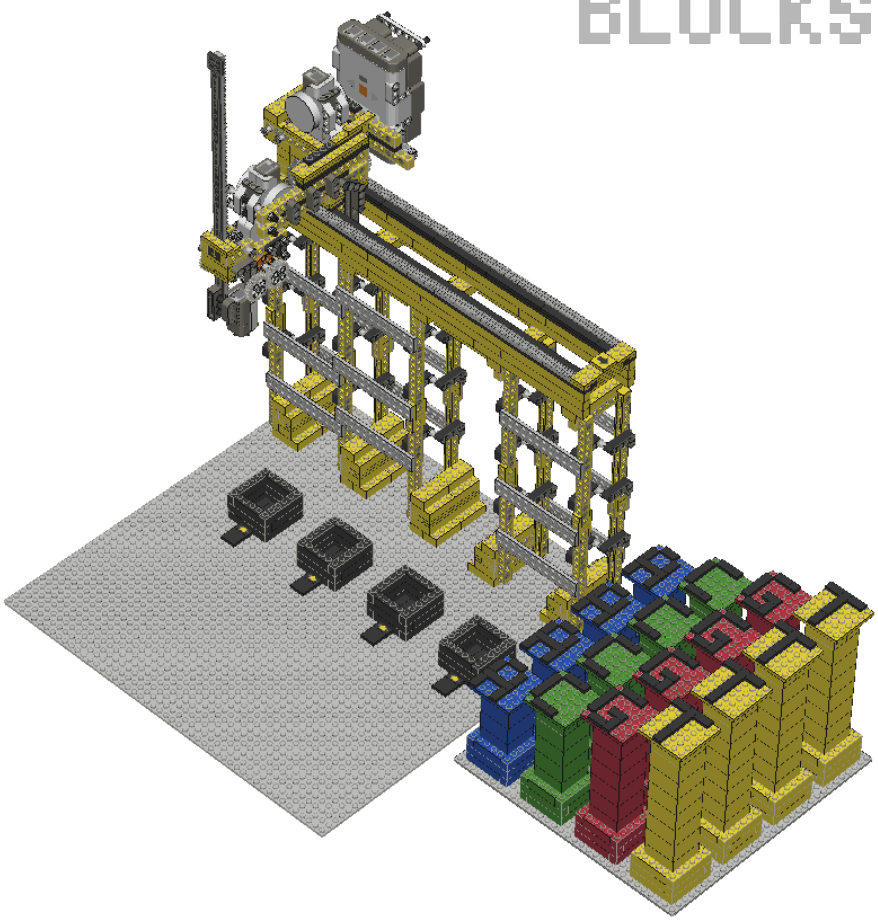
VIRAL BLOCKS



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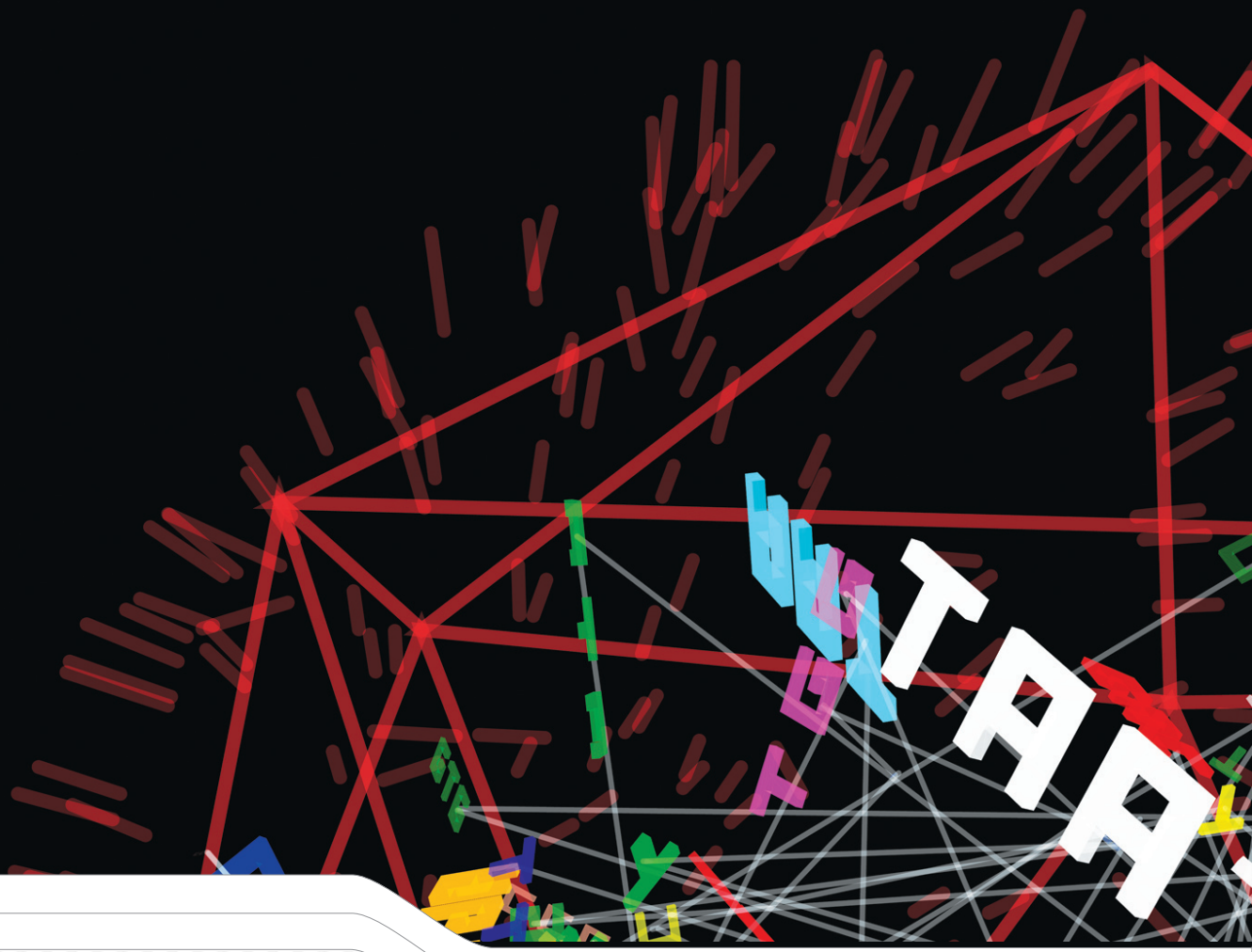

