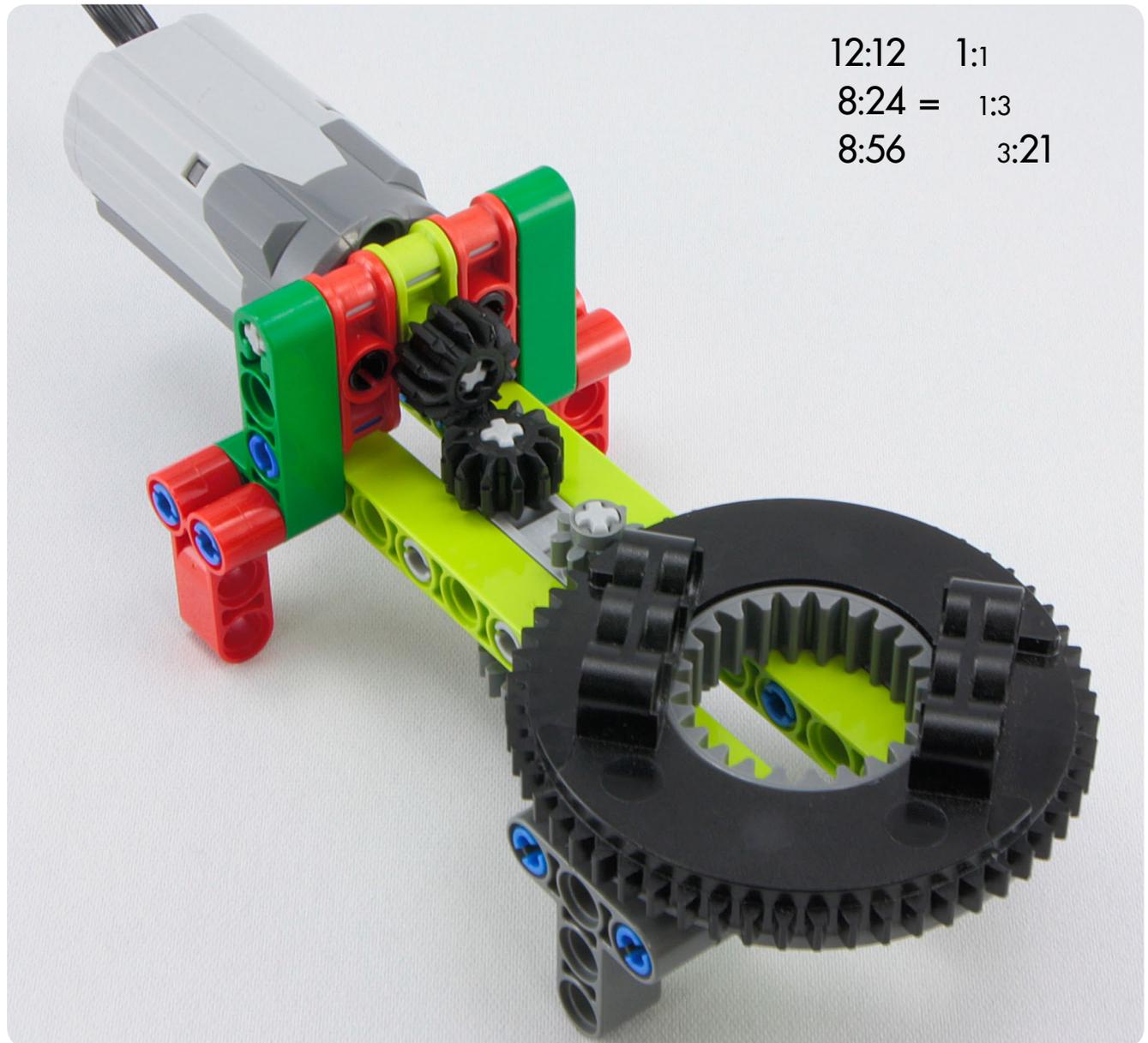
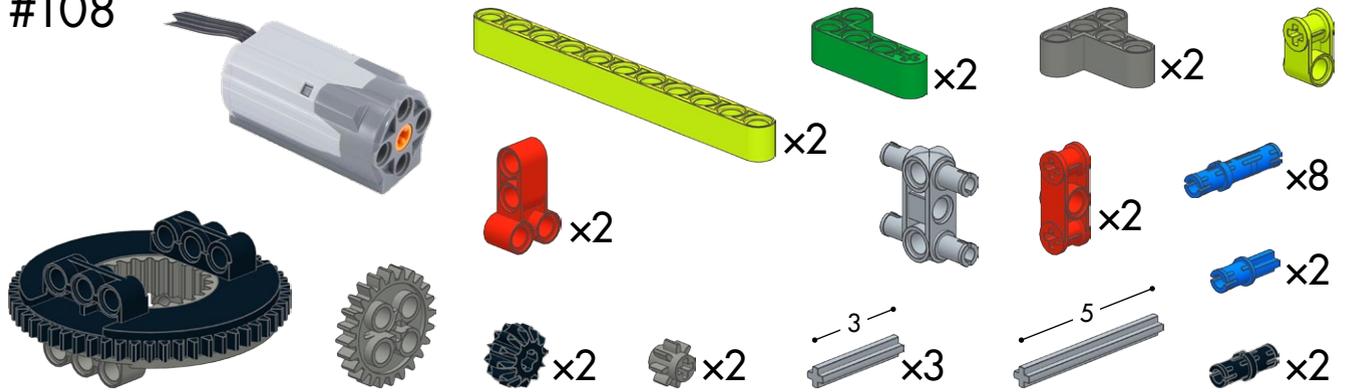
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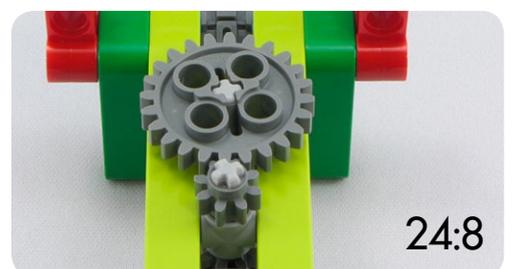
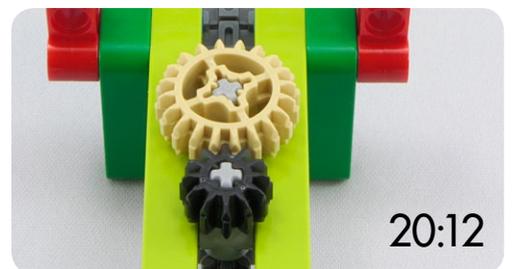
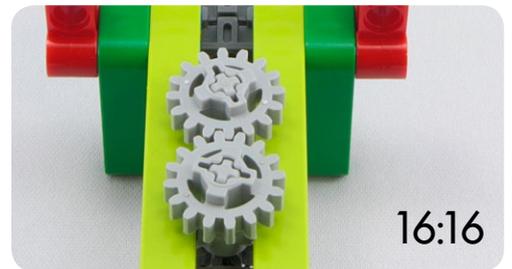
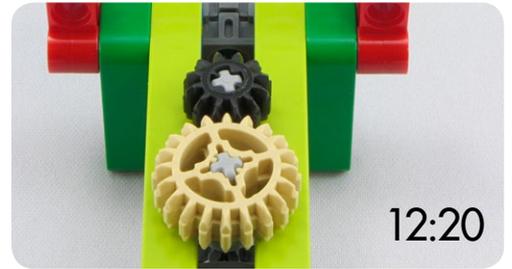
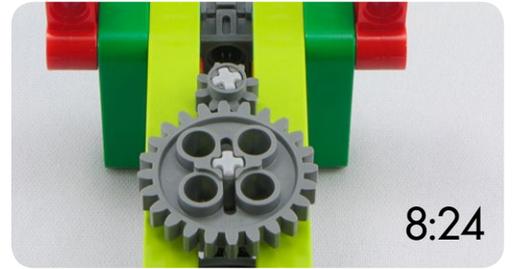
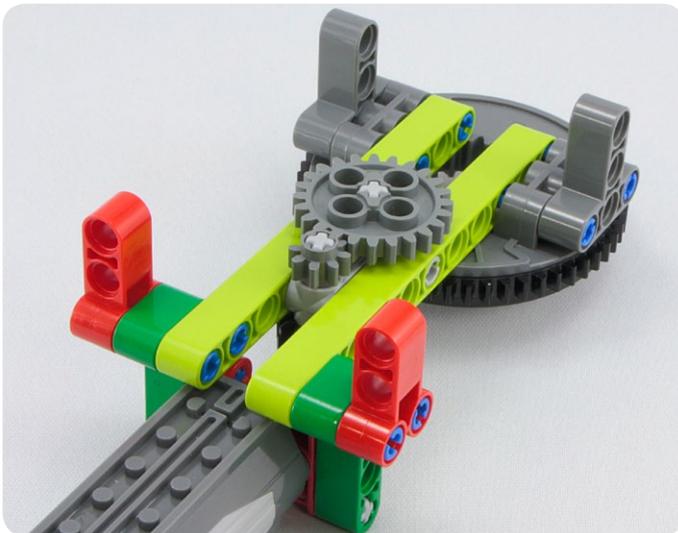
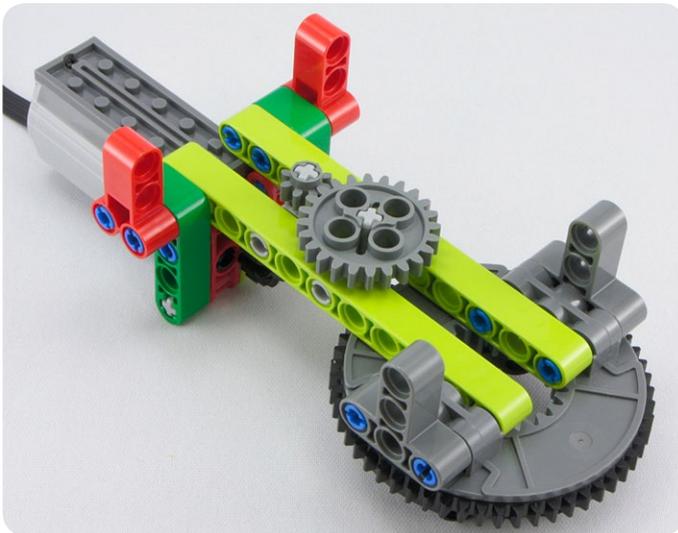
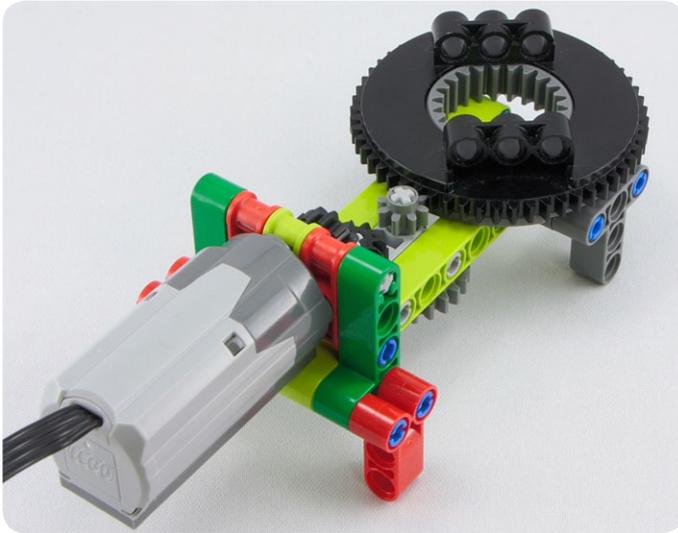


$16:24 = 2:3$
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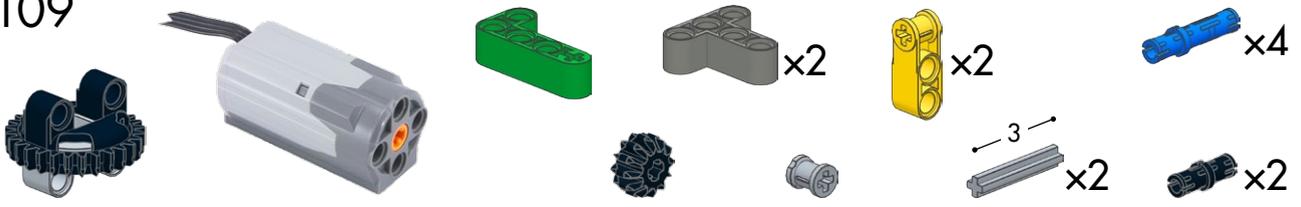


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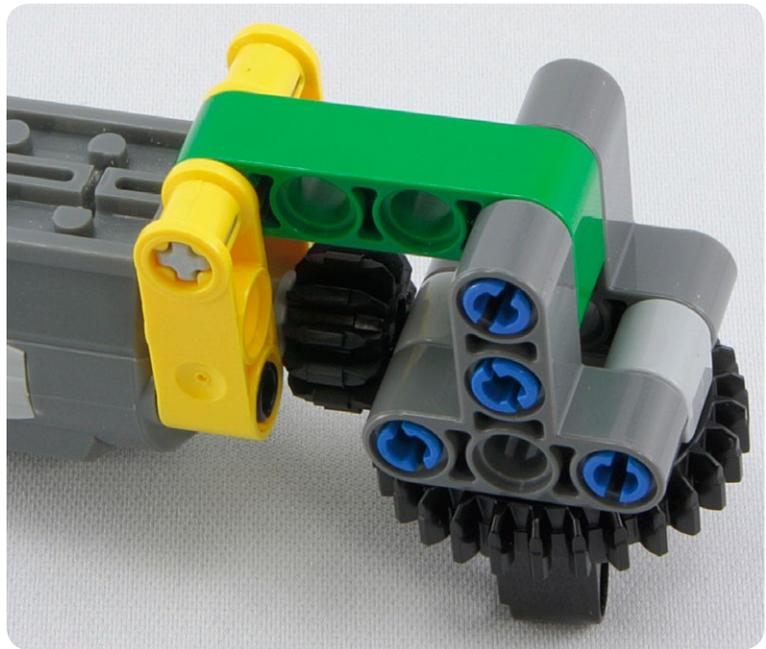
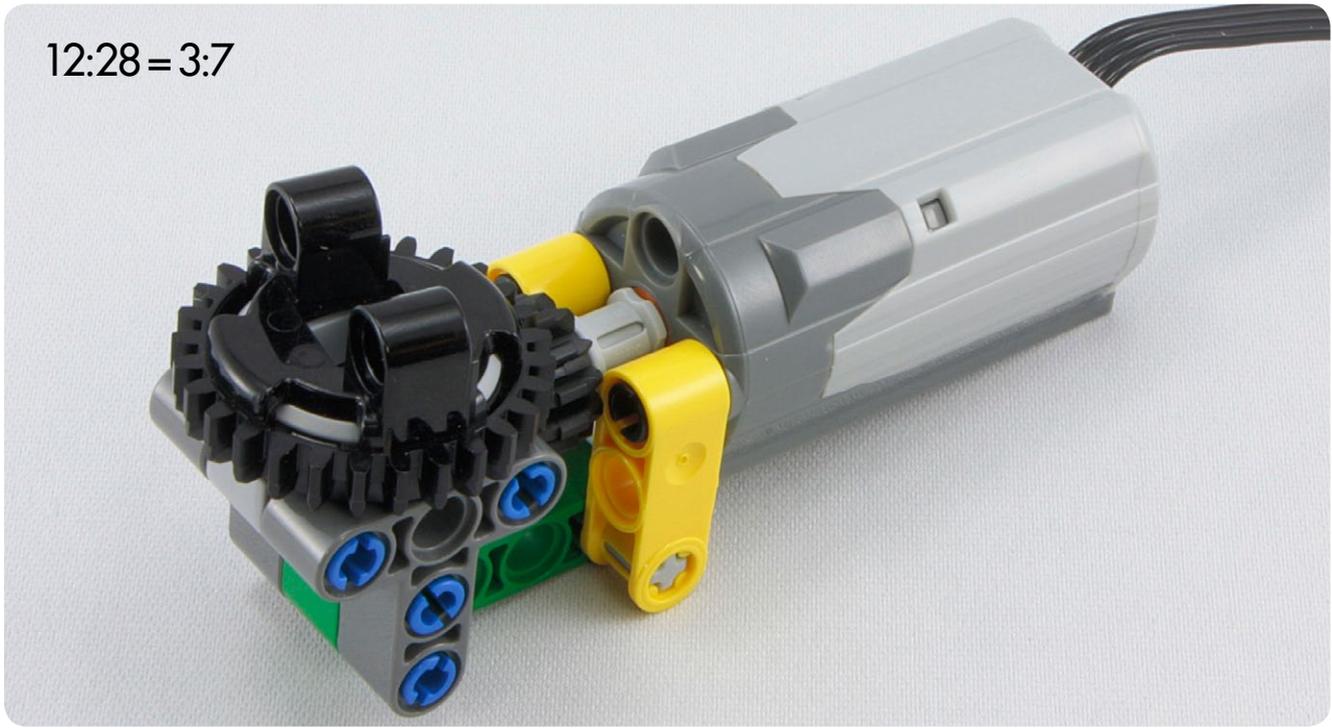




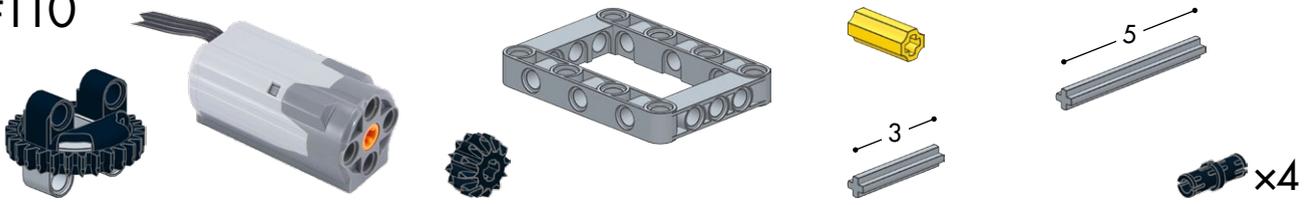
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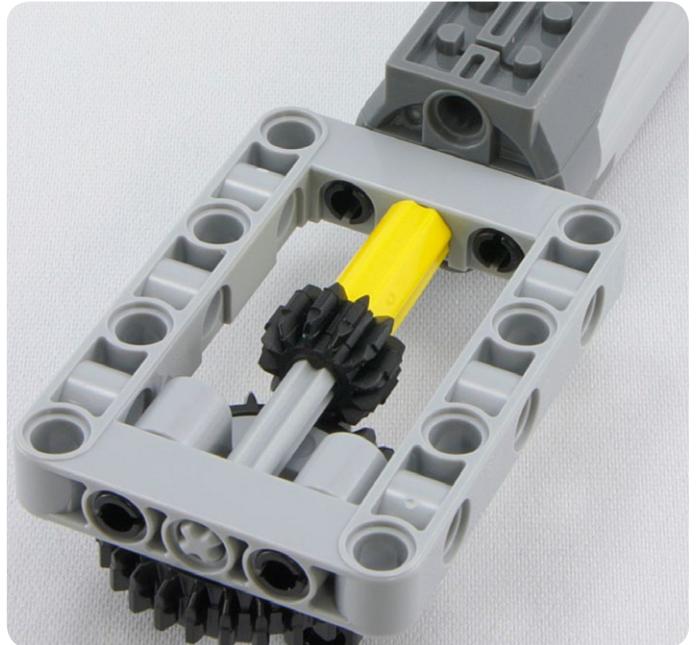
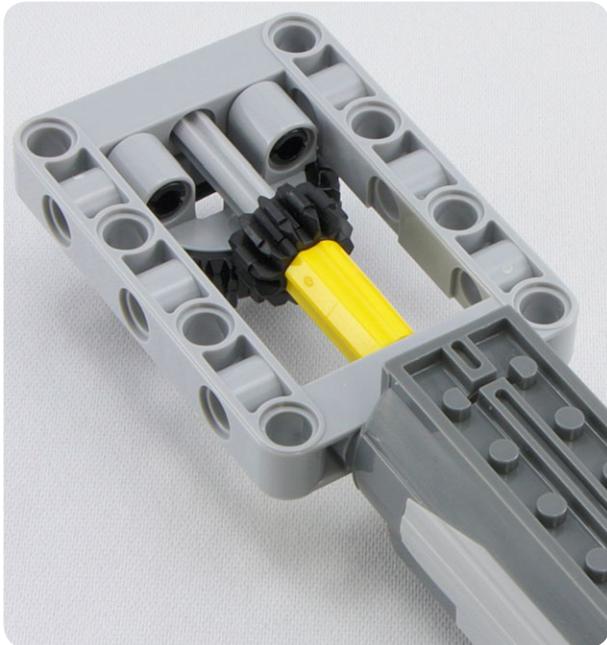
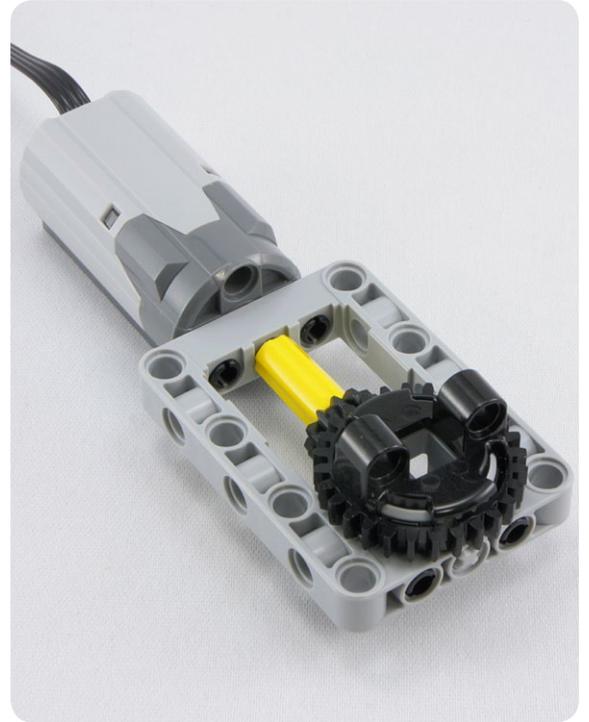
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#110



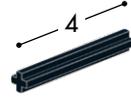
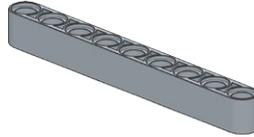
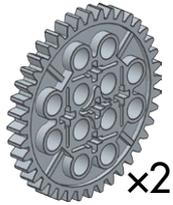
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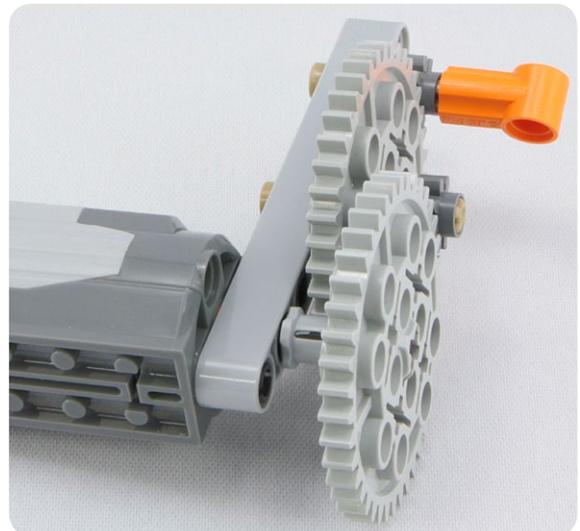
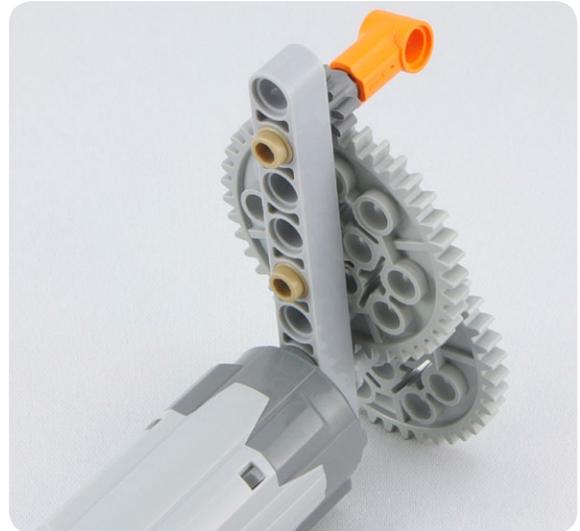
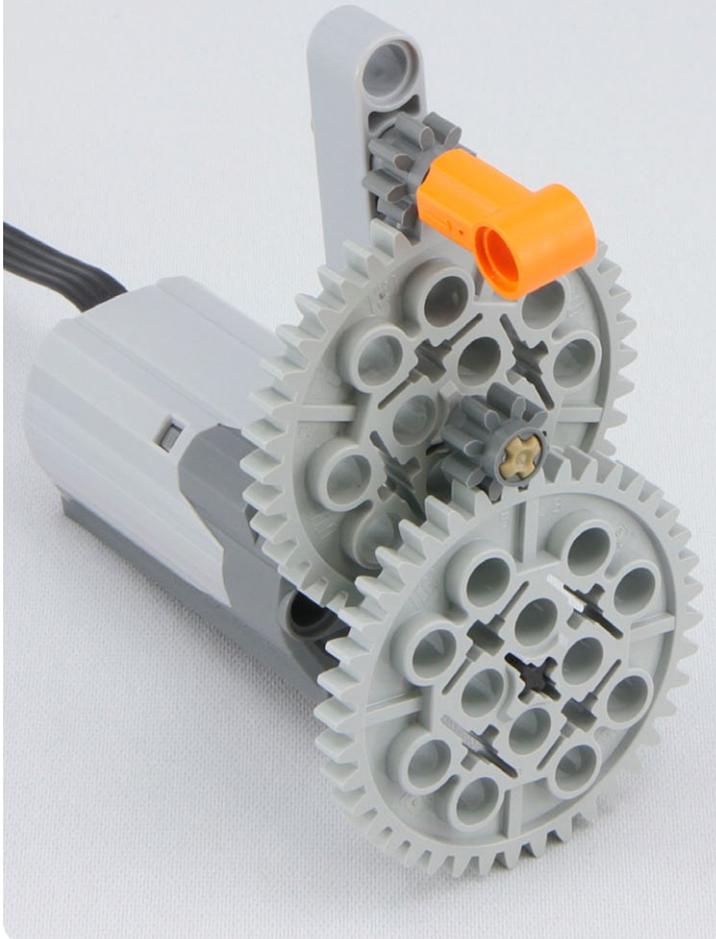


Gear systems

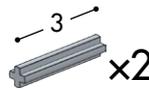
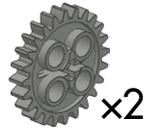
#113



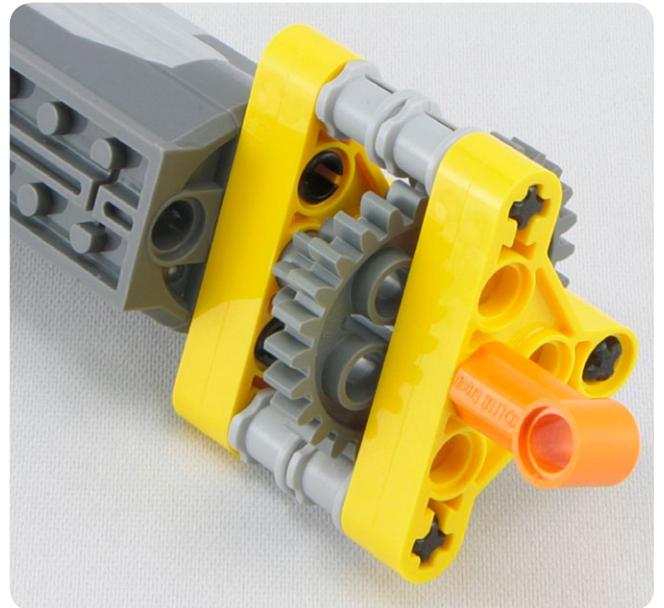
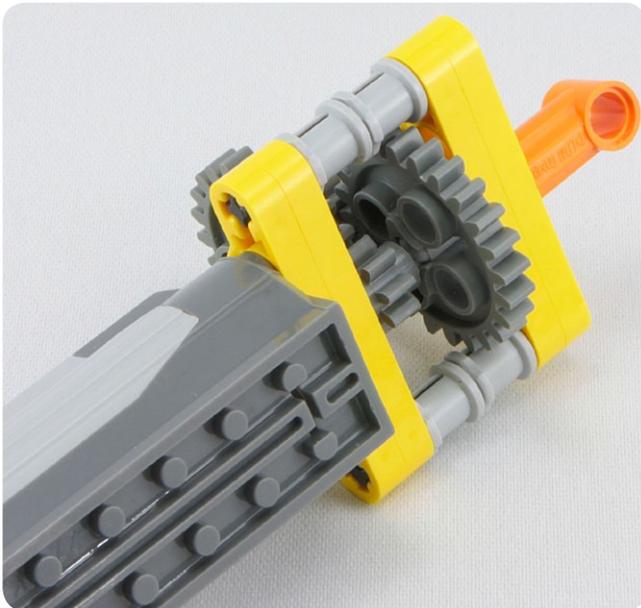
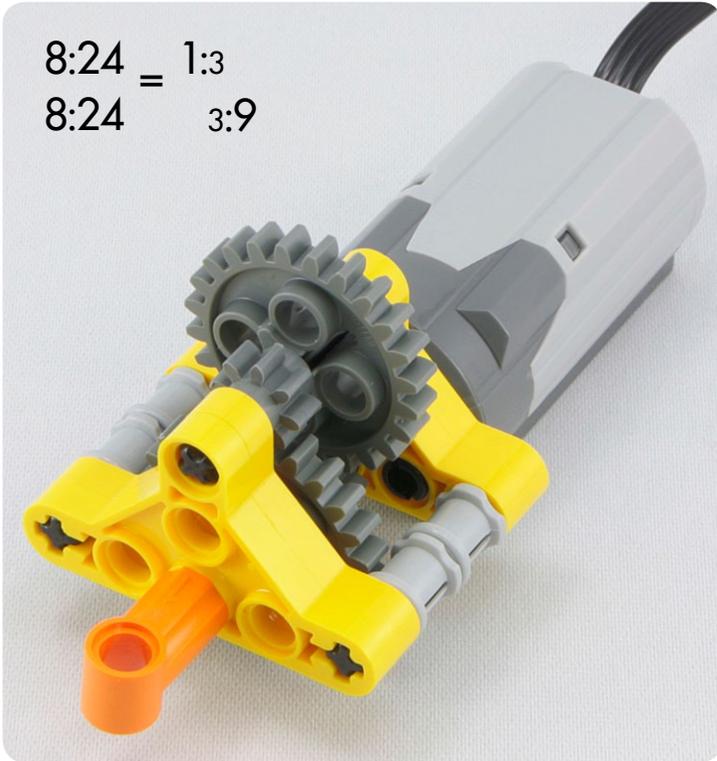
$$\begin{array}{l} 40:8 = 25:5 \\ 40:8 \quad 5:1 \end{array}$$



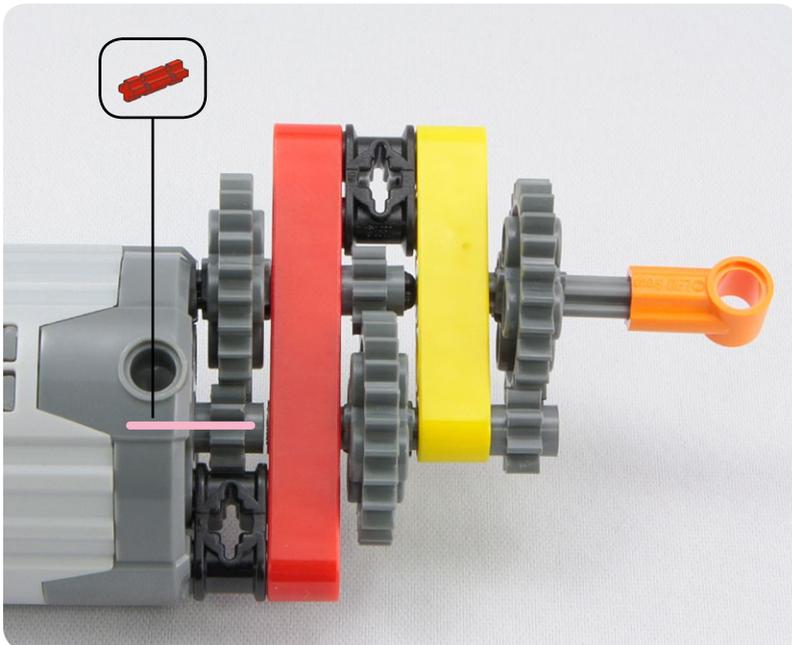
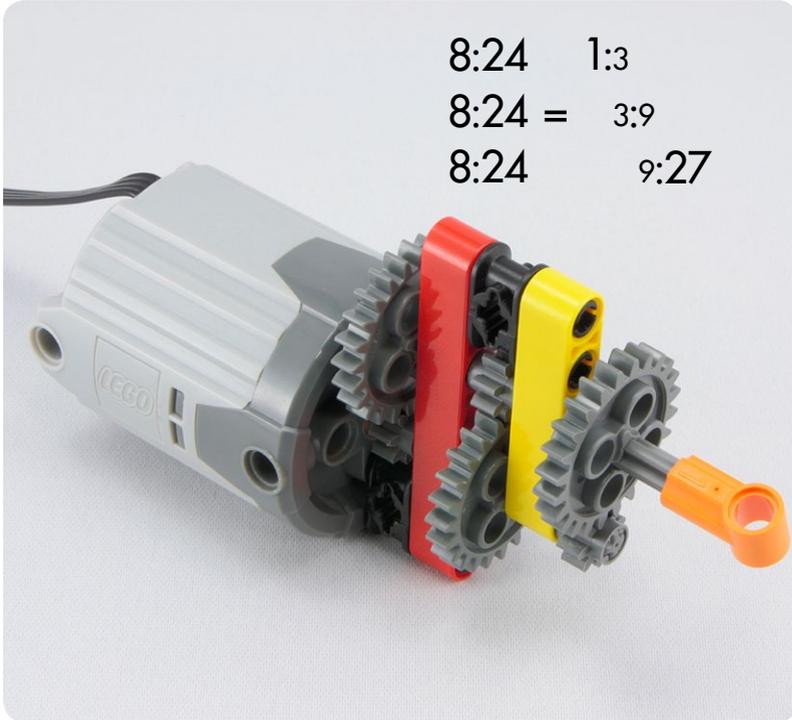
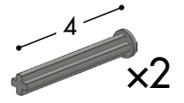
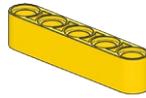
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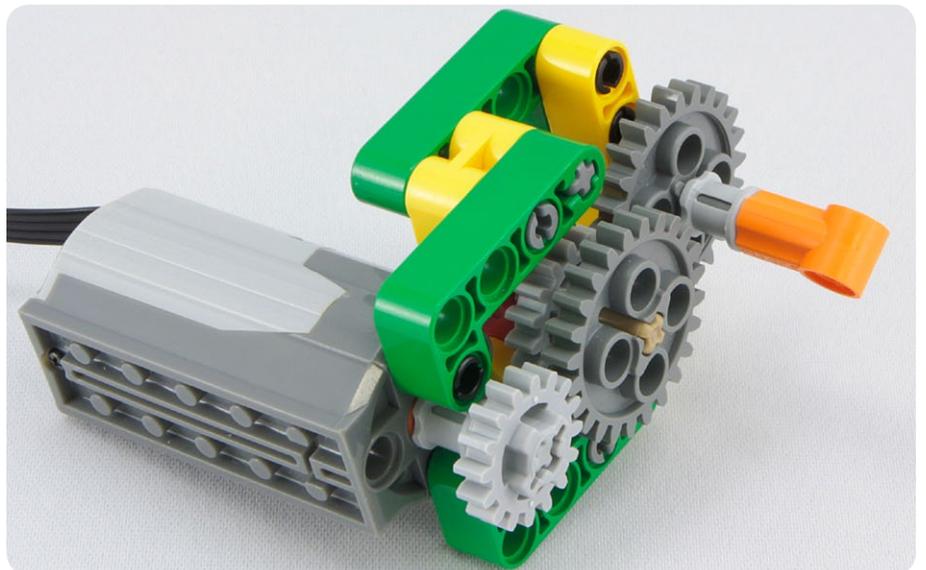
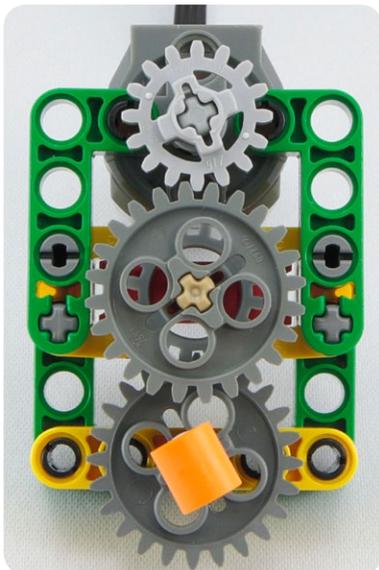
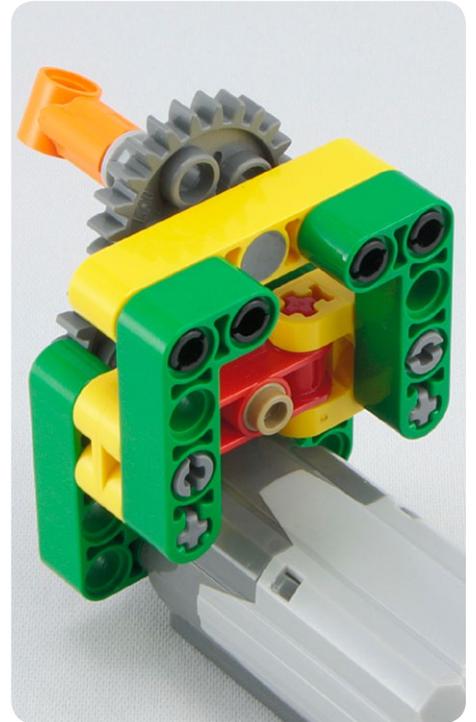
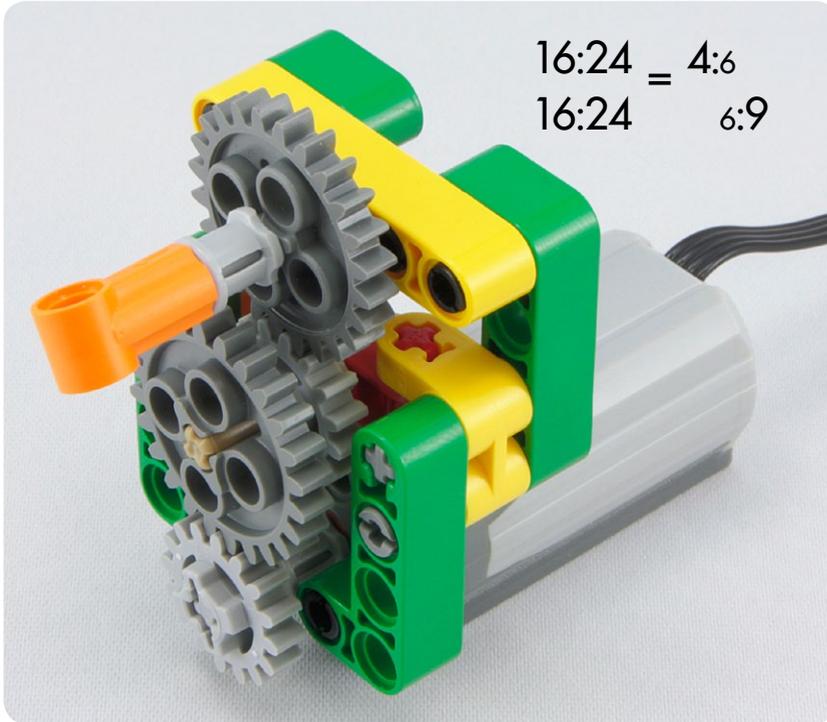
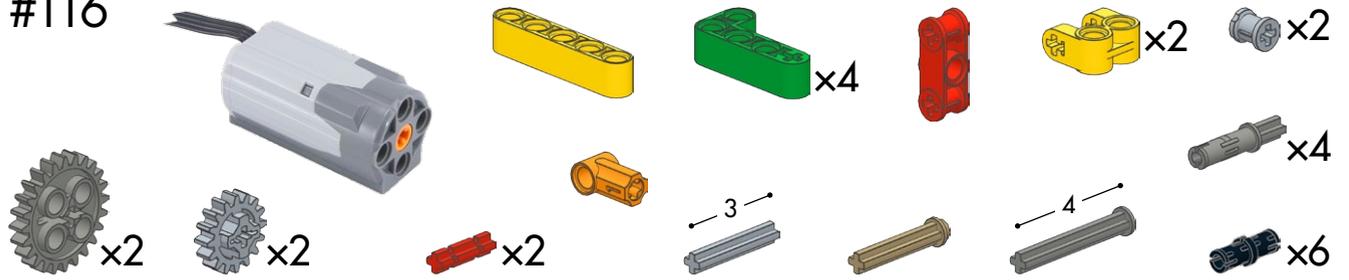
$8:24 = 1:3$
 $8:24 = 3:9$



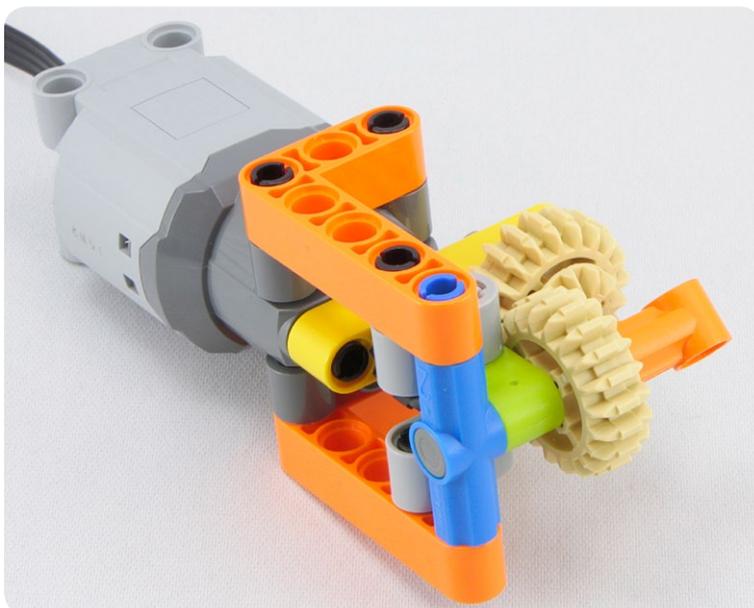
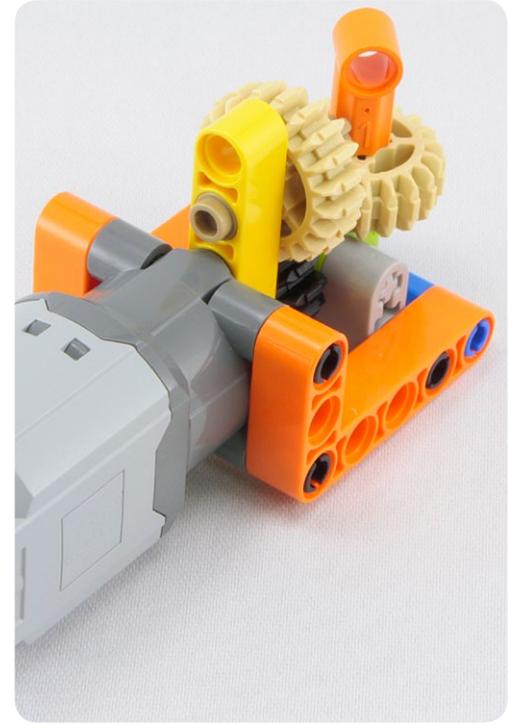
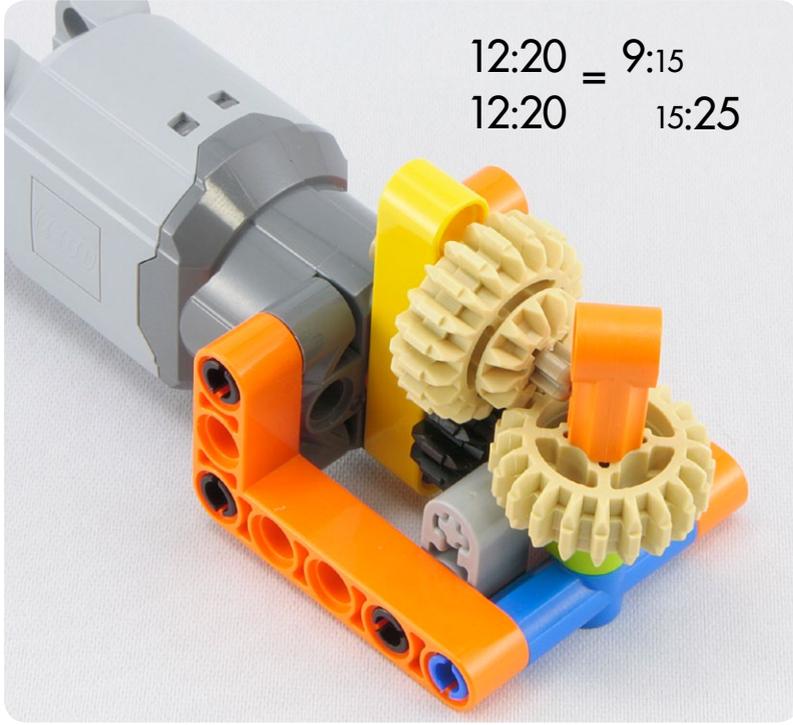
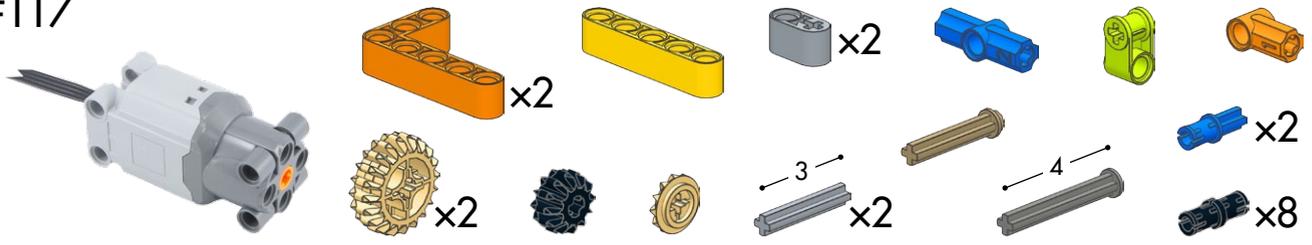
#115



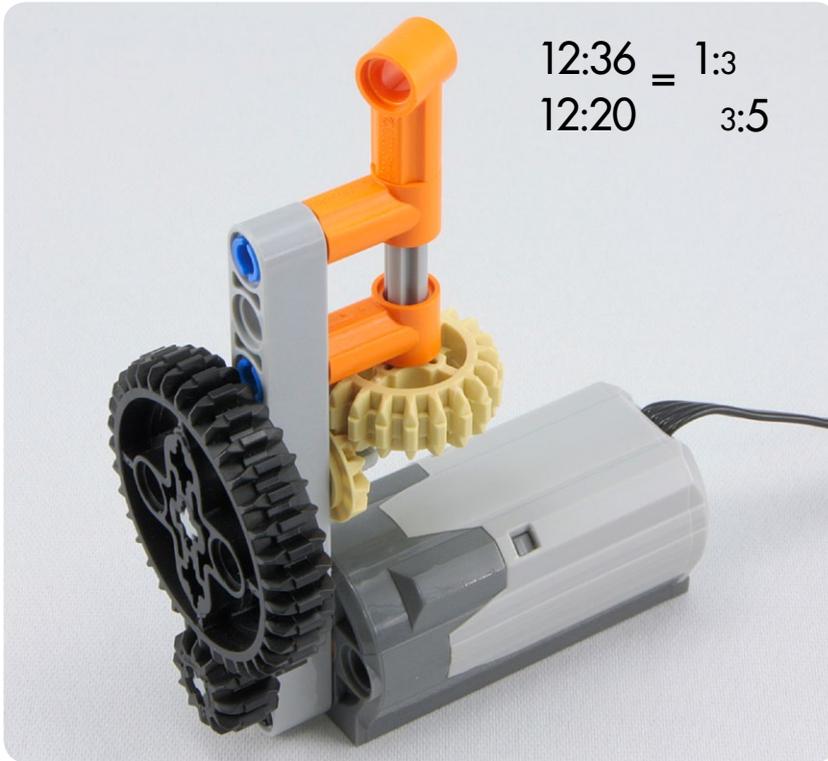
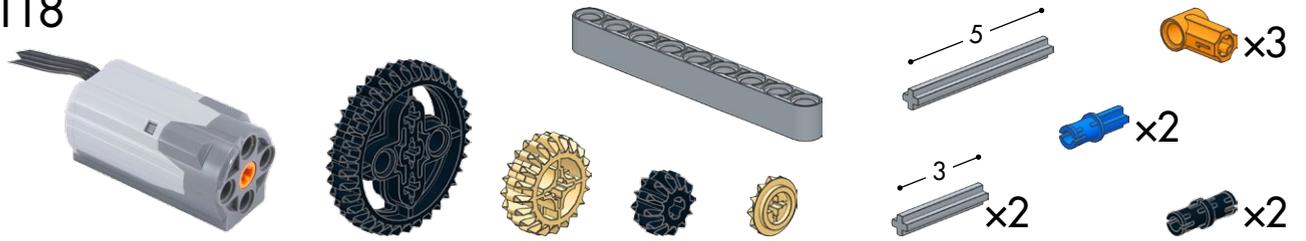
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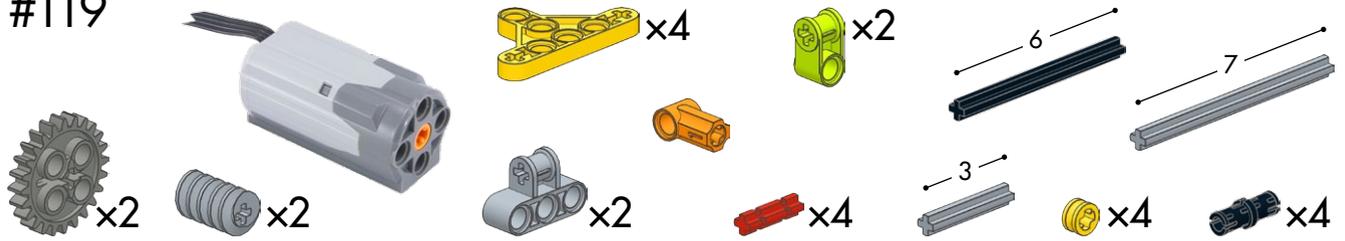
#117



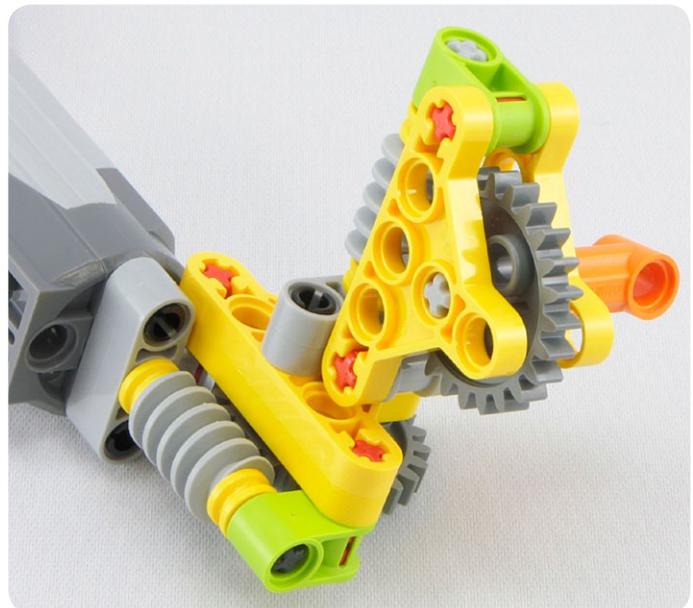
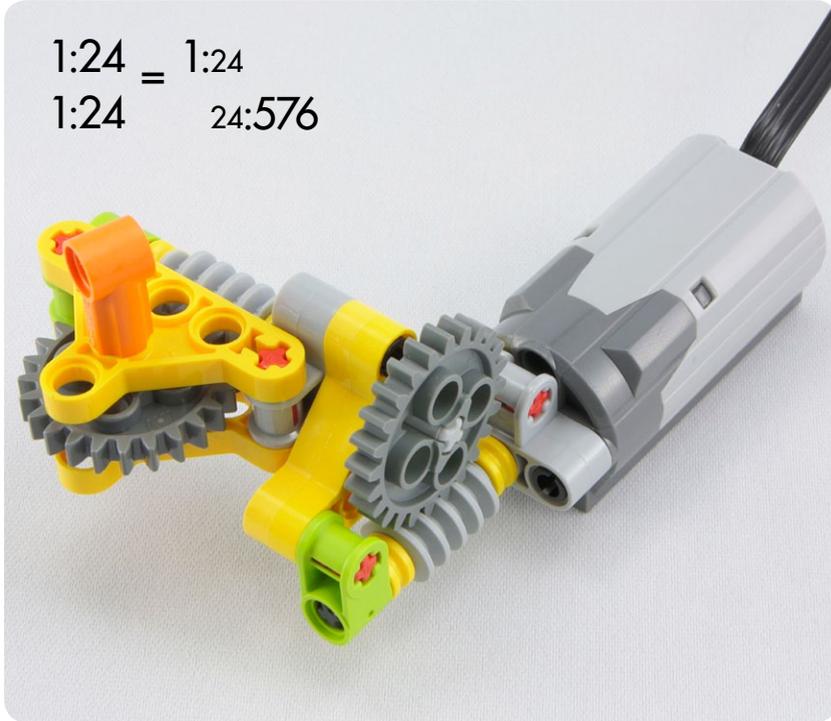
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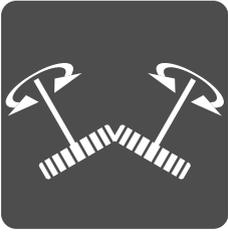


#119



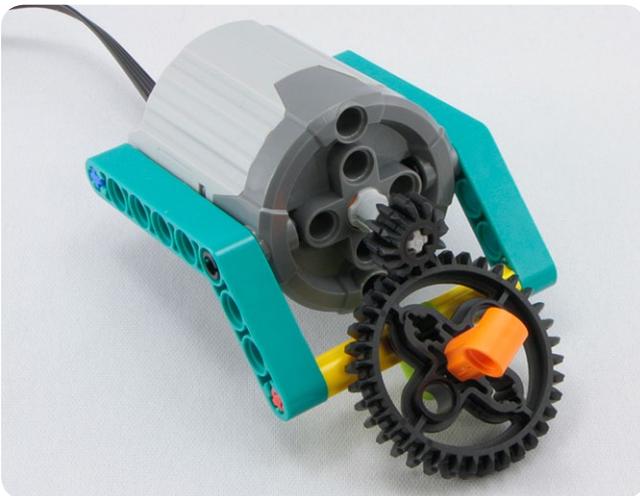
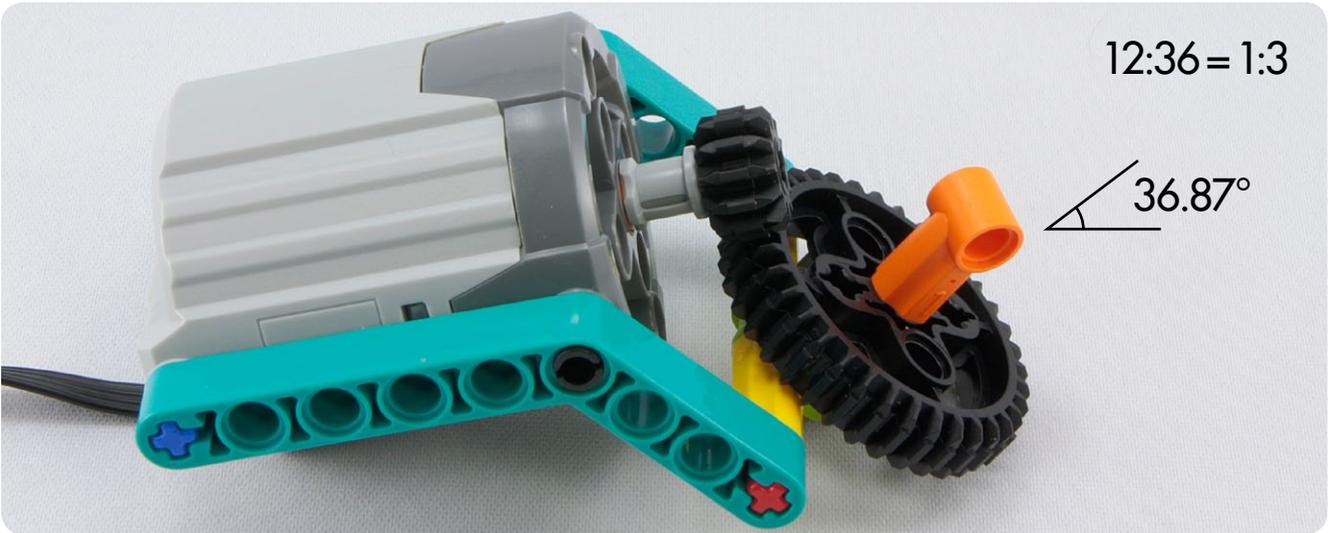
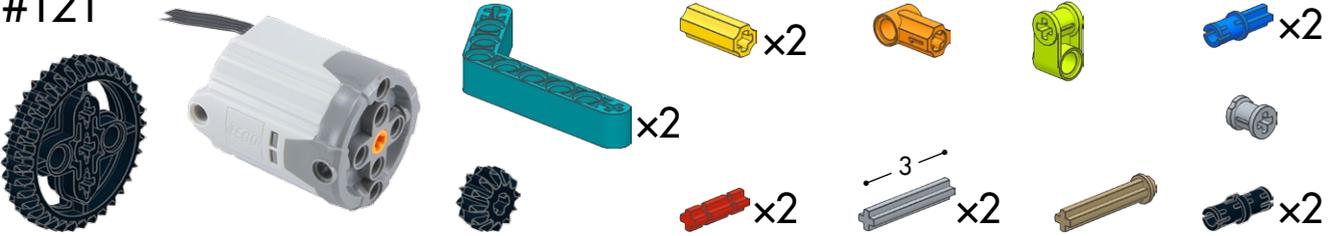
$1:24 = 1:24$
 $1:24 \quad 24:576$



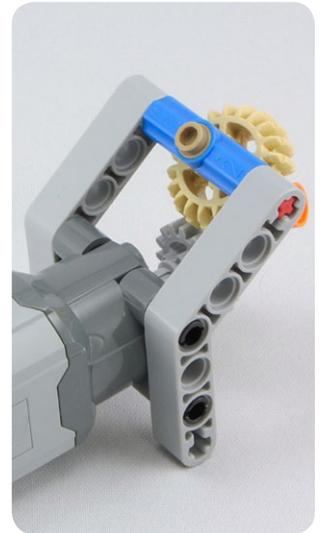
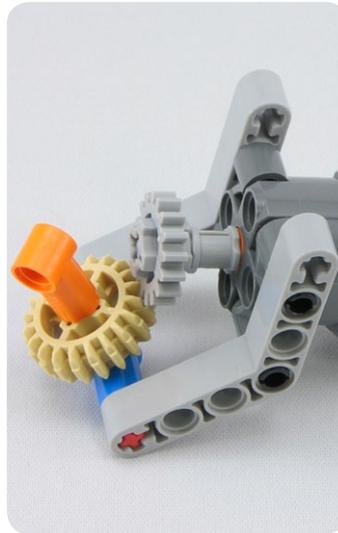
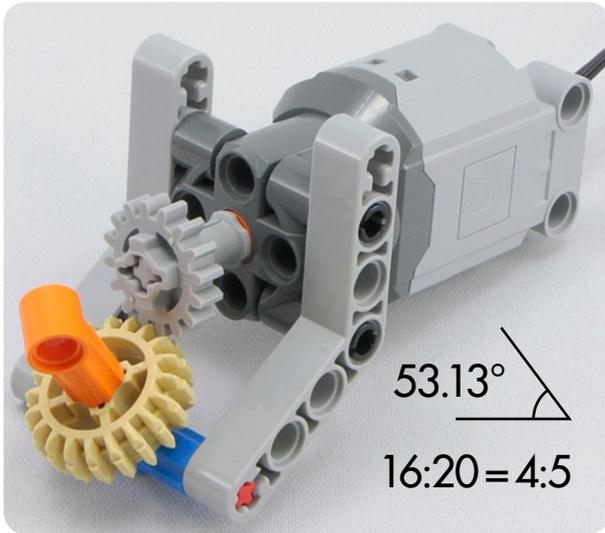
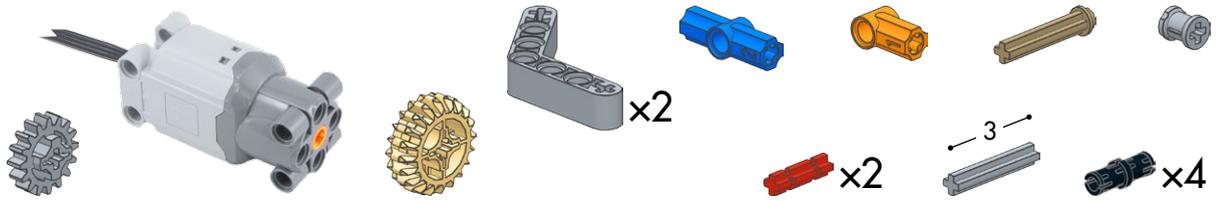


Tilting the angle of the axle

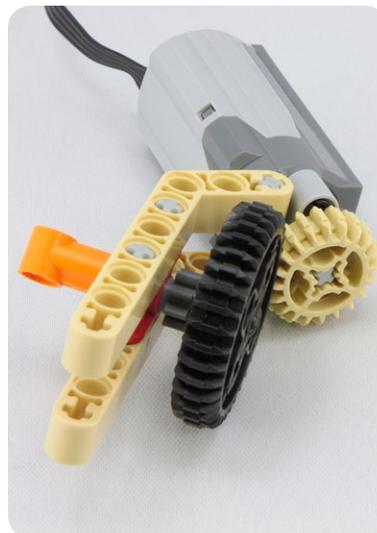
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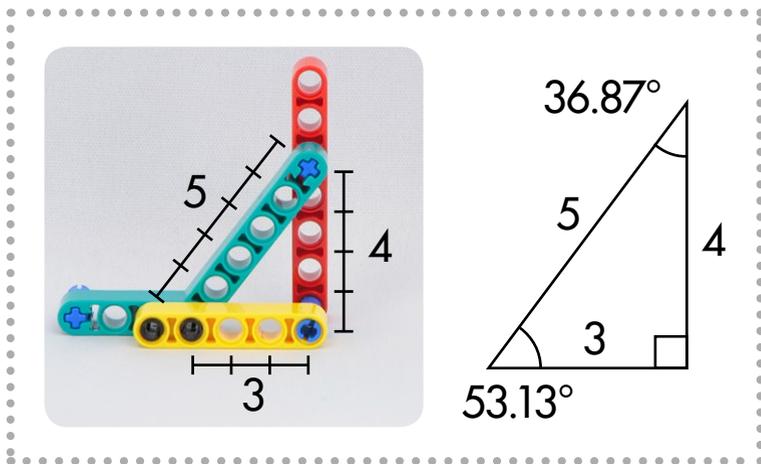
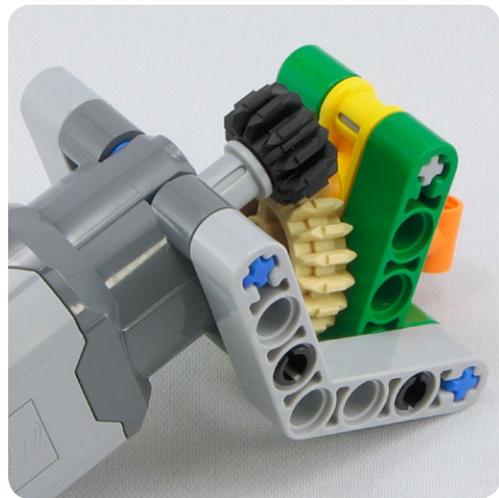
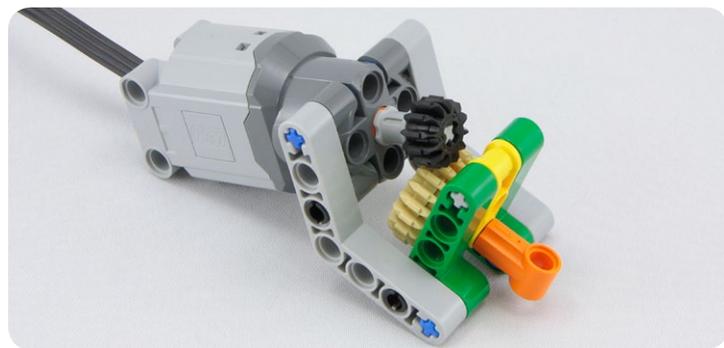
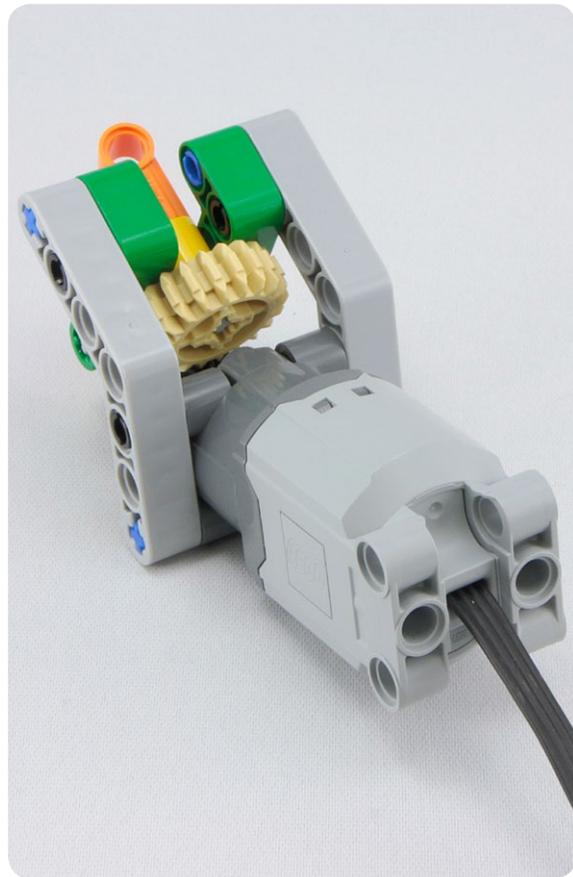
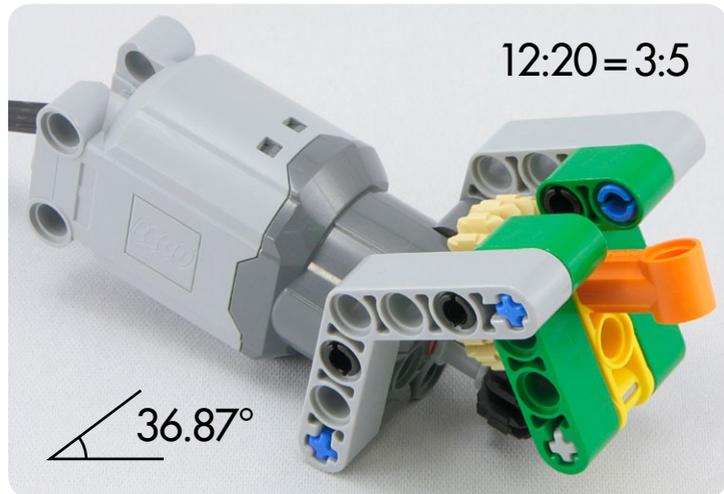
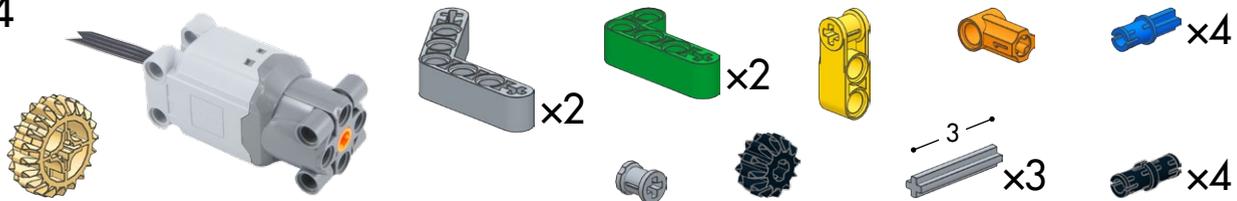
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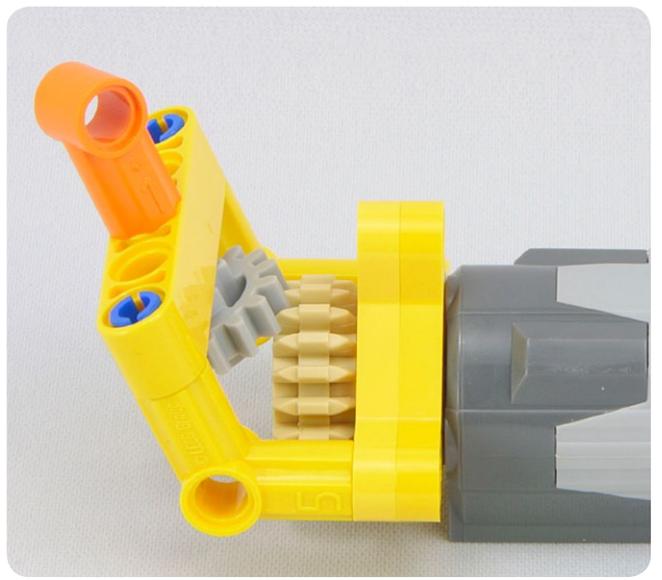
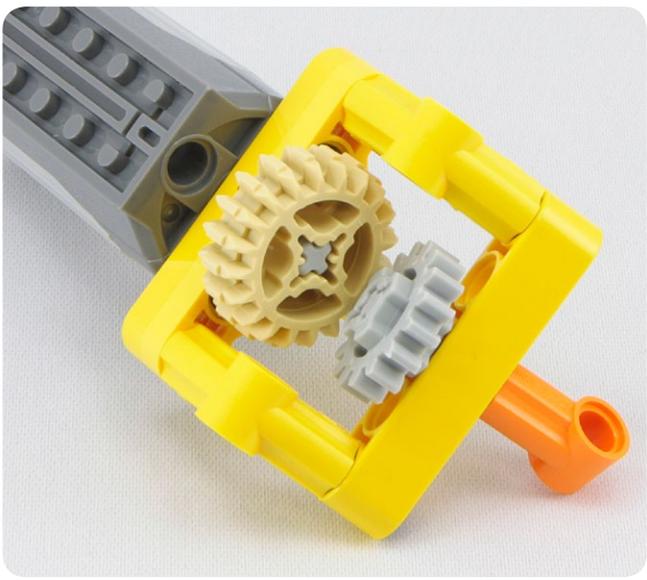
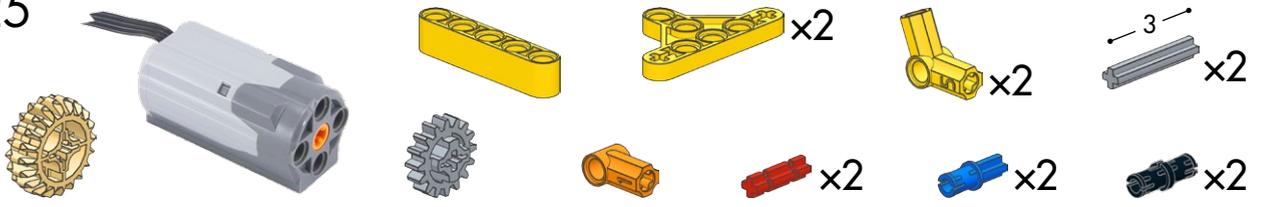
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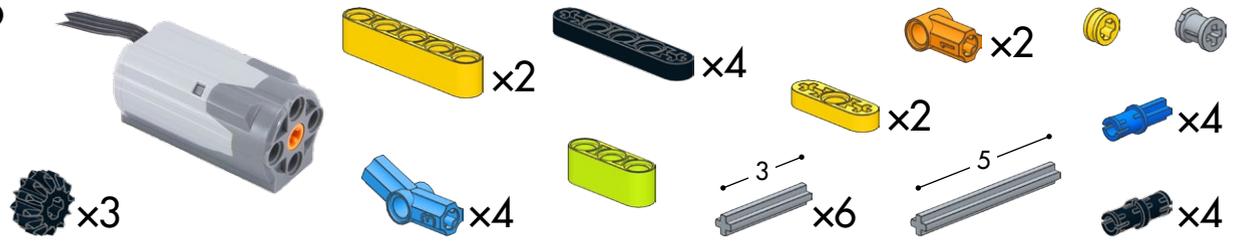
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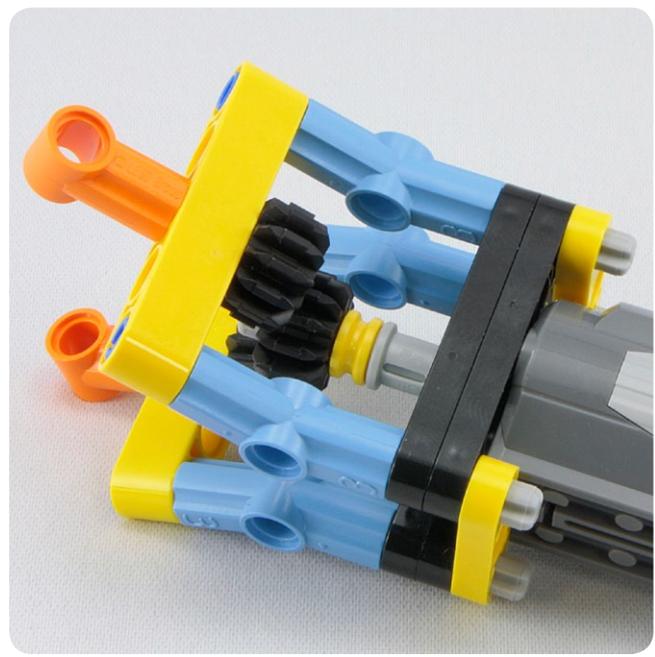
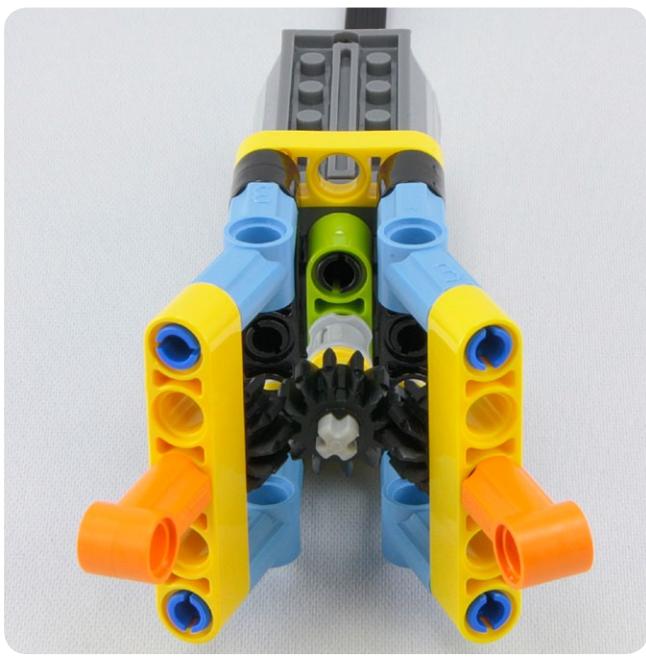
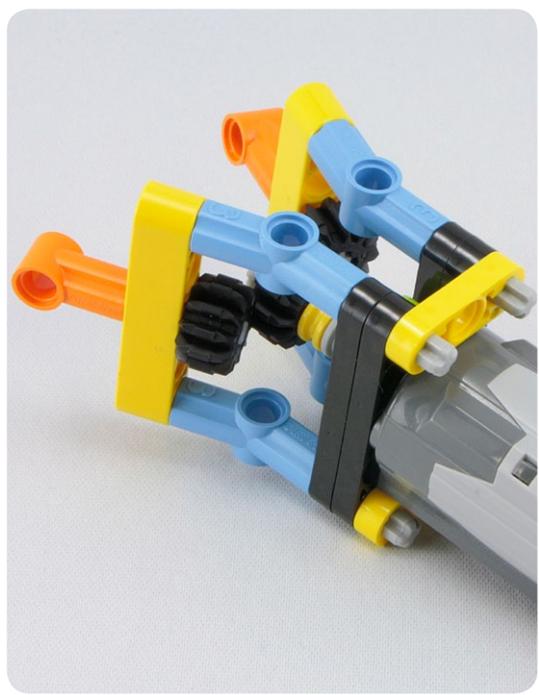
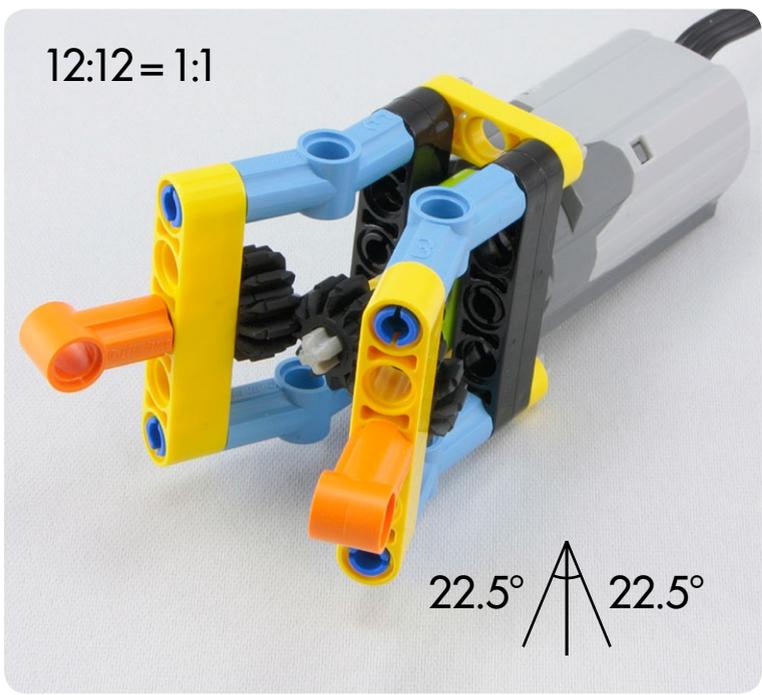
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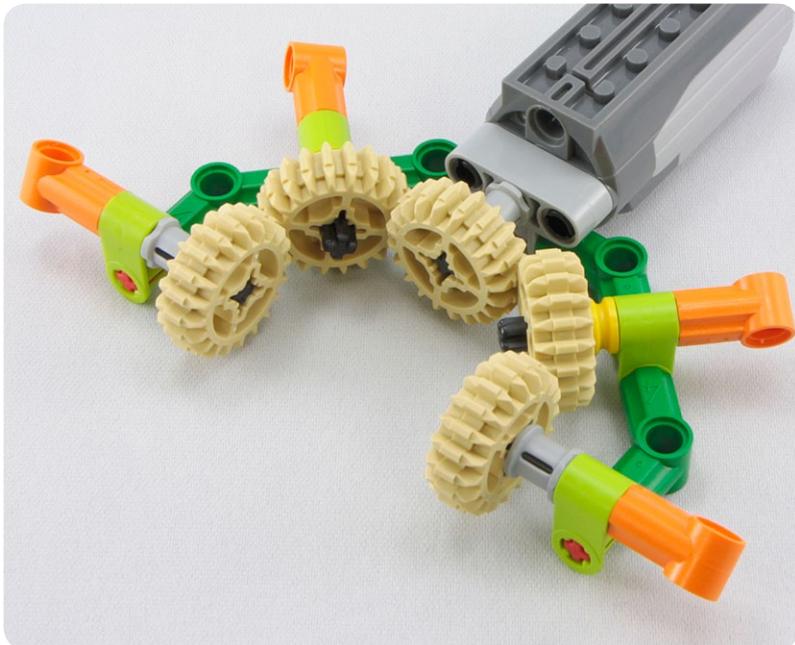
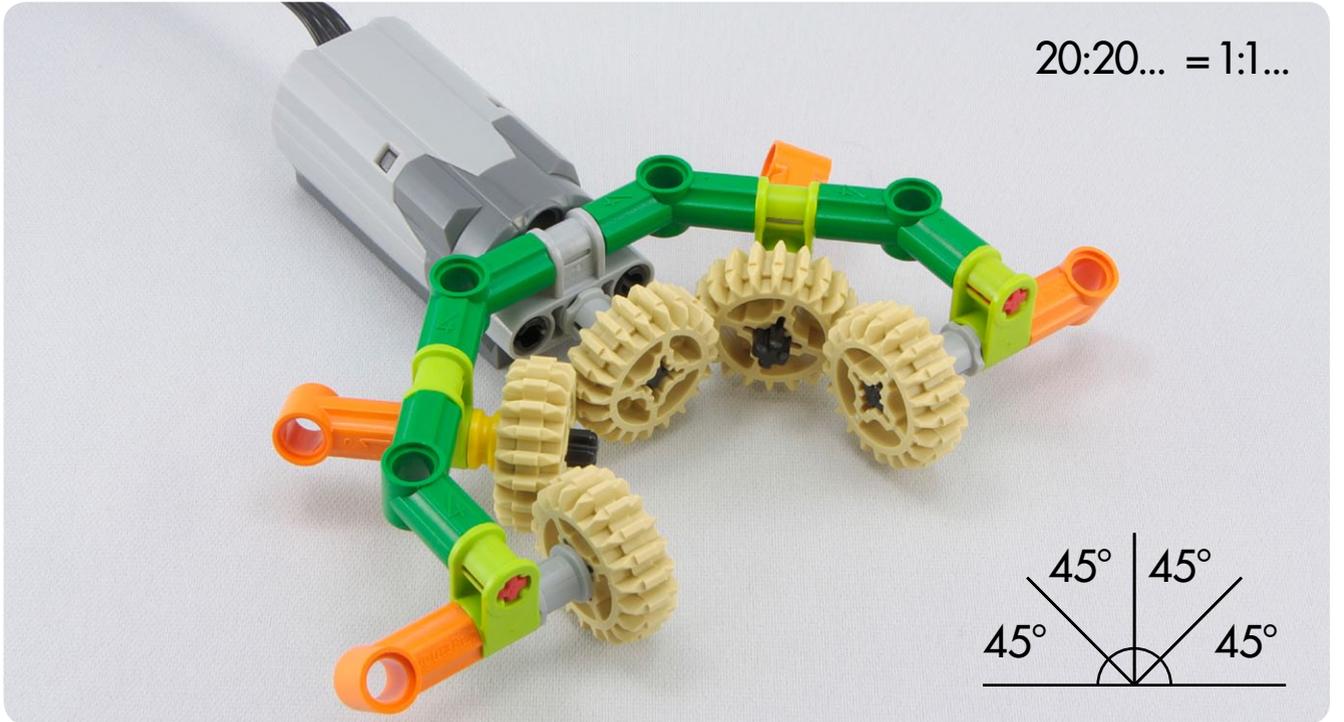
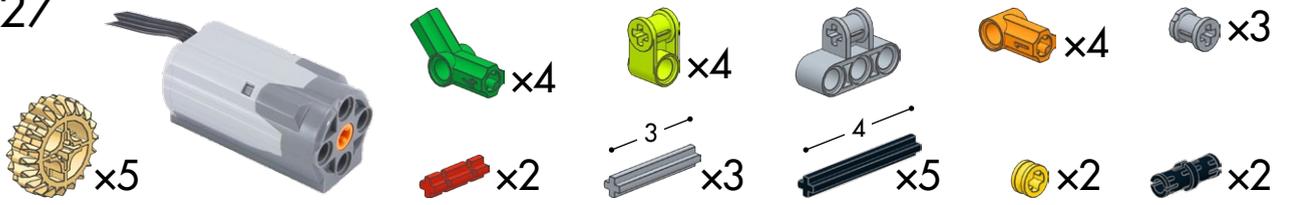
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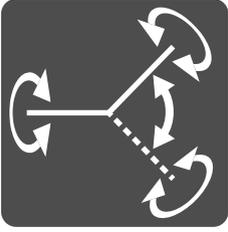


12:12 = 1:1



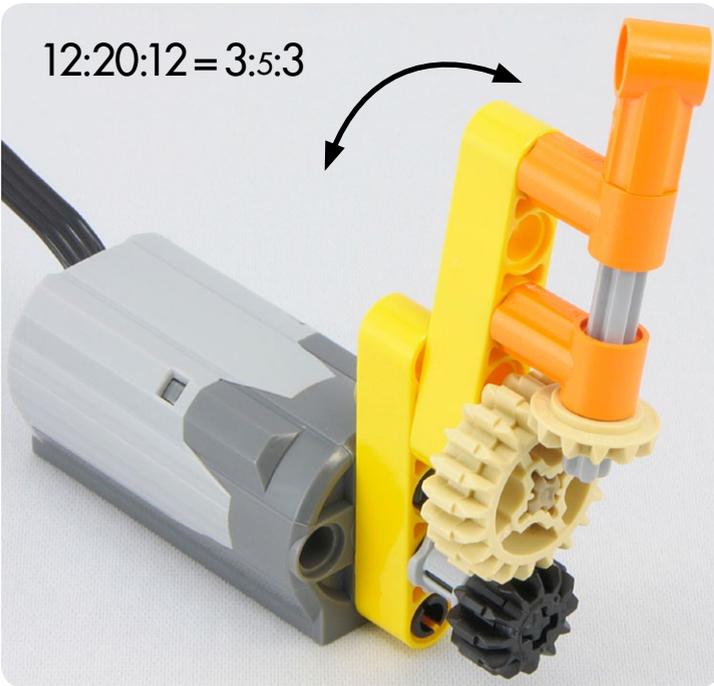
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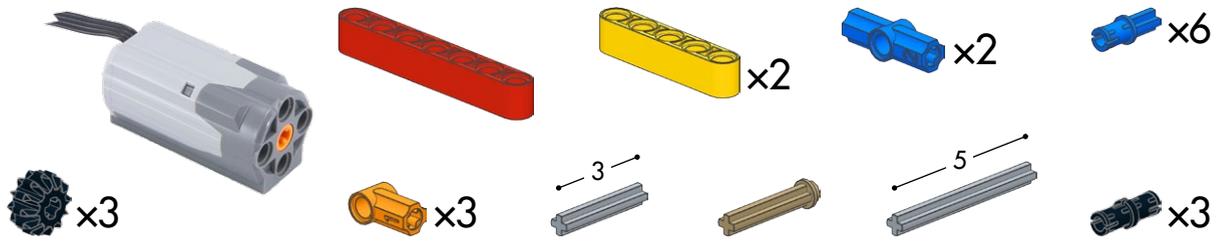


Changing the angle of the axle freely

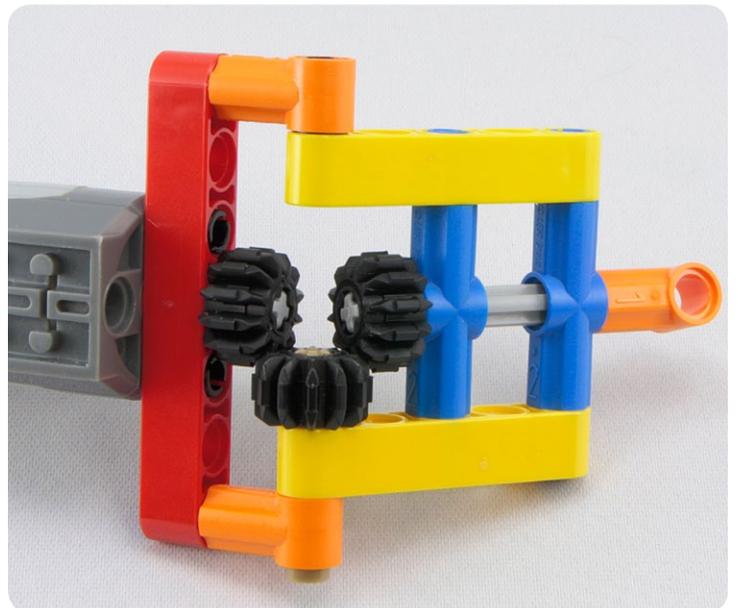
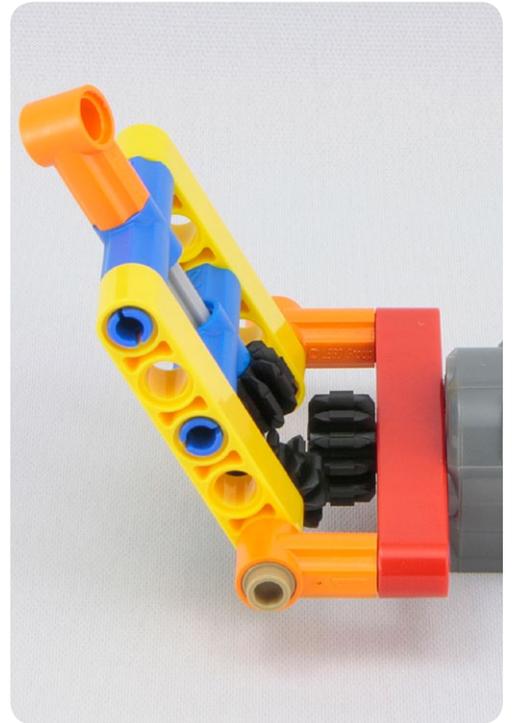
#128



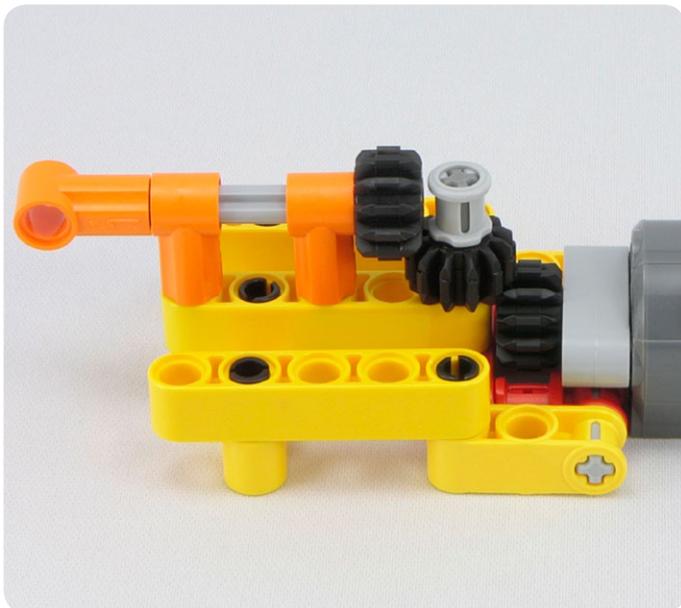
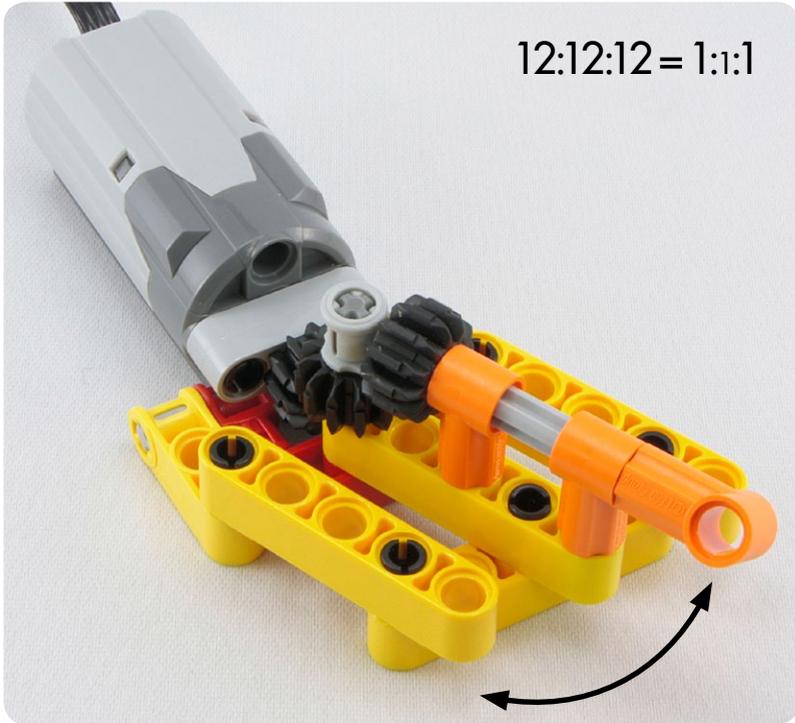
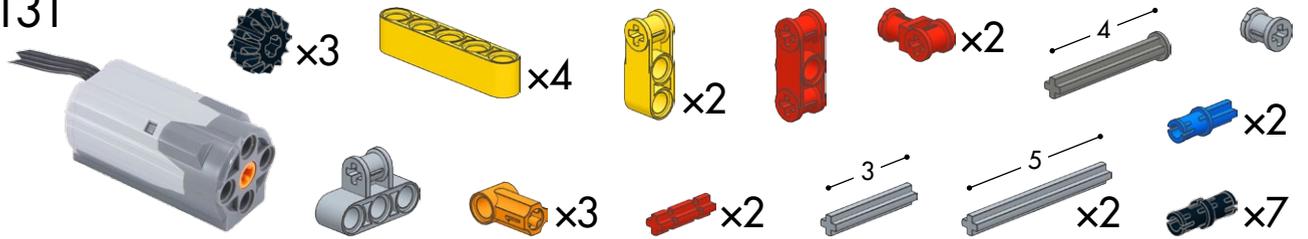
#129



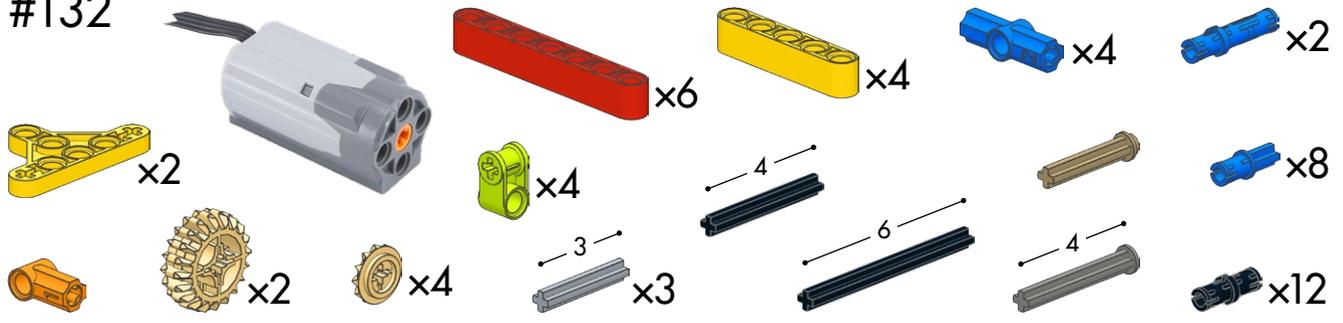
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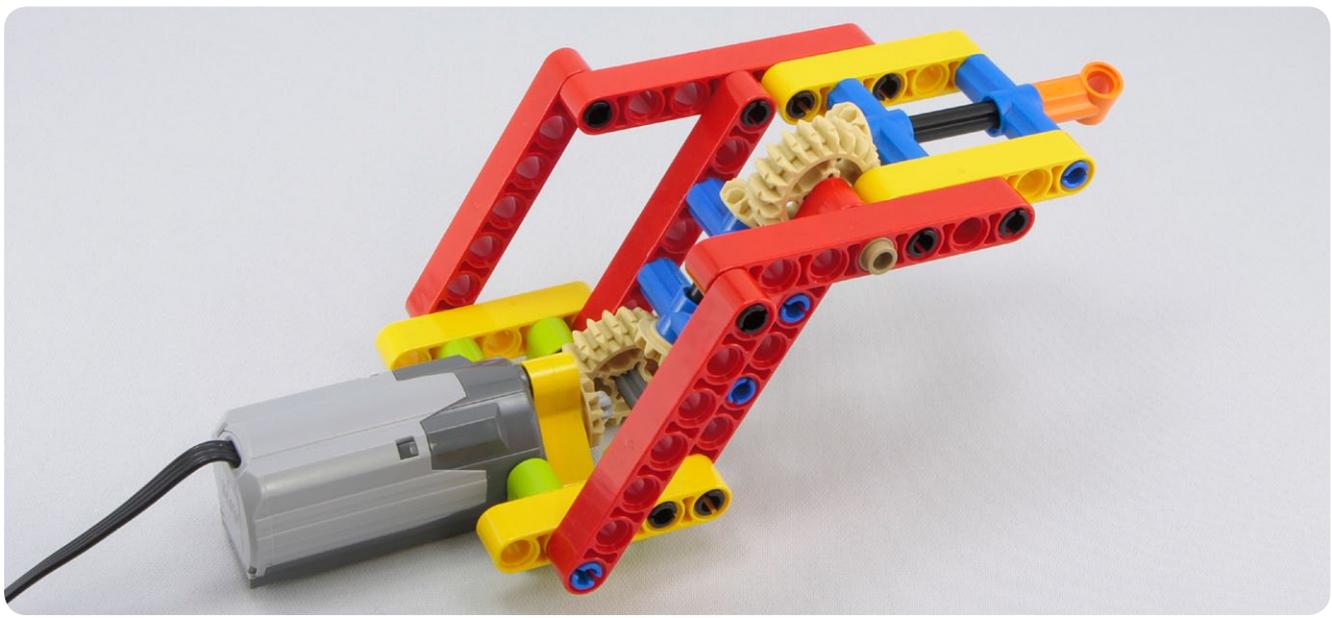
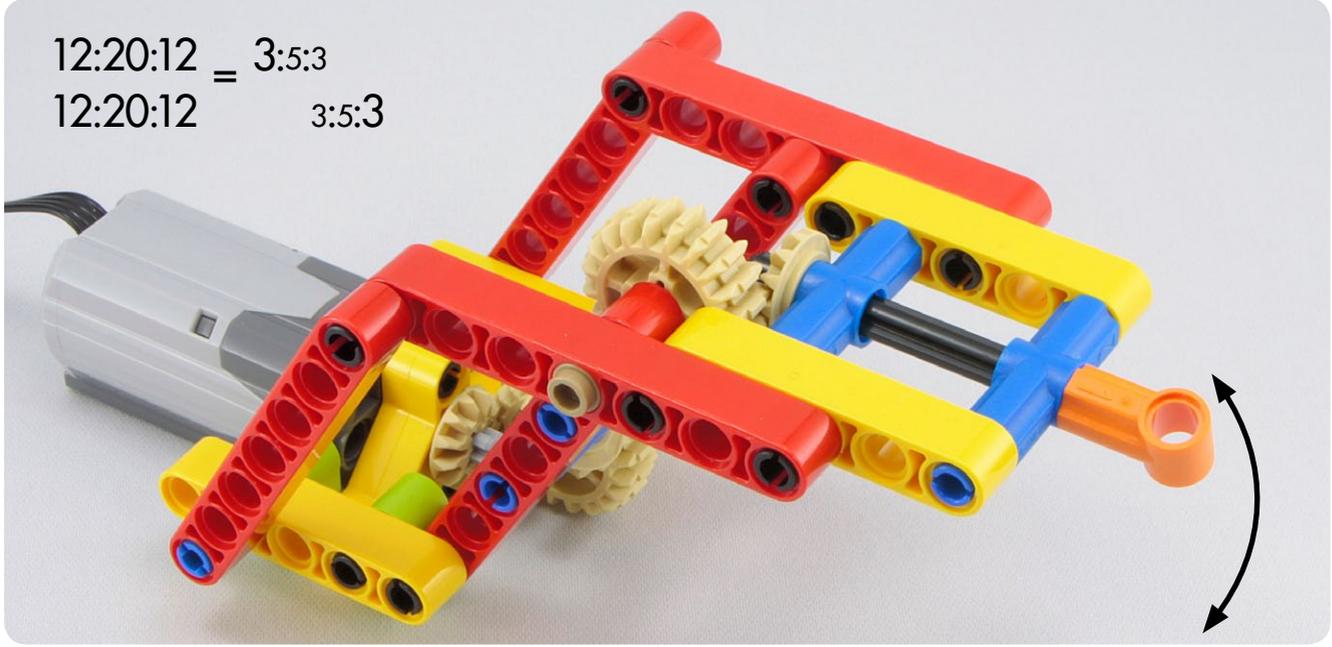
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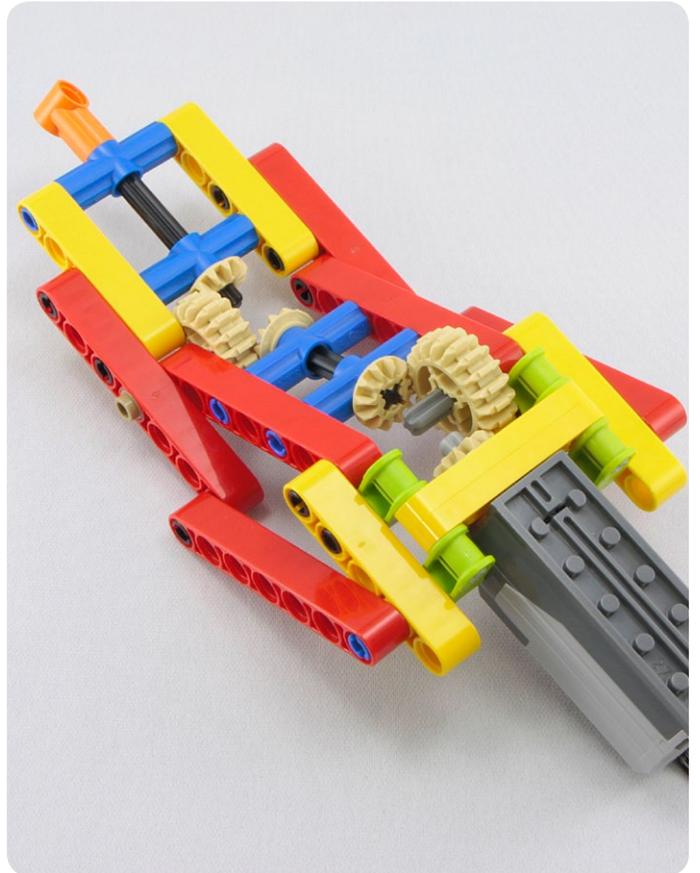
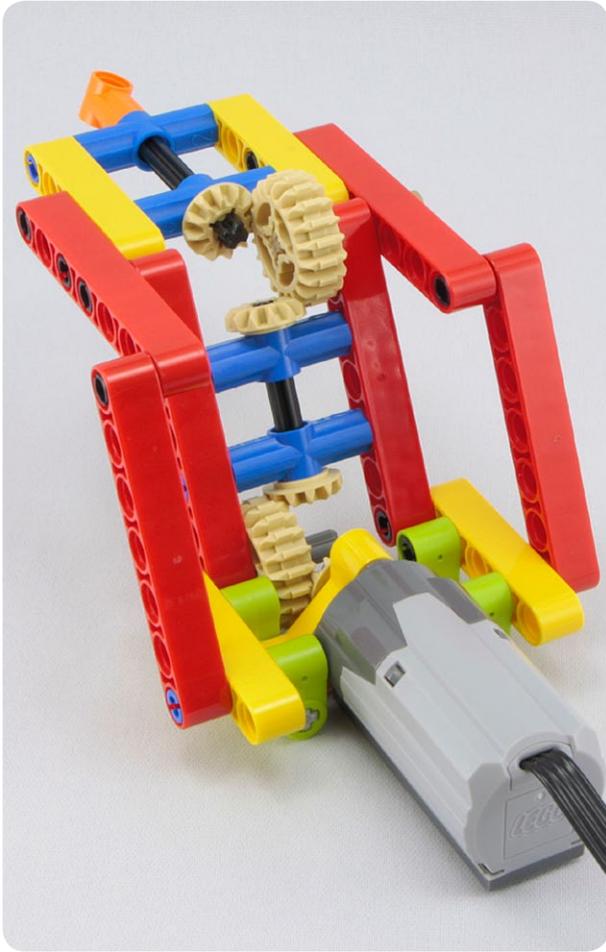


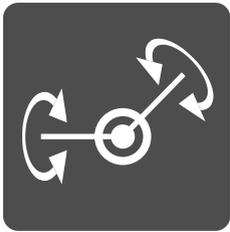
#132



12:20:12 = 3:5:3
12:20:12 3:5:3

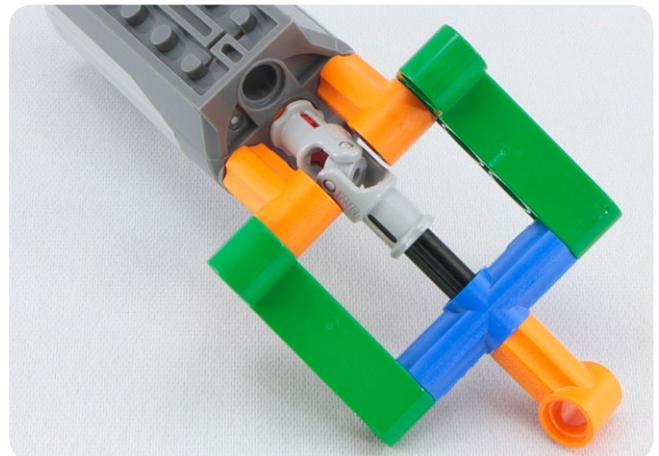
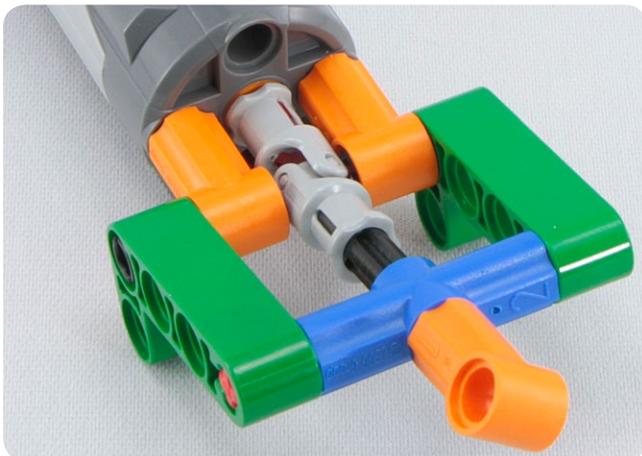
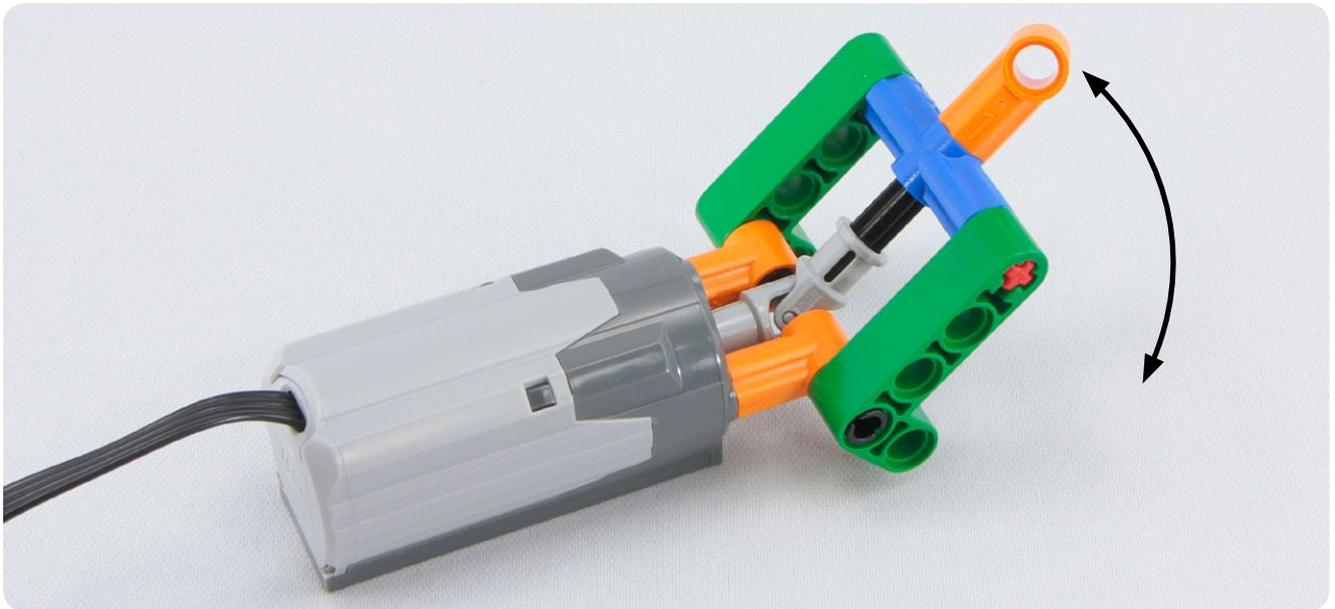
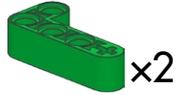




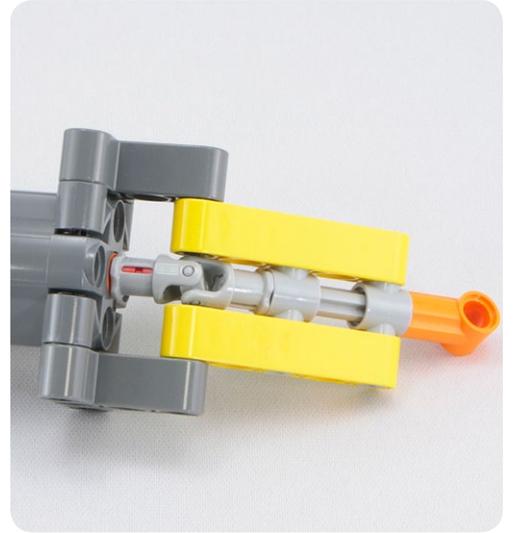
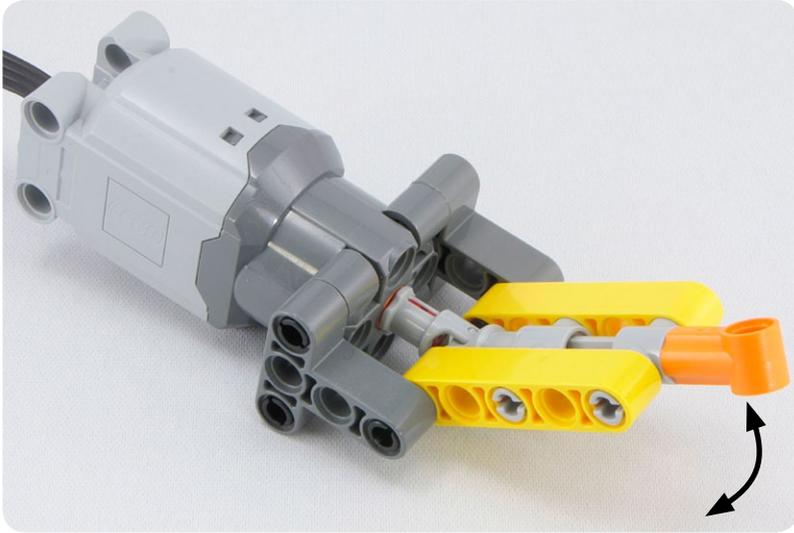
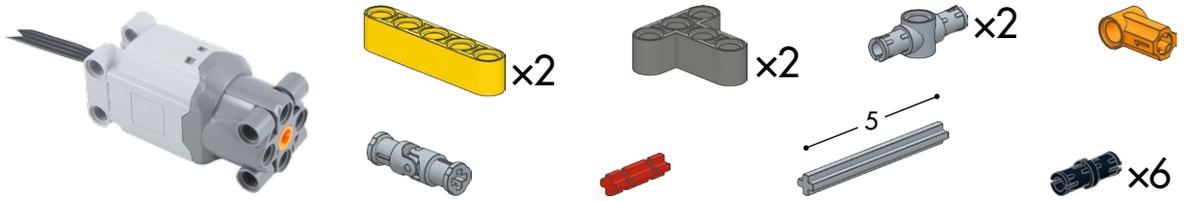


Universal joints

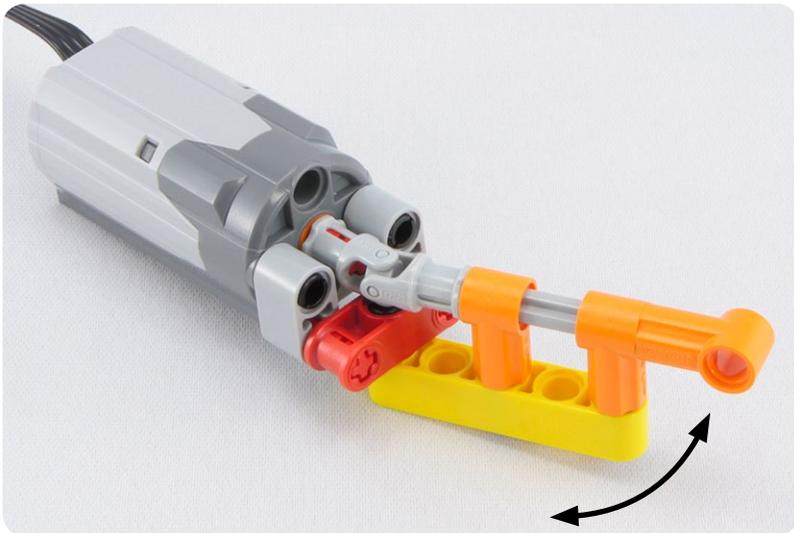
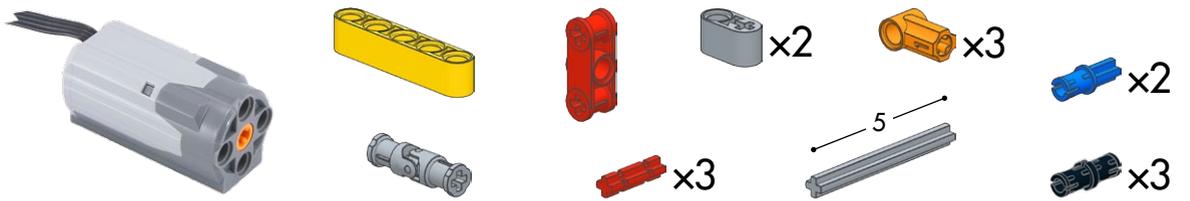
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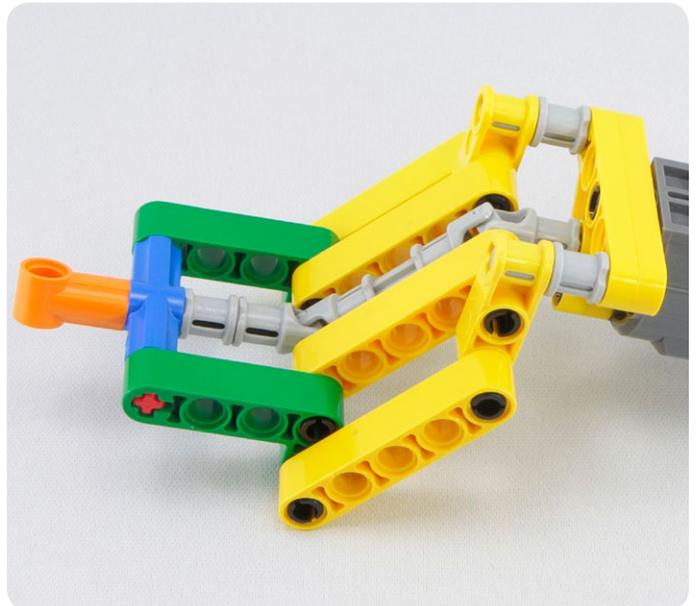
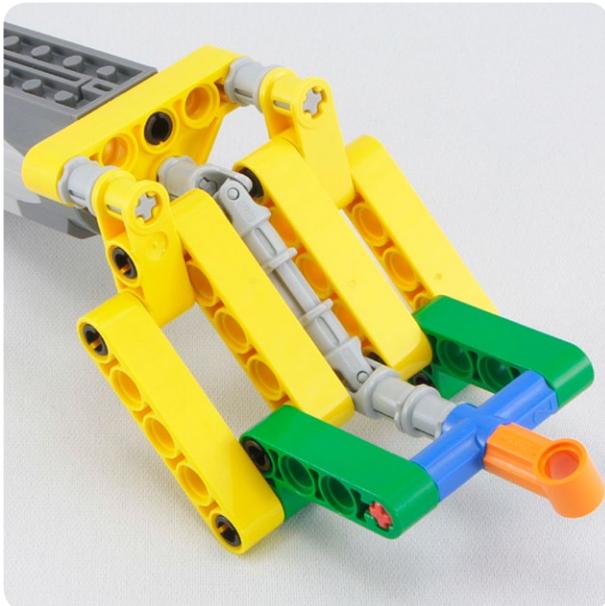
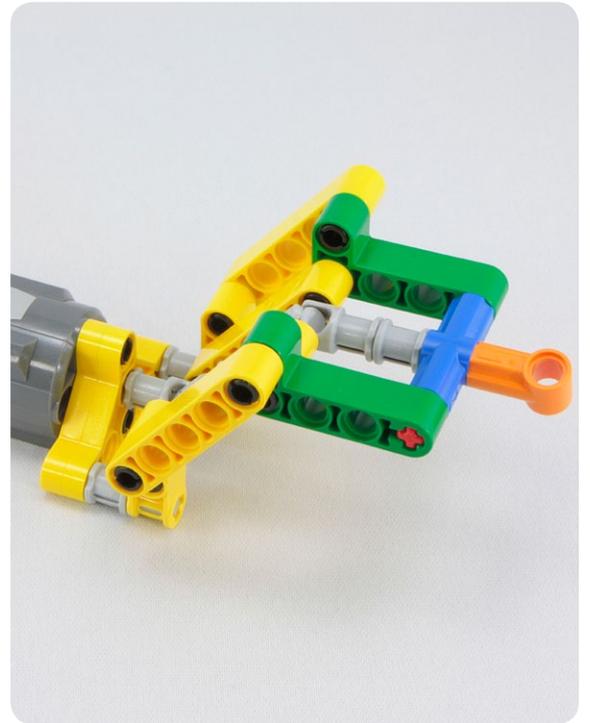
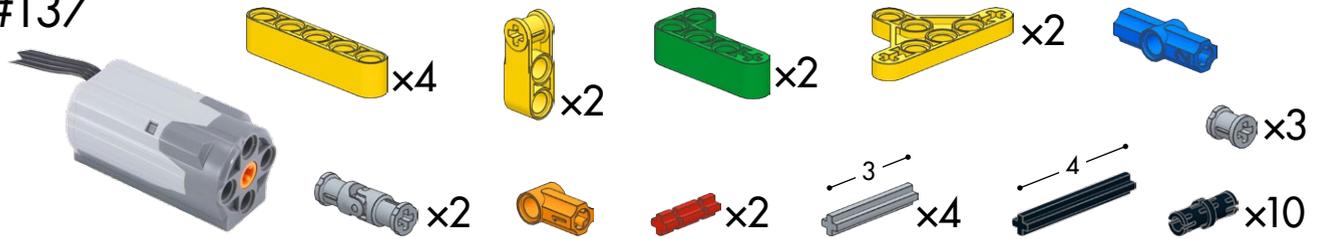
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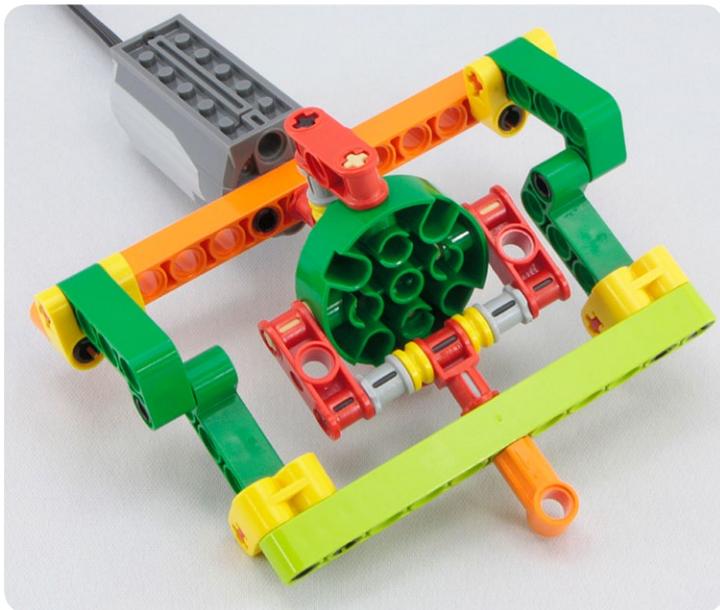
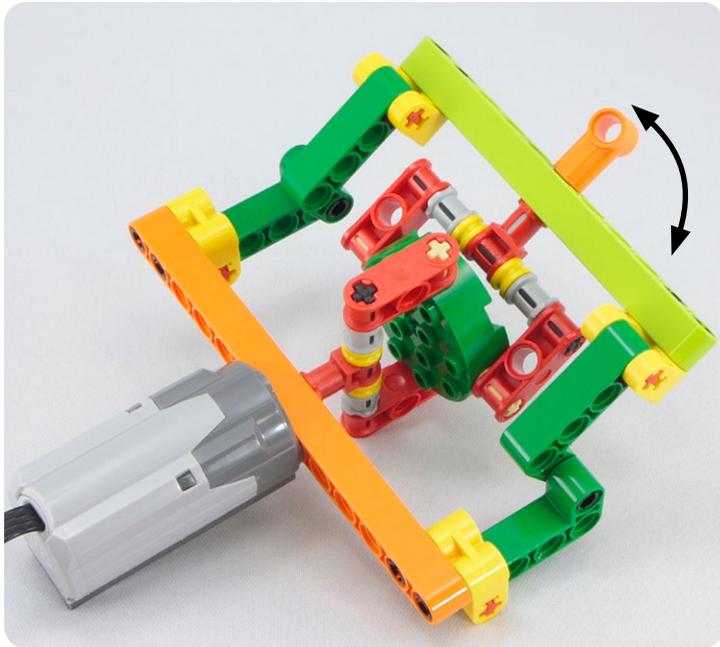
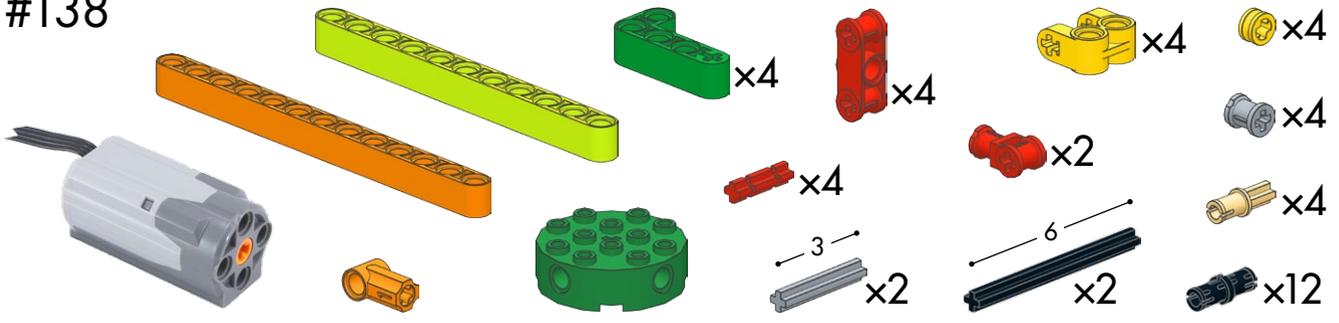
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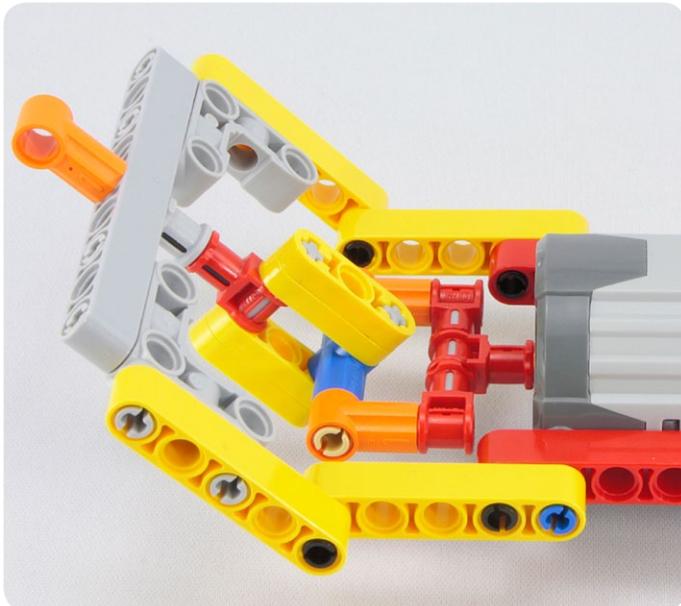
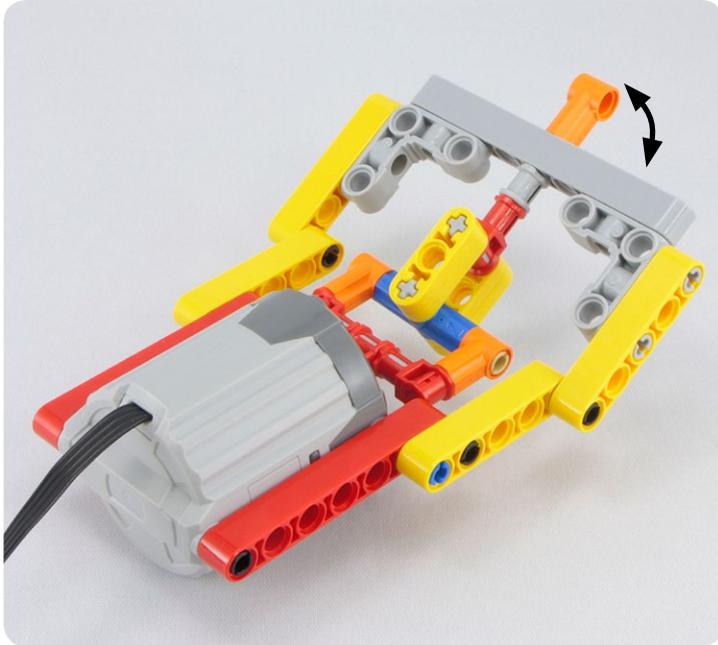
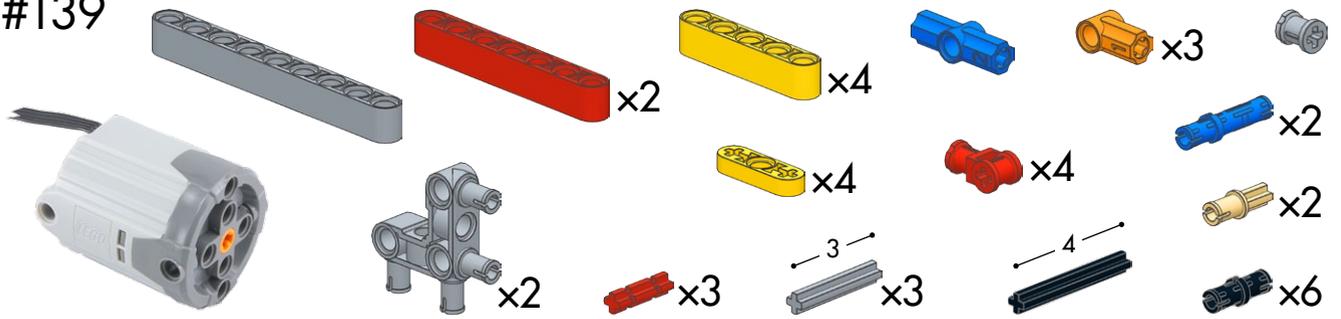
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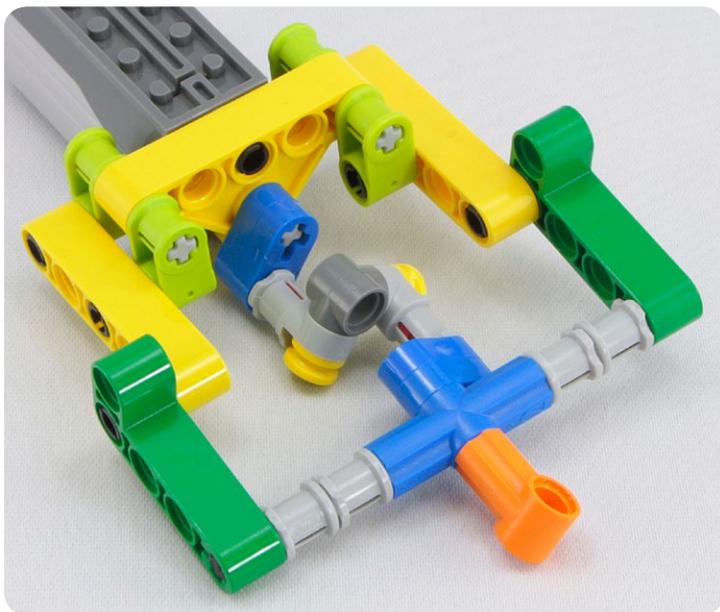
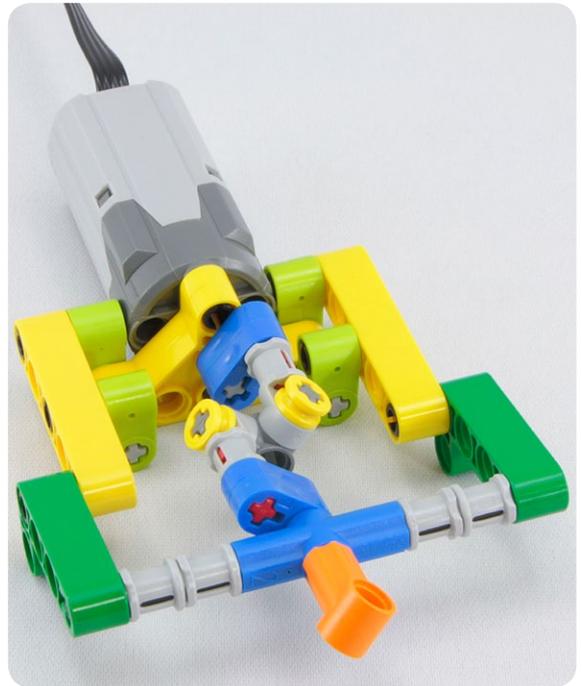
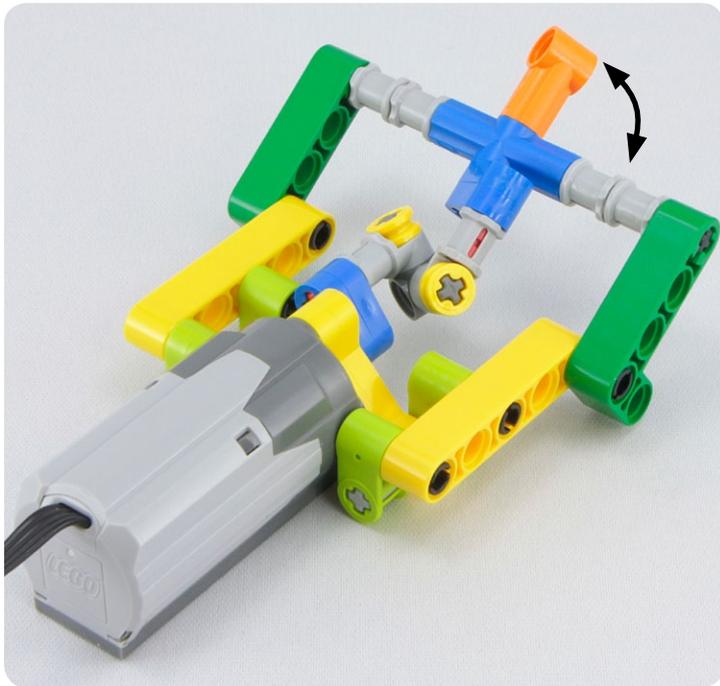
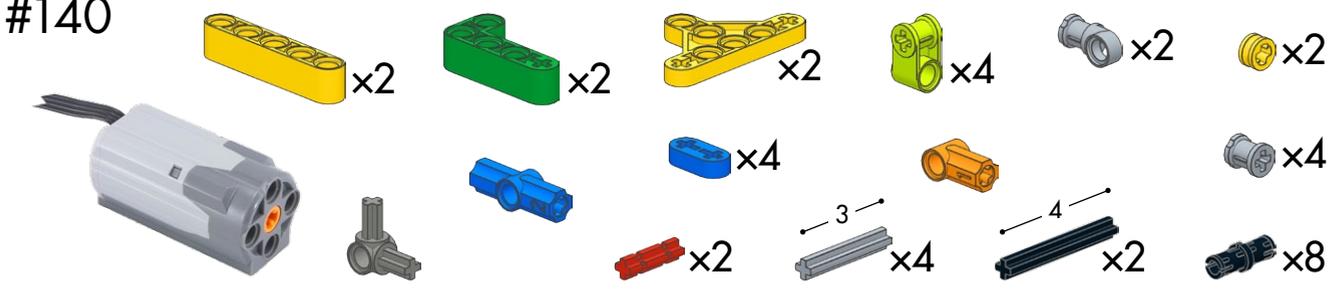
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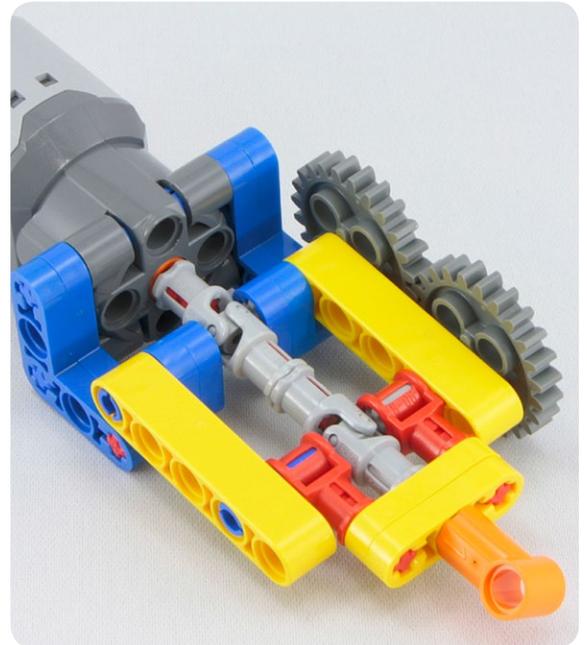
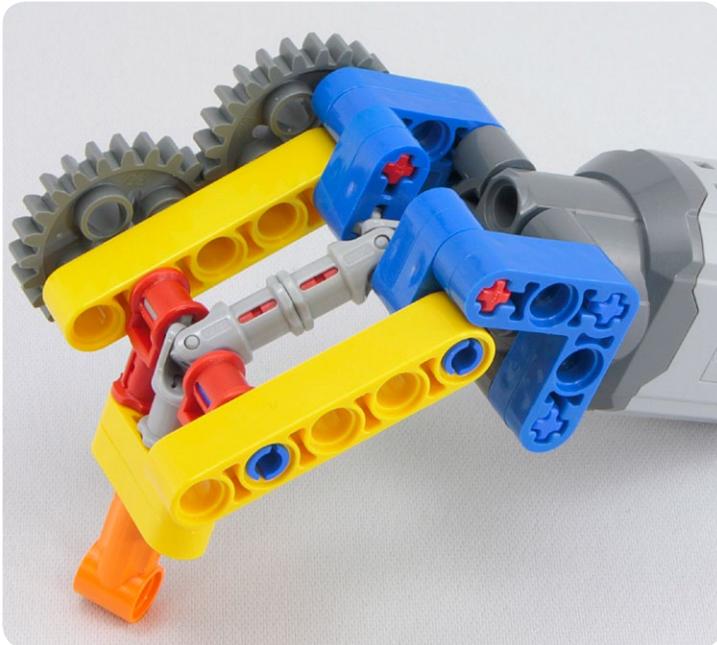
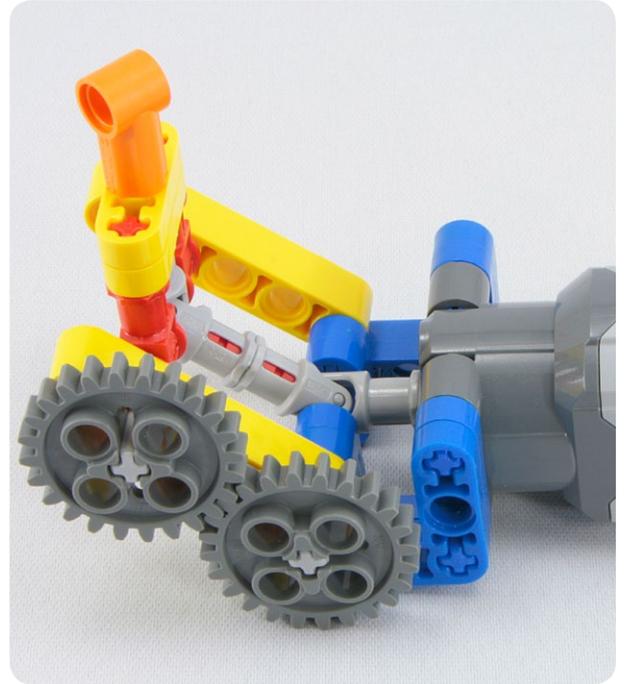
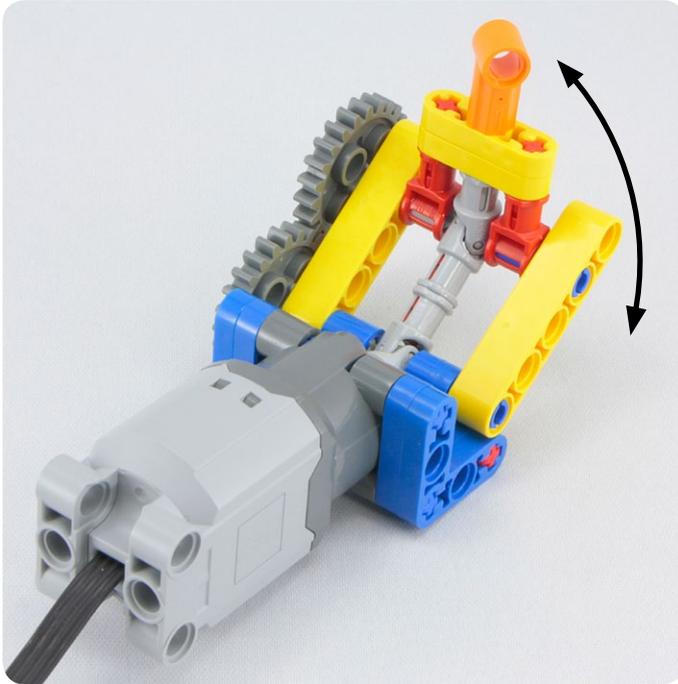
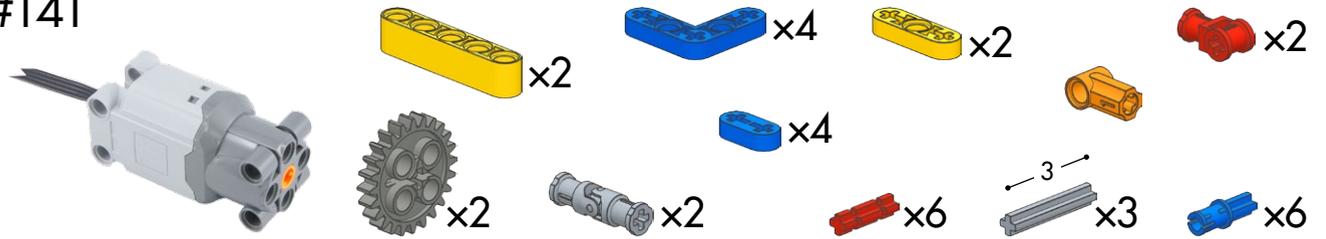
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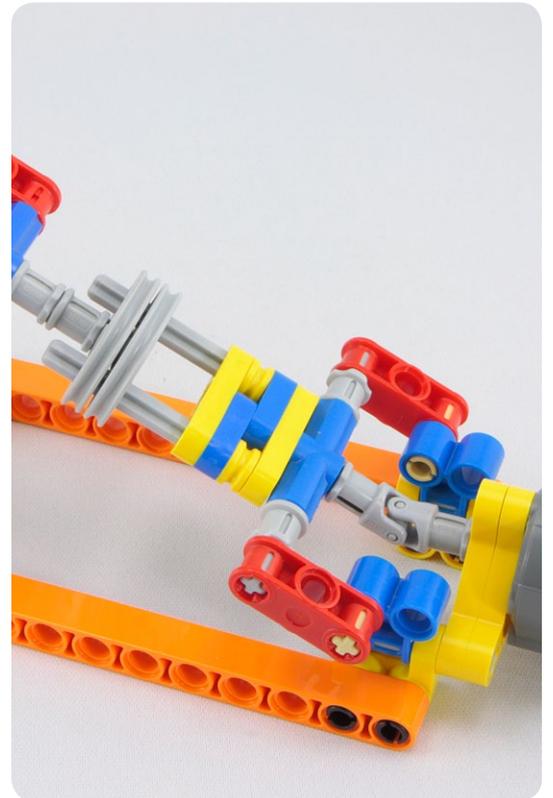
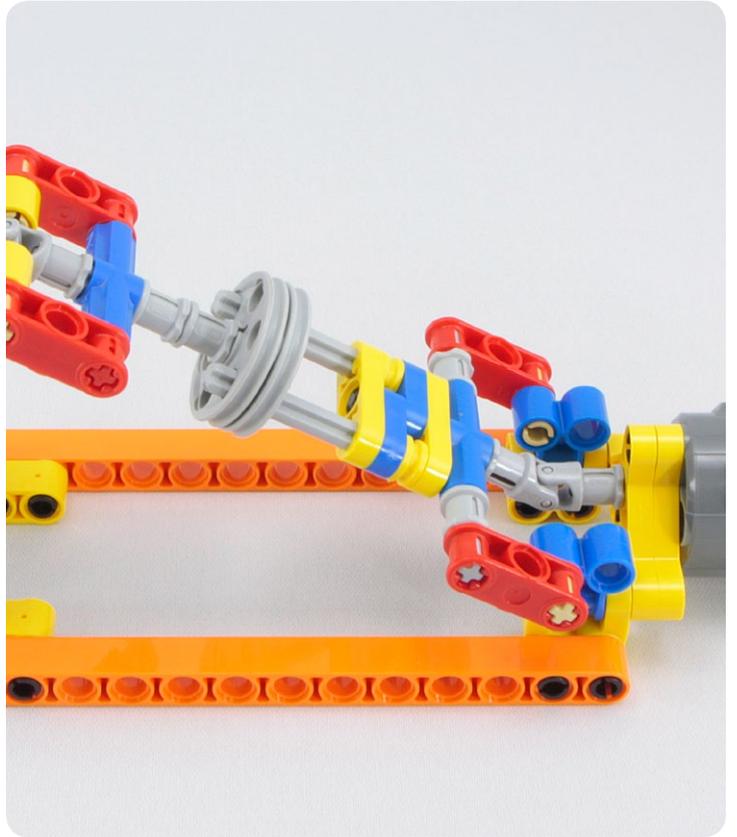


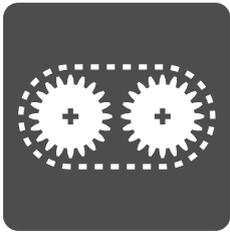
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#141

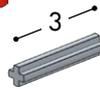




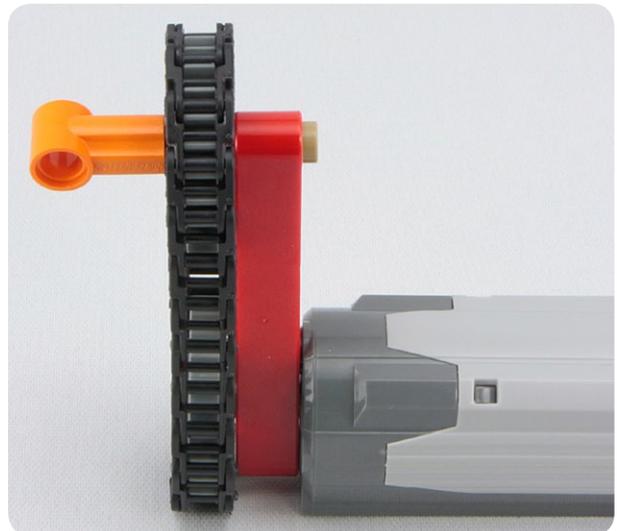


Transmitting rotation with chains and treads

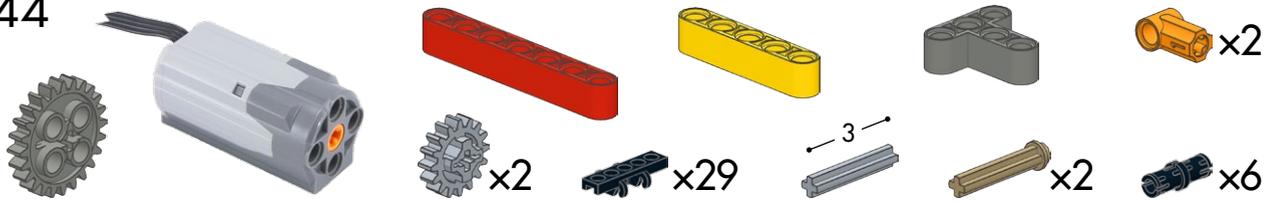
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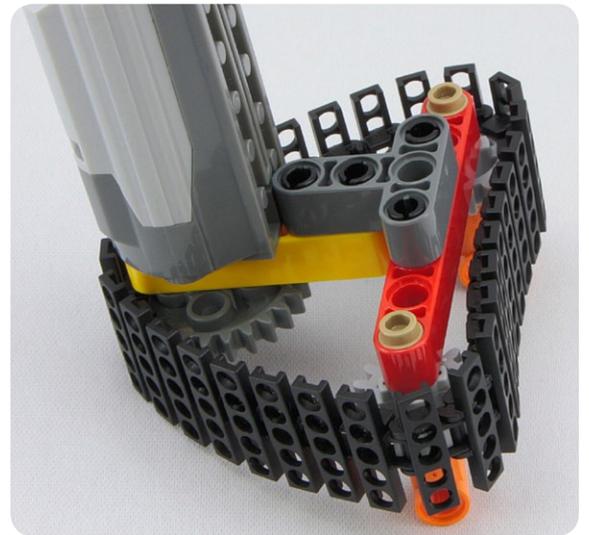
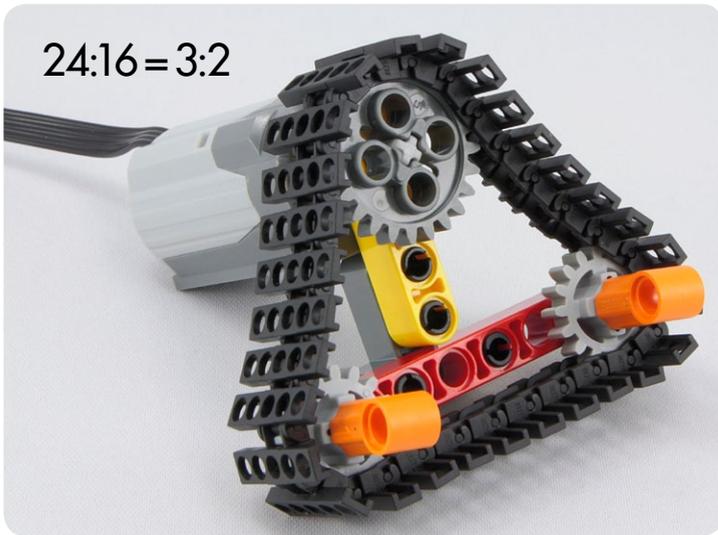
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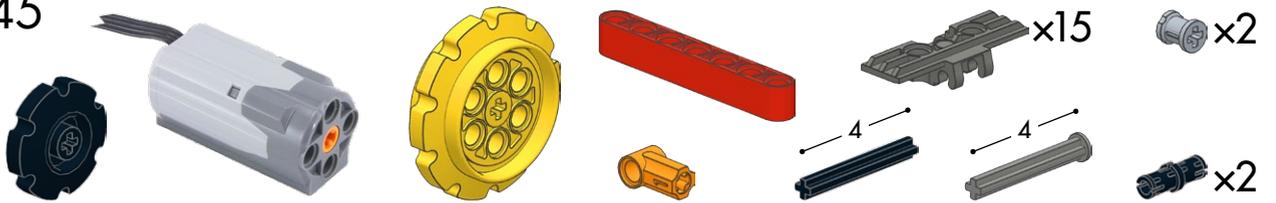
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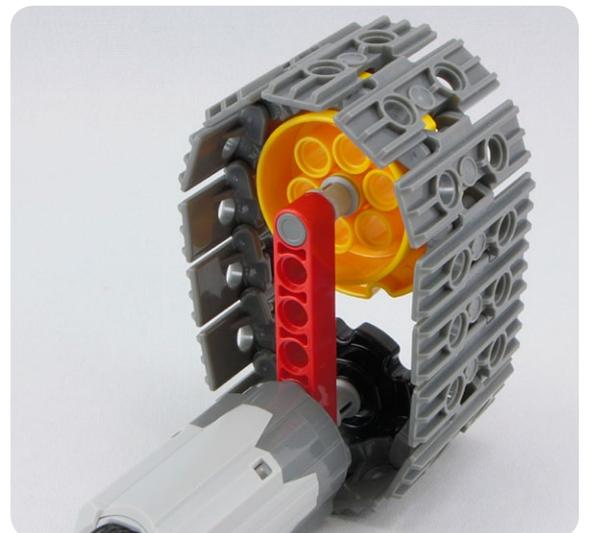
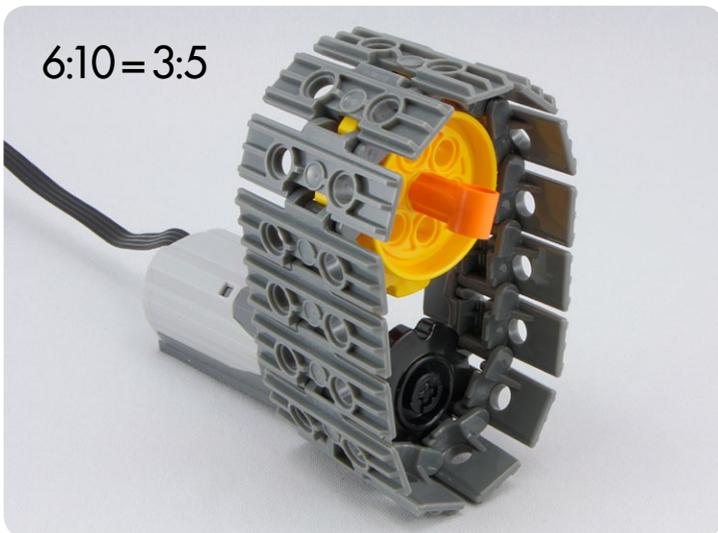
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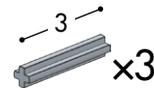
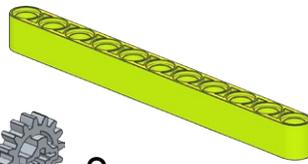
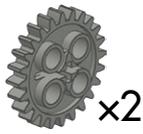
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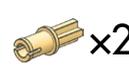
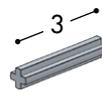
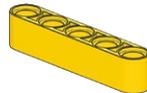
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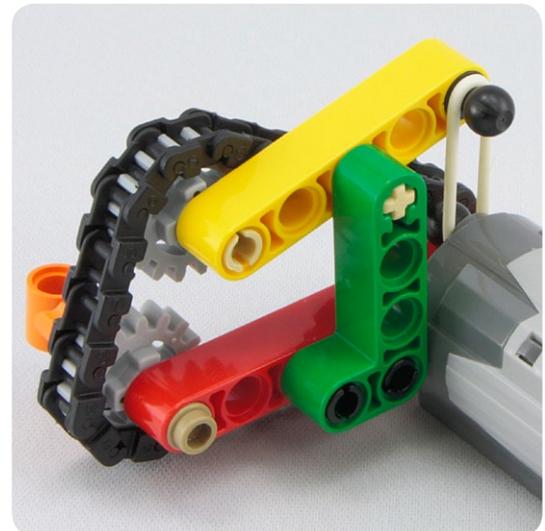
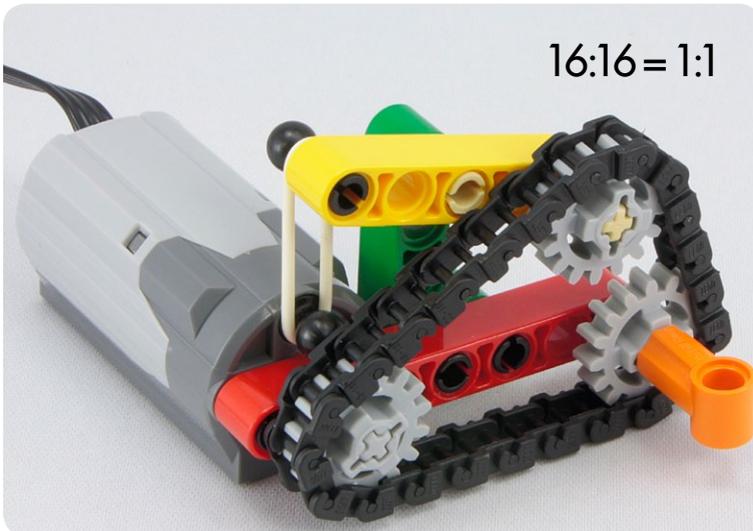
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 $16:24 = 6:9$



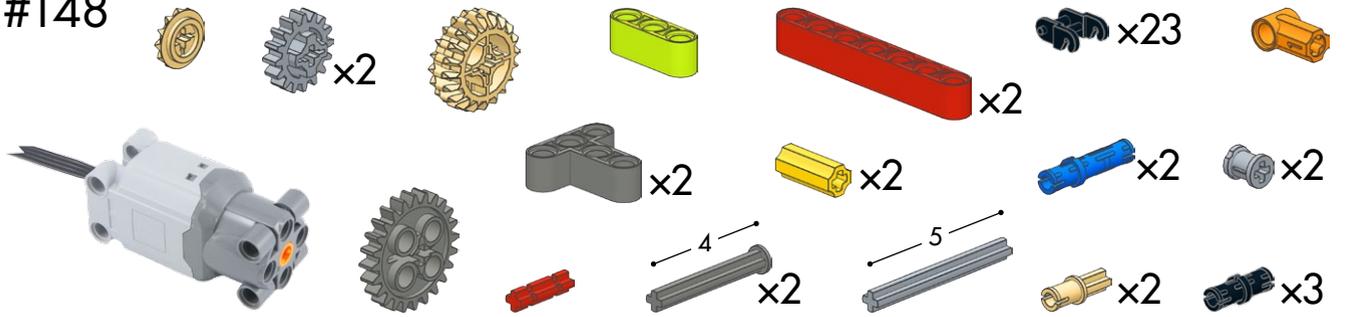
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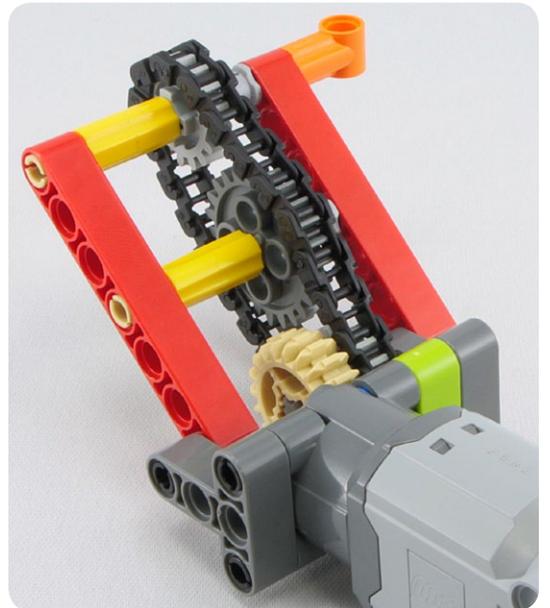
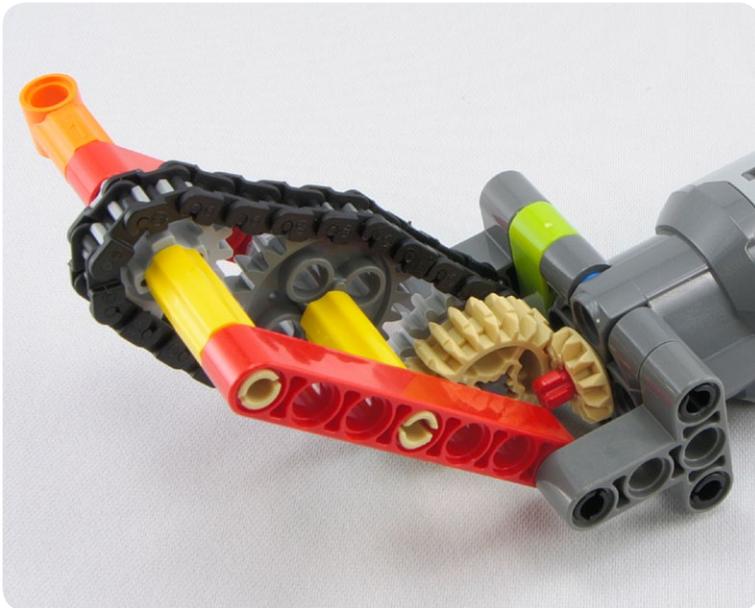
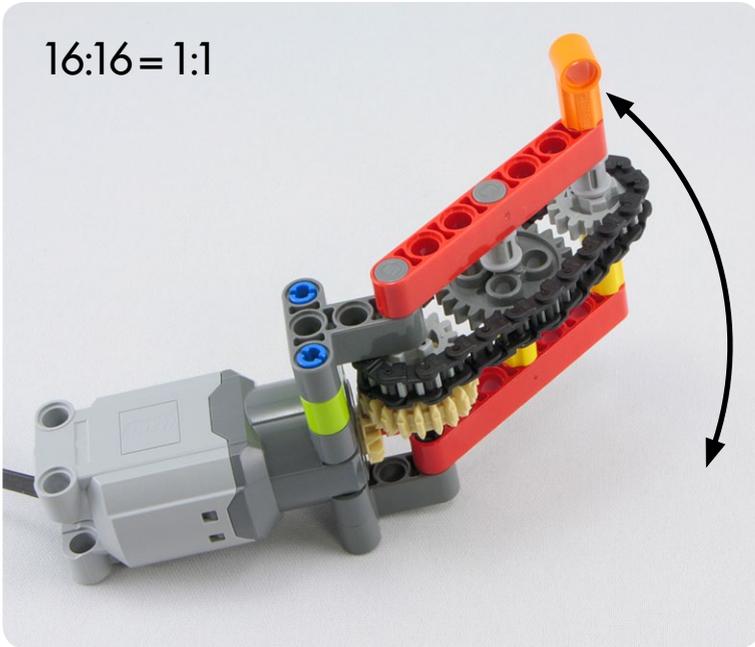
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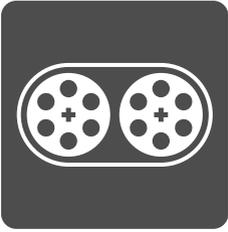


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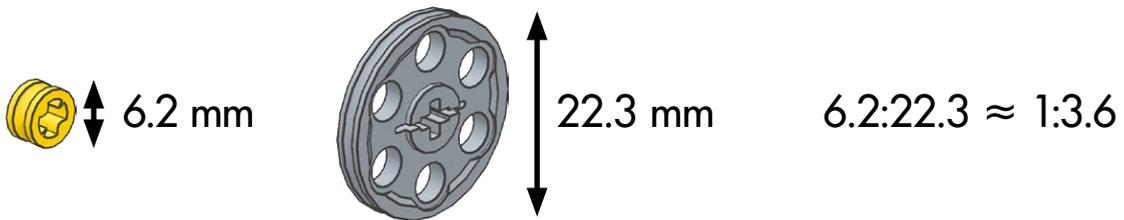
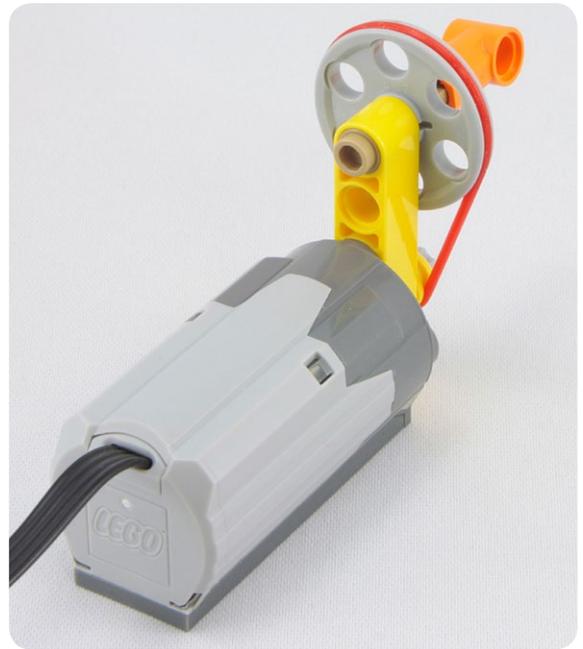
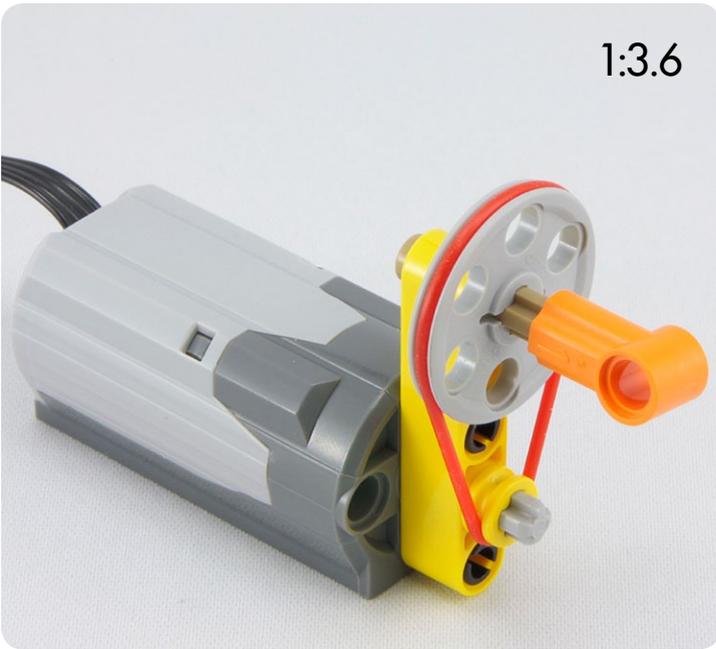
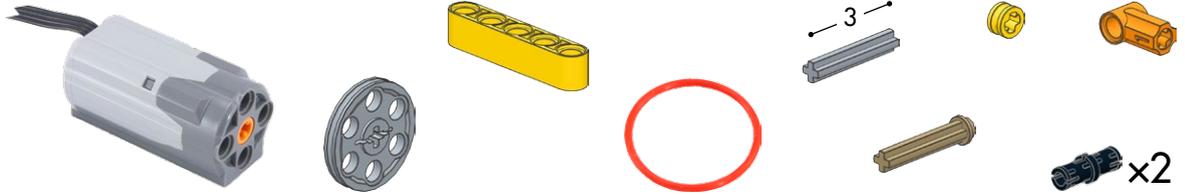
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Transmitting rotation with rubber bands

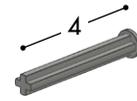
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#150



x2



4

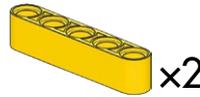
4



x2



#151



x2



x2



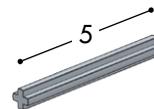
x2



x2



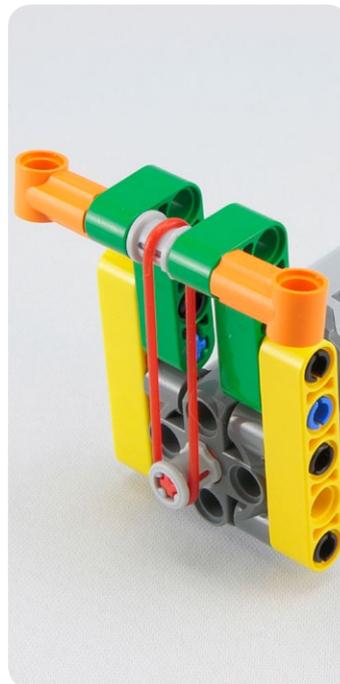
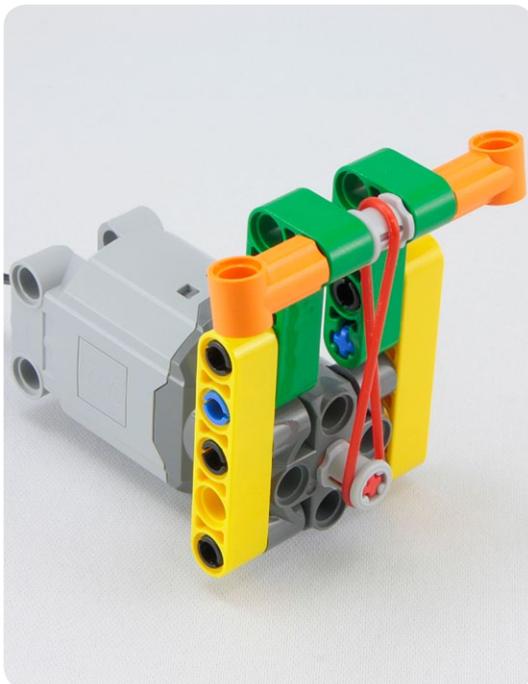
x2



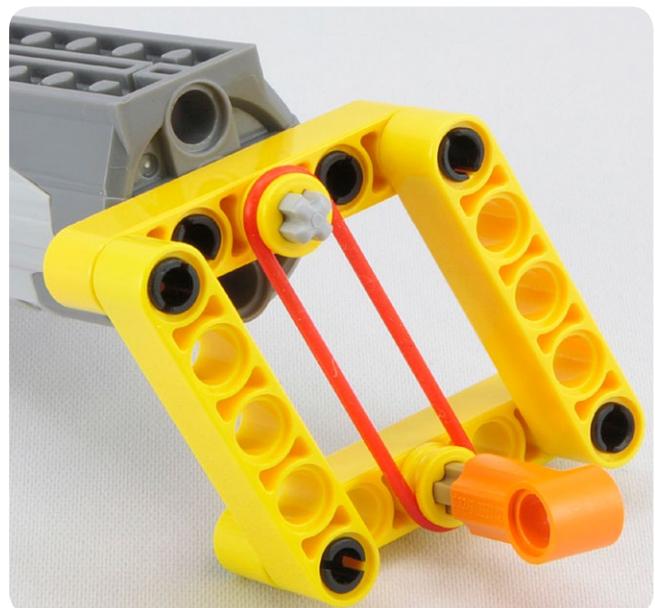
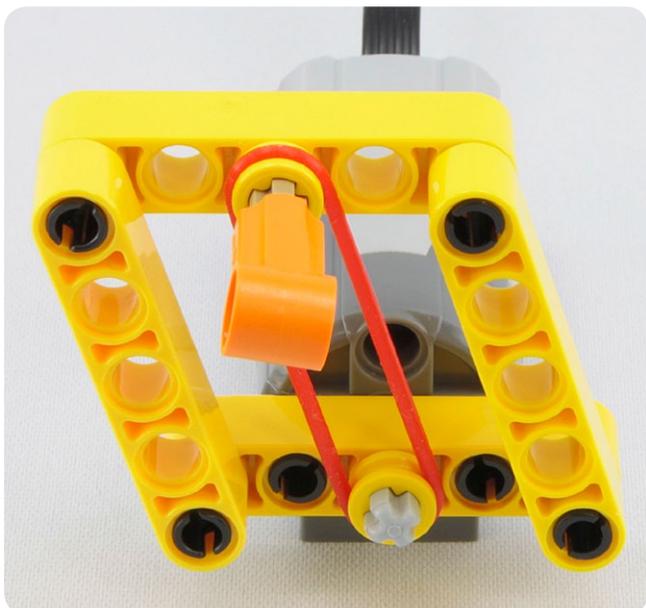
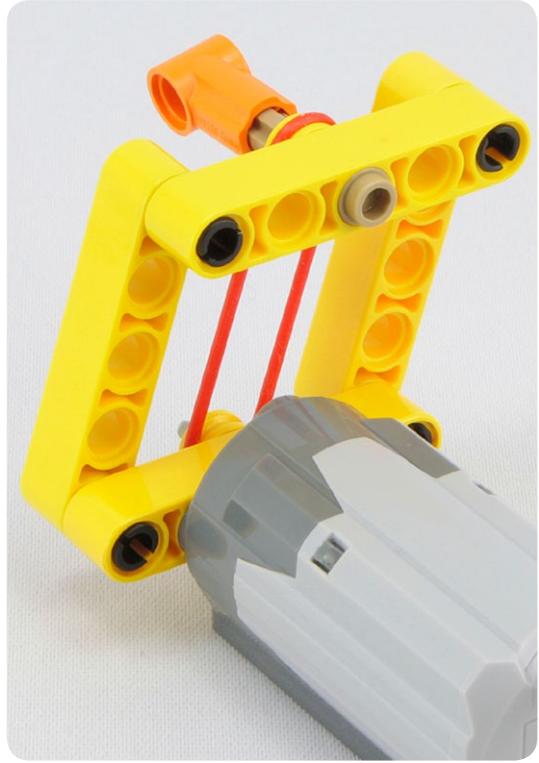
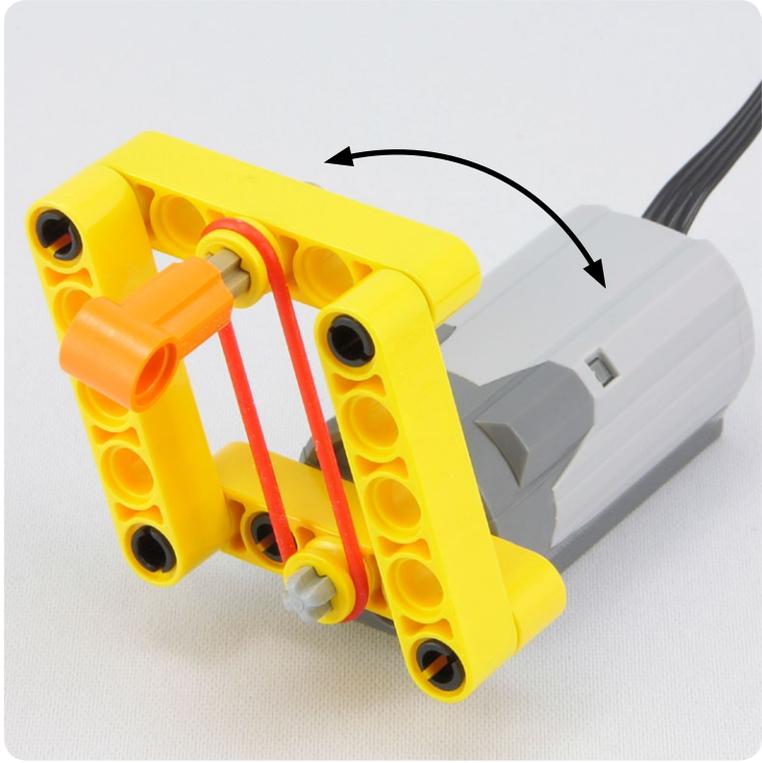
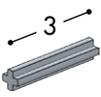
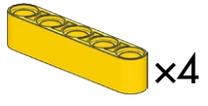
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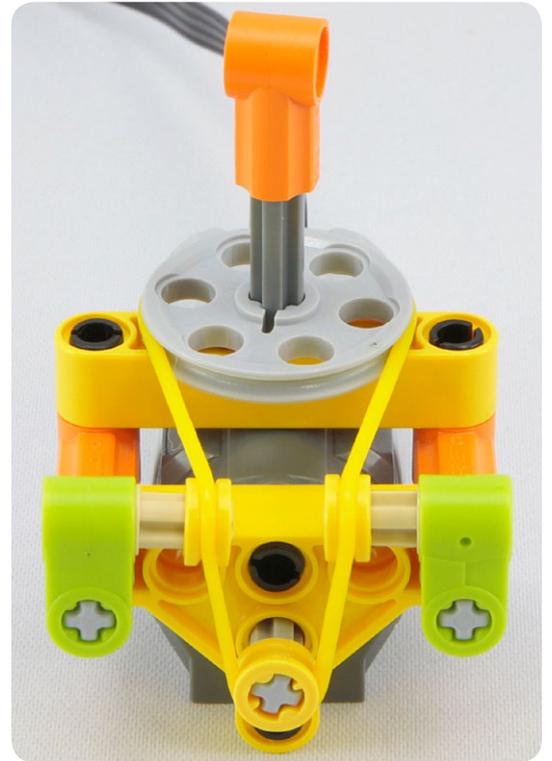
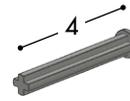
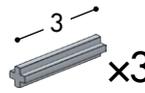
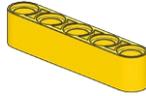
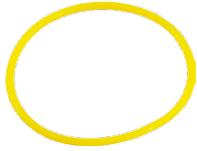
x6

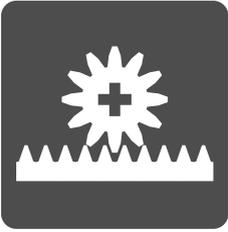


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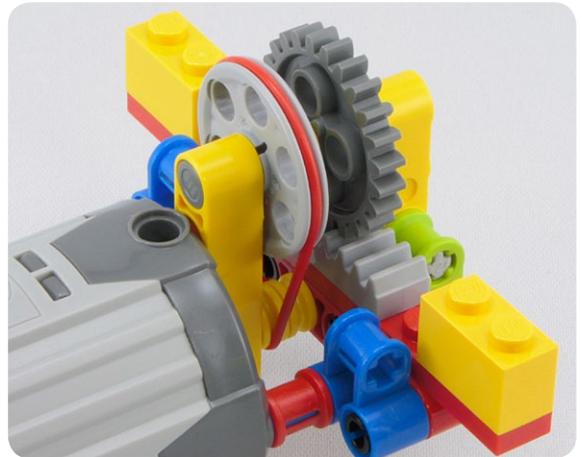
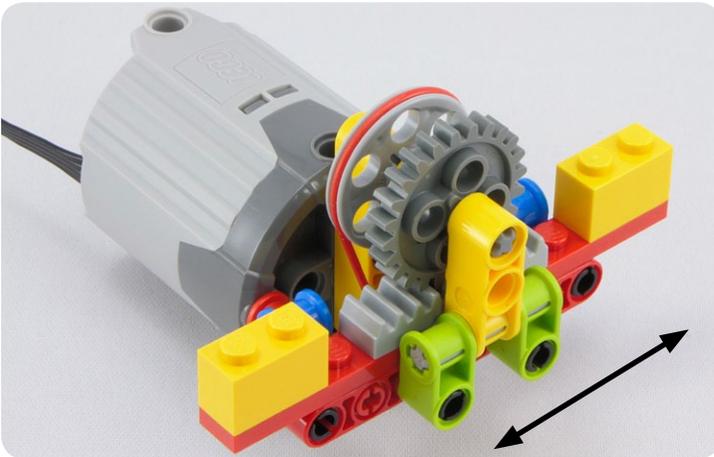
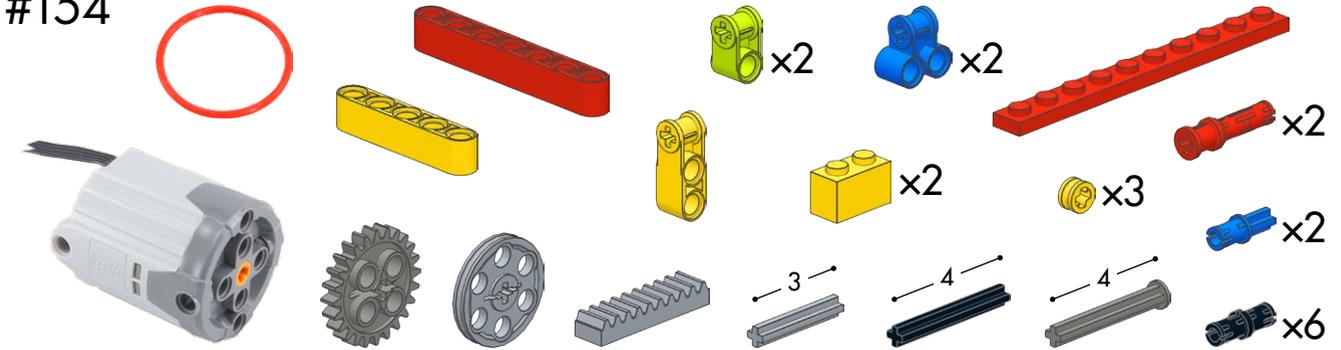
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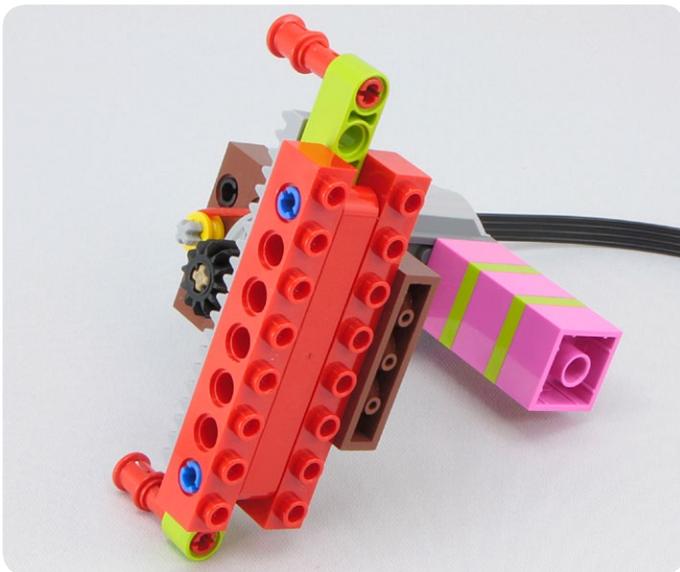
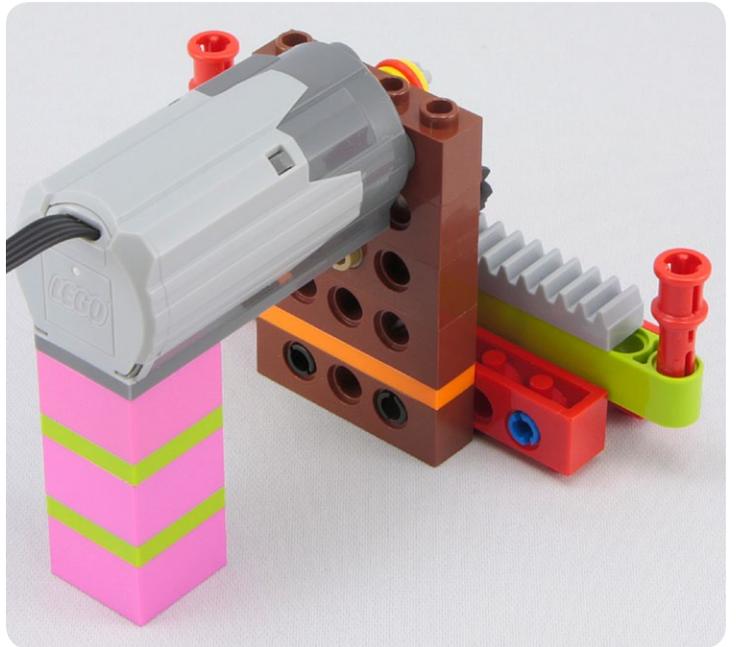
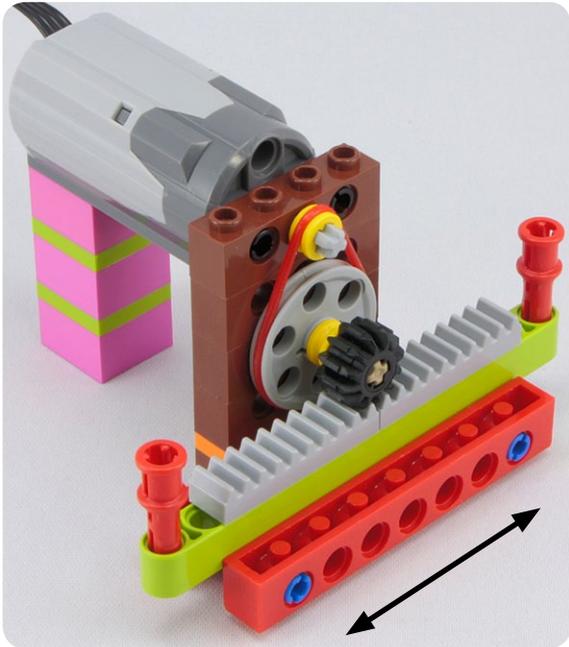
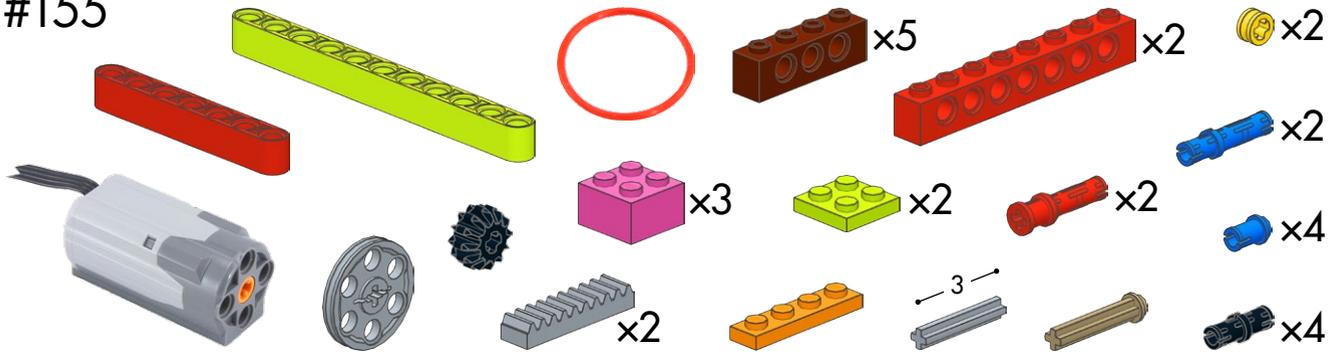


Rack-and-pinion gears

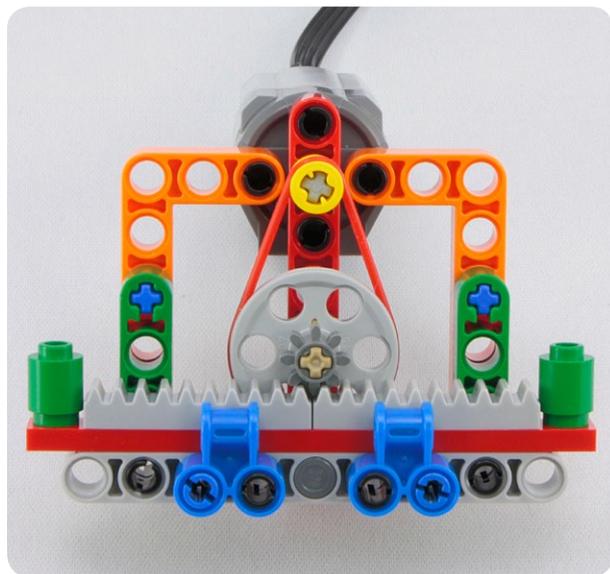
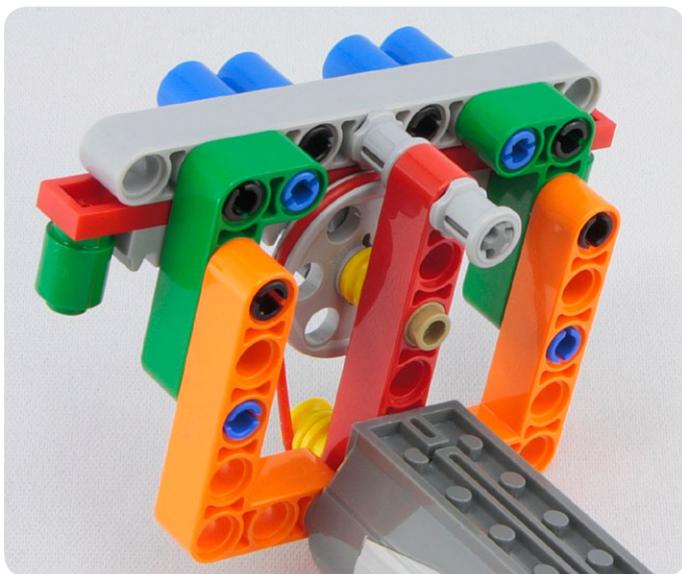
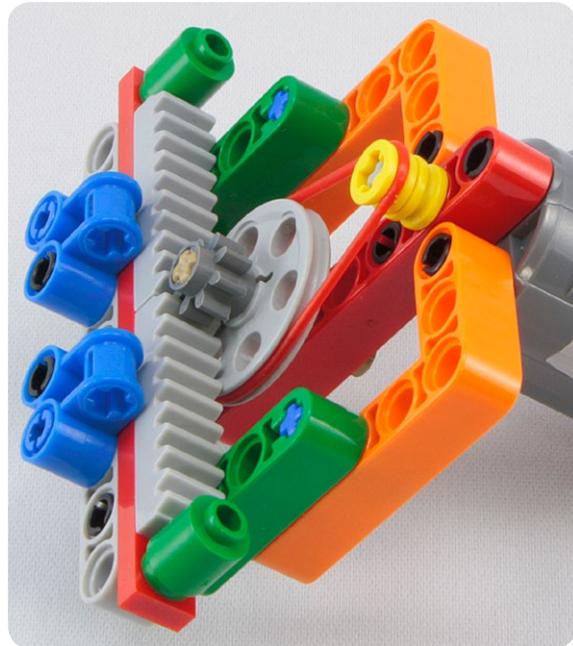
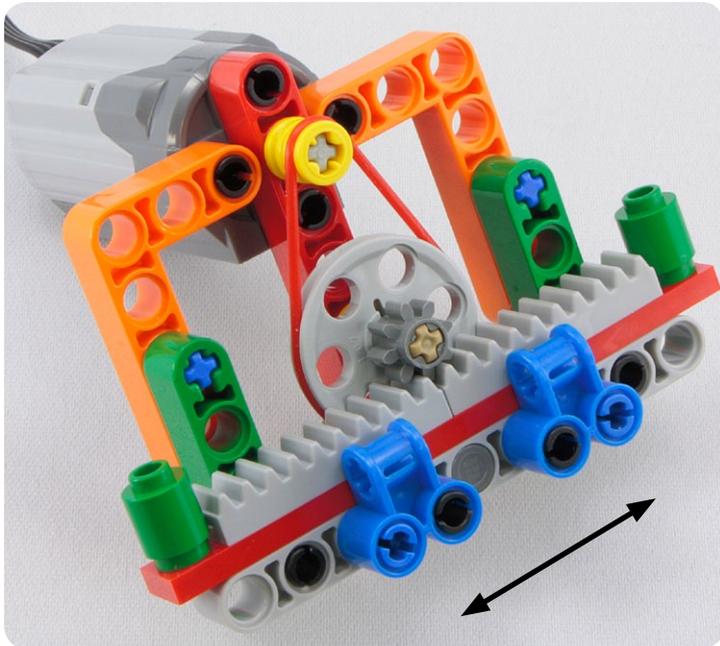
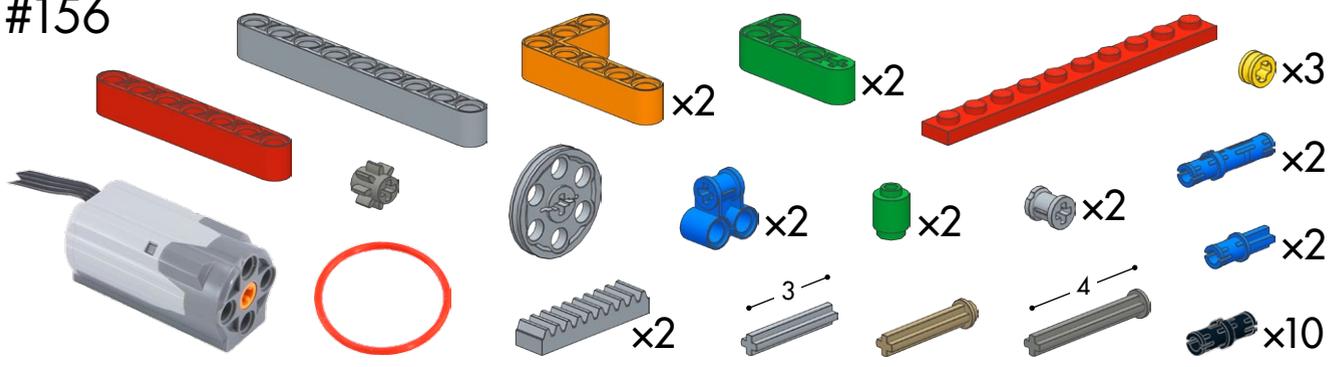
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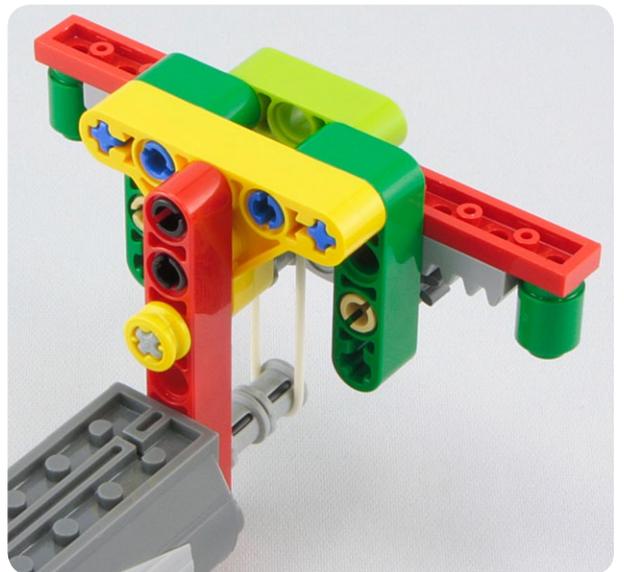
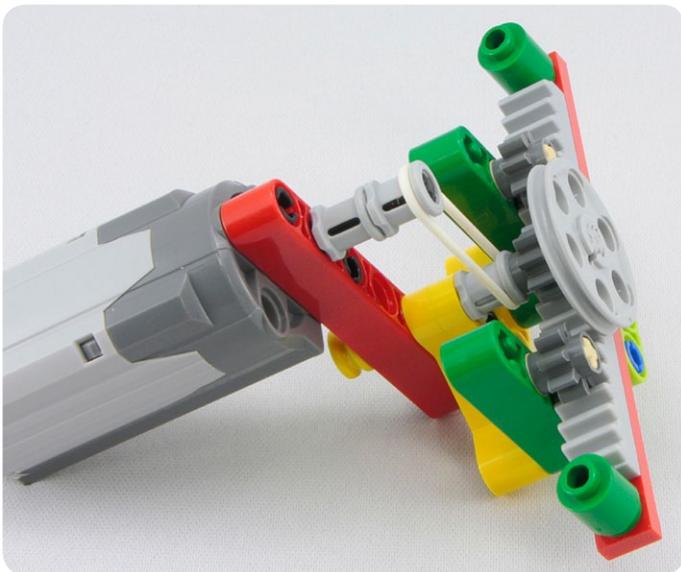
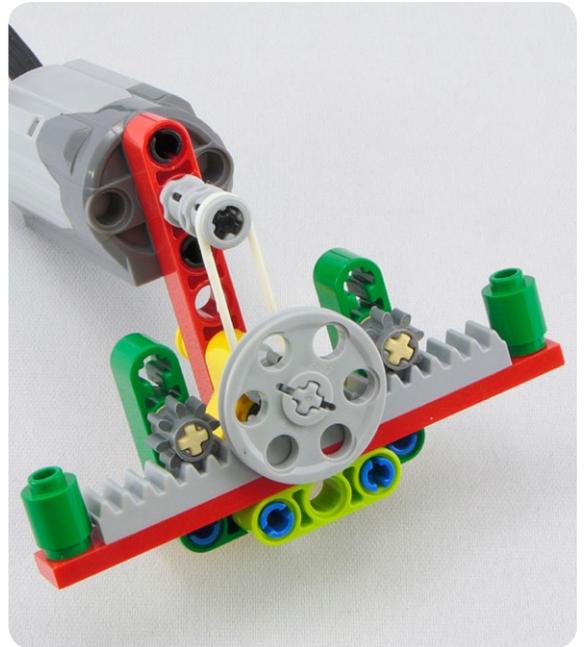
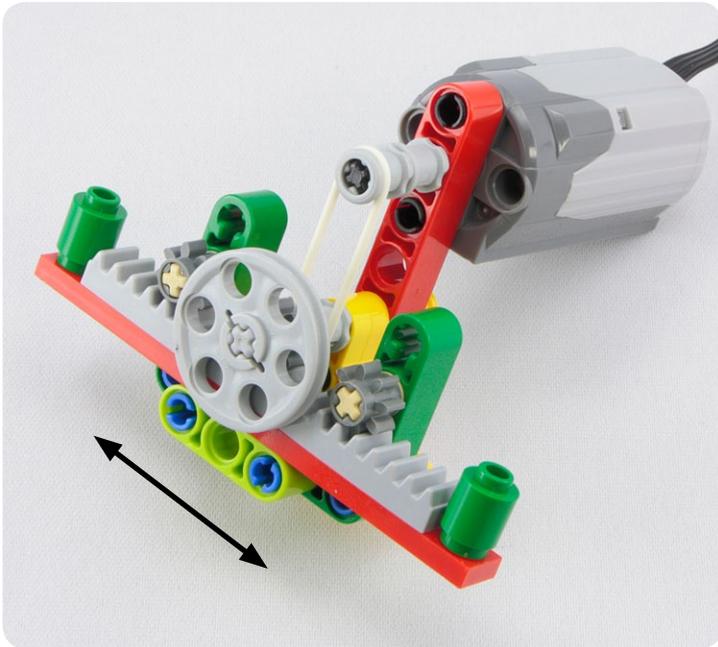
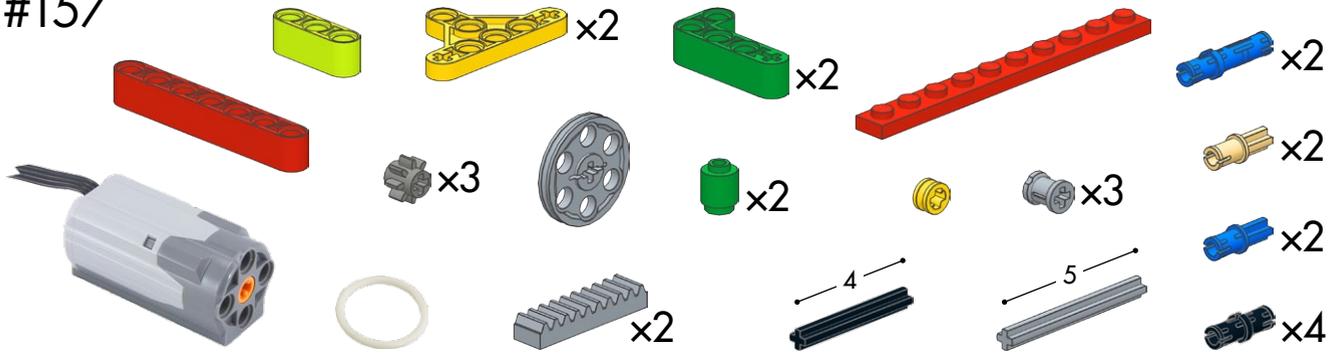
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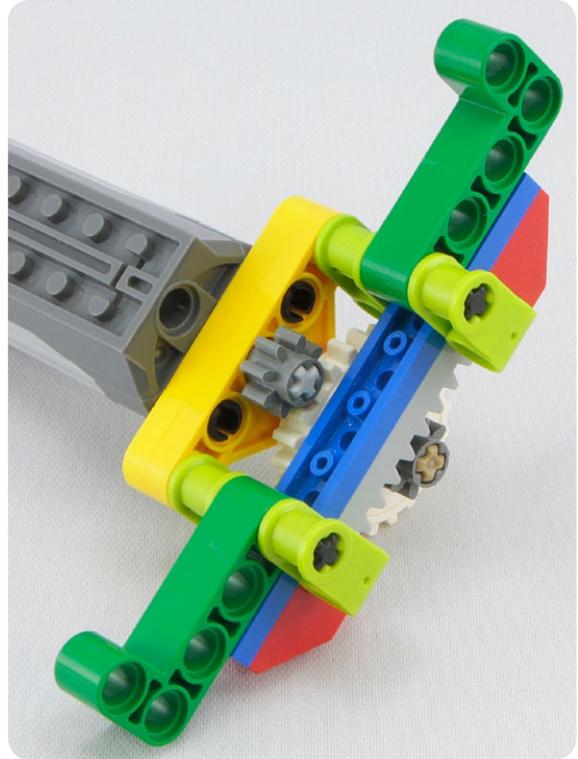
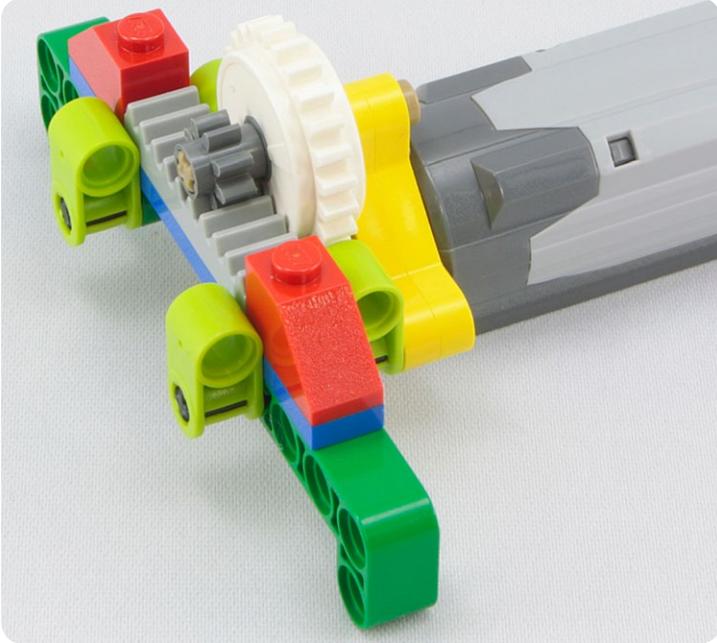
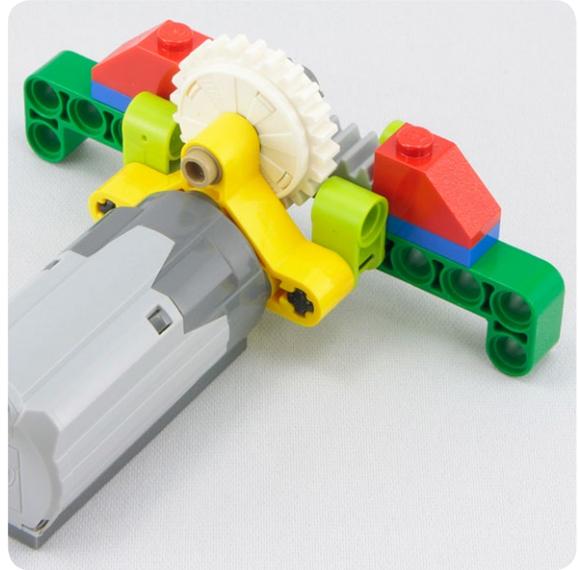
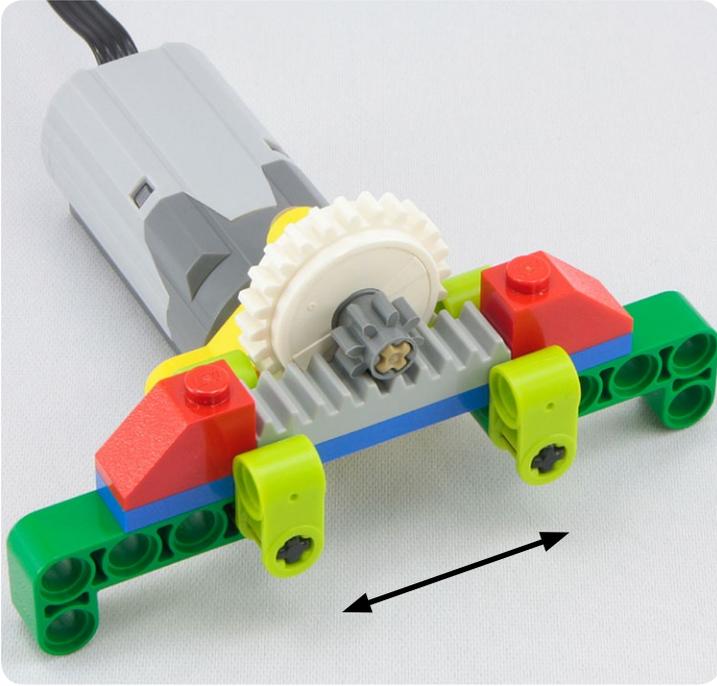
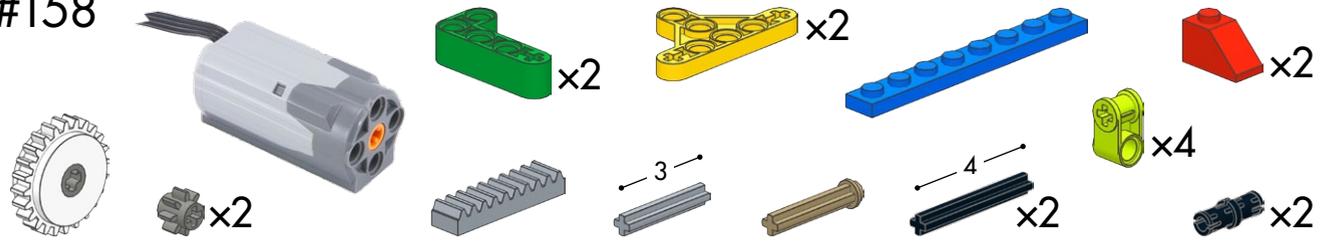
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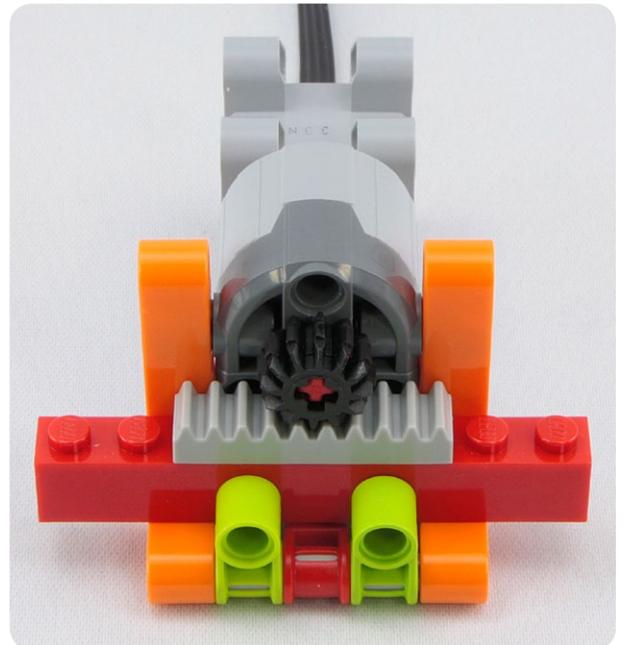
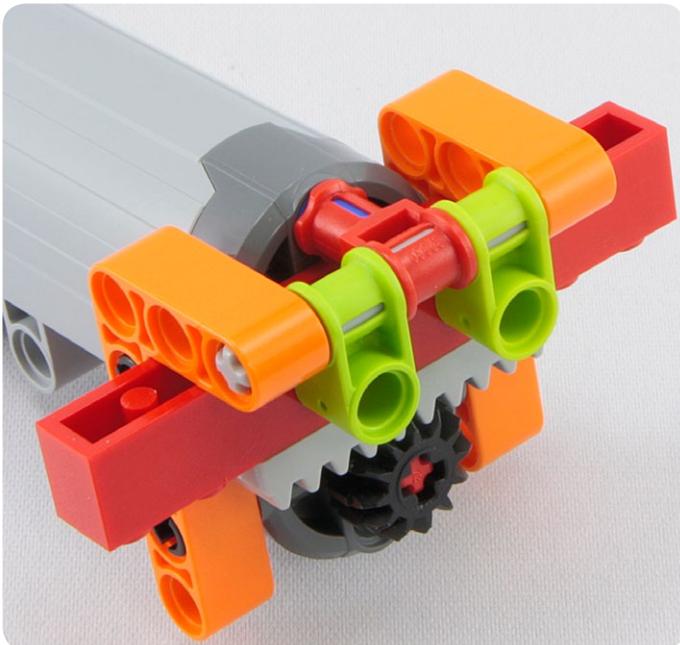
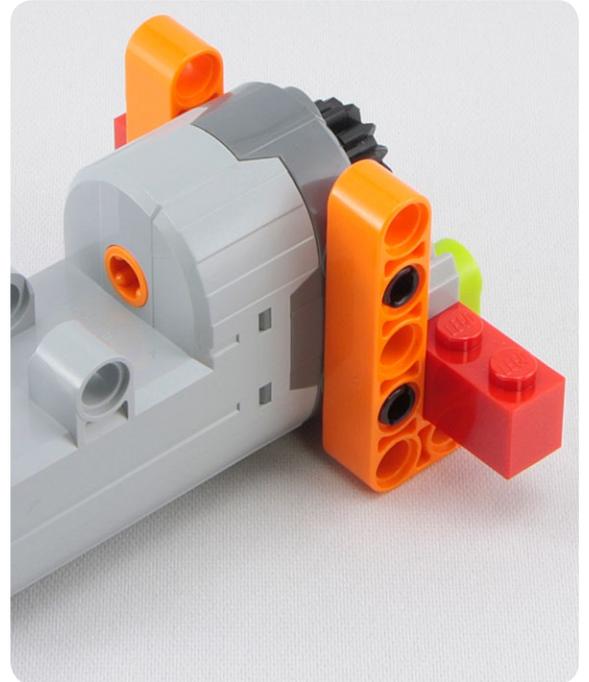
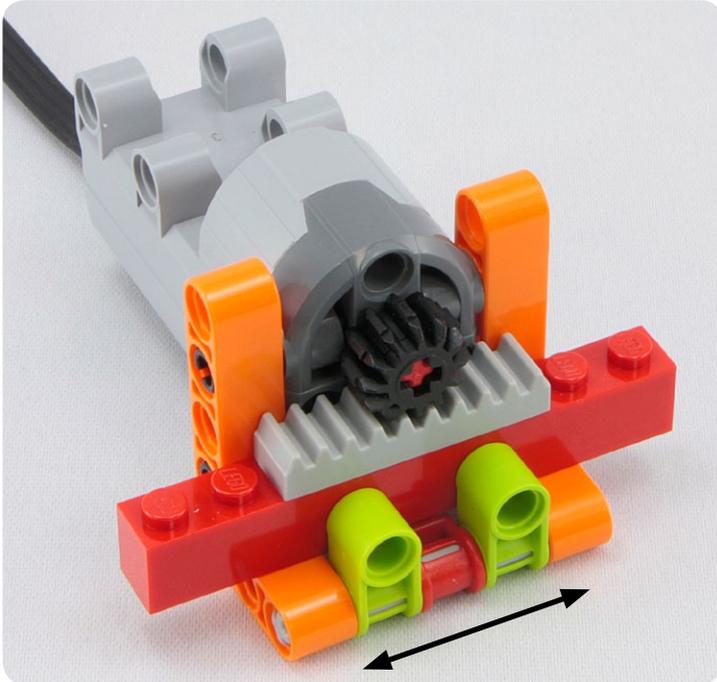
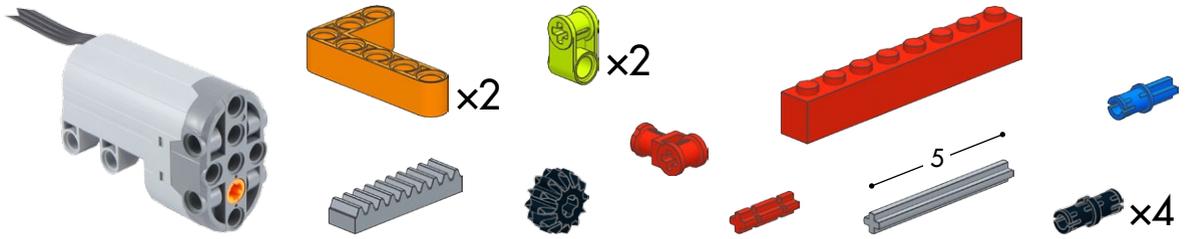
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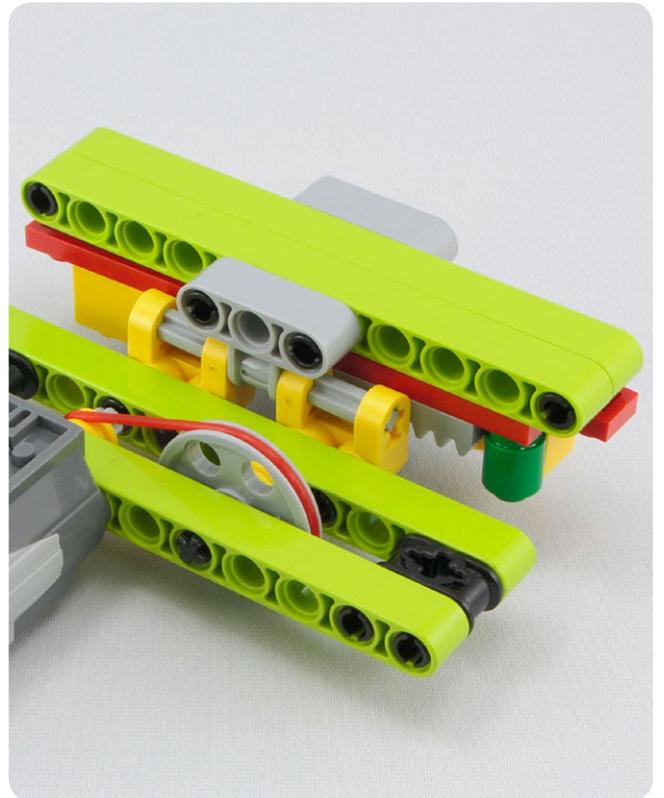
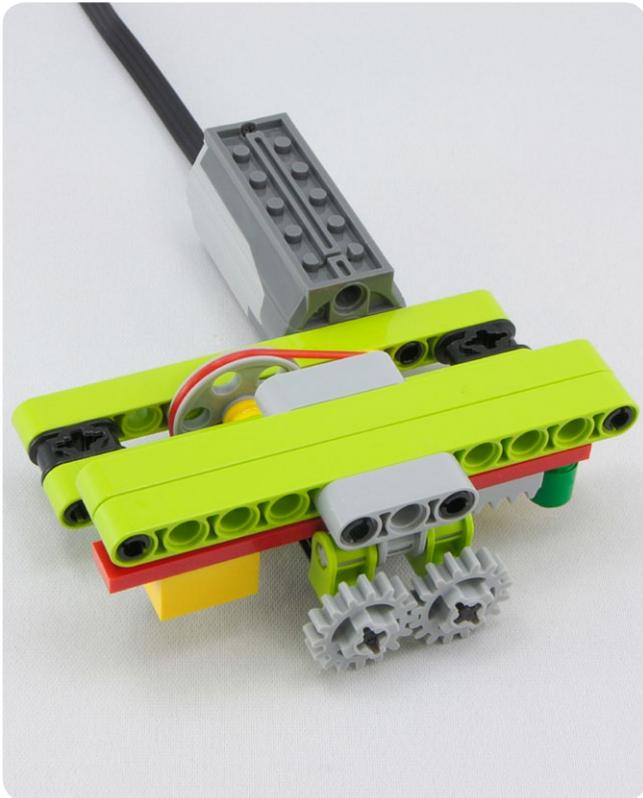
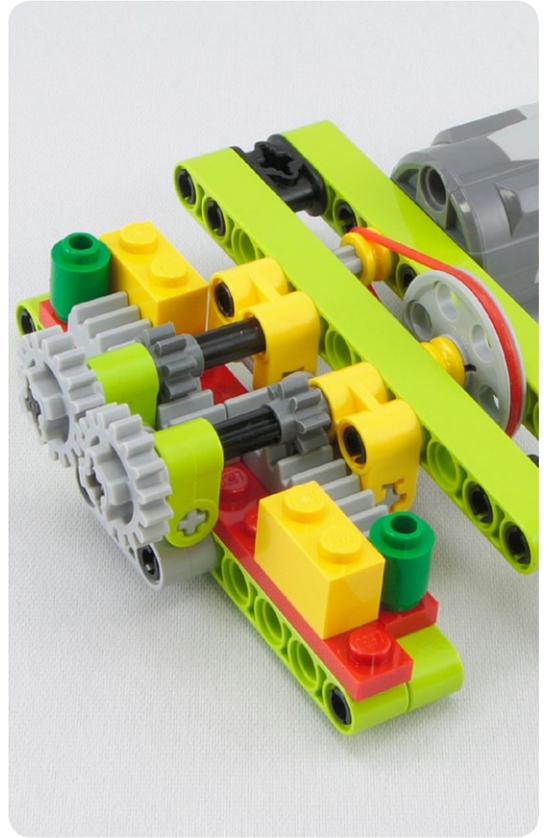
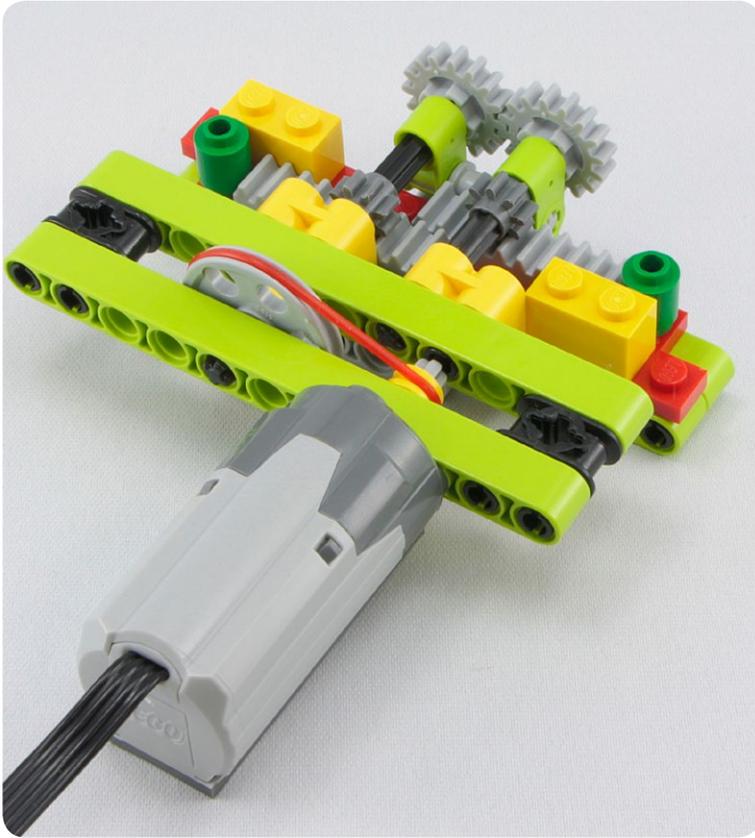


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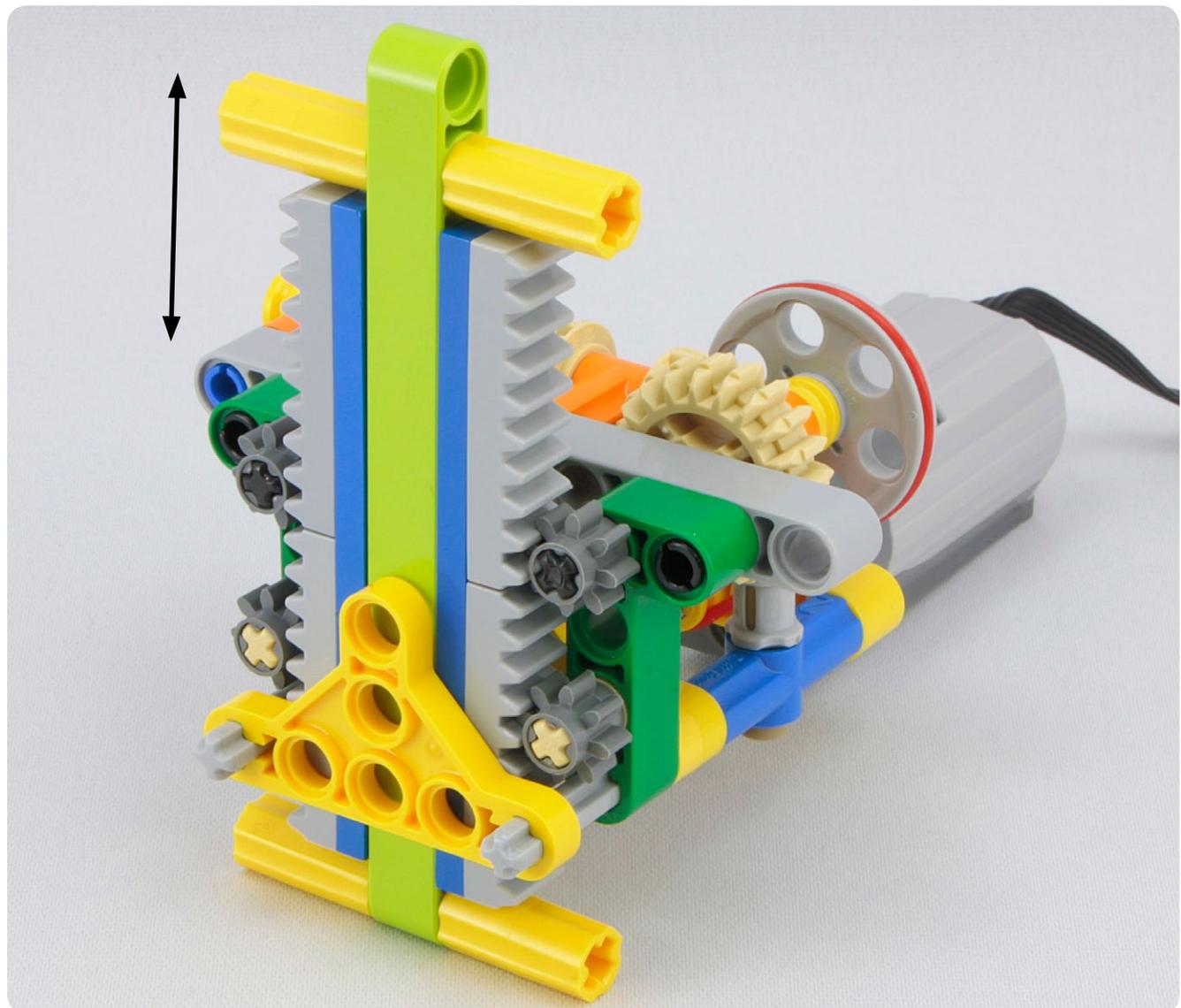
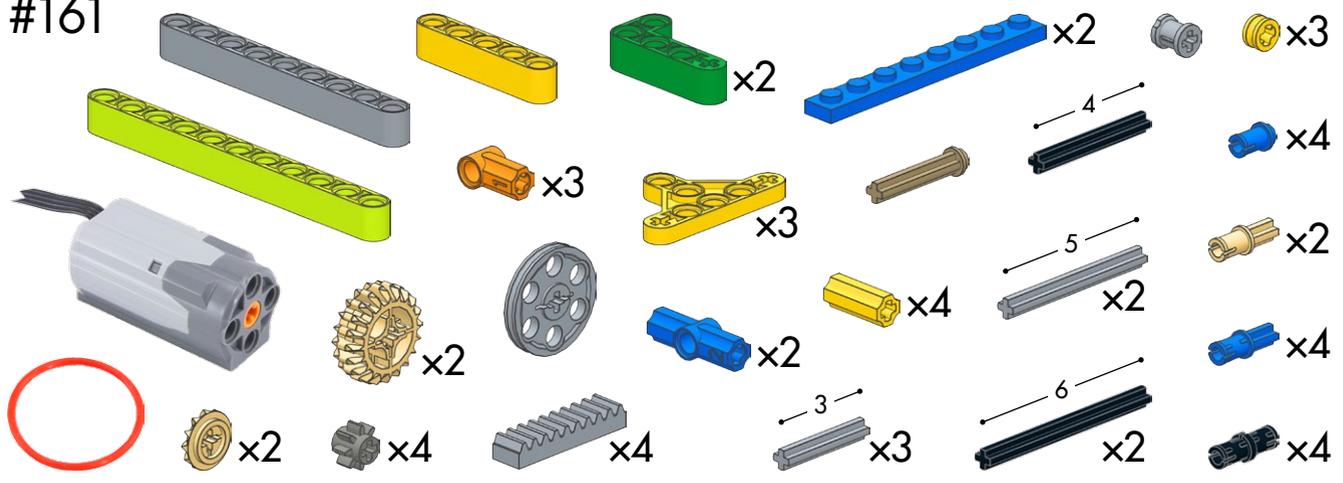