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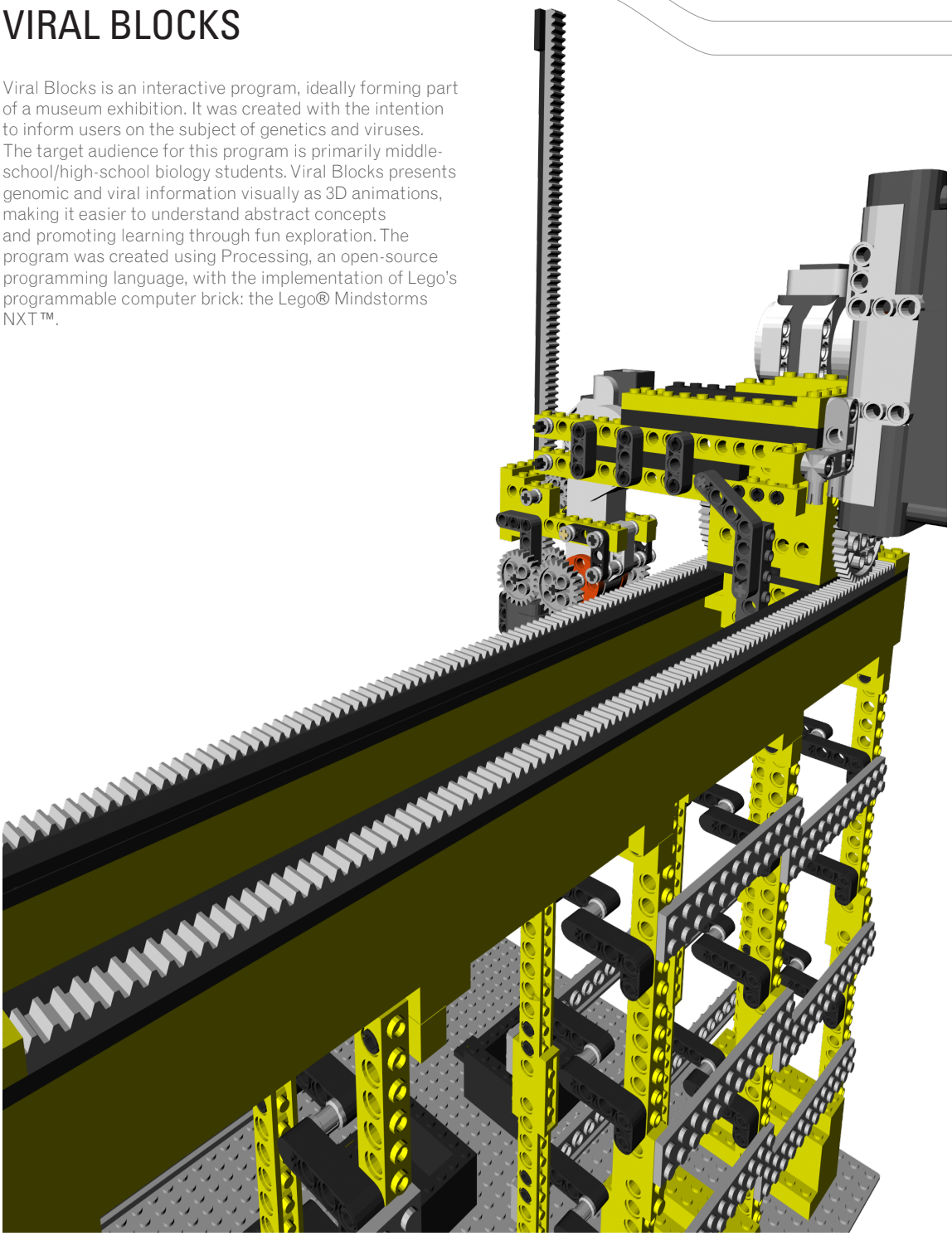
VIRAL BLOCKS

Viral Blocks is an interactive program, ideally forming part of a museum exhibition. It was created with the intention to inform users on the subject of genetics and viruses. The target audience for this program is primarily middle-school/high-school biology students. Viral Blocks presents genomic and viral information visually as 3D animations, making it easier to understand abstract concepts and promoting learning through fun exploration. The program was created using Processing, an open-source programming language, with the implementation of Lego's programmable computer brick: the Lego® Mindstorms NXT™.



SYSTEM REQUIREMENTS

Before installing Viral Blocks , you must make sure that your computer meets the following requirements:

*Minimum screen resolution: (1280 x 768).

Macintosh

- PowerPC G4, G5 or Intel Processor
- Apple MacOS X v. 10.4
- 1GB of RAM minimum
- Up to 50 MB of available hard disk space
- WSXGA+ display (1680x1050) (recommended)*
- OPENGL compatible video card
- CD-ROM drive
- Compatible Bluetooth adapter
- Lego® Mindstorms NXT™
- JAVA 2 SE 5.0 Release 4 + JOGL