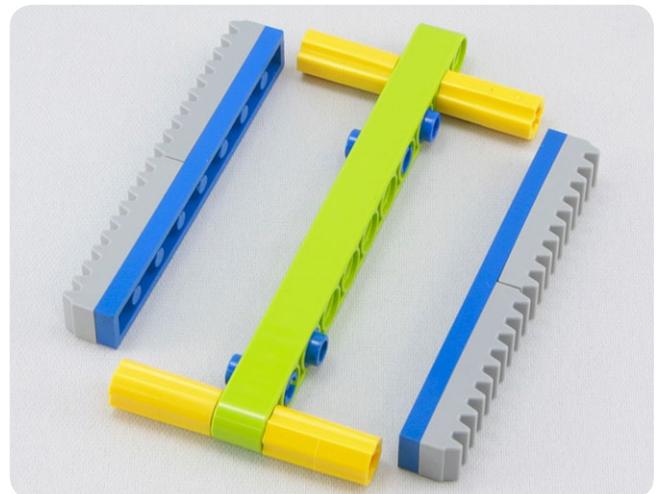
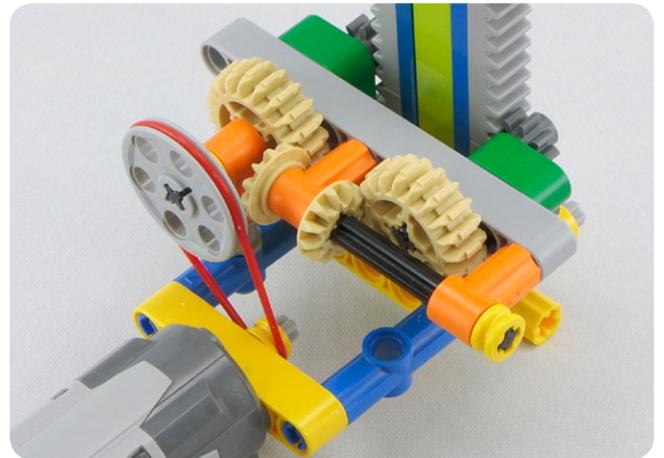
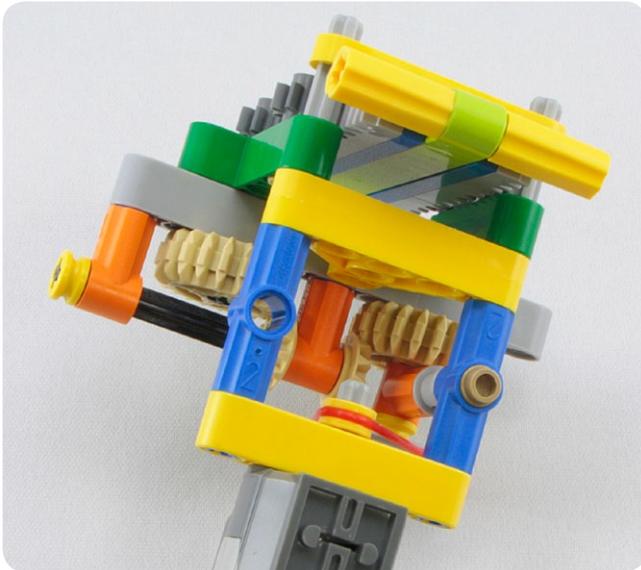
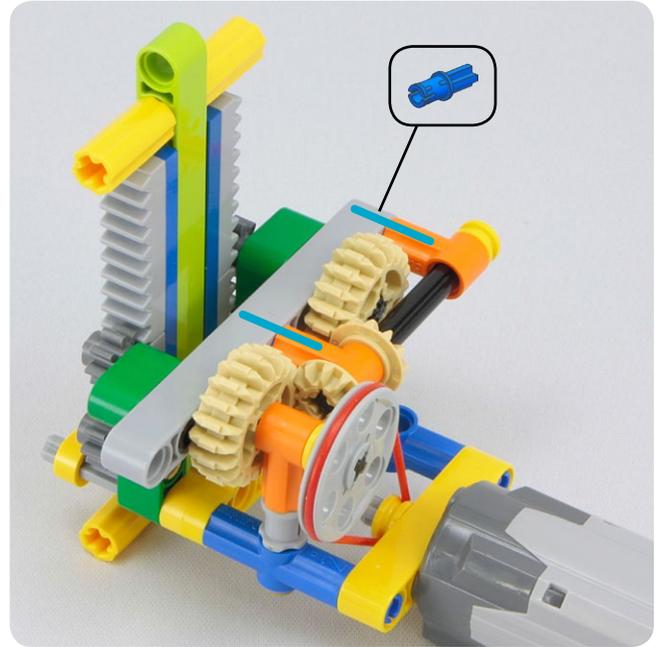
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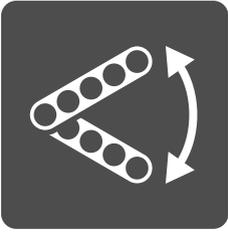




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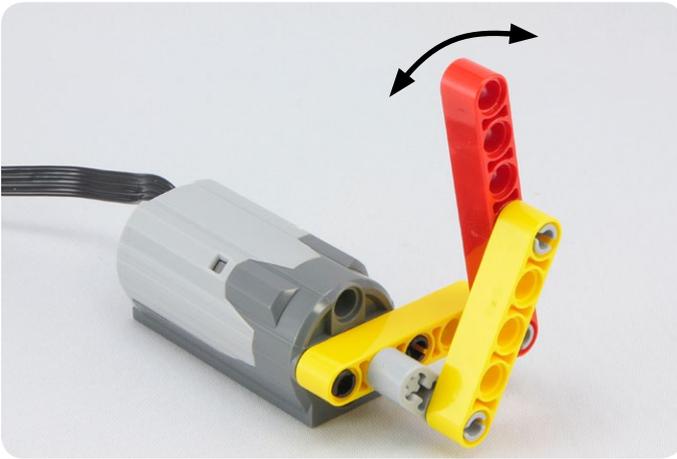
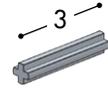




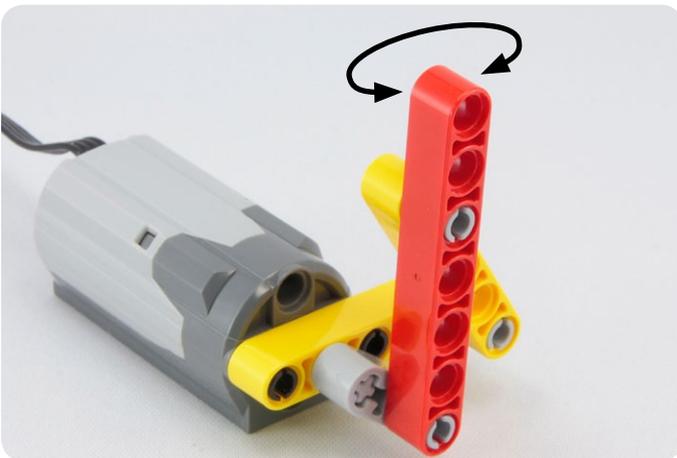
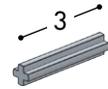


Swinging mechanisms

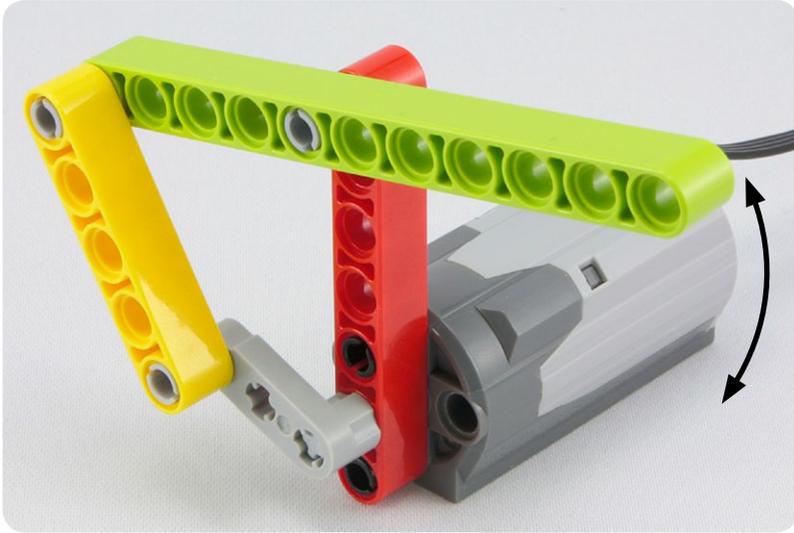
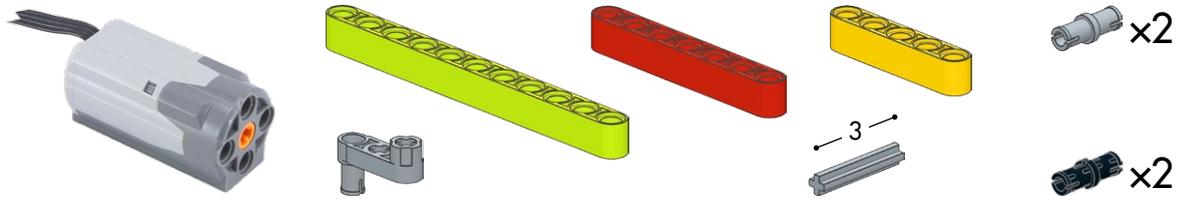
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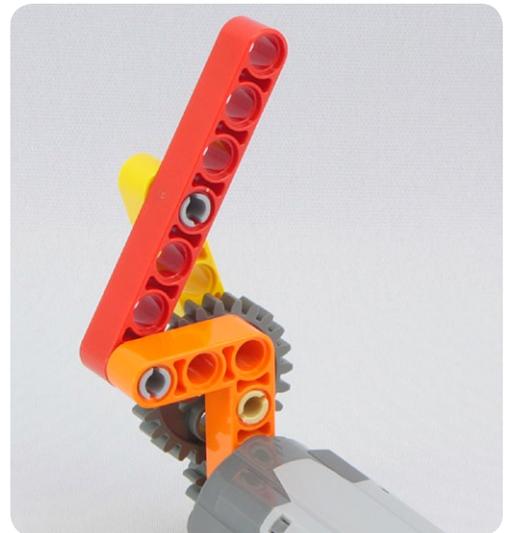
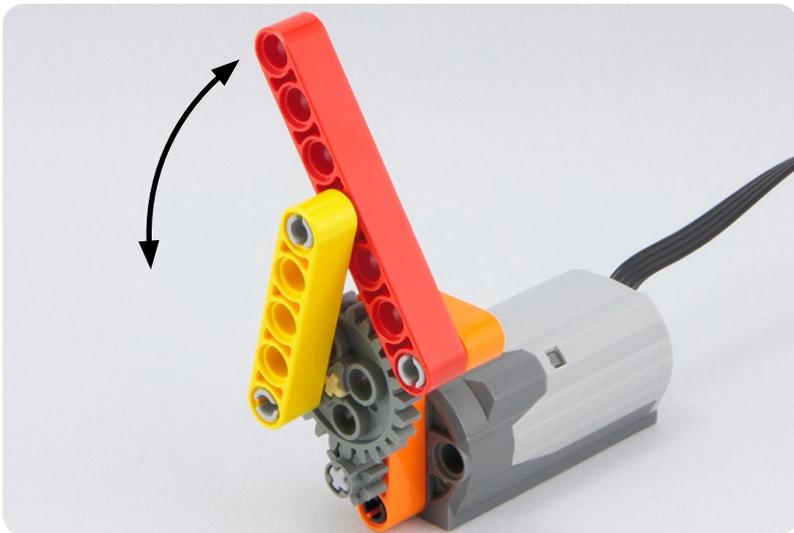
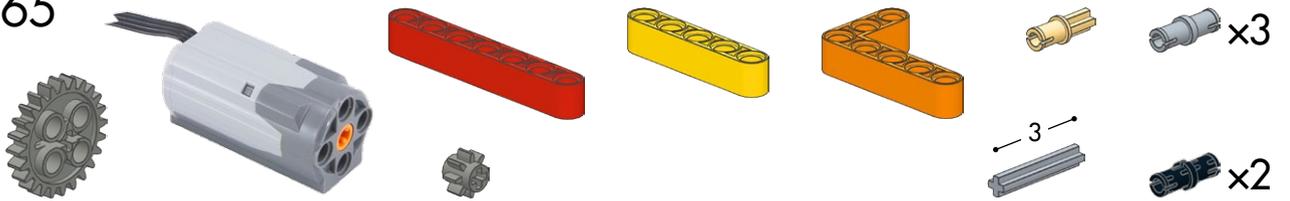
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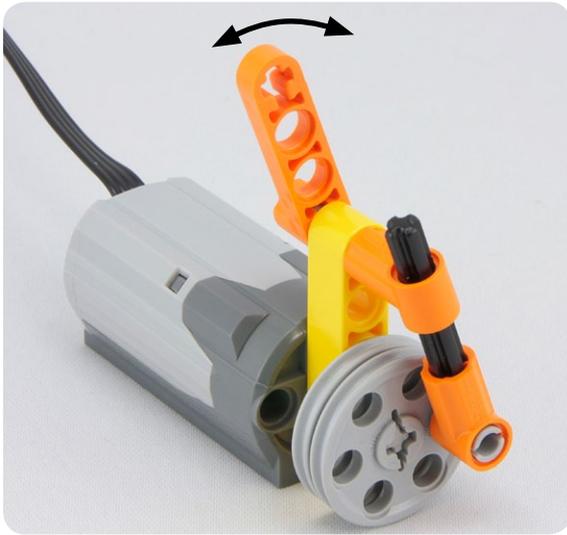
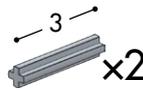
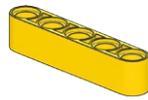
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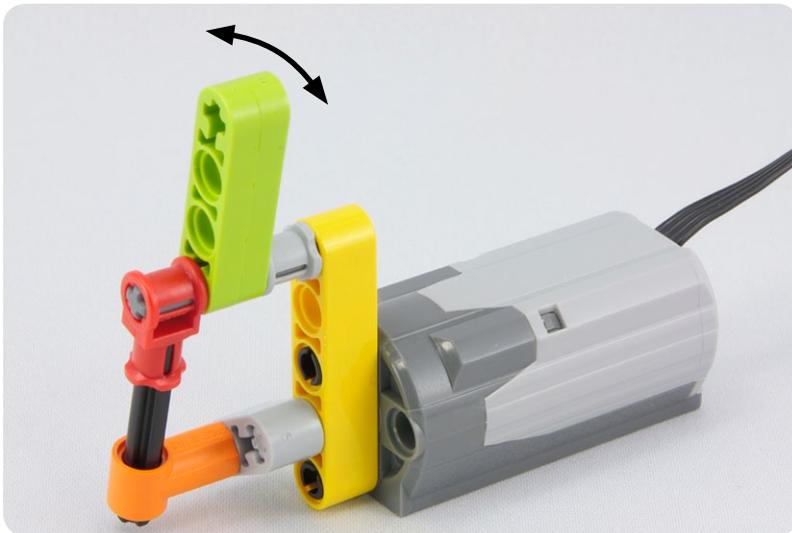
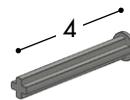
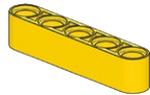
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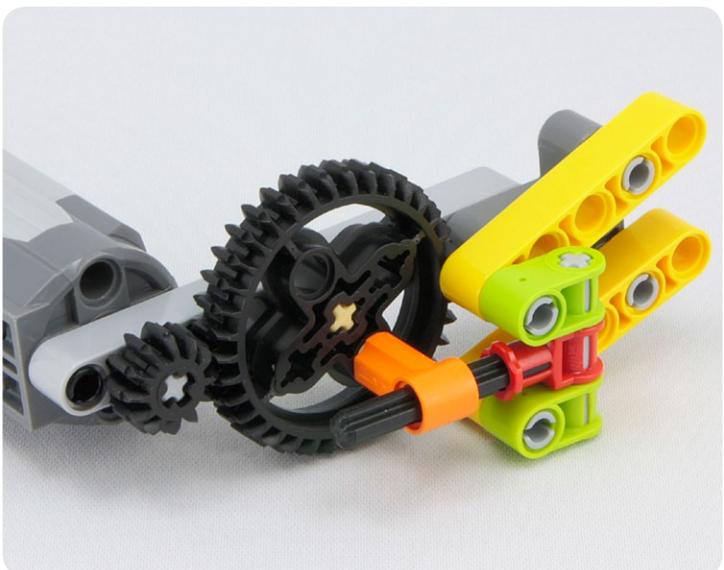
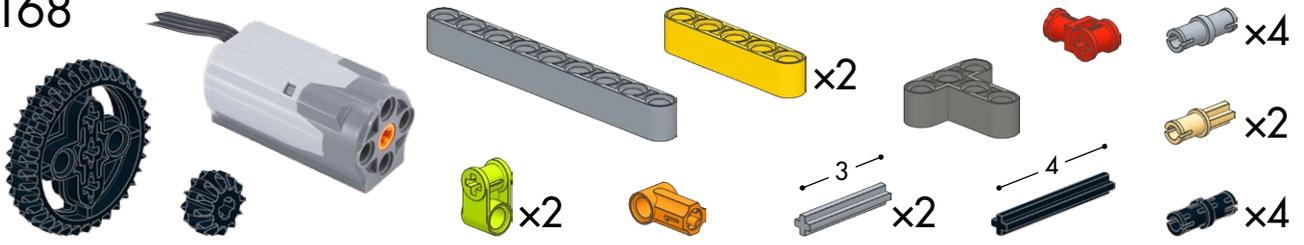
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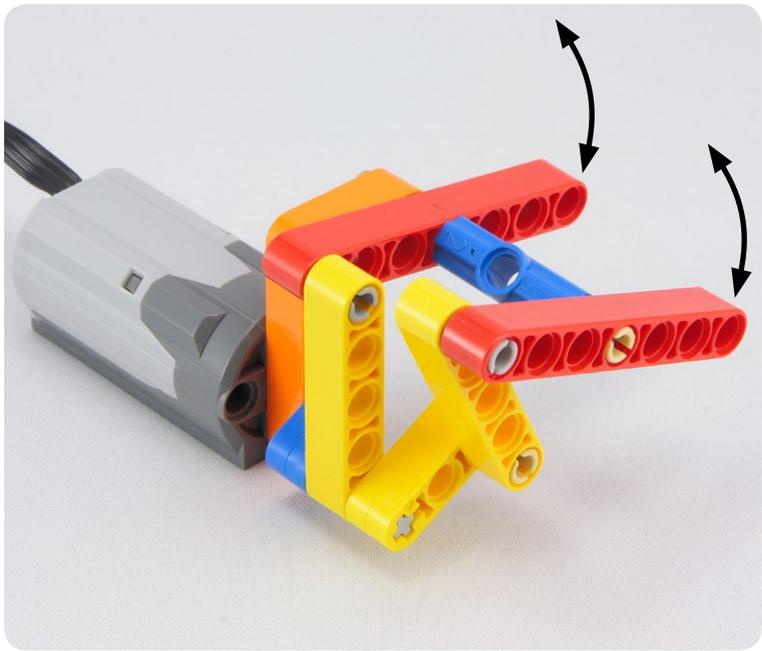
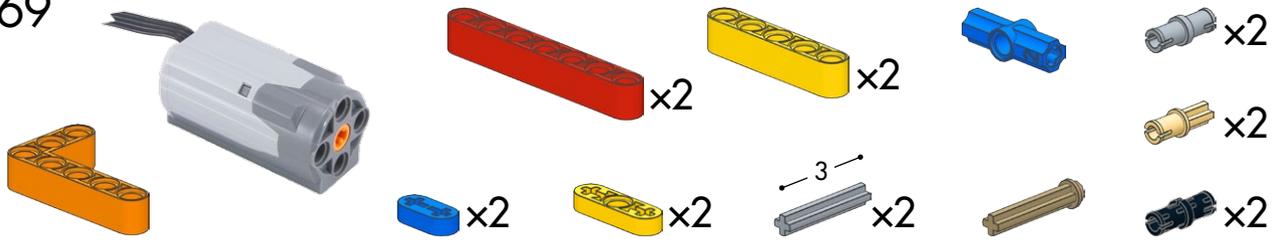
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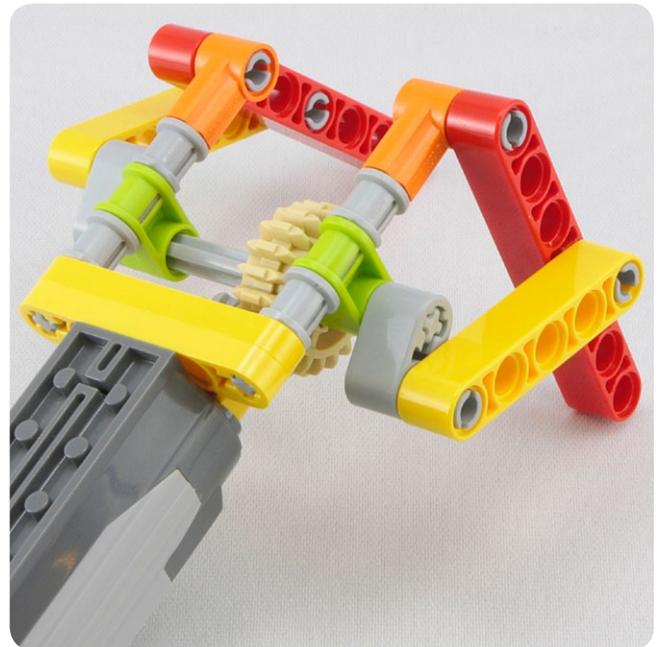
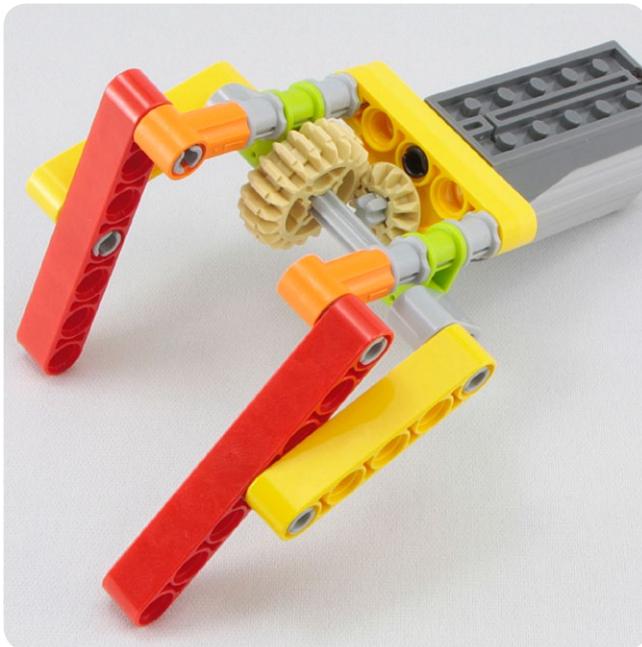
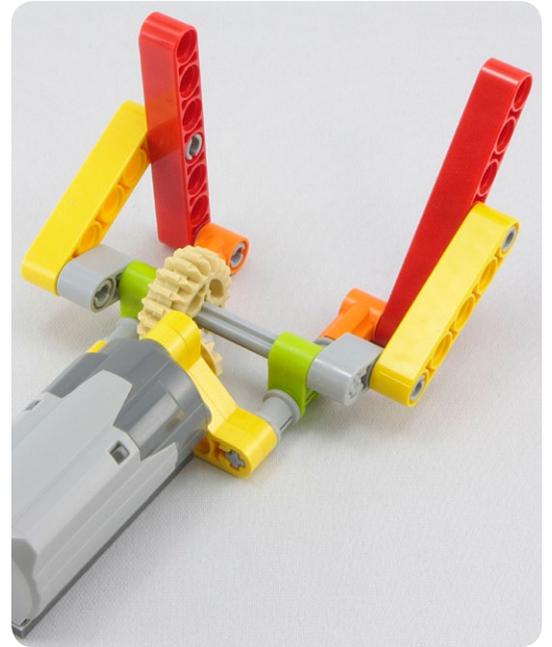
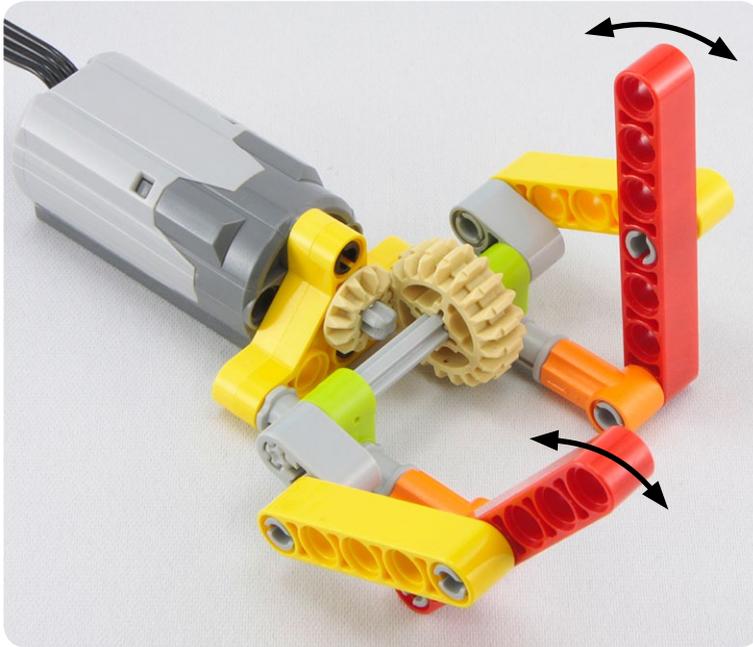
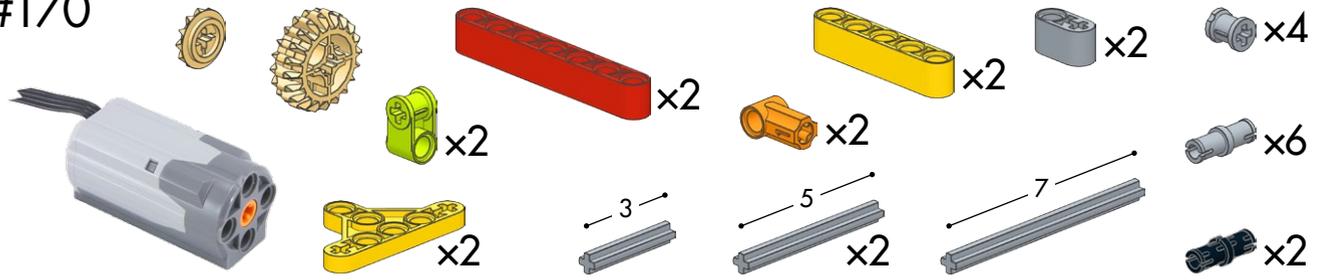
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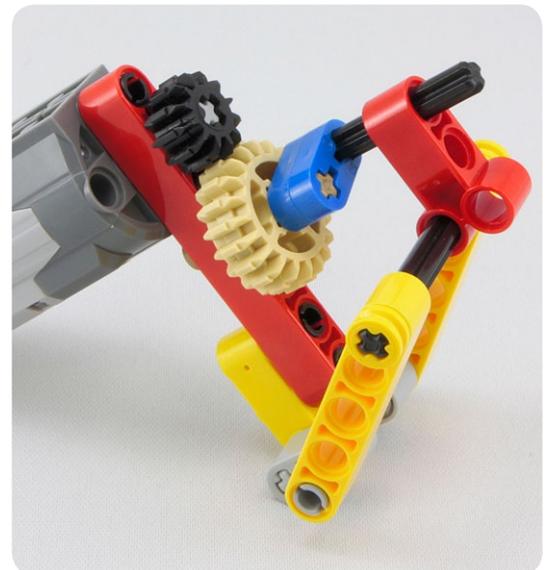
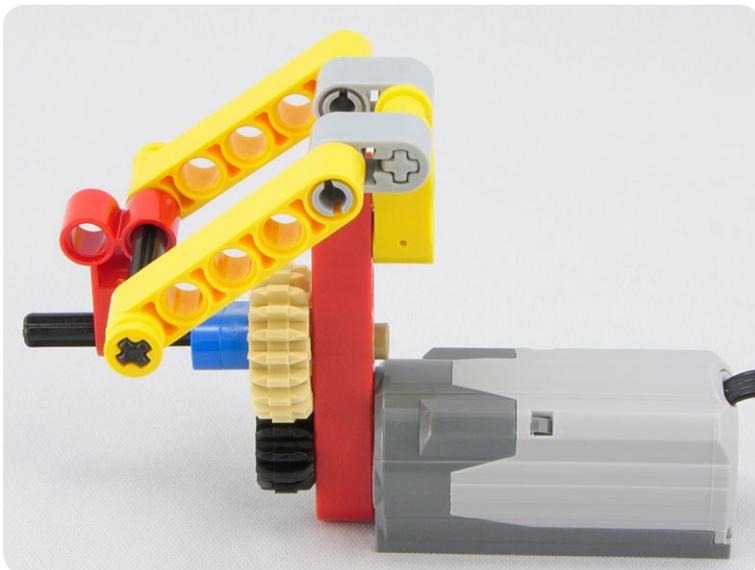
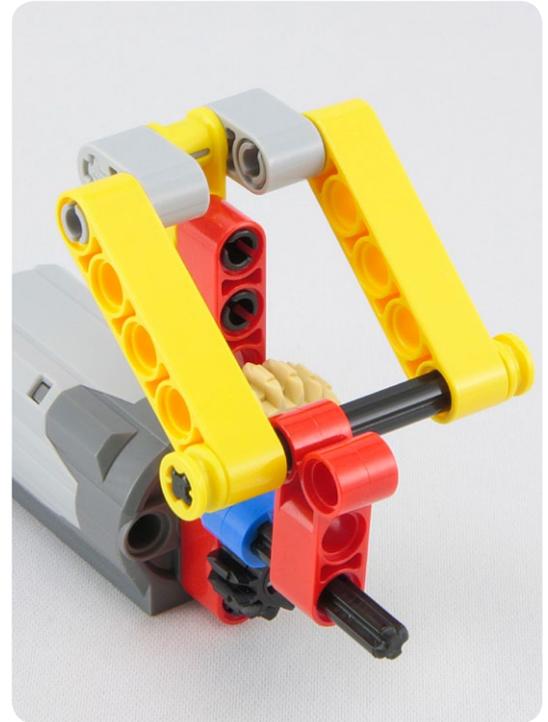
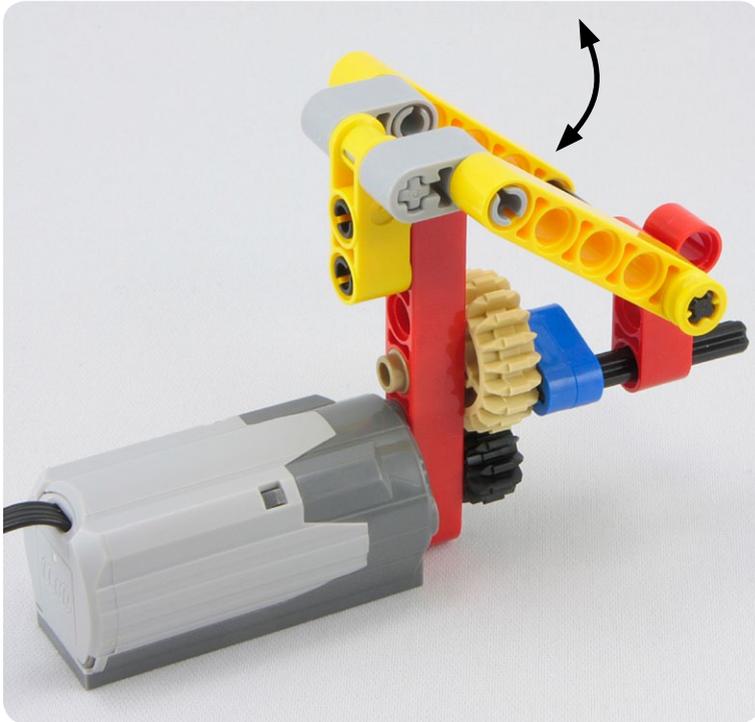
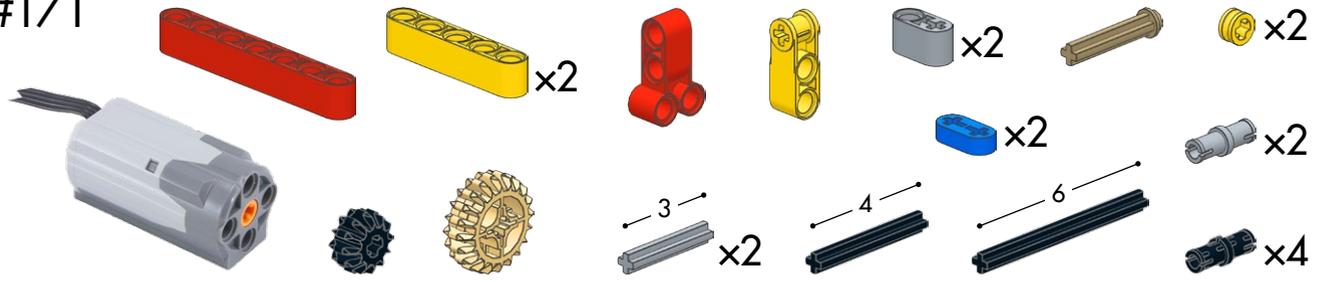
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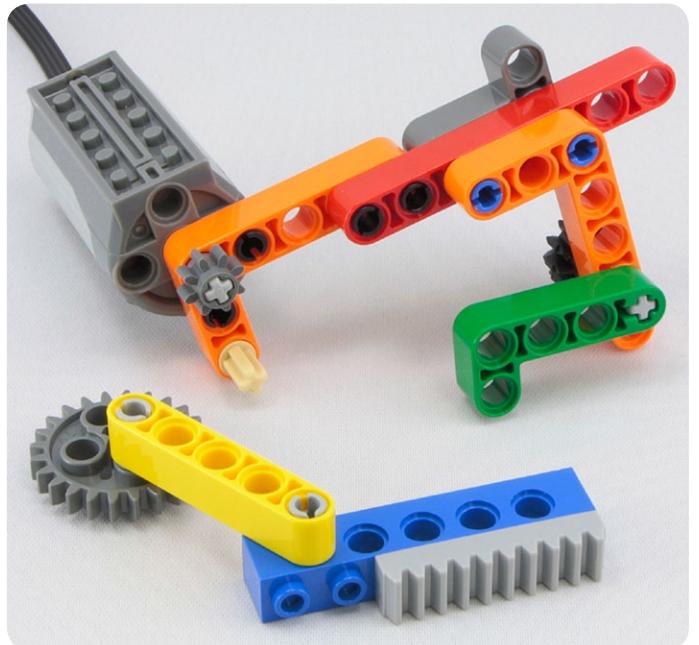
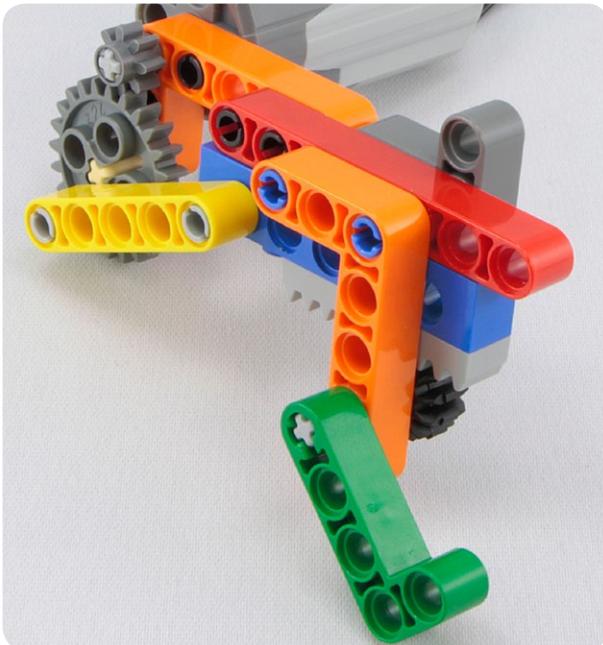
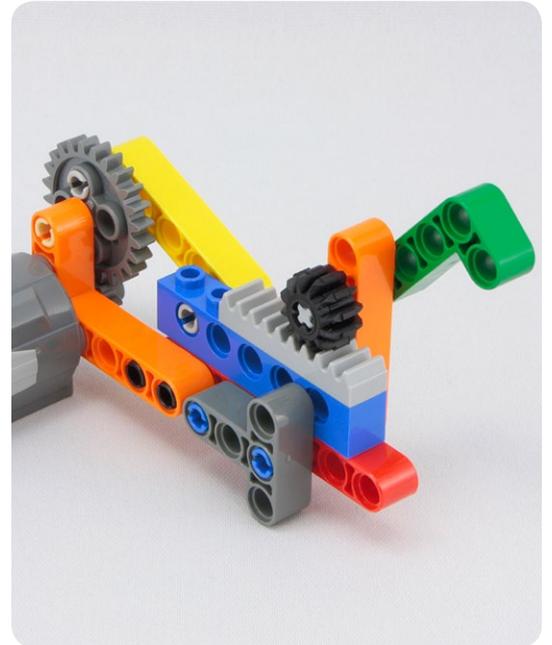
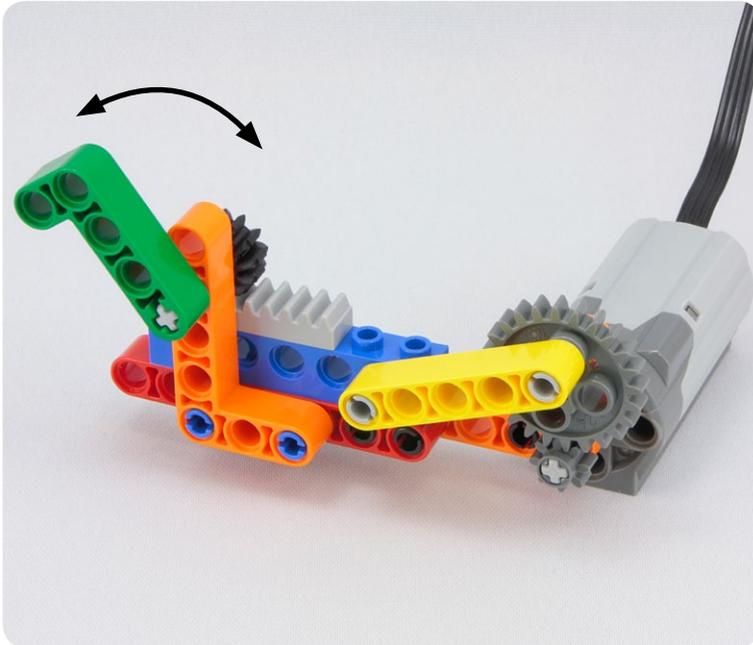
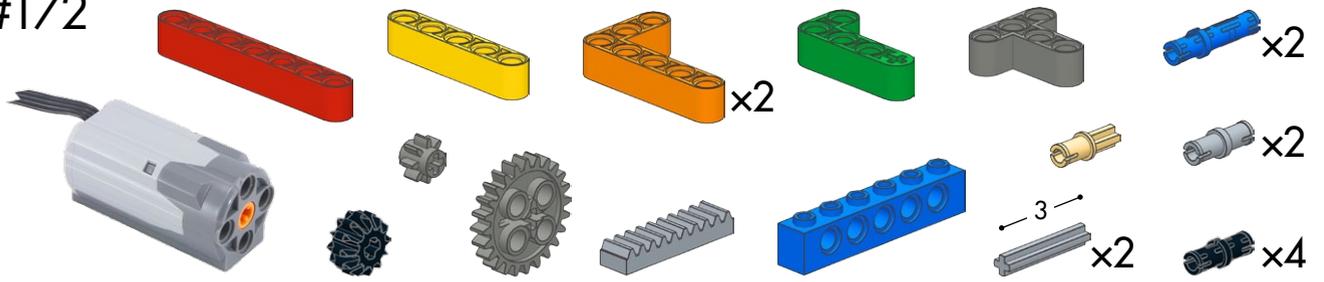
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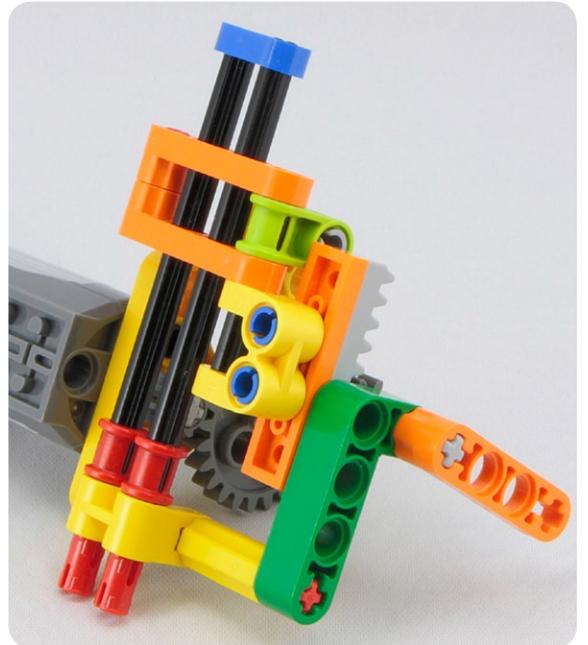
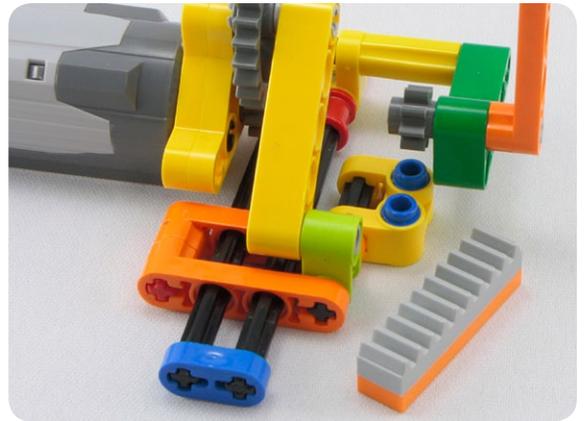
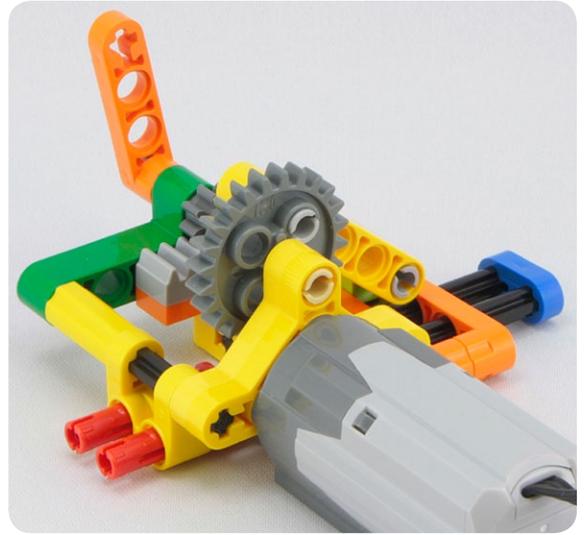
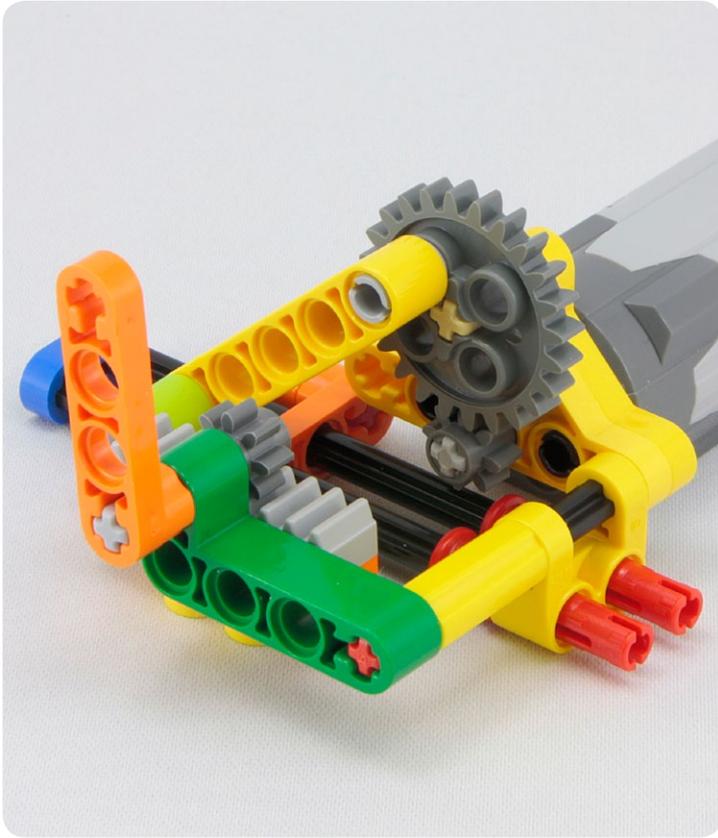


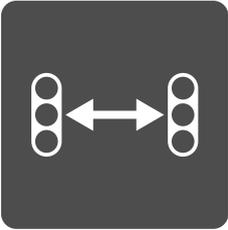
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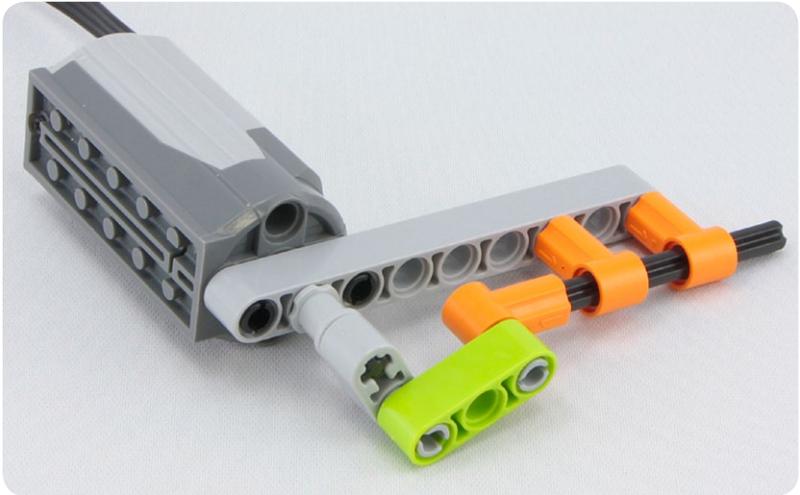
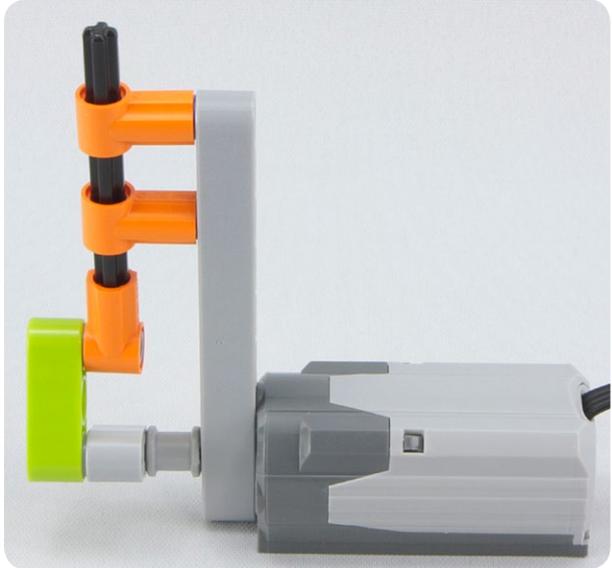
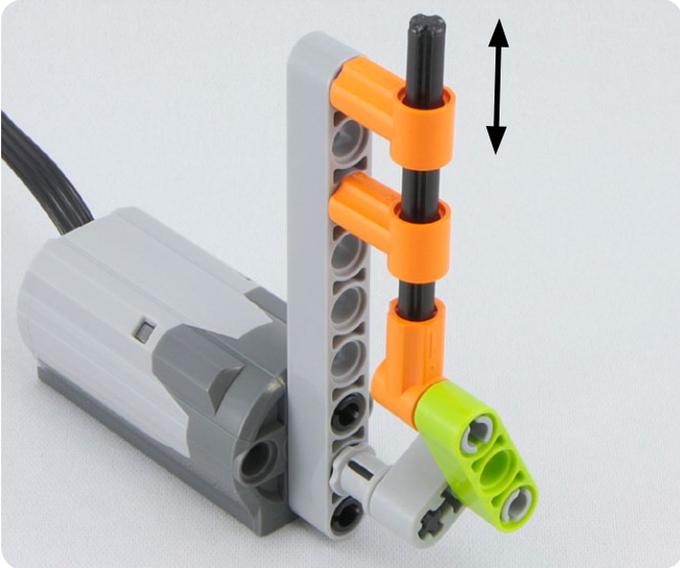
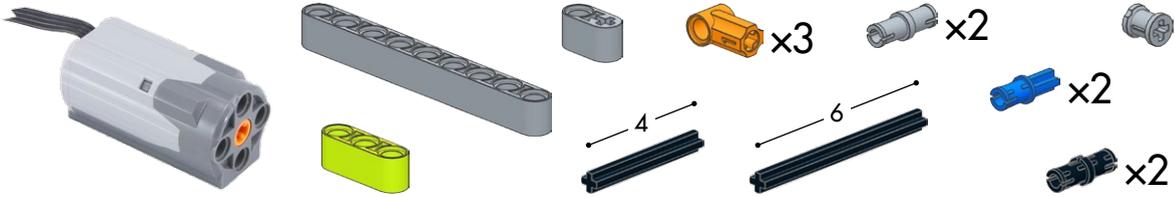




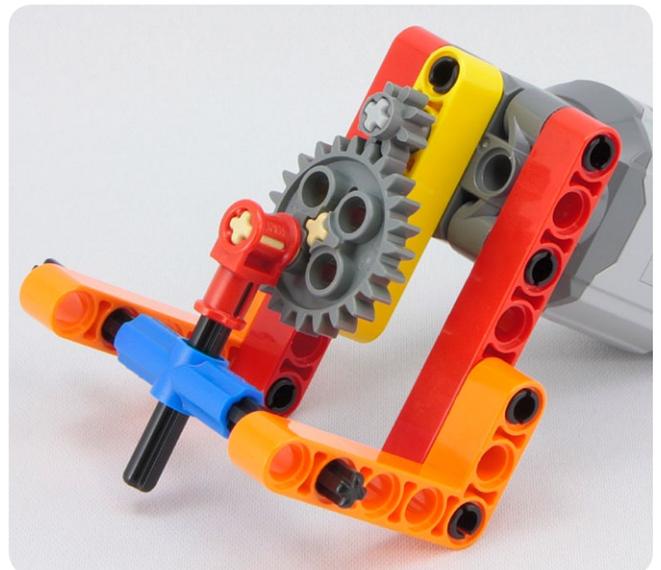
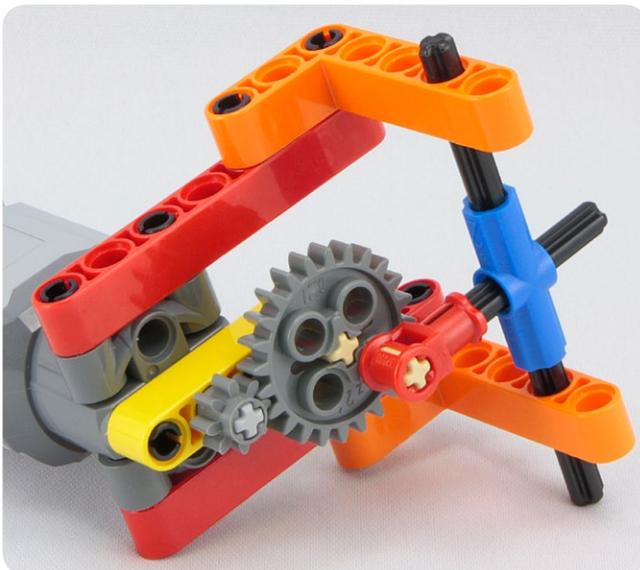
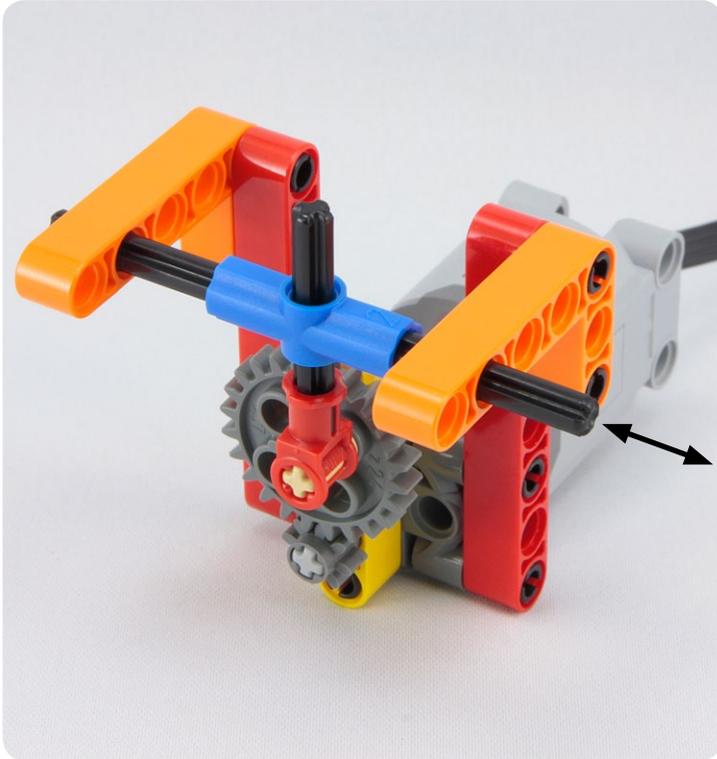
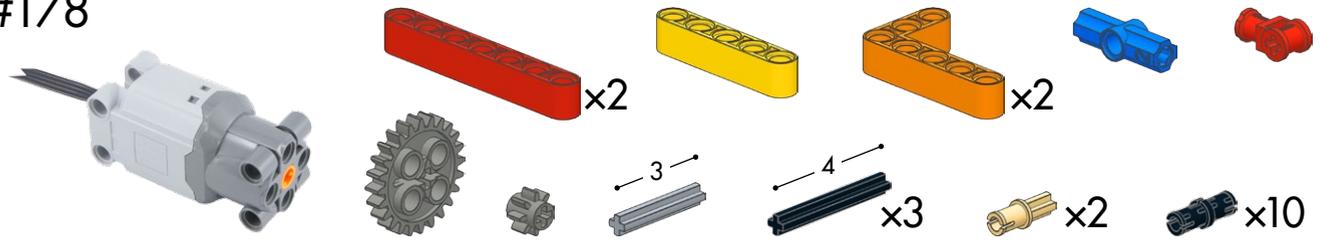


Reciprocating mechanisms

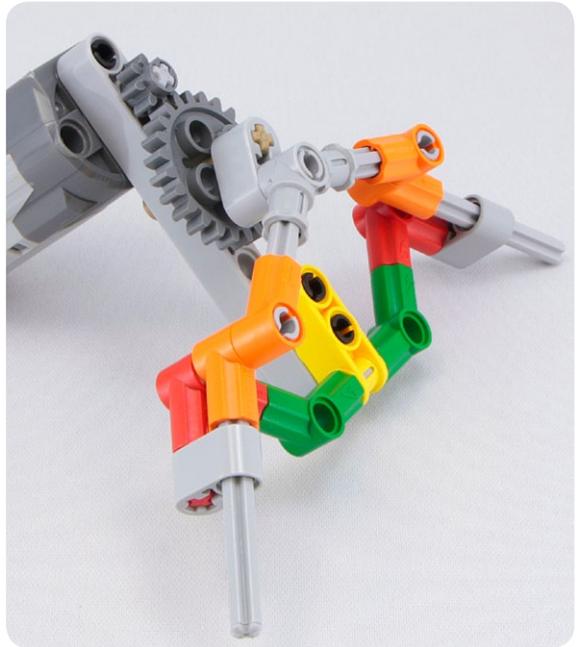
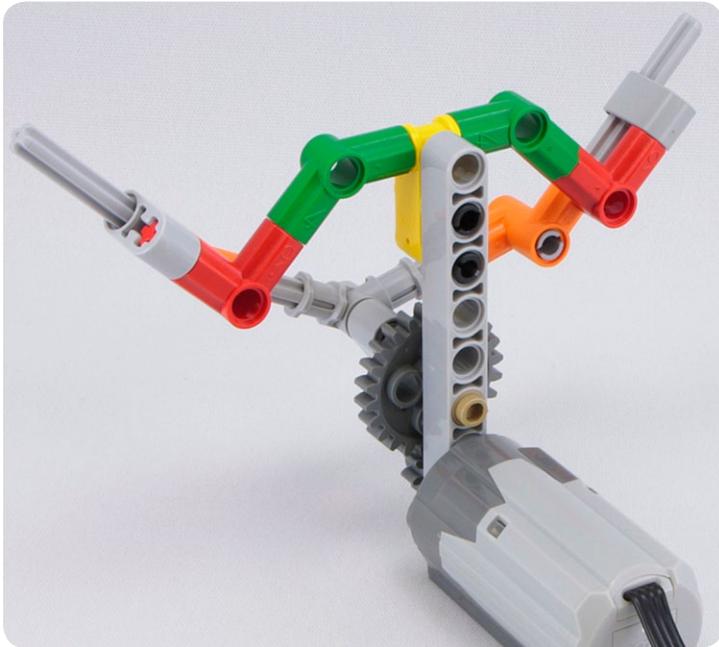
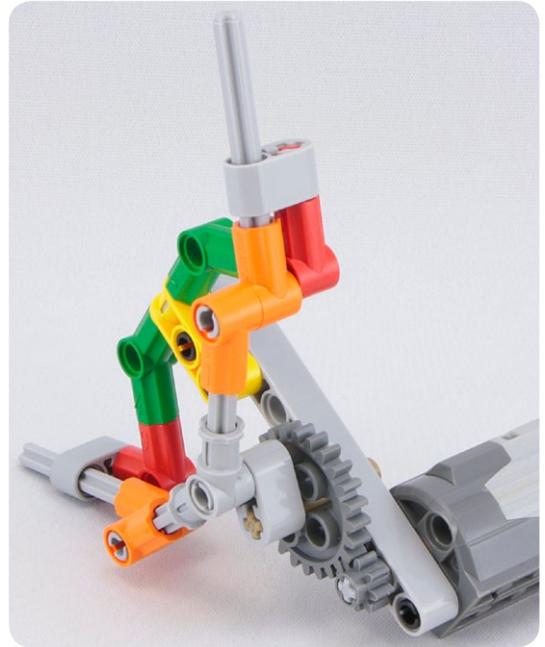
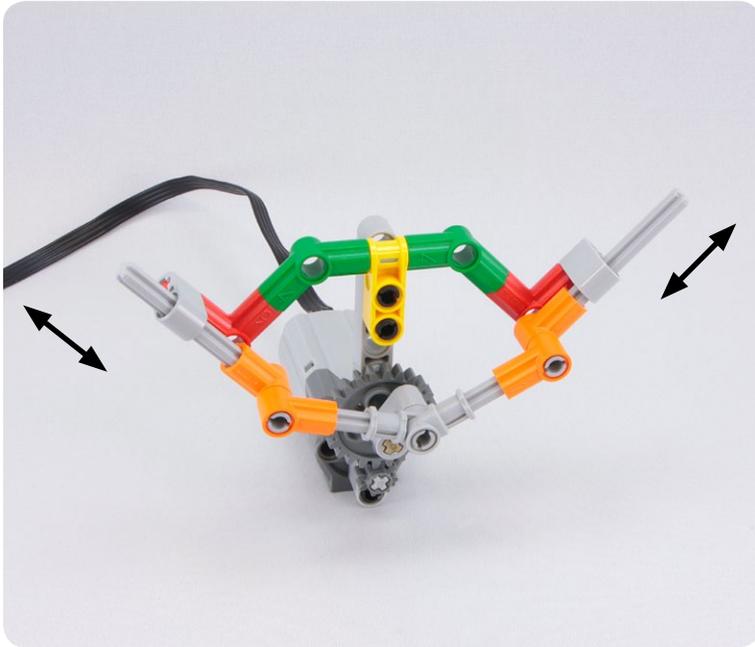
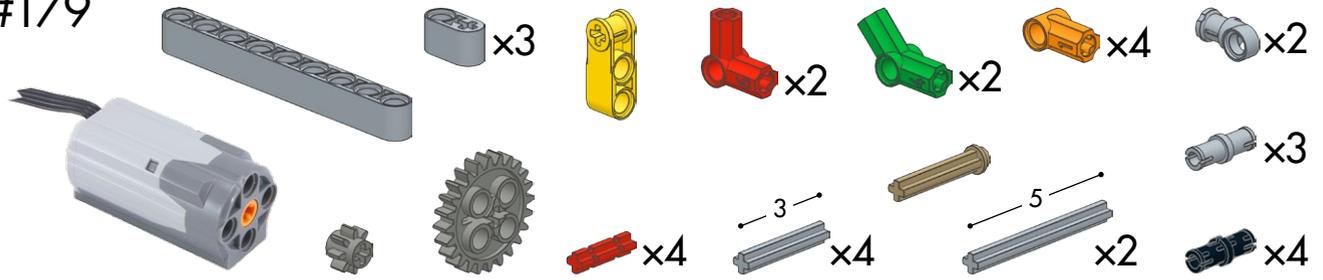
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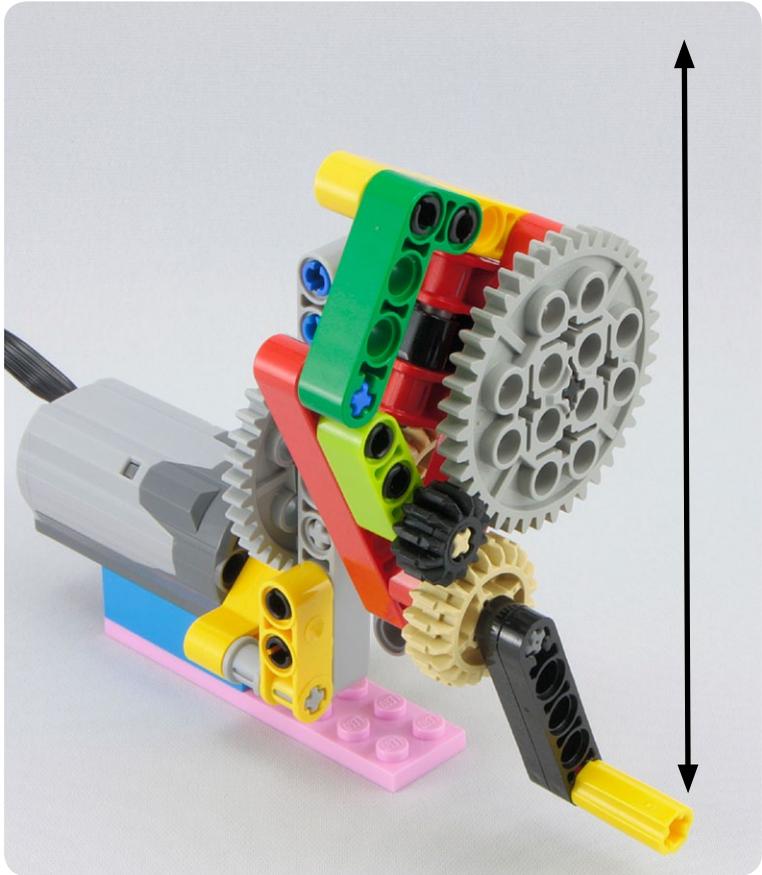
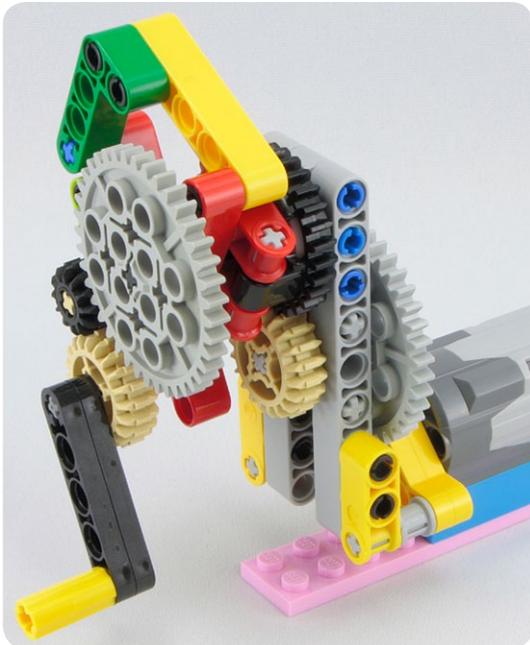
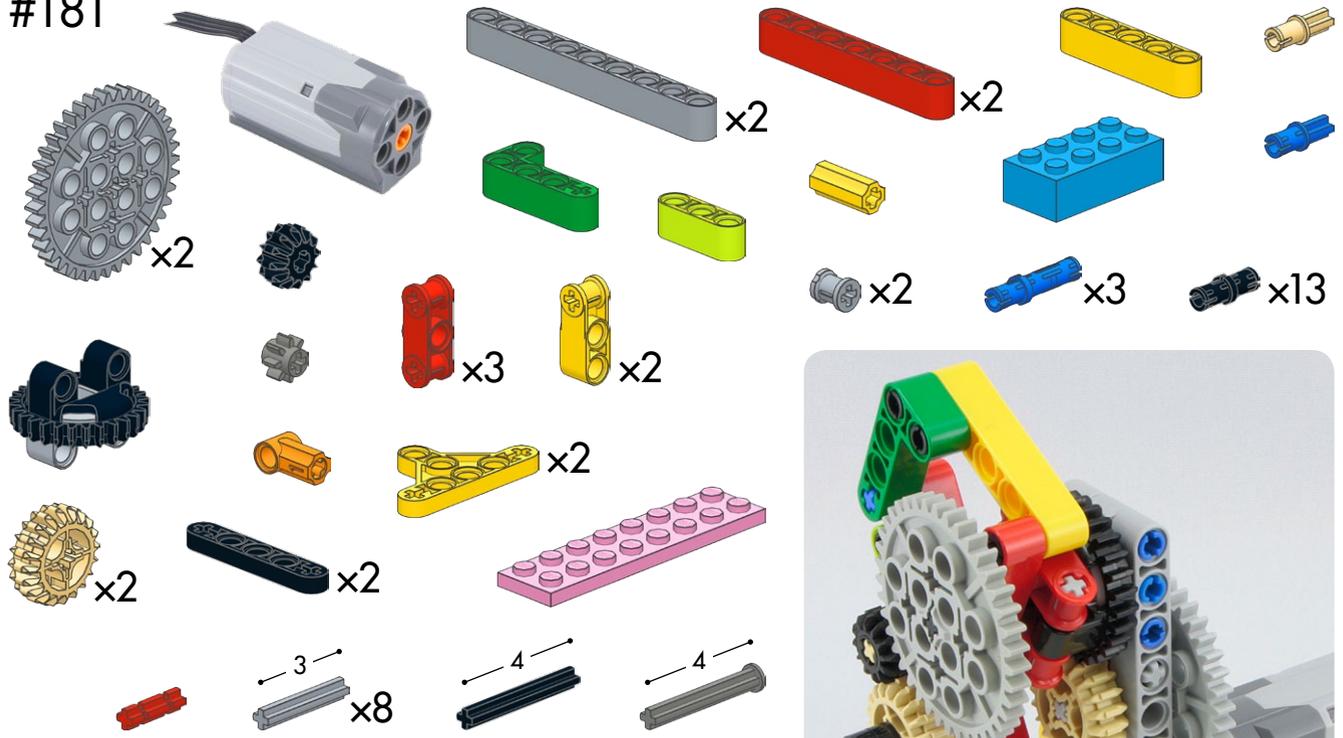
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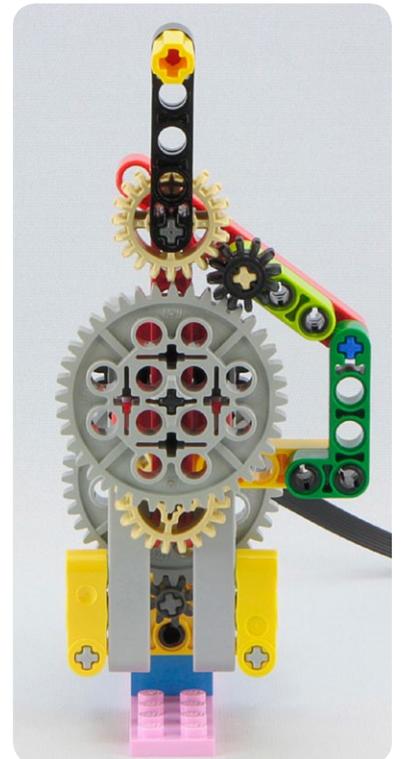
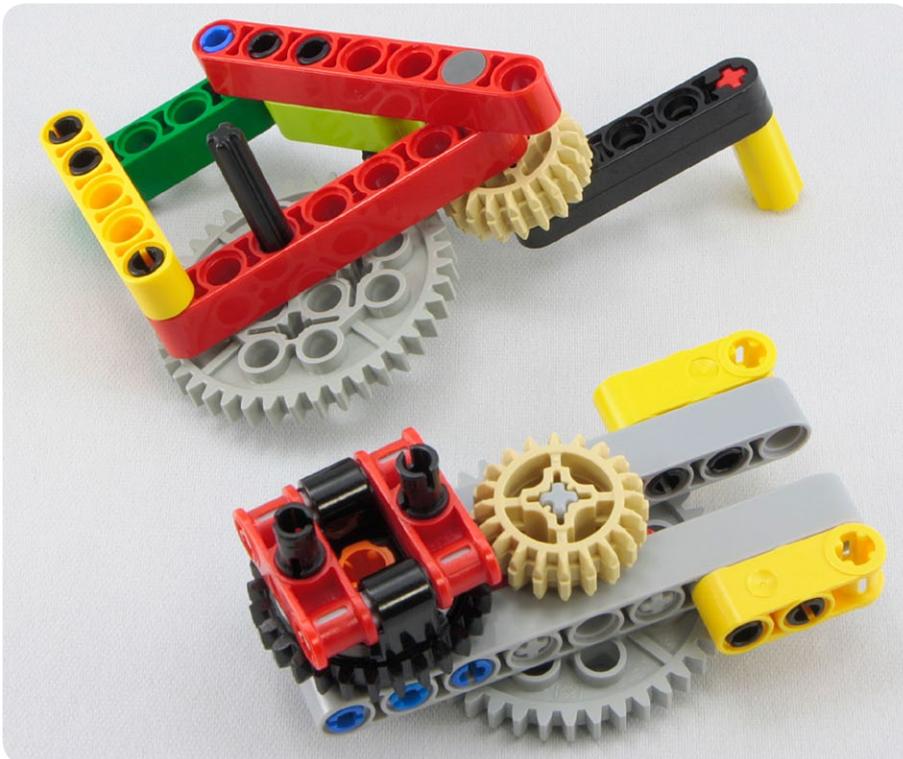
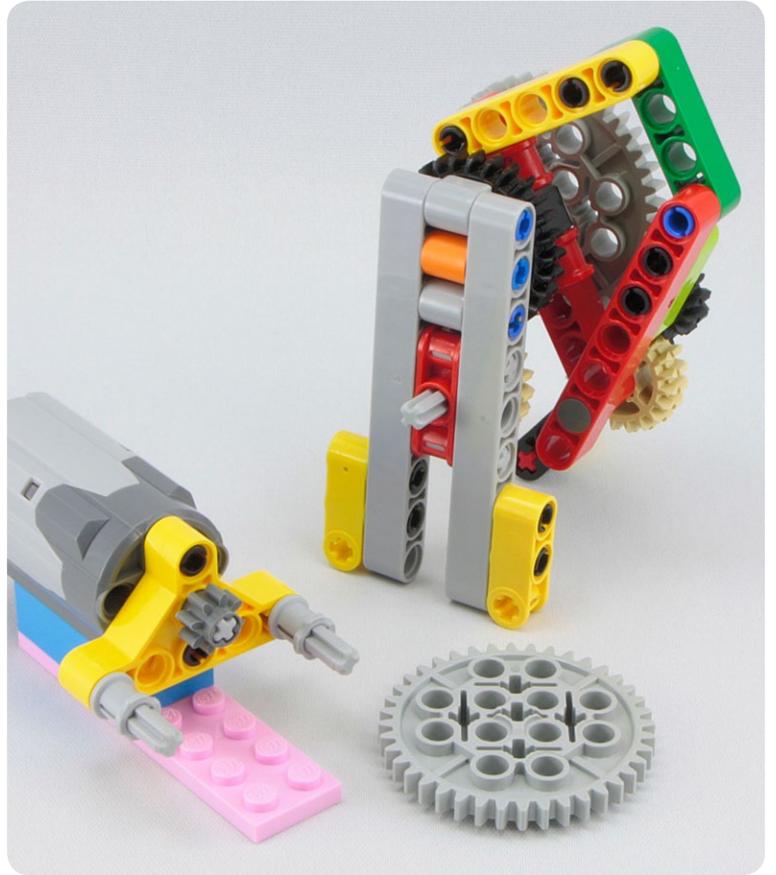
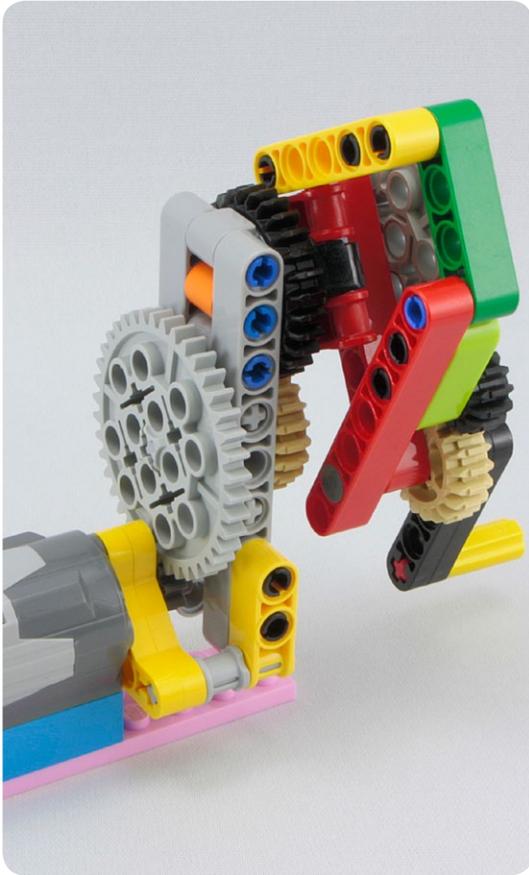


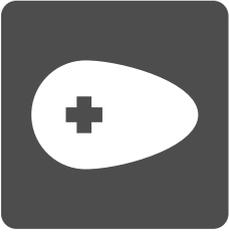
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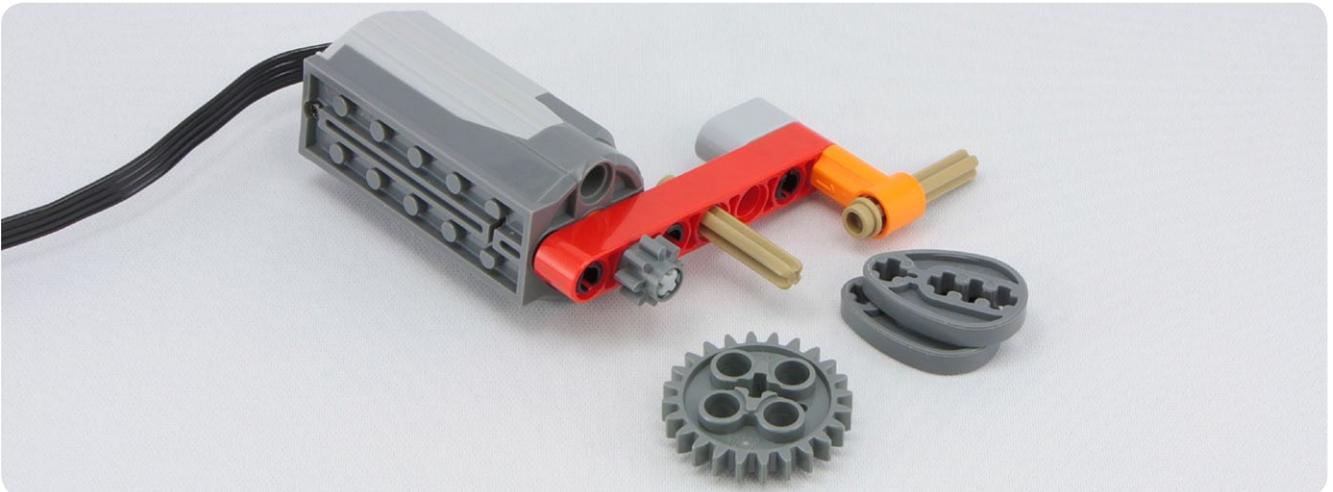
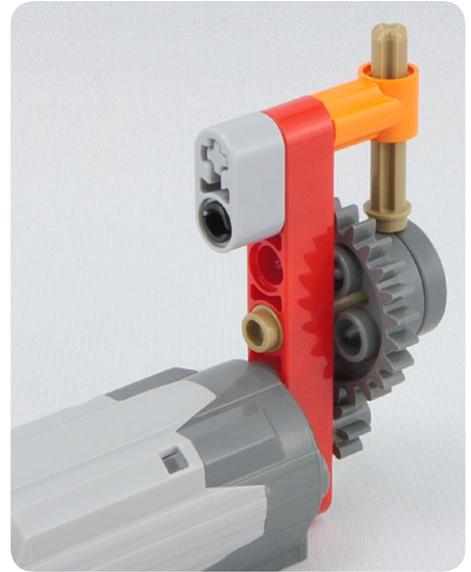
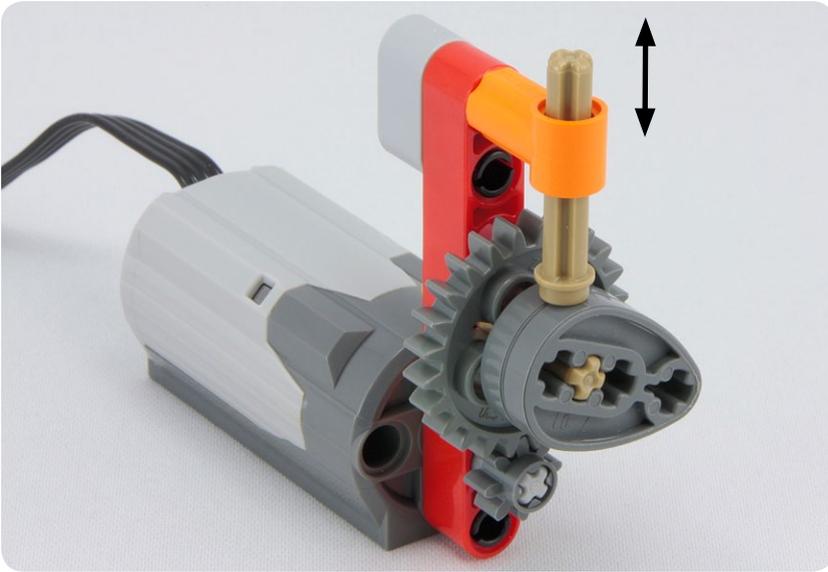
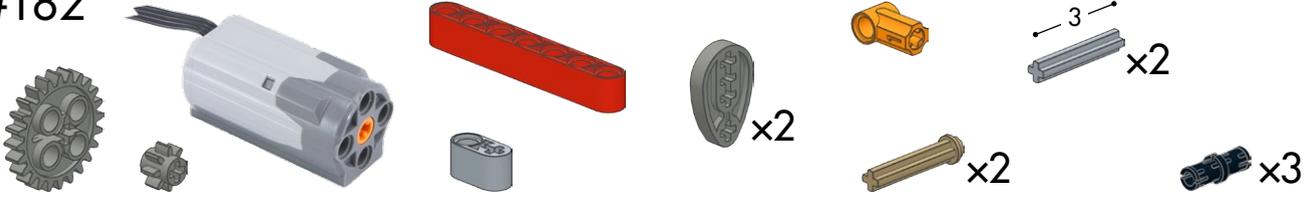




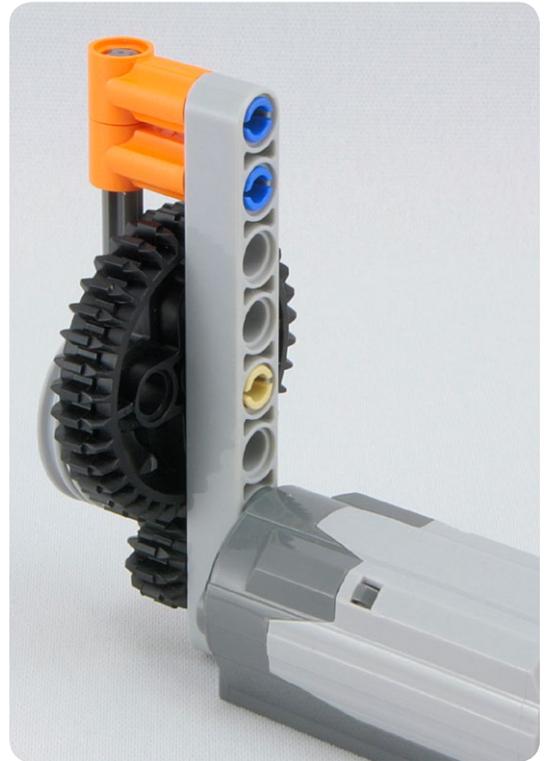
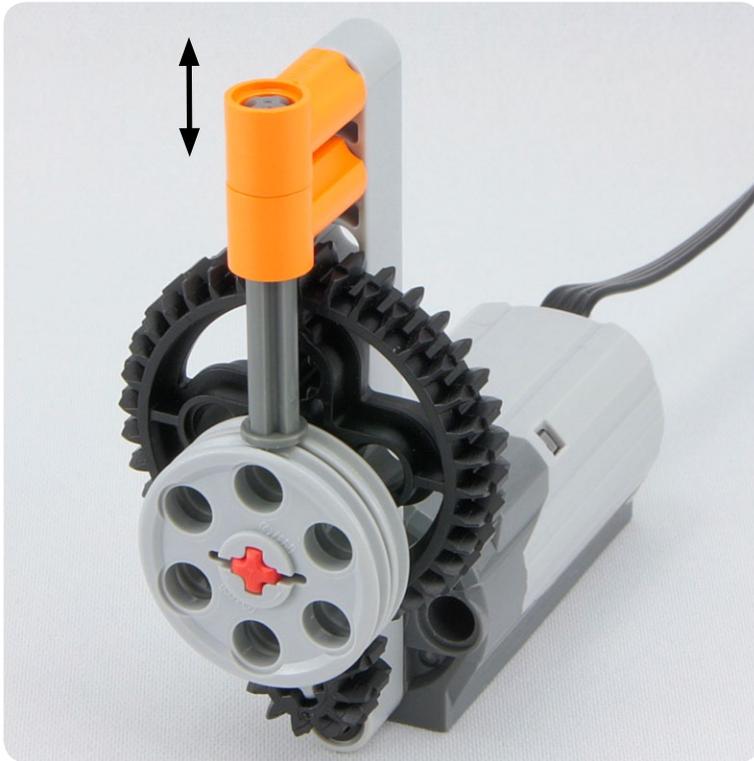
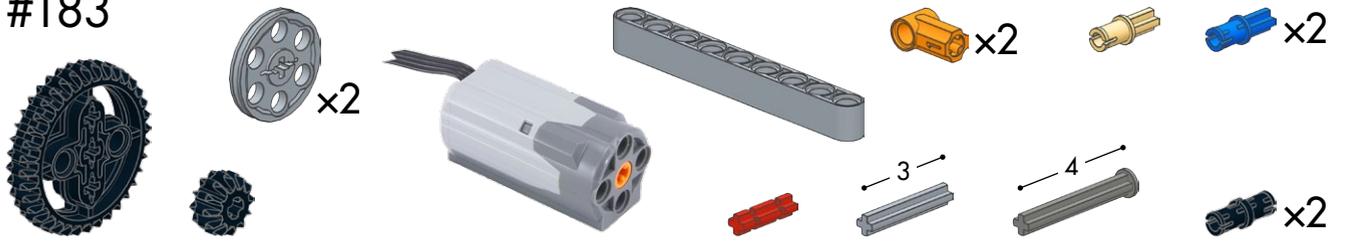


Cam mechanisms

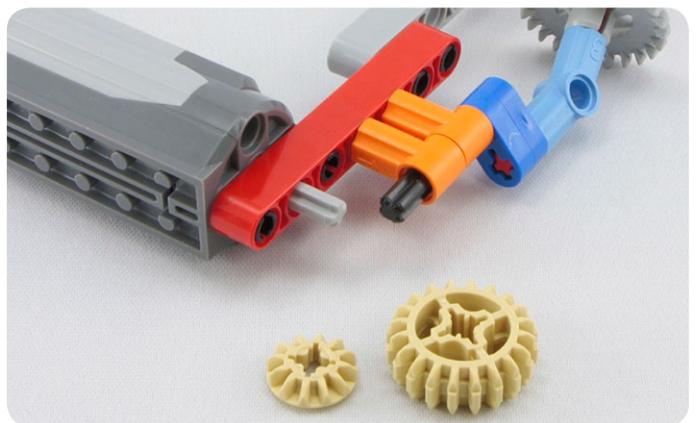
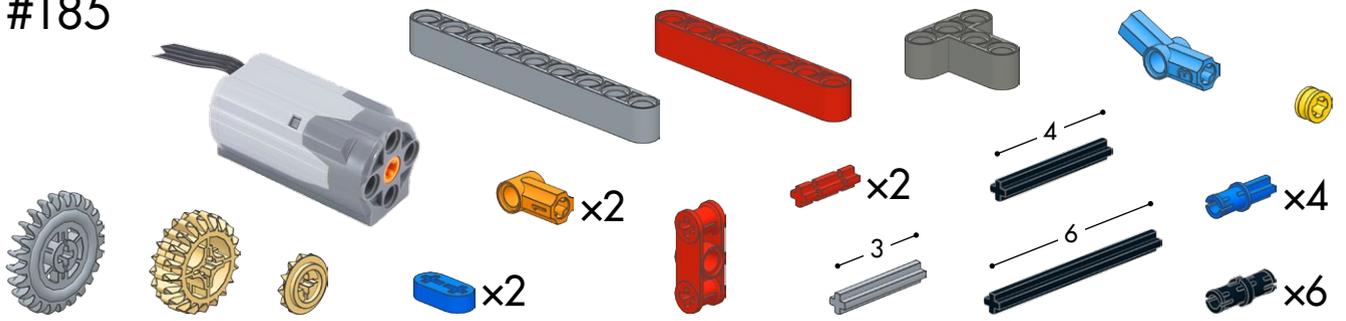
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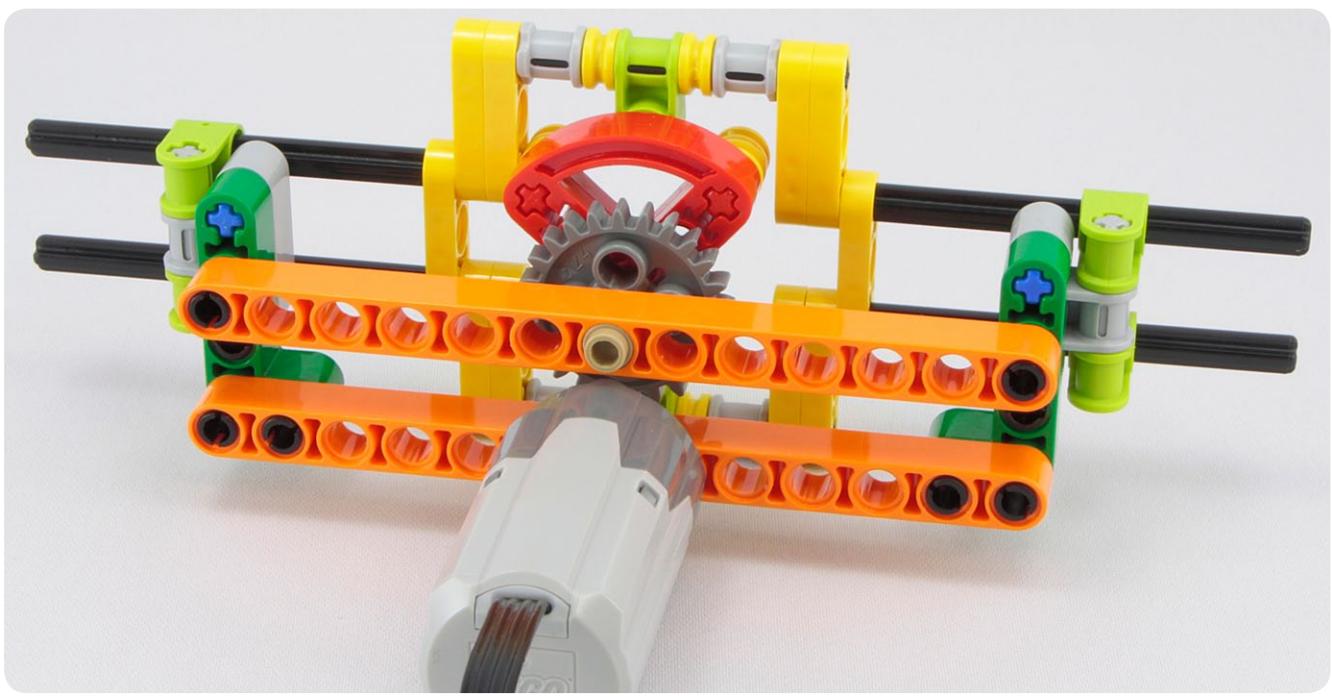
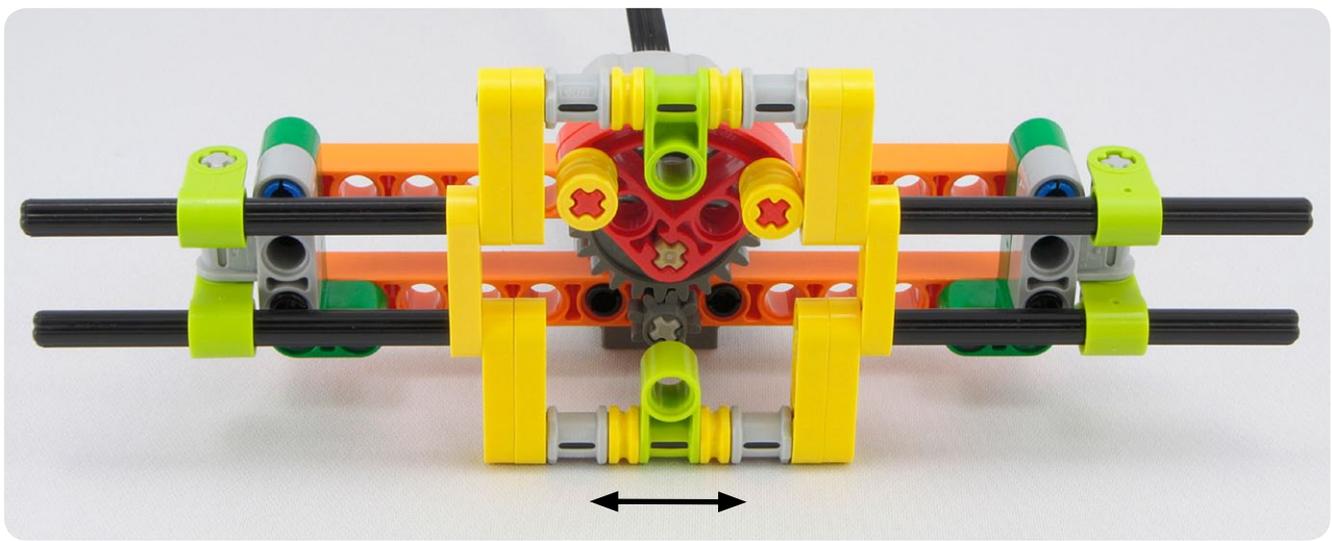
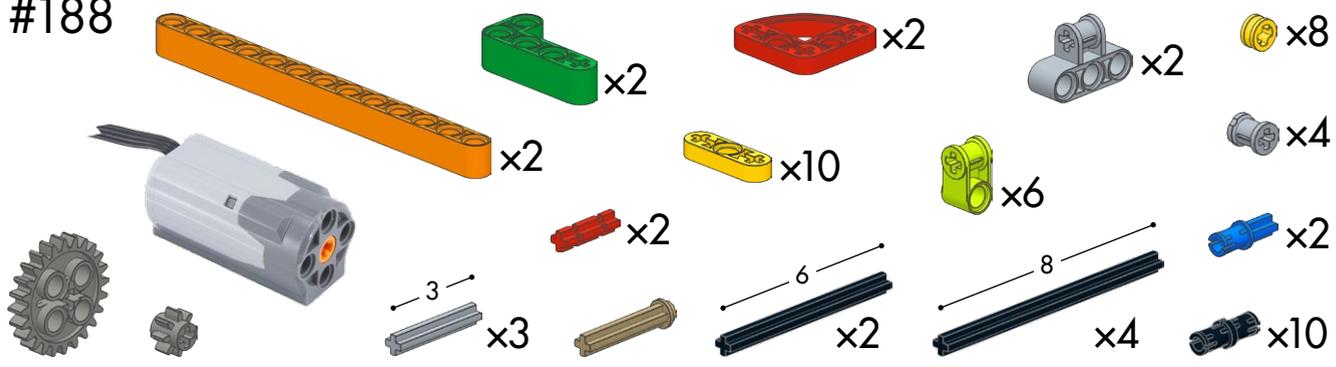
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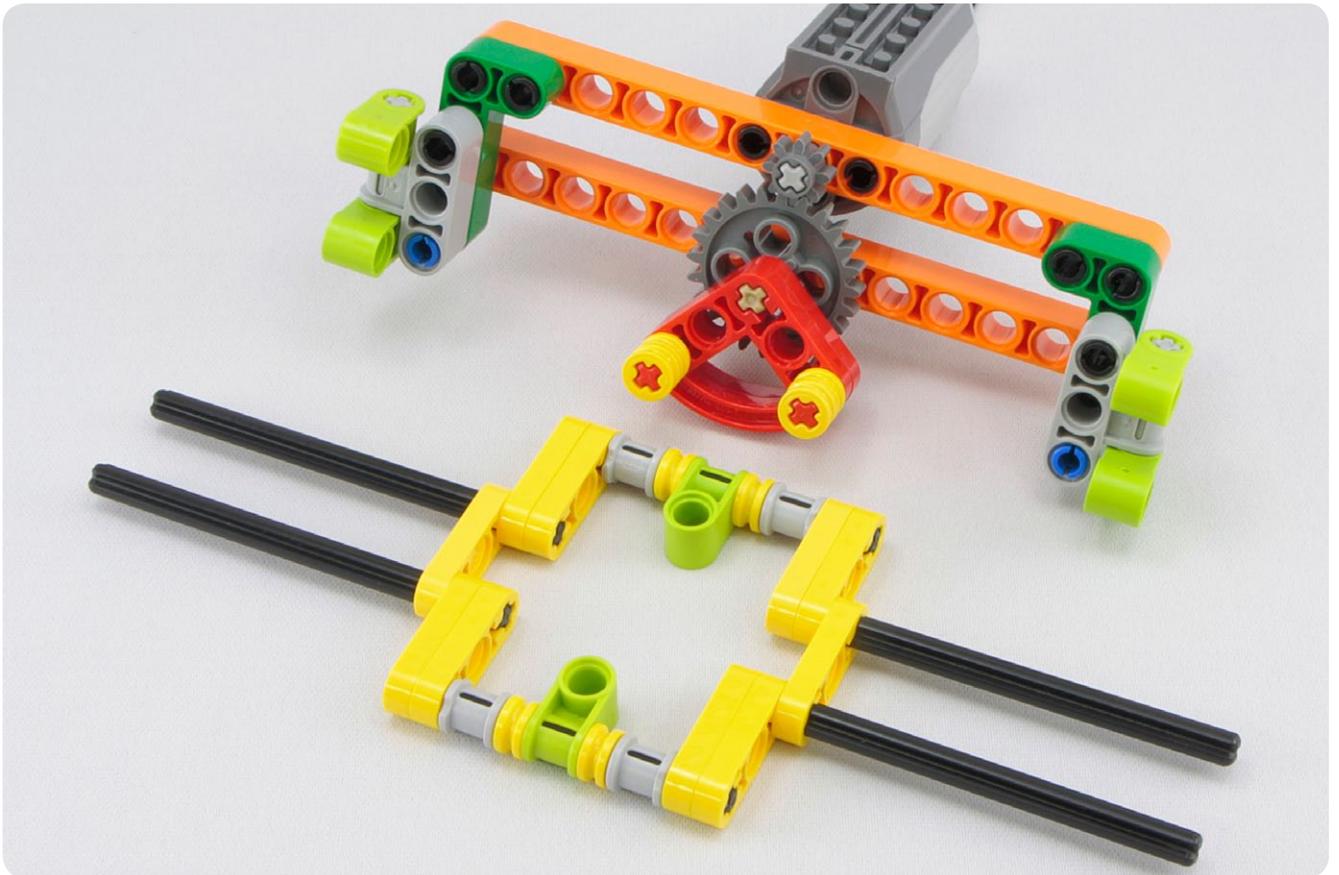
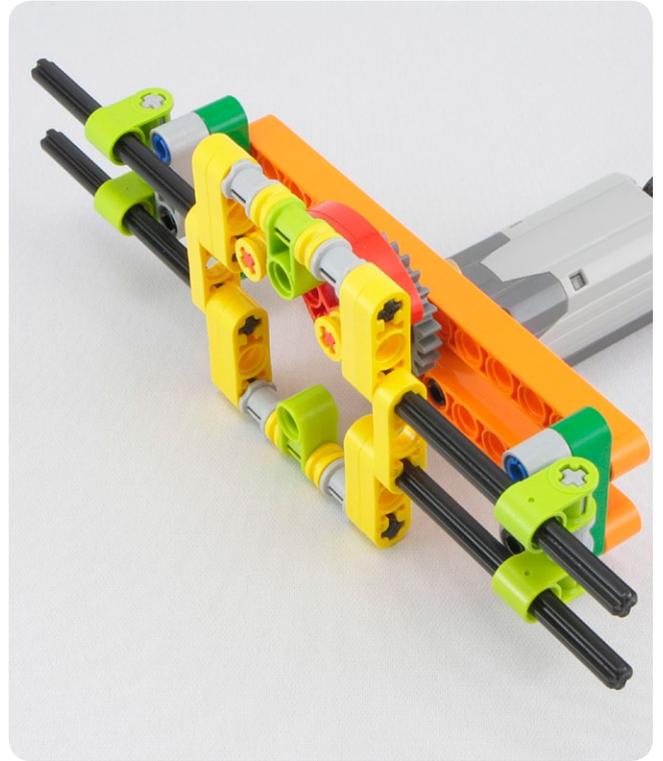
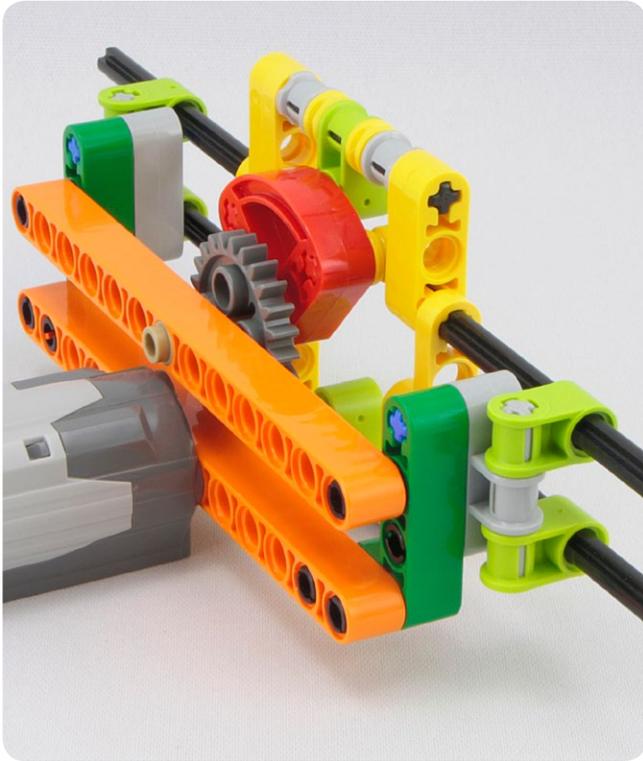


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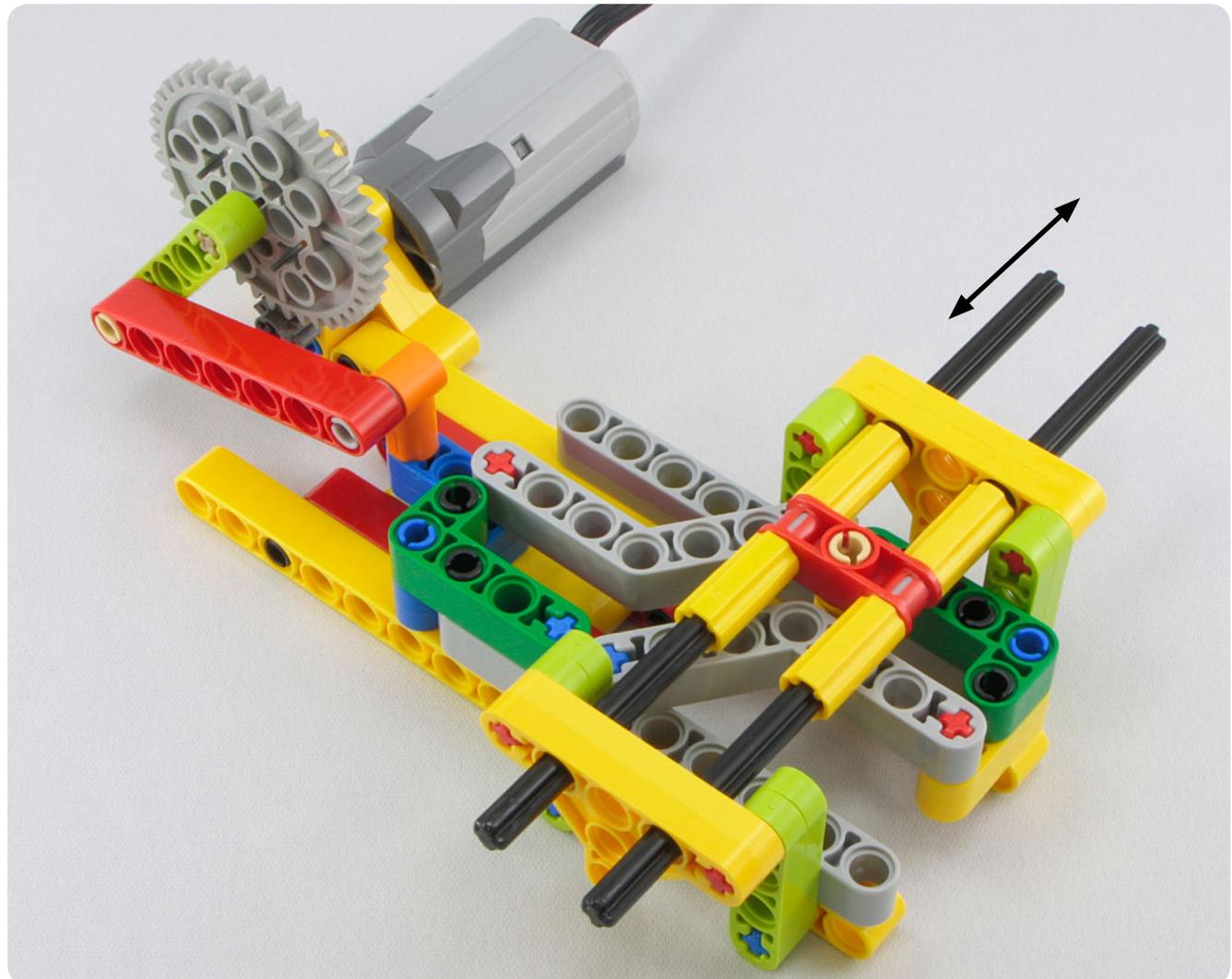
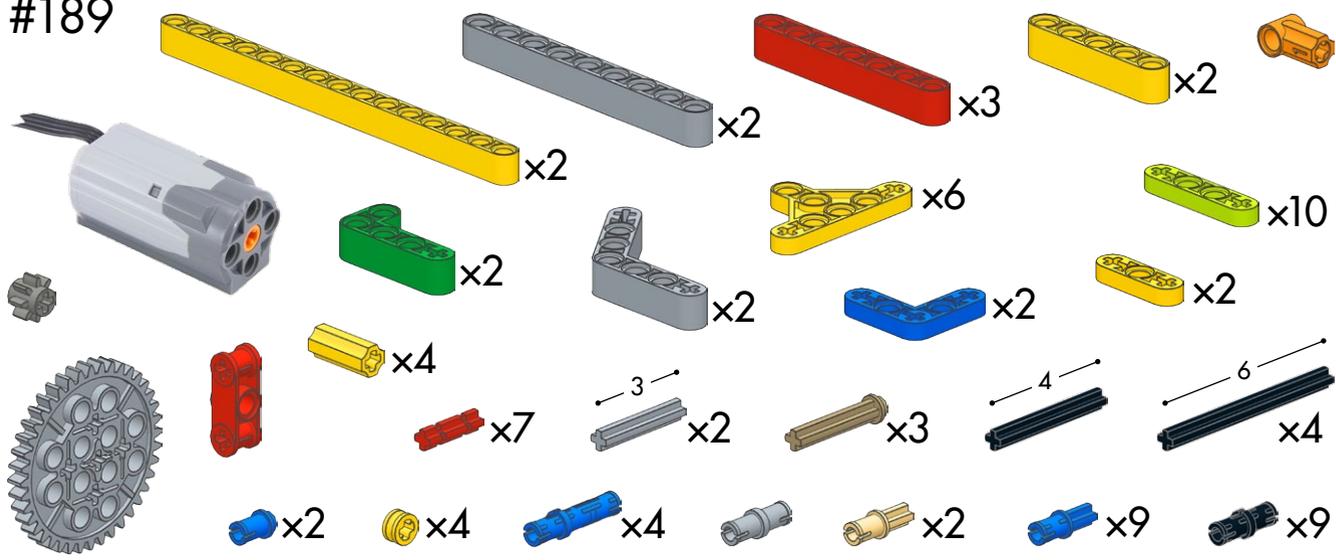


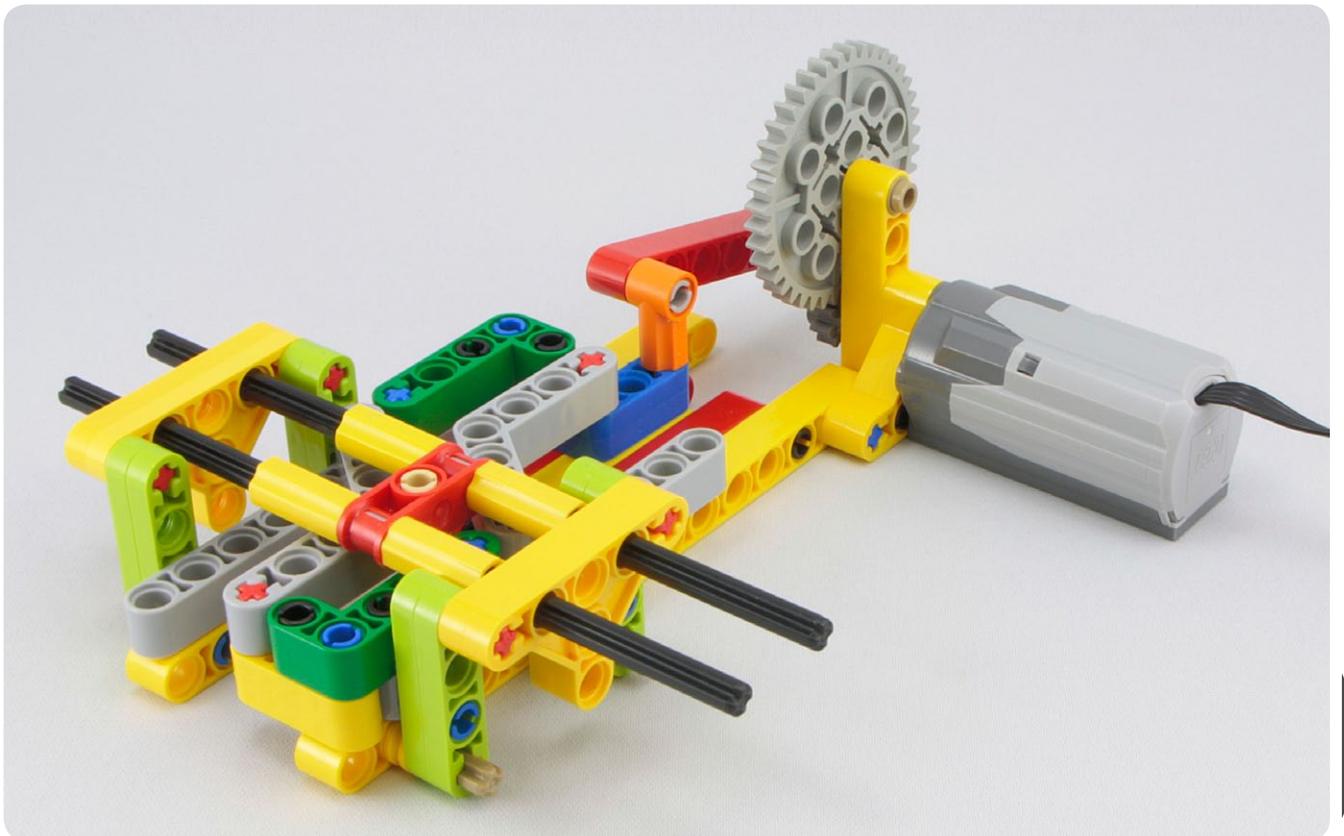
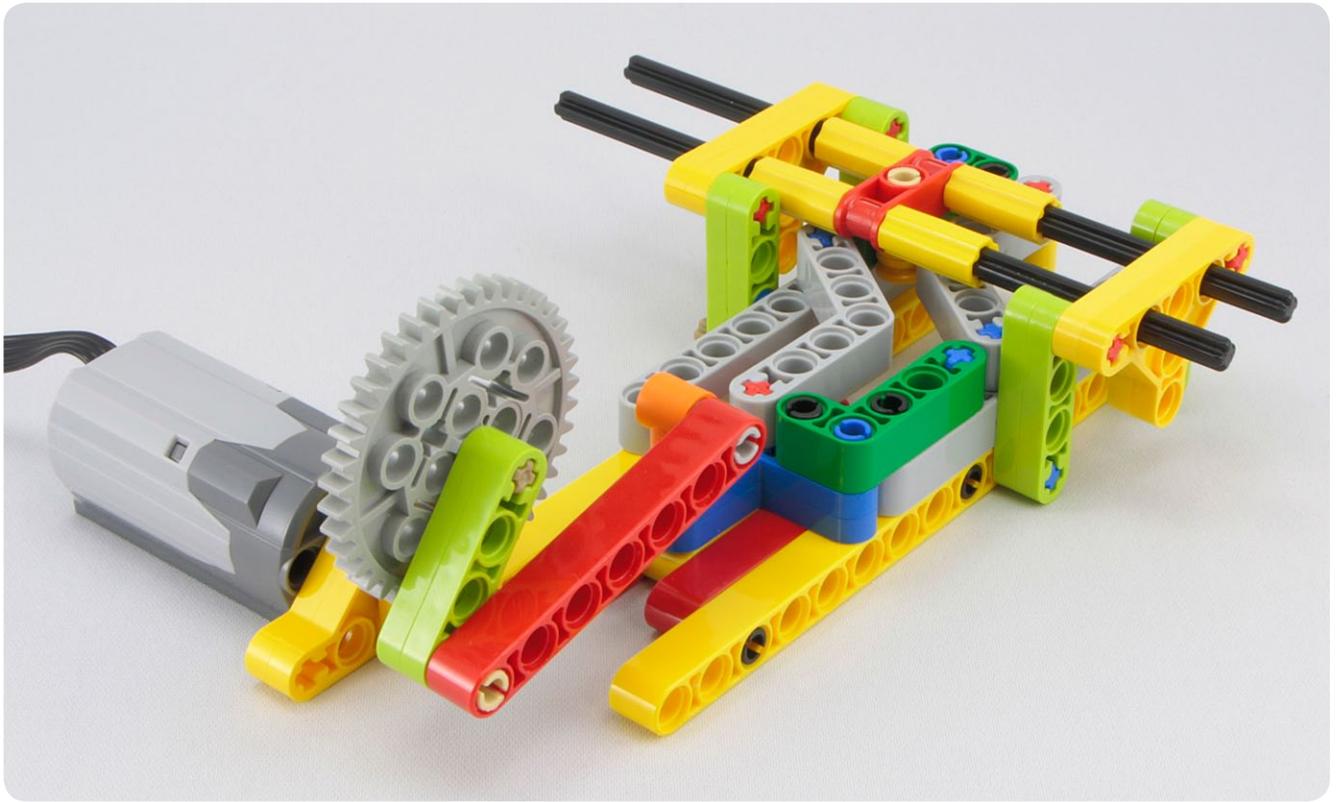
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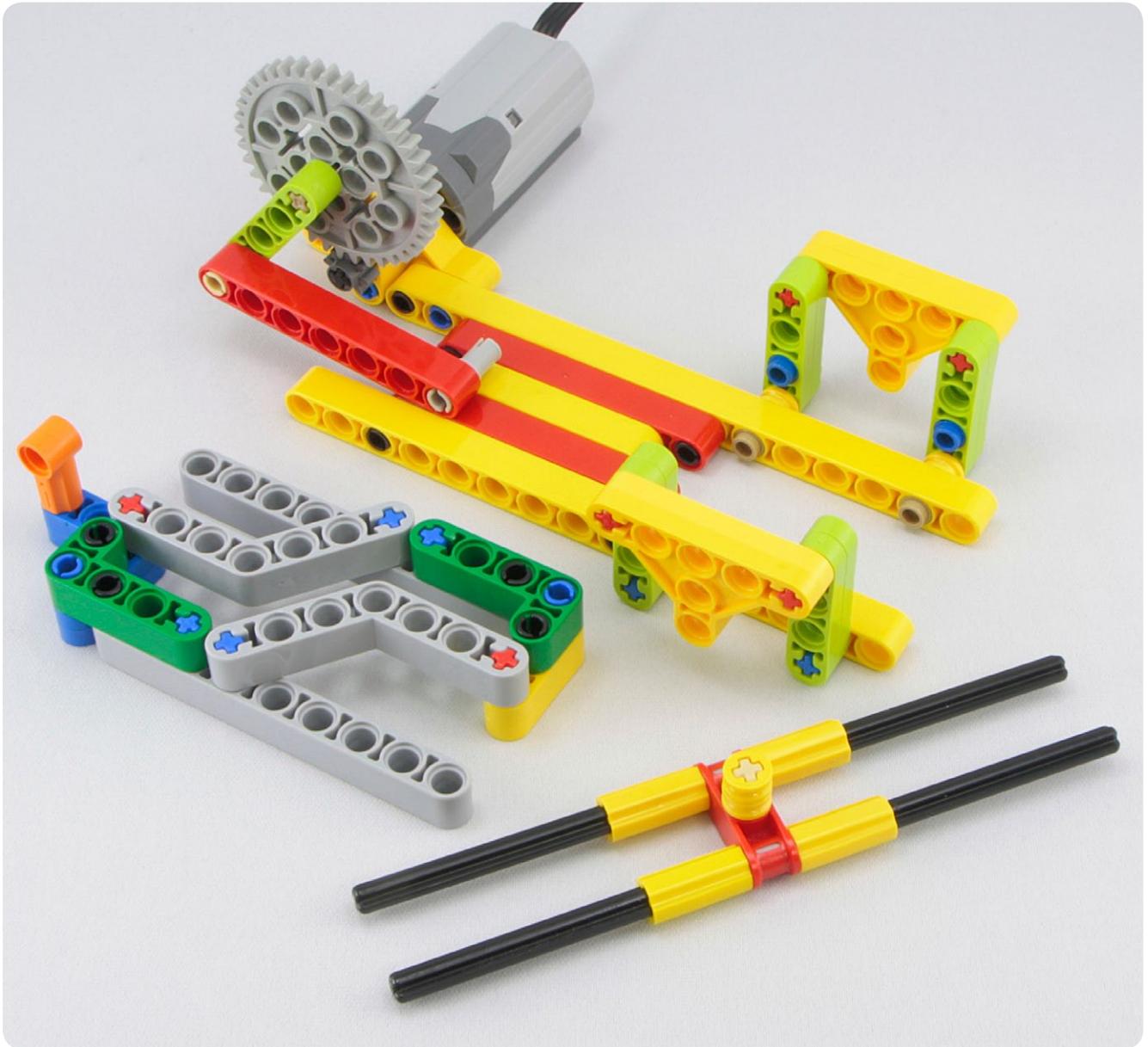


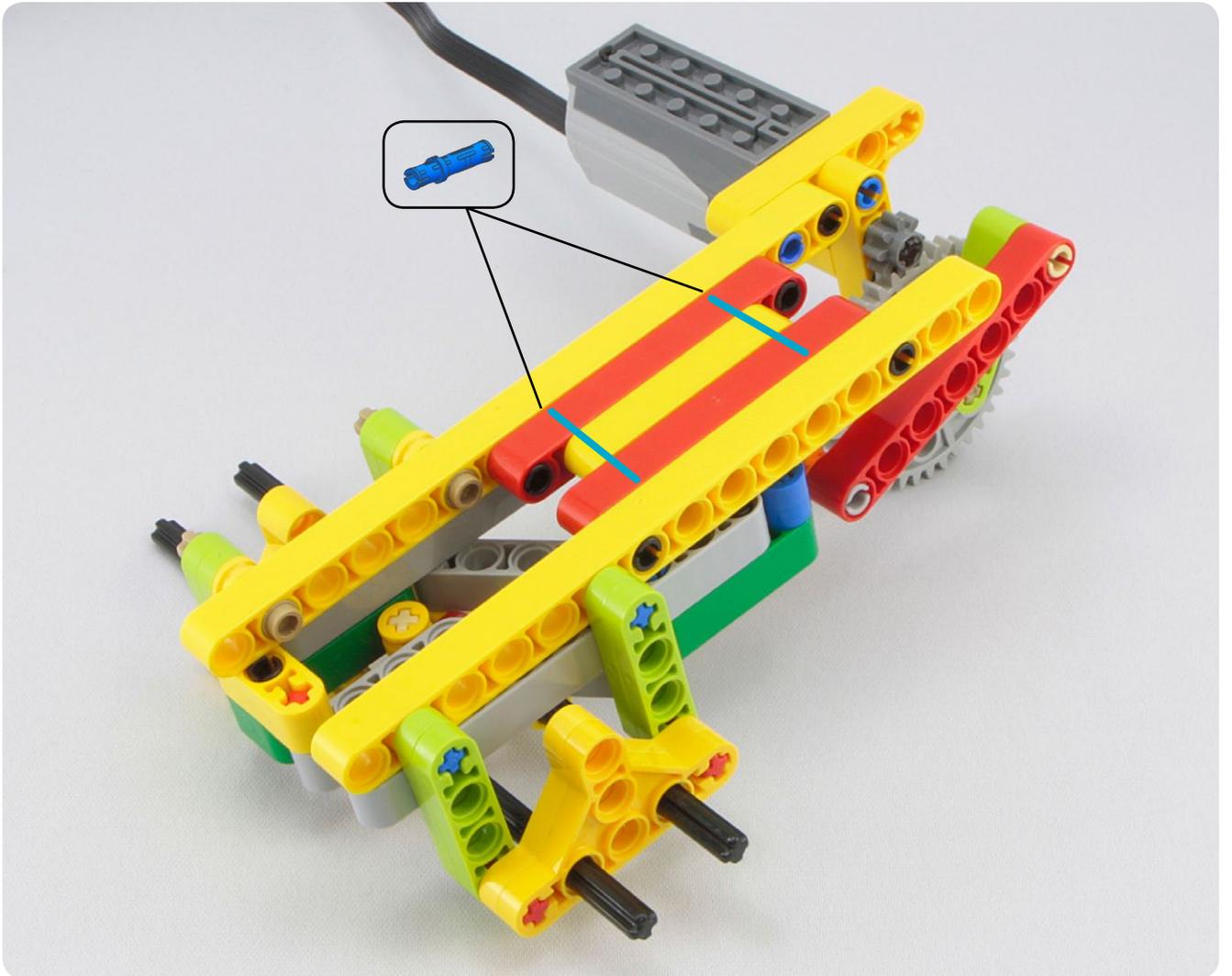
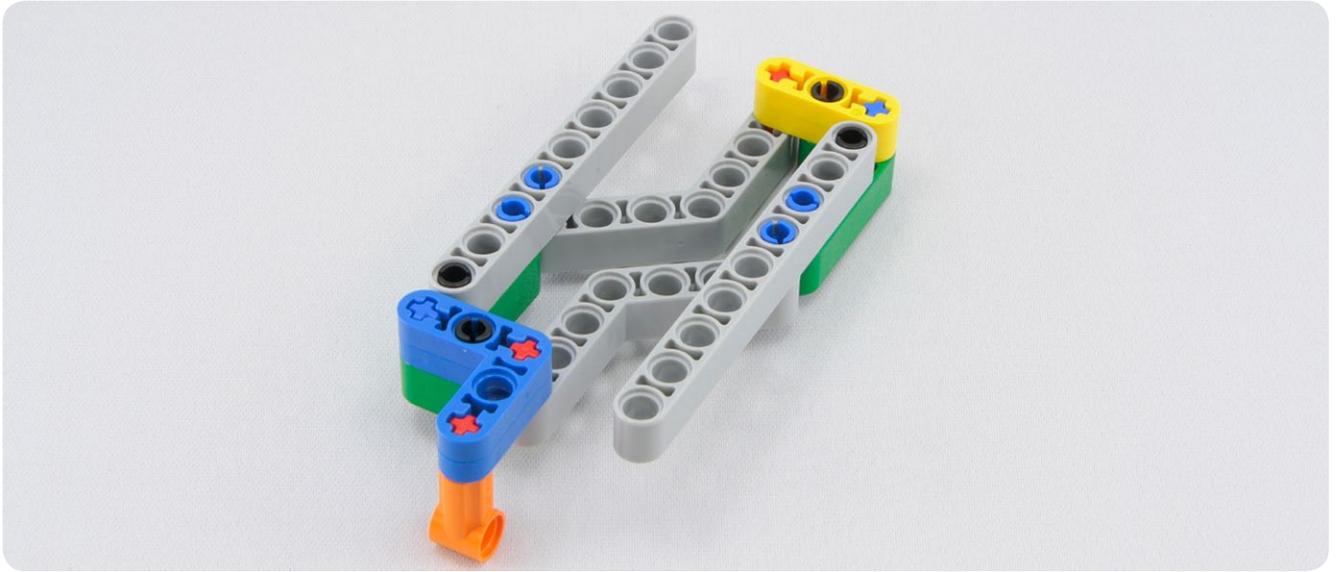


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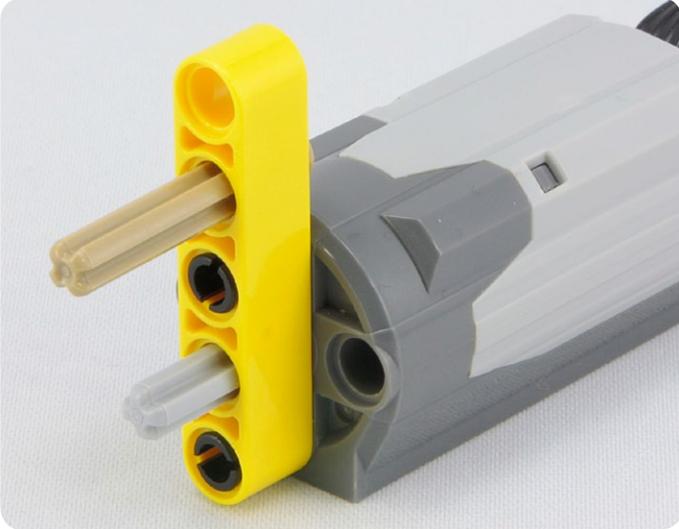
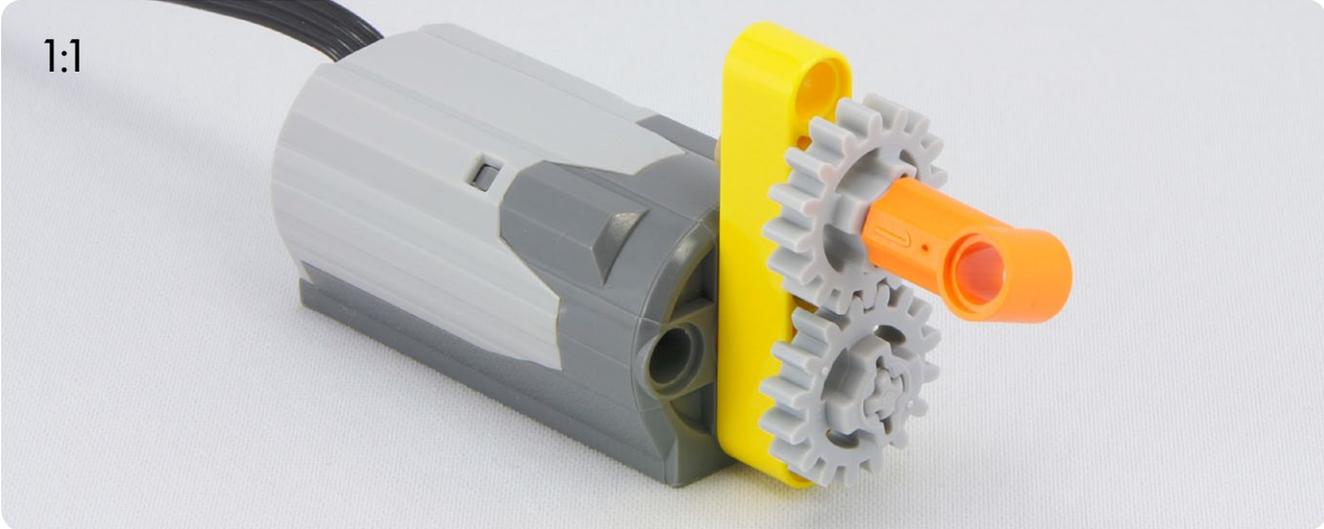
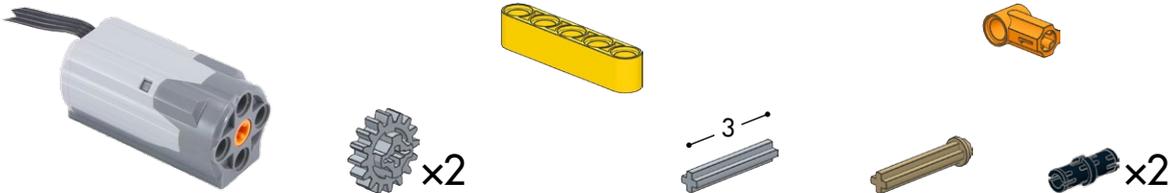




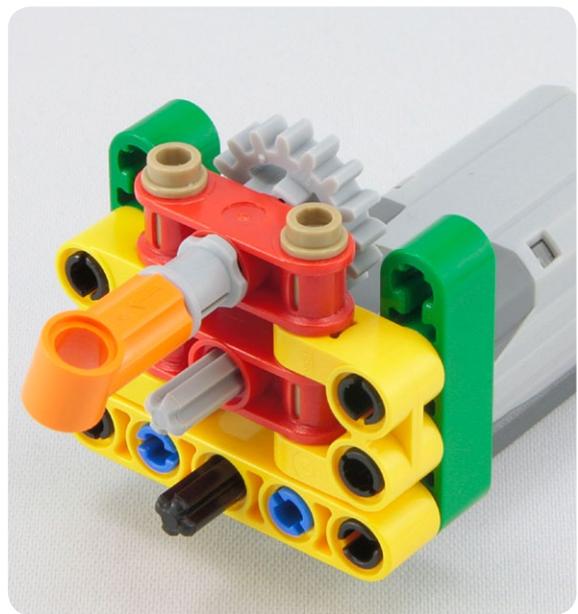
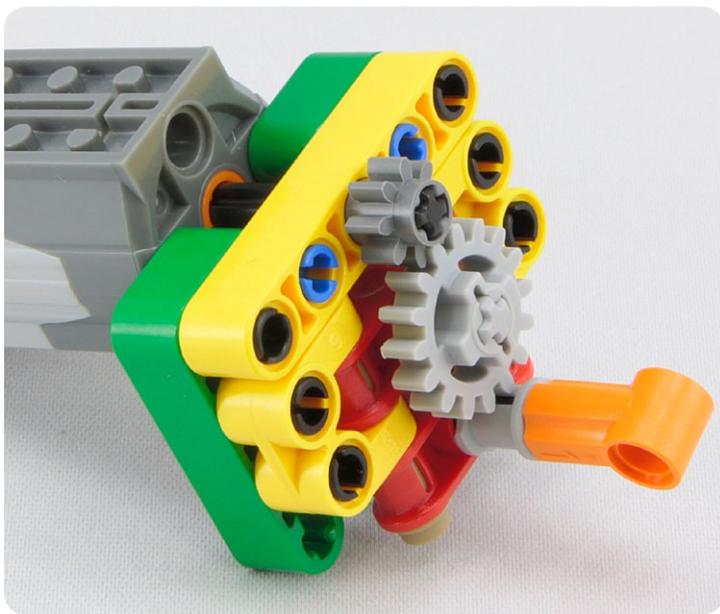
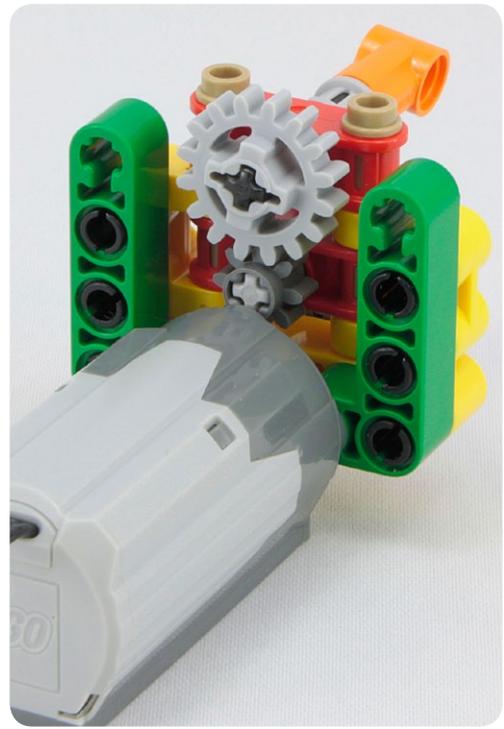
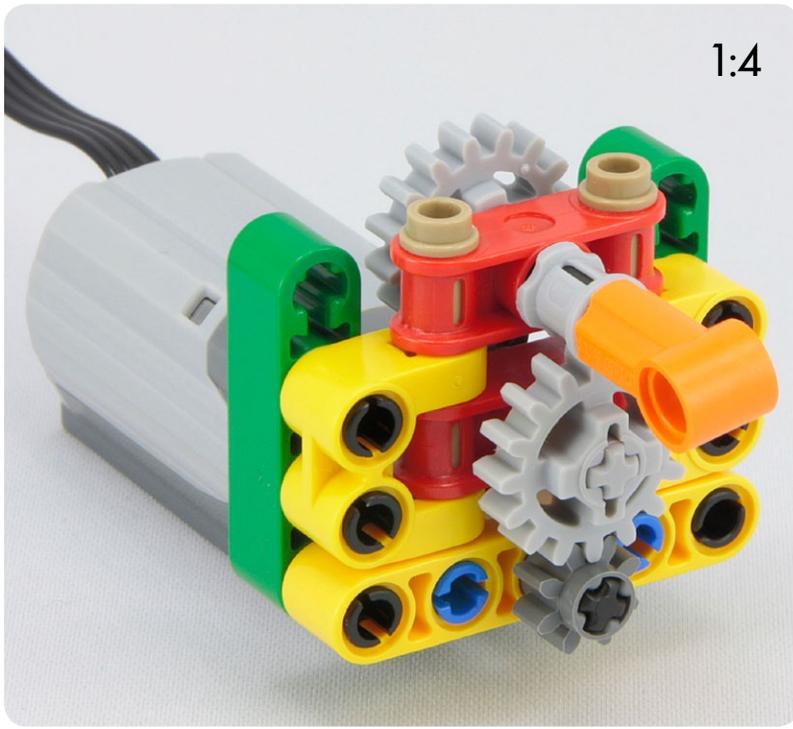
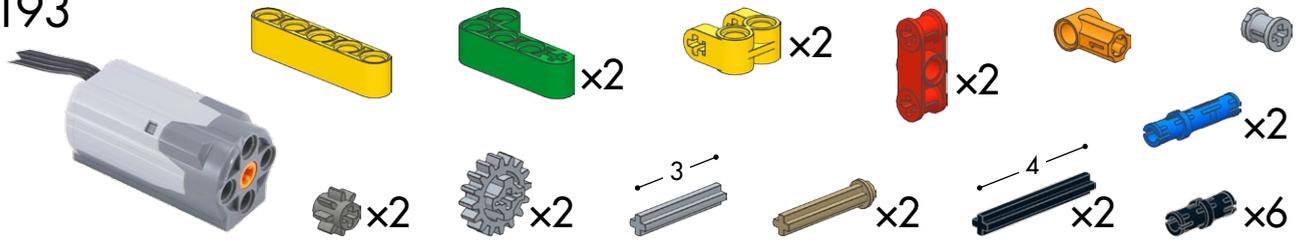
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Gear systems with whole number ratios

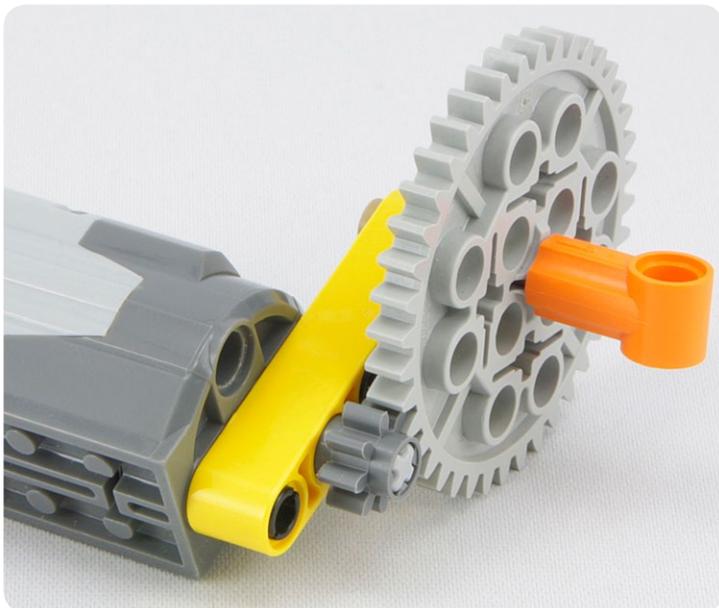
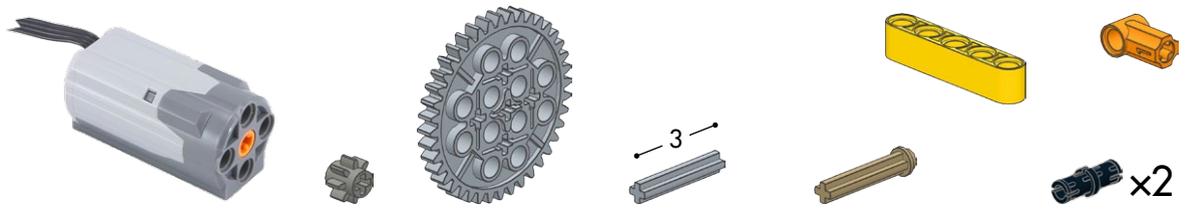
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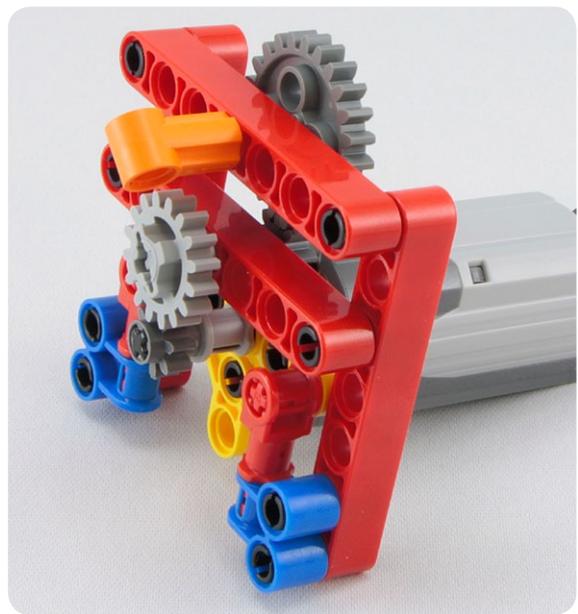
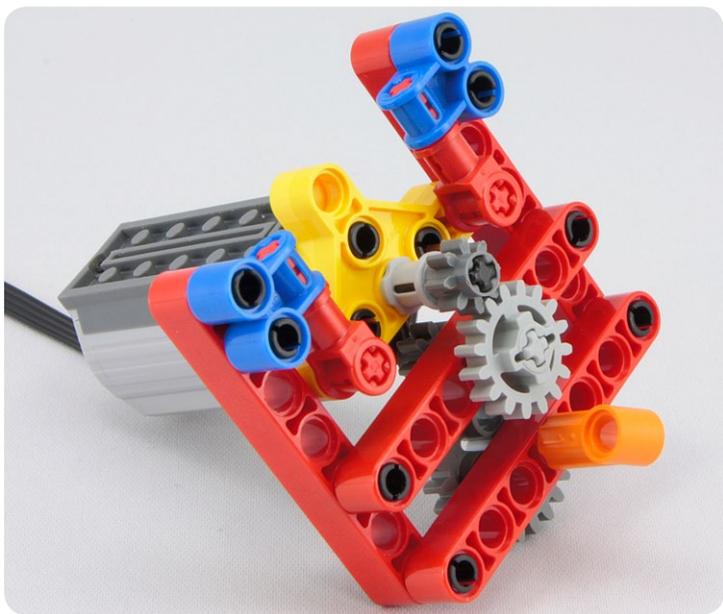
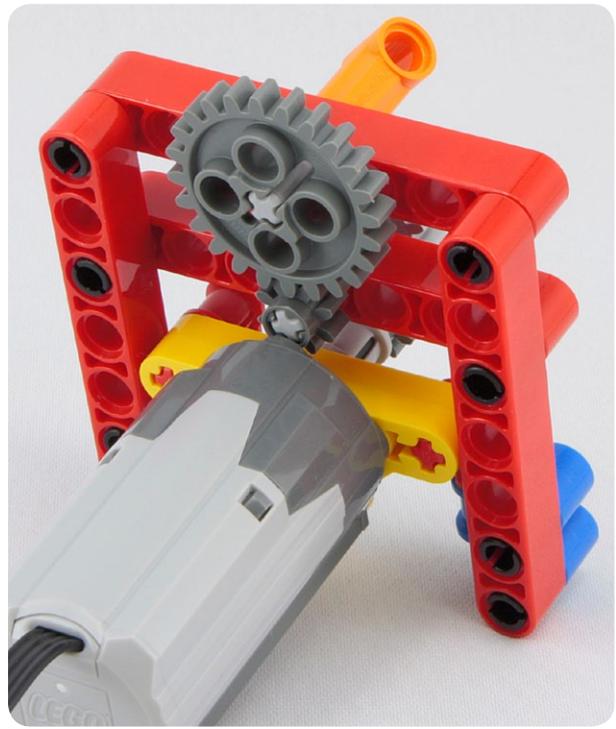
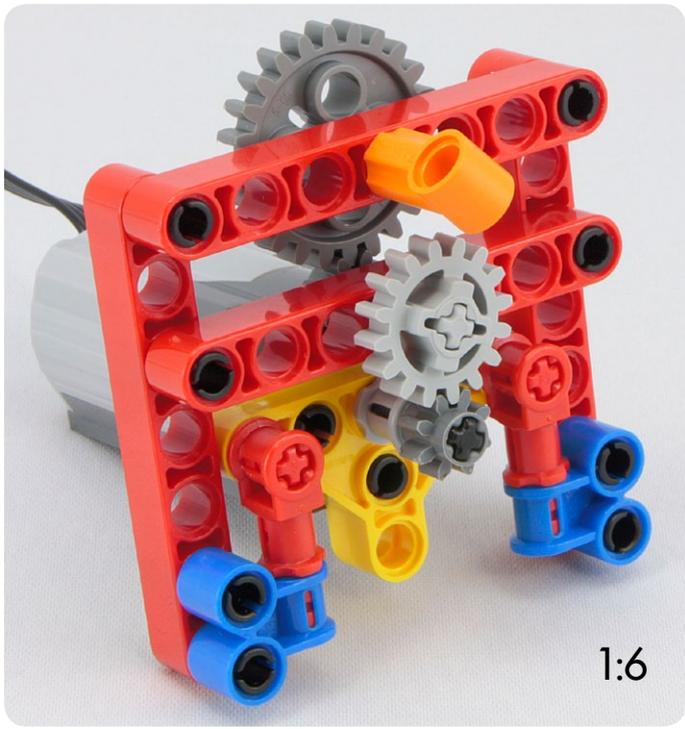
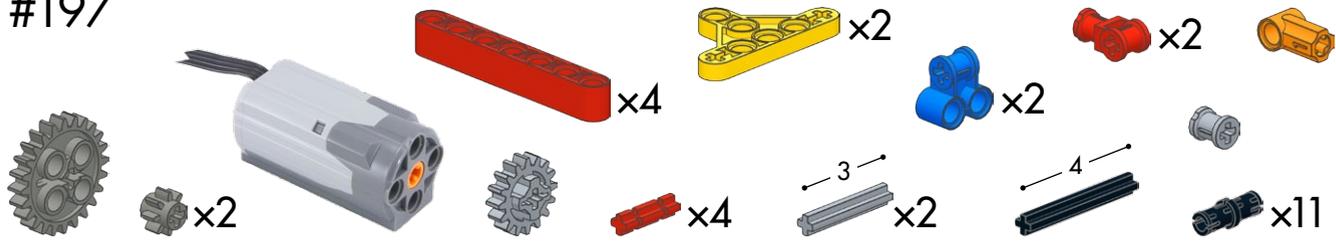
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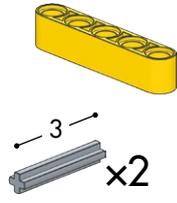
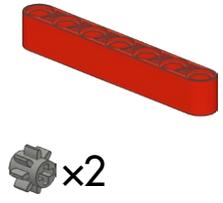
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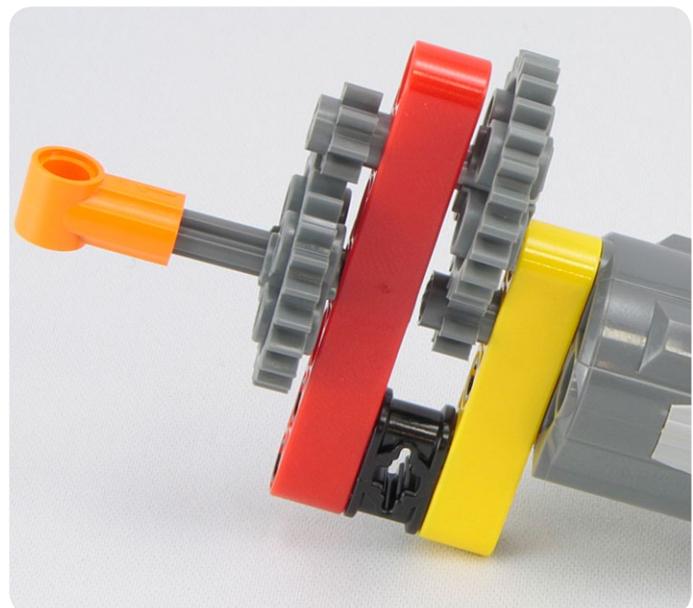
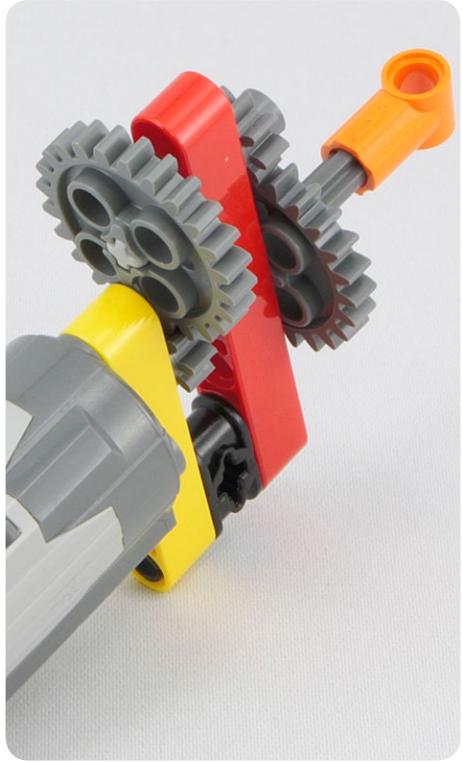
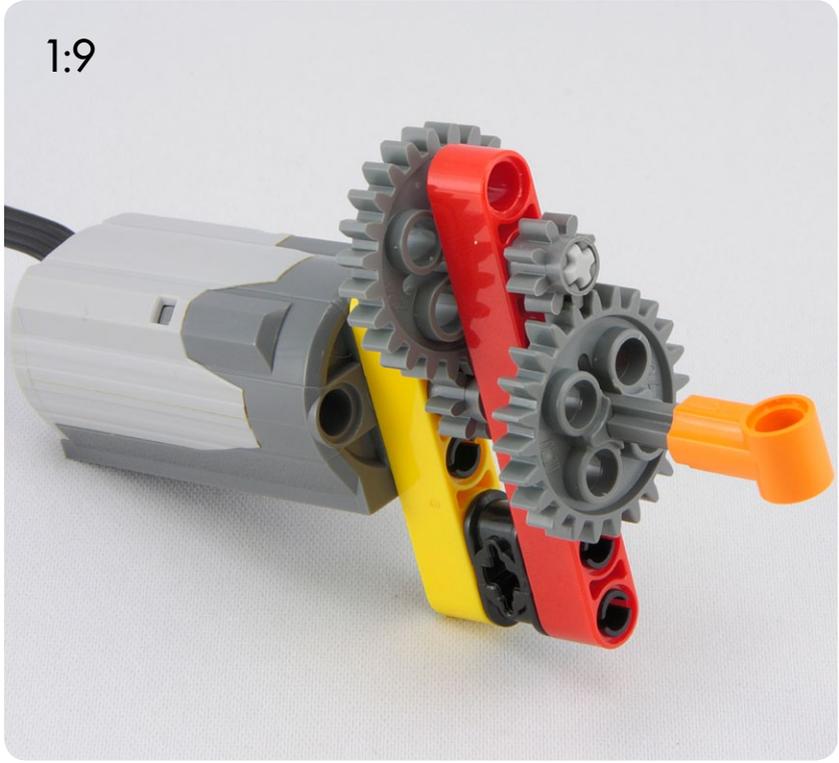
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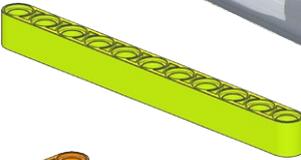
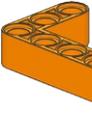
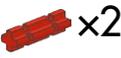
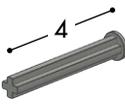


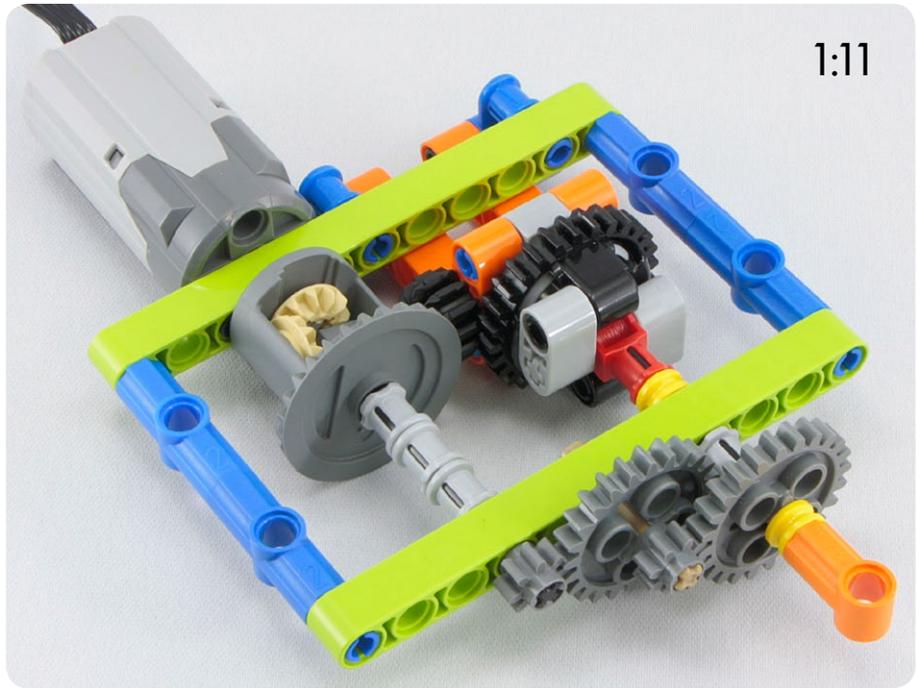
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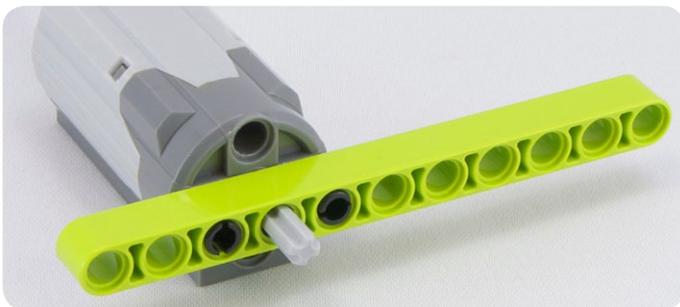
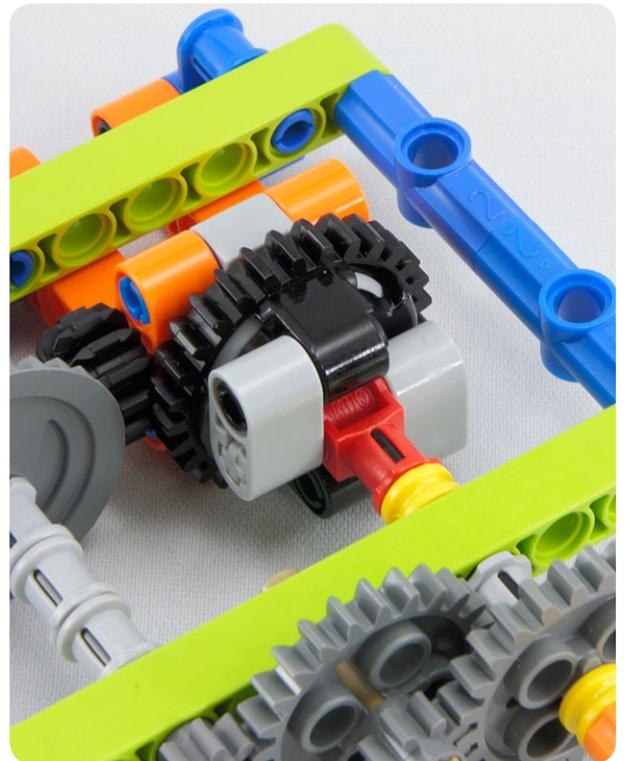
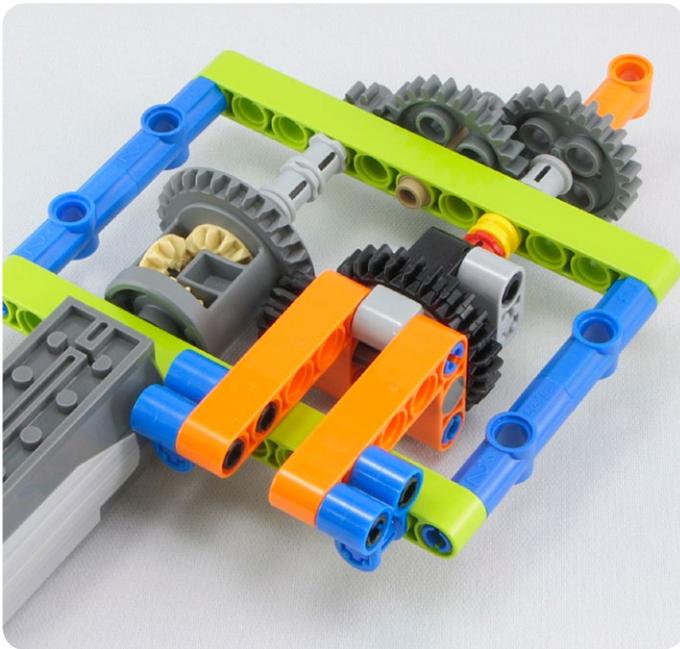
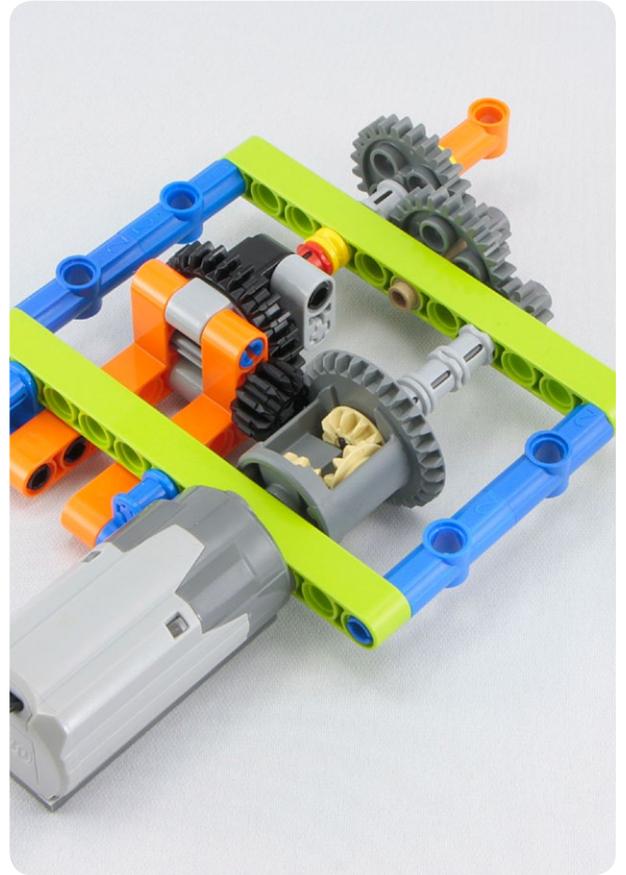
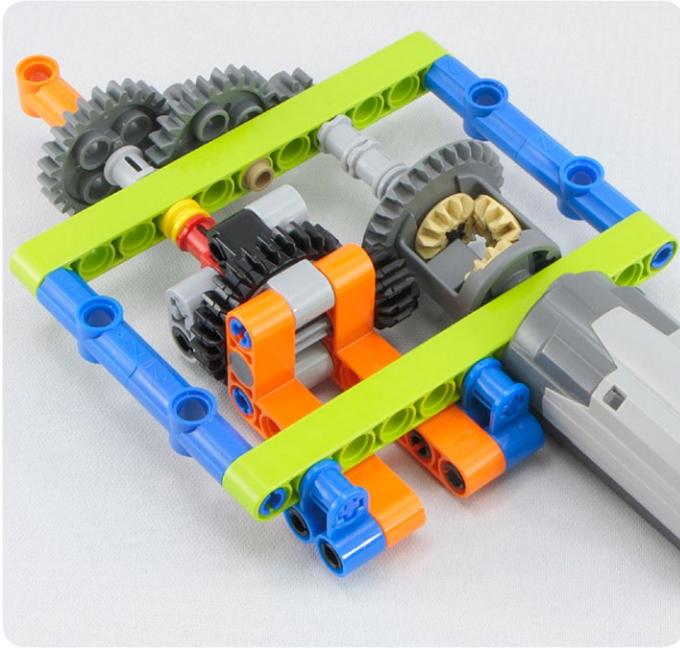


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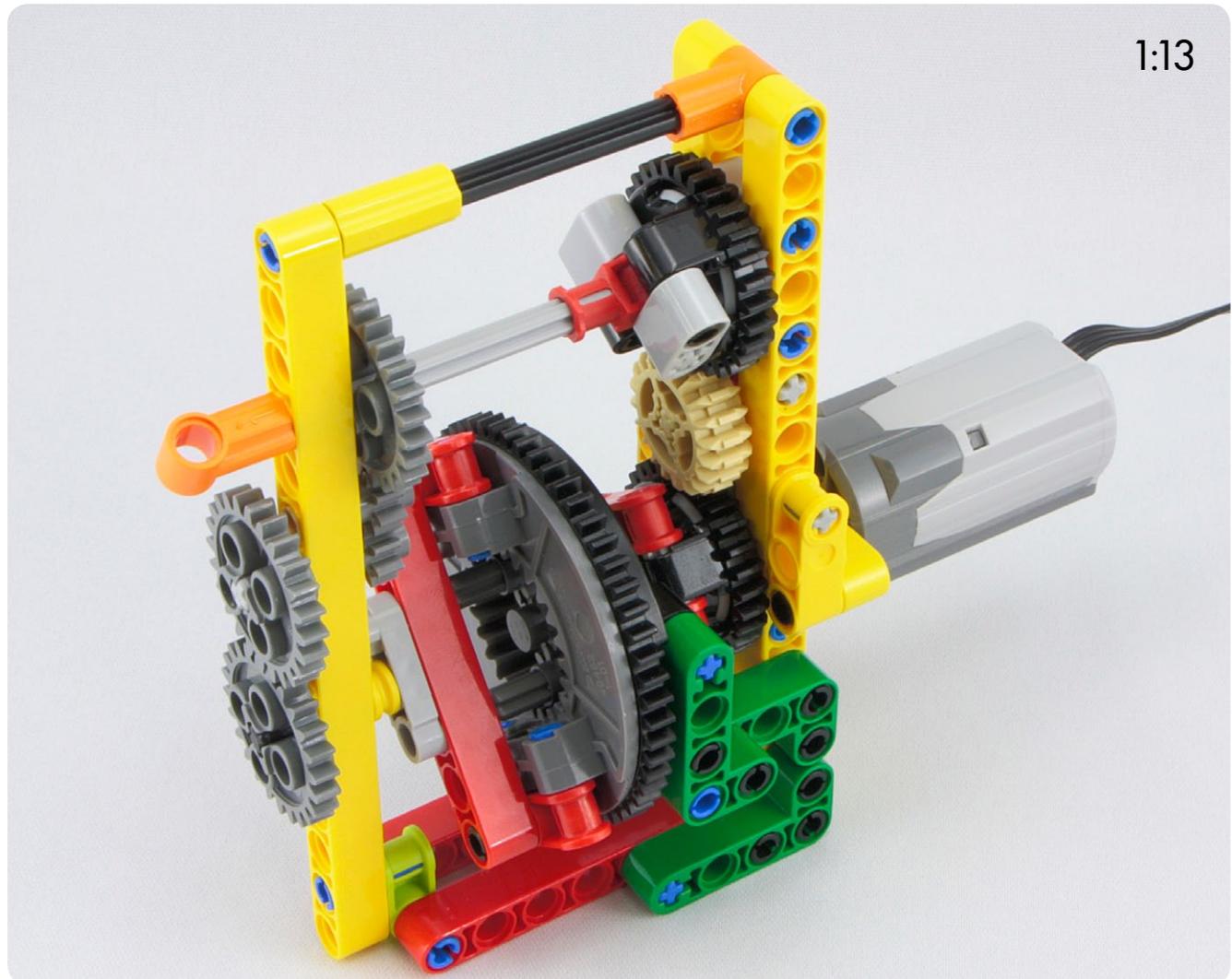
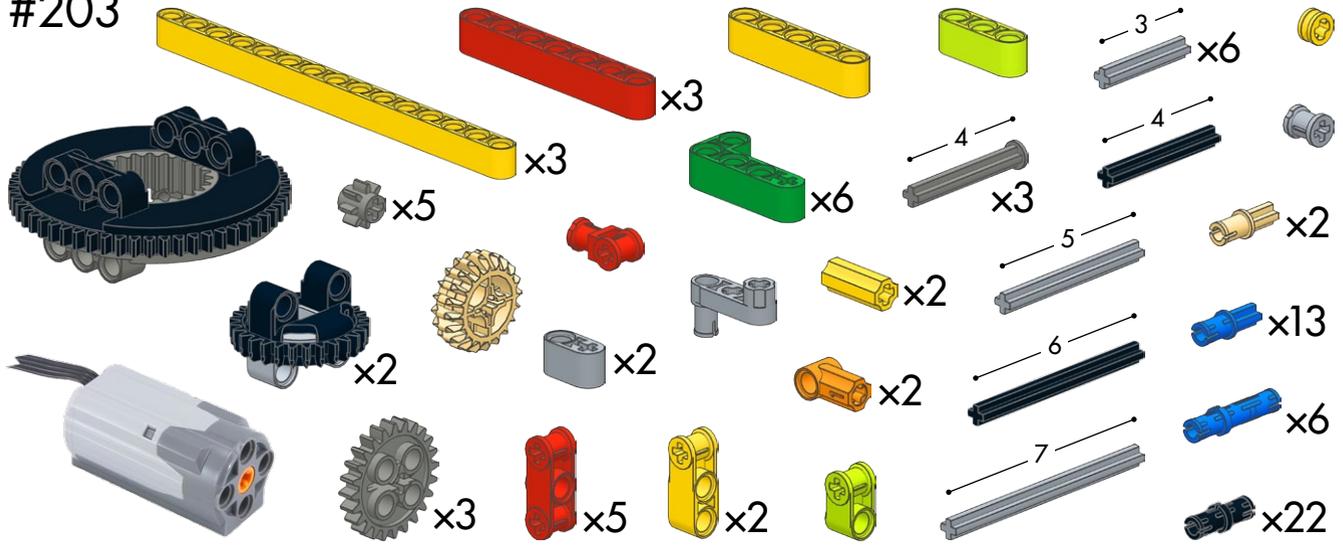
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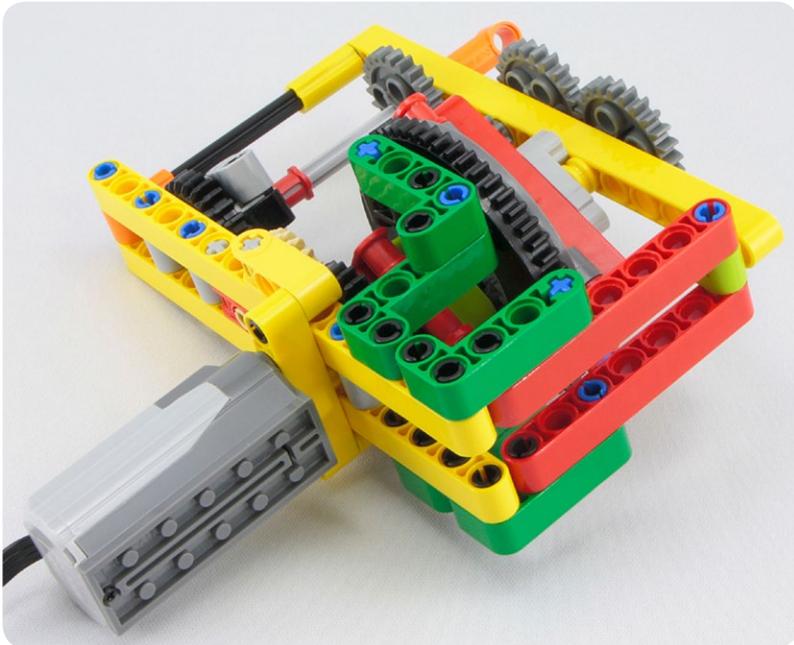
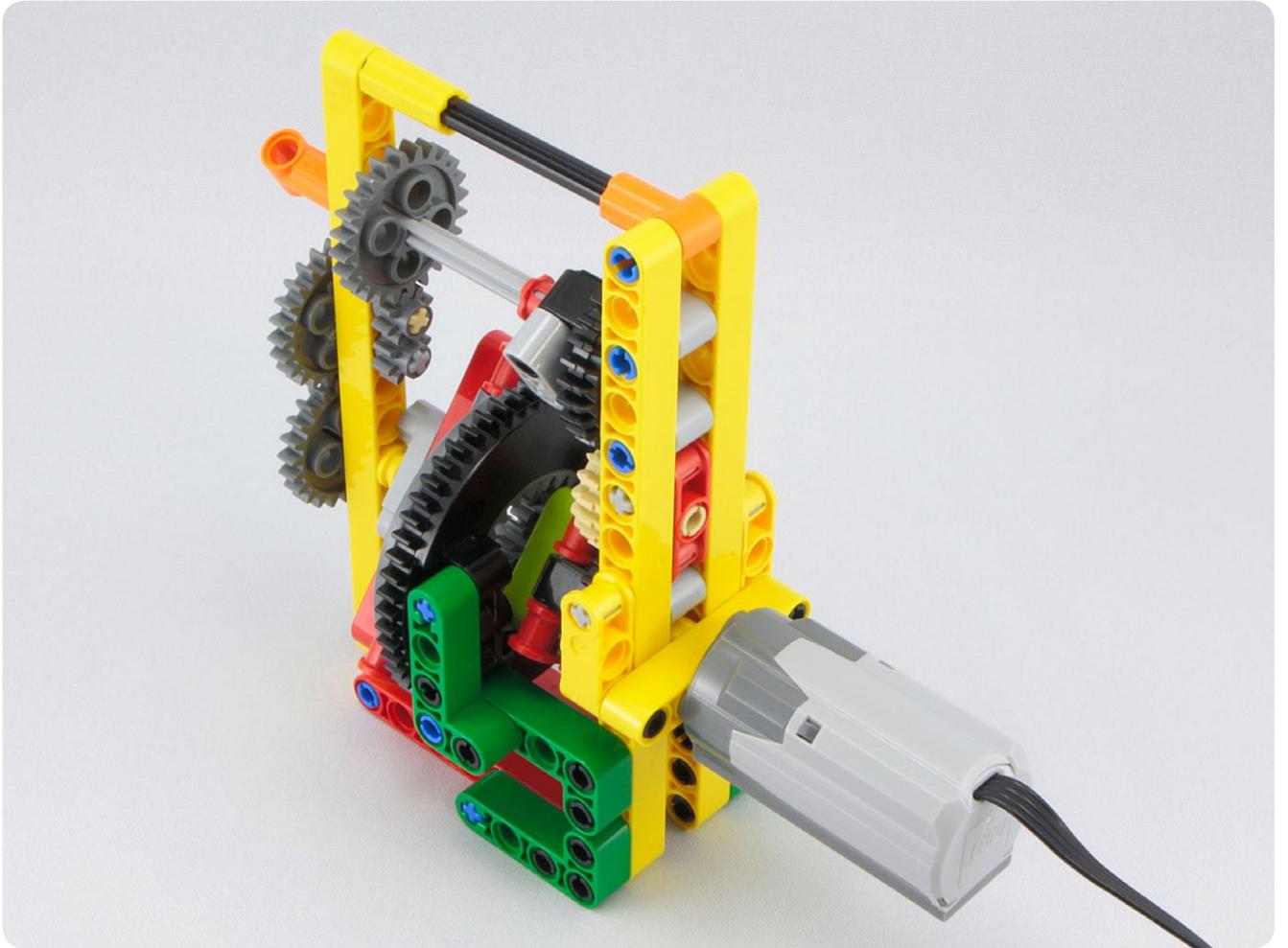
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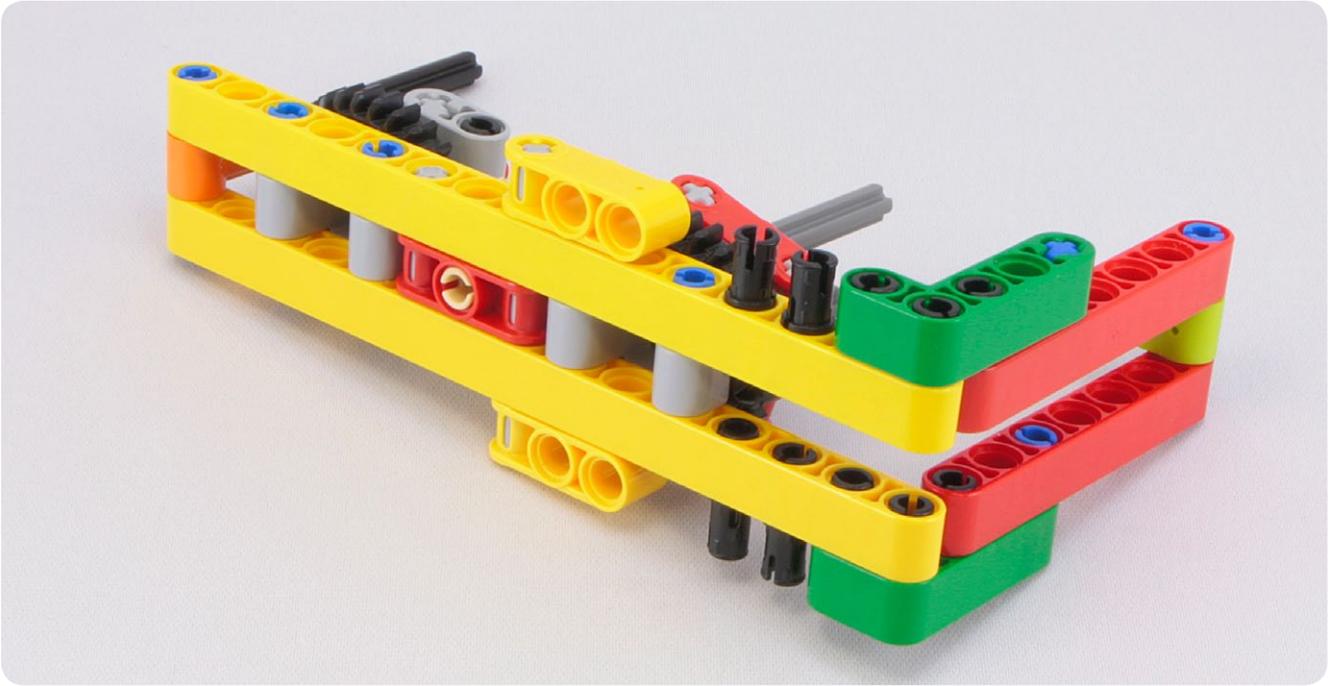


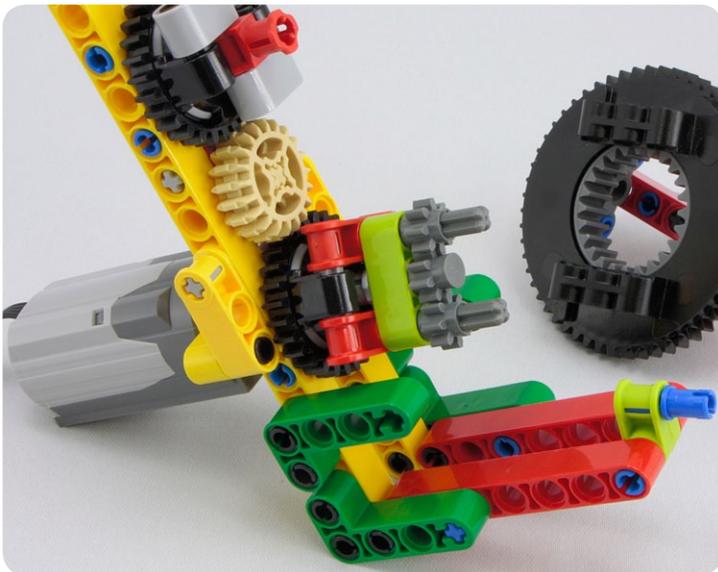
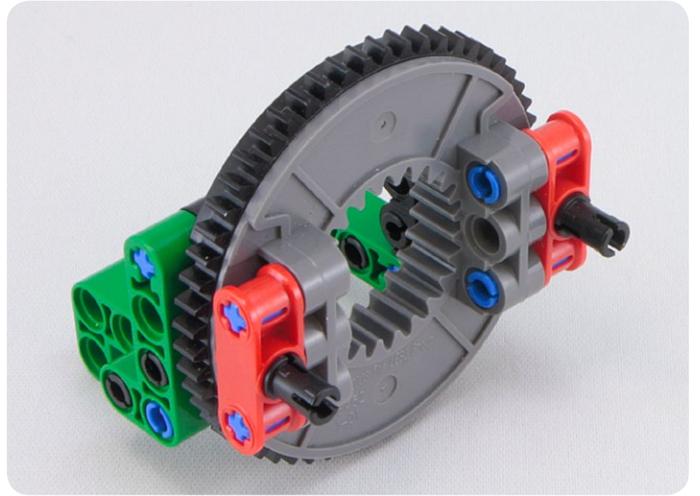


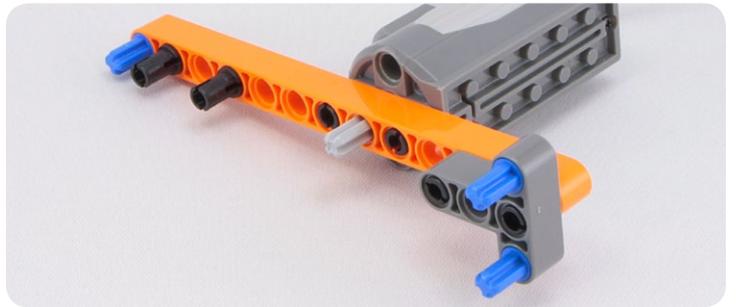
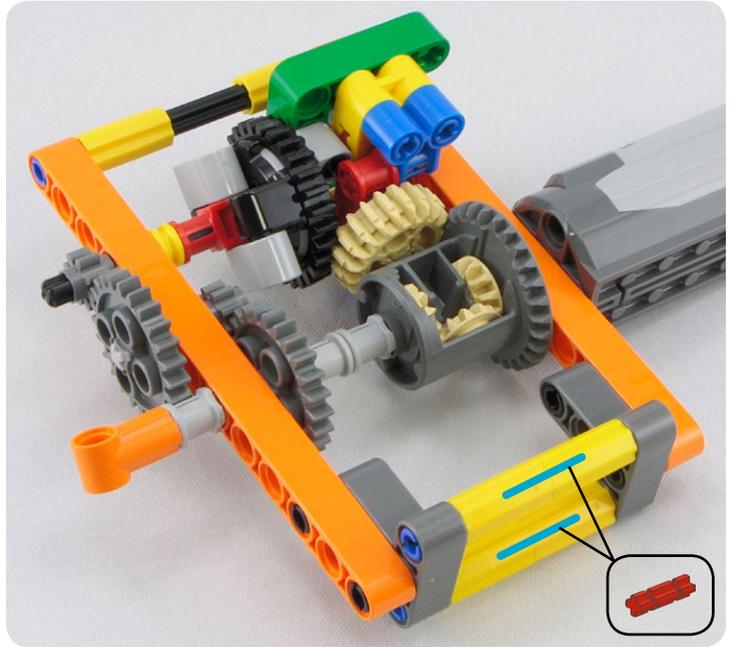
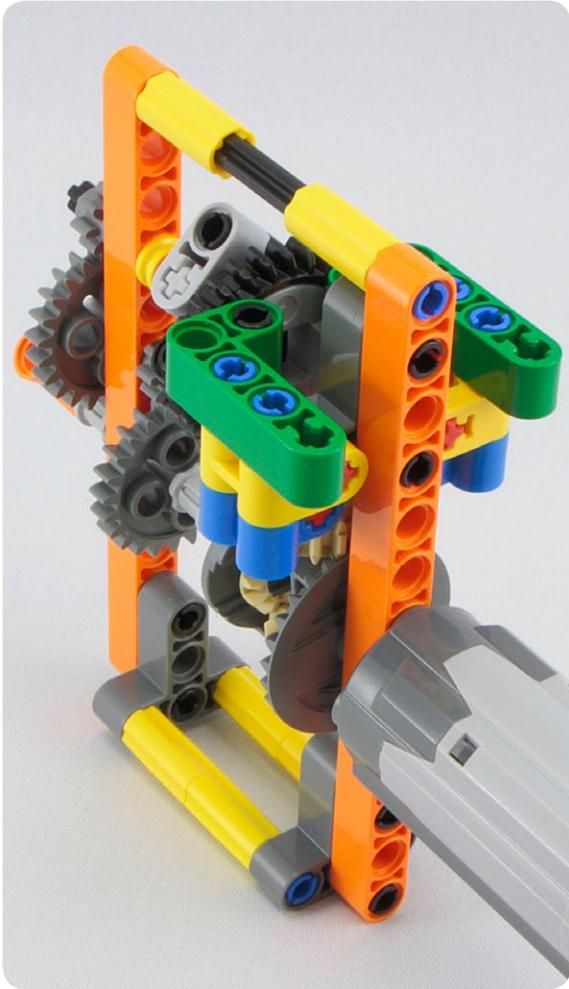
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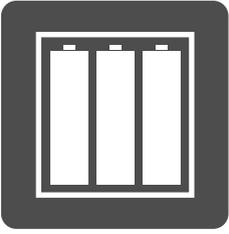






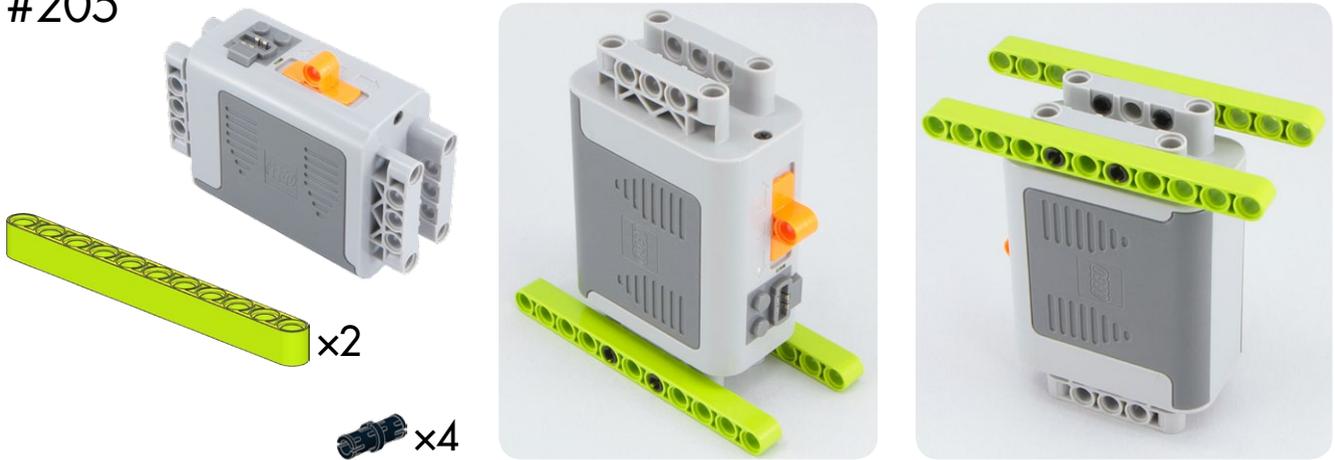




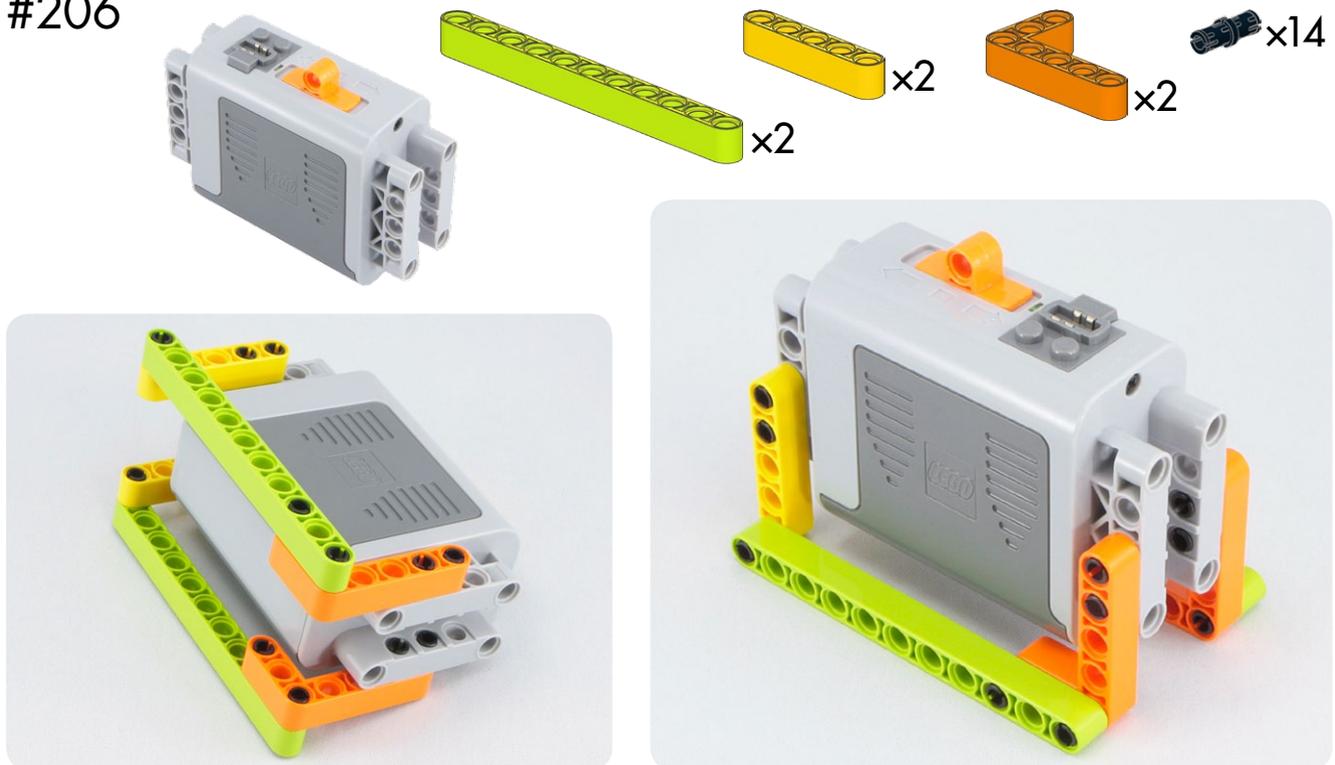


Attaching a battery box

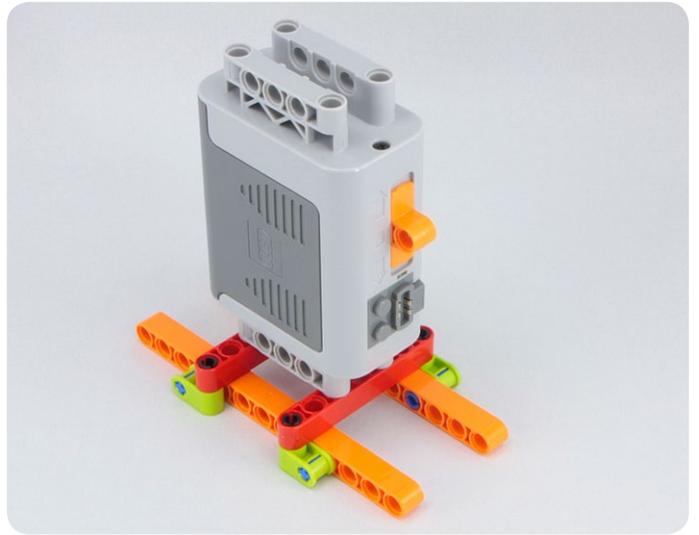
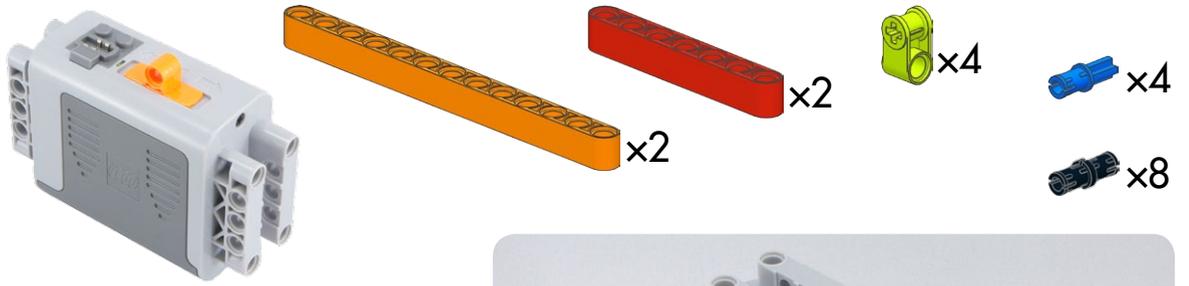
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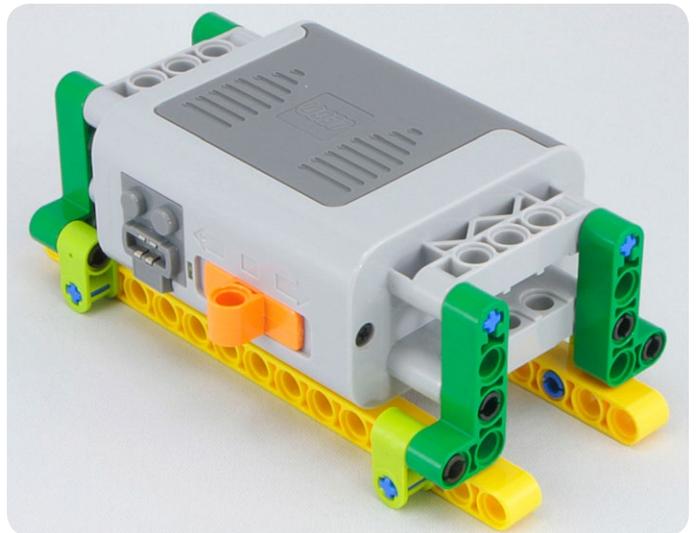
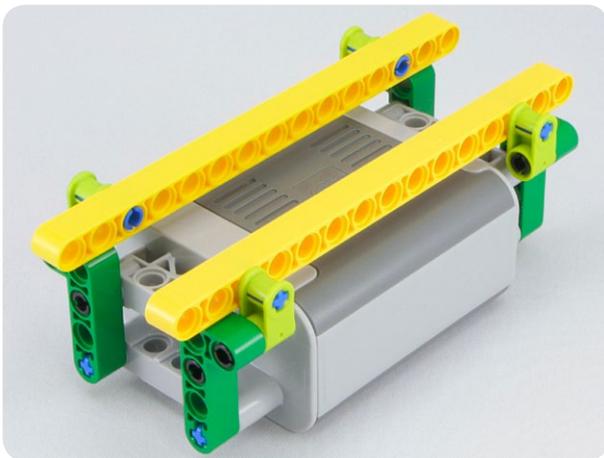
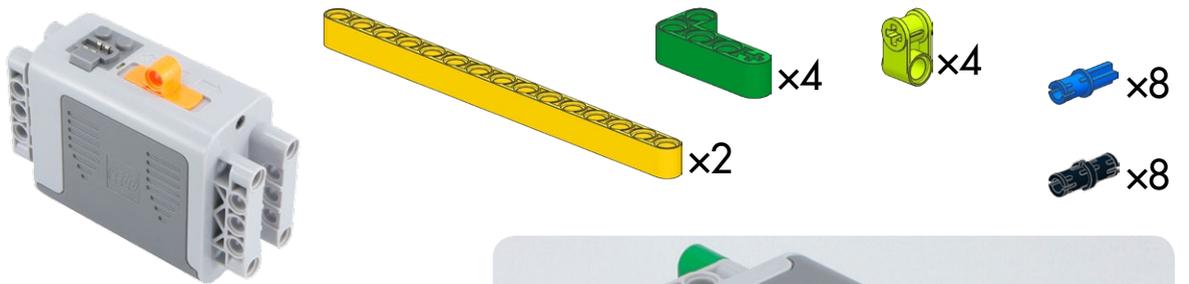
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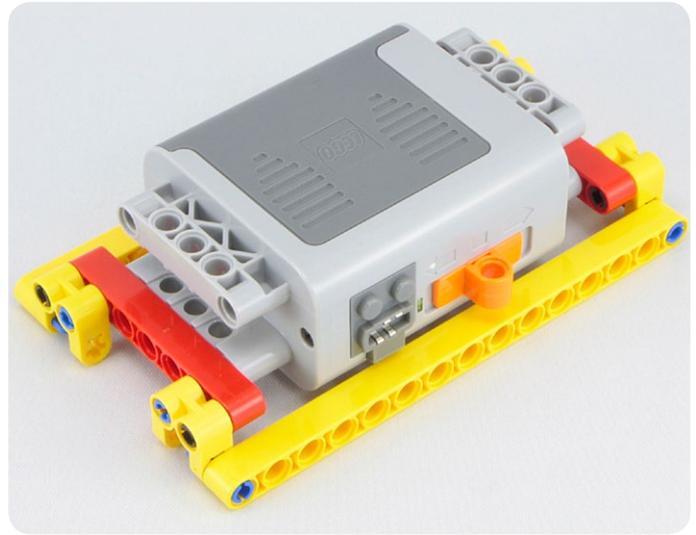
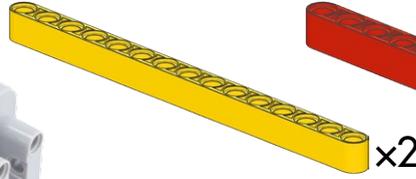
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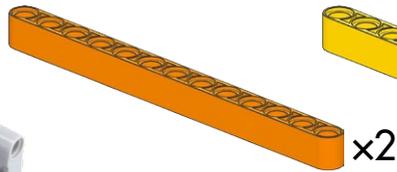
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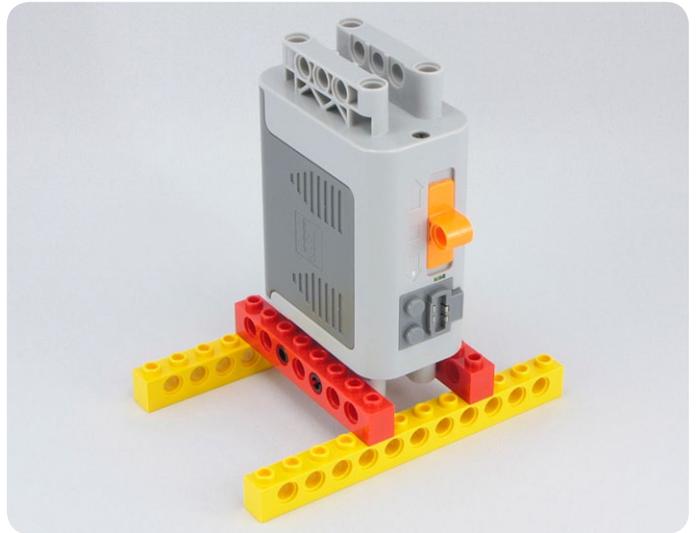
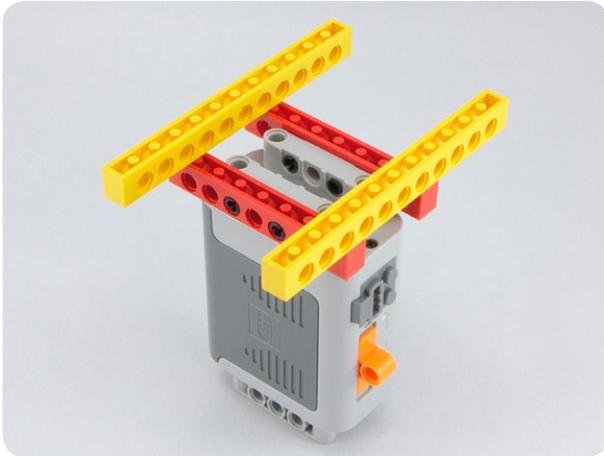
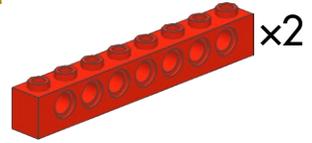
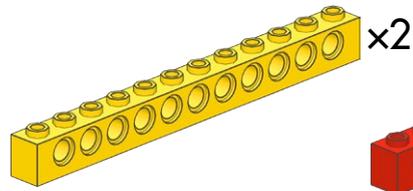
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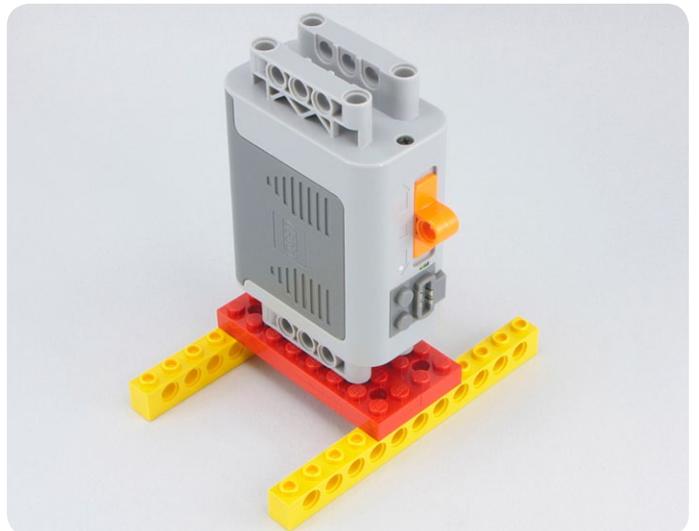
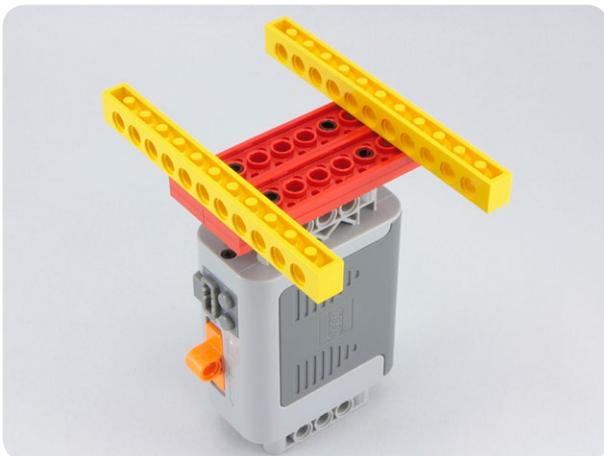
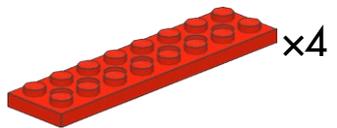
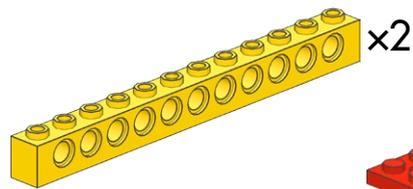
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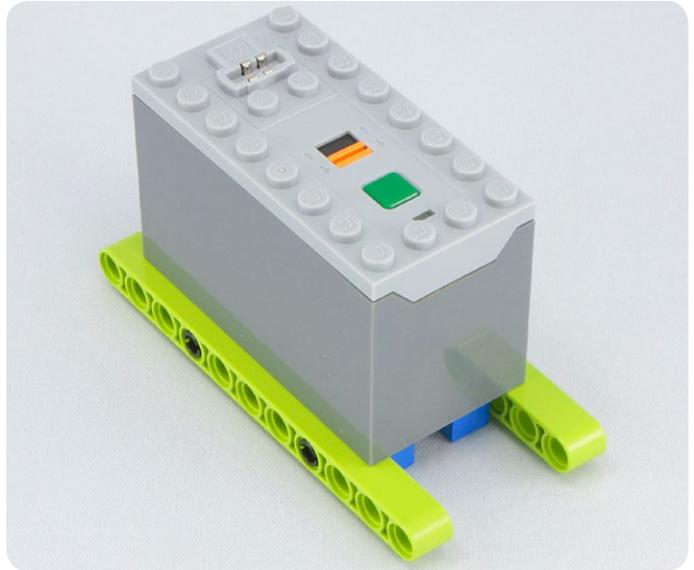
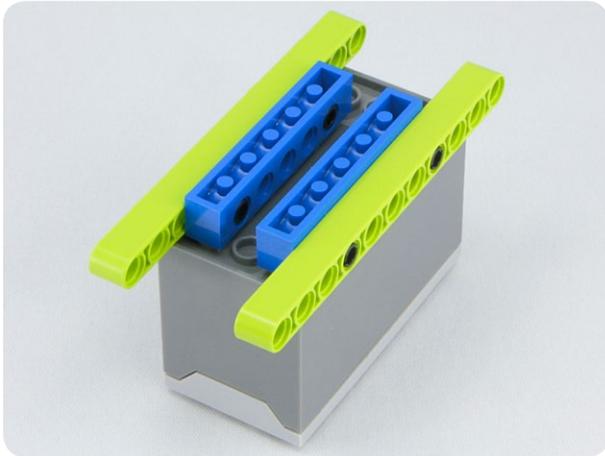
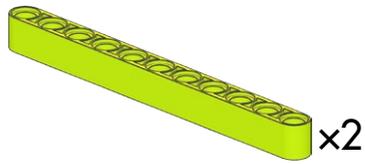
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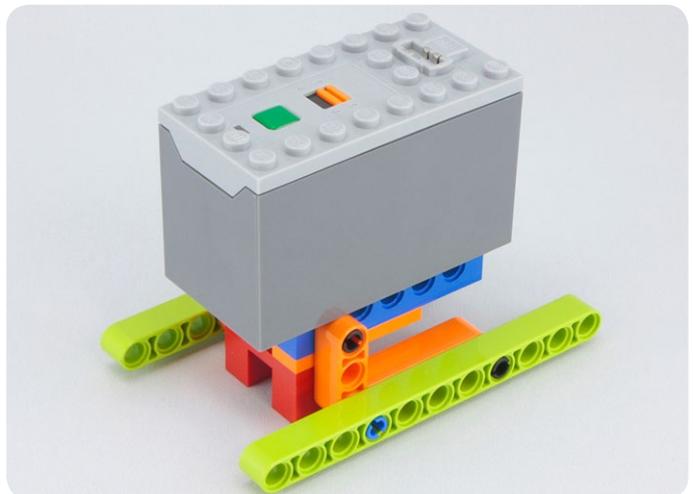
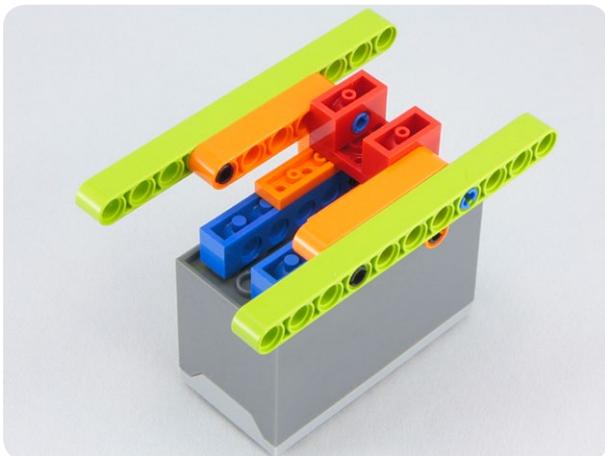
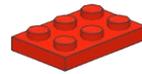
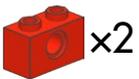
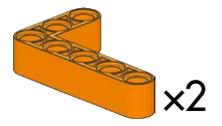
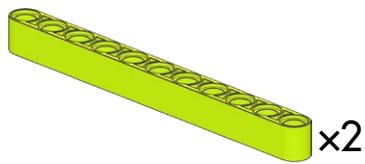
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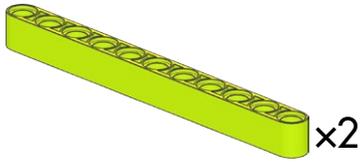
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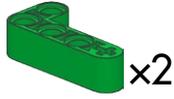
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x2



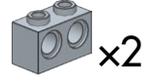
x2



x2



x2



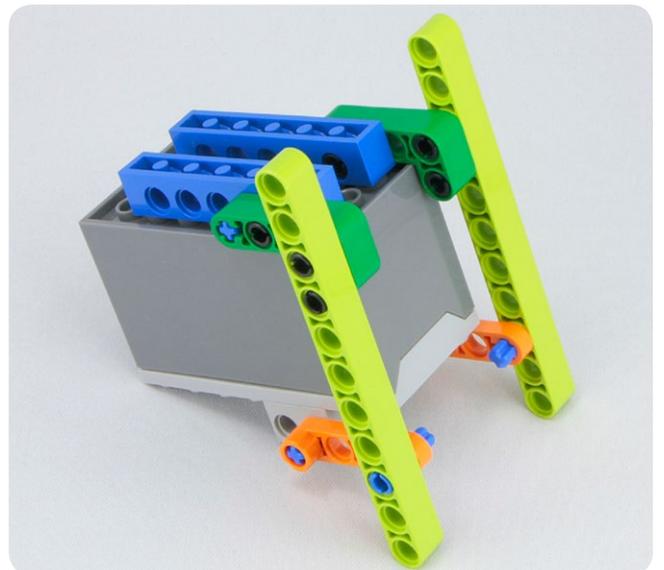
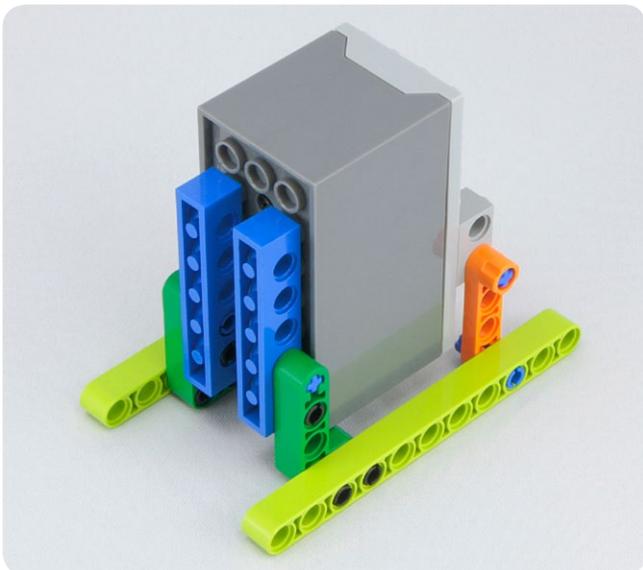
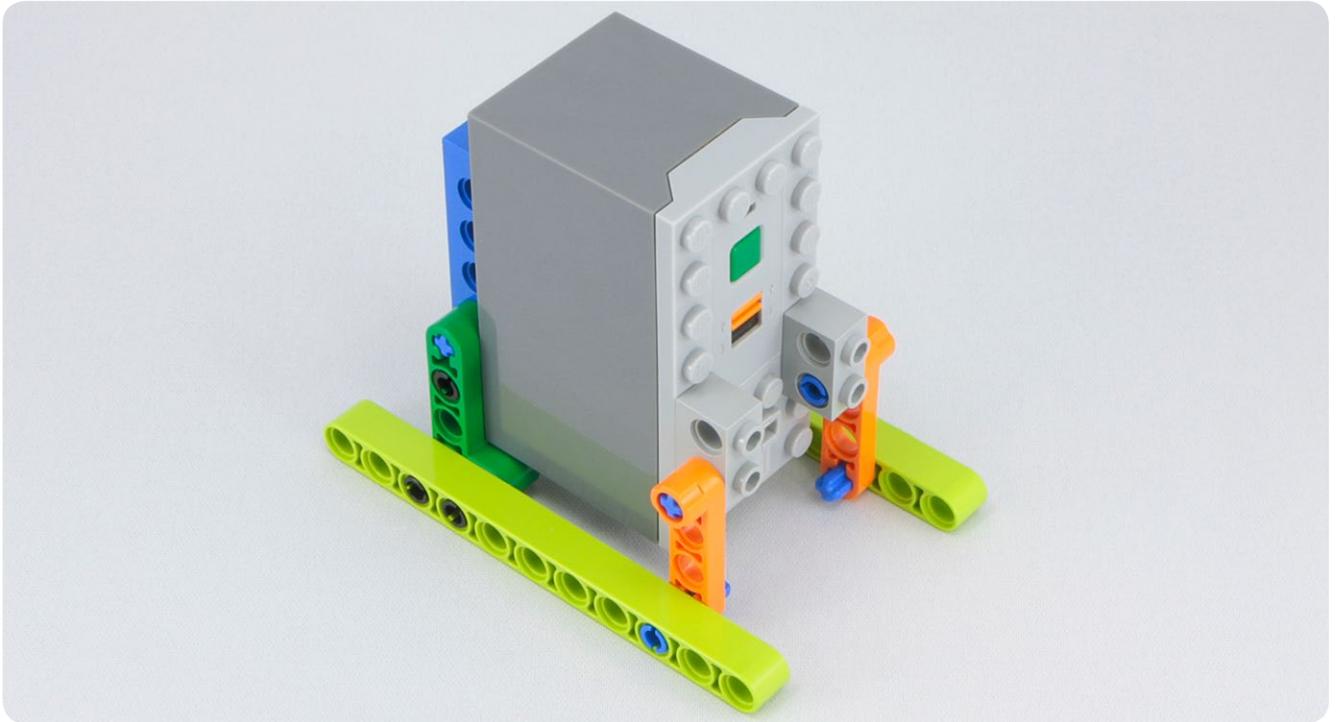
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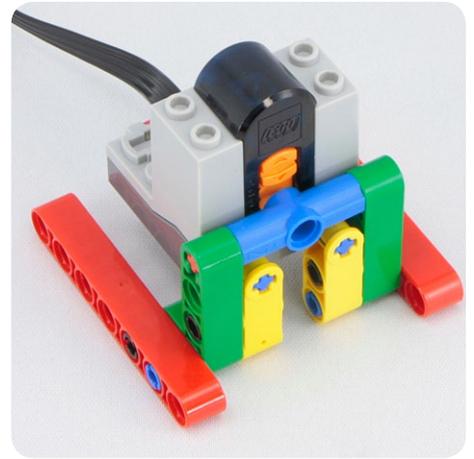
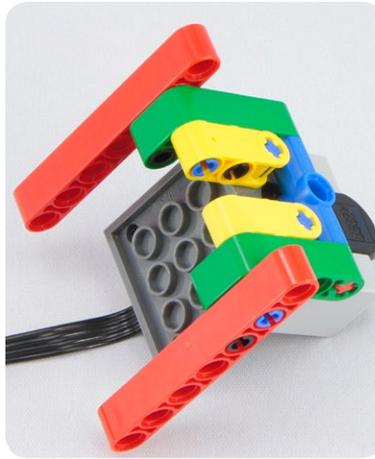
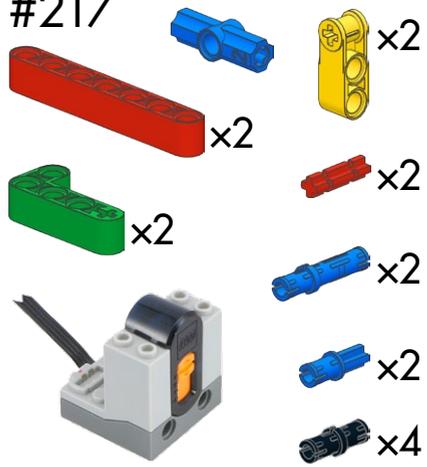
x6



x6



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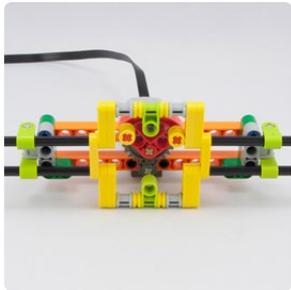
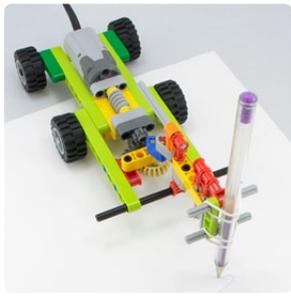
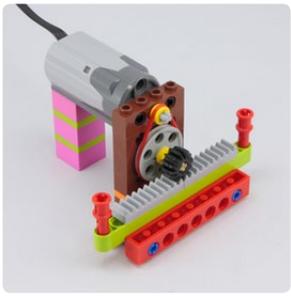


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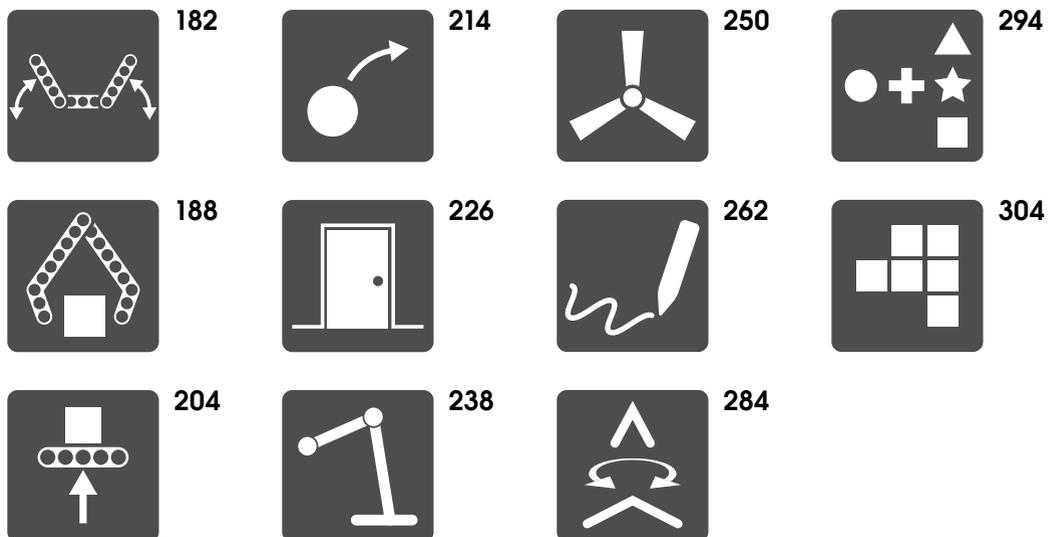
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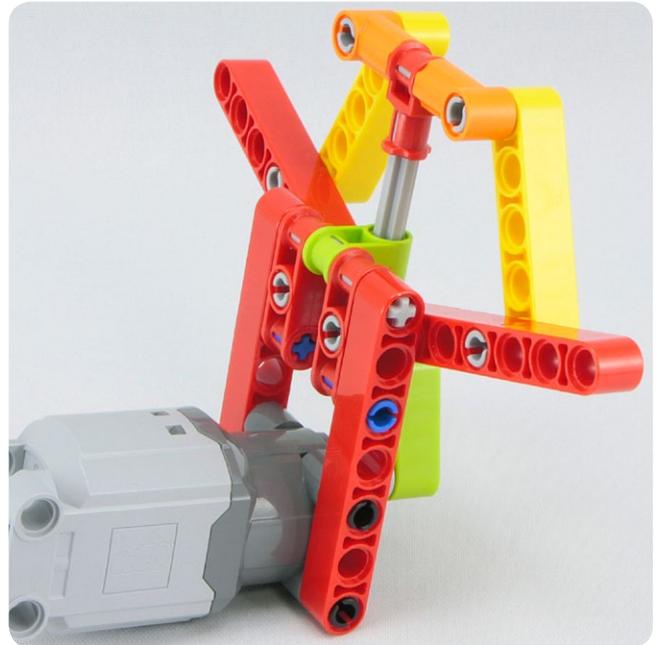
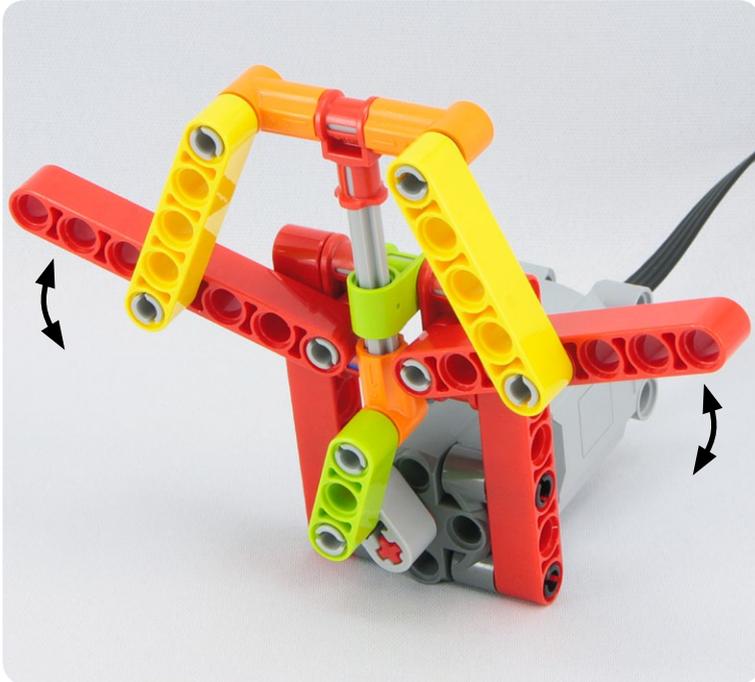
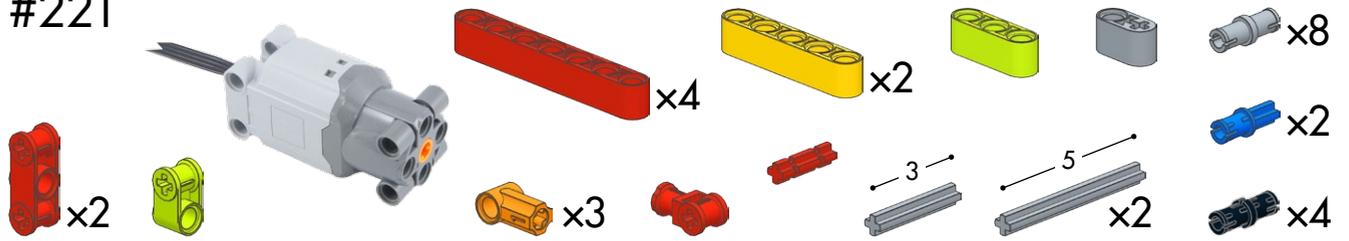