INSTALLING THE SOFTWARE

Viral Blocks

Apple Macintosh

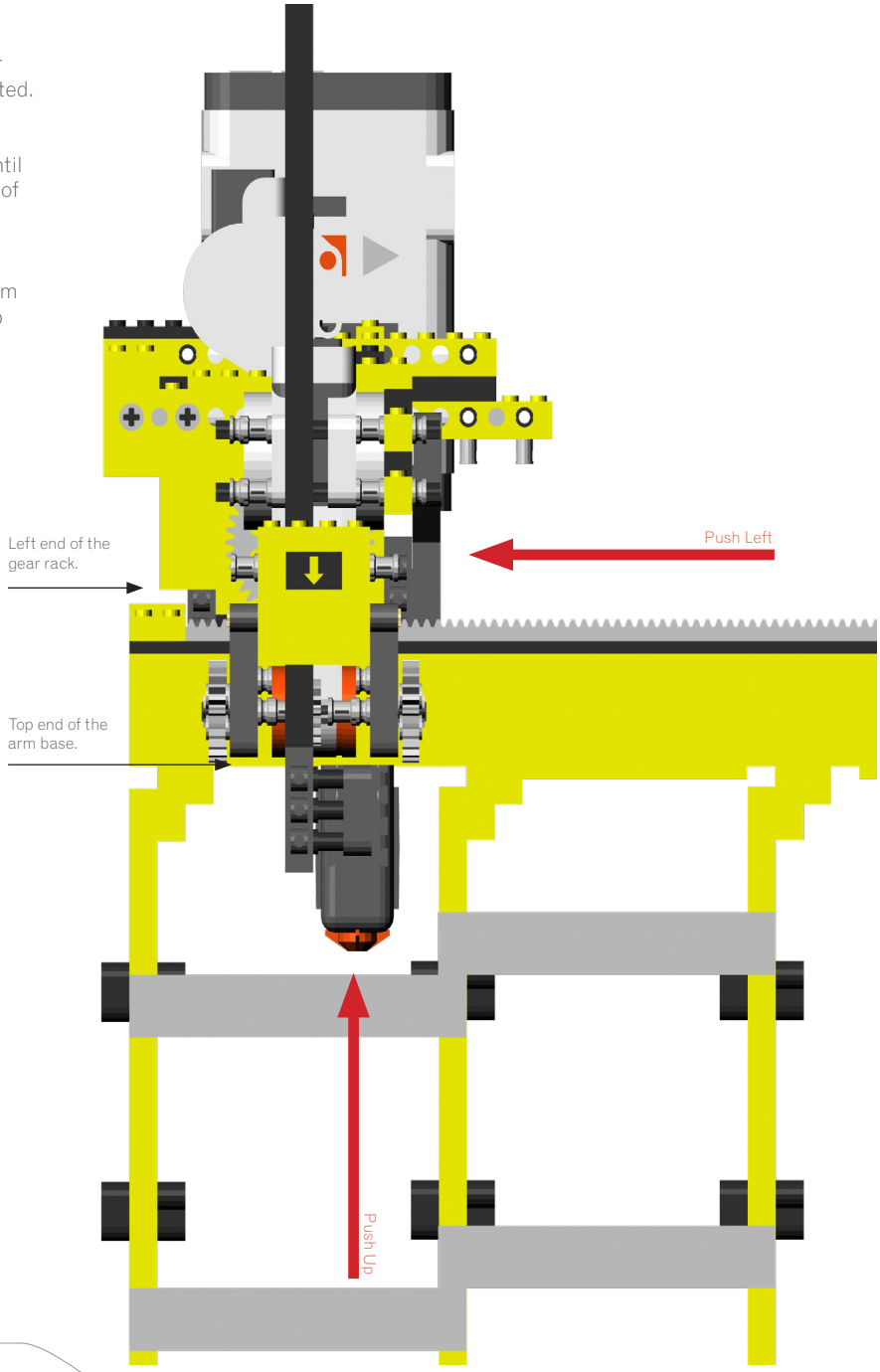
- Exit all open programs. Insert the CD-ROM.
- Open the Viral Blocks CD-ROM. If you wish to install Viral Blocks without Lego NXT support double-click “Install Viral Blocks”. If you wish to have NXT support double-click “Install Viral Blocks NXT”.
- Follow the on-screen instructions.

When the installation procedure is complete, click Finish. You are now ready to use the Viral Blocks software and explore viral structures.

CALIBRATION

Before using the sequencer machine, it must be calibrated.

- Push the base of the sequencer machine until it reaches the left end of the gear rack.
- Additionally, push the sequencer machine arm until it reaches the top end of the arm base.