PART 2

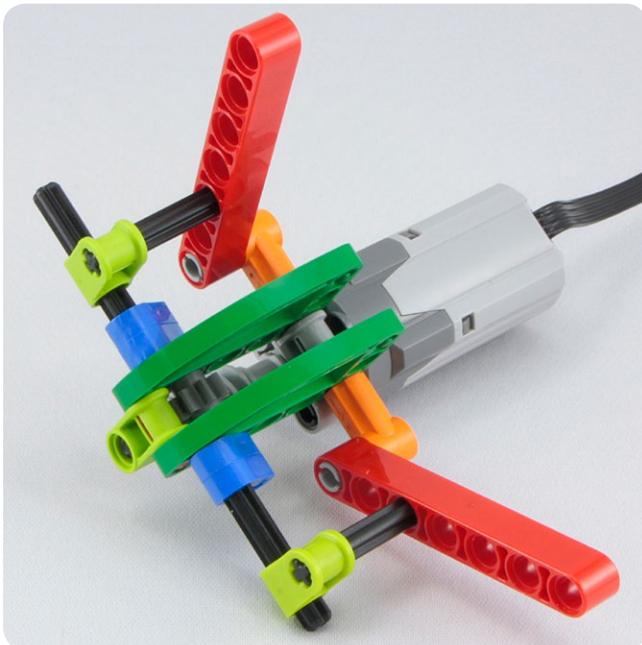
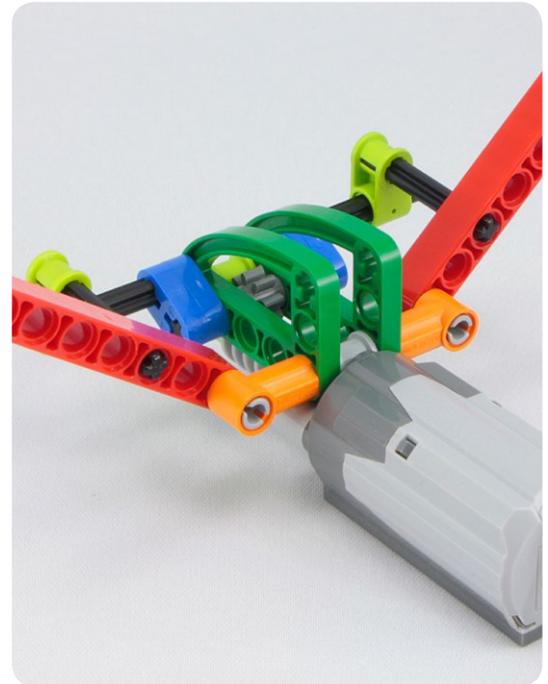
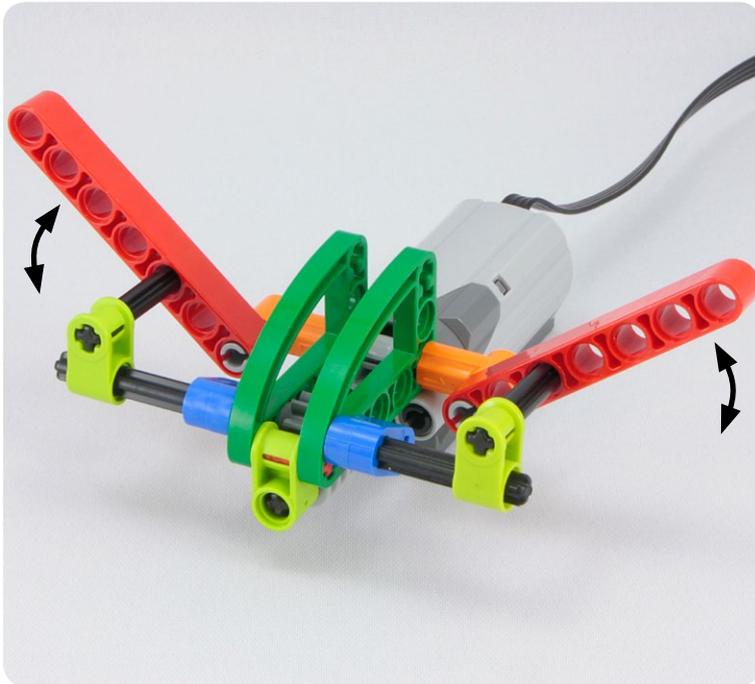
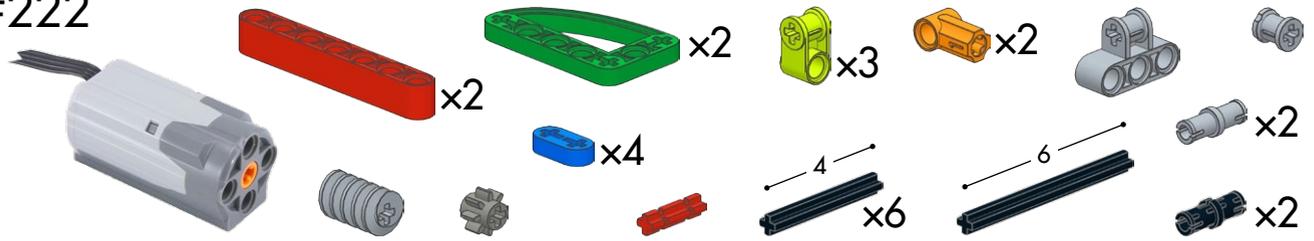
Arms, Wings, and Other Movements

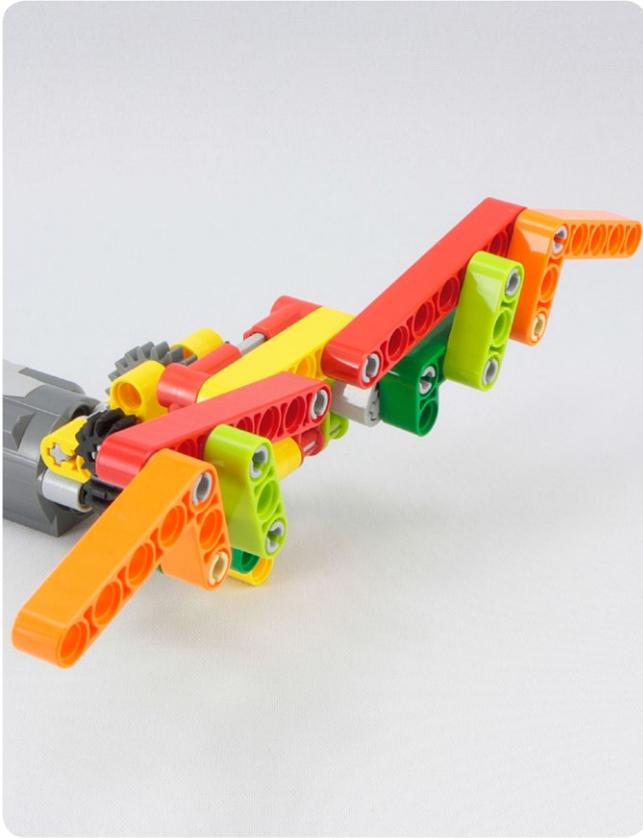


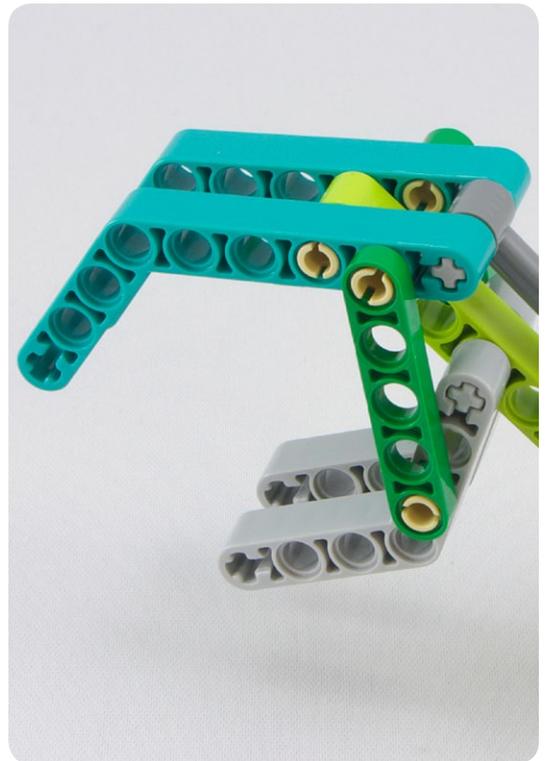
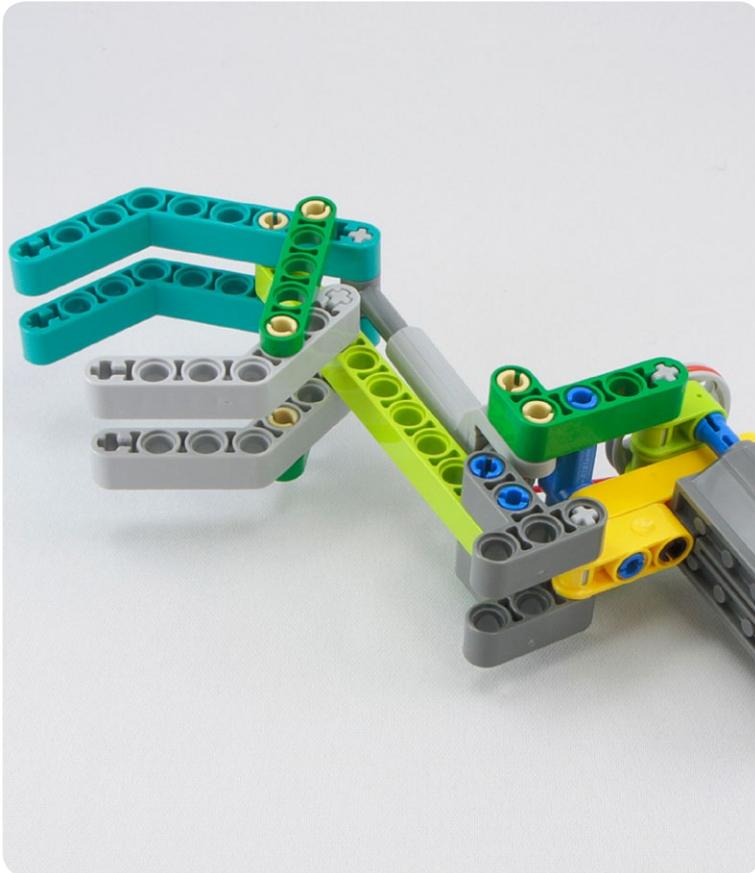
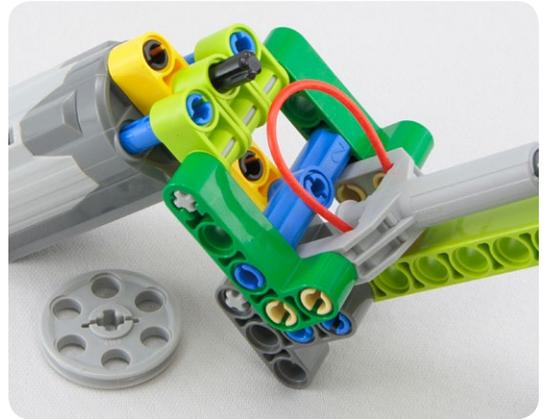
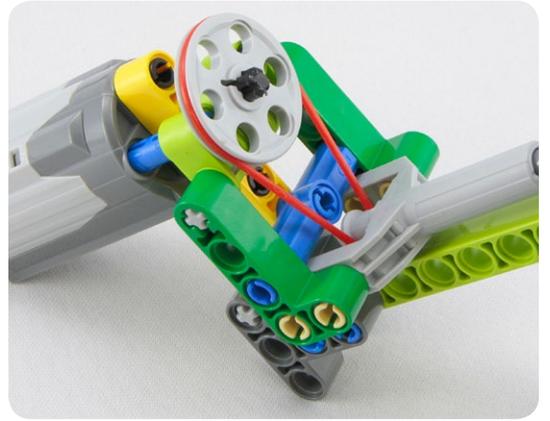
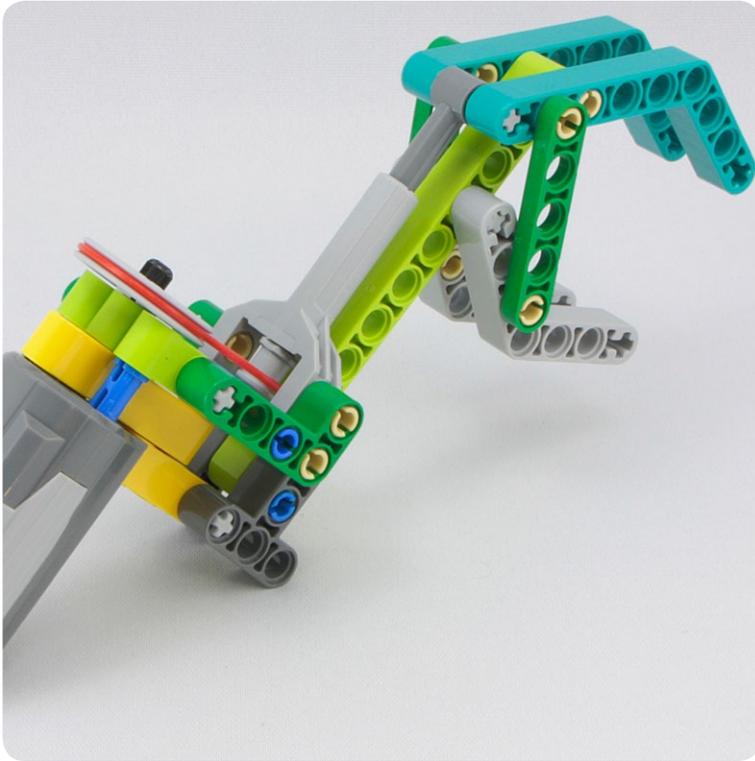
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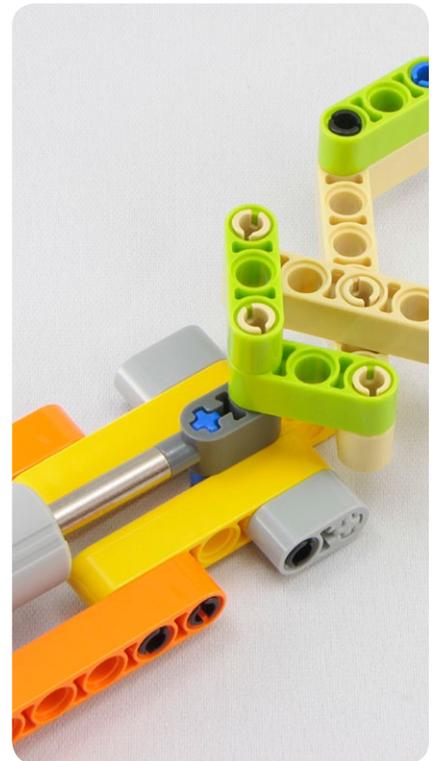
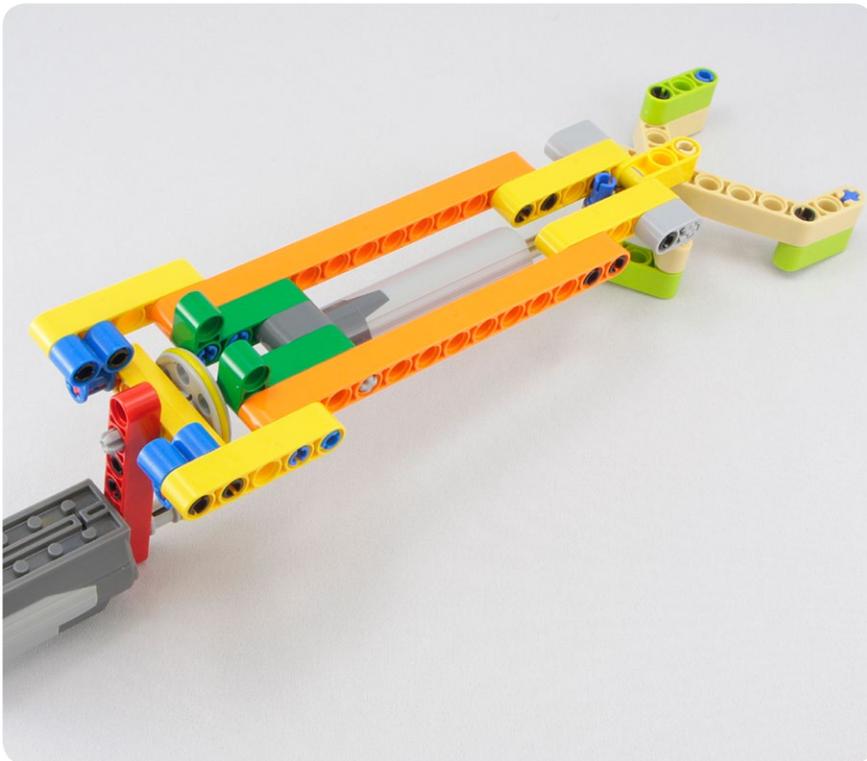
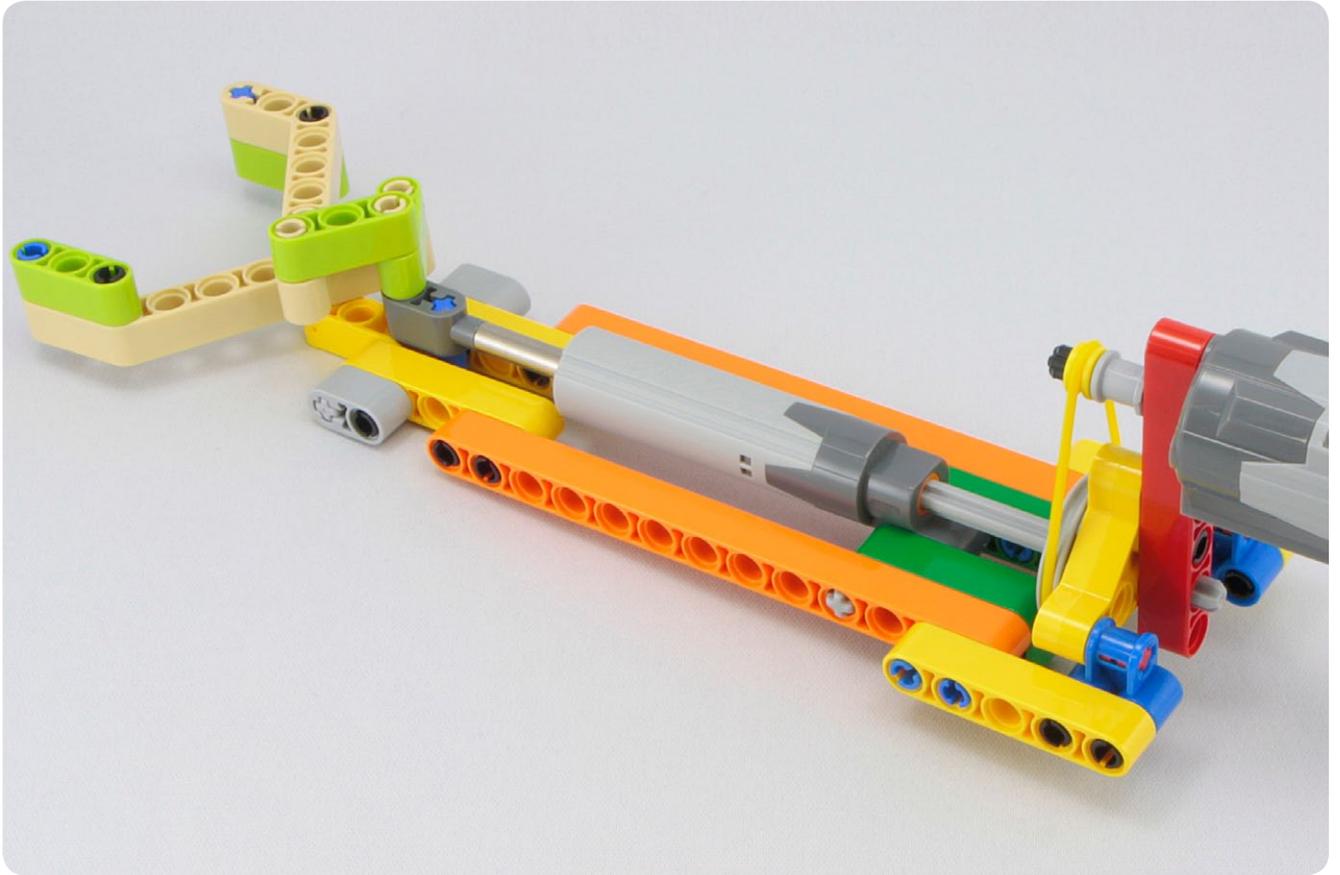


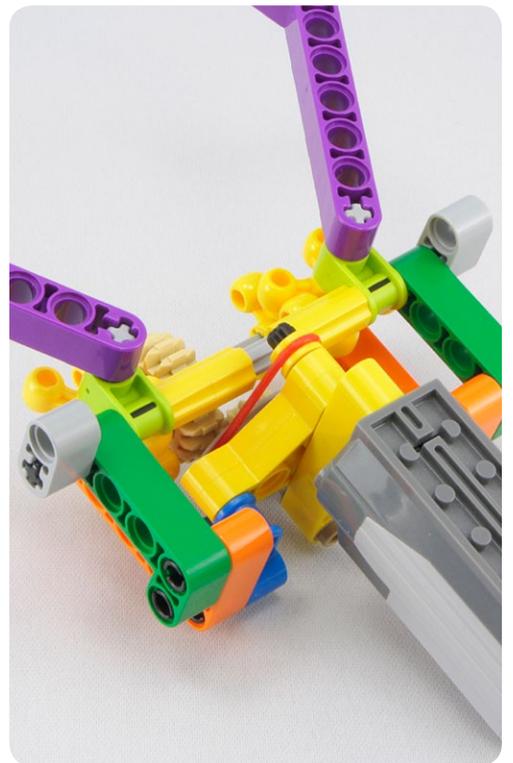
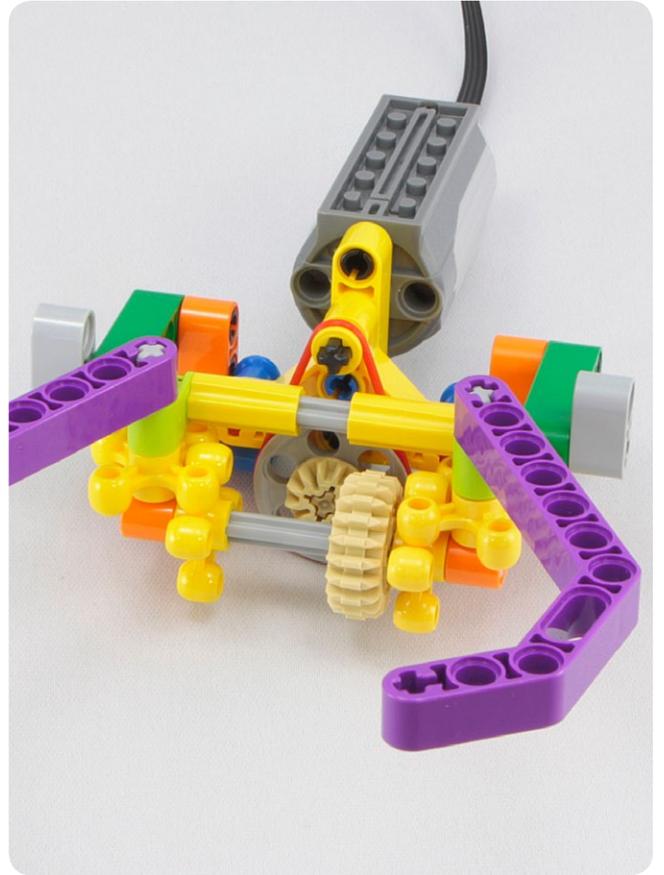
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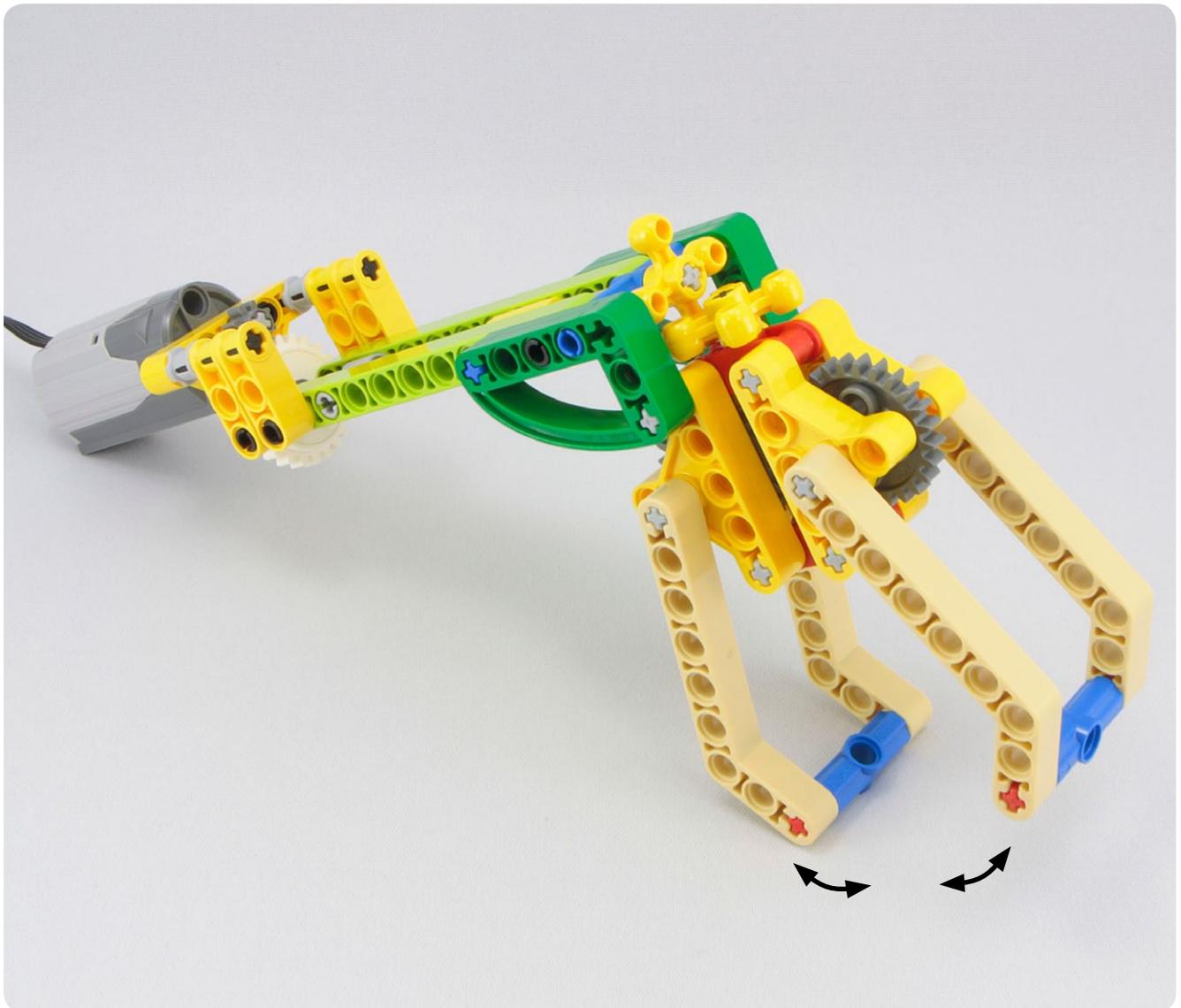
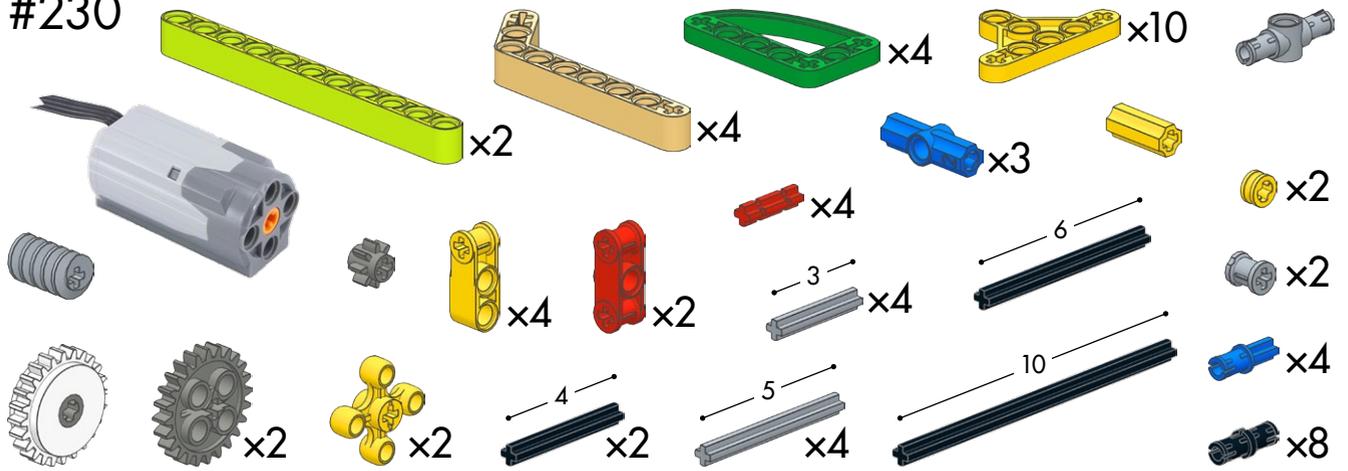


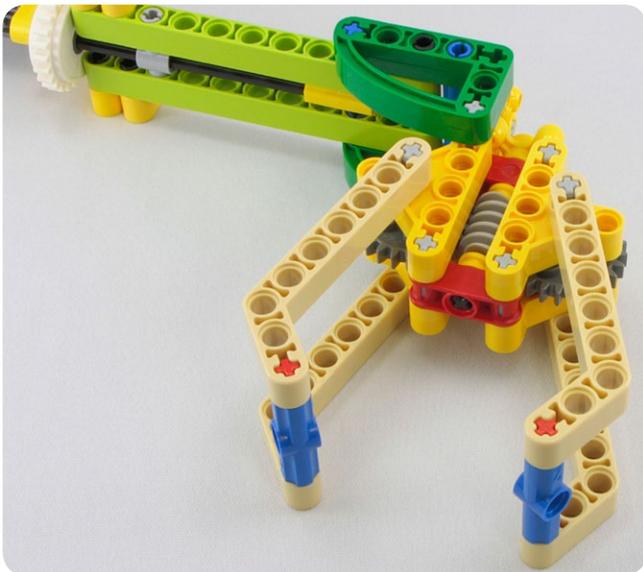
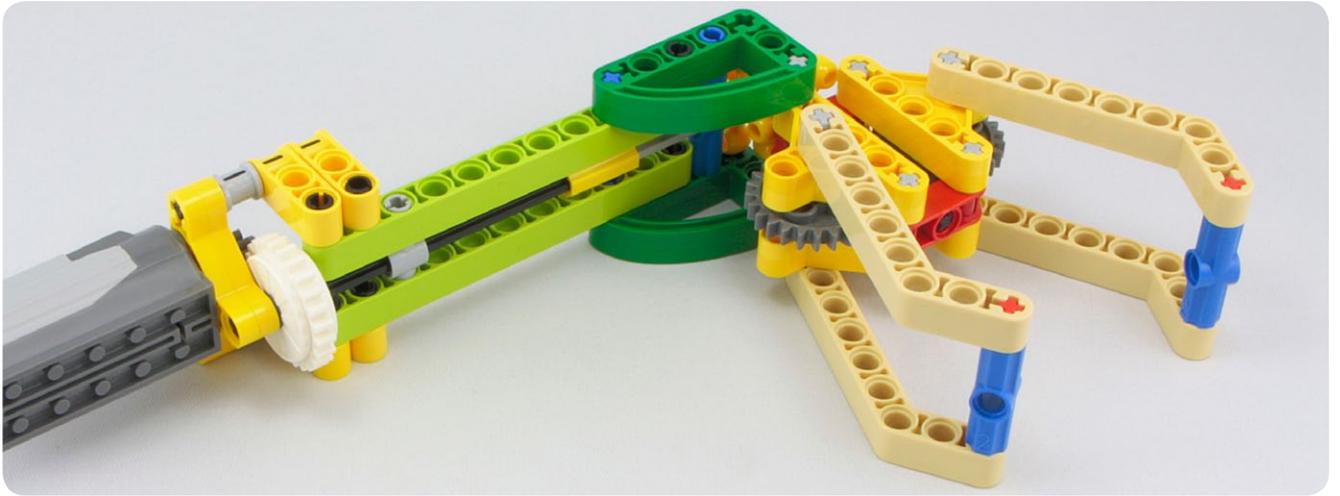
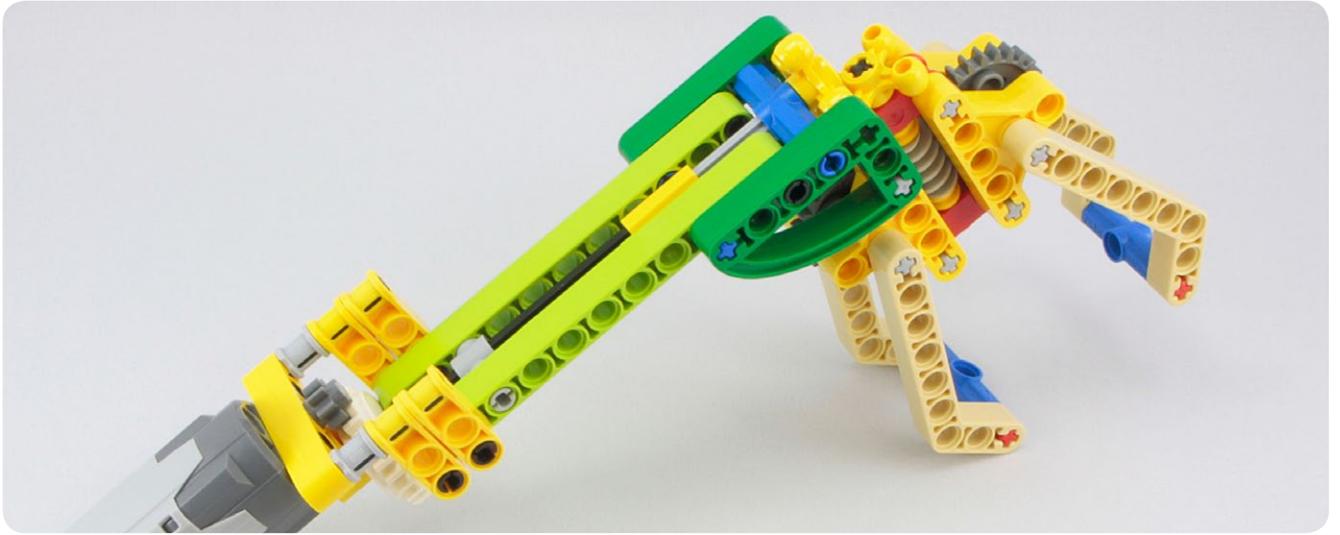


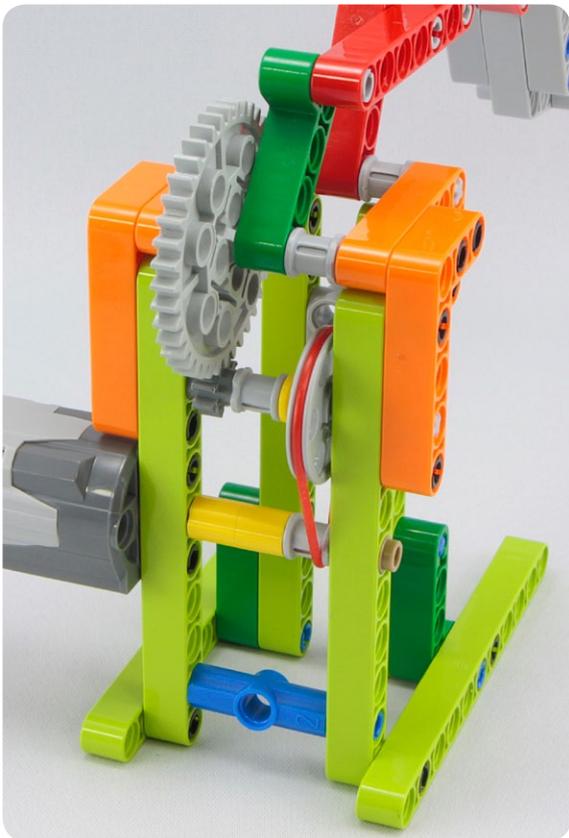
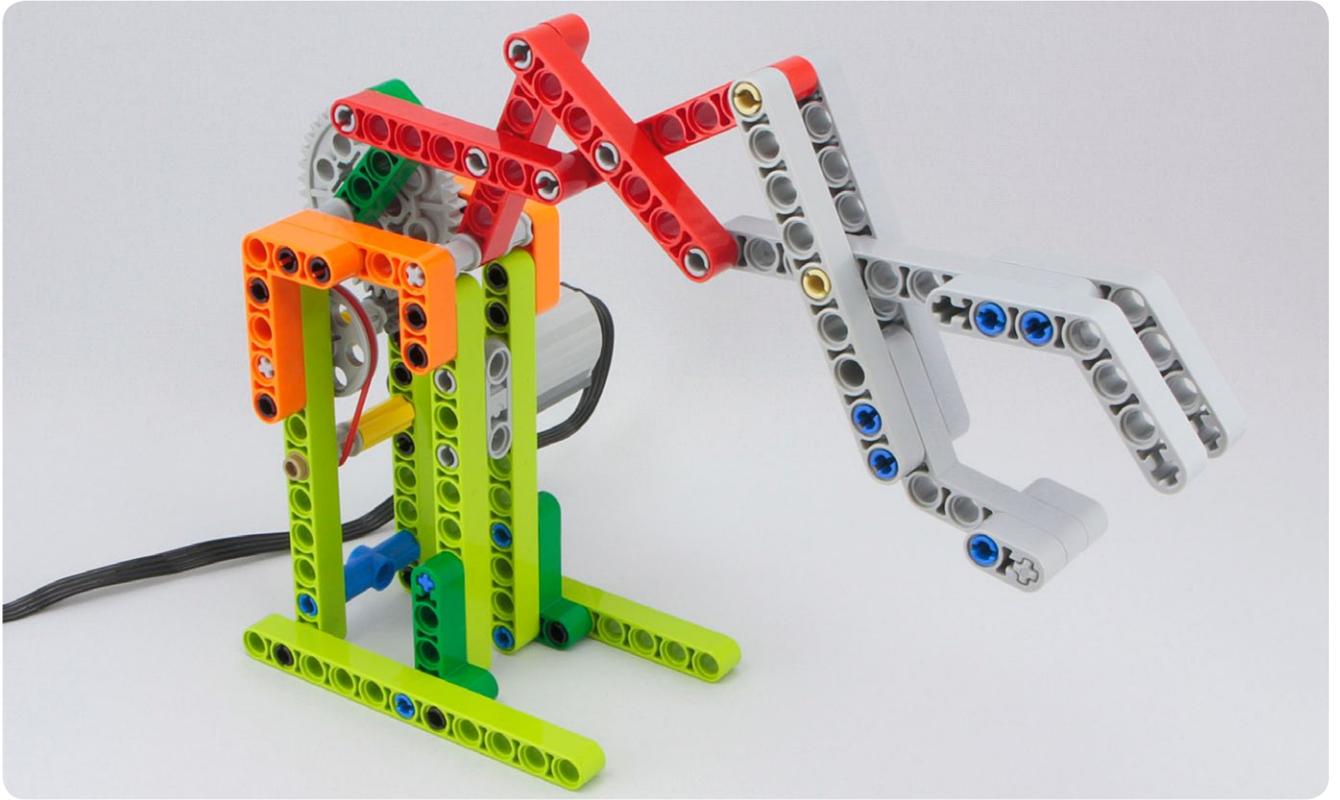


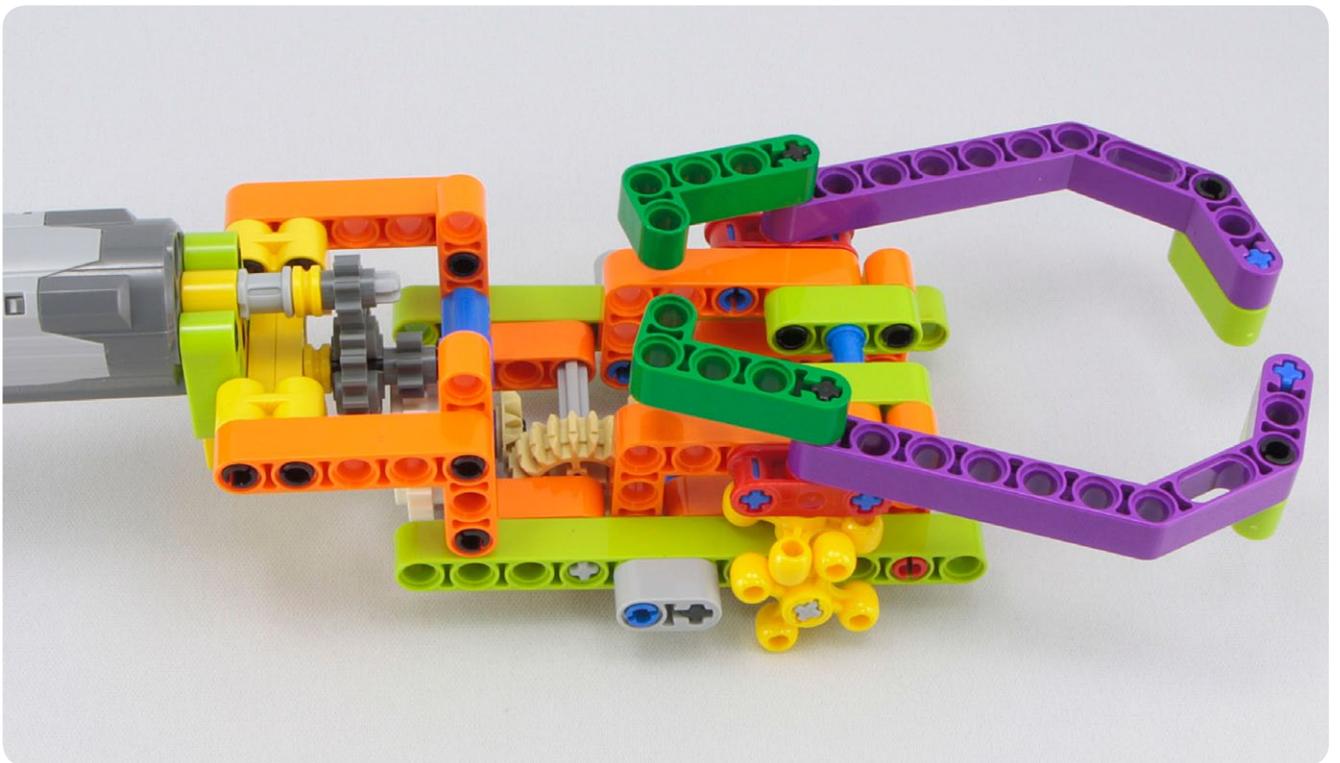
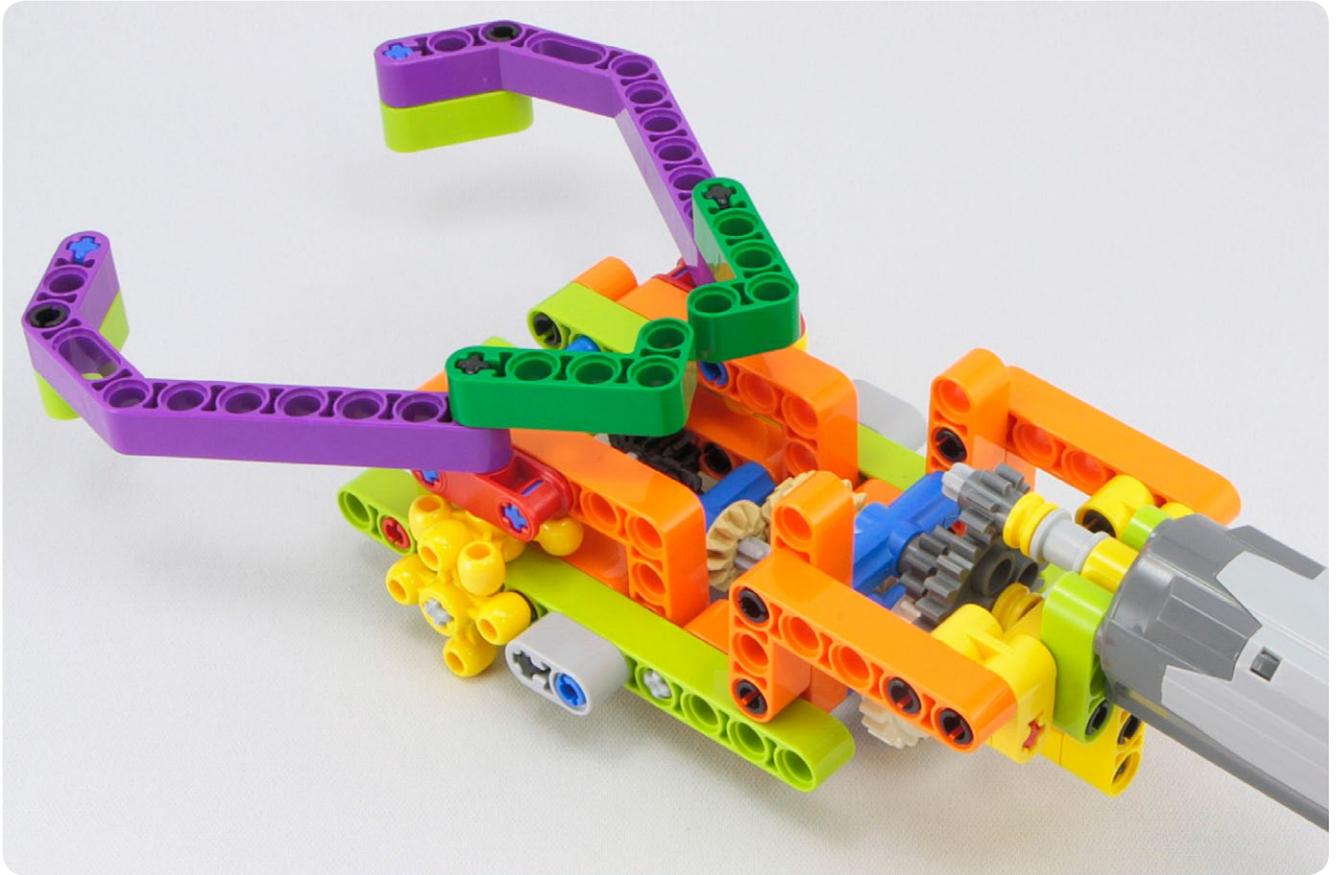


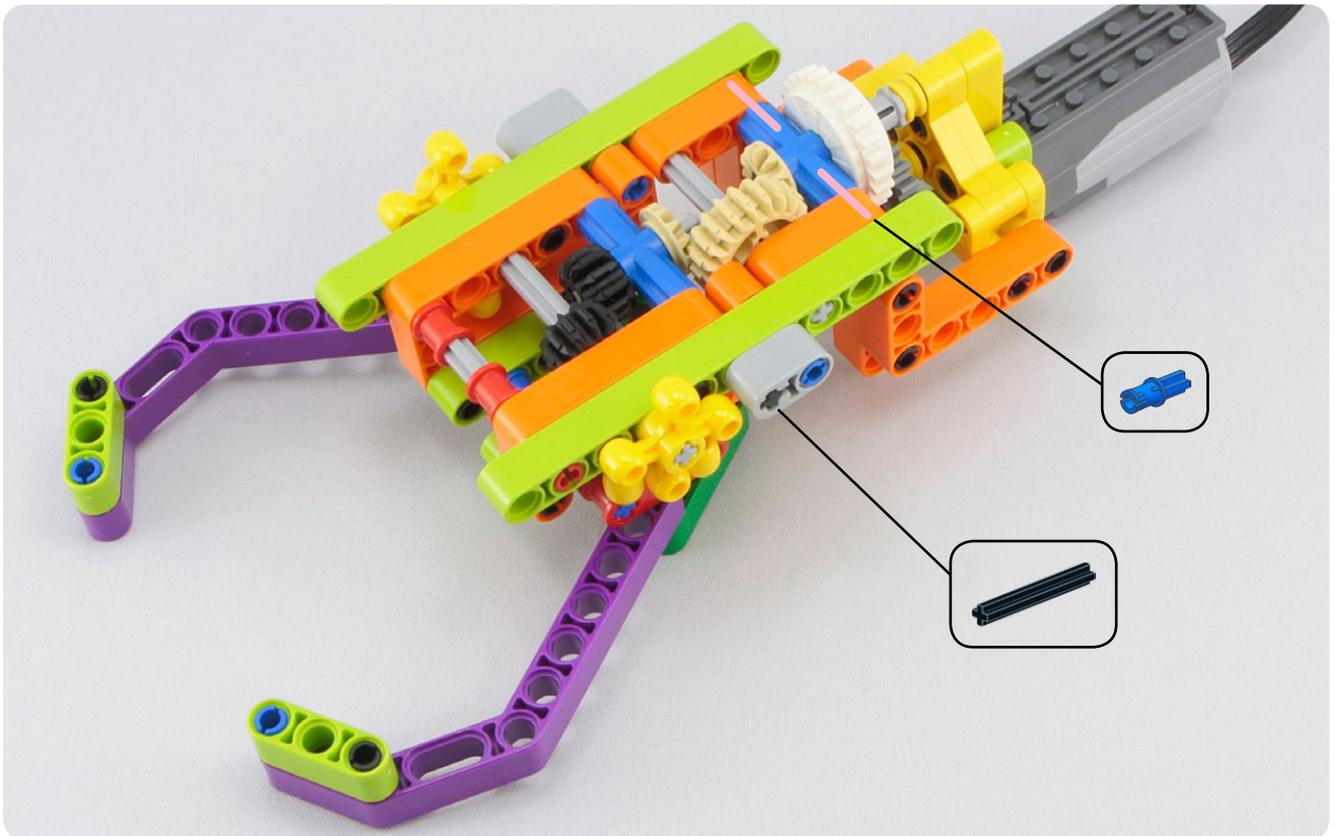
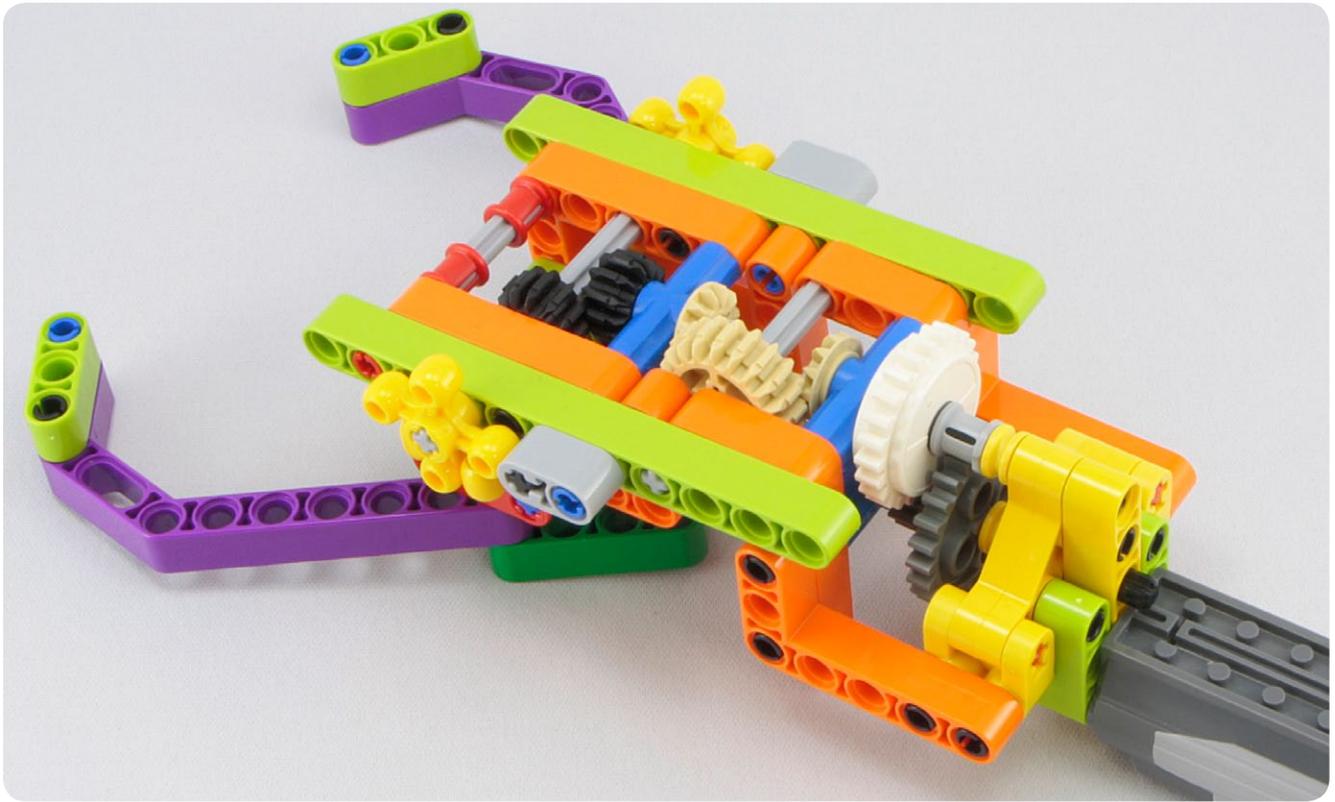
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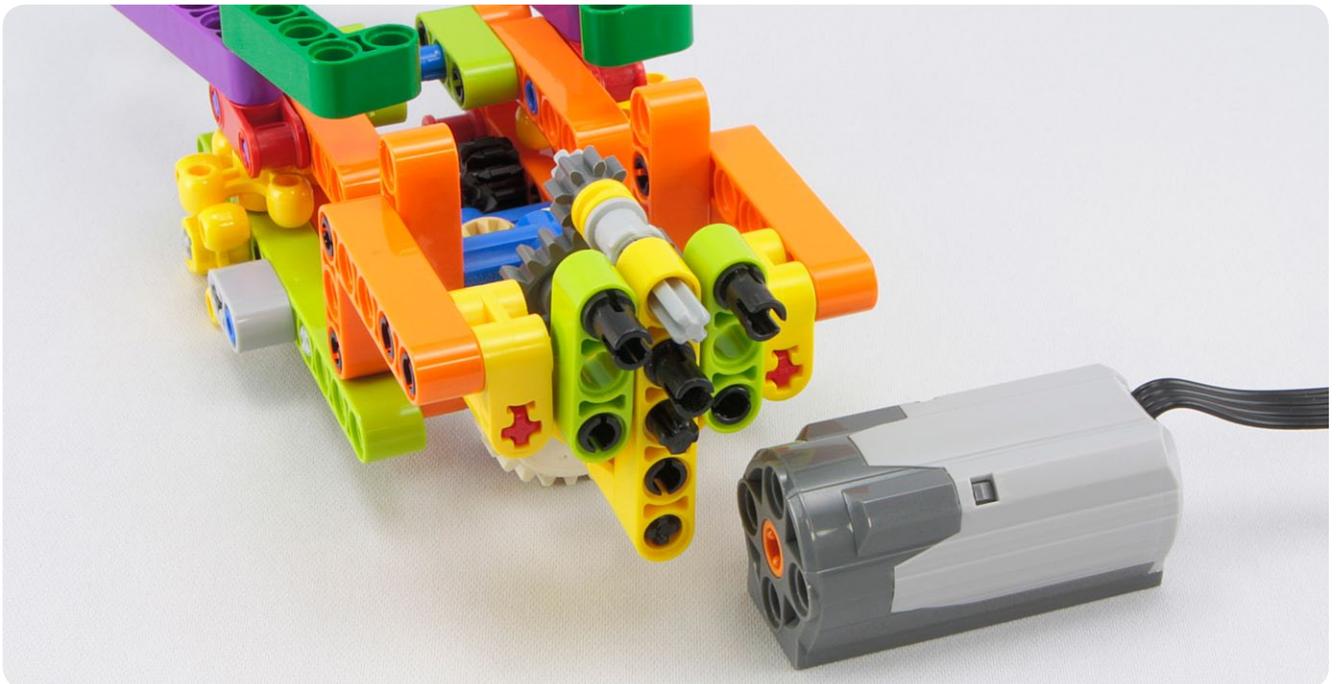
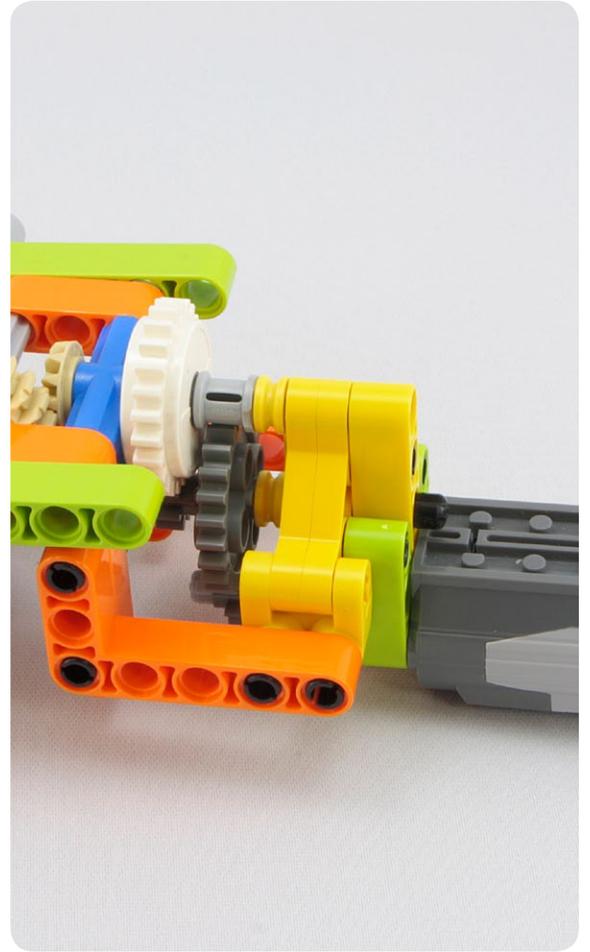


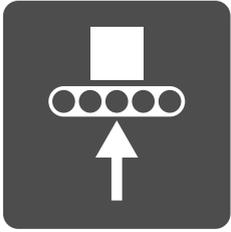






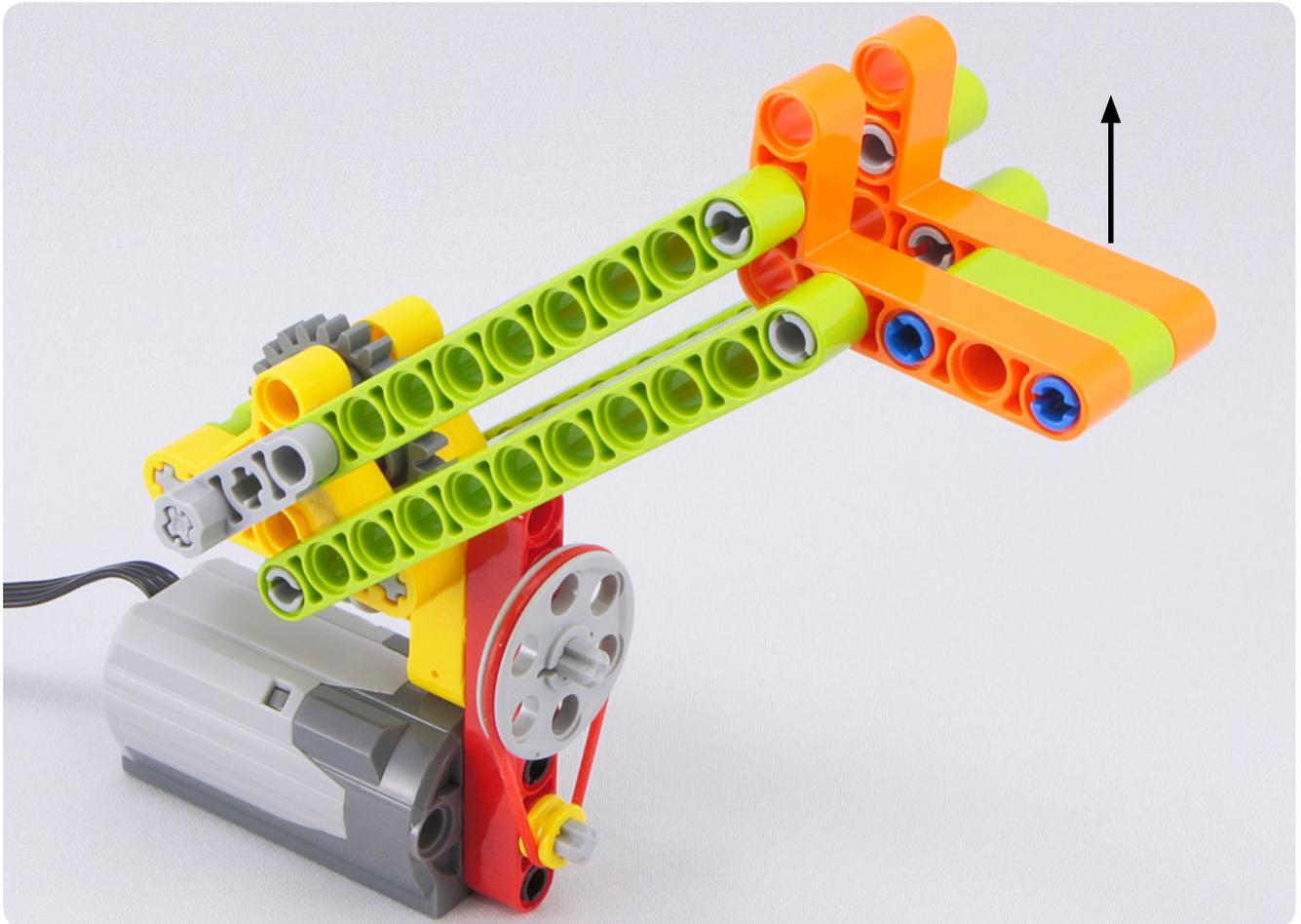
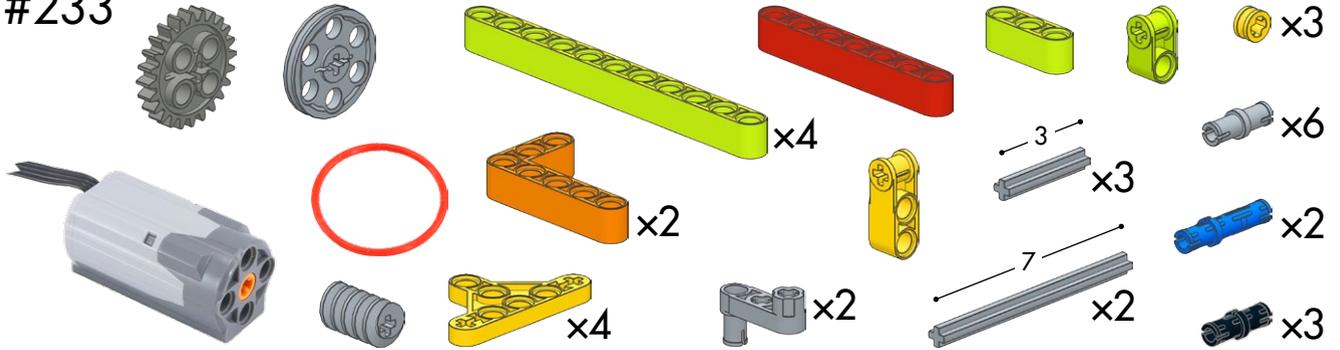






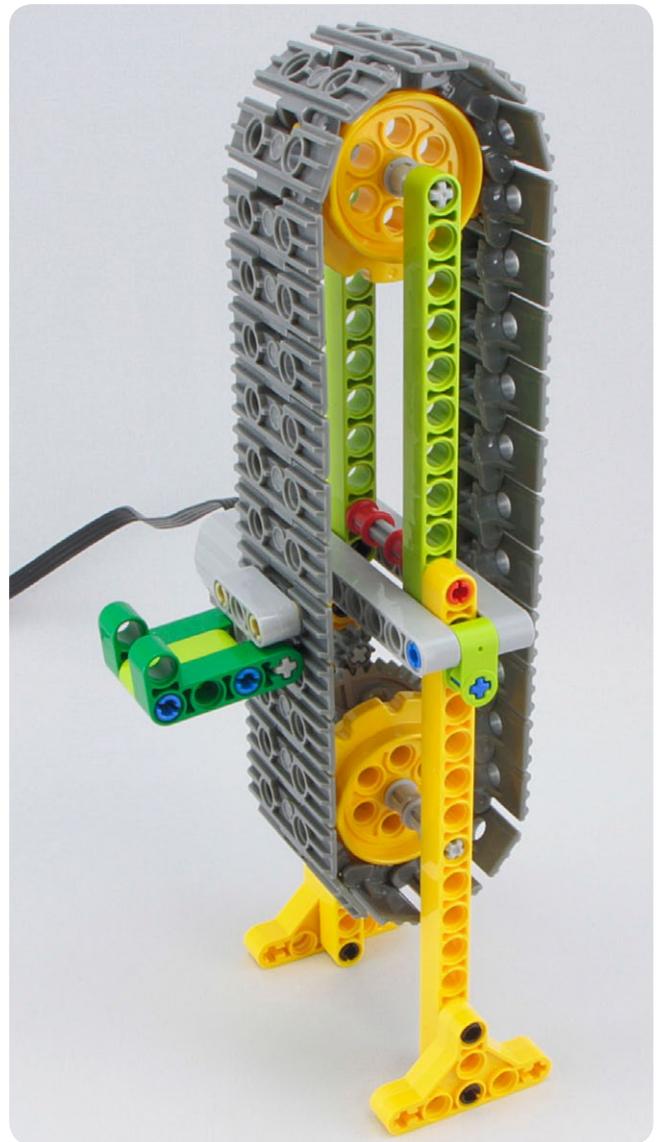
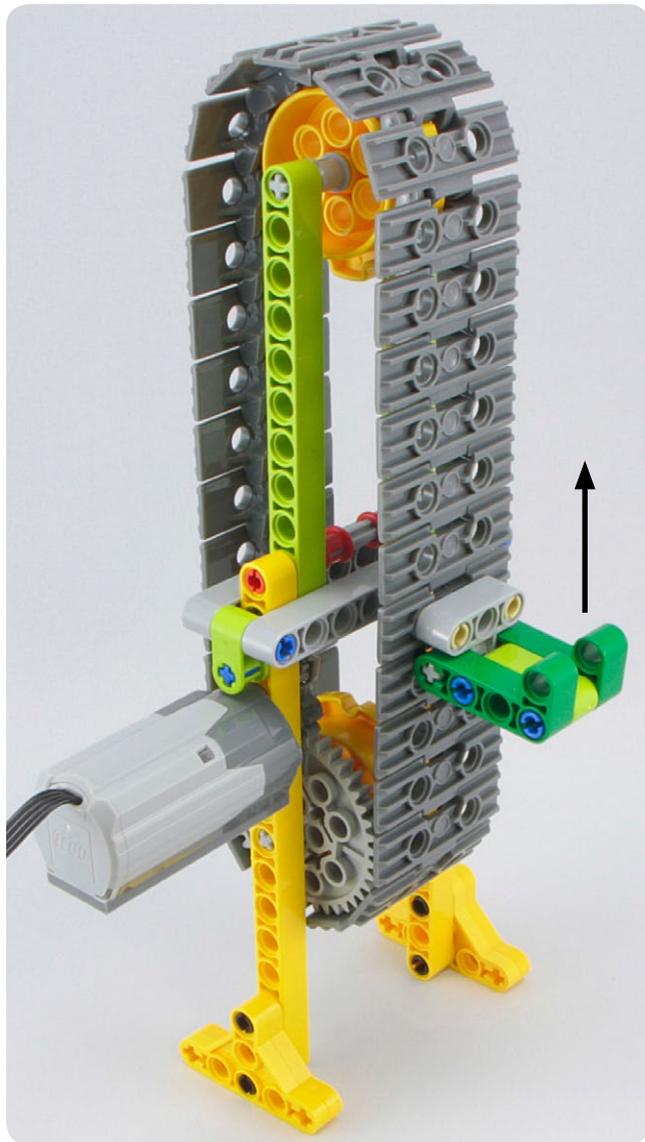
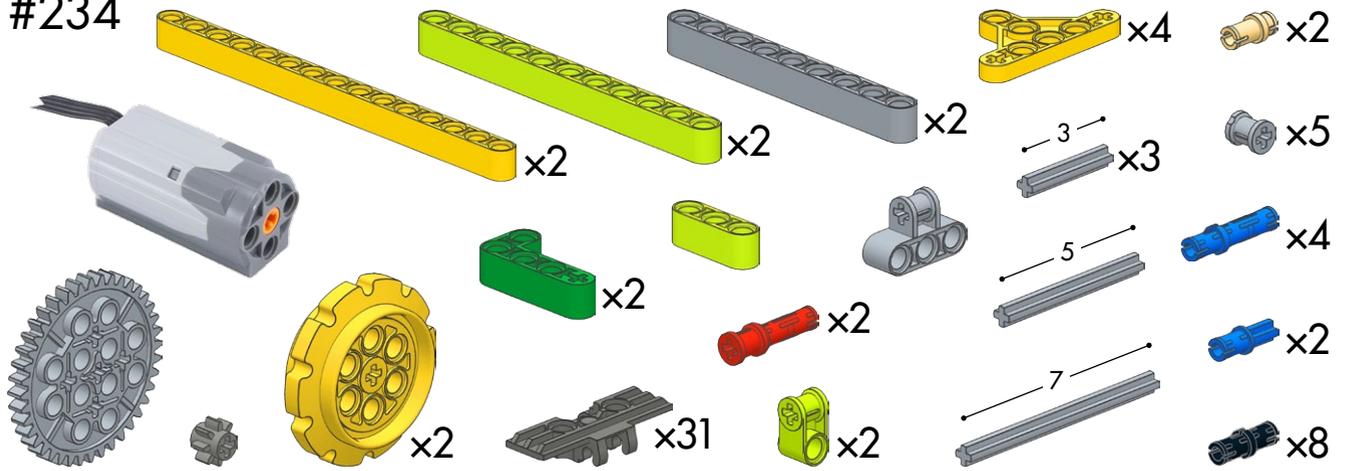
Lifting things

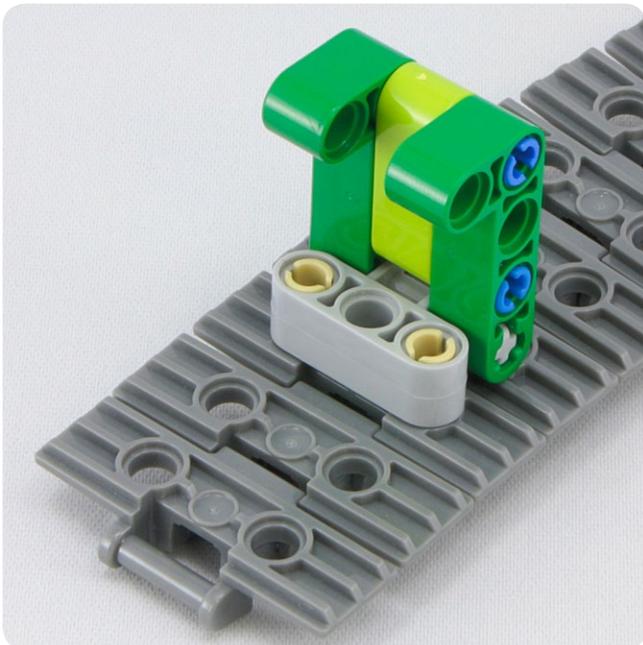
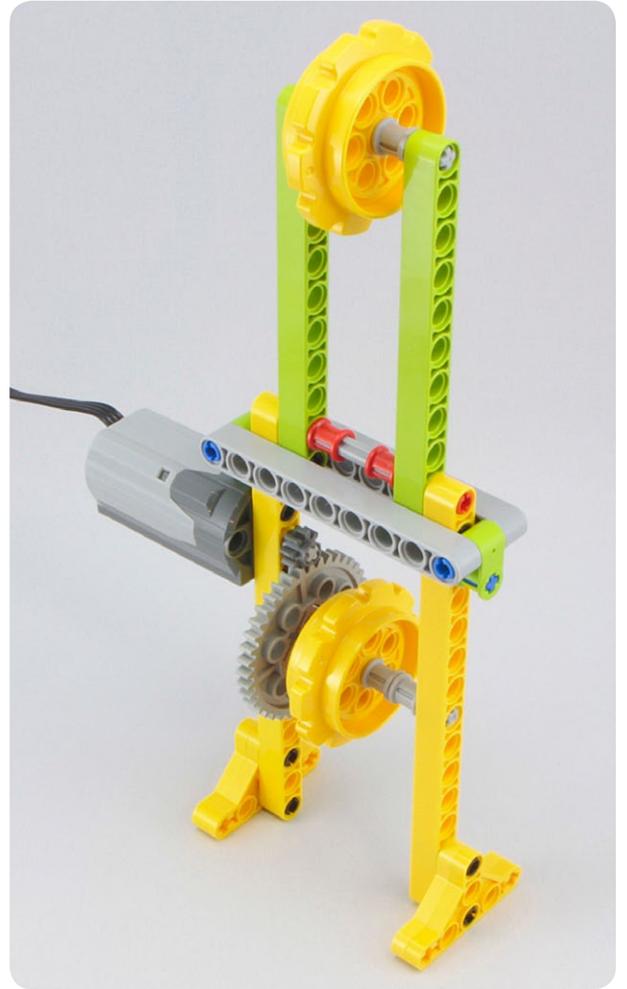
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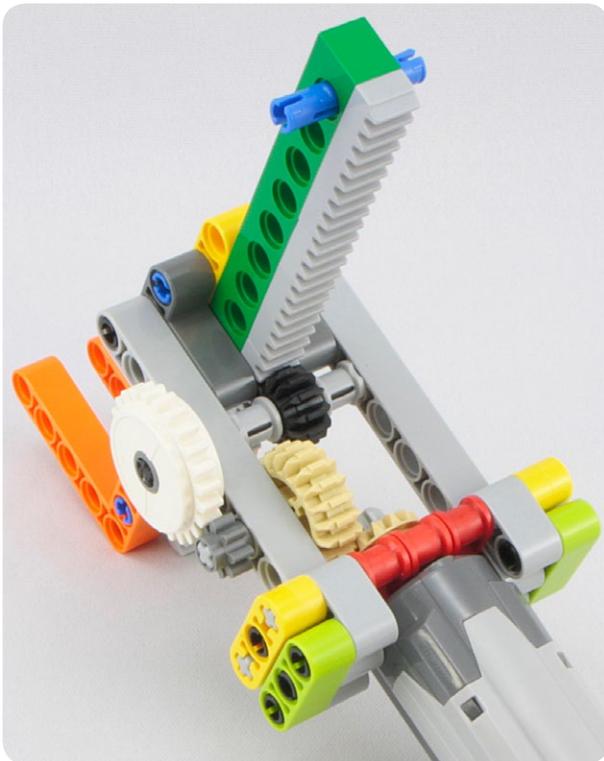
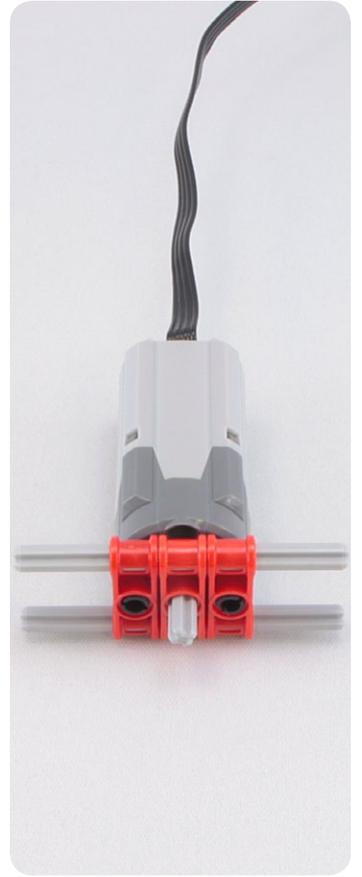
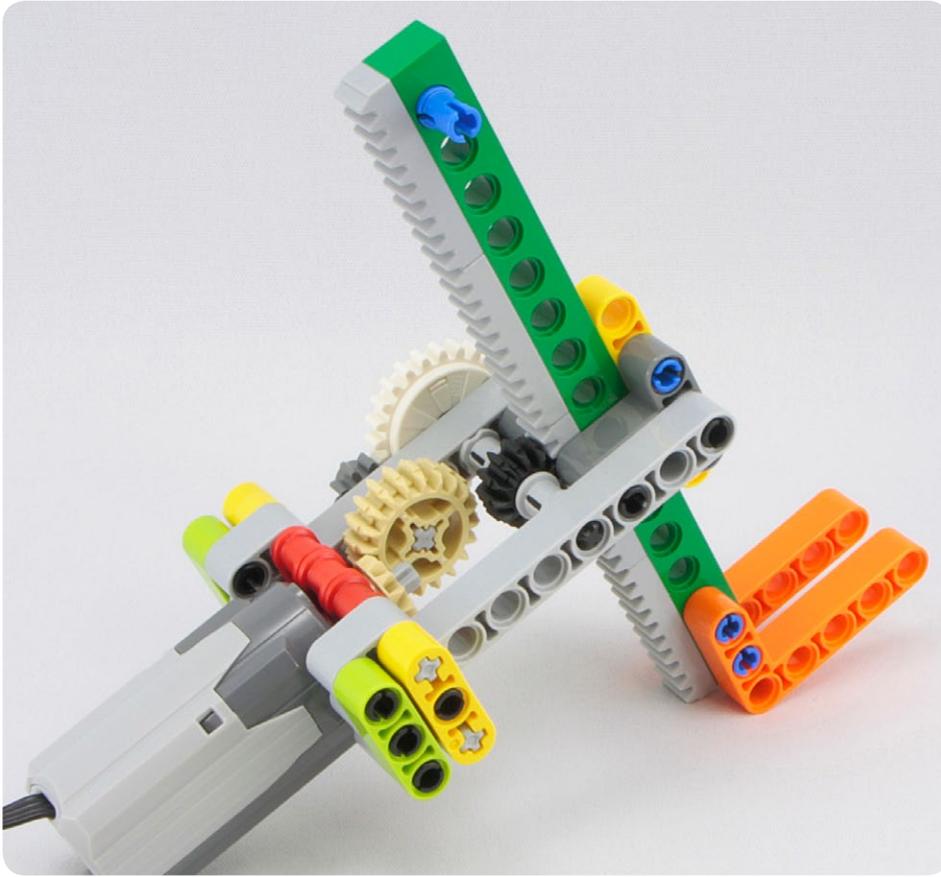




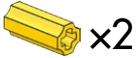
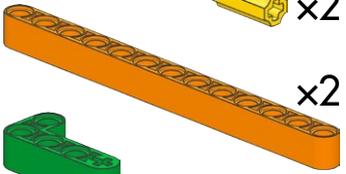
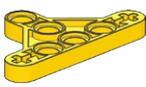
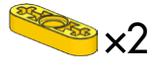
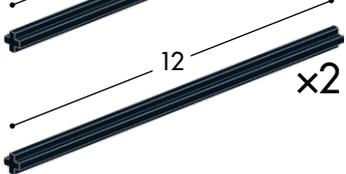
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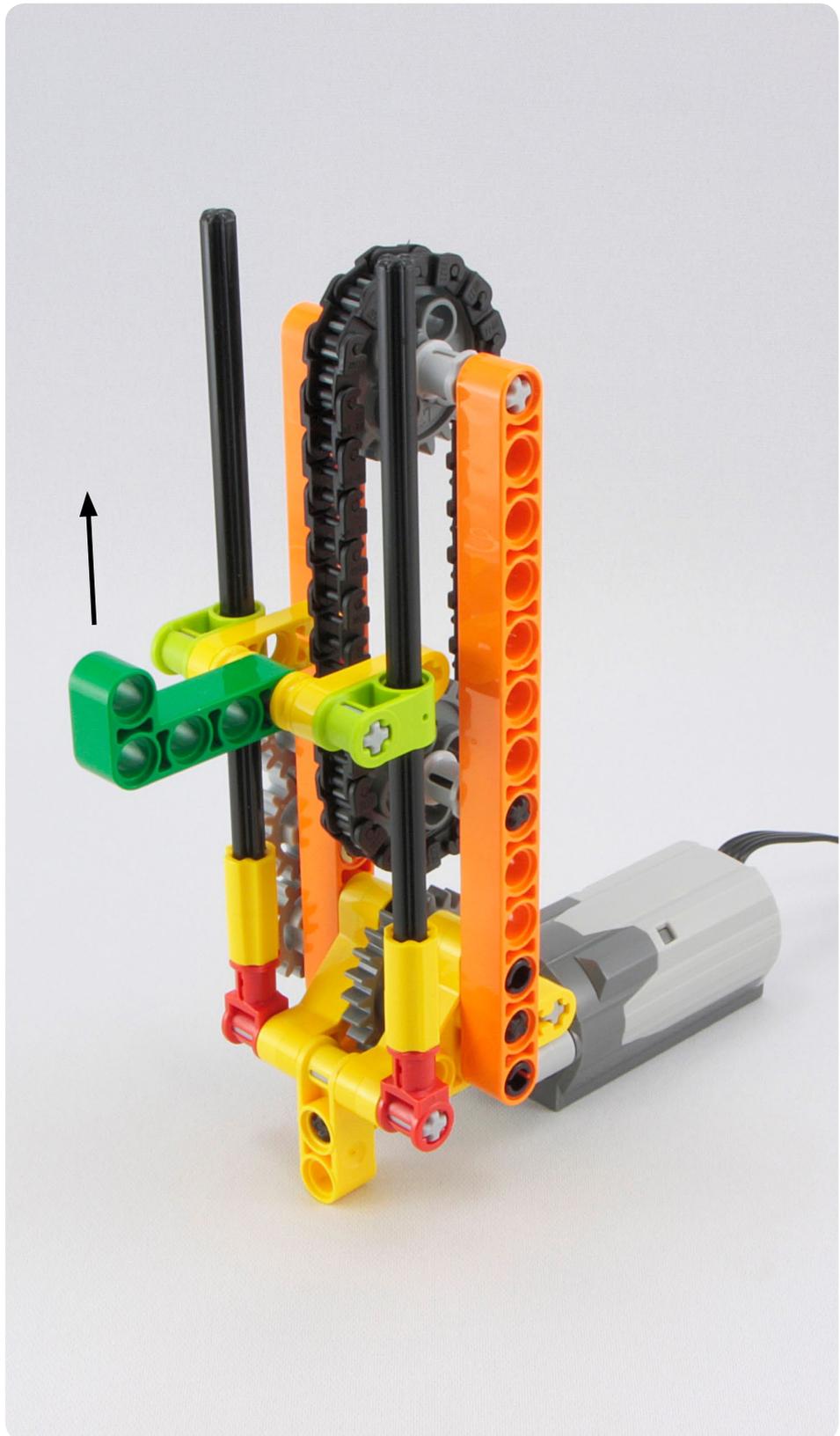


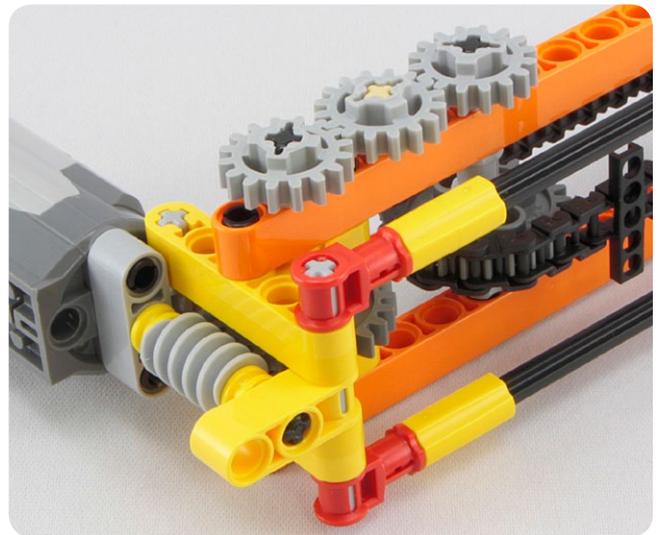
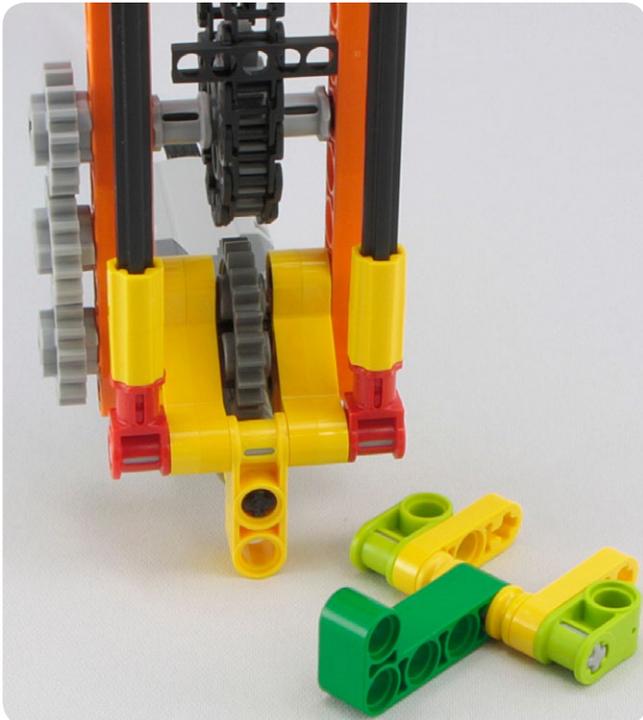




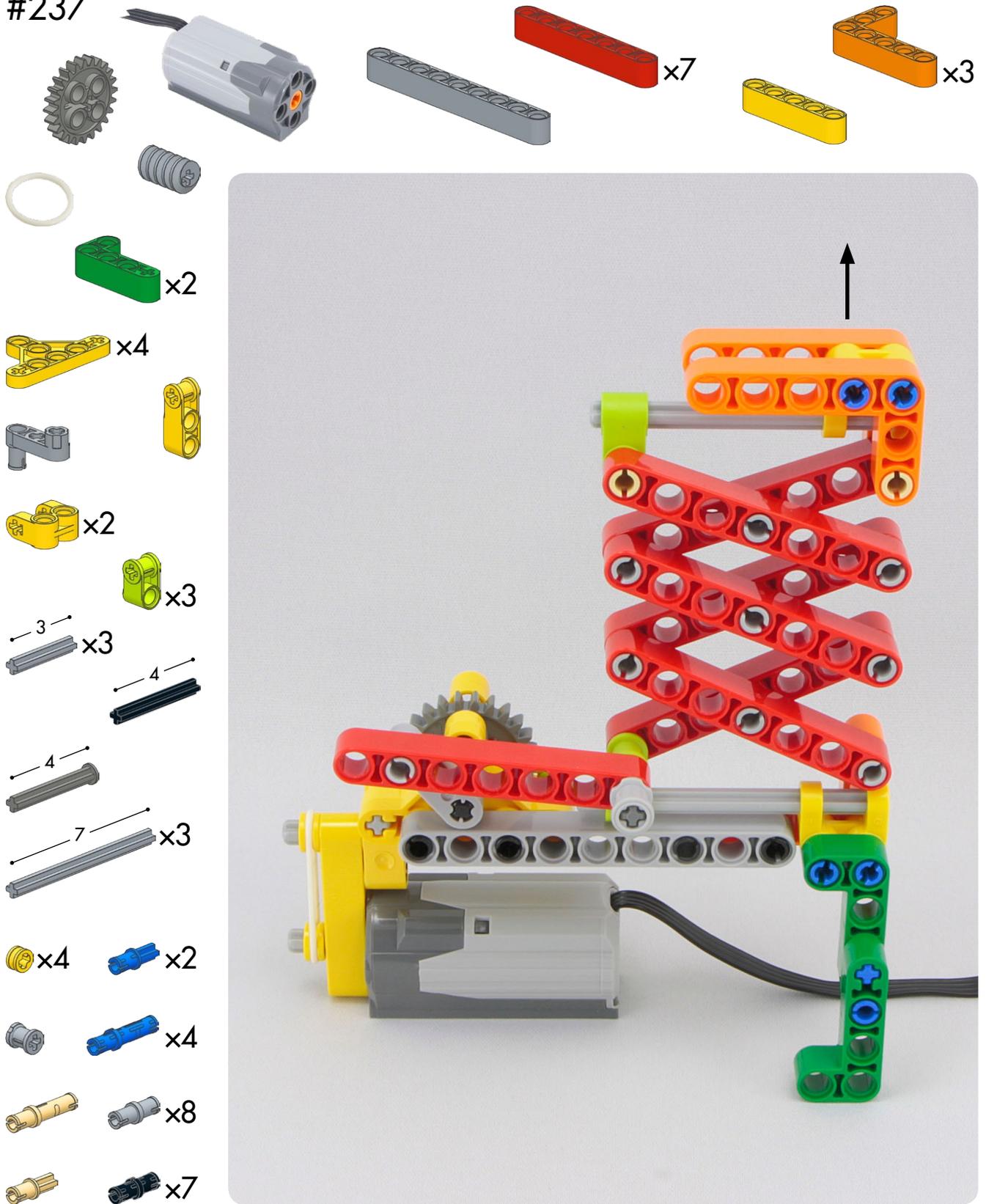
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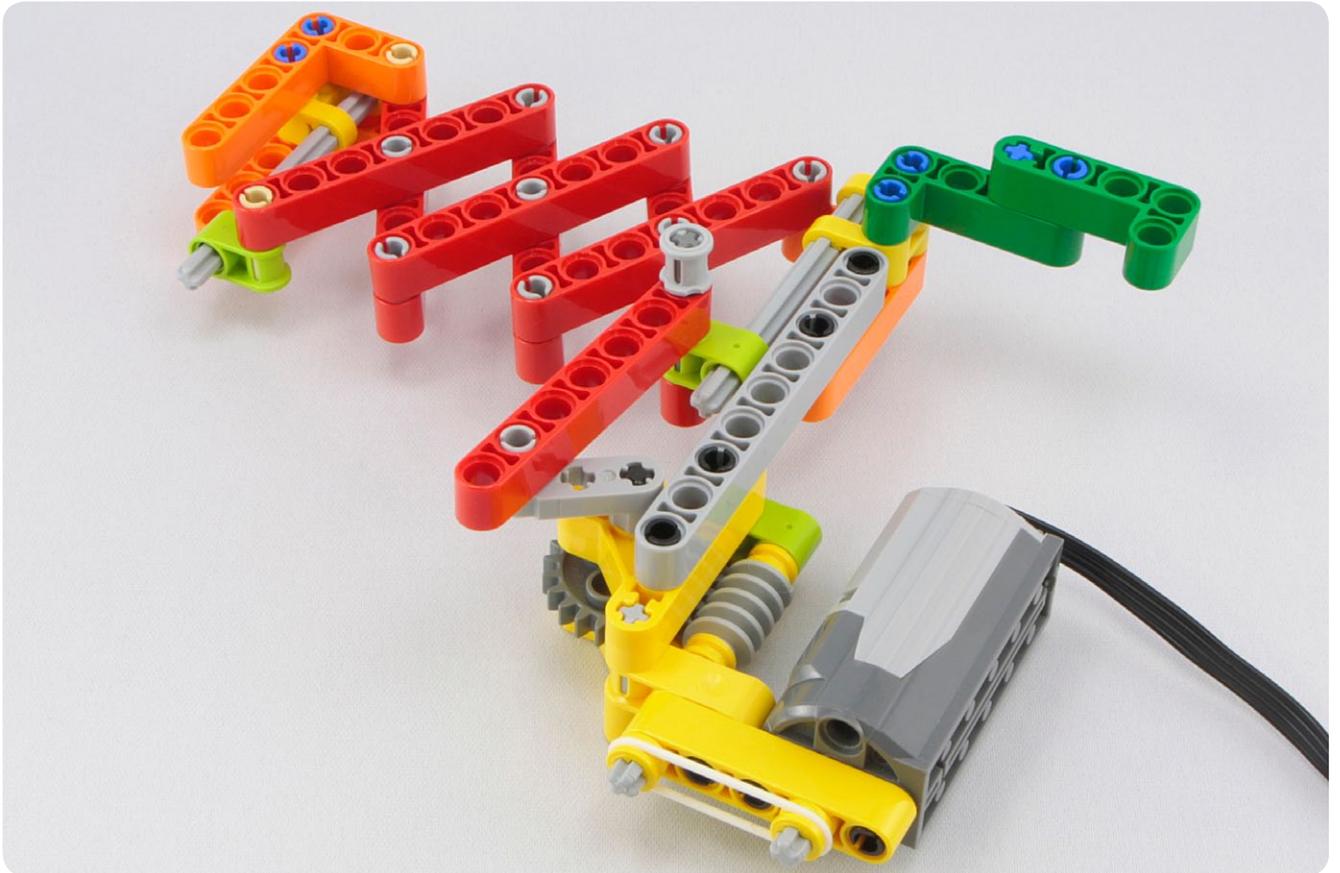
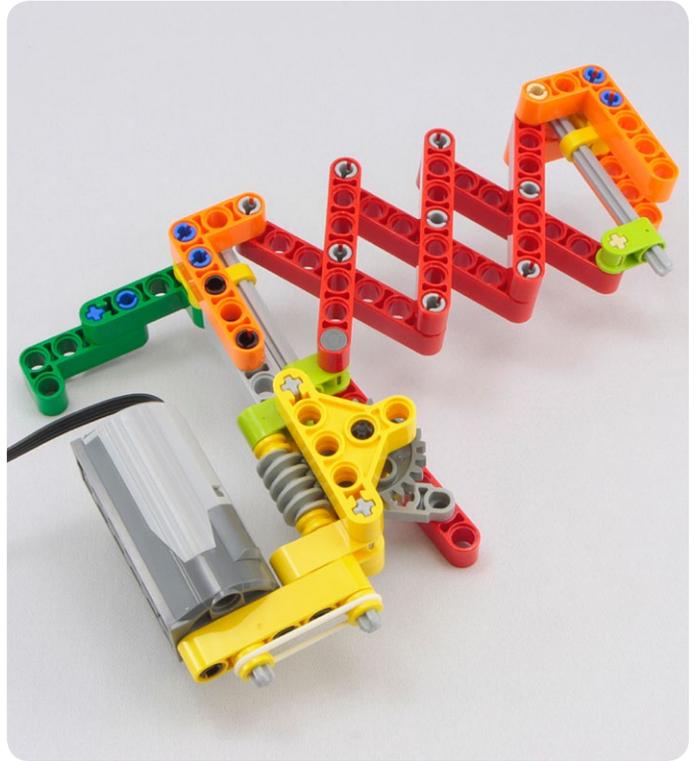
-  Motor
-  x3
-  x3
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-  x28
-  1
-  x2
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-  1
-  x2
-  x4
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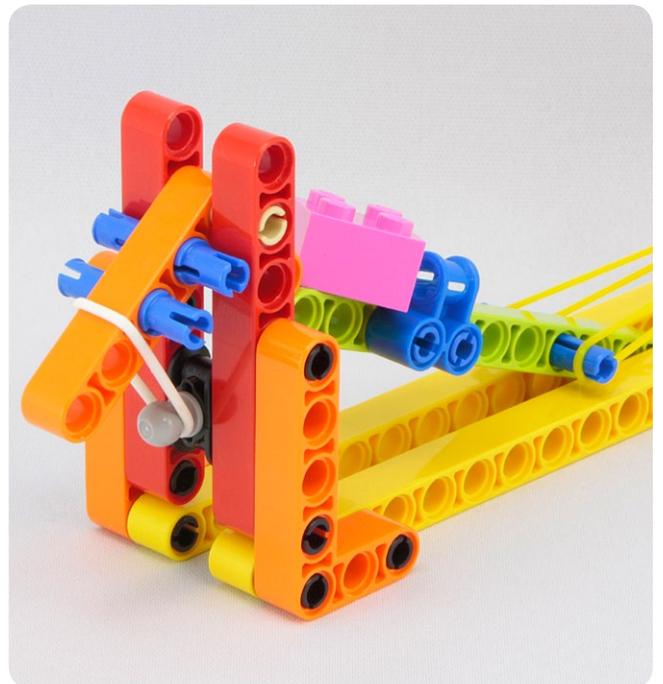
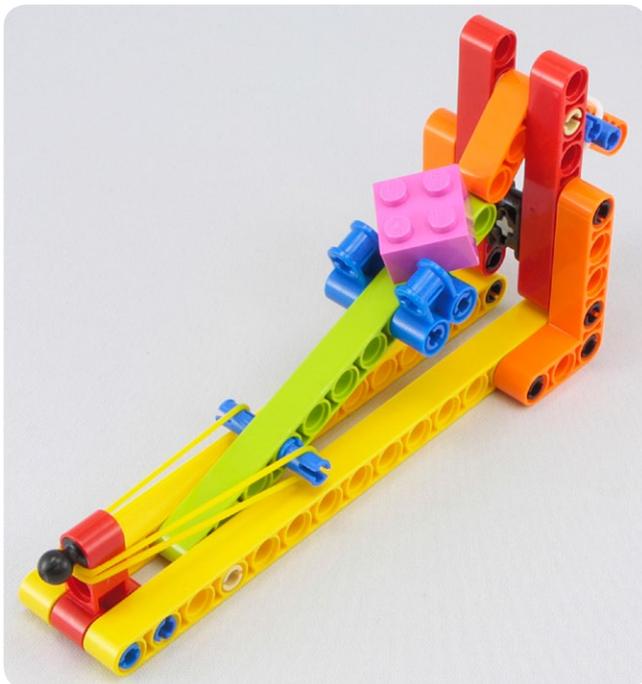
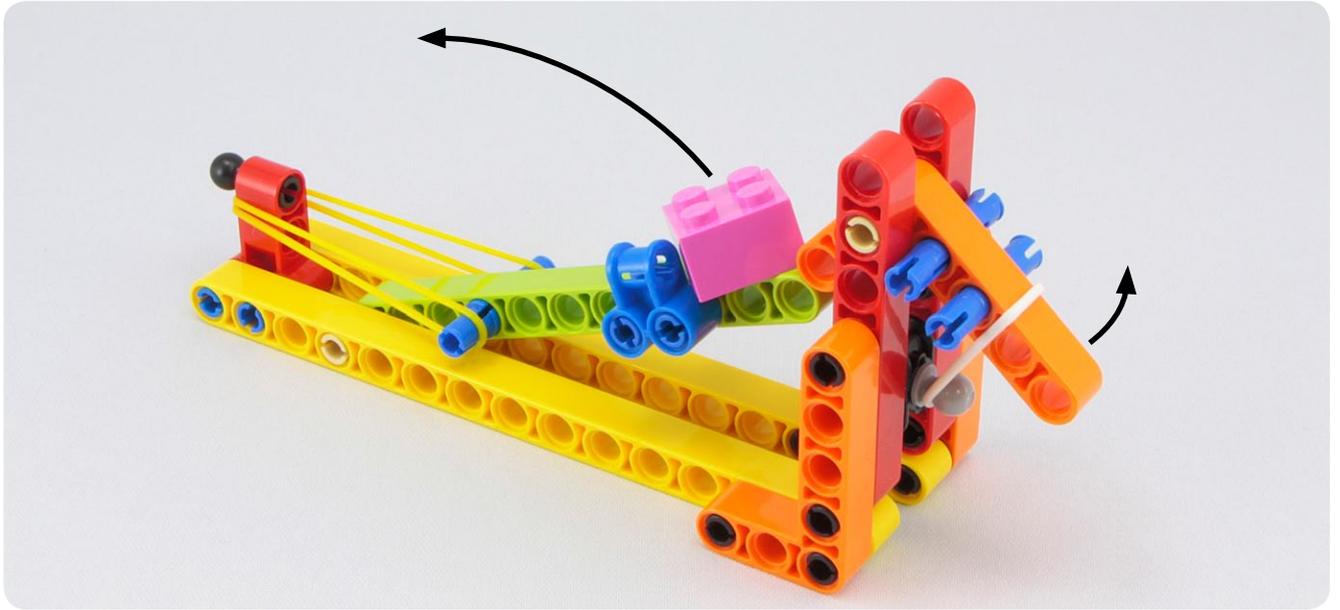
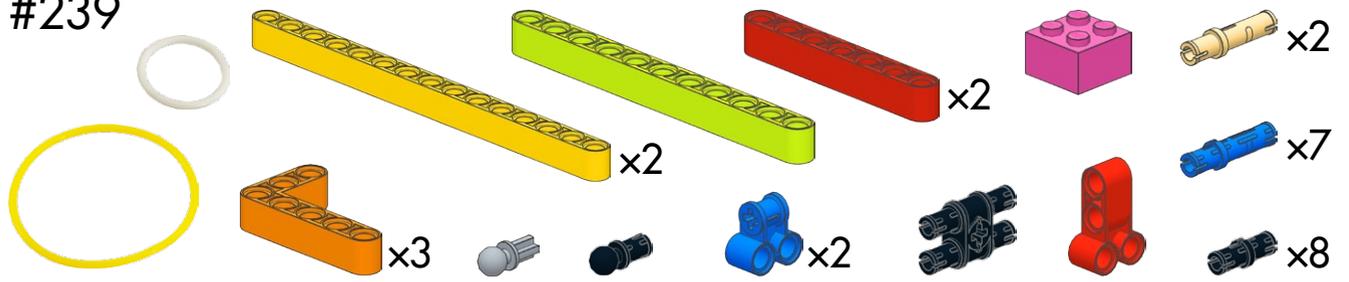


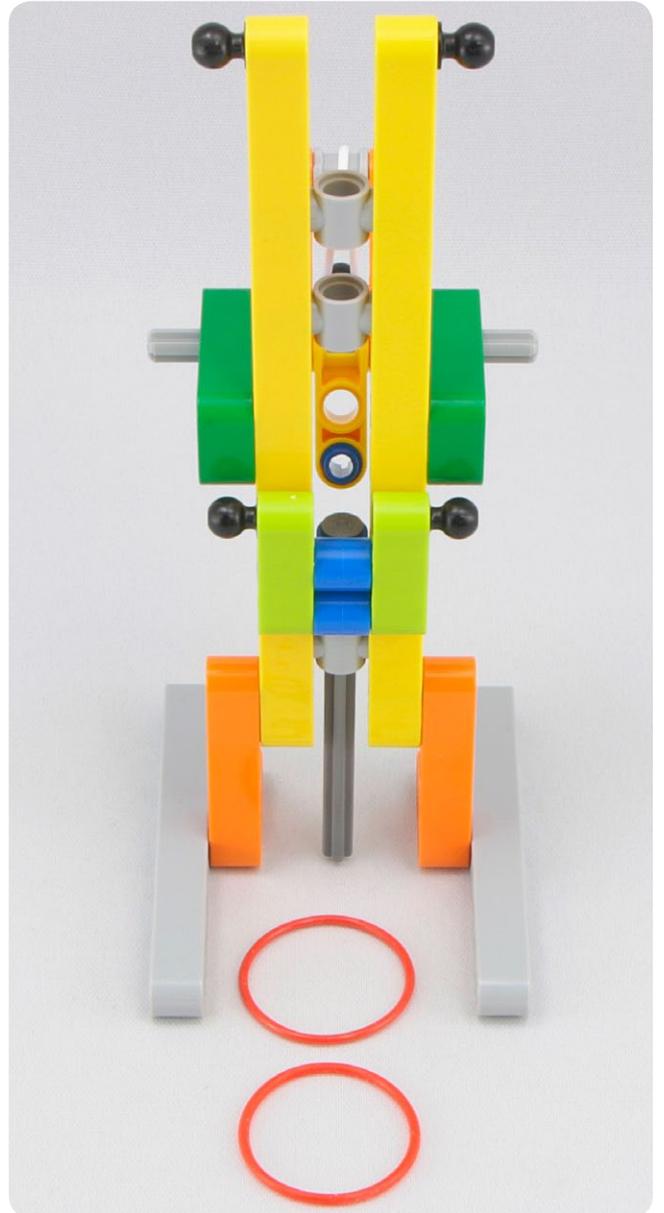
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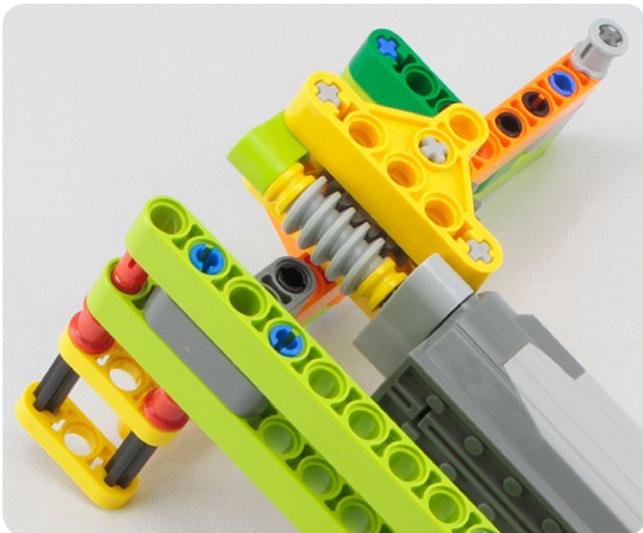
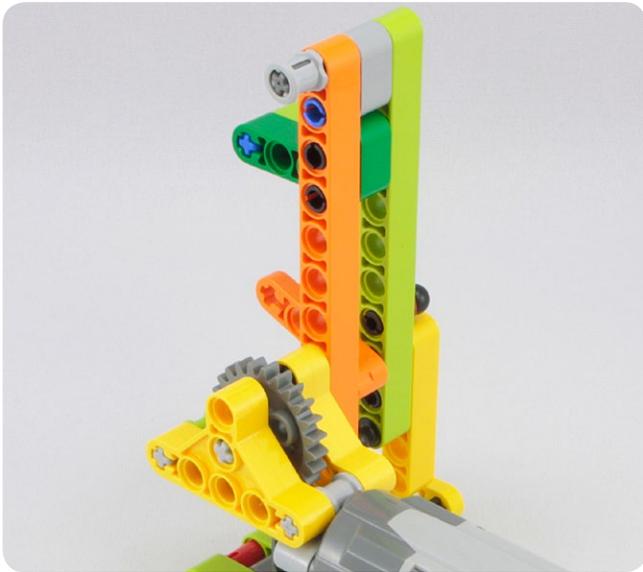
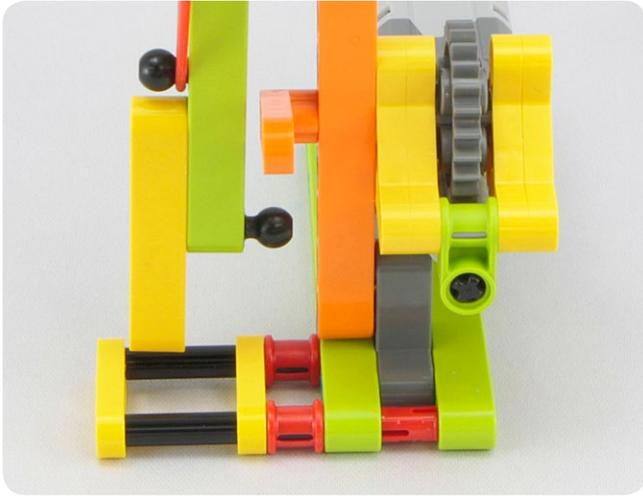


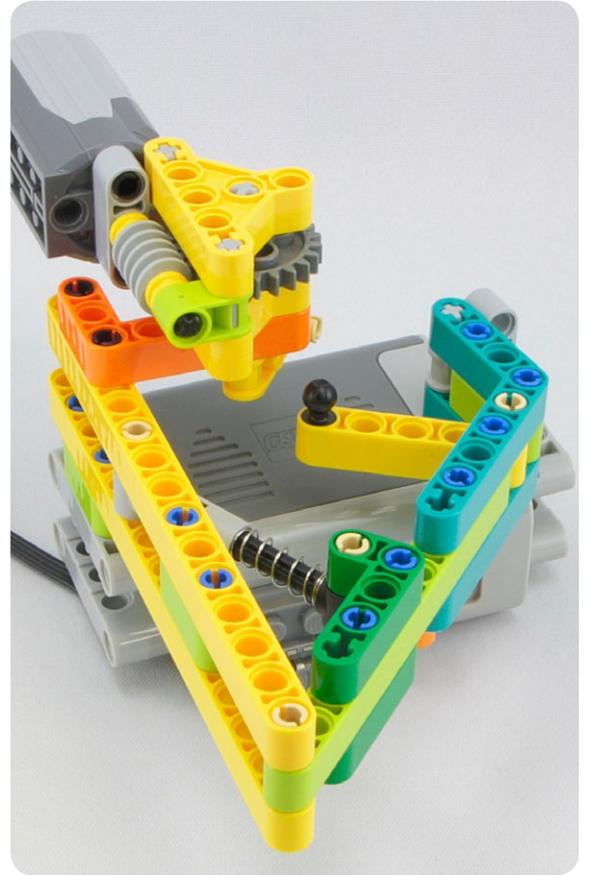
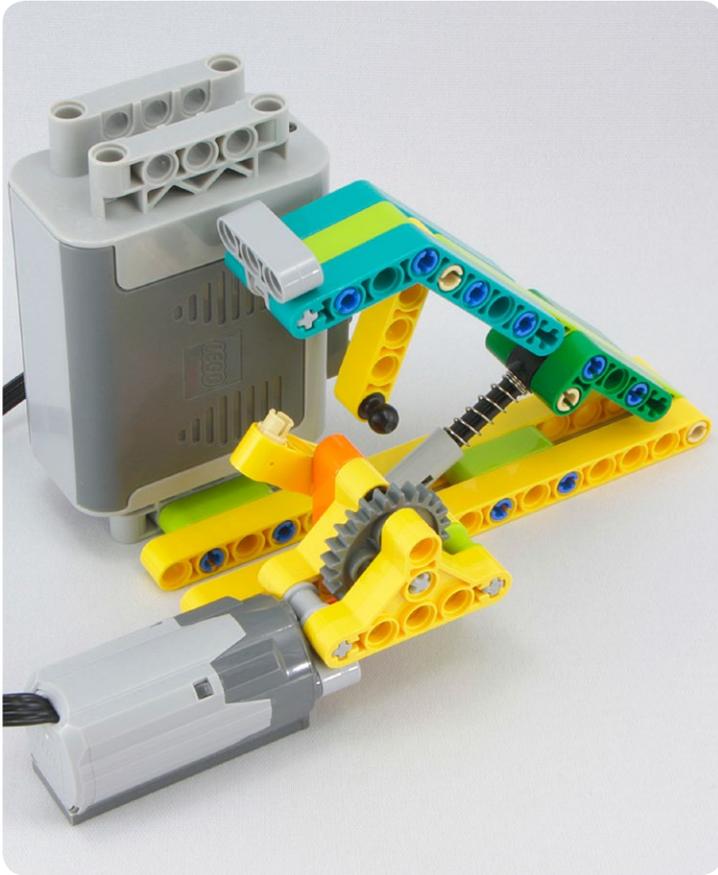


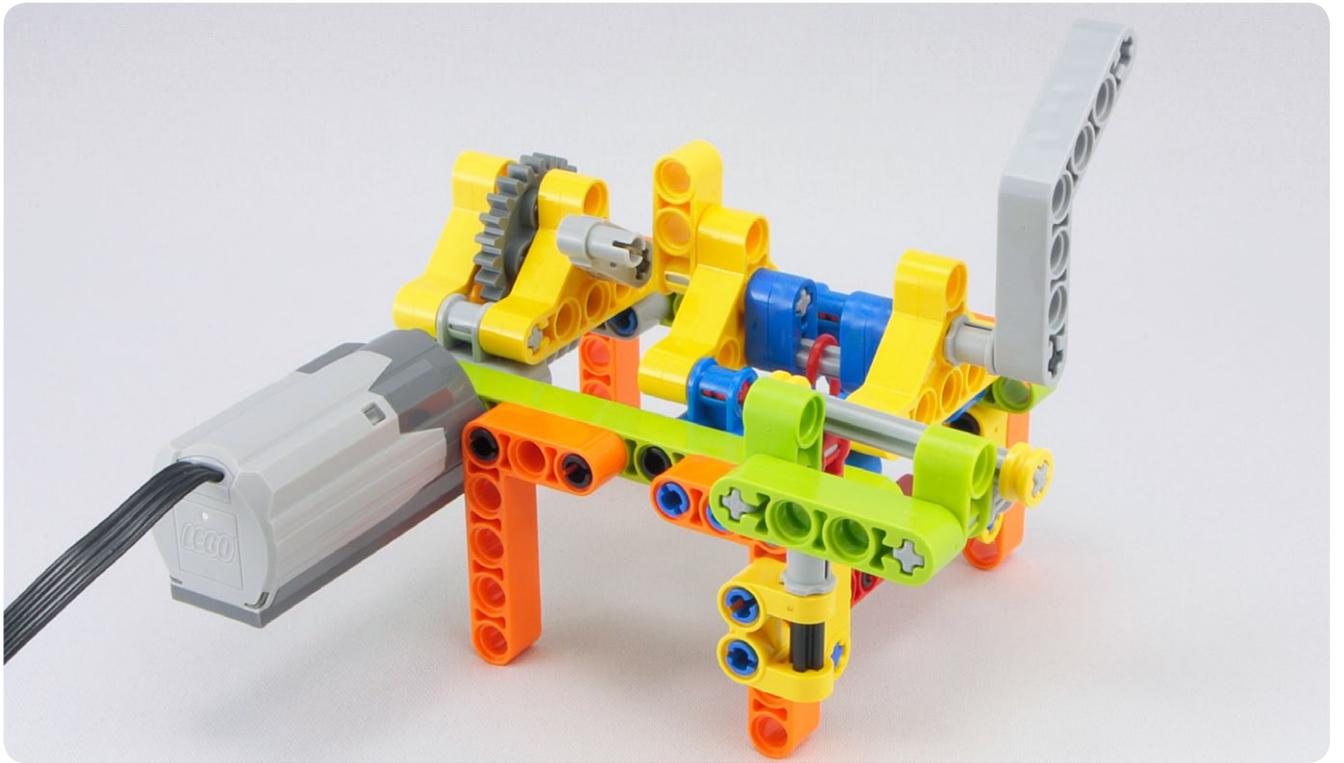
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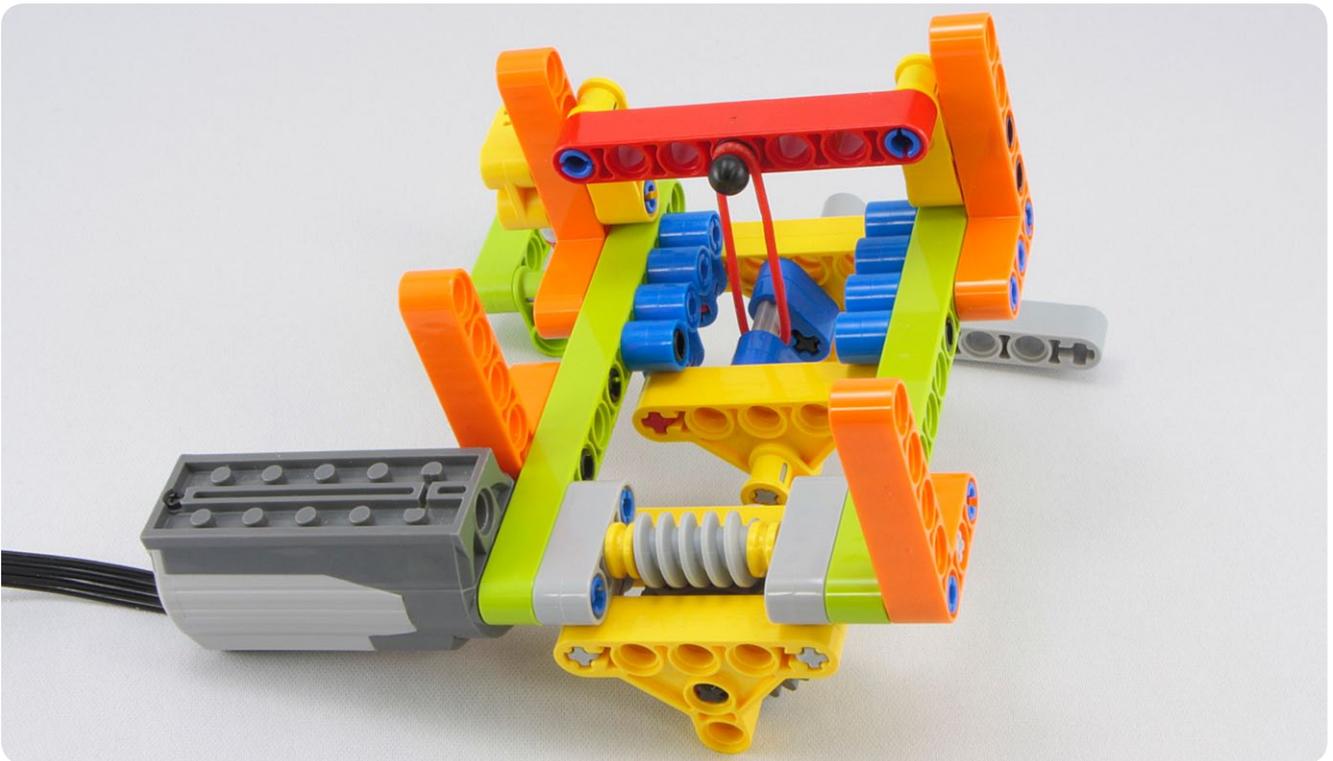
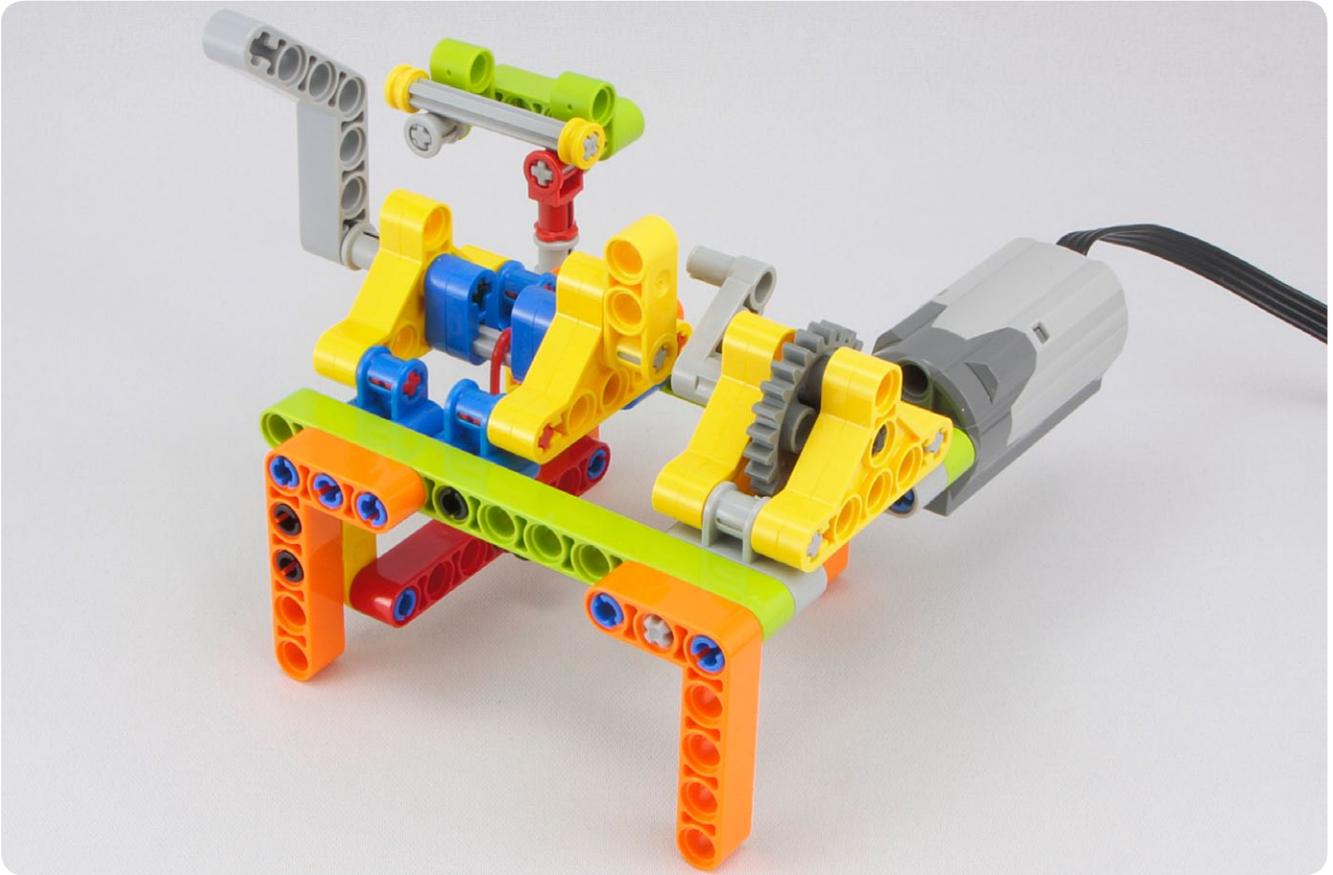


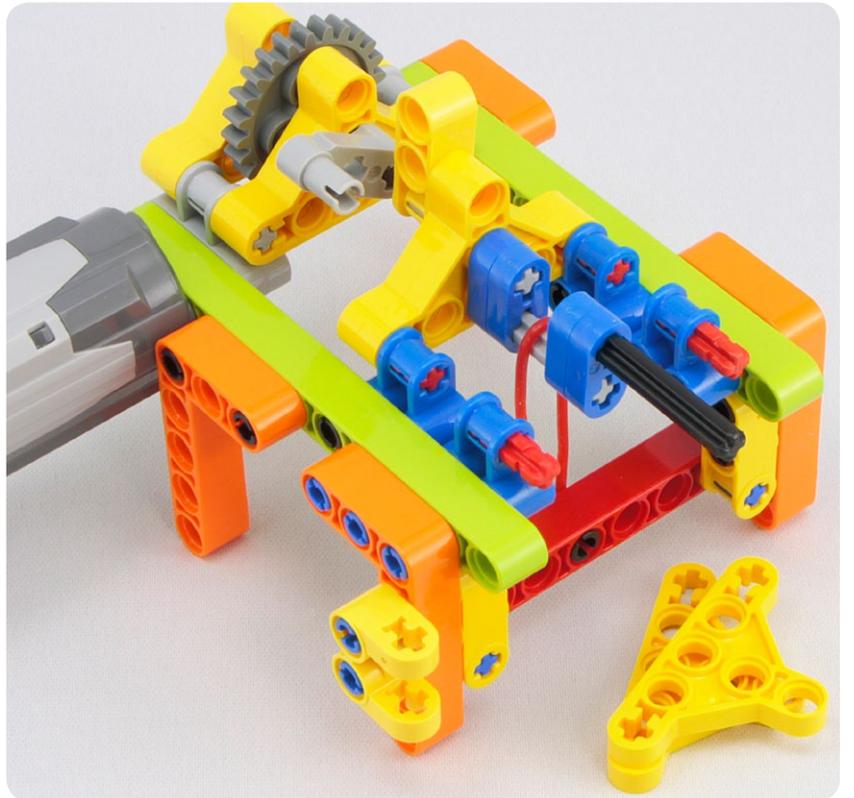
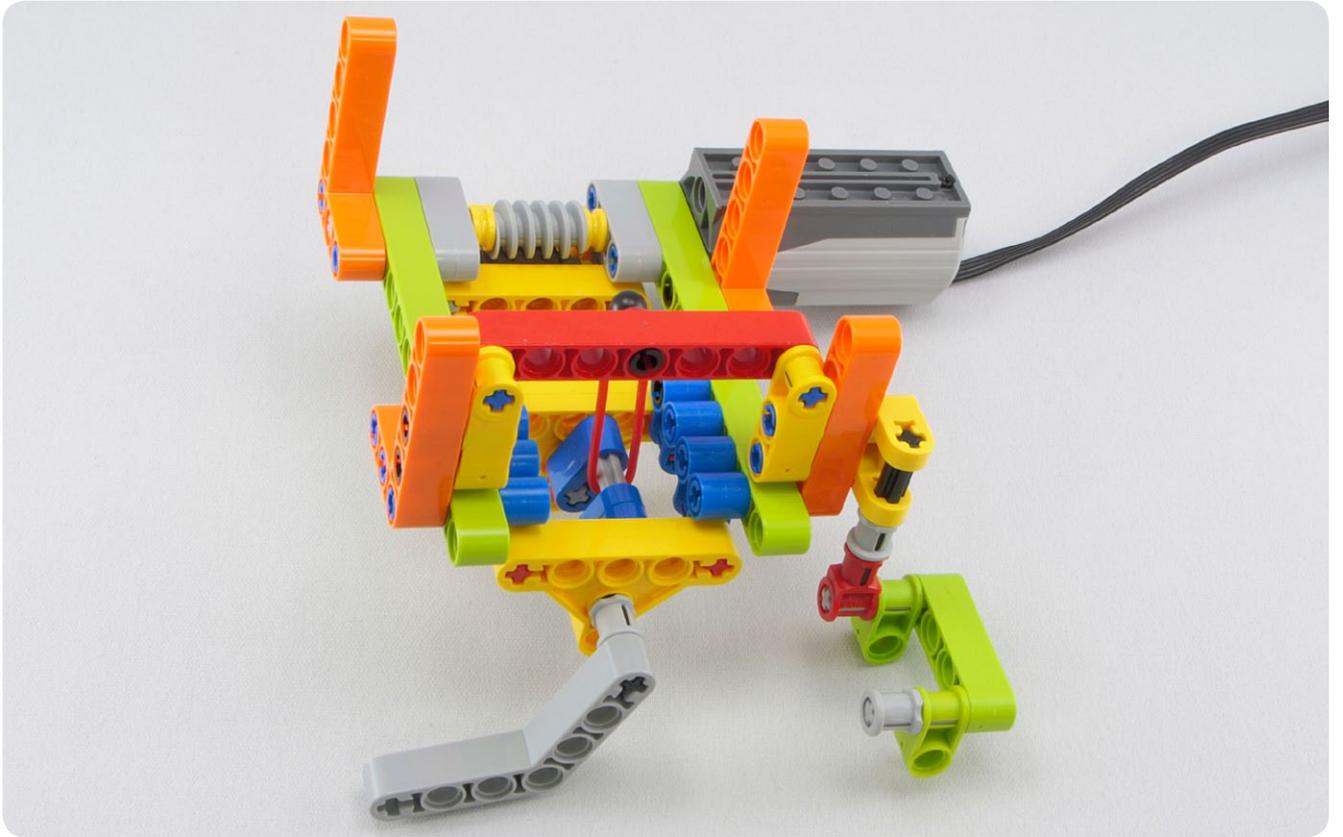


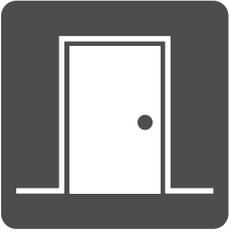






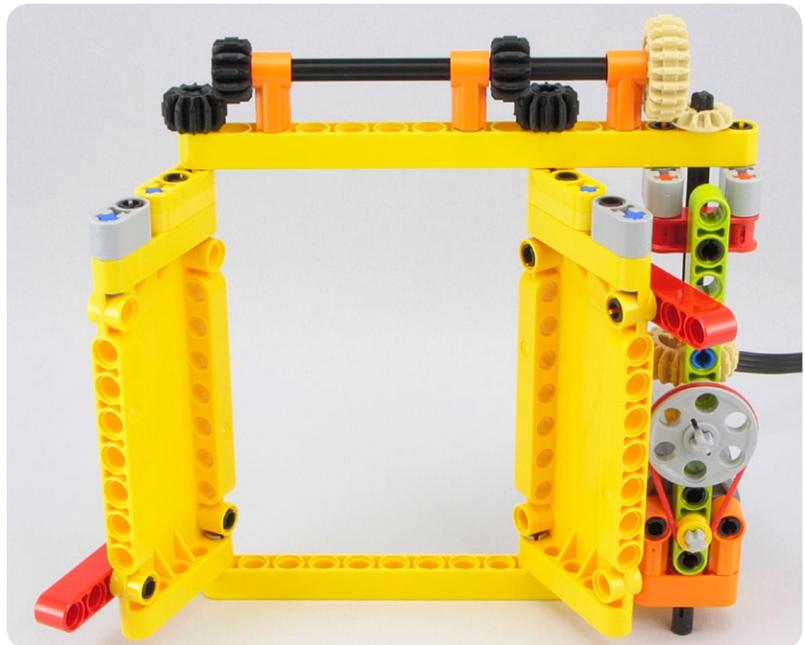
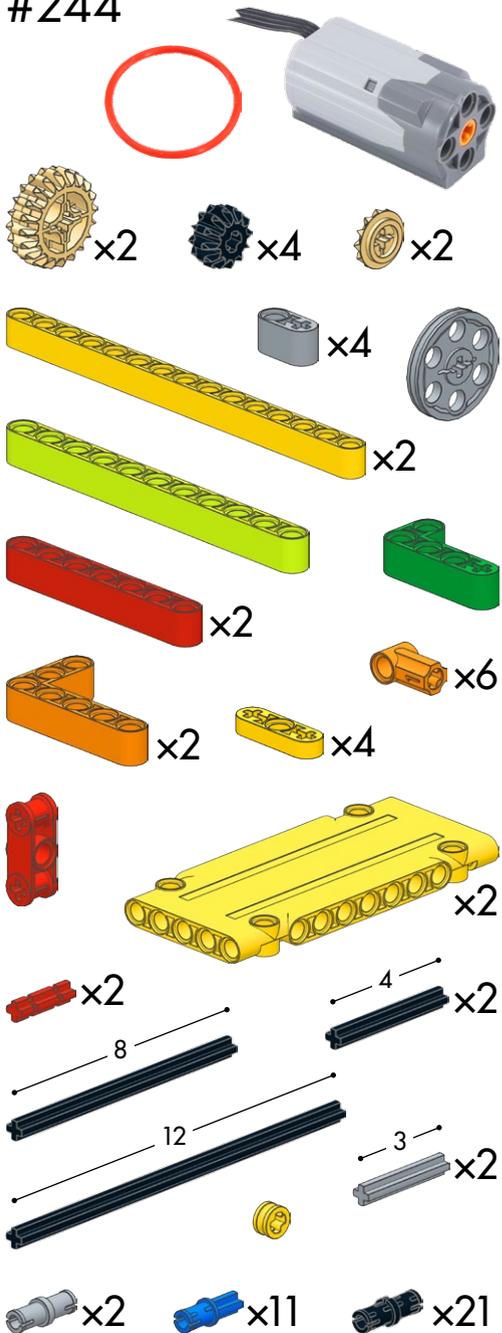


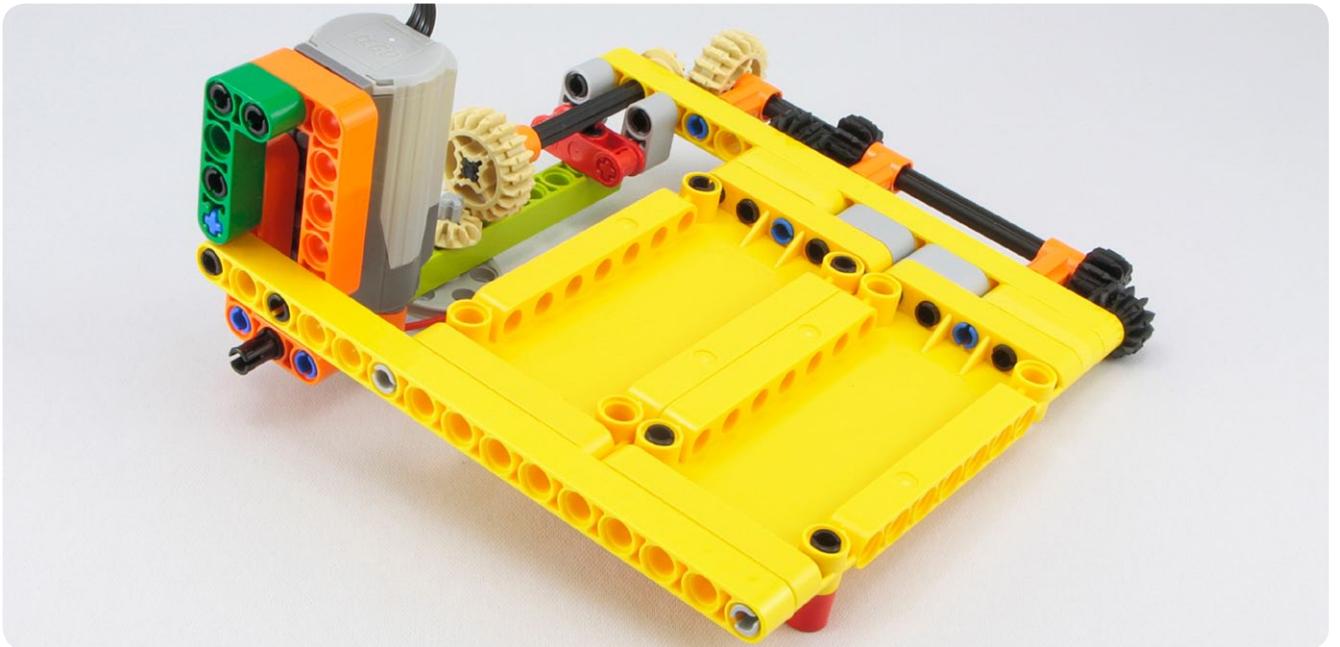
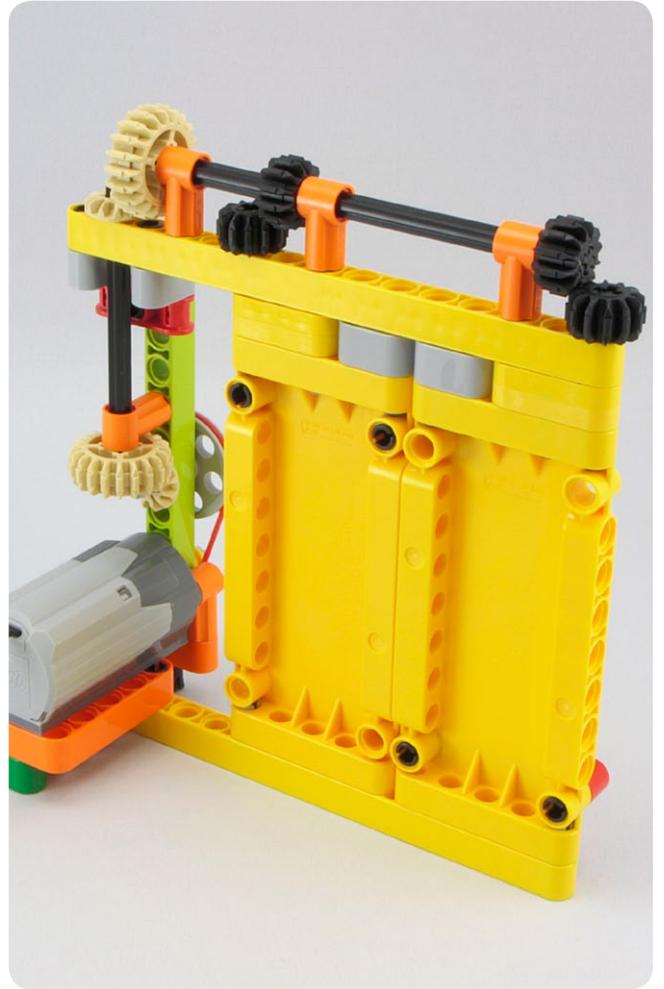


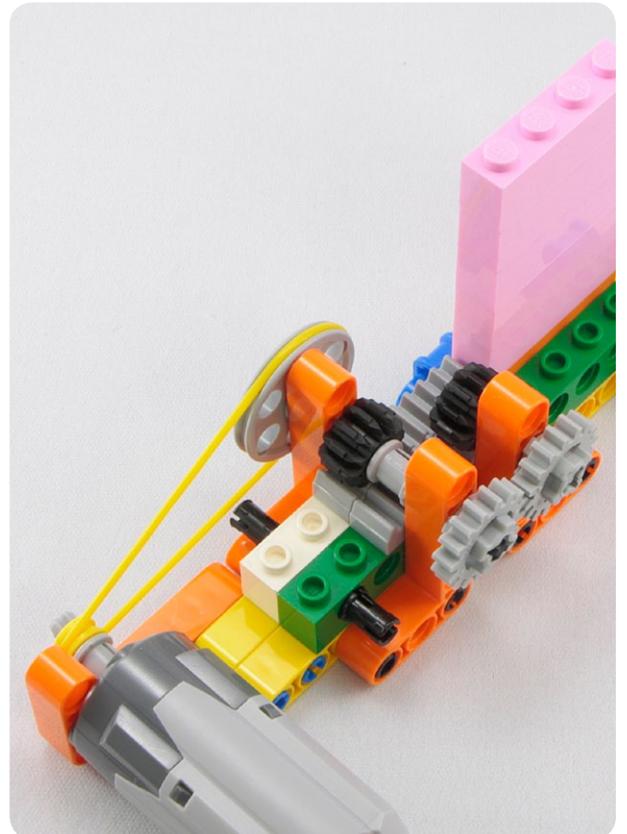
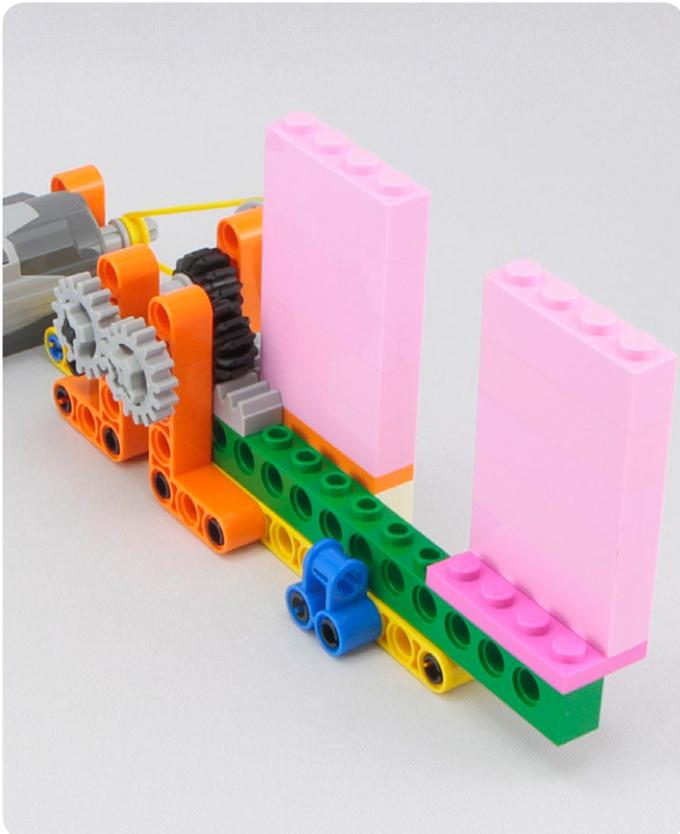
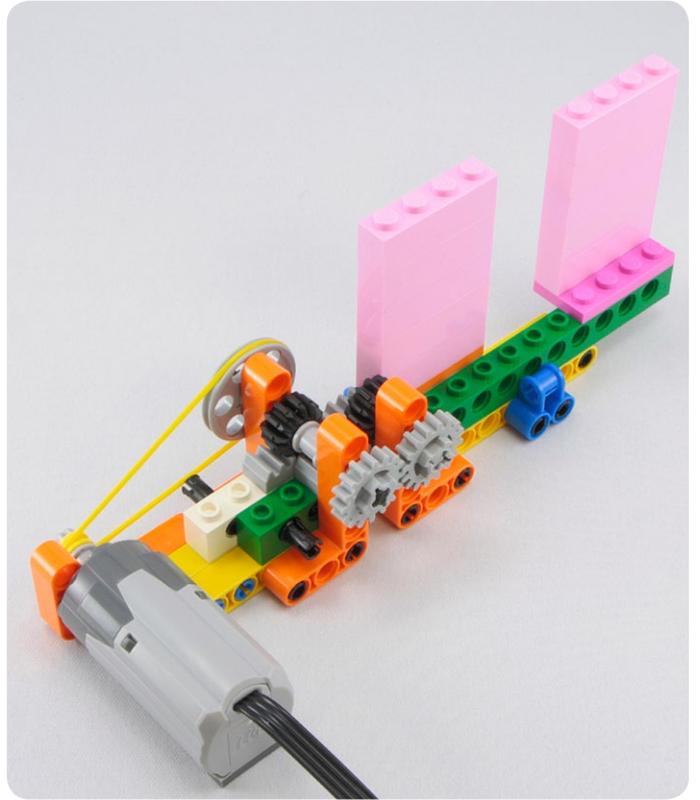
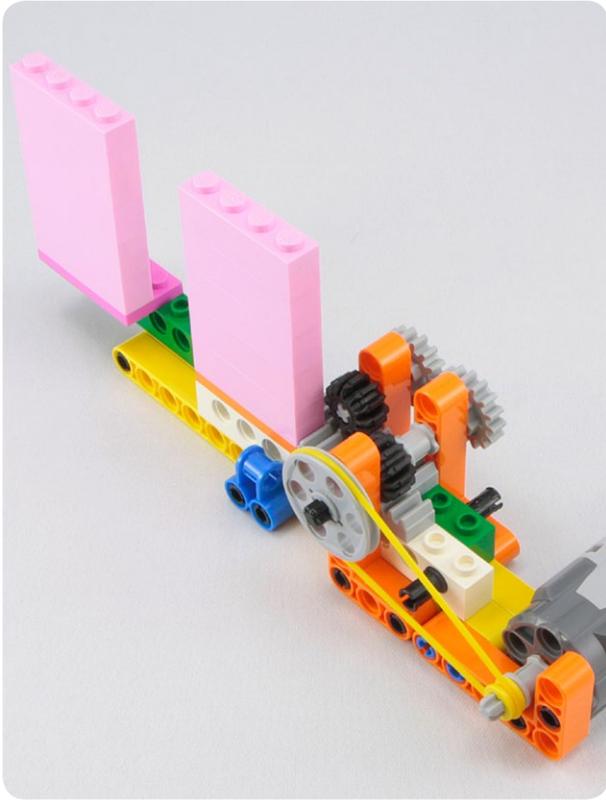


Automatic doors

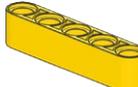
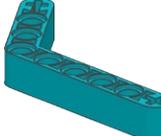
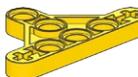
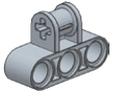
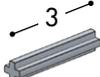
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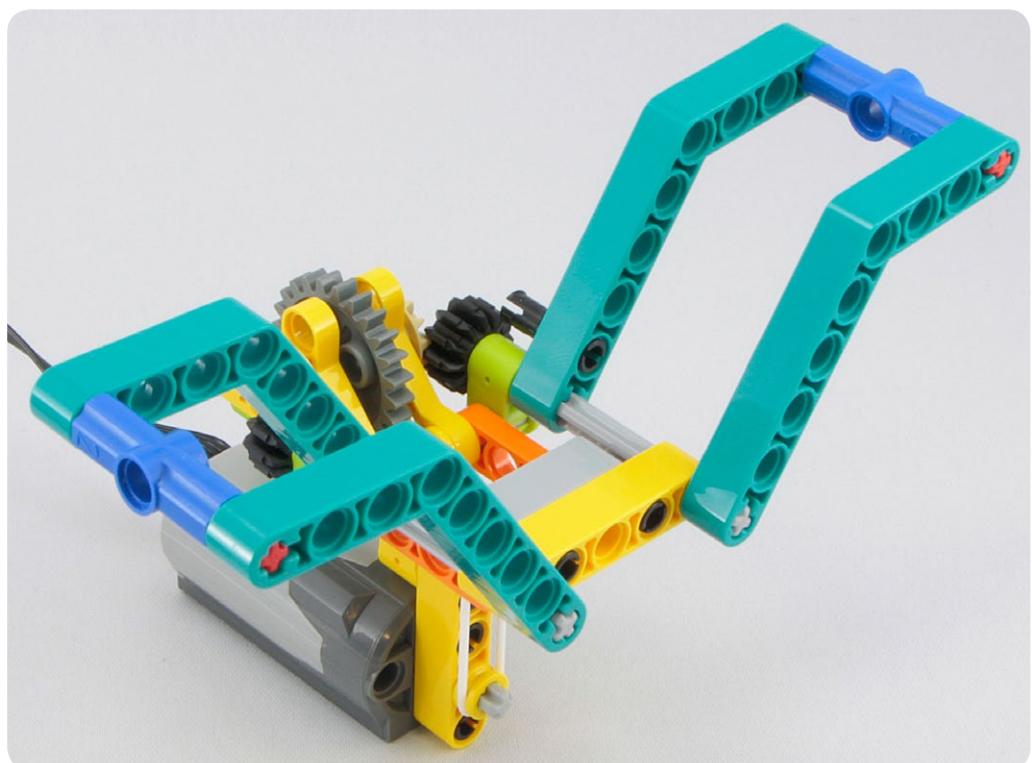
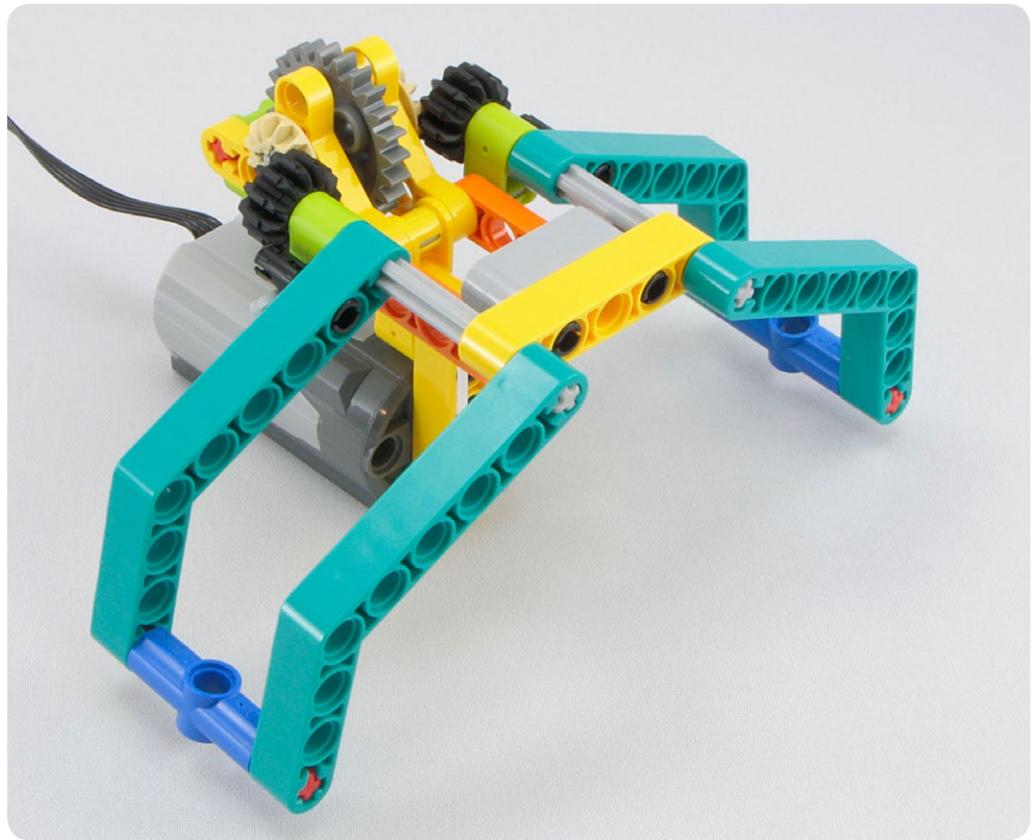


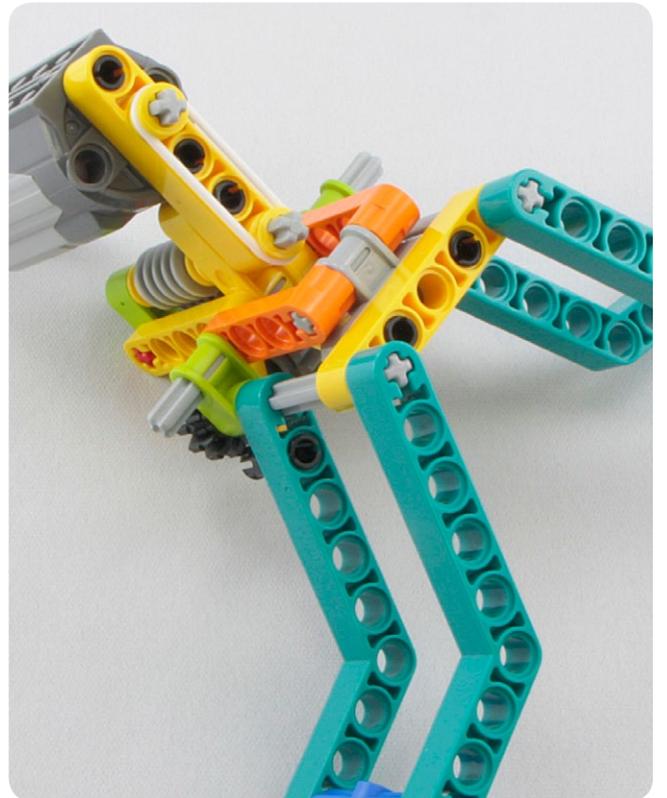
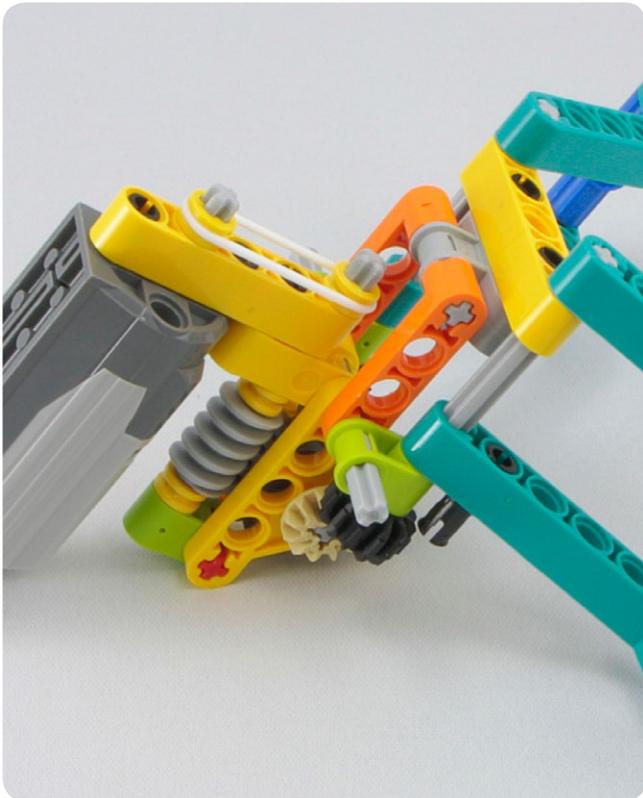
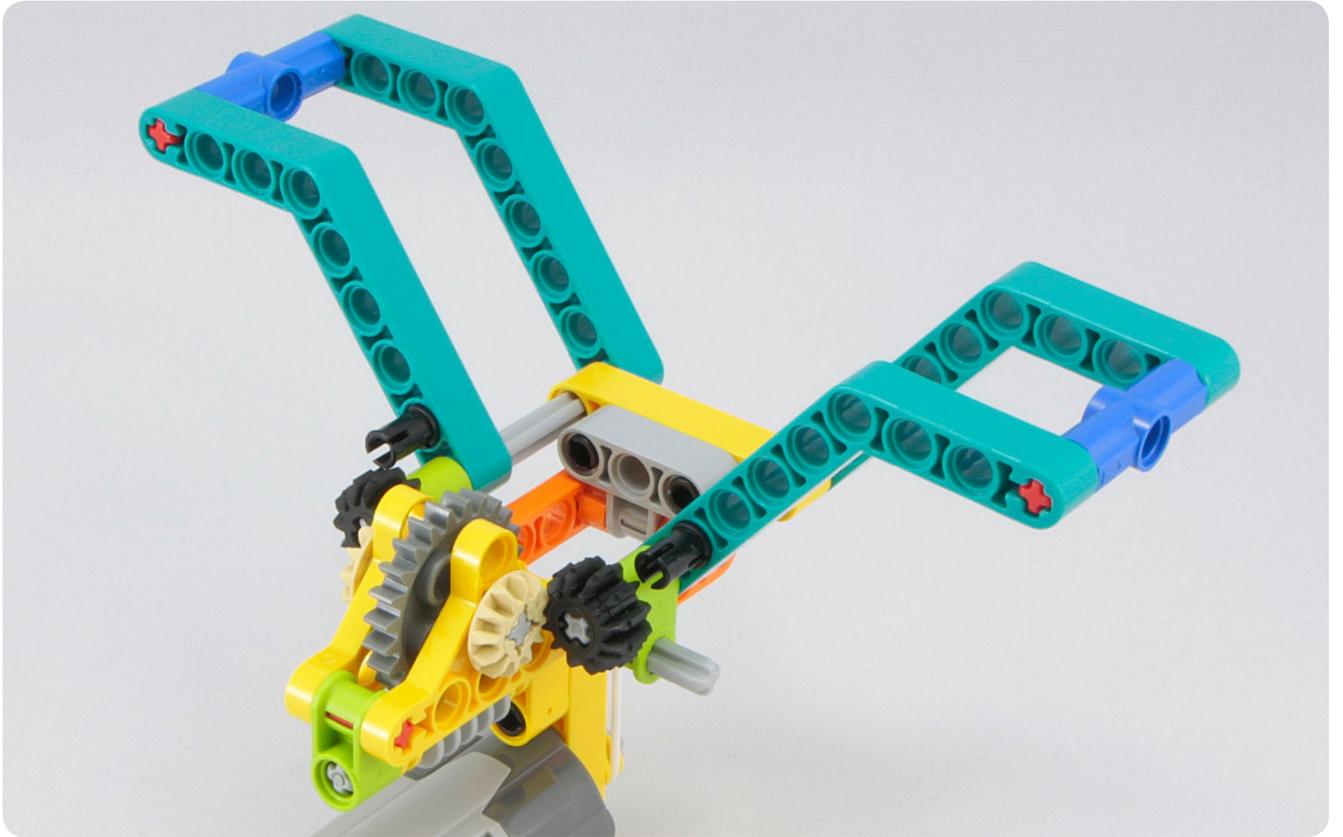




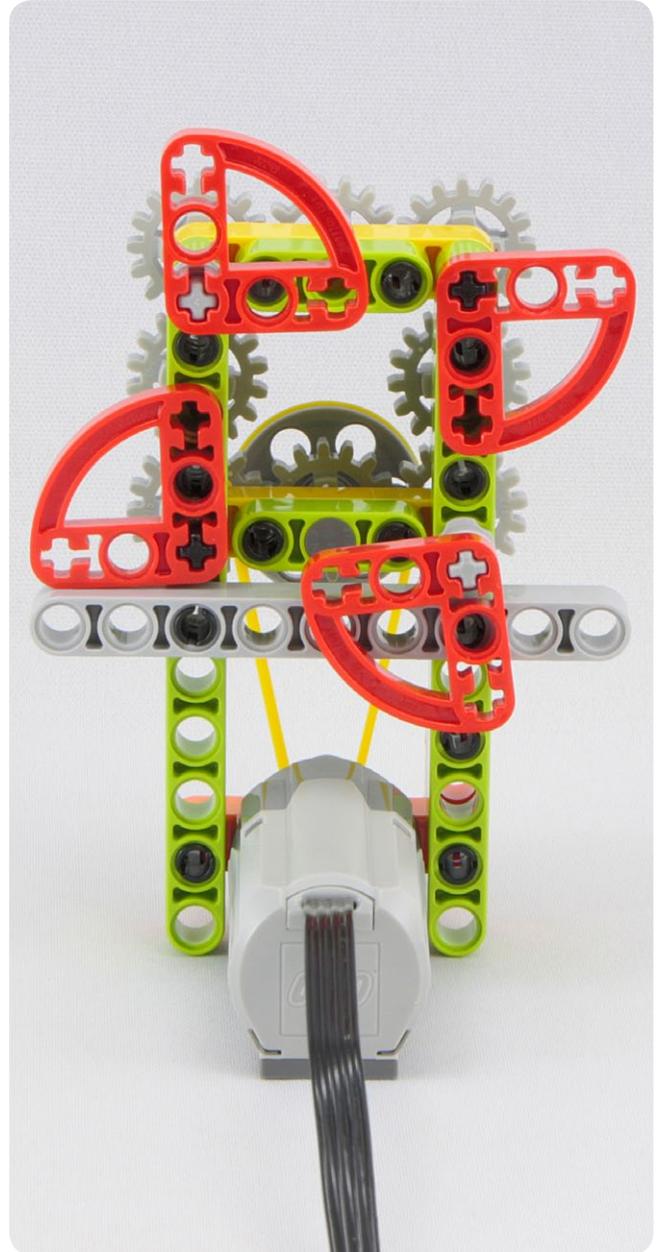
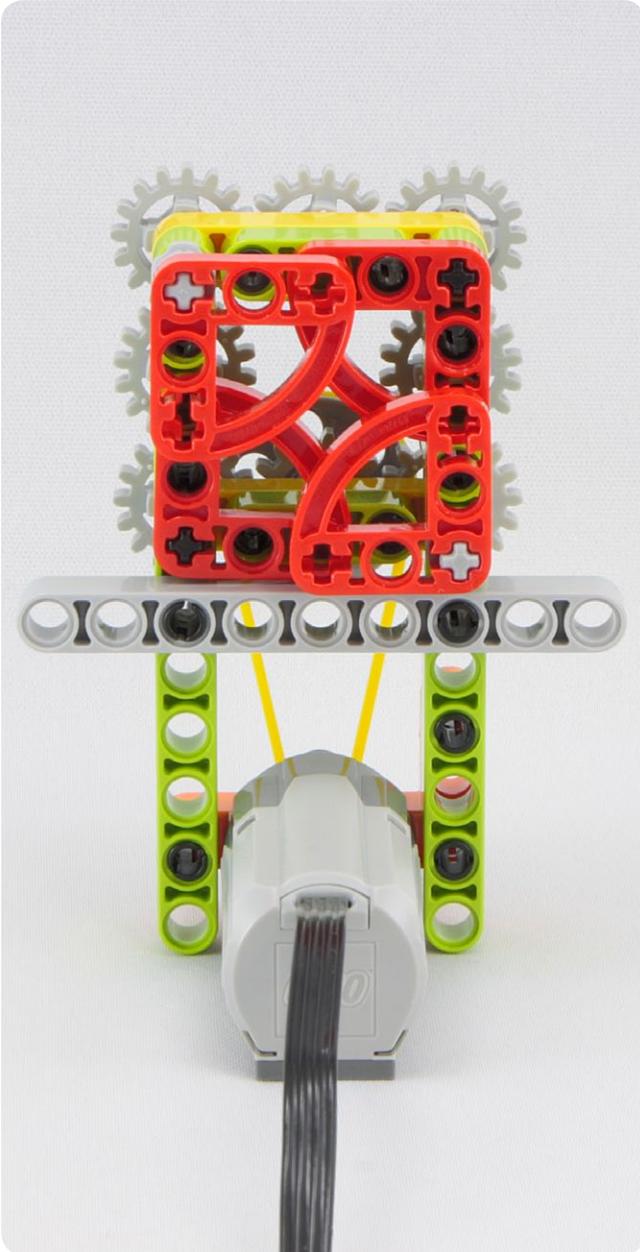
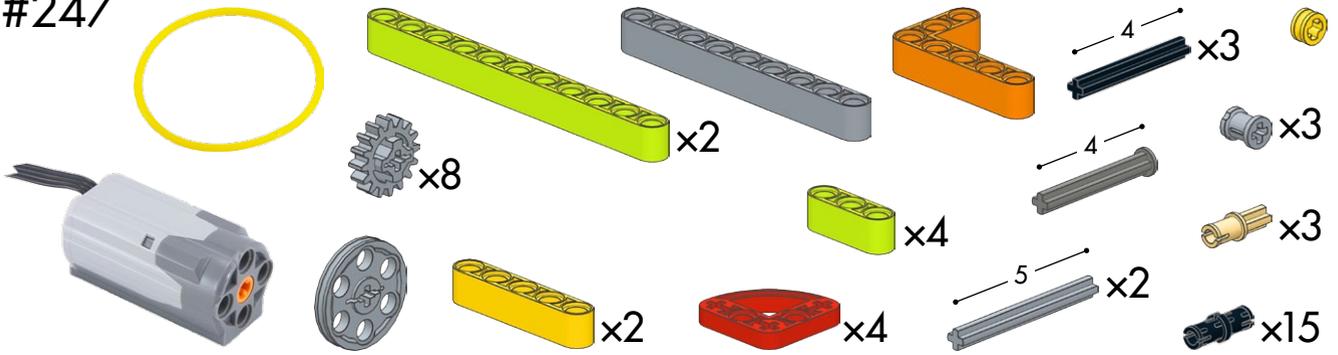
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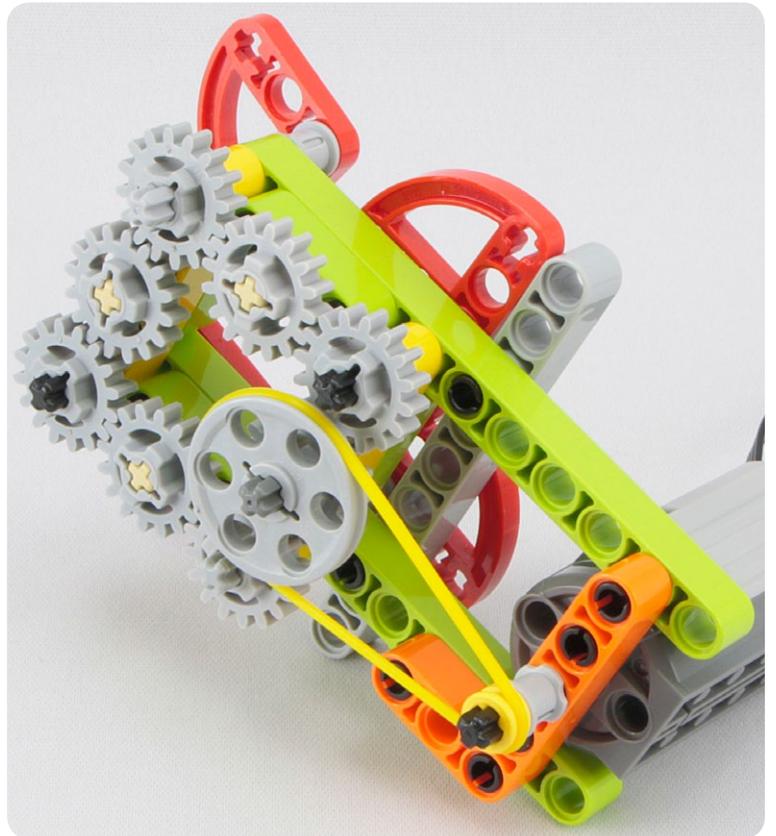
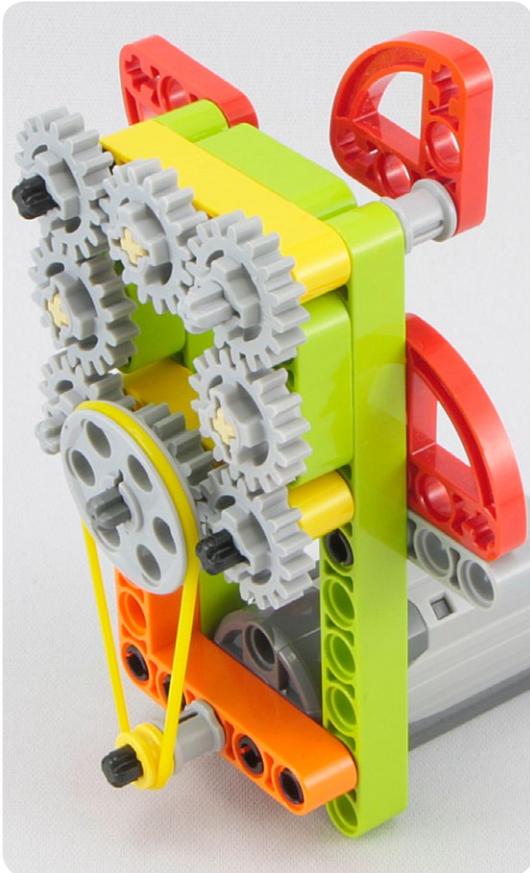
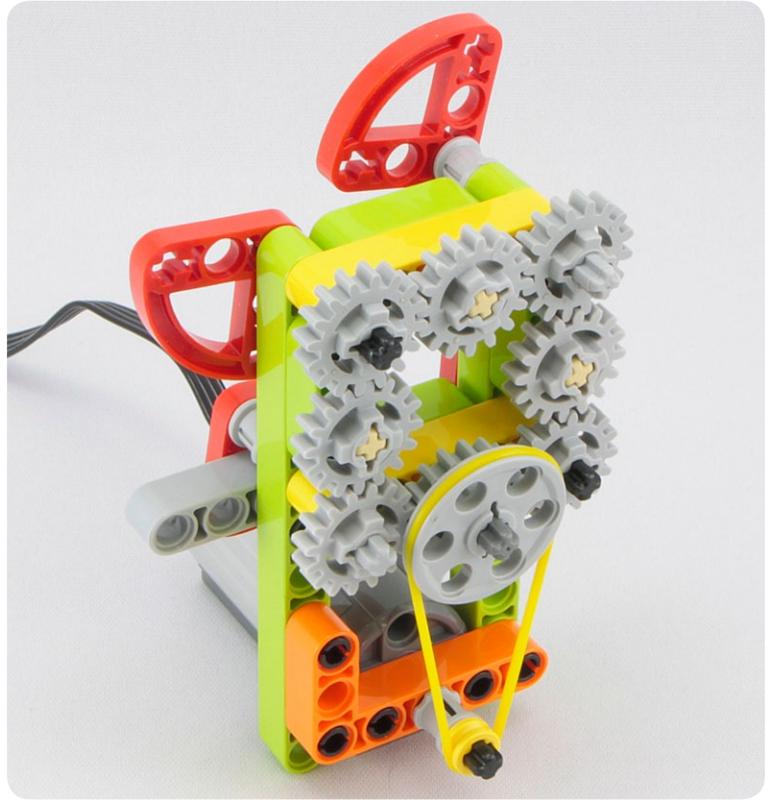
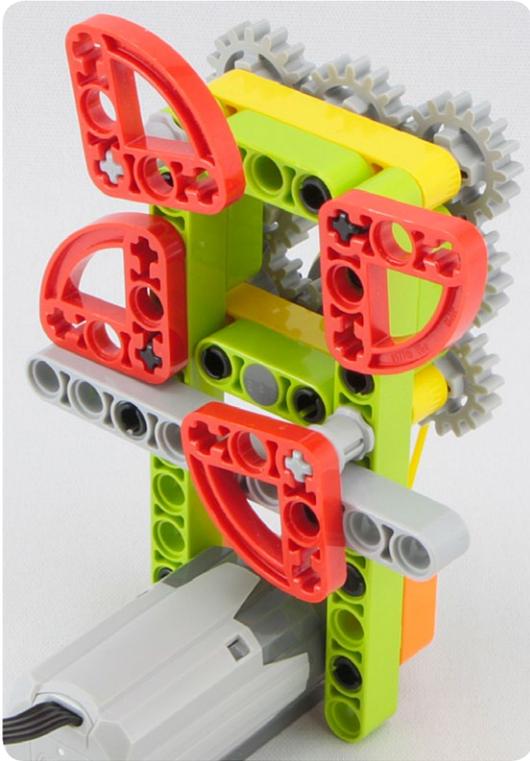
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-  x2
-  x2
-  x2
-  x4
-  x2
-  x2
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-  x3
-  x2
-  x5
-  x3
-  x4
-  x4
-  x7



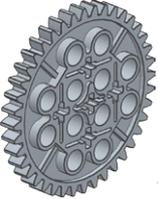
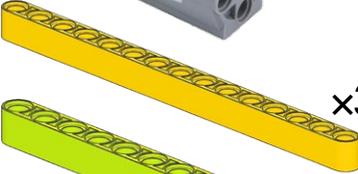
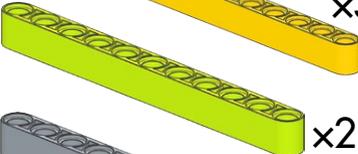
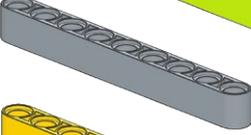
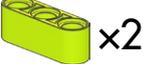
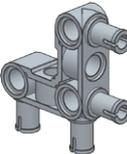
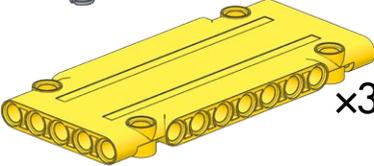


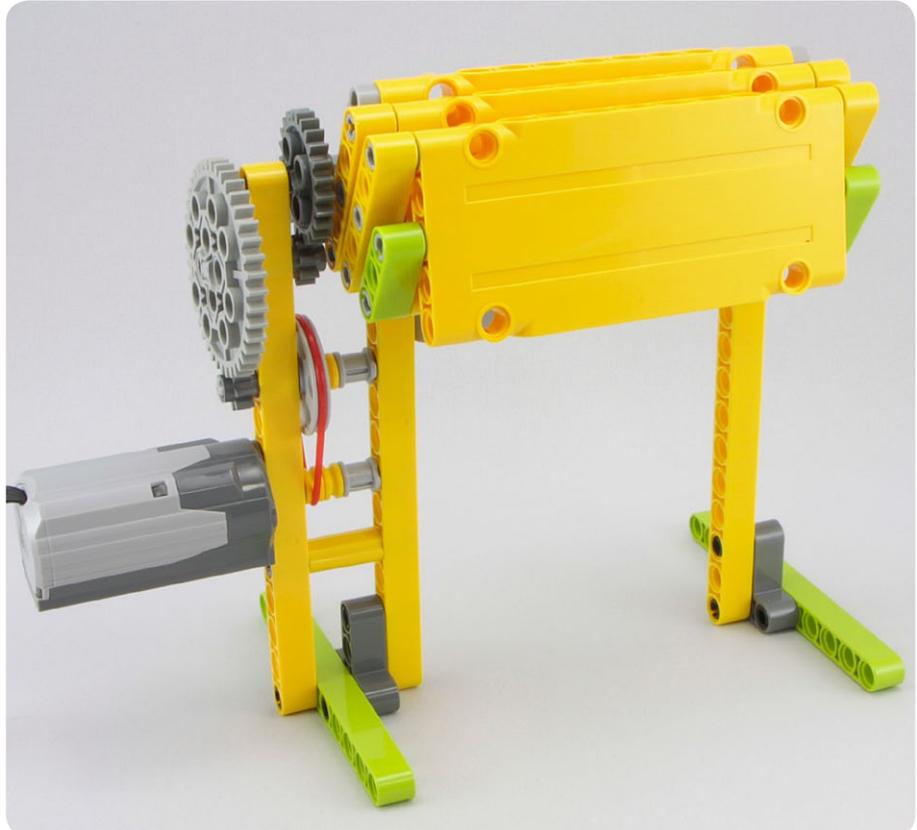
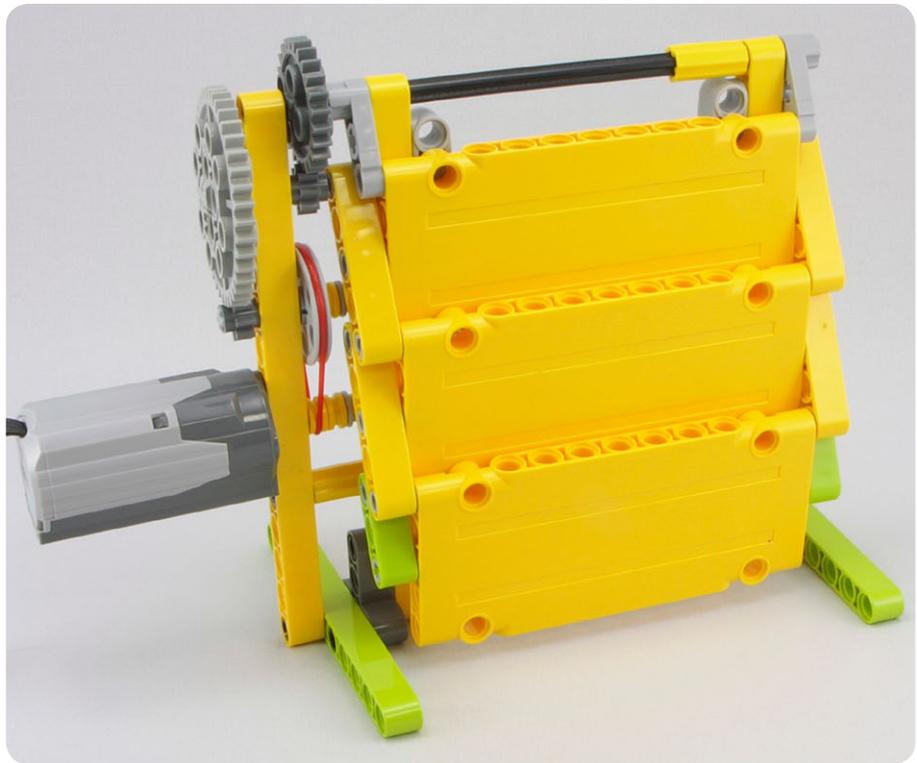
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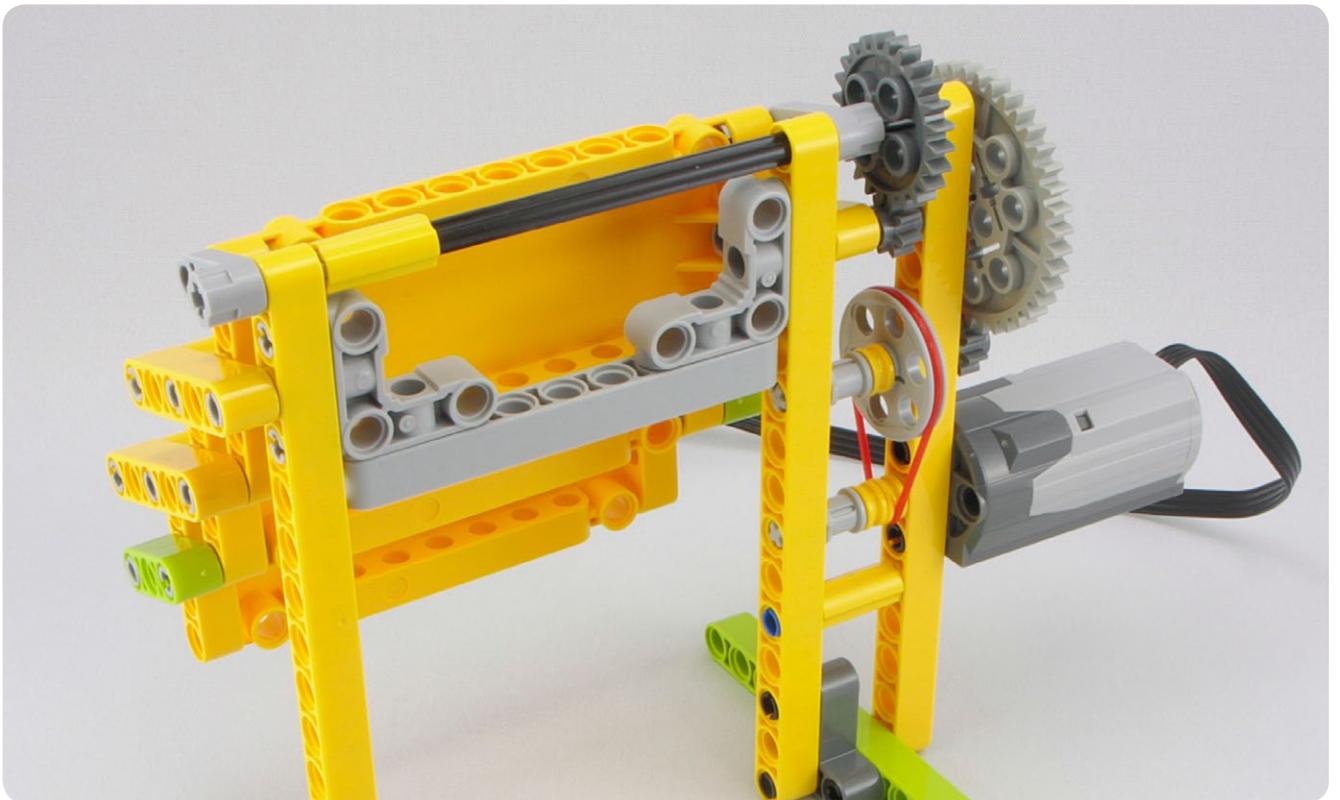
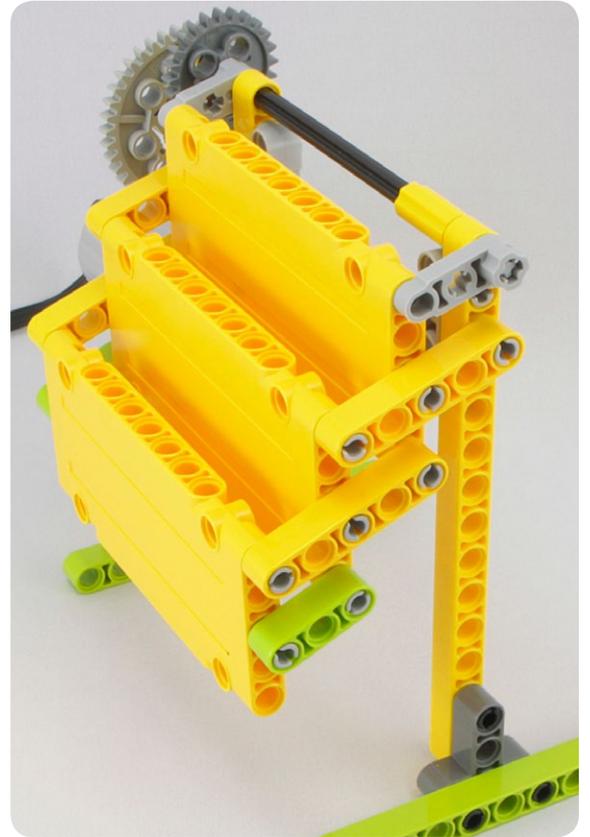
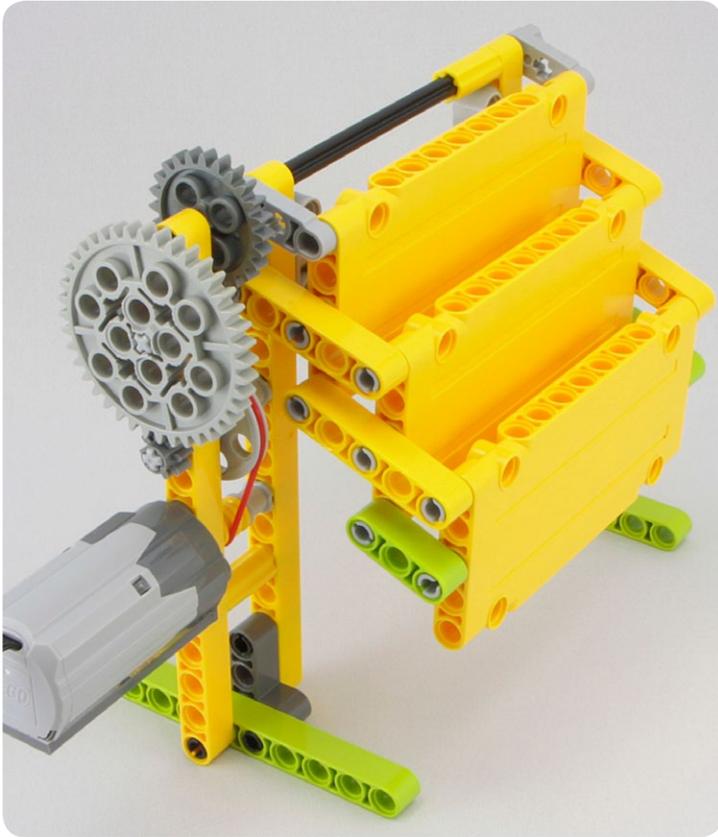


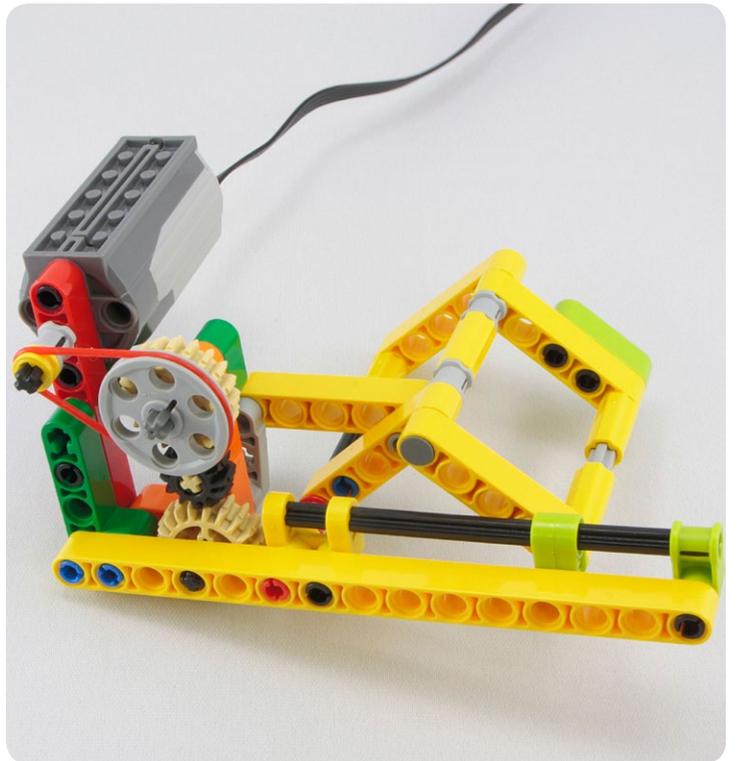
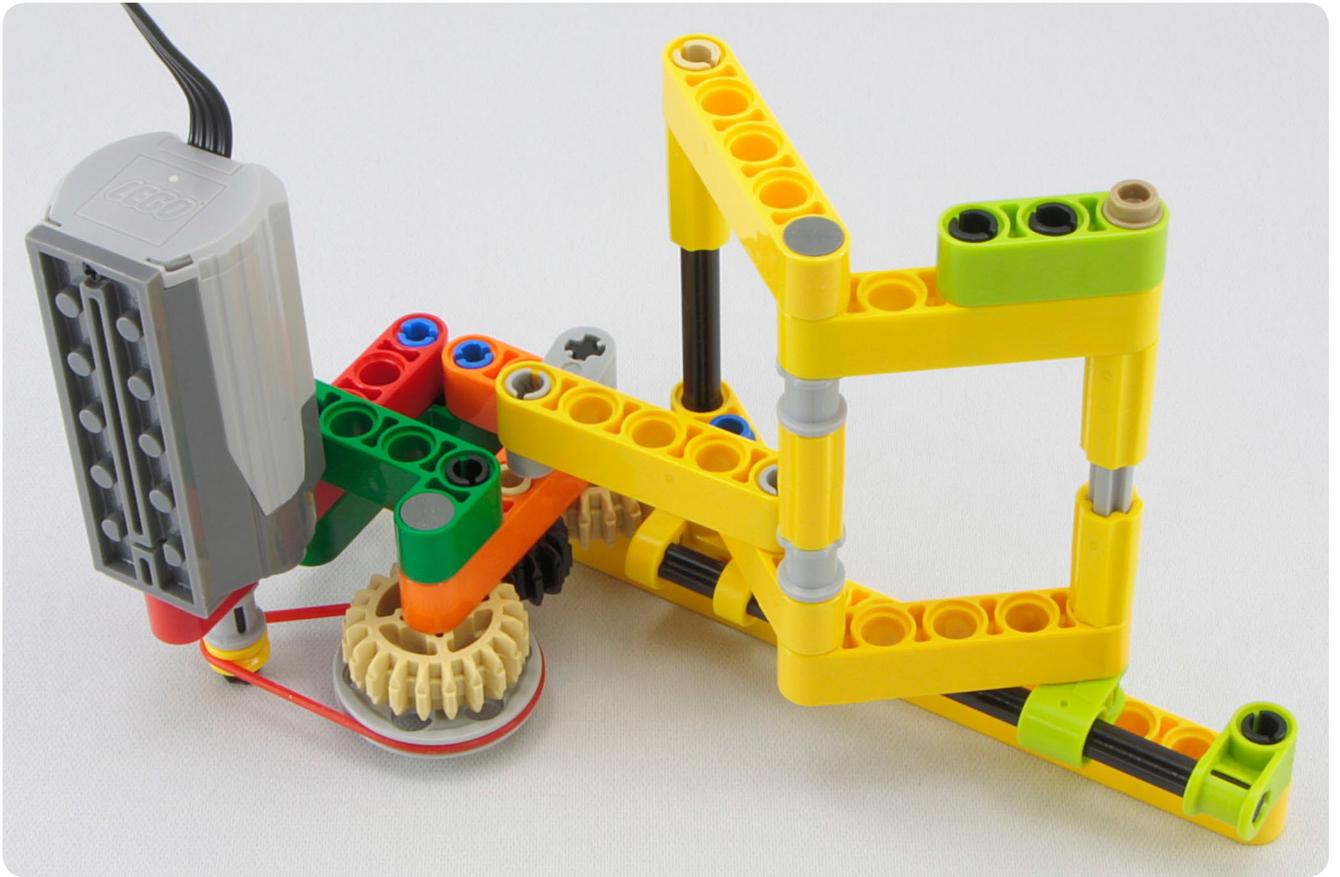


#248

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-  x2
-  x3
-  x2
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-  x4
-  x2
-  x2
-  x2
-  x2
-  x2
-  x3
-  x2
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-  x2
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-  x3
-  x2
-  x16
-  x11



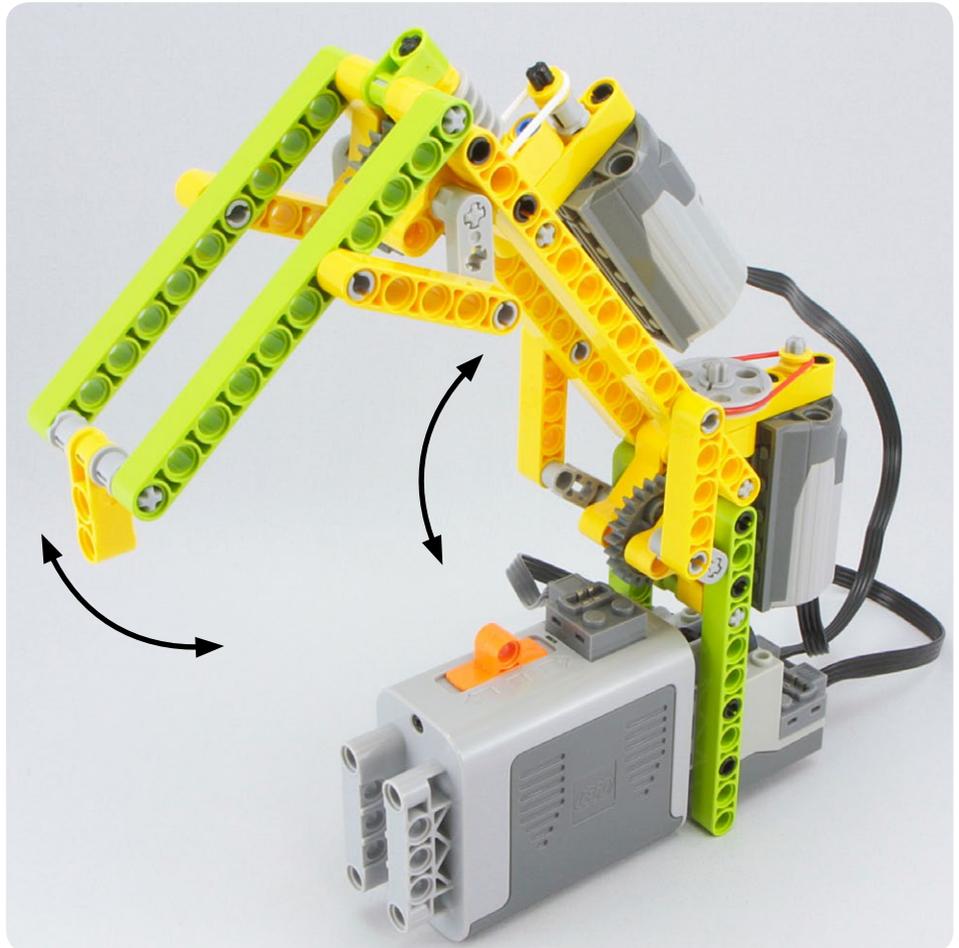
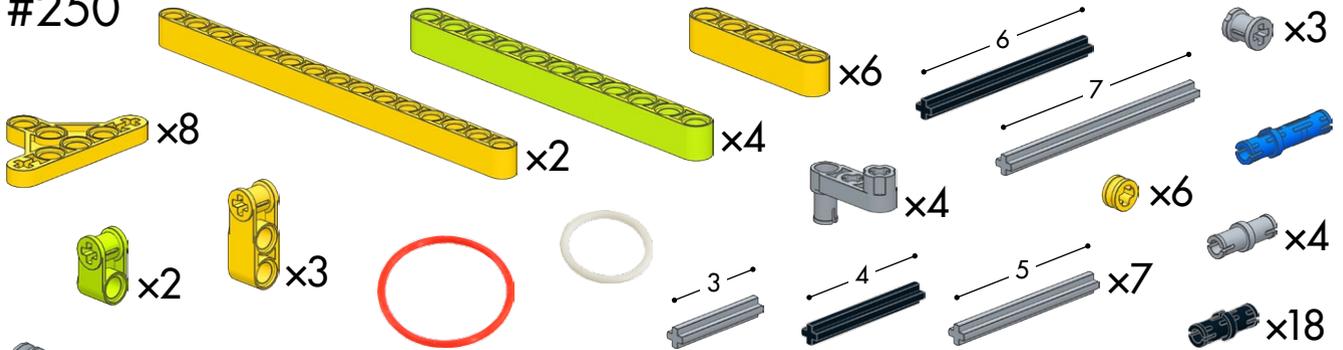




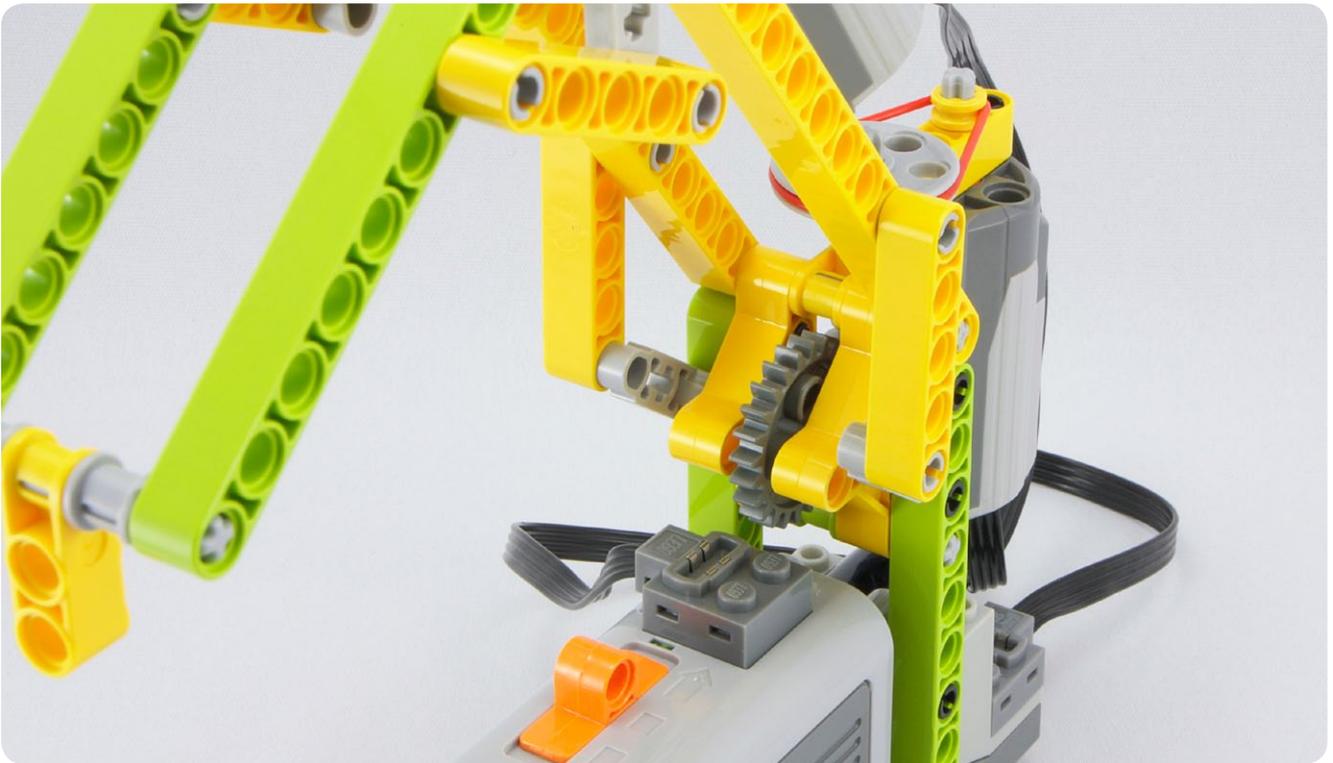
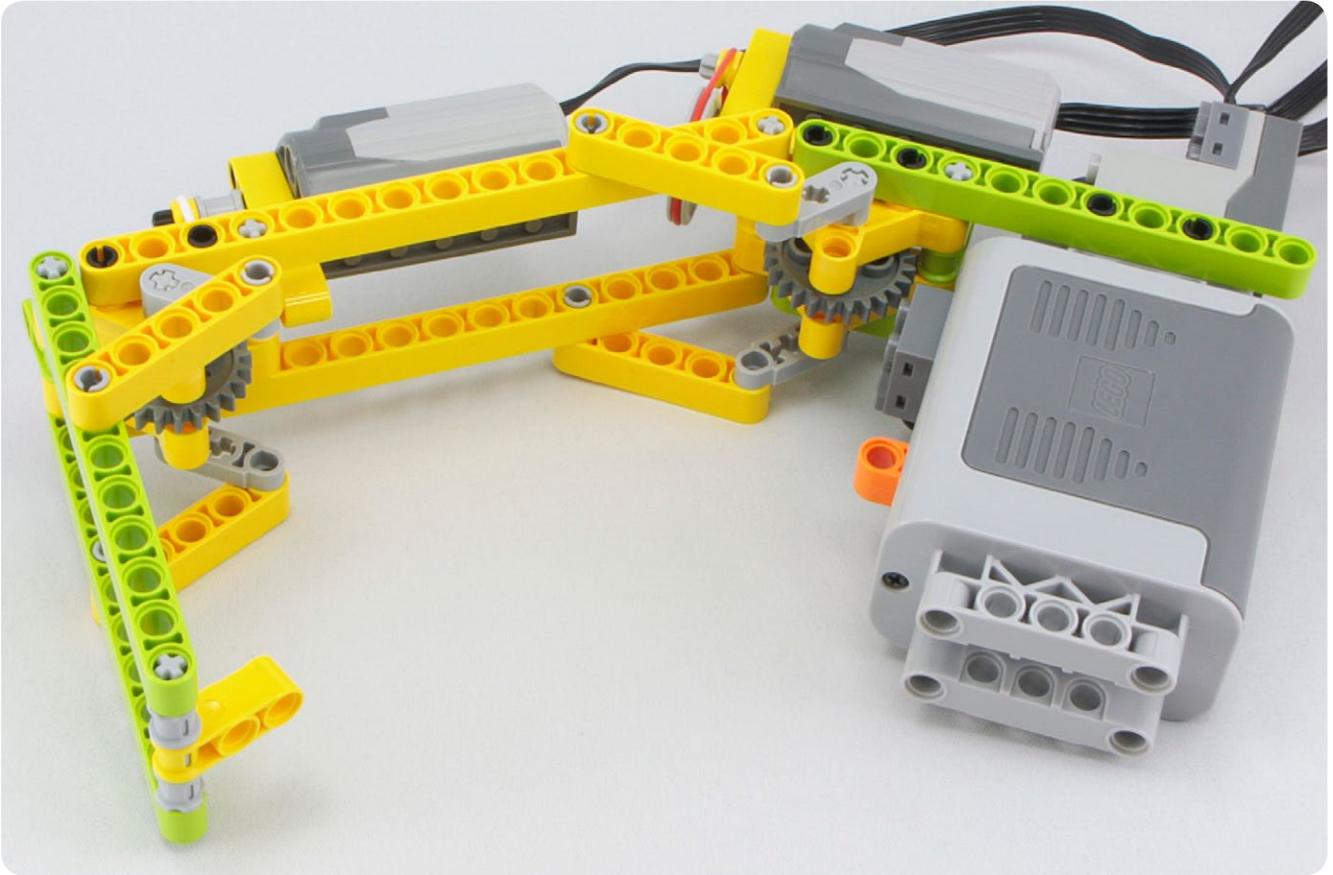


Moving arms

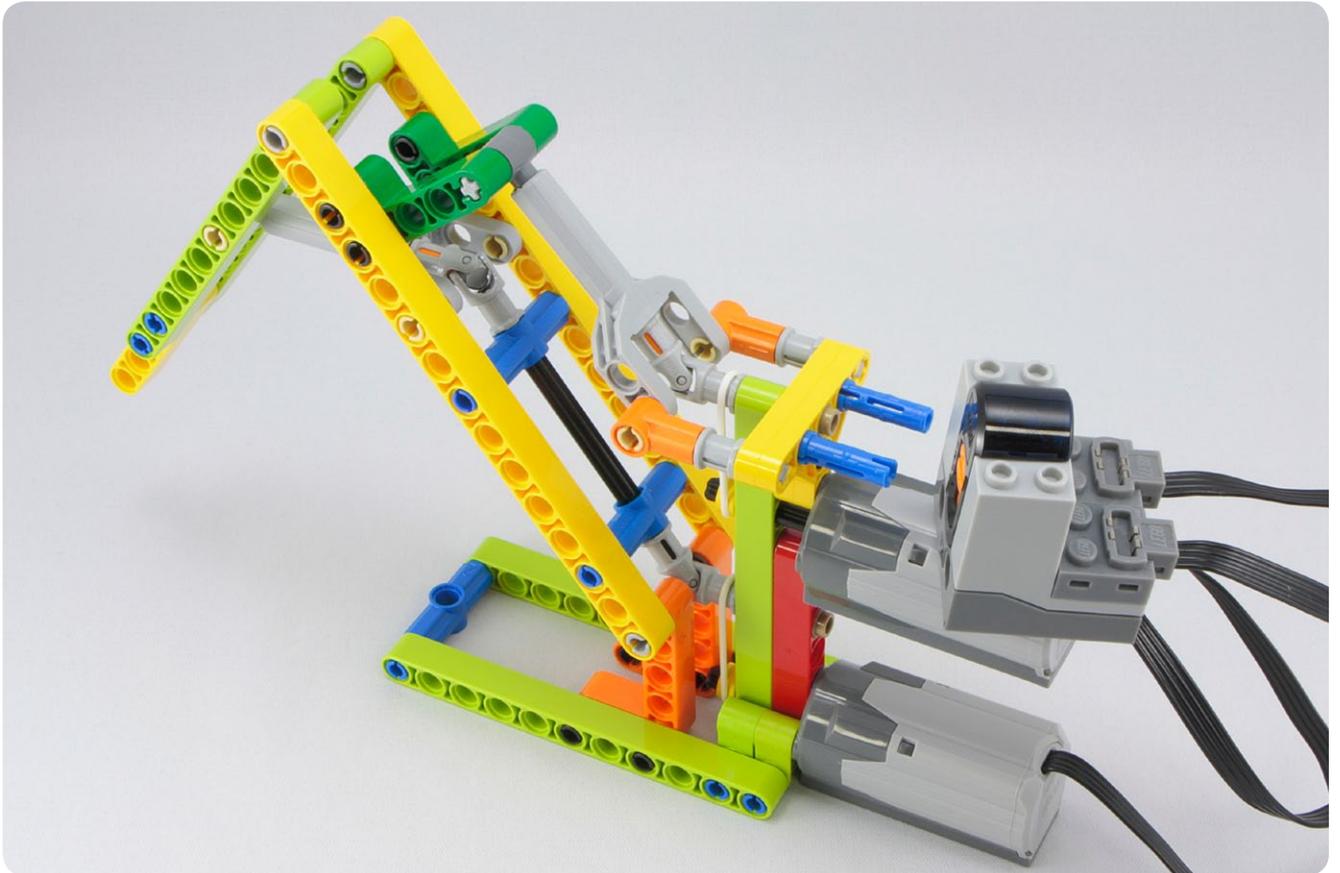
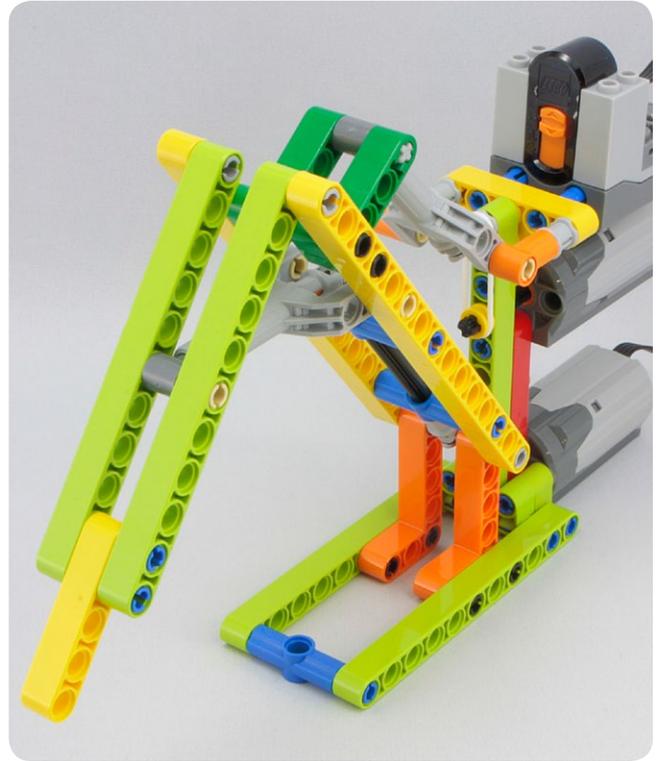
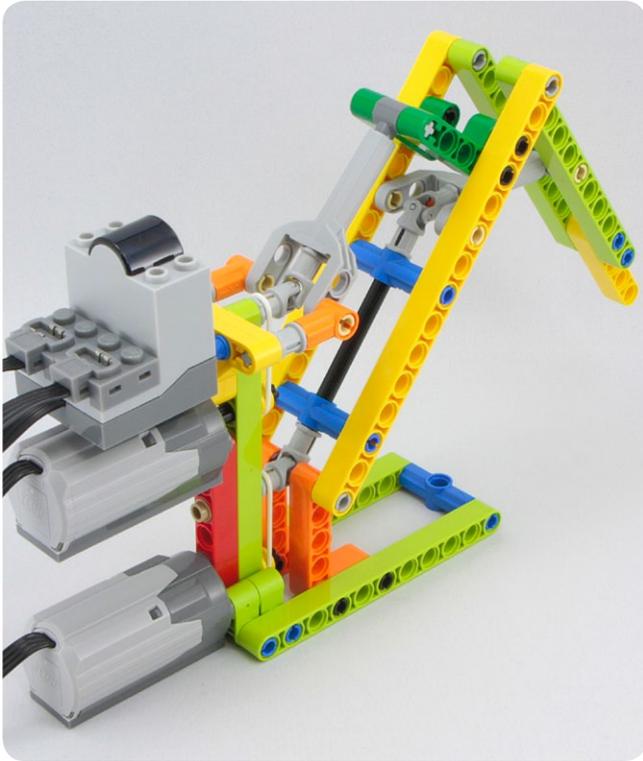
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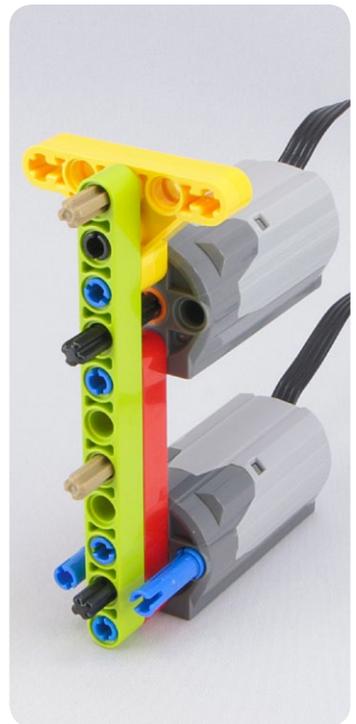
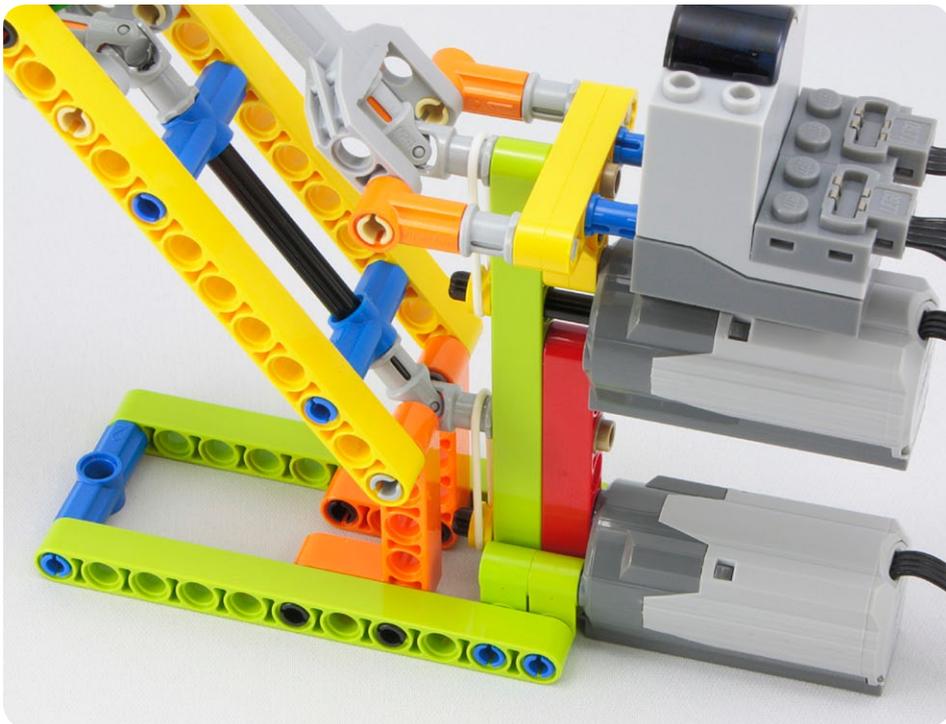
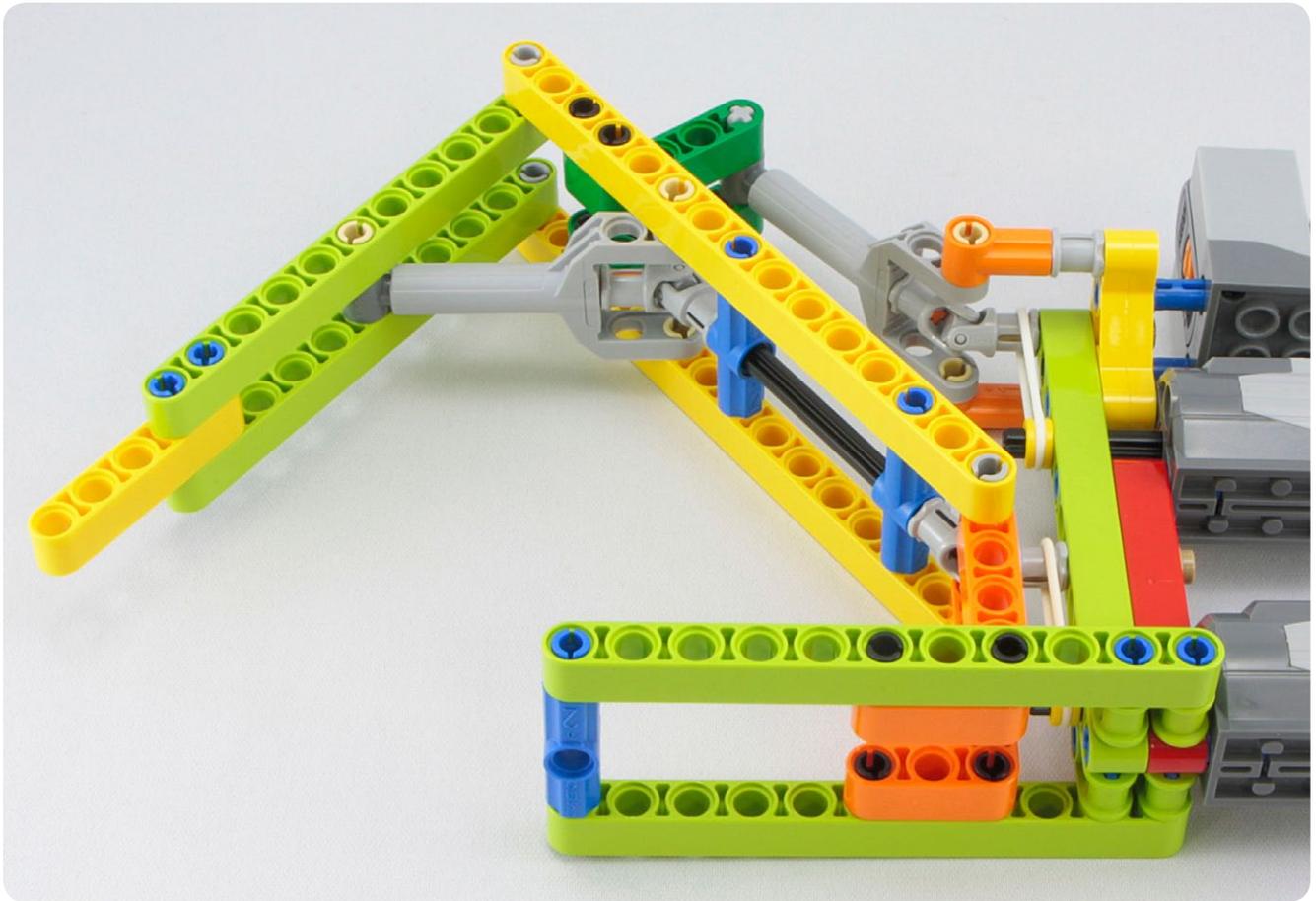


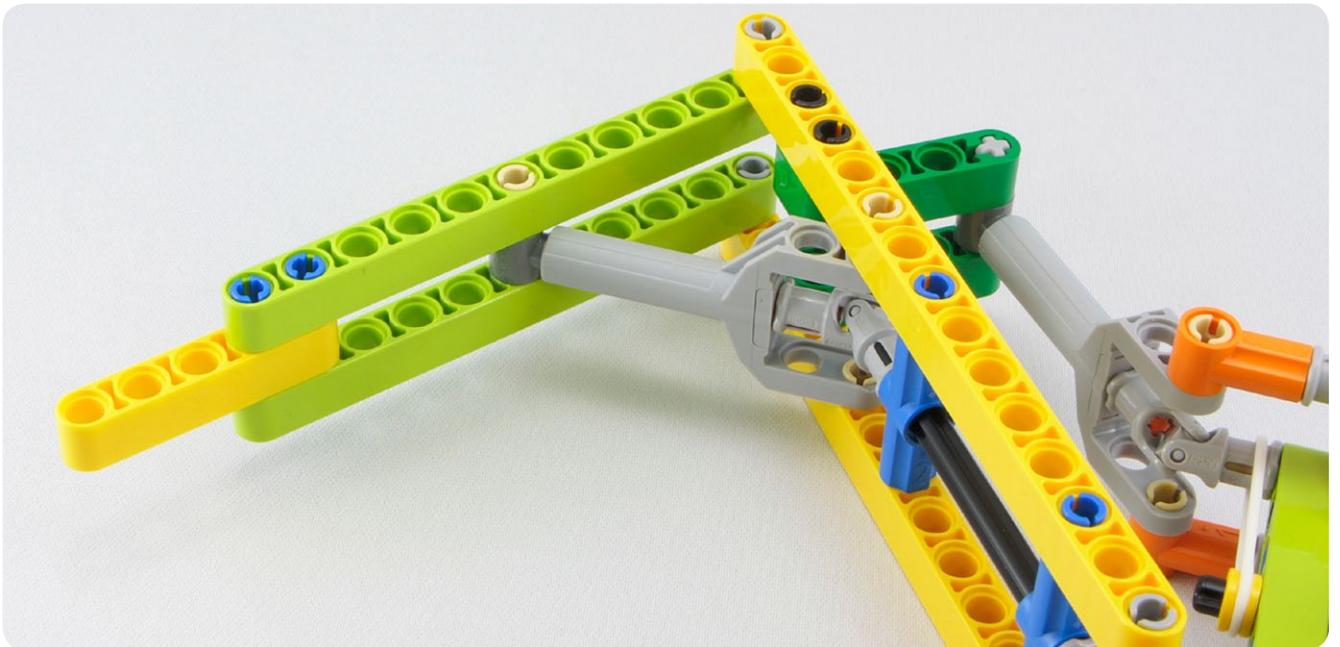


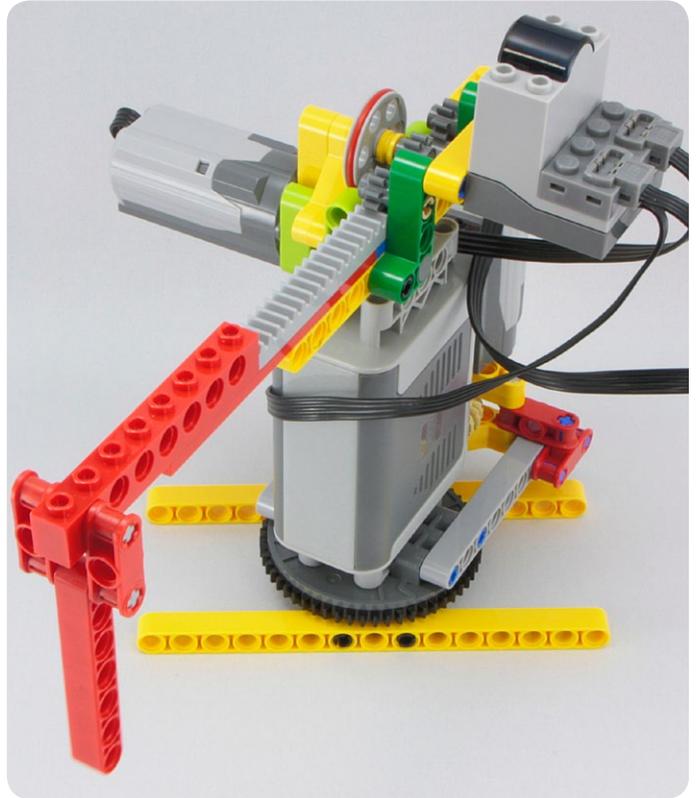
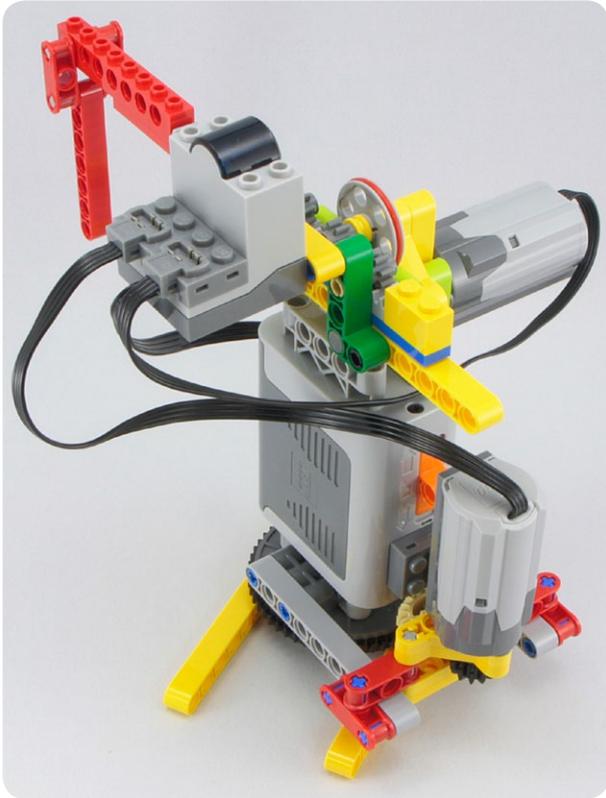


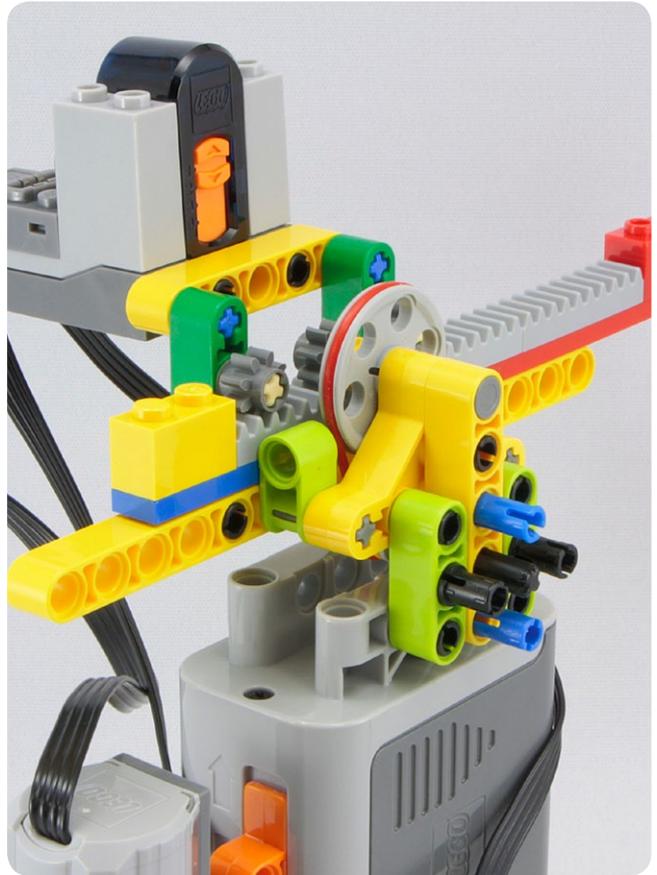
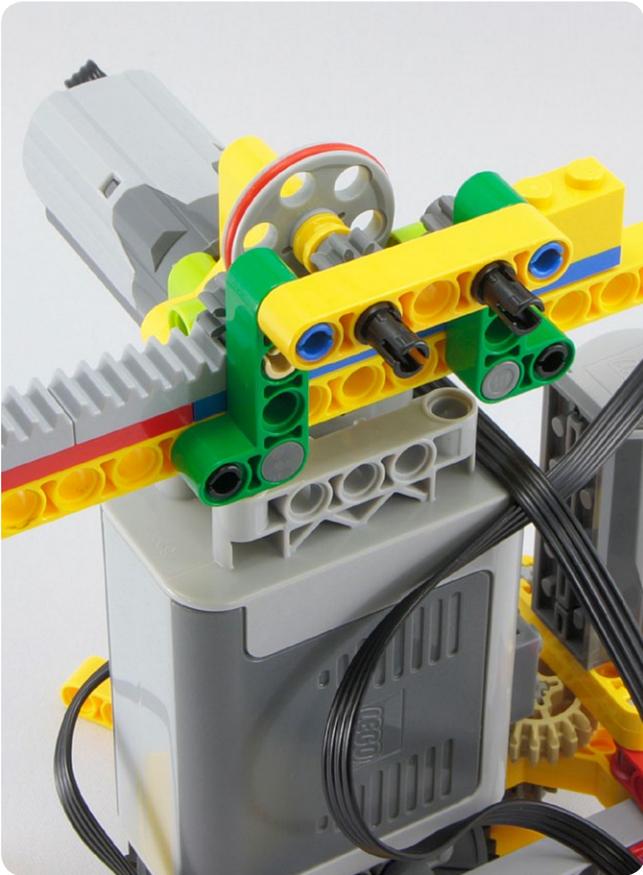
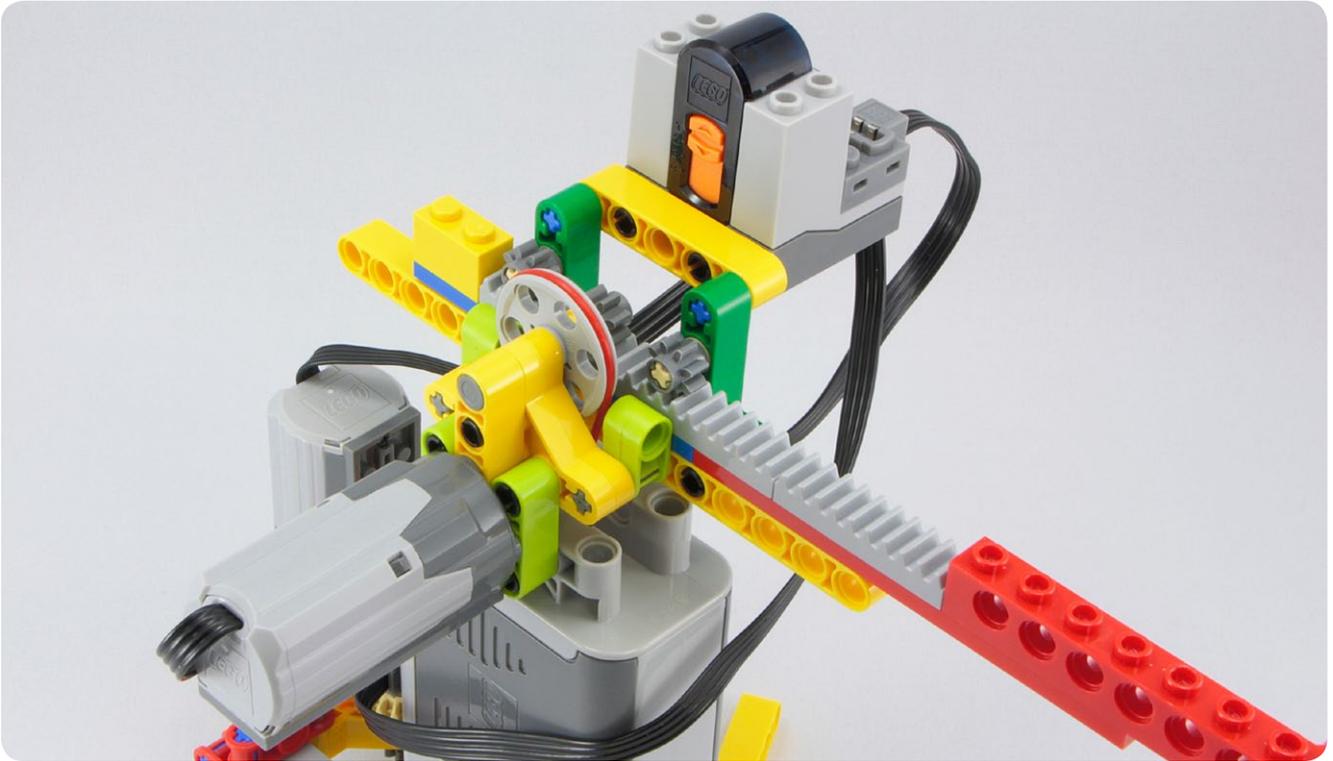


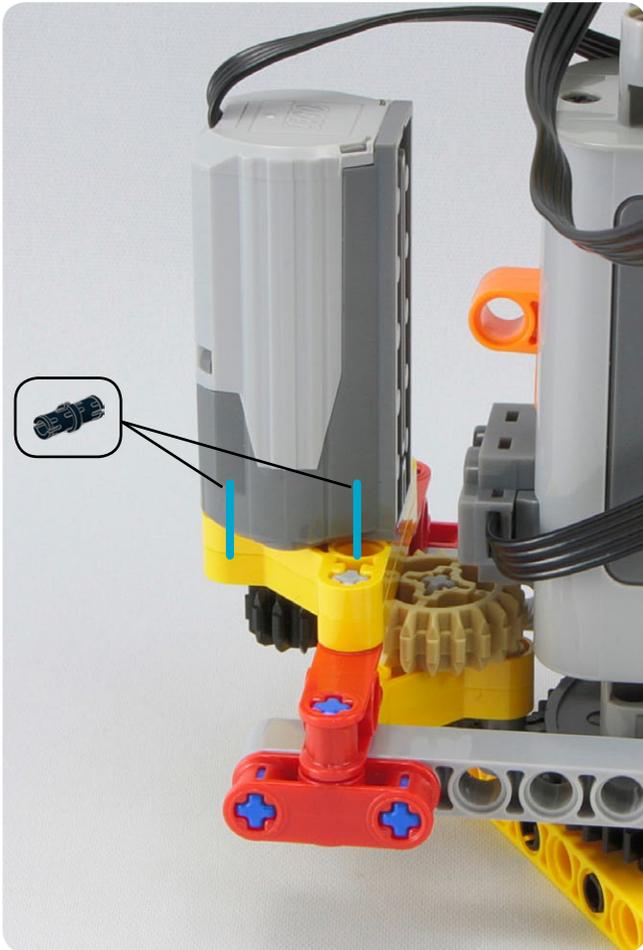
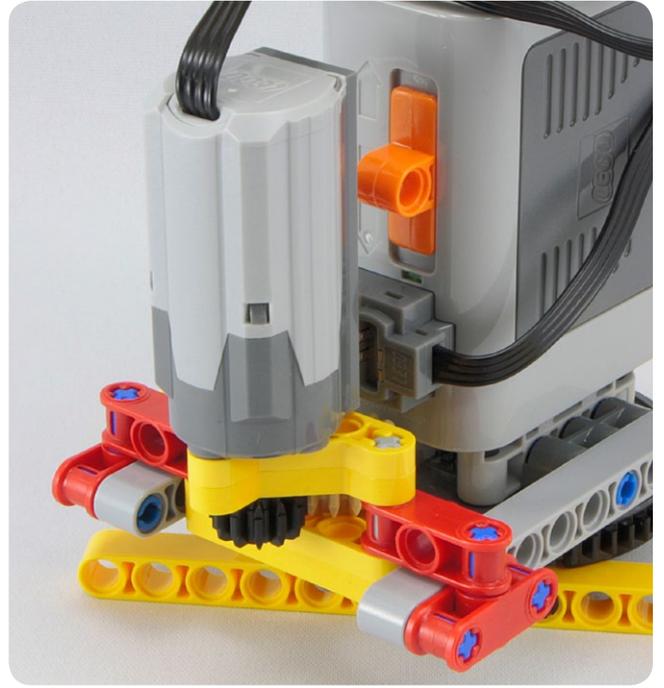
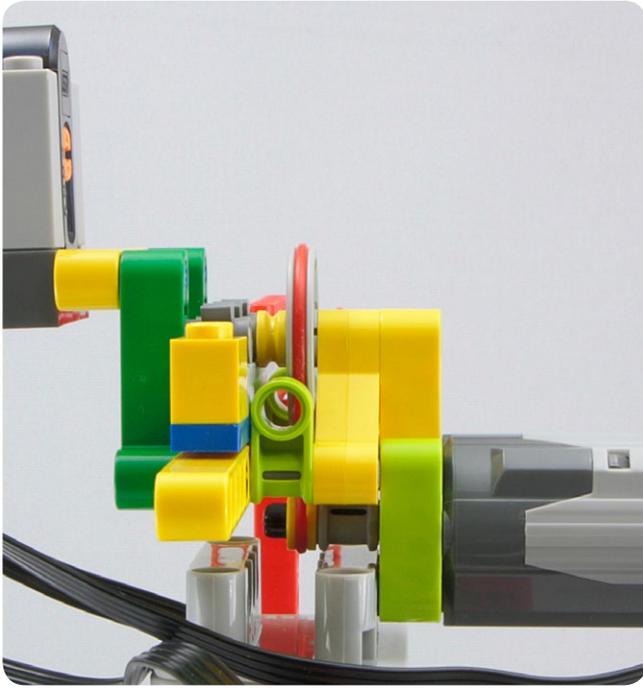


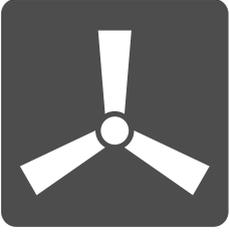










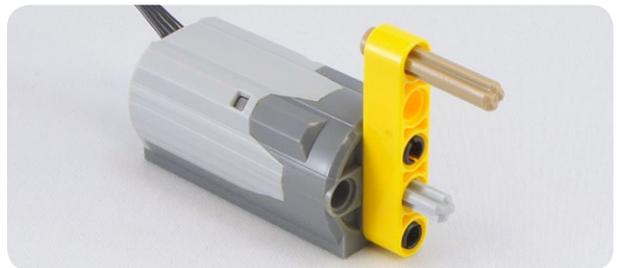
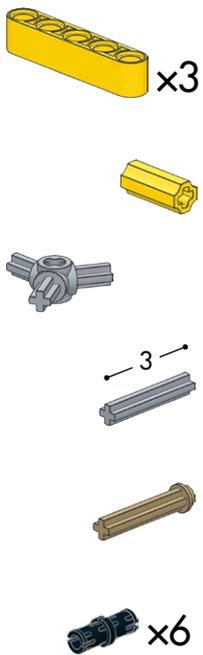


Caution!
These models spin.
Protect your eyes.