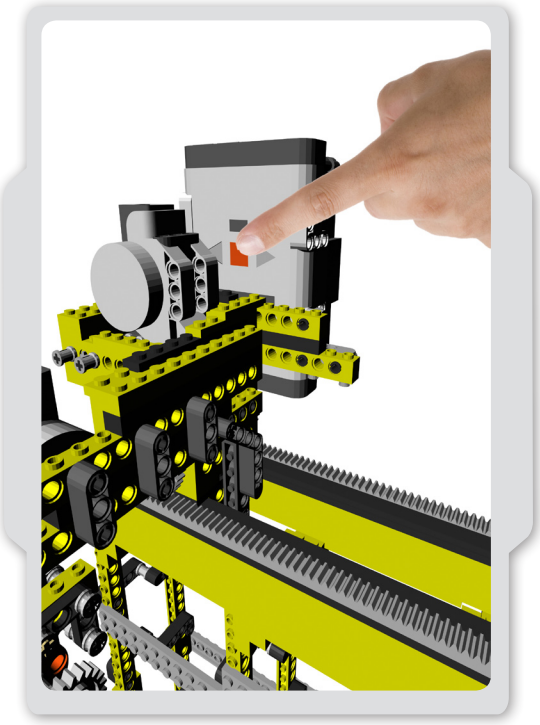


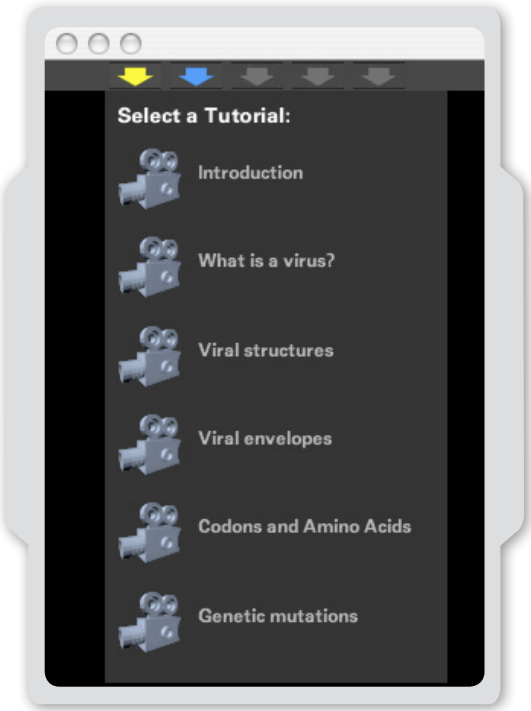
GETTING STARTED

To start using Viral Blocks, first turn the Lego® Mindstorms NXT™ programmable brick, by pressing the “ON” orange button*.

Then start the software on your Macintosh by double-clicking the Viral Blocks program icon under “Applications”.

*Follow this step if you have chosen to use Viral Blocks with NXT support.



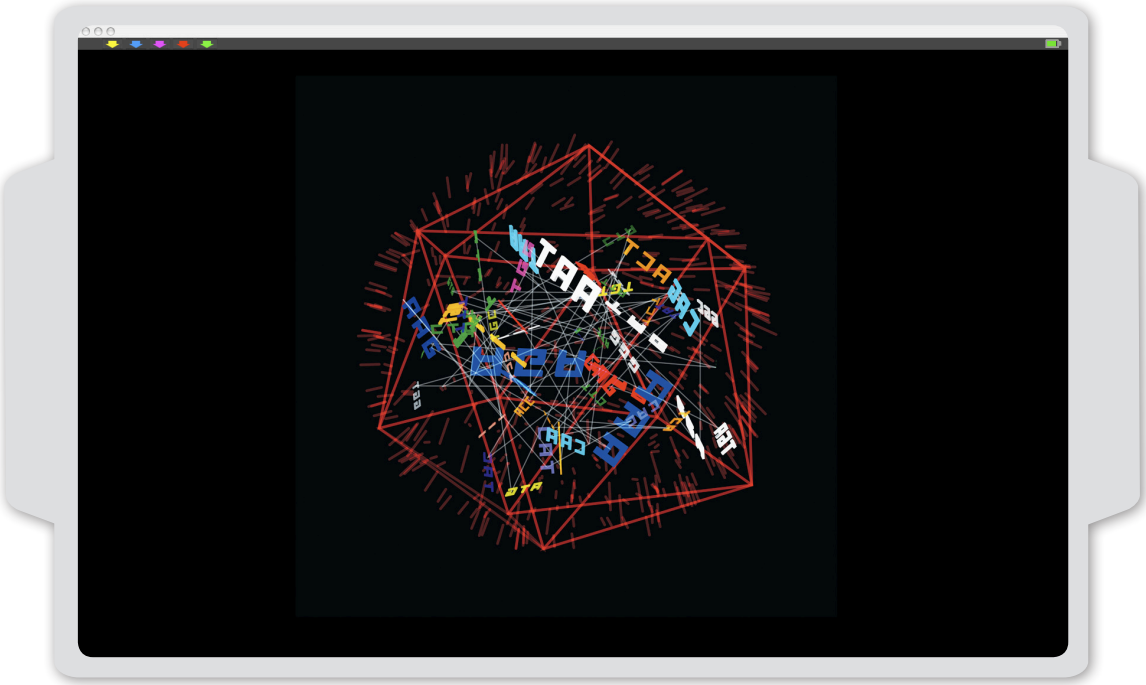


Tutorials

After opening the Viral Blocks program, the best place to start is by exploring the tutorials.

Please view the tutorials under the yellow arrow to view animations underlining program operation and viral structure basics.

SOFTWARE USER INTERFACE



Menu Overview

Rollover to access the tutorials

Rollover to access the viral genomes

Rollover to select different display options

Rollover to explore the amino acids

Rollover to mutate the virus*

Battery level indicator

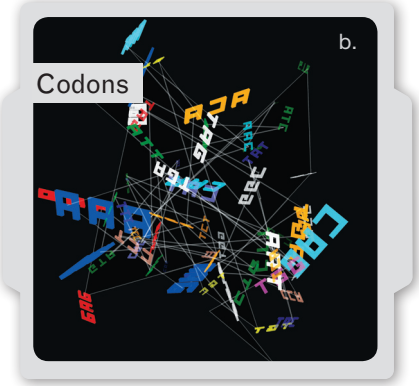
Esc

Press the ESC key to quit Viral Blocks

*Mutation option only available if you have chosen to use Viral Blocks with NXT support.

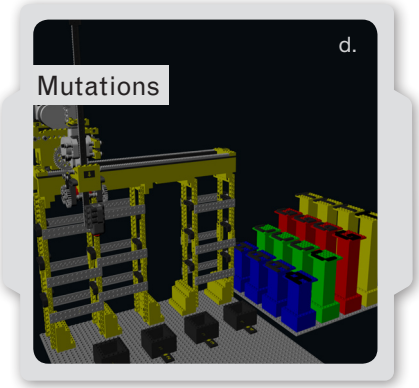
Viral Structures

The capsid is a protein layer which protects the genetic material inside a virus. There are three primary types of capsid geometries: complex, helical and icosahedral. The Viral Blocks program uses capsid geometry as a layer of information, which is represented visually using cubes, cylinders and icosahedrons (fig. a). The colours of the capsids represent a second layer of information, indicating the viral host (the organism the virus infects): blue for bacteria, yellow for fungi, green for plants, and red for animals. In the Viral Blocks program this information, as well as subsequent viral structure information, is summarised as animated tutorials, providing clear program operation basics and background information on the viral structures.