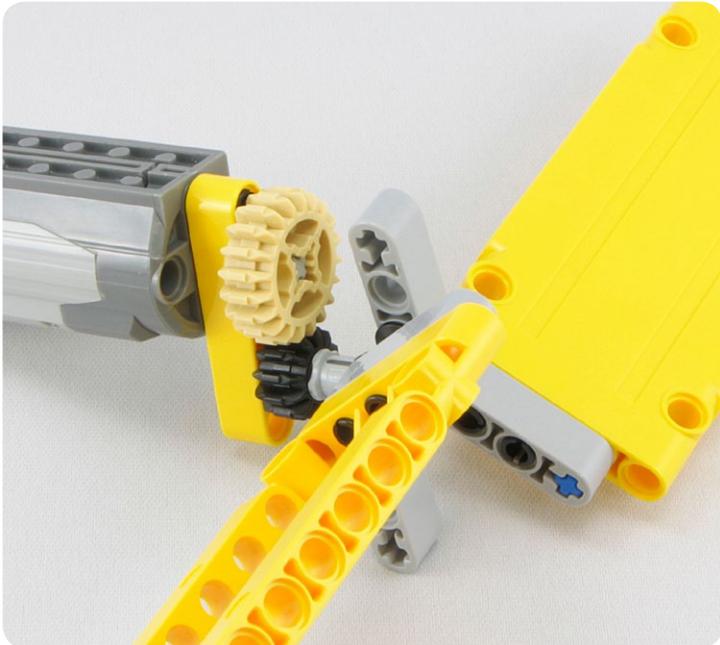
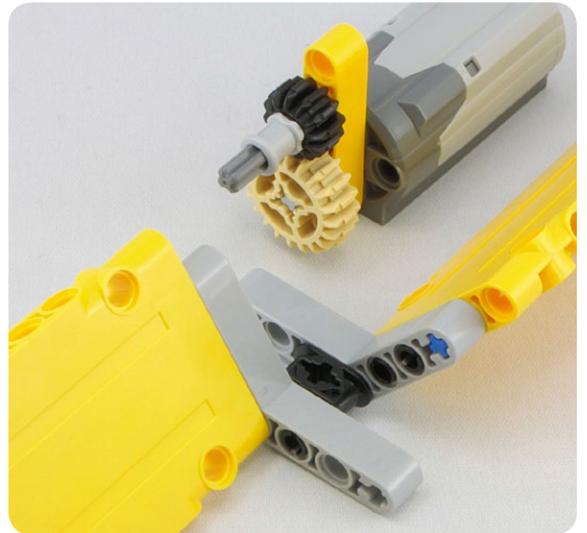
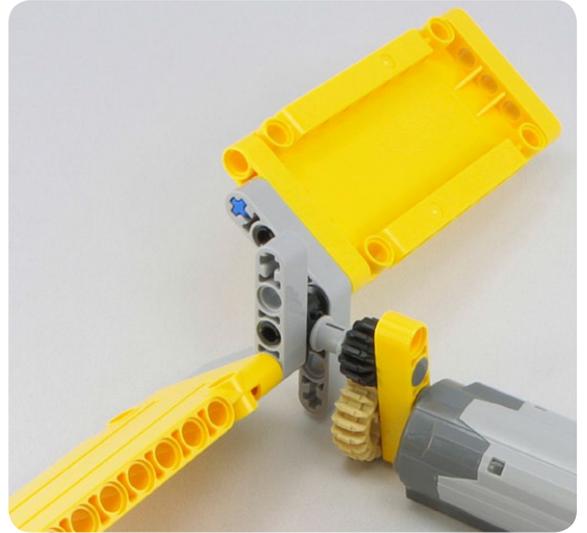
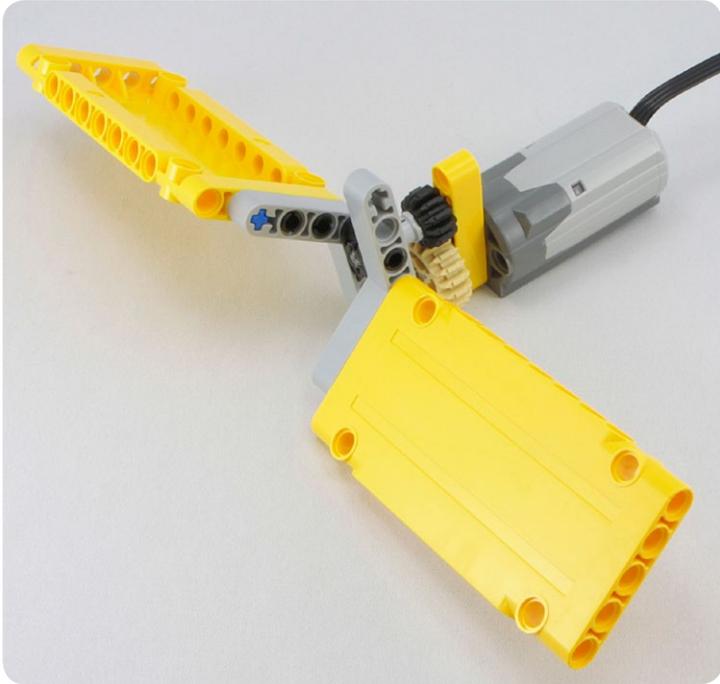
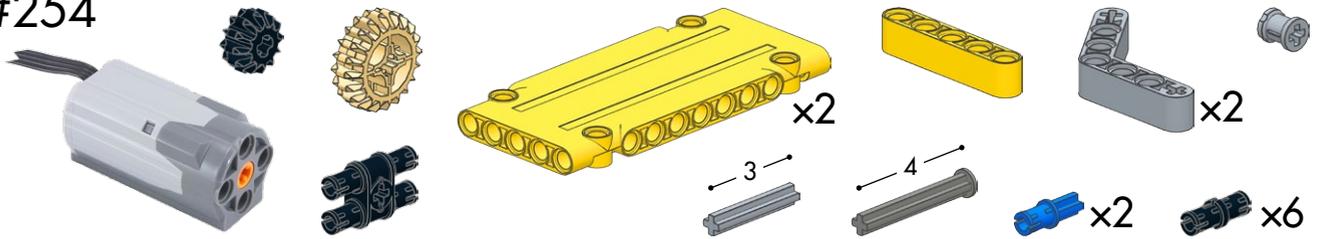


Spinning fans

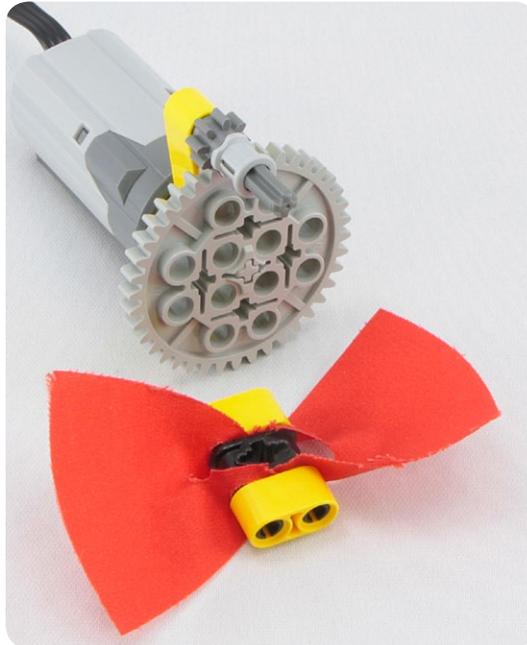
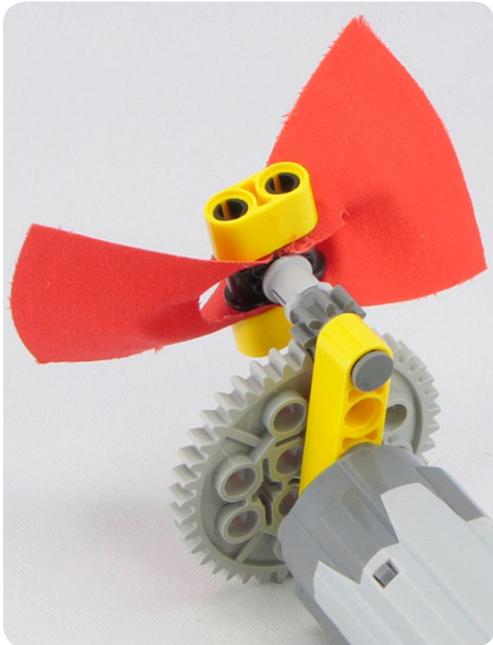
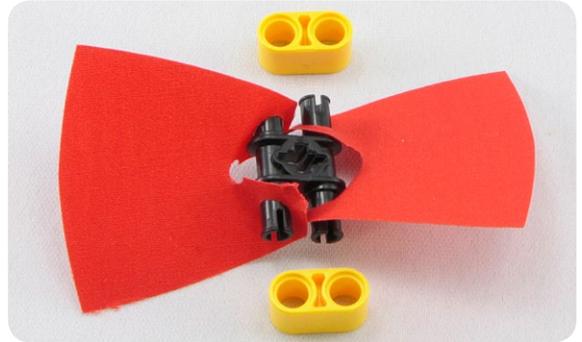
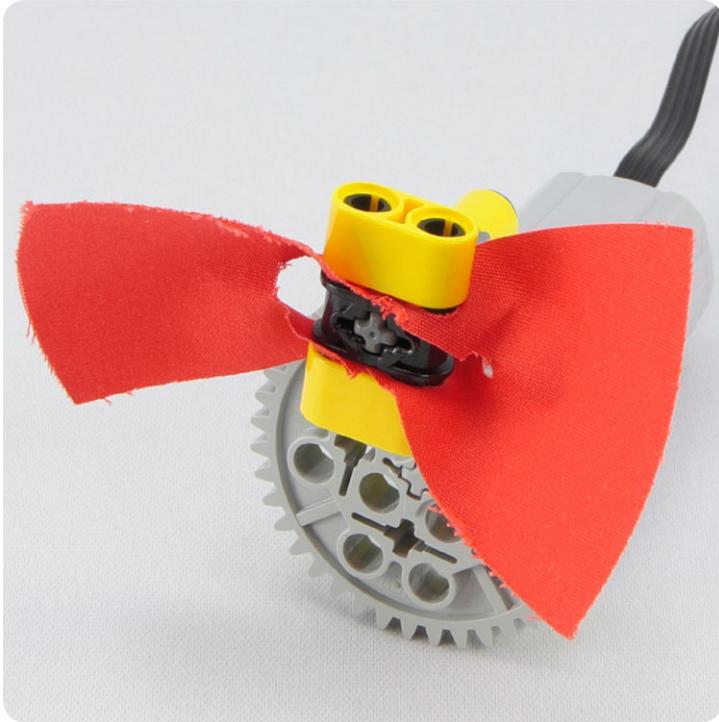
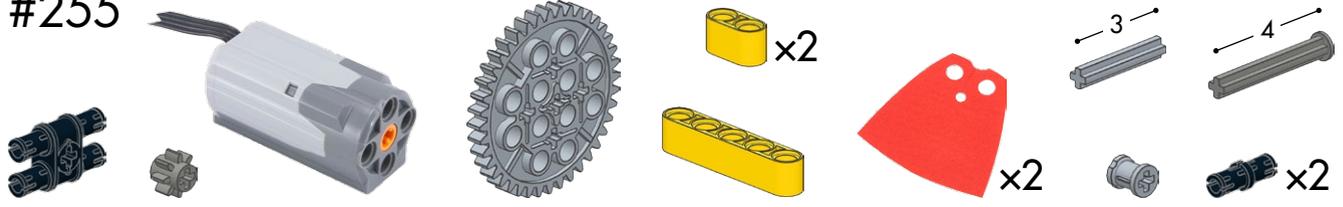
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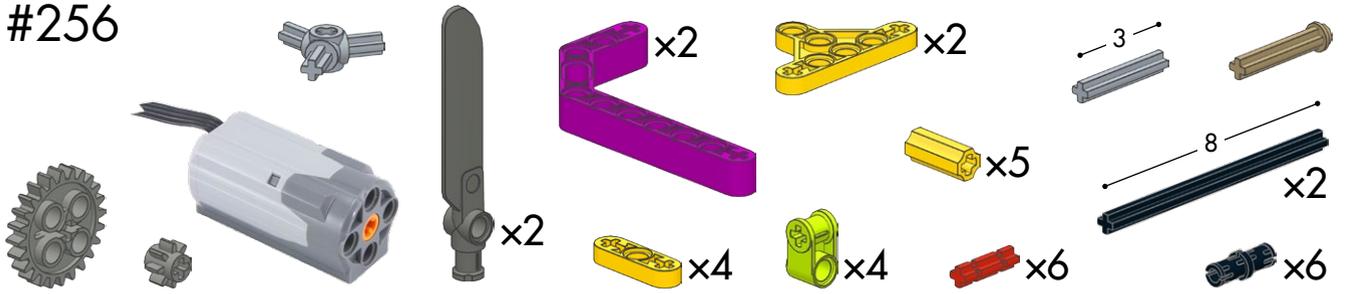
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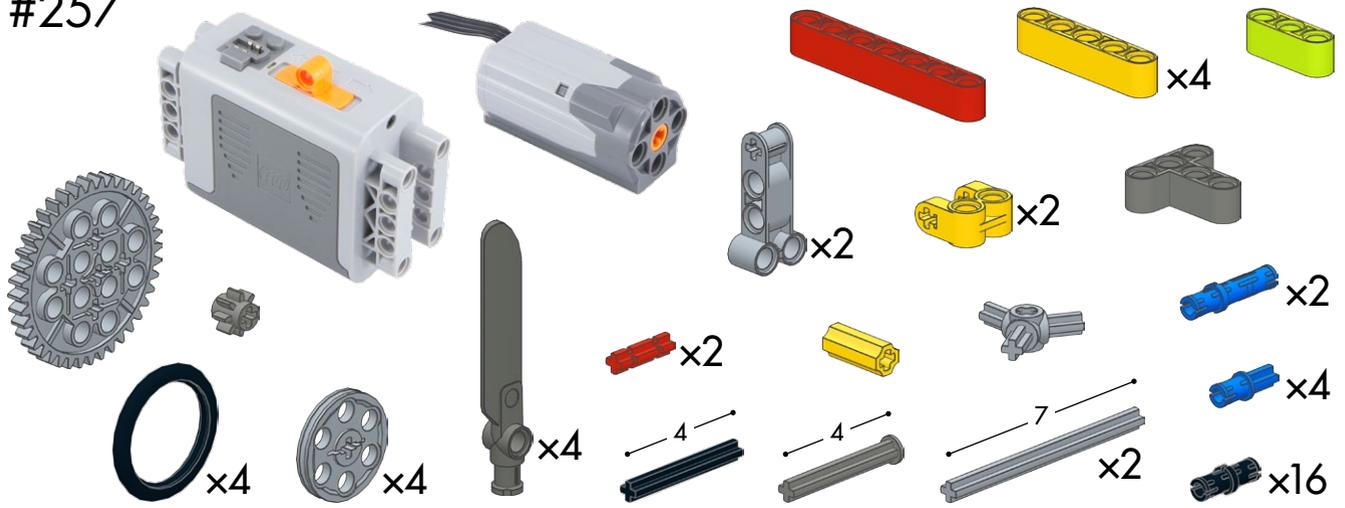
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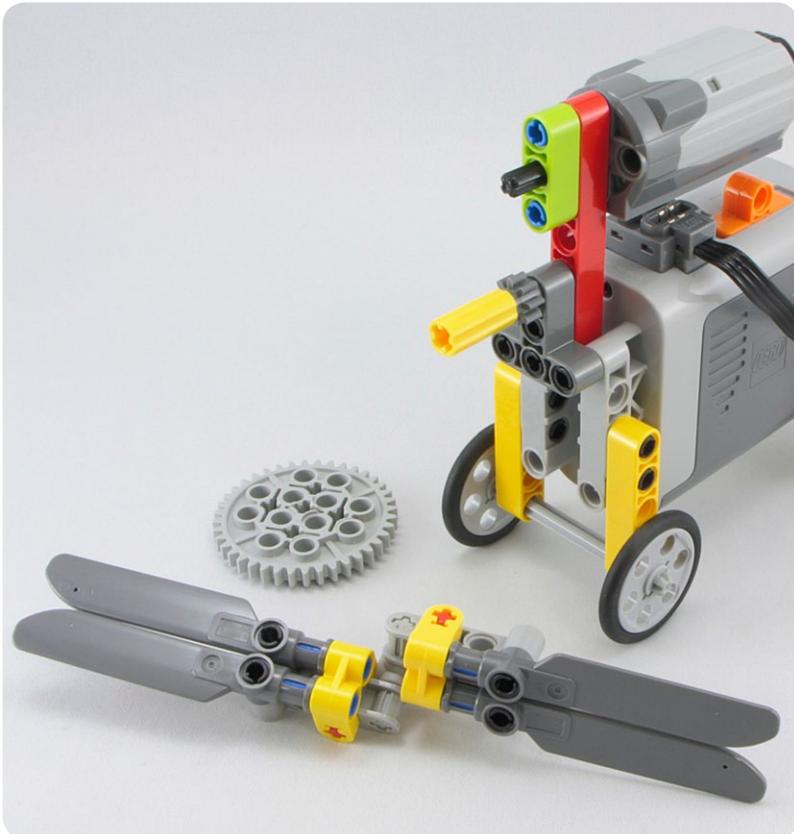
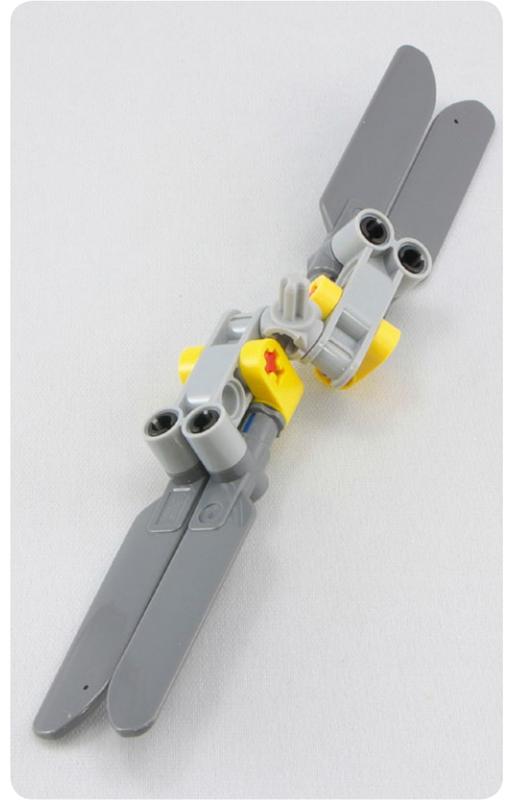


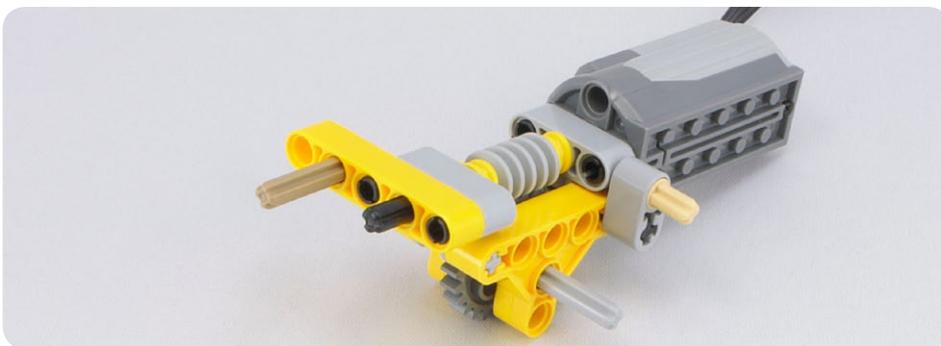
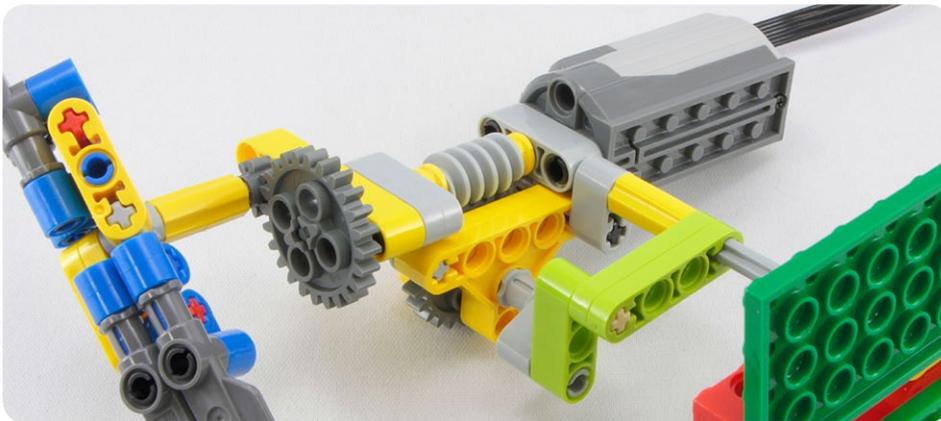
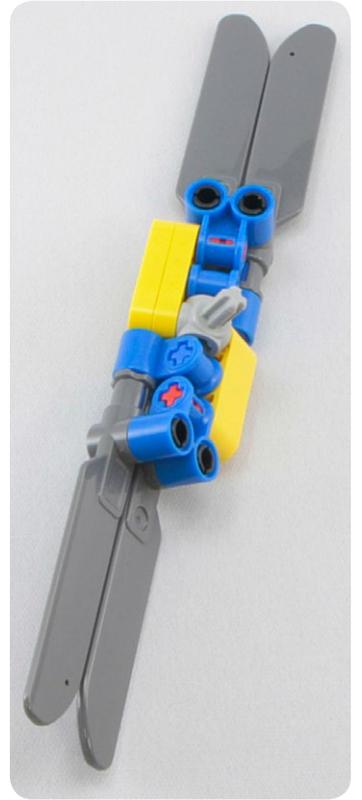
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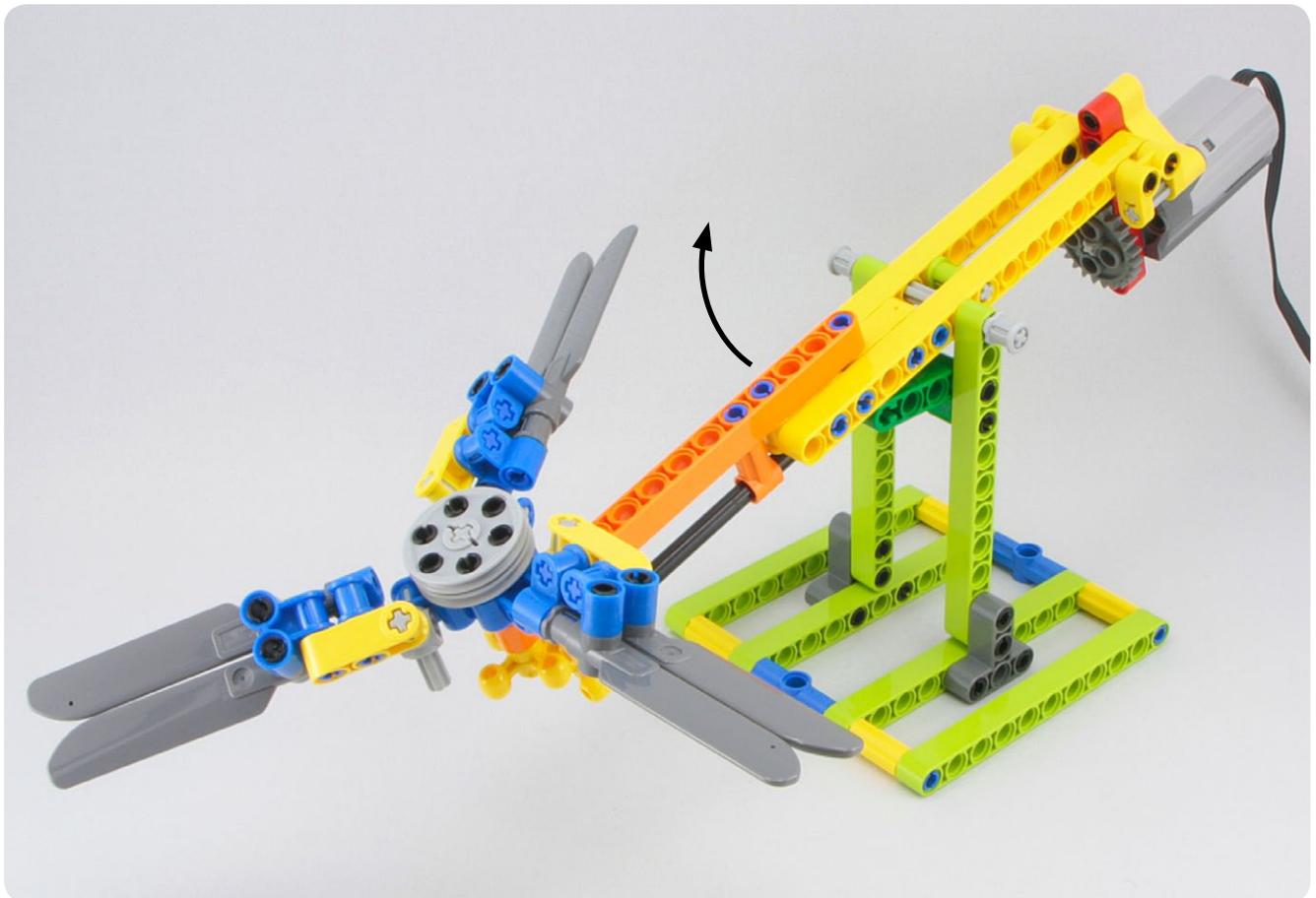
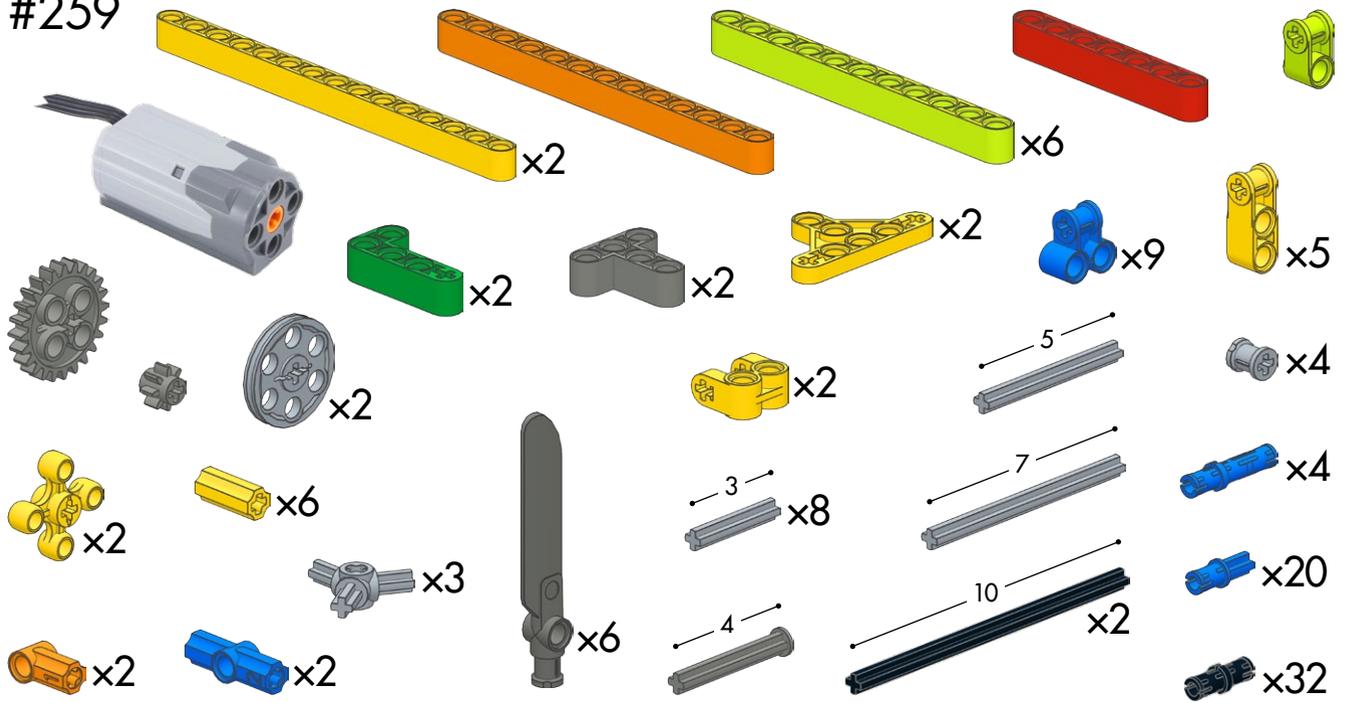
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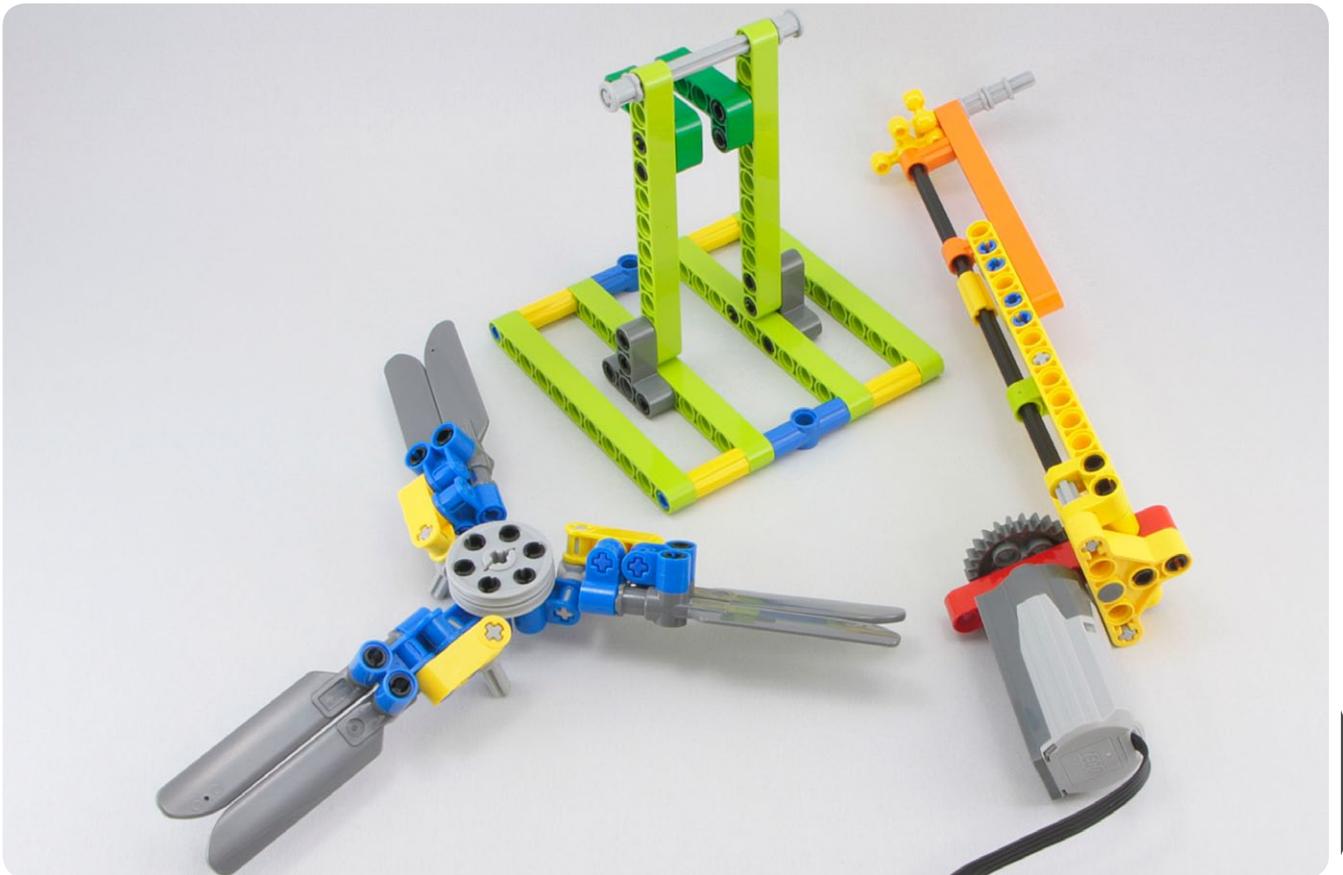


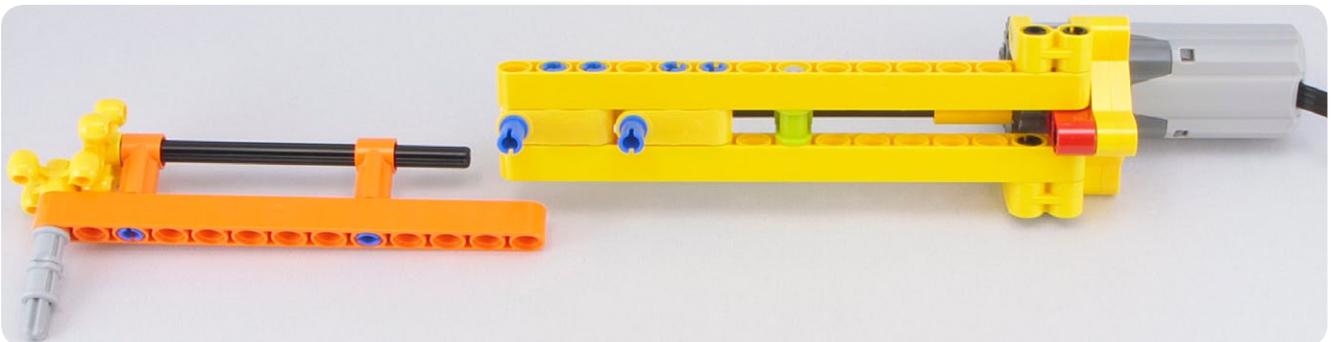
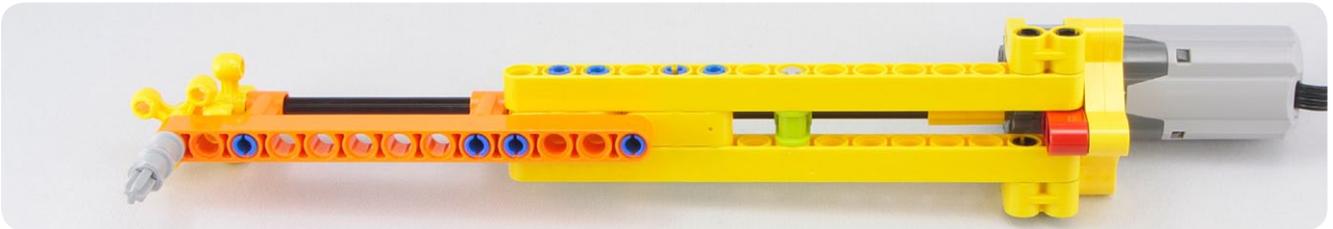
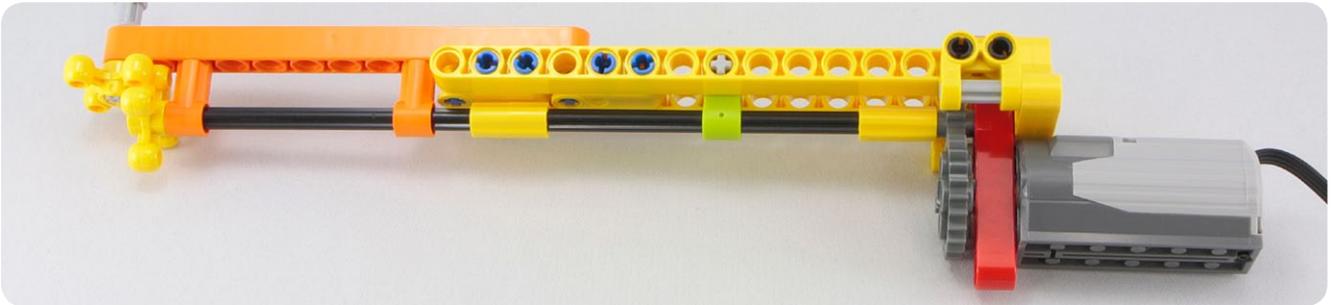
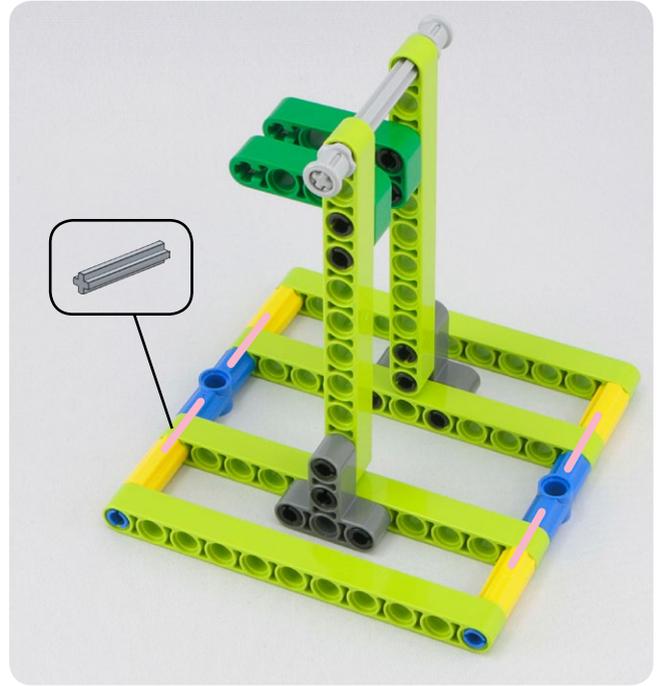
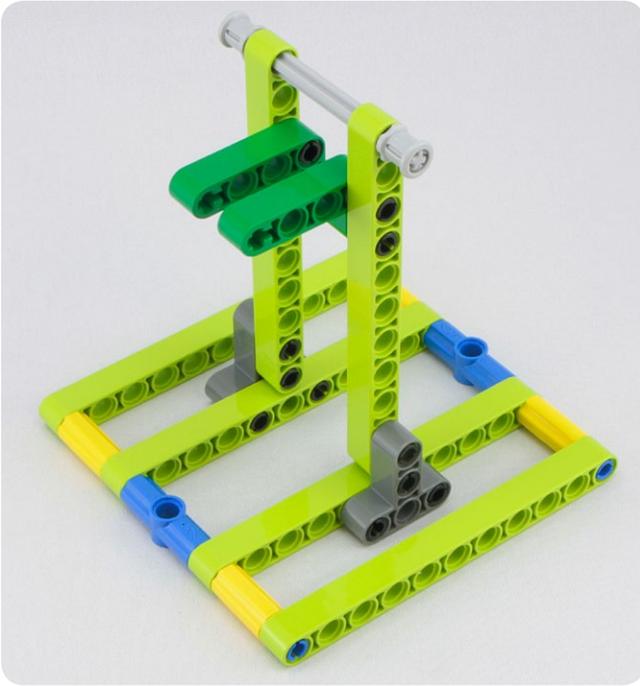


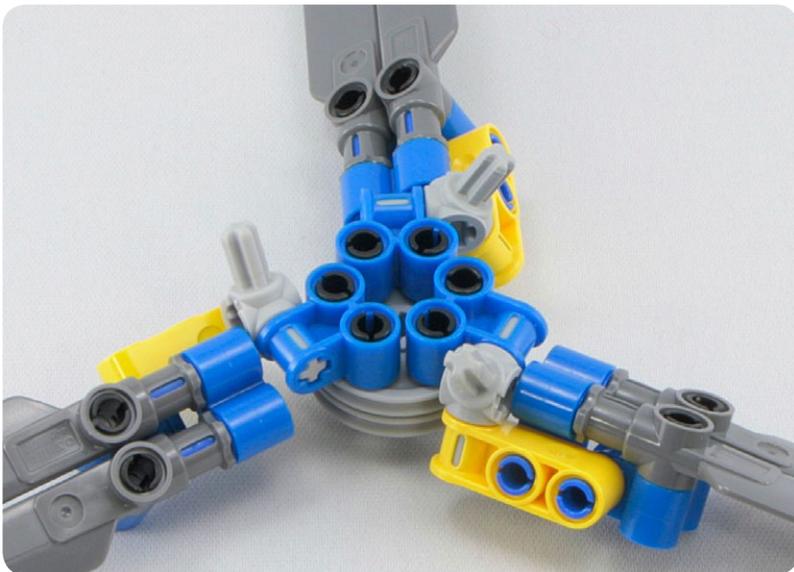
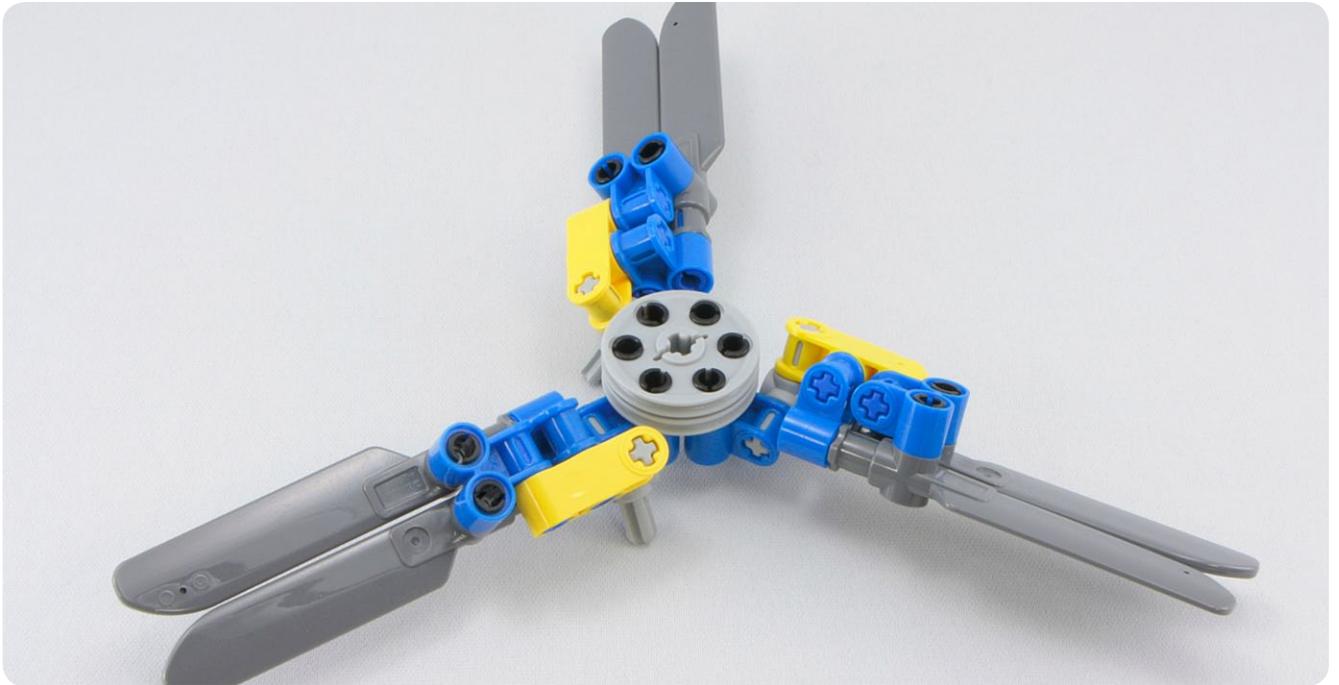


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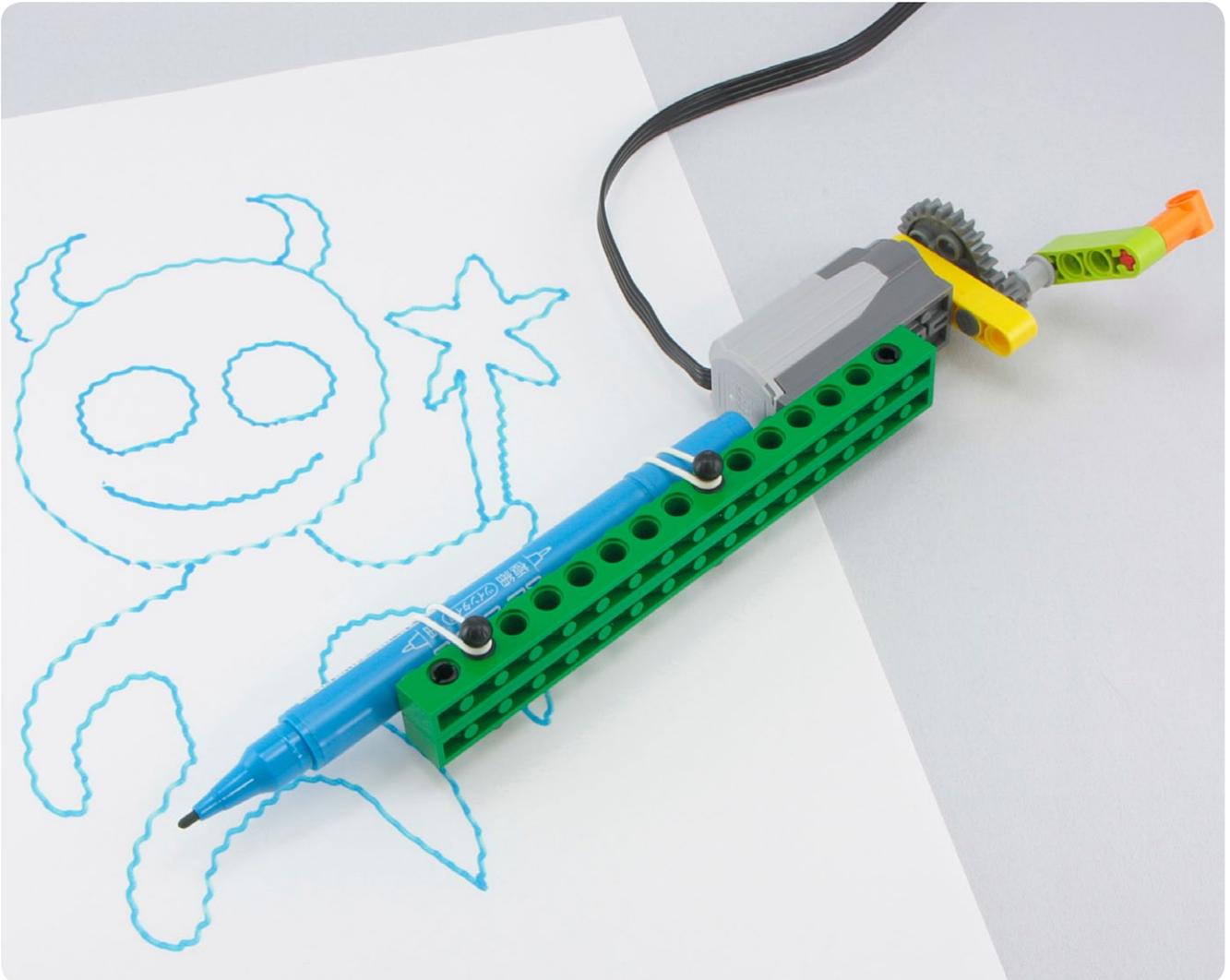
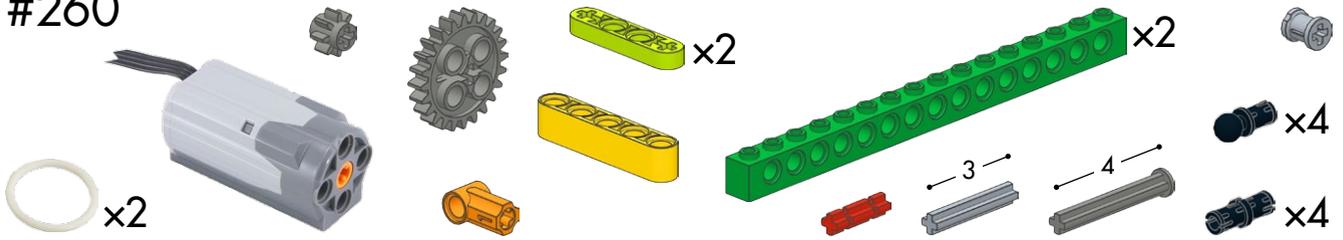


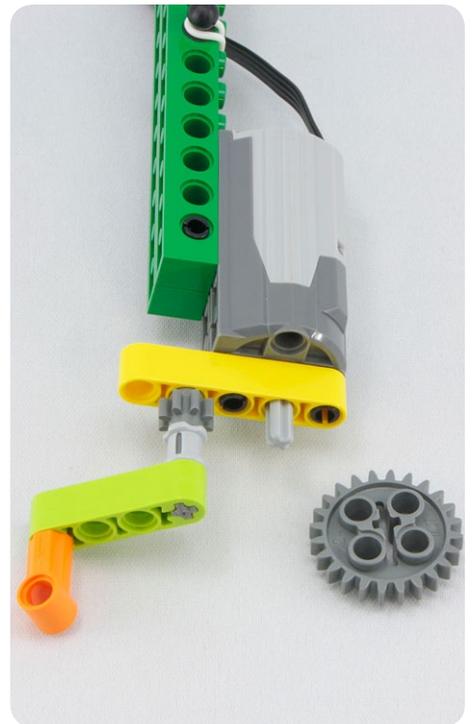
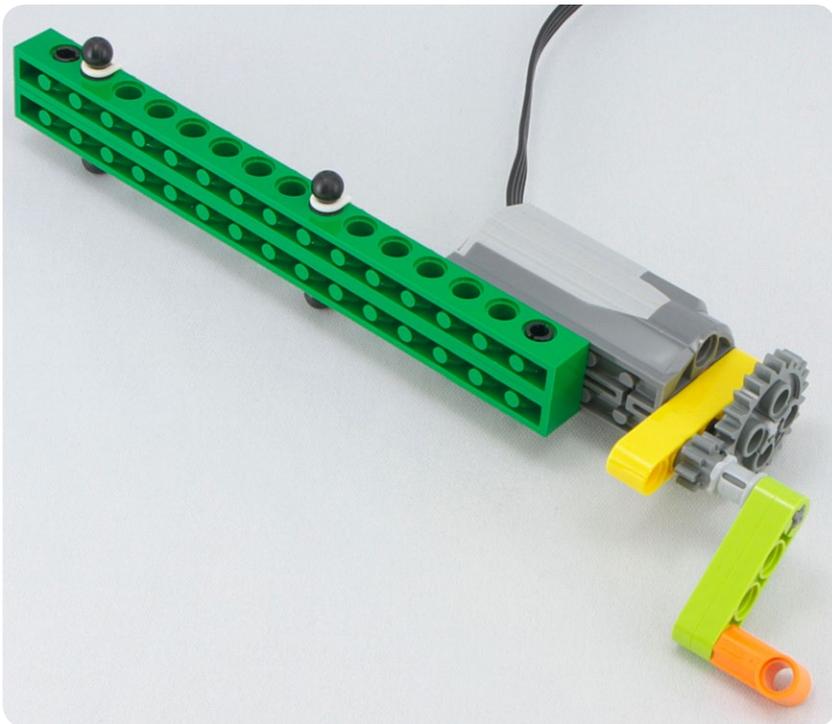
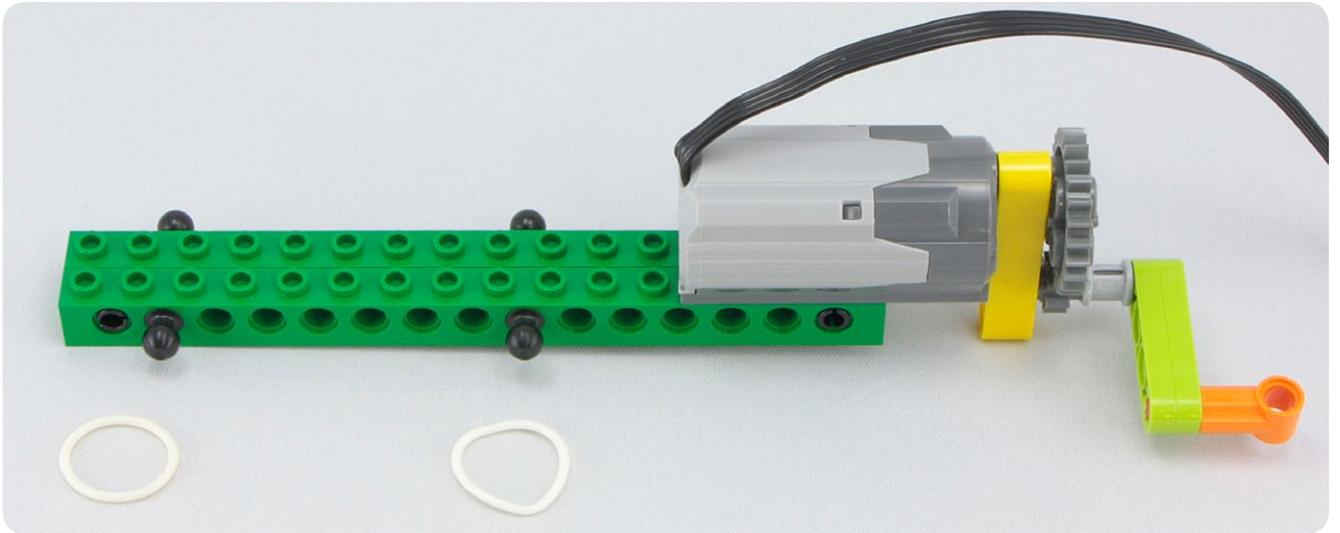
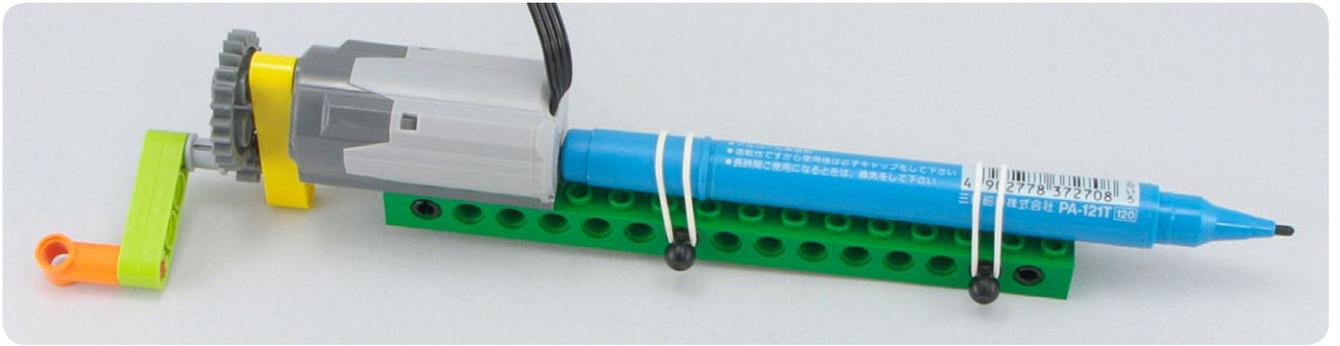


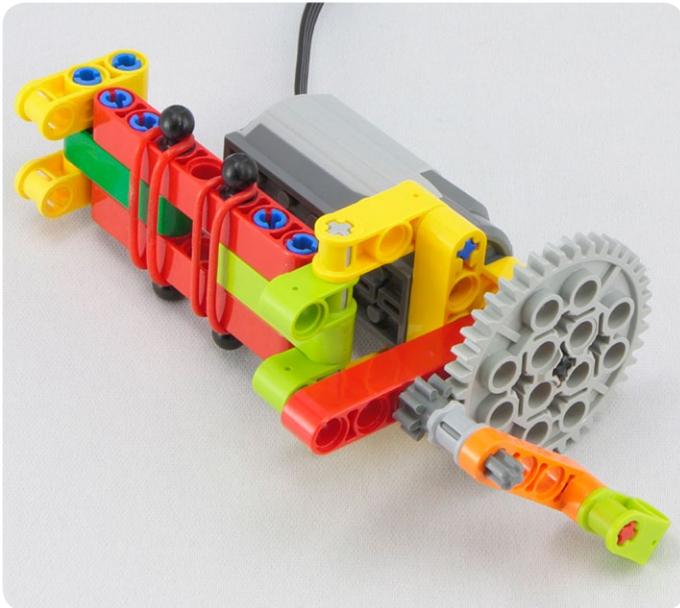
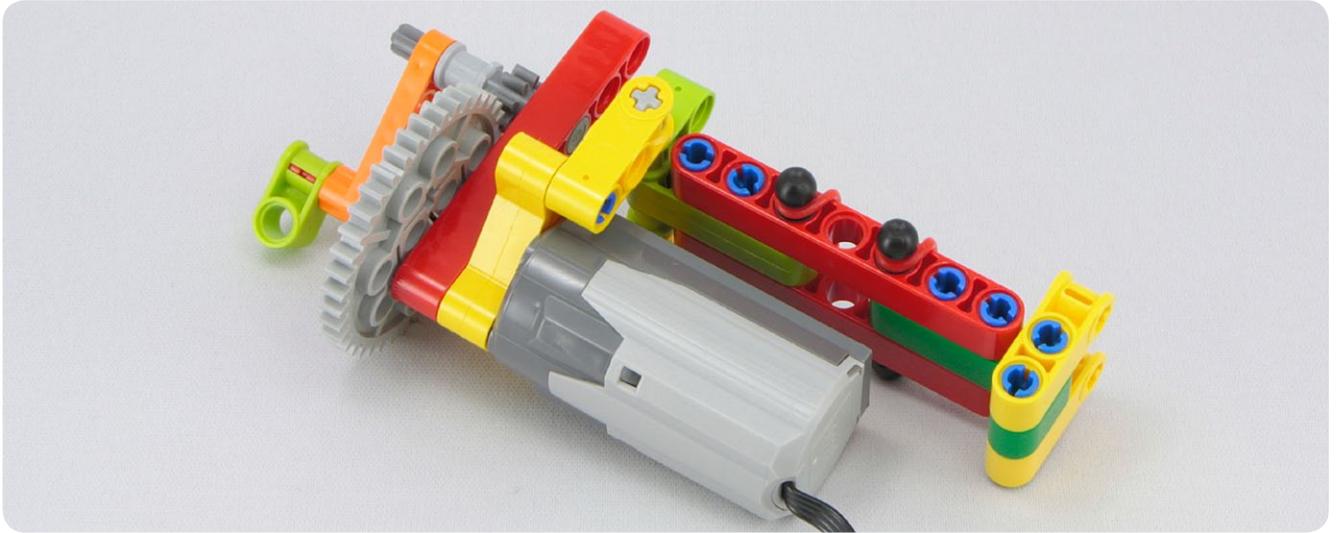
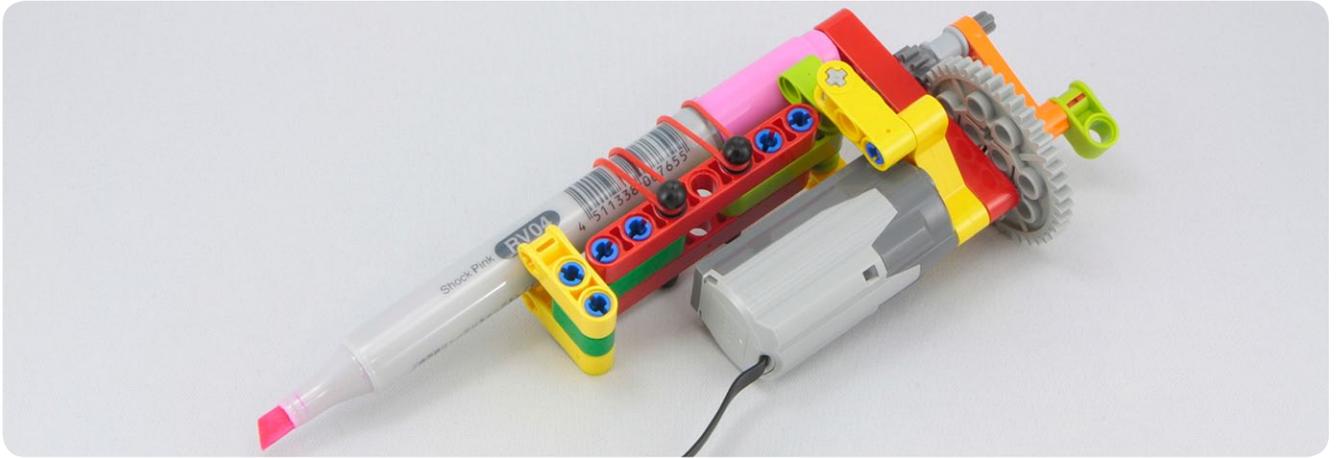


Drawing pictures

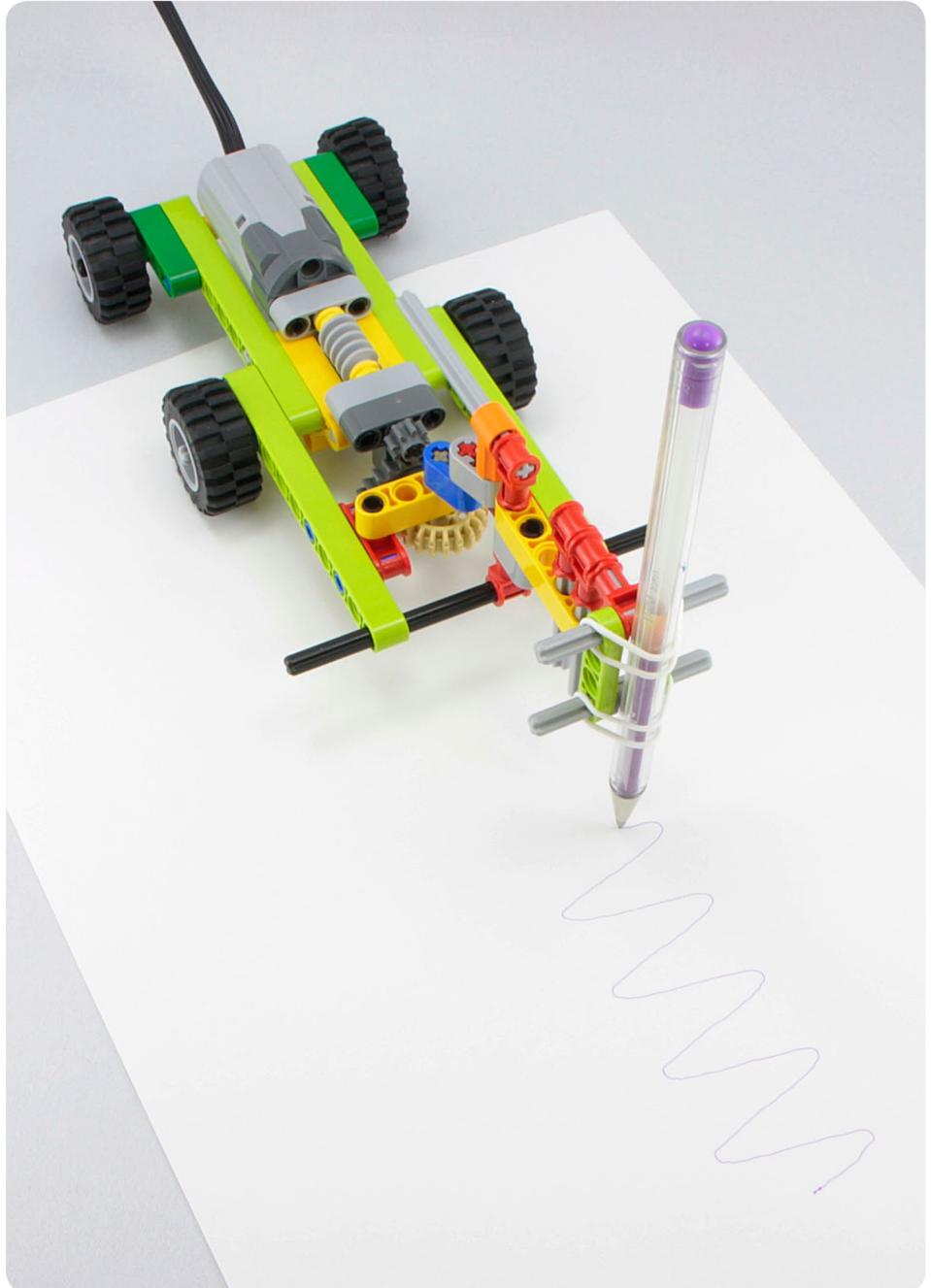
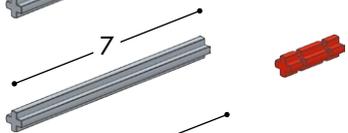
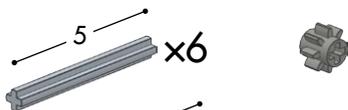
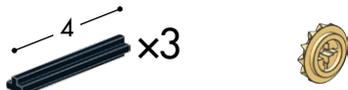
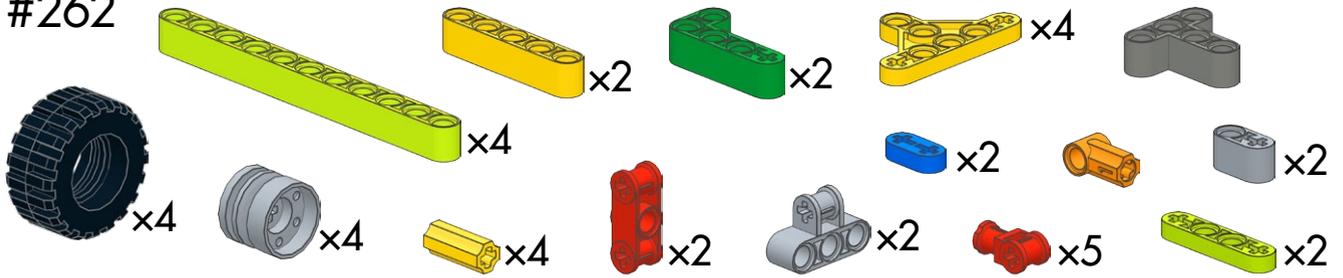
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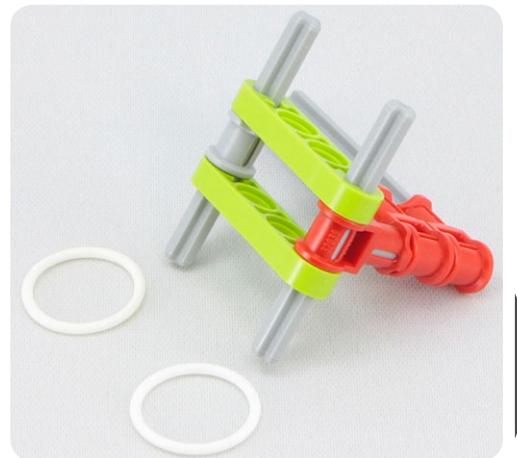


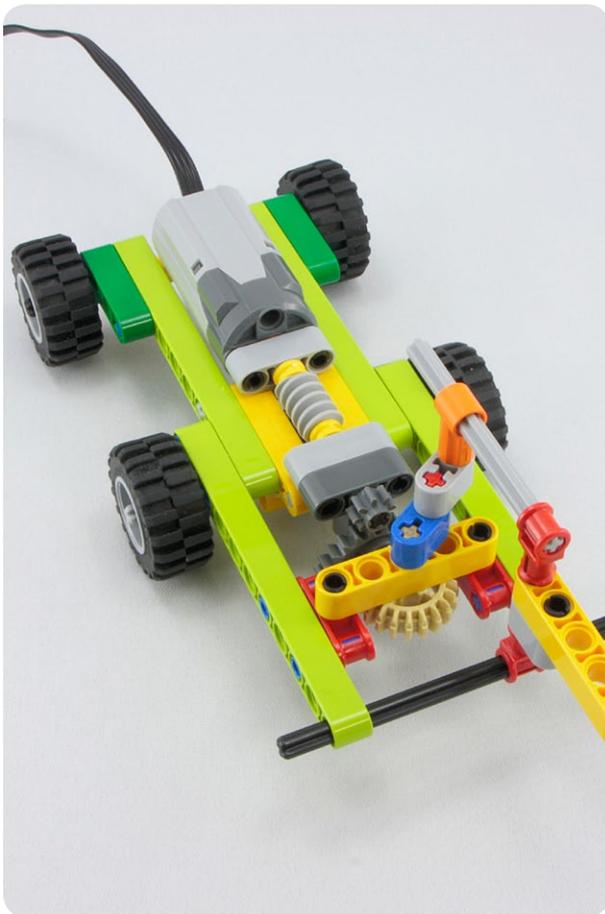
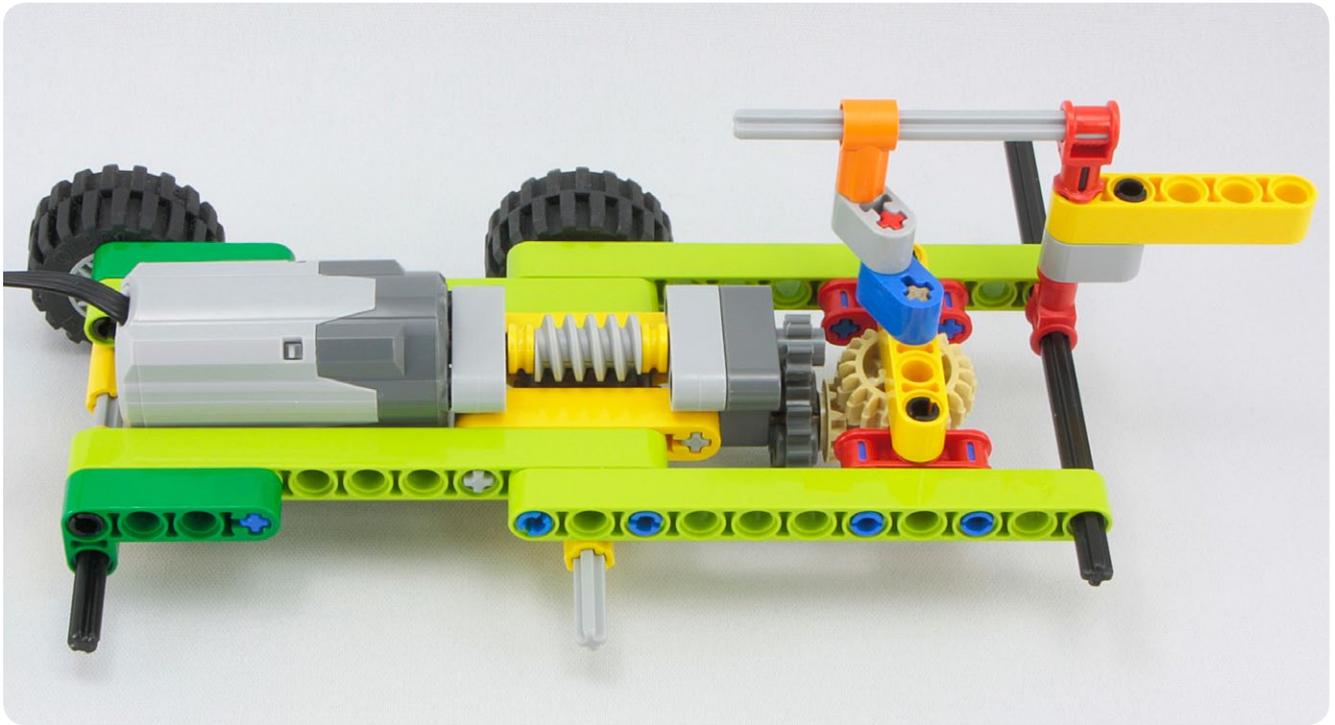


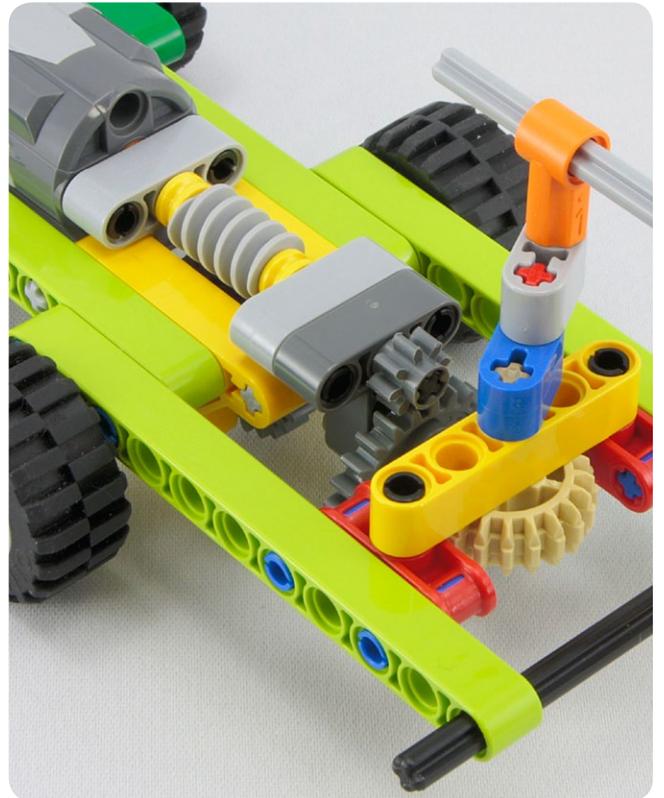


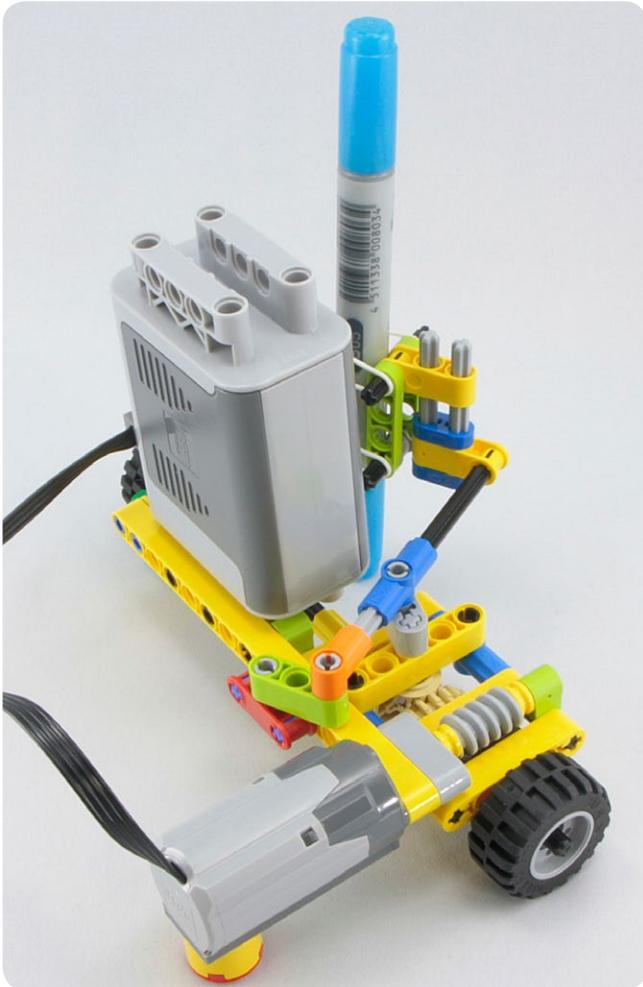
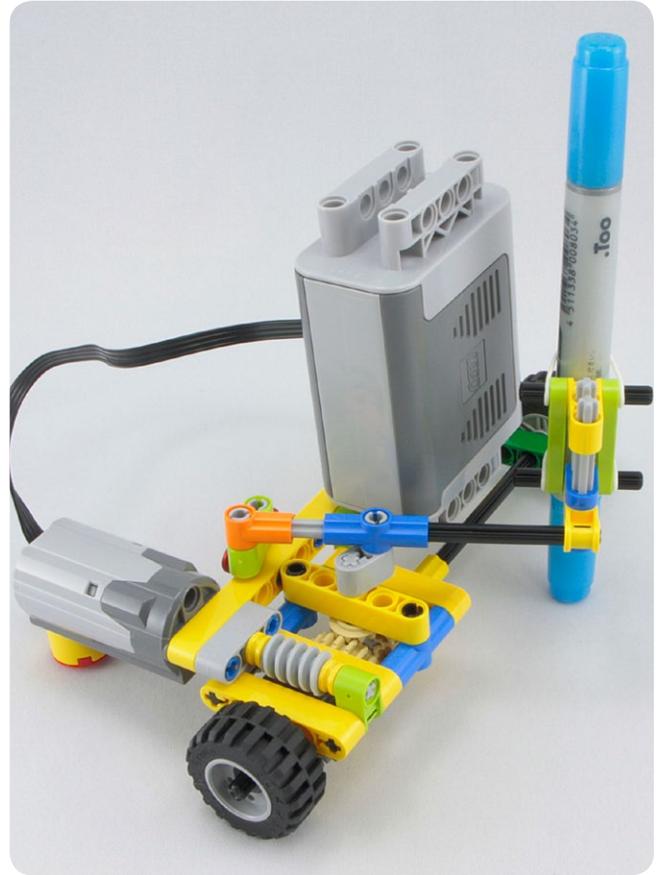
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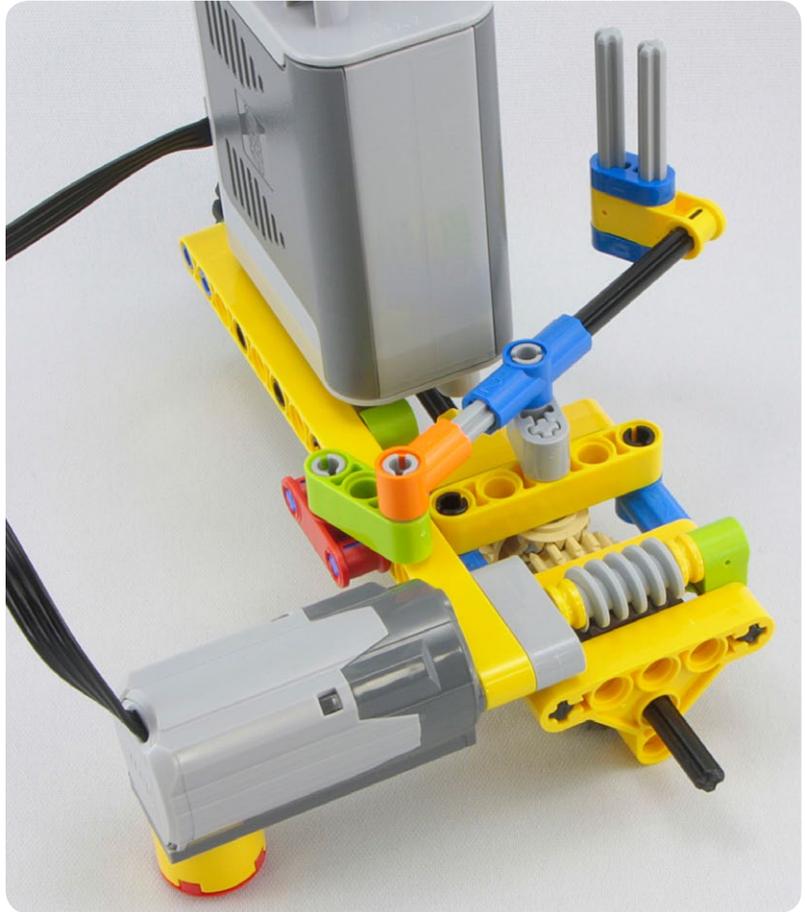


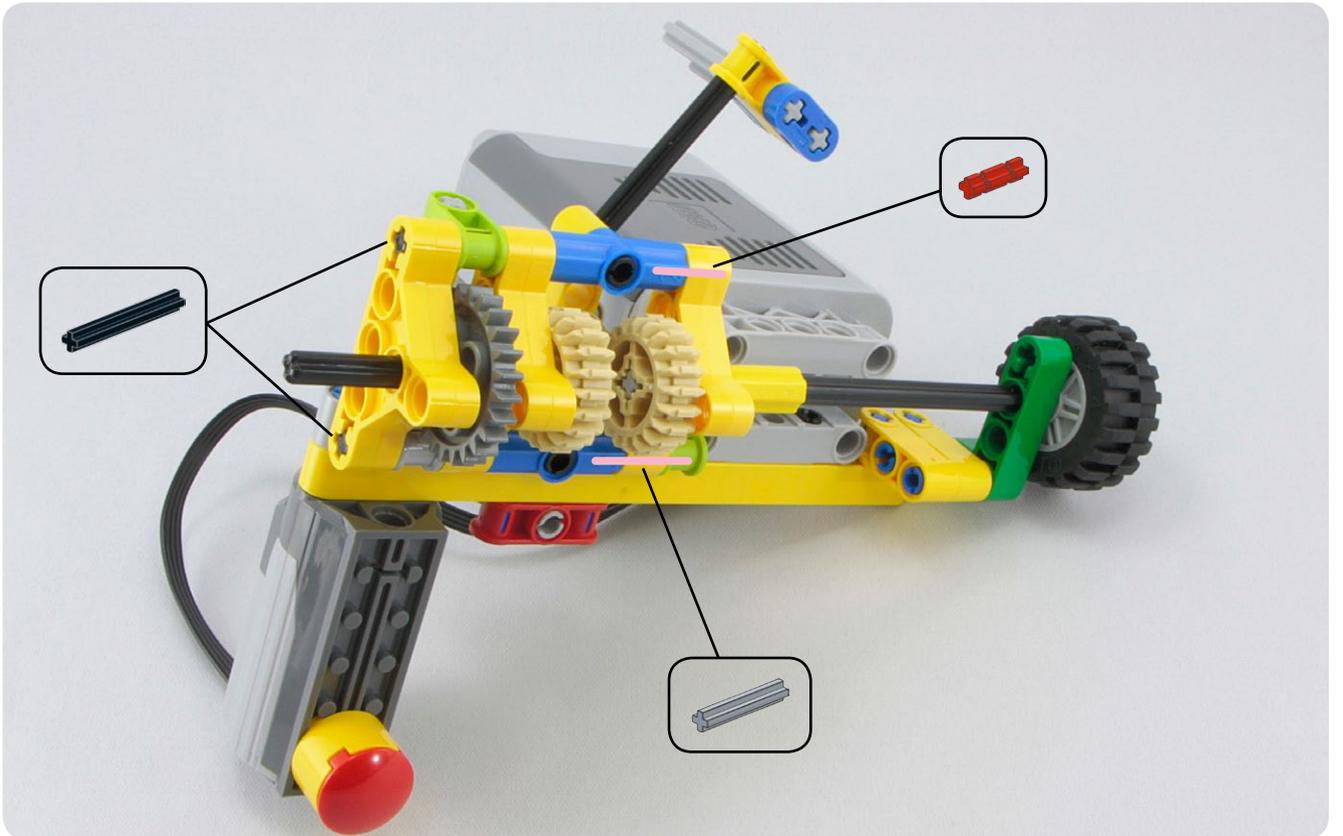
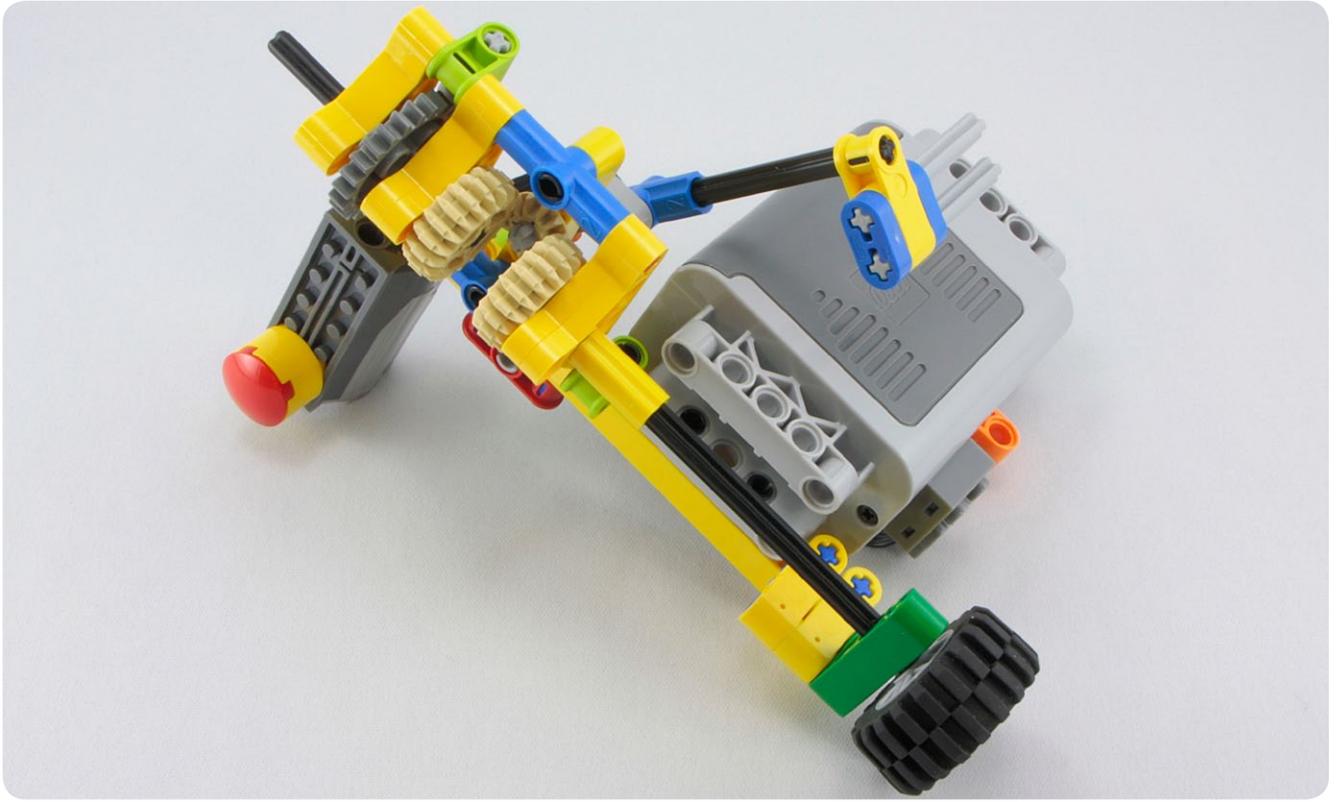


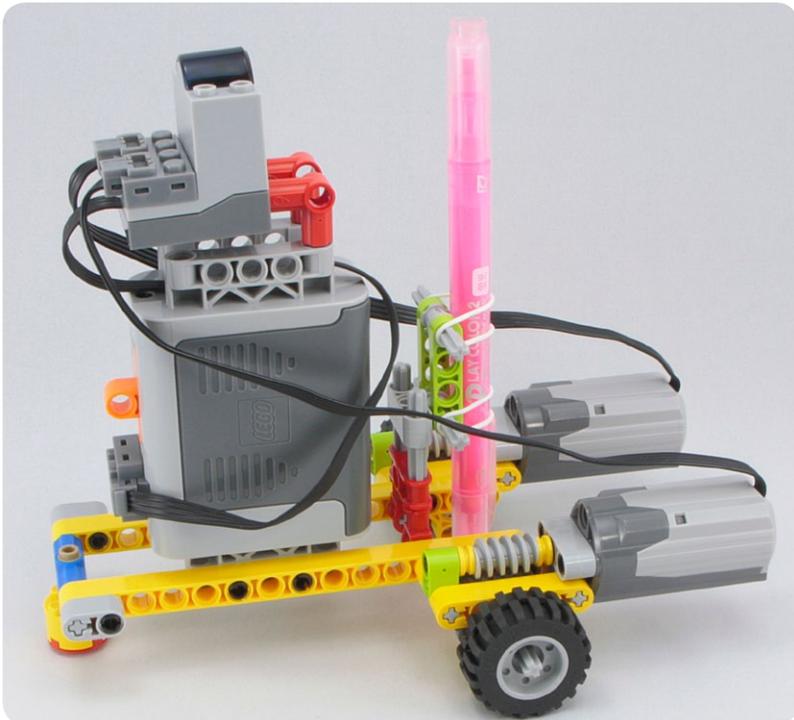


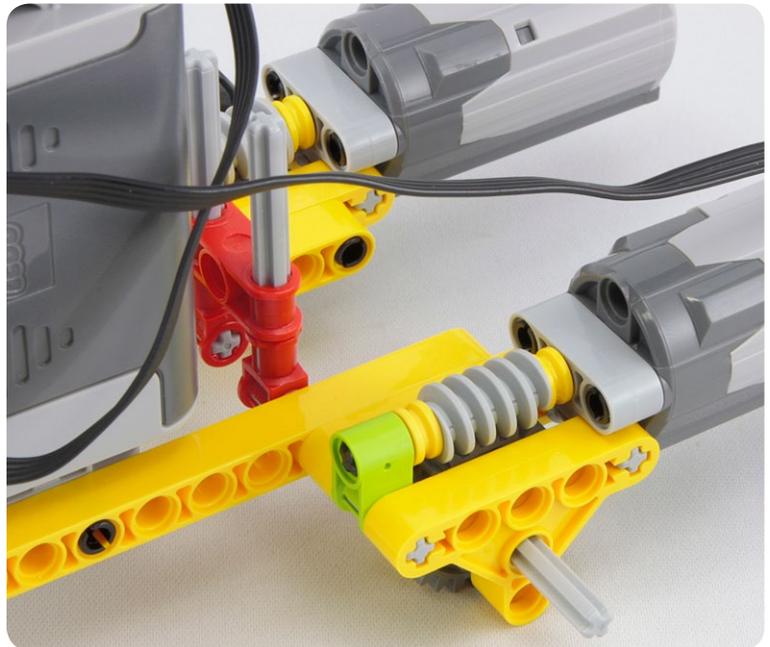
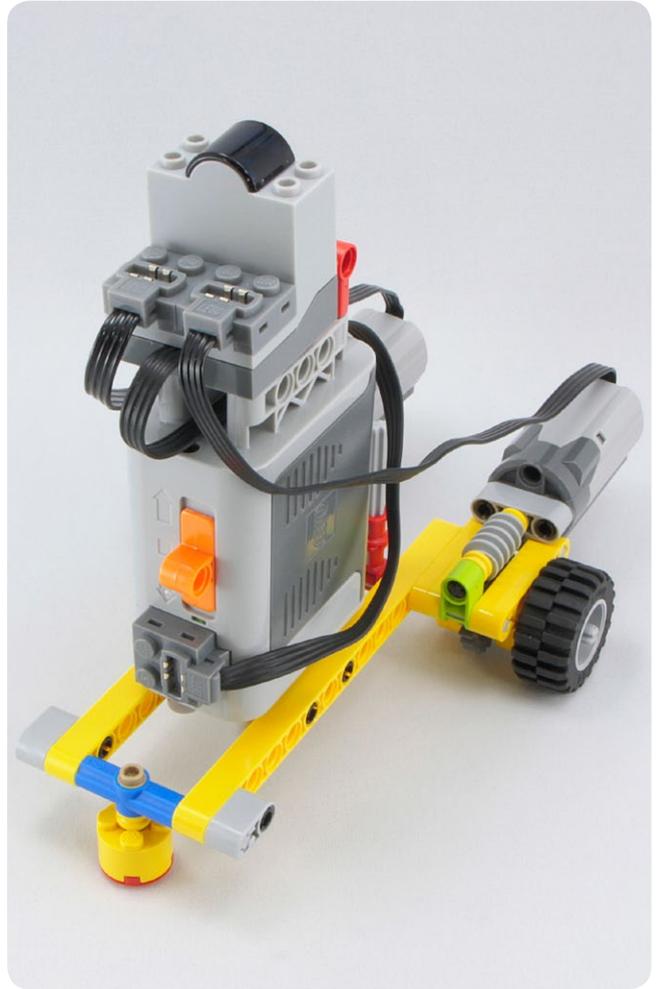


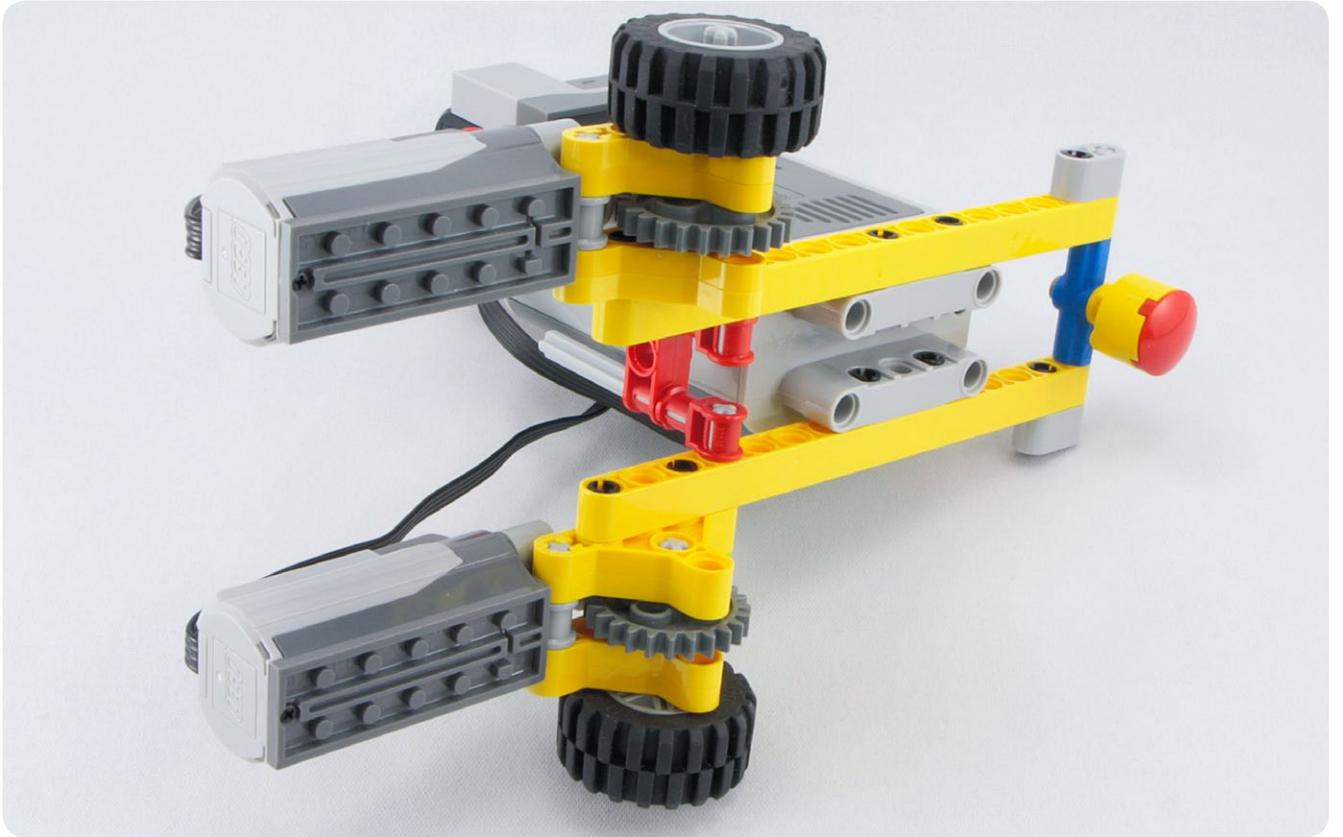


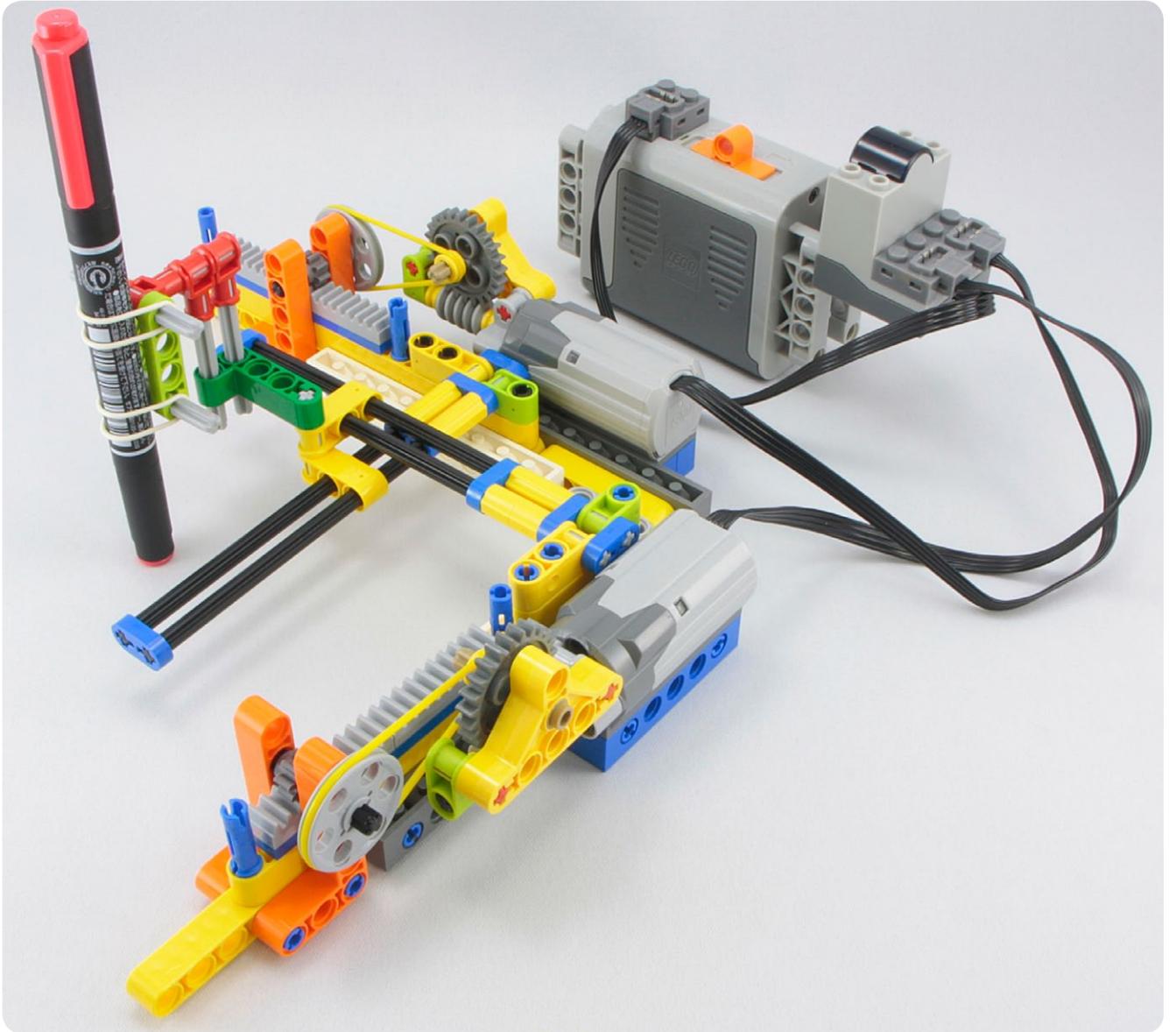


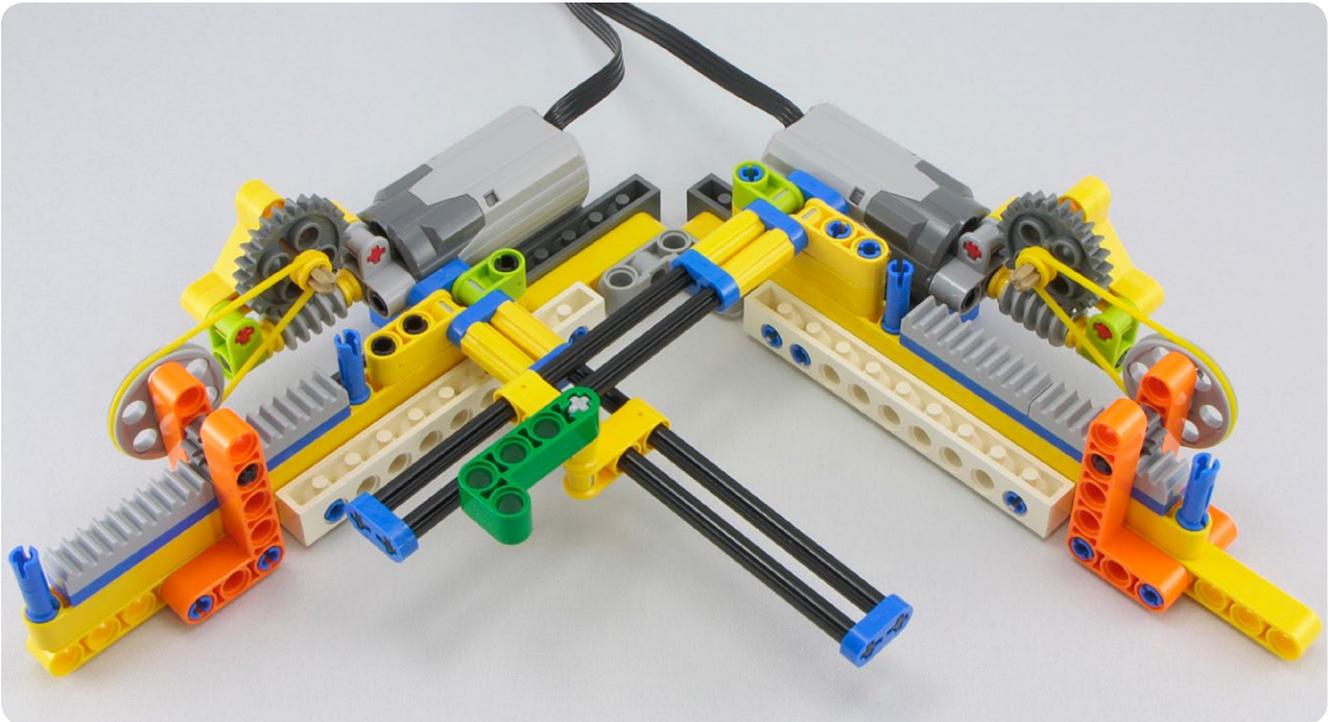
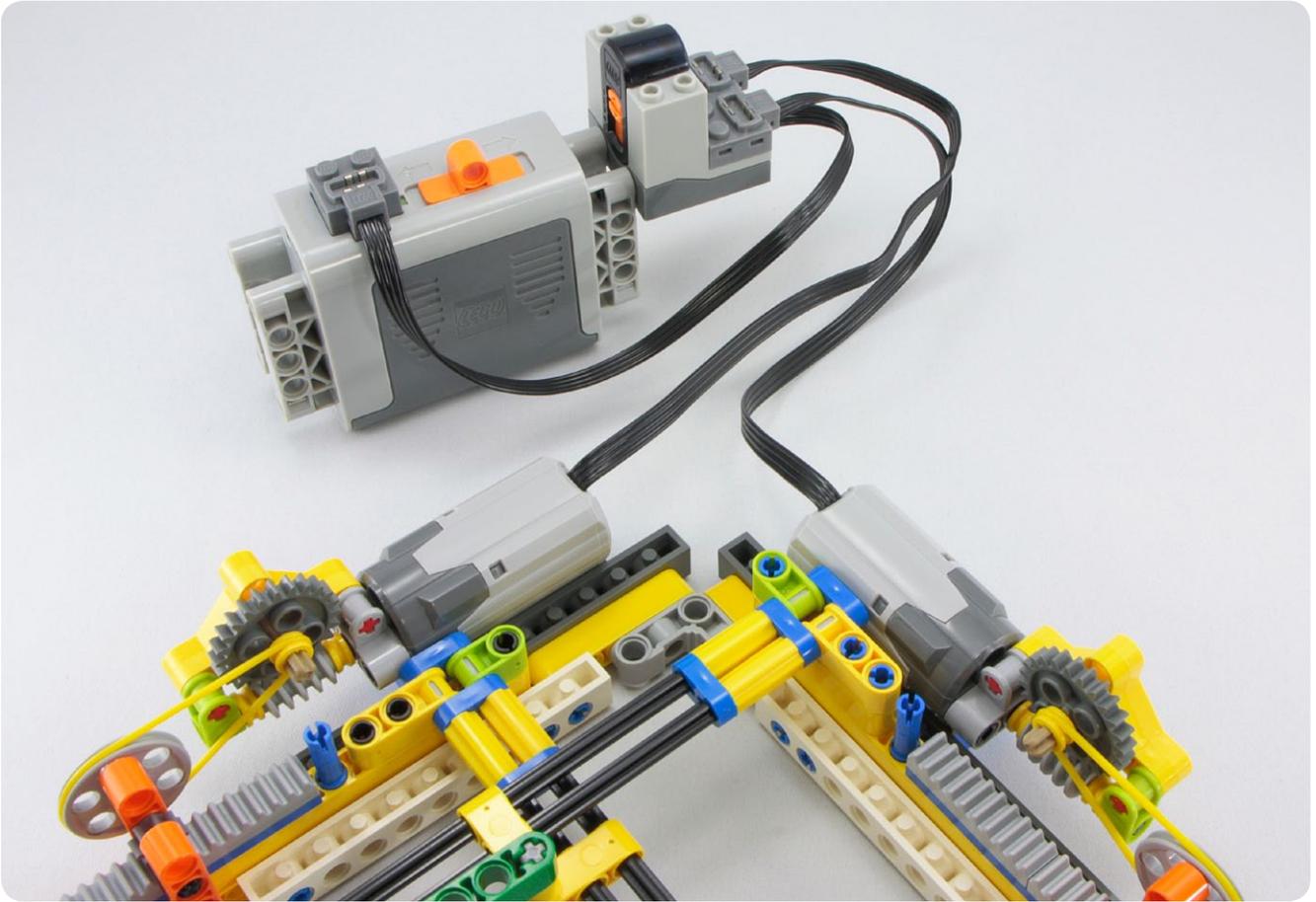


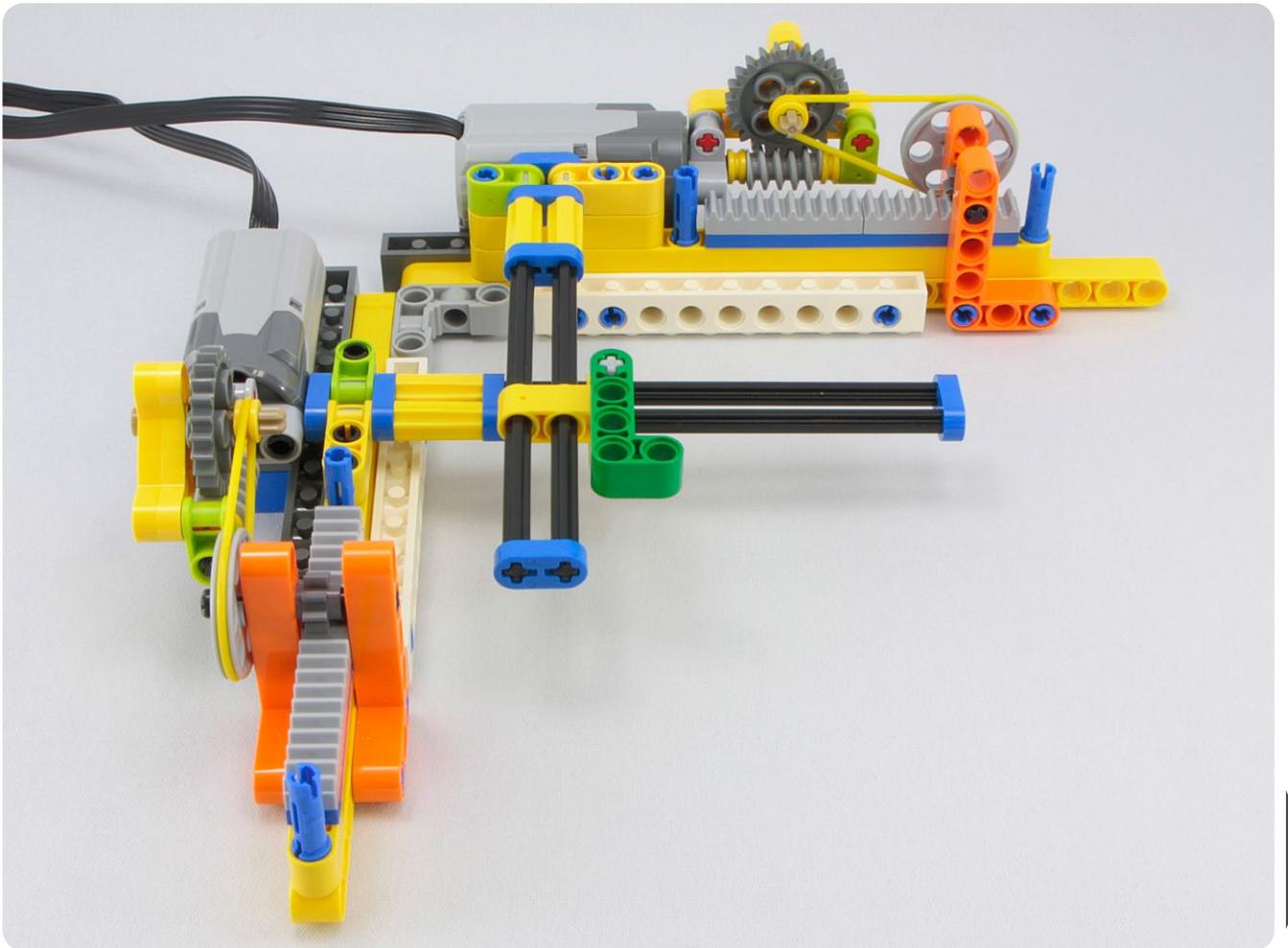
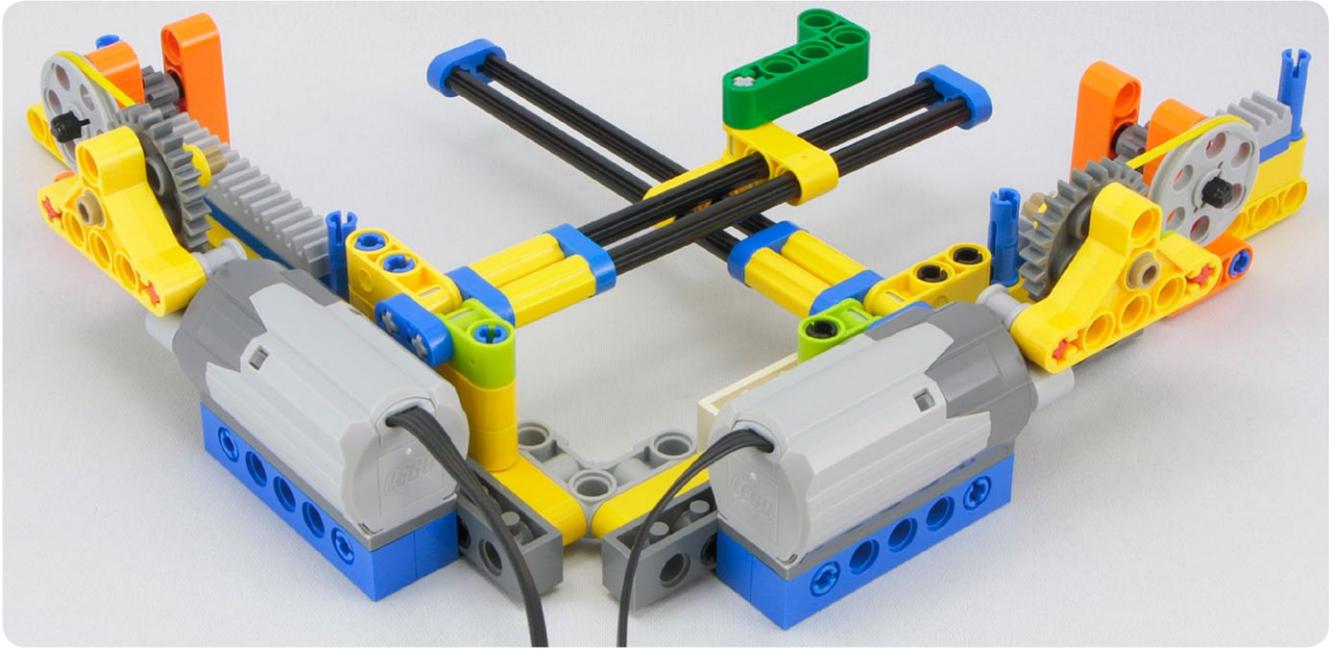


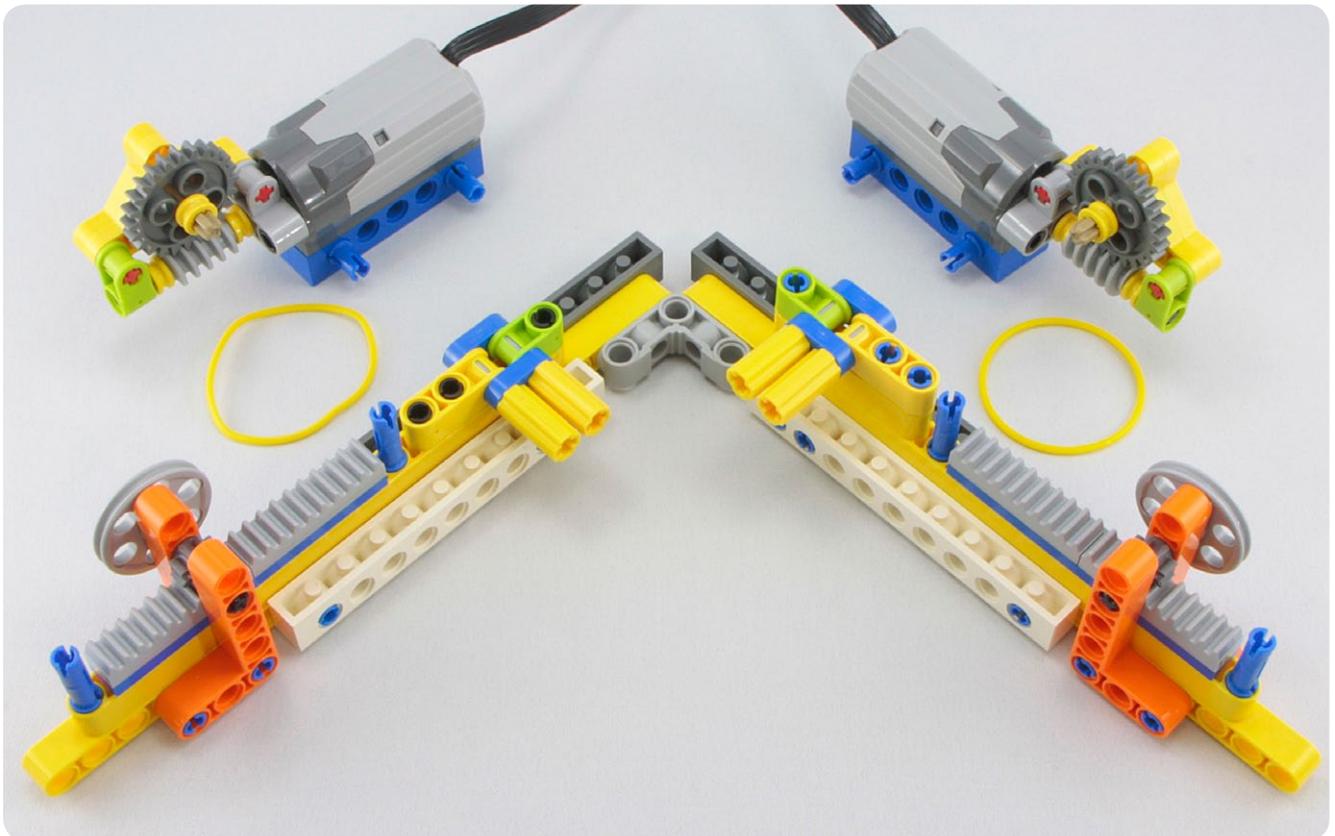
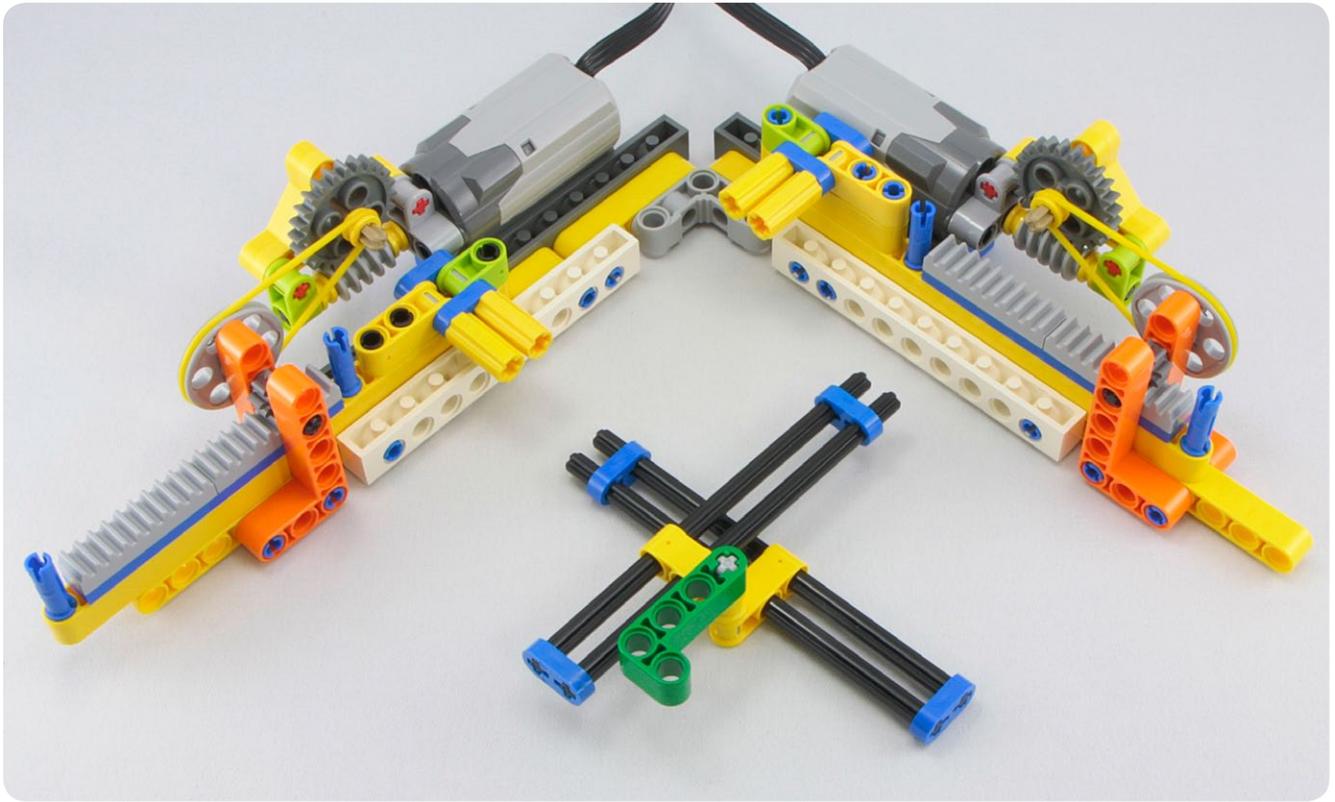


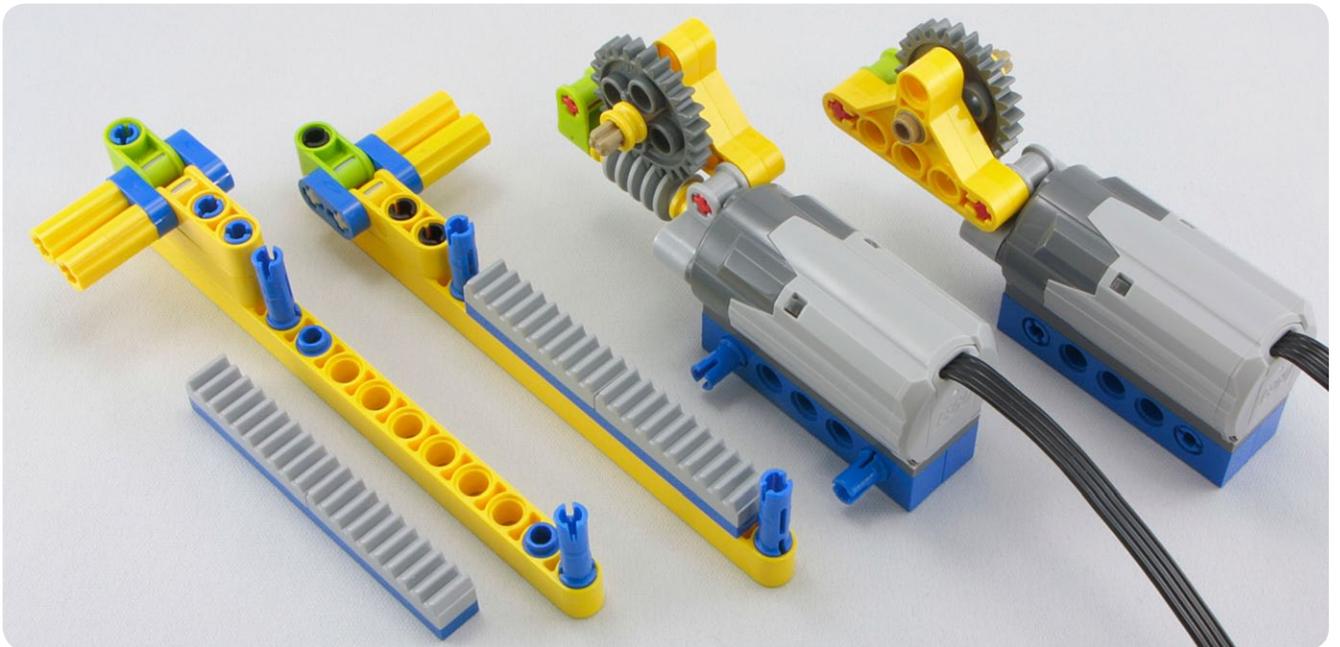
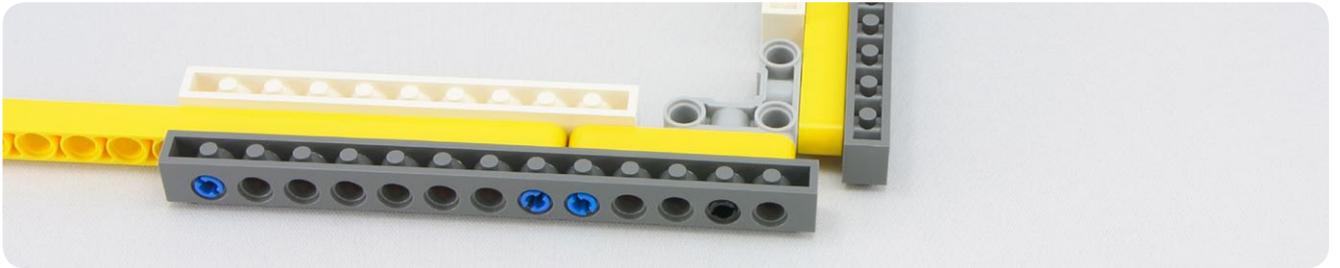
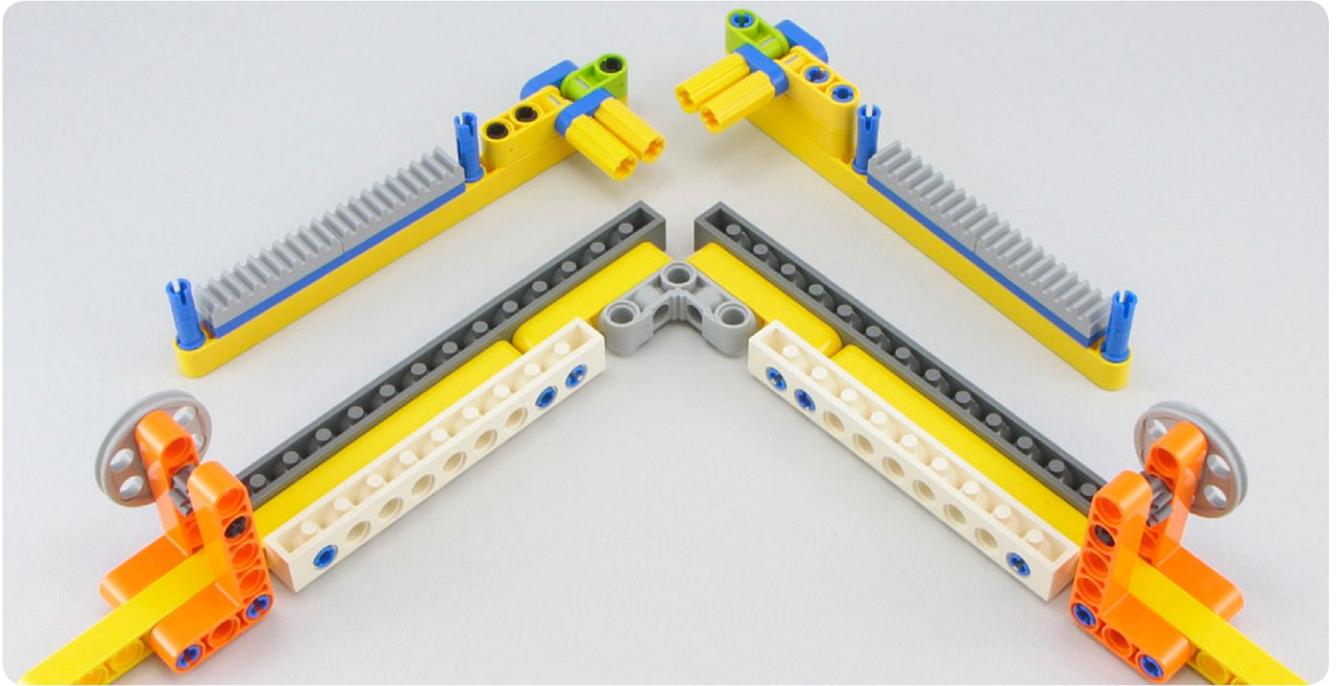


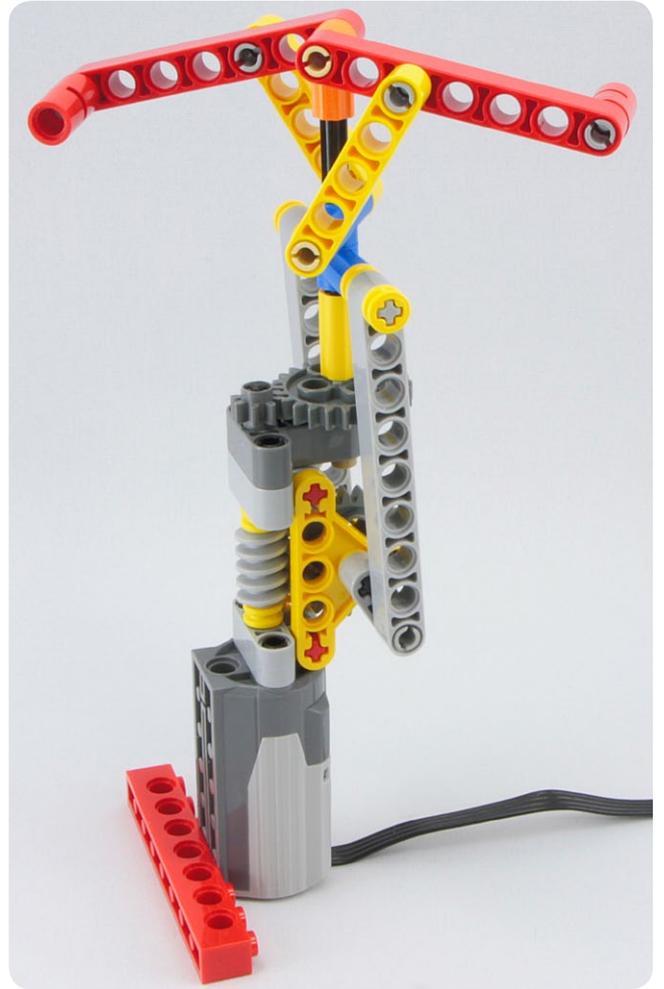


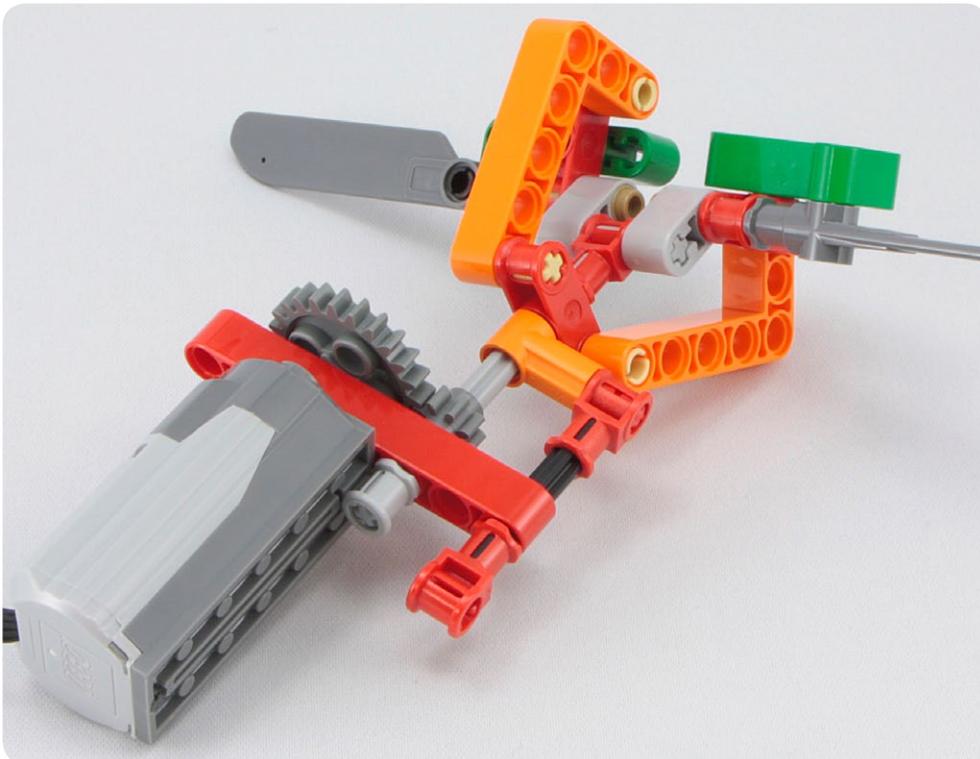
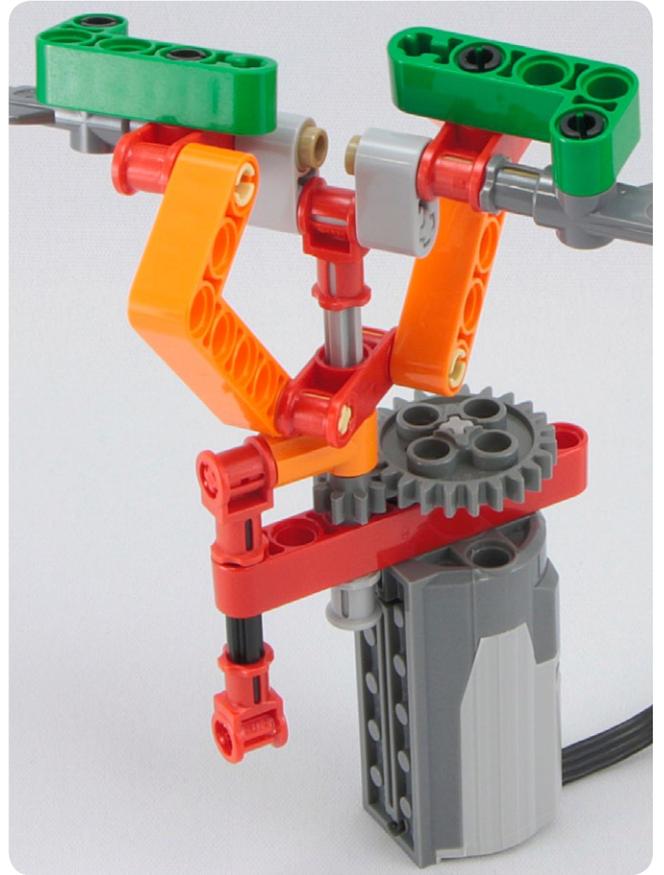
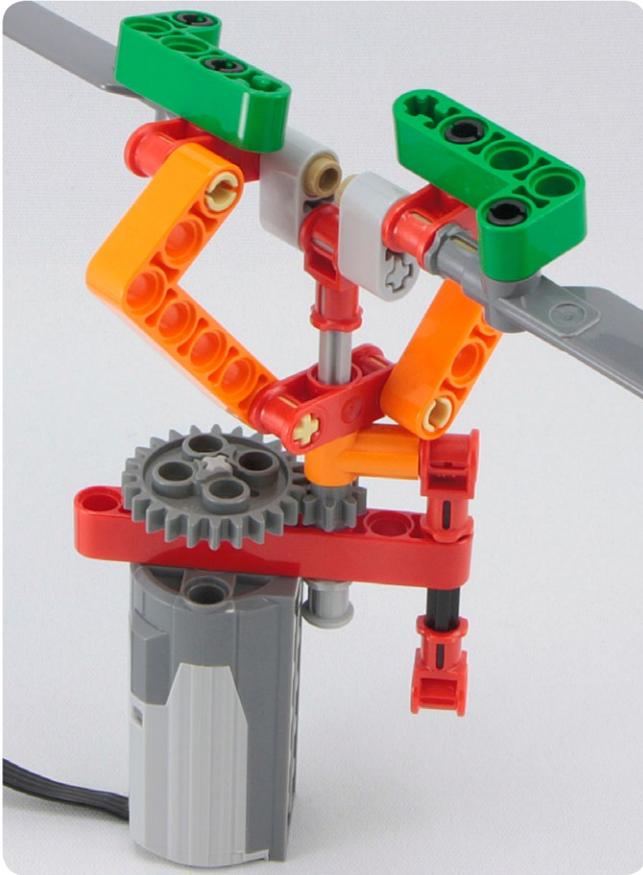




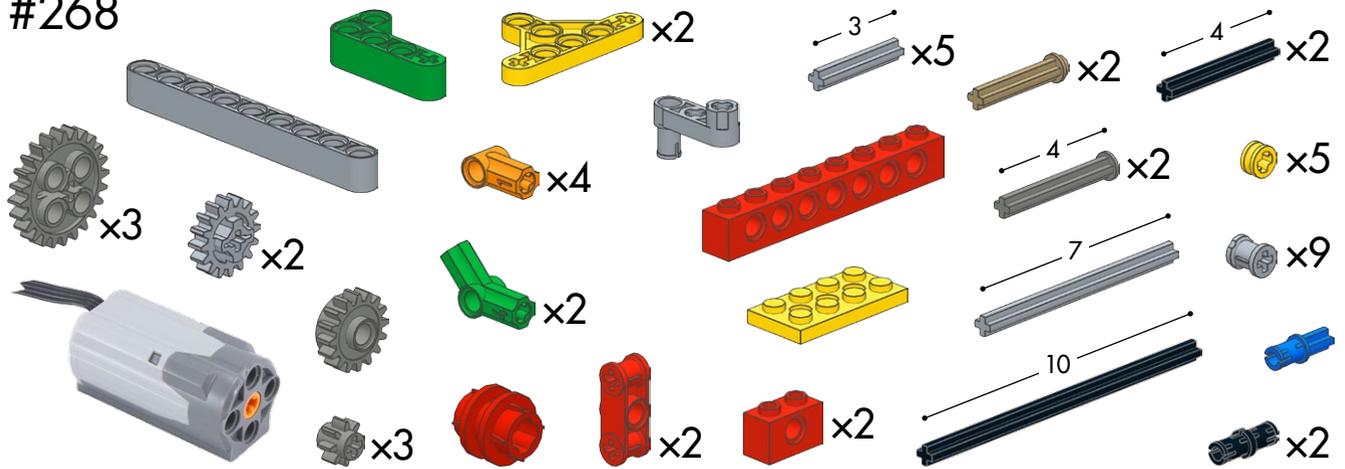


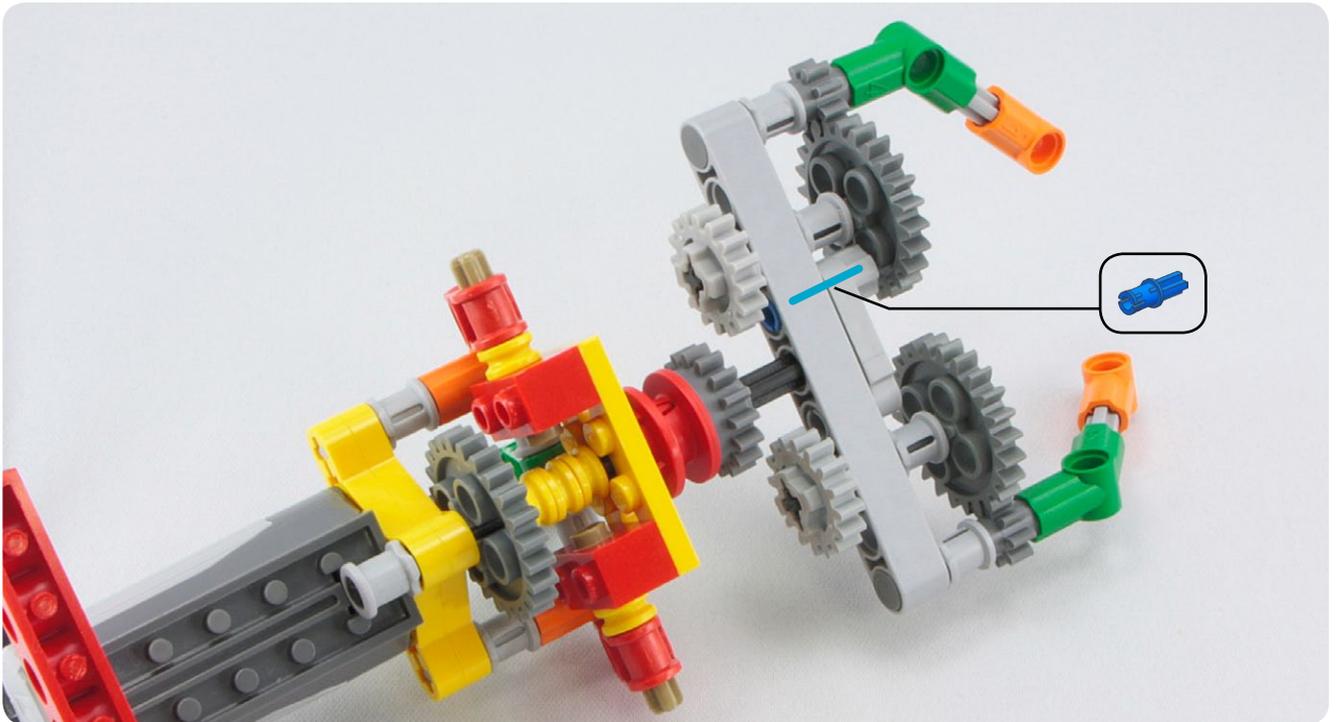


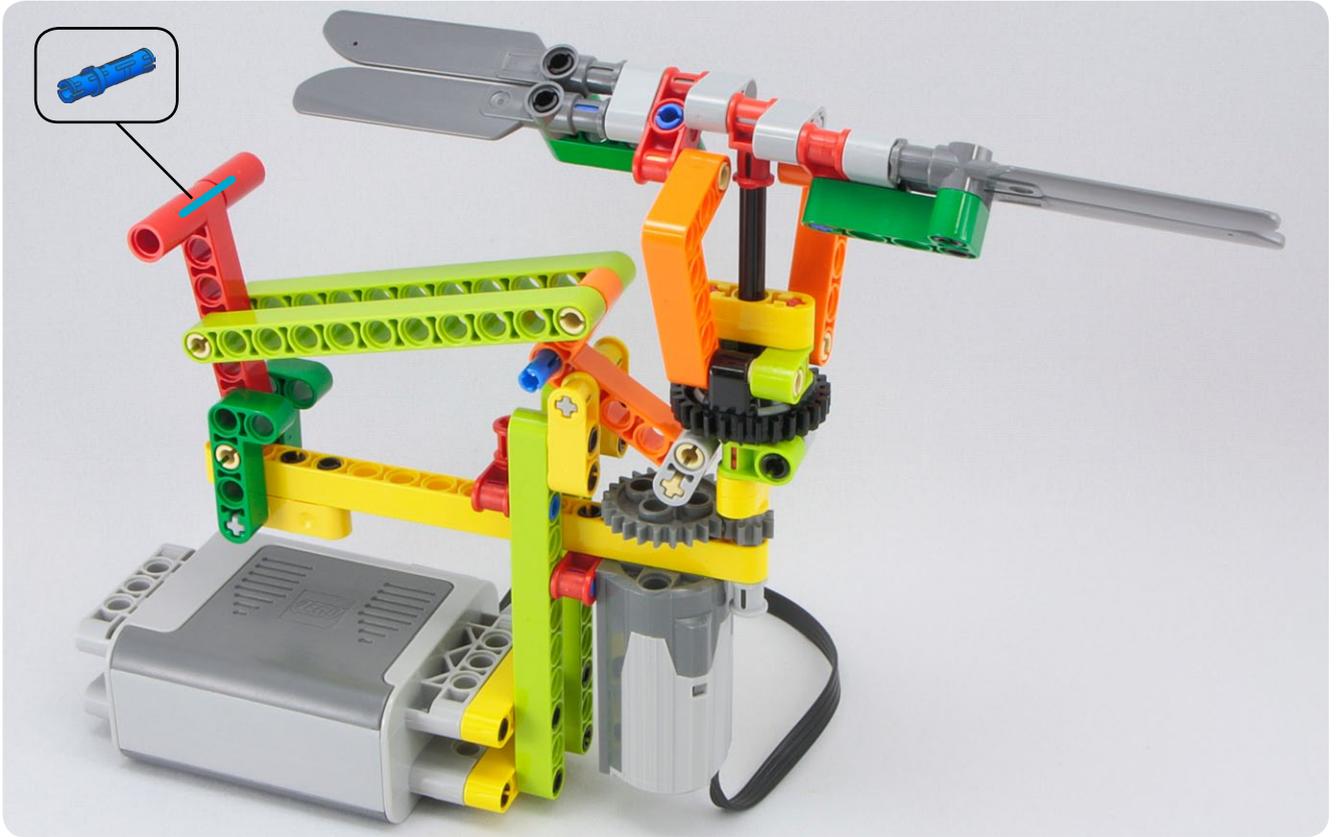


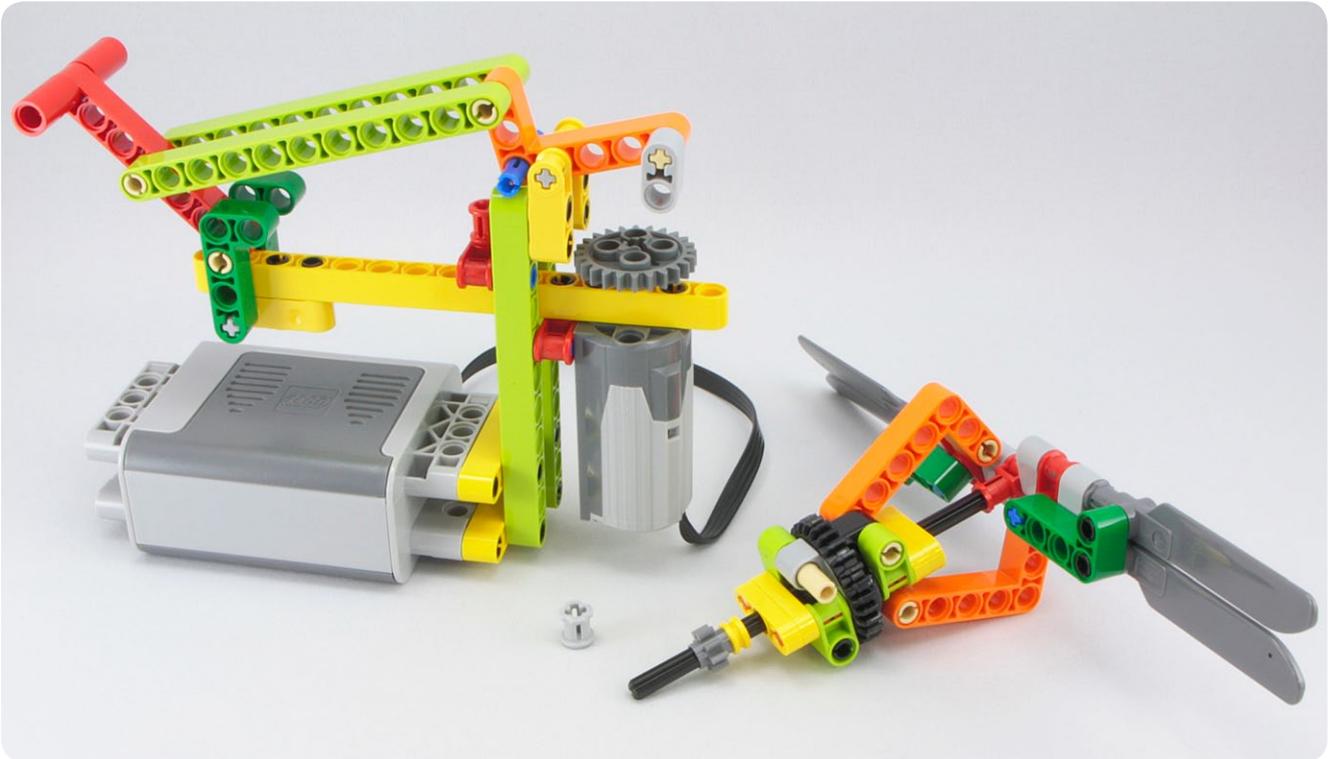
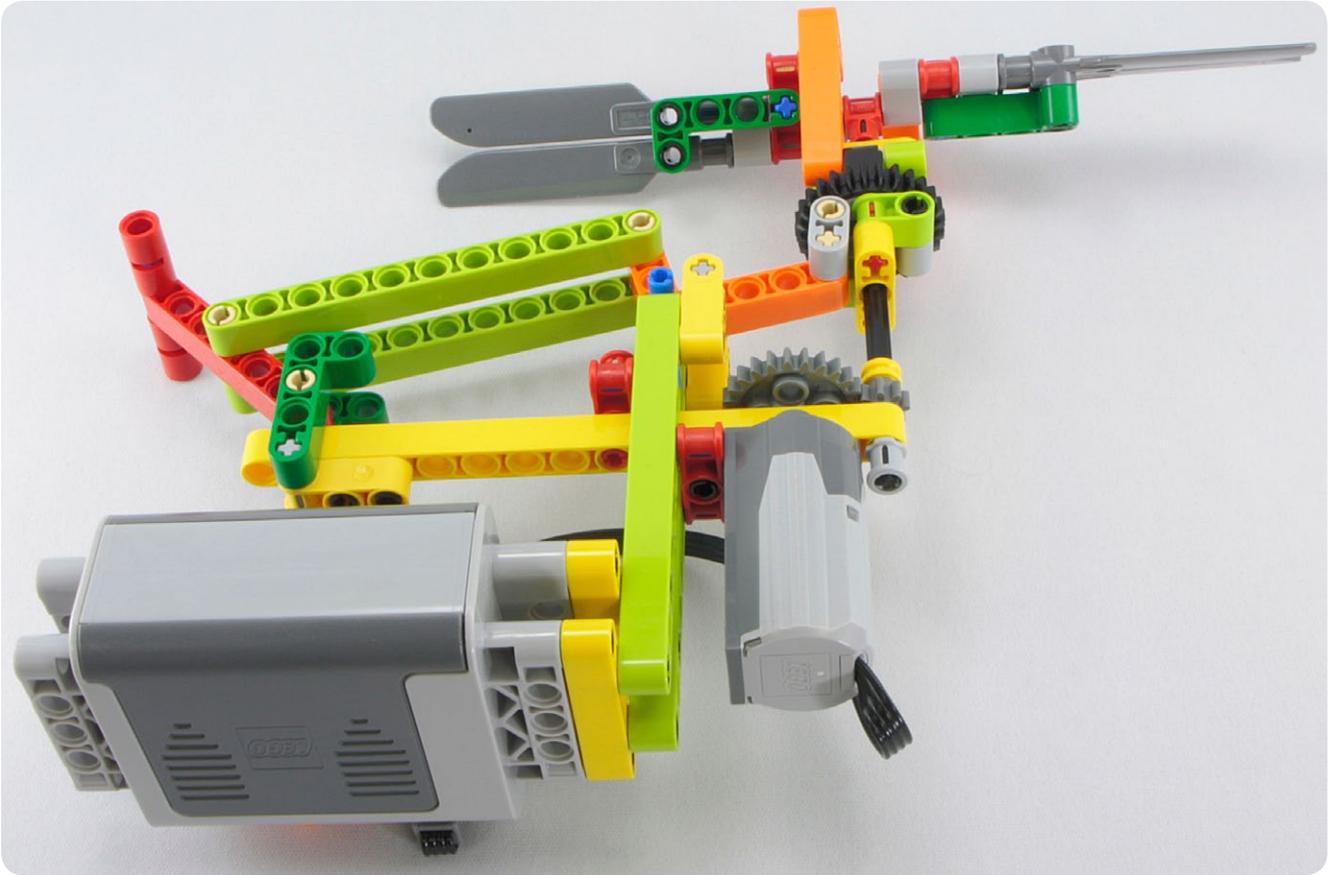


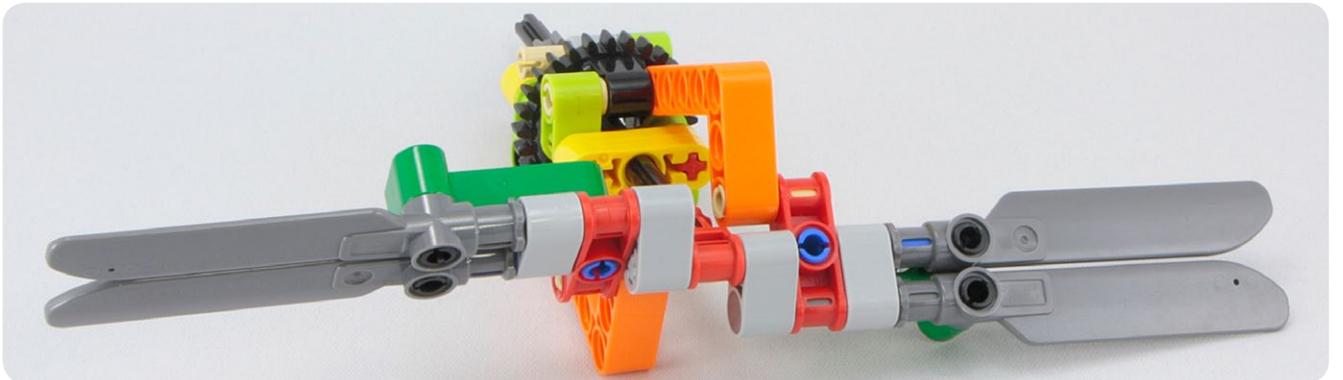
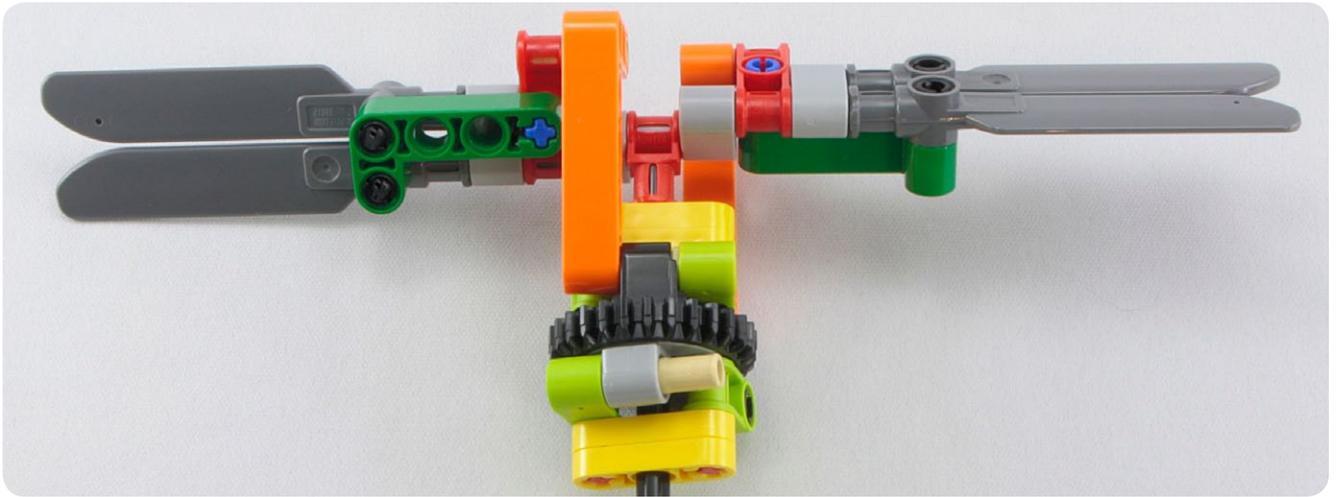
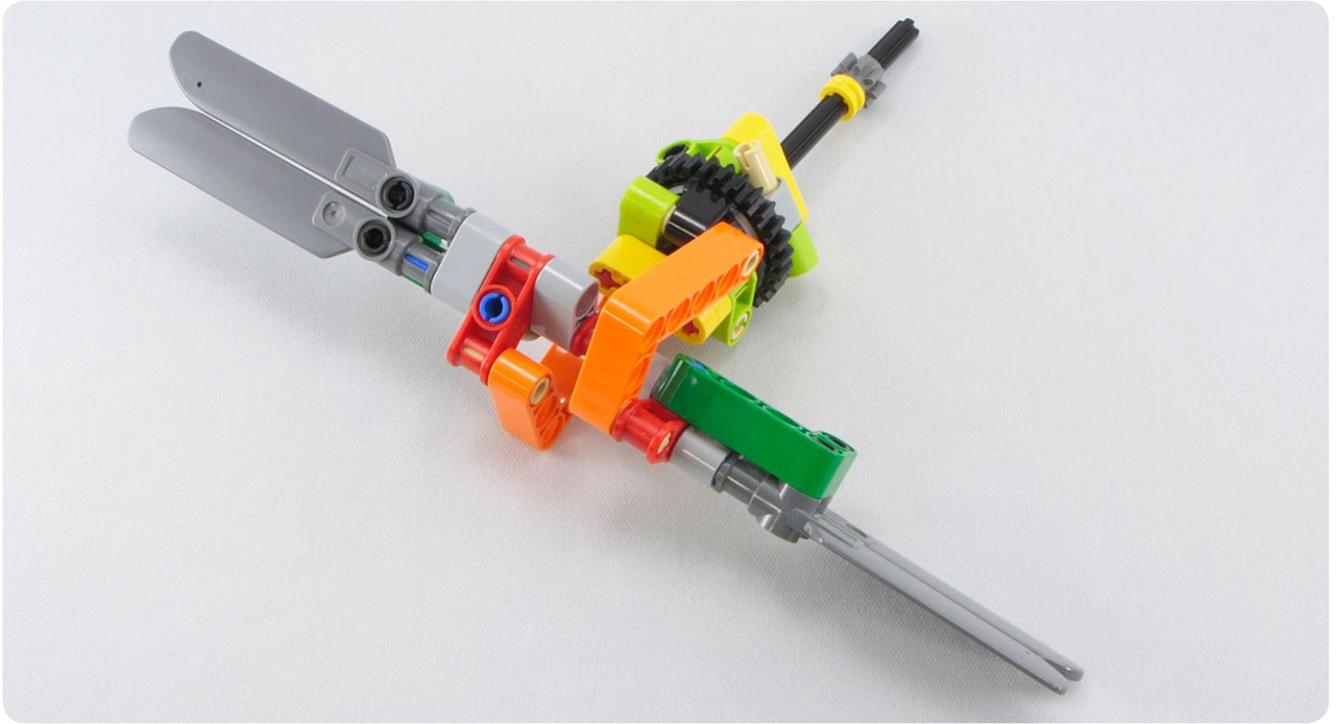
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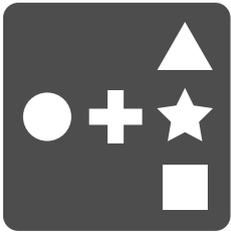












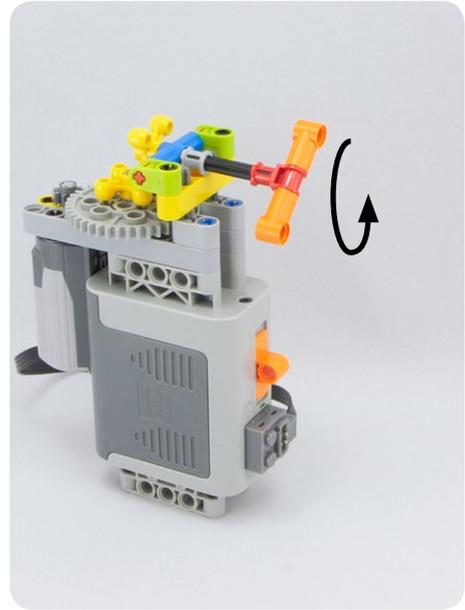
Using attachments to change motion



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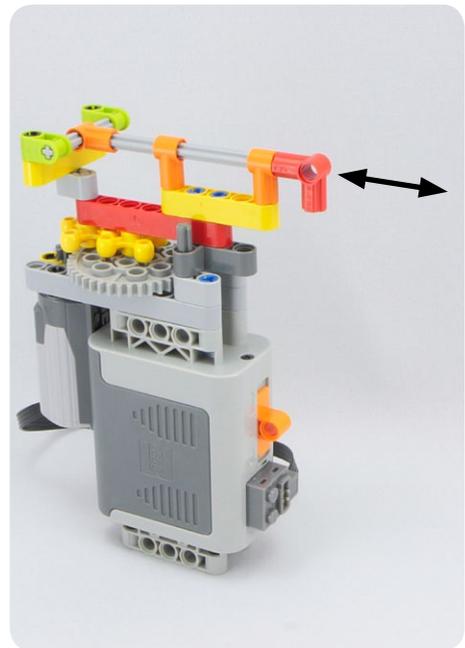
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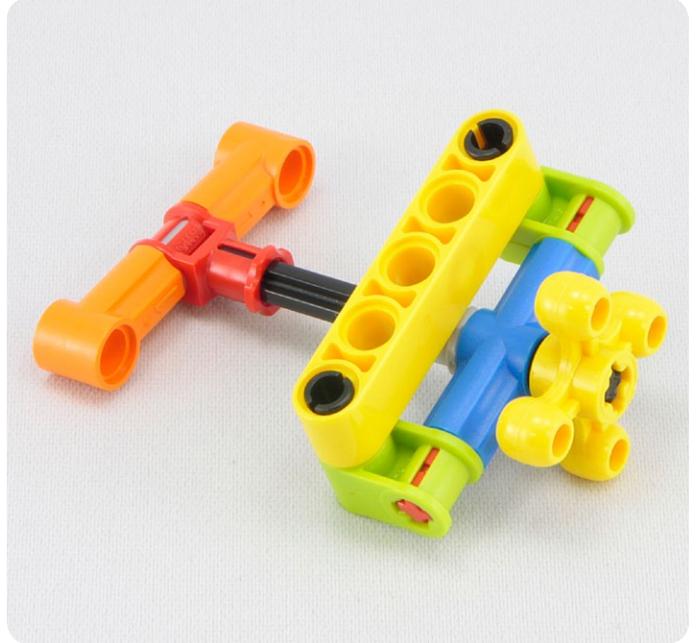
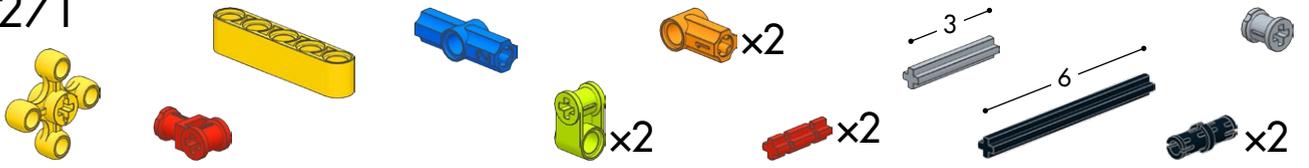
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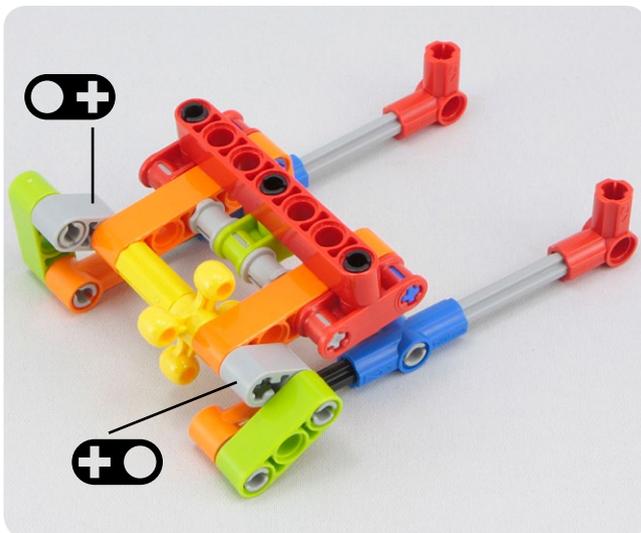
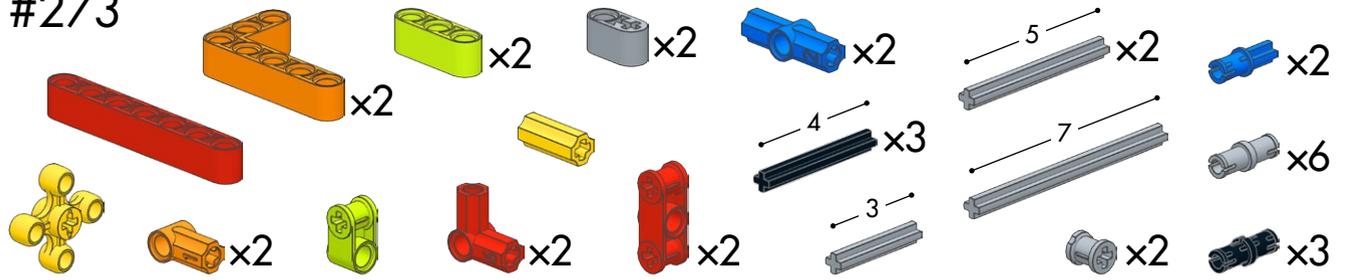
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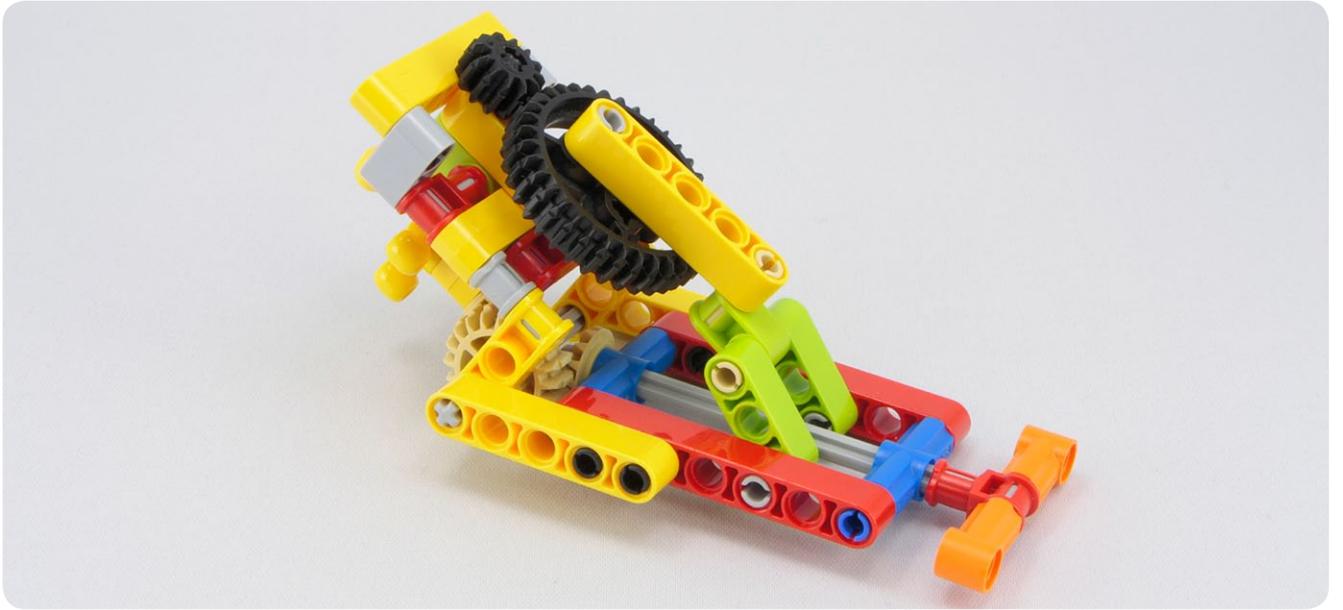


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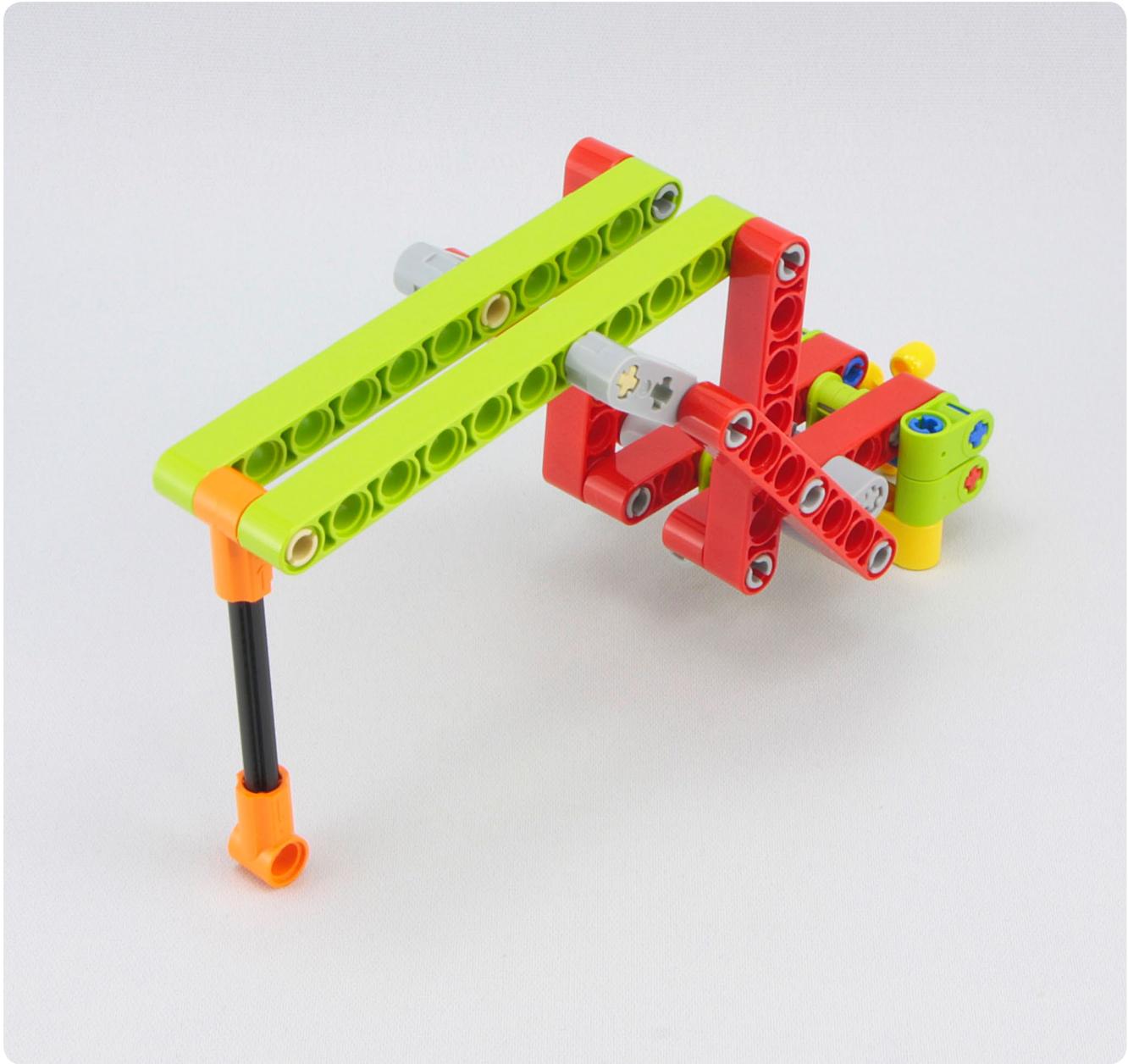
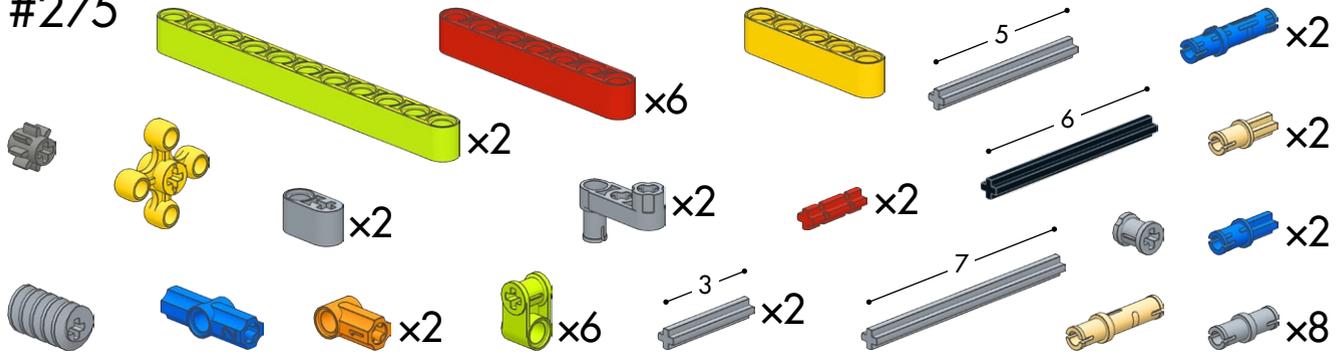


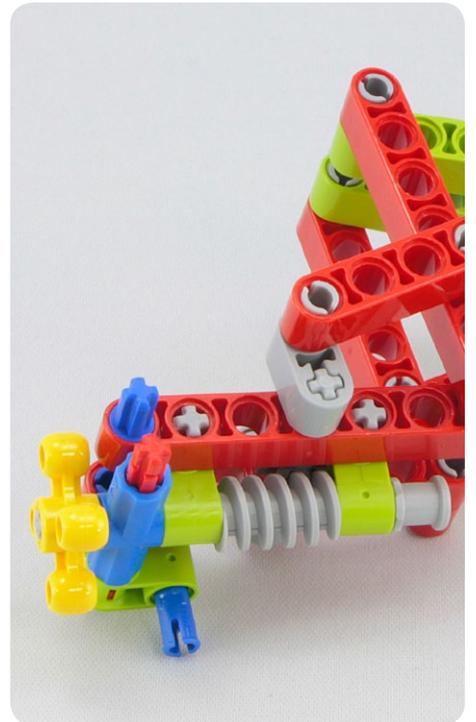
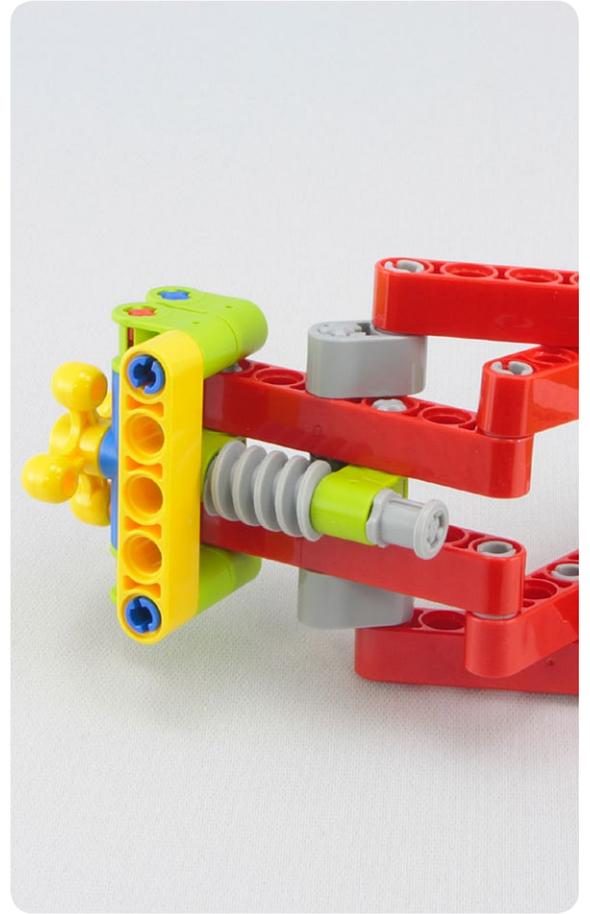
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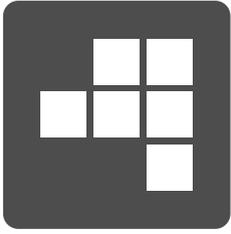




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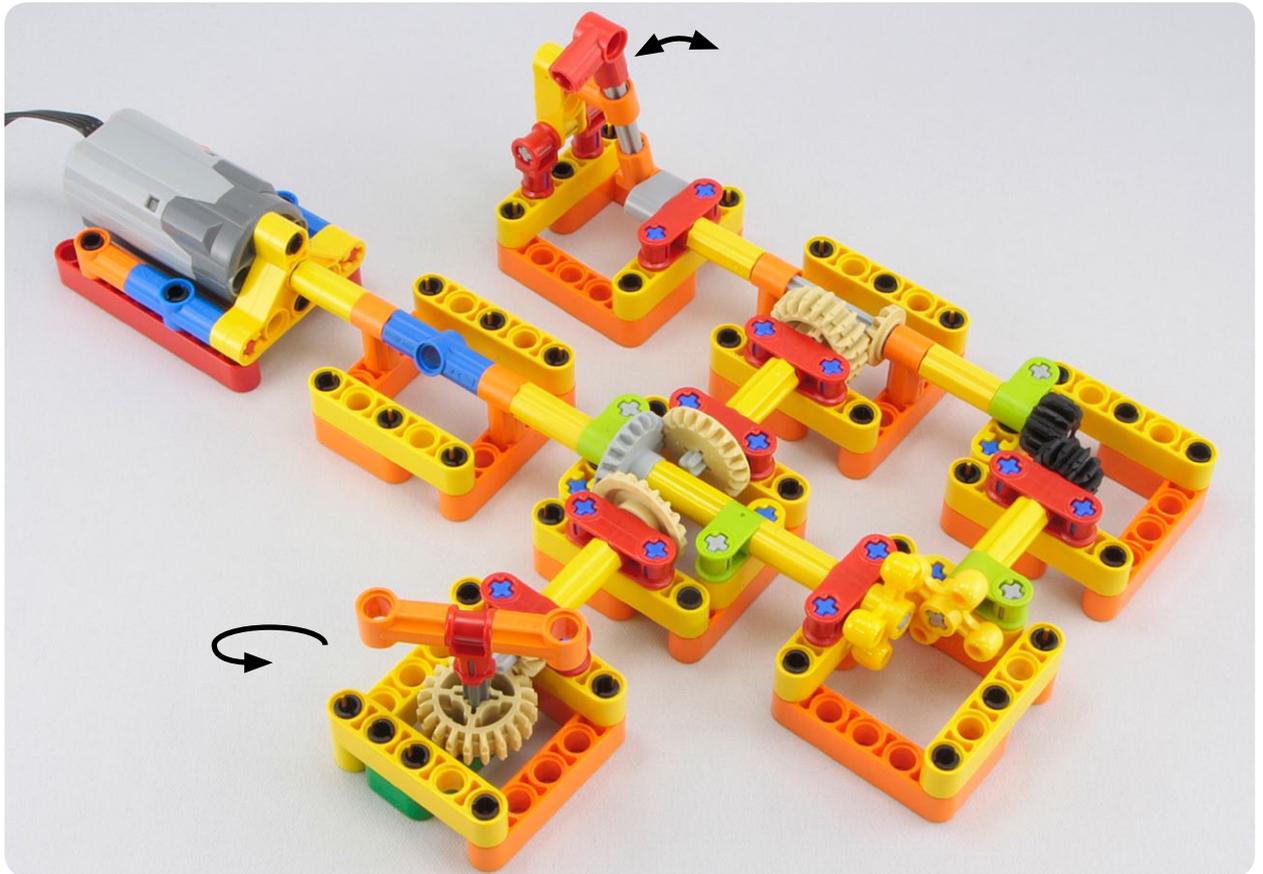
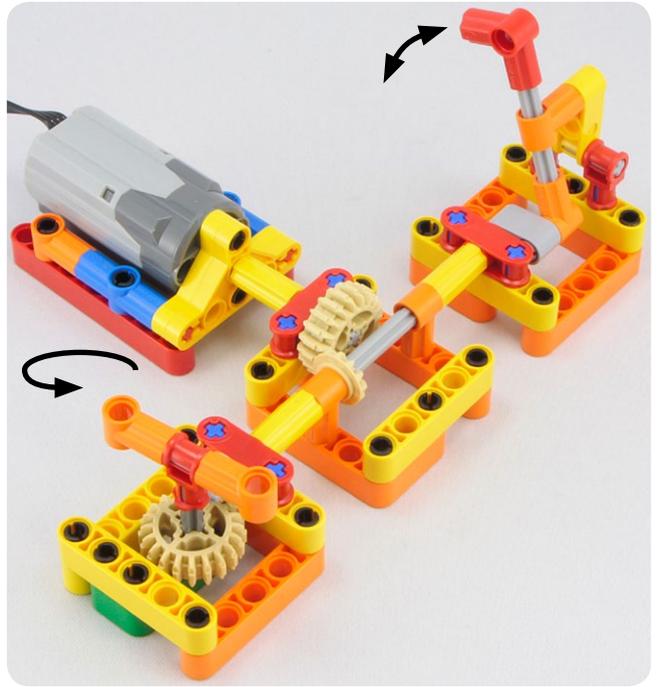




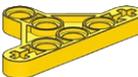


Combining modules



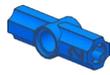
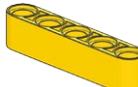
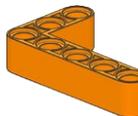
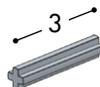


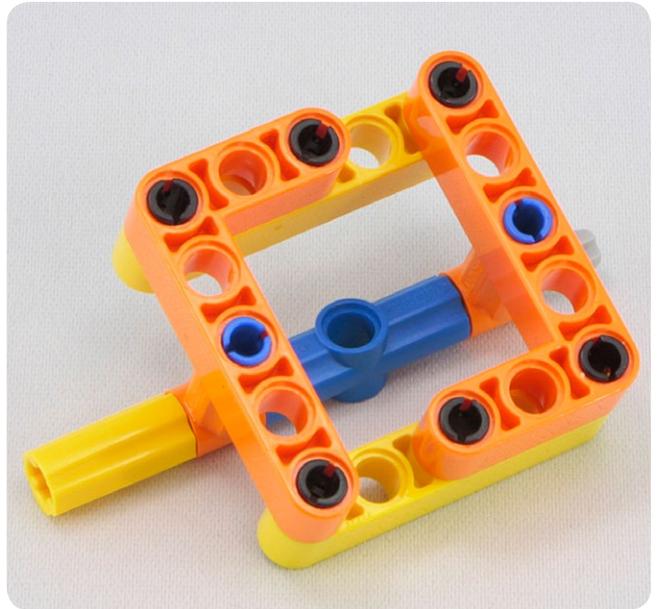
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-  x2
- 
-  x2
-  x2
-  x2
- 
-  x4
-  3
-  x6

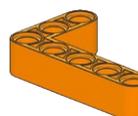
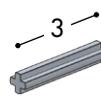


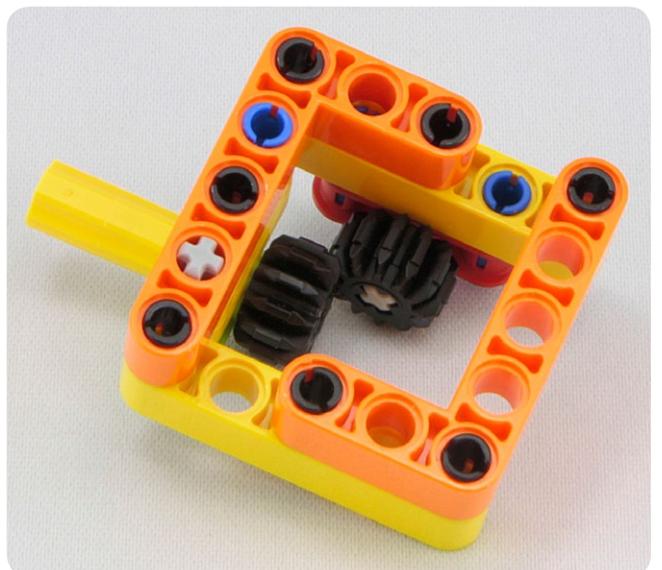
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-   x2
-  x2
- 
-  x2
-  x2
-  x2
-  x6

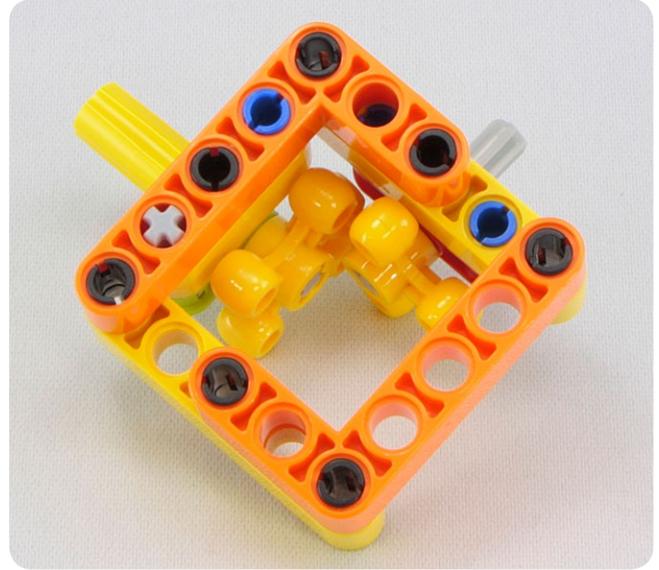
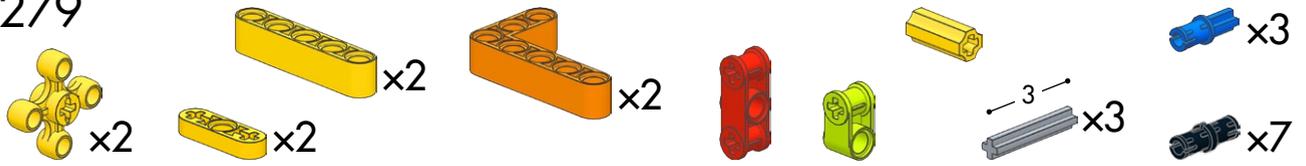


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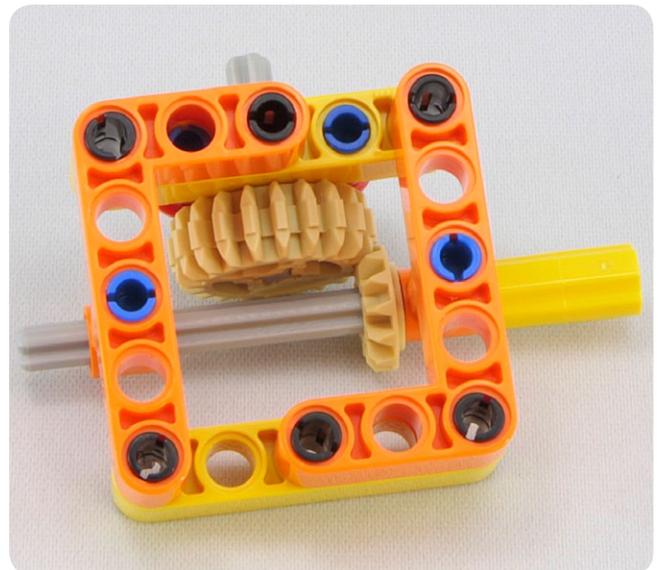
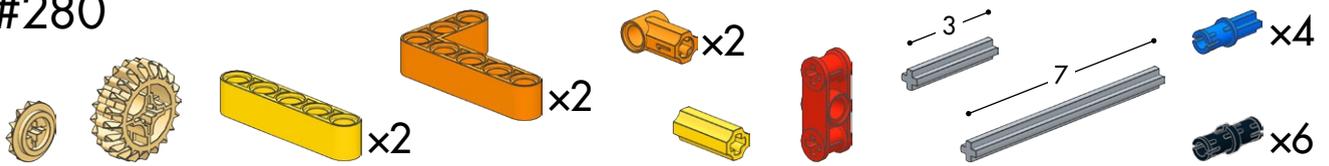
-  x2
-  x2
-  x2
-  x2
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-  x3
-  x3
-  x7



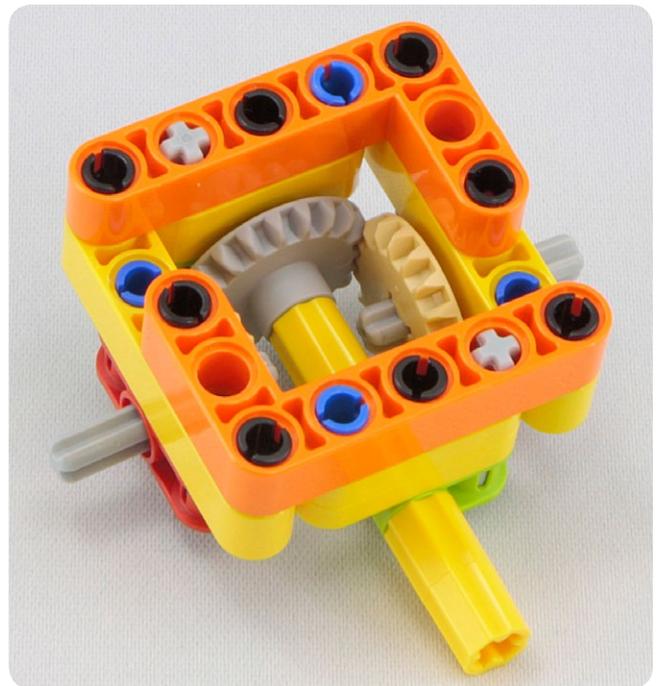
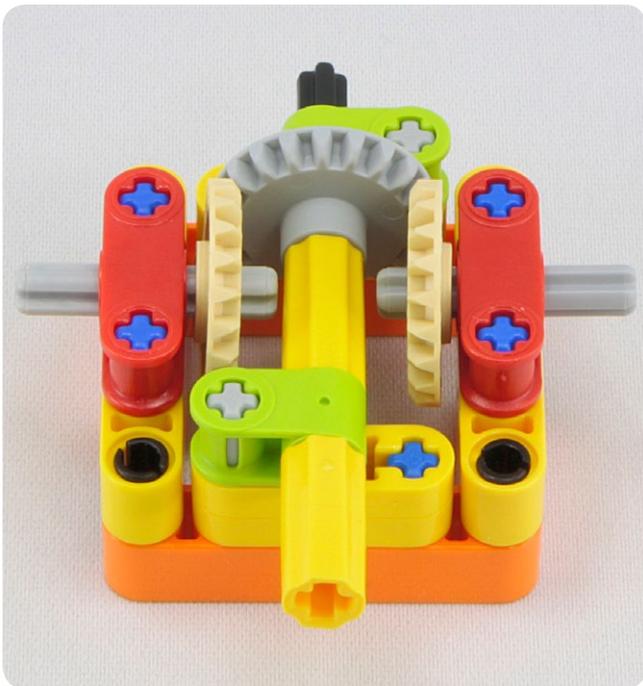
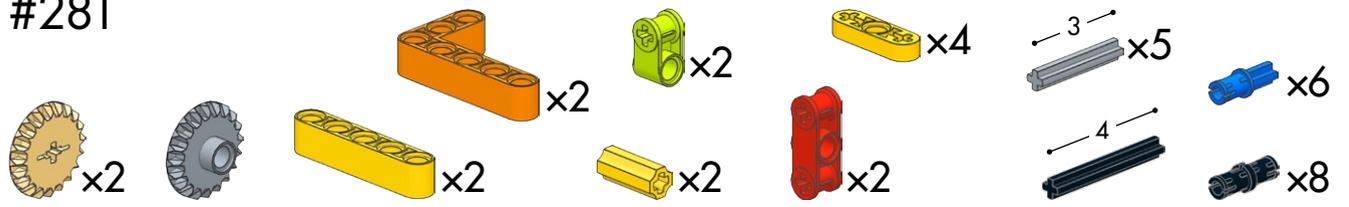
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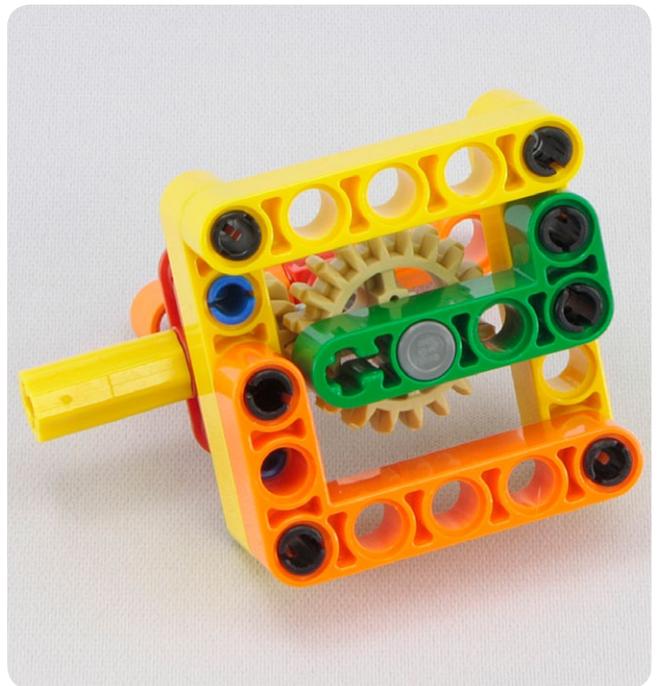
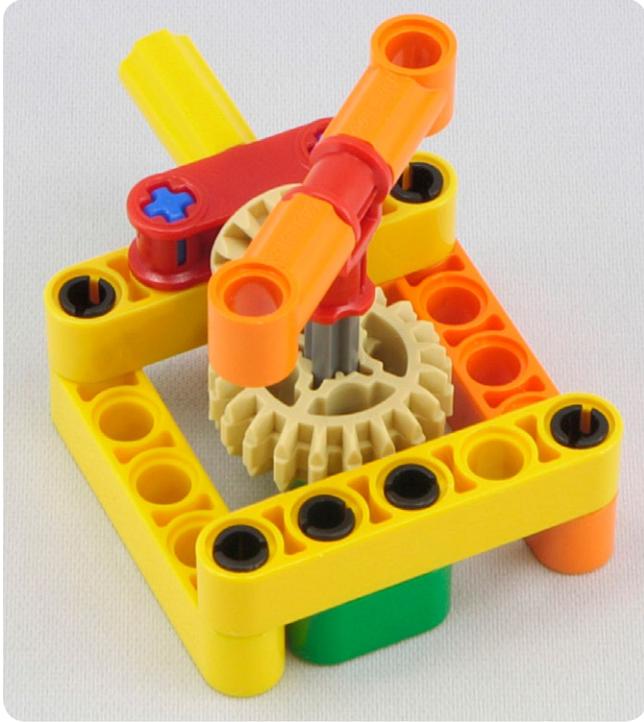
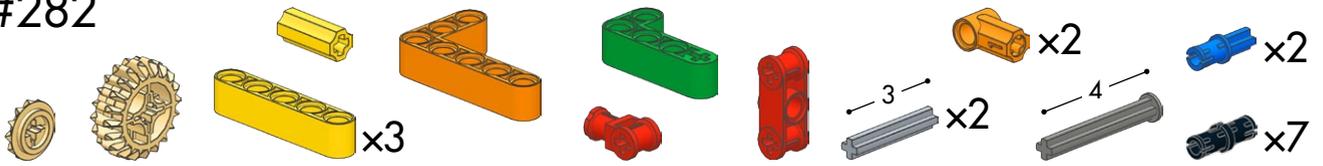
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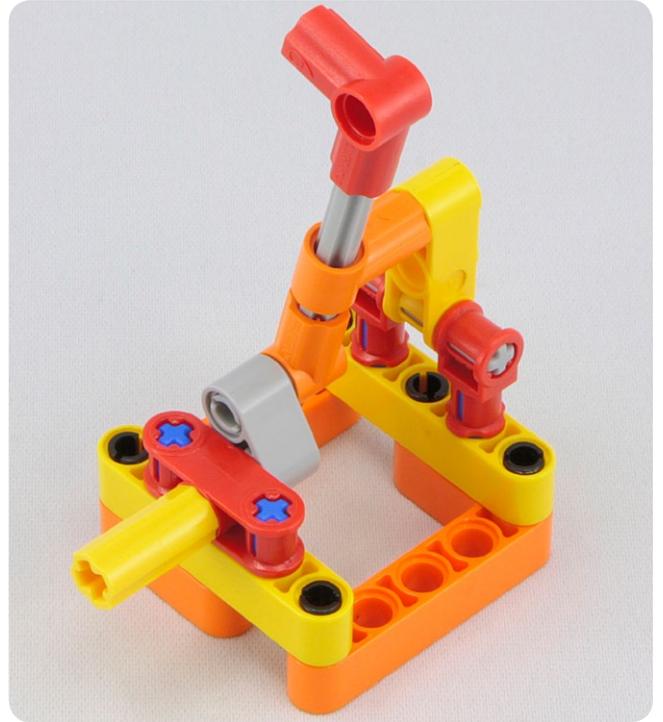
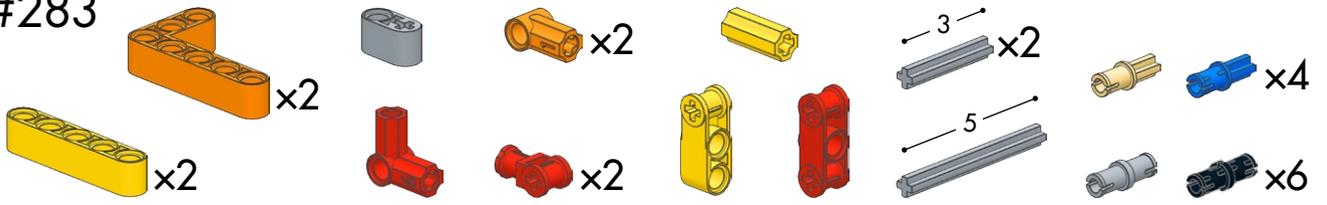
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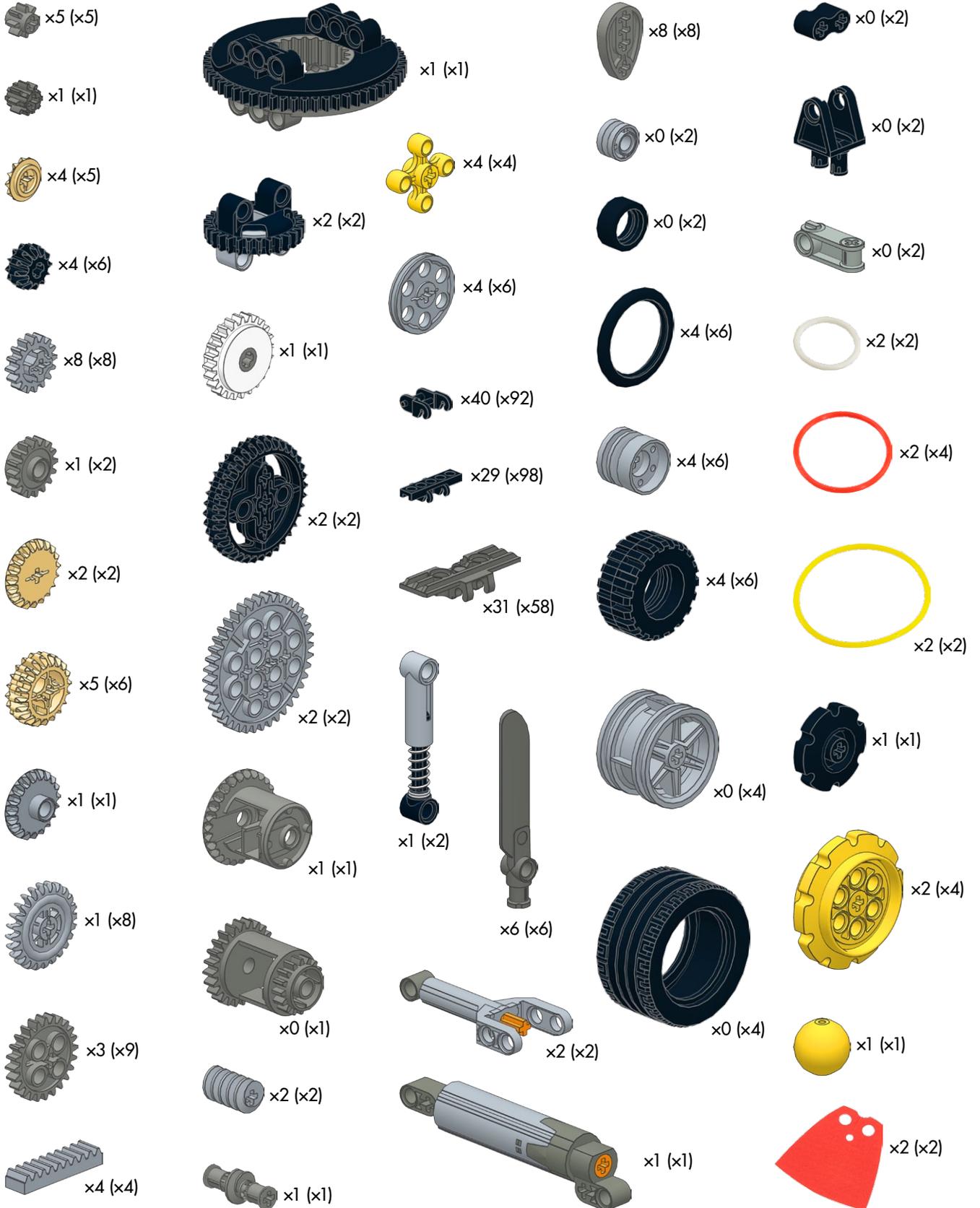


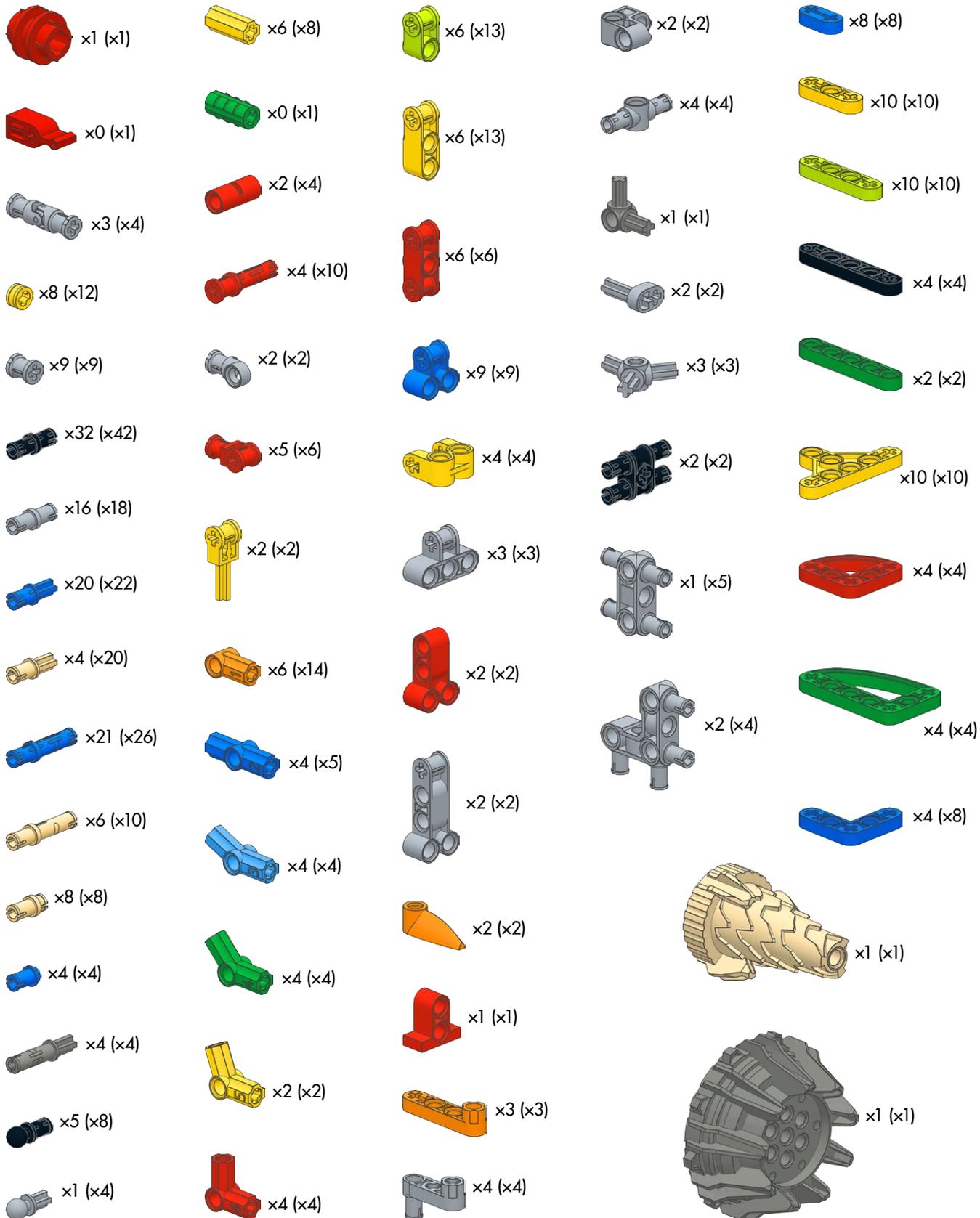
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#283







 x5 (x16)

 x3 (x4)

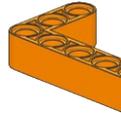
 x2 (x2)

 x2 (x2)

 x6 (x10)

 x0 (x2)

 x6 (x6)

 x8 (x8)

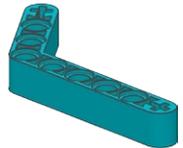
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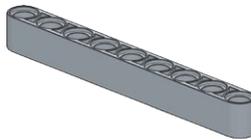
 x4 (x4)

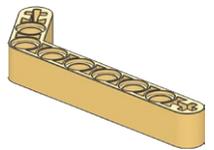
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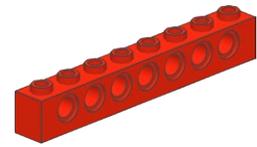
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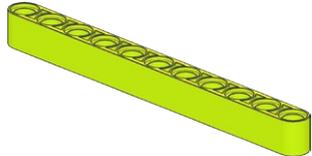
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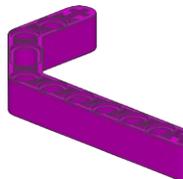
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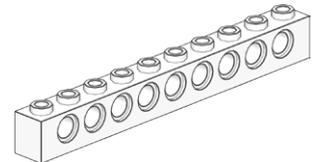
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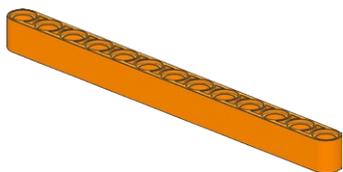
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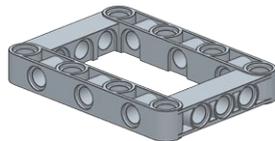
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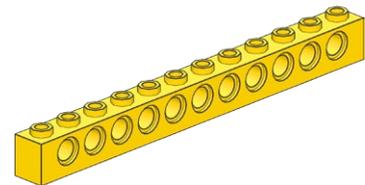
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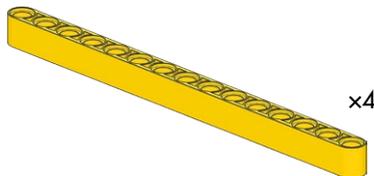
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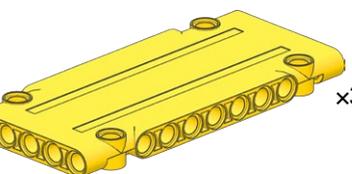
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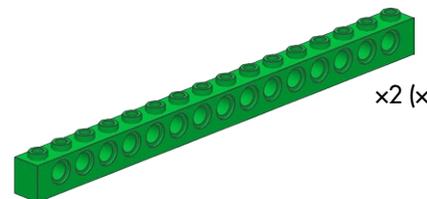
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 x2 (x2)

 x4 (x4)

 x3 (x3)

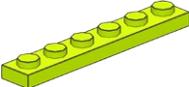
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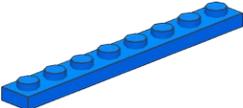
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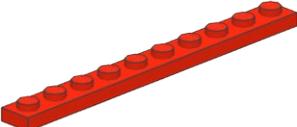
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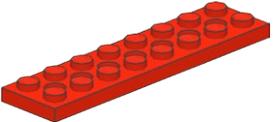
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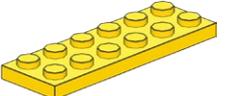
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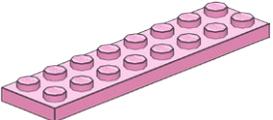
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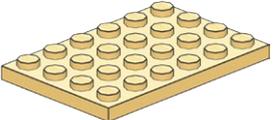
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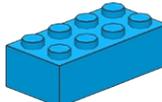
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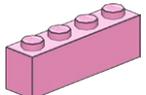
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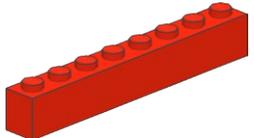
 x2 (x2)

 x2 (x3)

 x3 (x3)

 x1 (x1)

 x10 (x10)

 x1 (x1)

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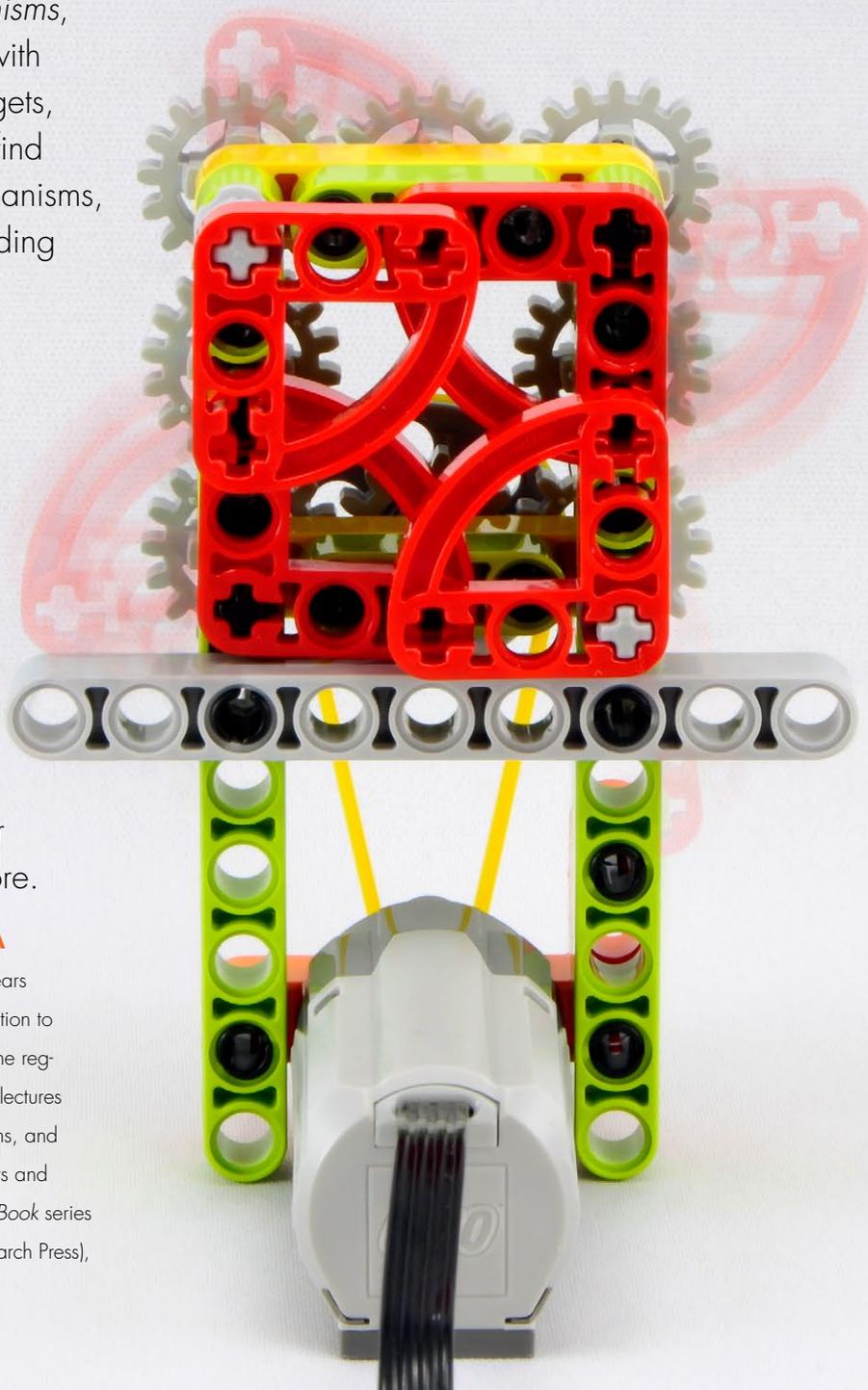
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