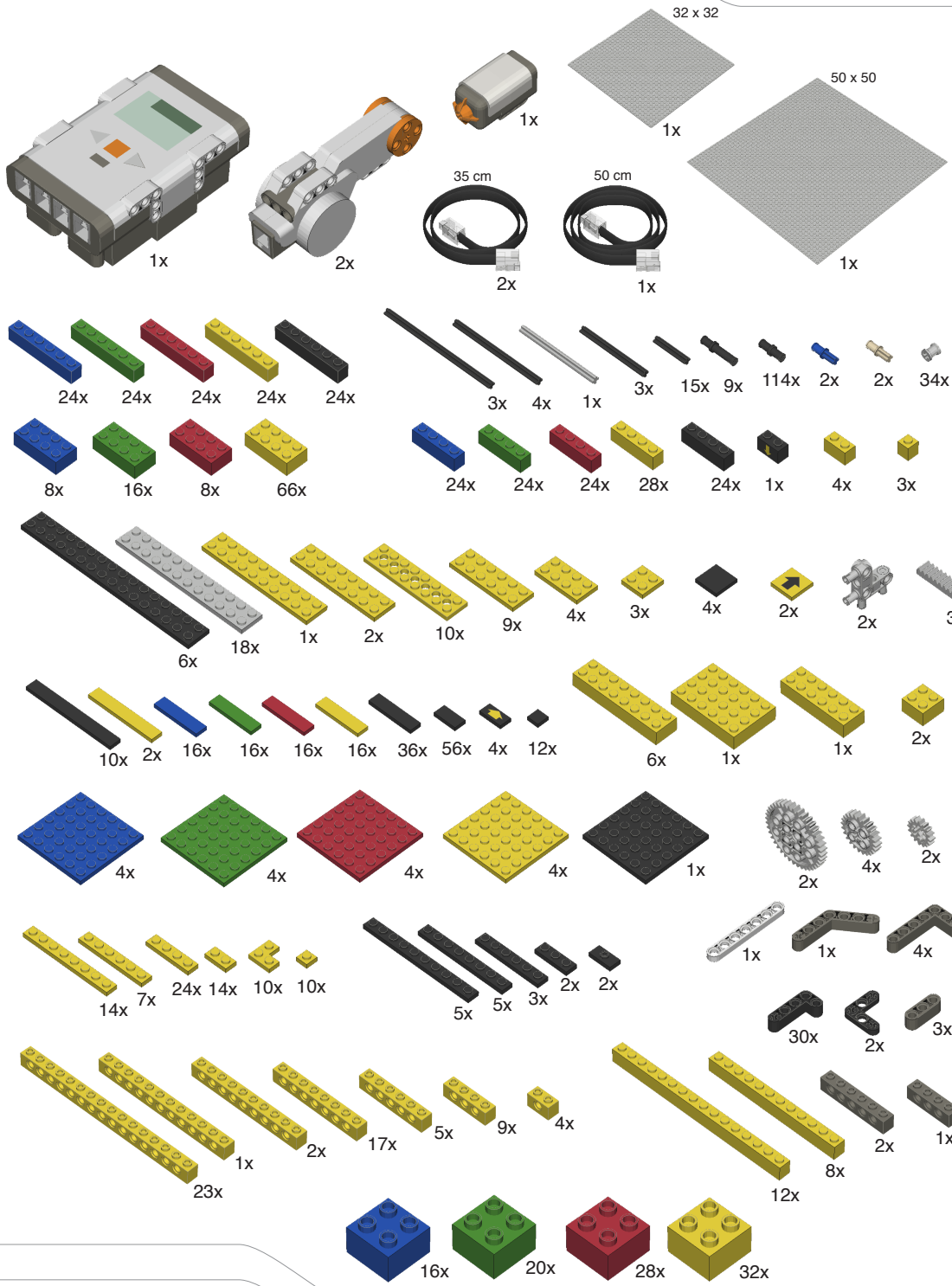
The genetic code, which defines all the unique characteristics of each individual virus, is the third layer of information presented in the Viral Blocks program. The end products of the code are proteins. Proteins are some of the most important parts of viral structure and function, responsible for everything from the physical structure of the virus to the mechanism in which viruses reproduce themselves. Proteins are made up of building blocks called amino acids. The virus knows which amino acids to make because the genetic code contains a series of three-letter units called codons. Each codon tells the virus to make a certain amino acid, a bit like an architectural blueprint. For our purposes, genetic information is portrayed as frequencies of the 64 codons present in the genetic code (fig. b). The codon frequencies in the Viral Blocks program are indicated by letter size and the opacity of the letters. In addition, the program enables isolation of individual codons, allowing easy exploration of the three-letter combinations.

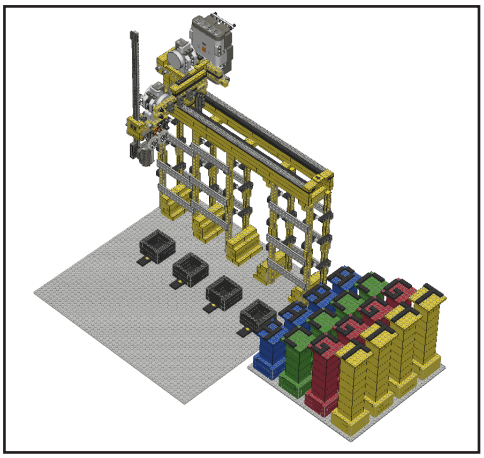
The fourth layer of information presented in the Viral Blocks program is: viral envelope presence. A viral envelope is a coat made of molecules called lipids, which facilitates the infection of host cells. The Viral Blocks program represents the presence of the viral envelope as a spherical hair-like structure (fig. c) surrounding the same coloured capsid geometry.

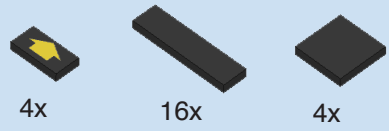


The final feature of the Viral Blocks program is the ability to mutate viral structures using the Sequencer Machine (fig. d), created with the Lego® Mindstorms NXT™ programmable computer. The machine is able to read an arbitrary combination of bricks of different heights placed on each of its four bins. Each bin represents a distinct virus characteristic: capsid geometry, host organism, viral envelope presence, and codon frequency. Changes in the brick height combinations among the four bins create drastically different visual representations, which indicate possible mutations in the viruses' structure and genome.

Element overview







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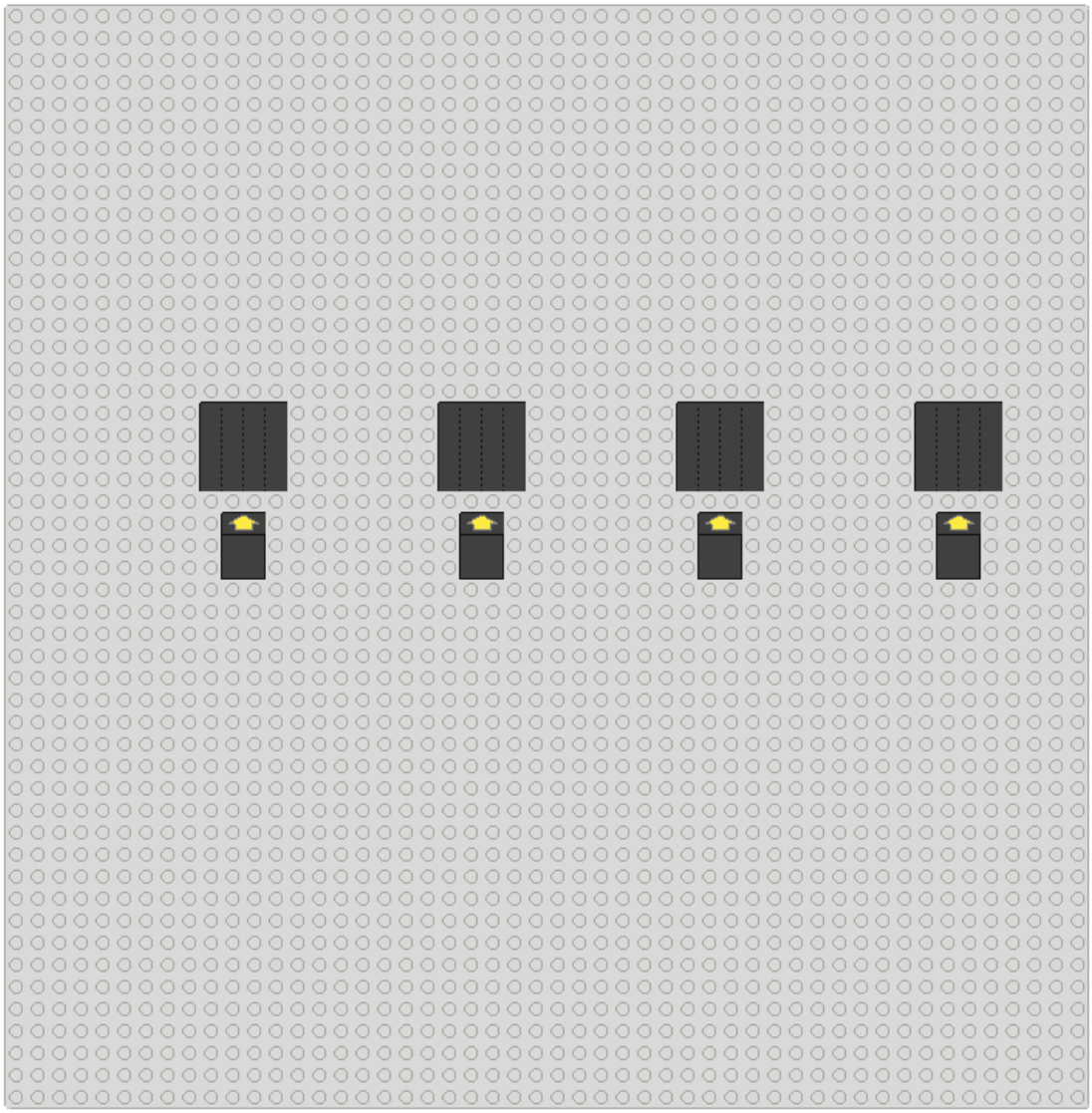

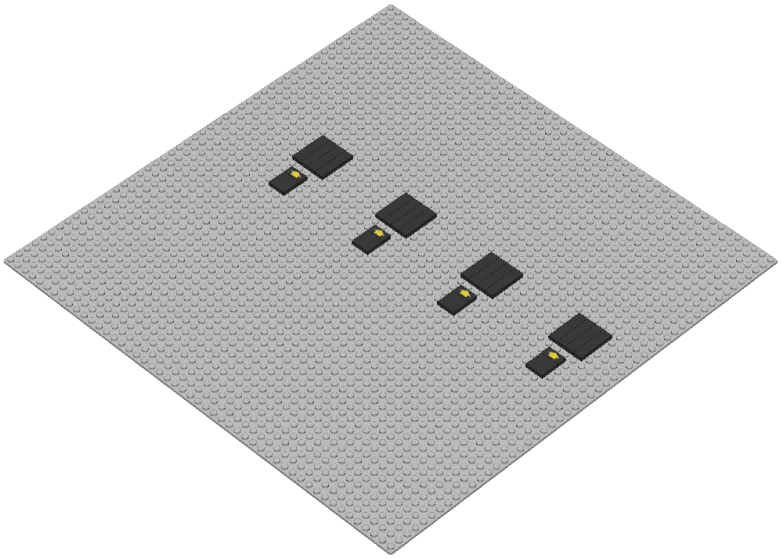

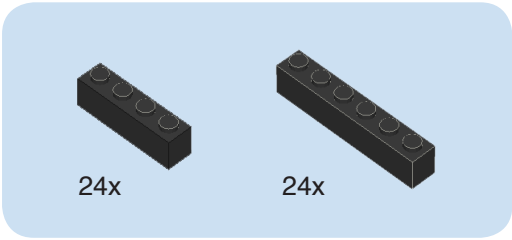

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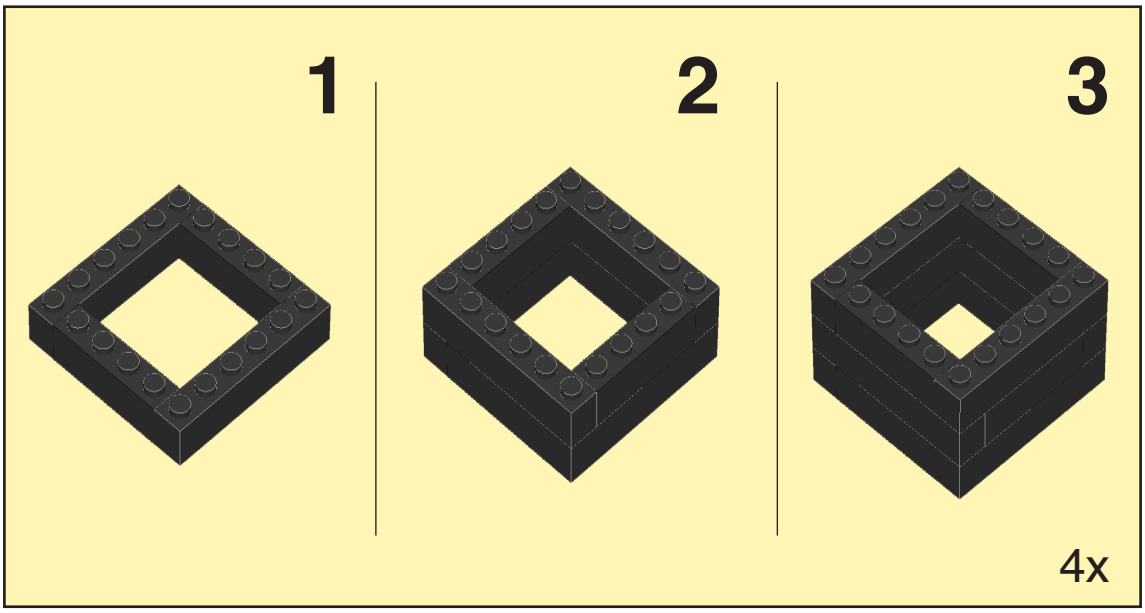

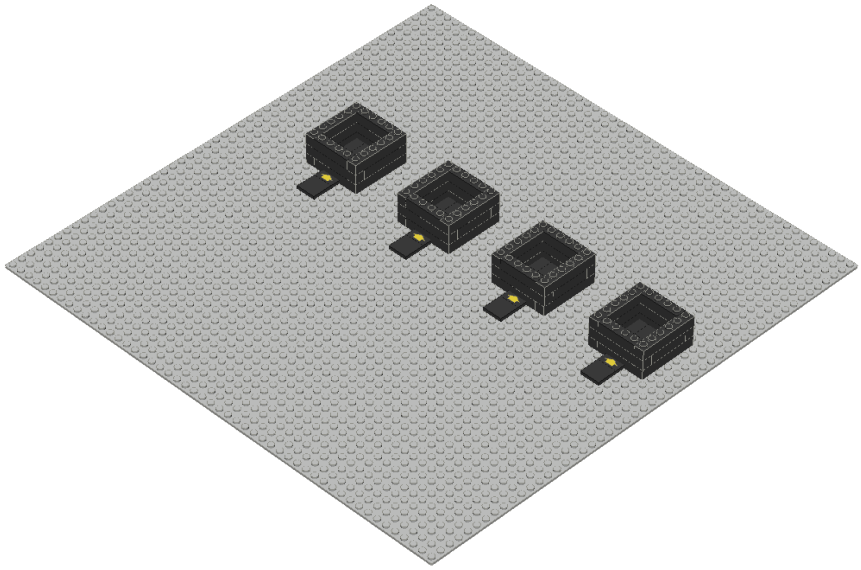

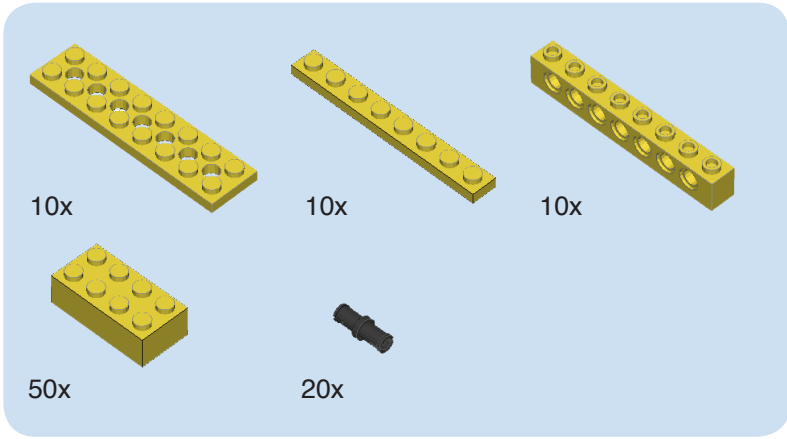

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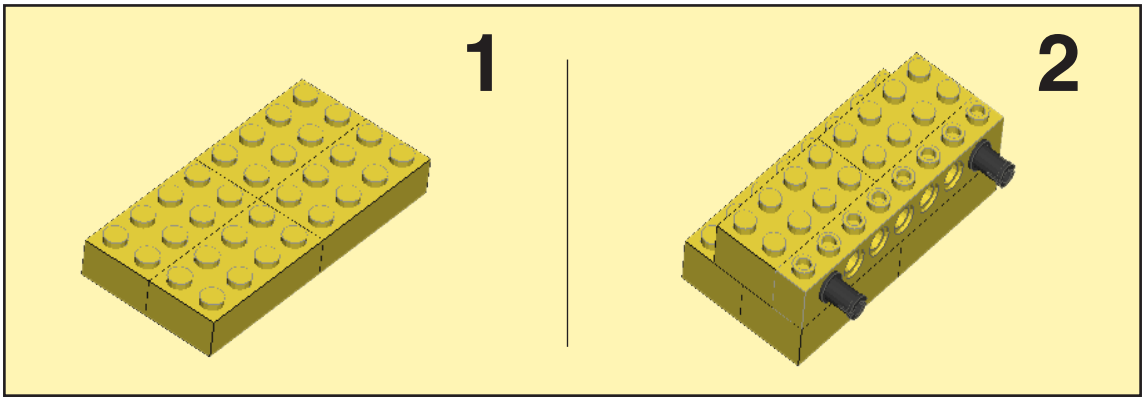

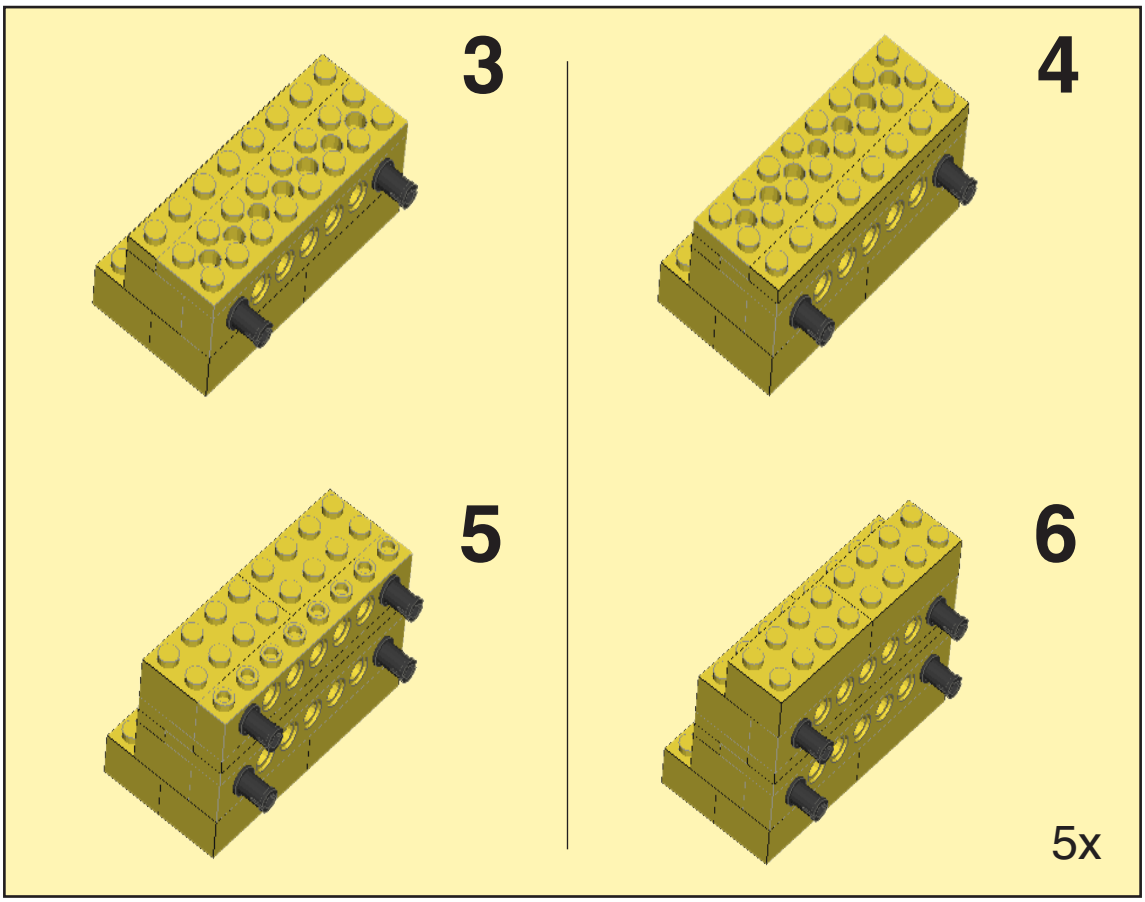
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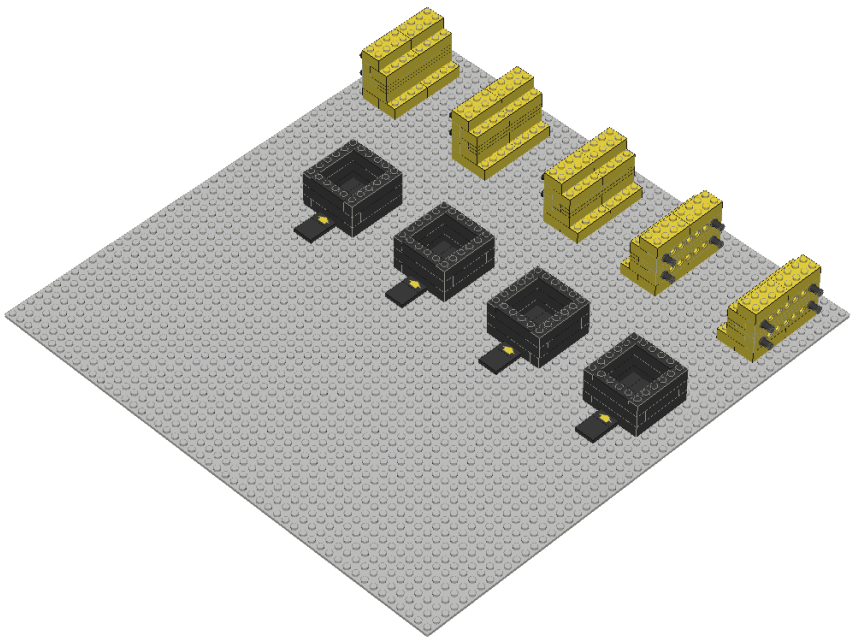

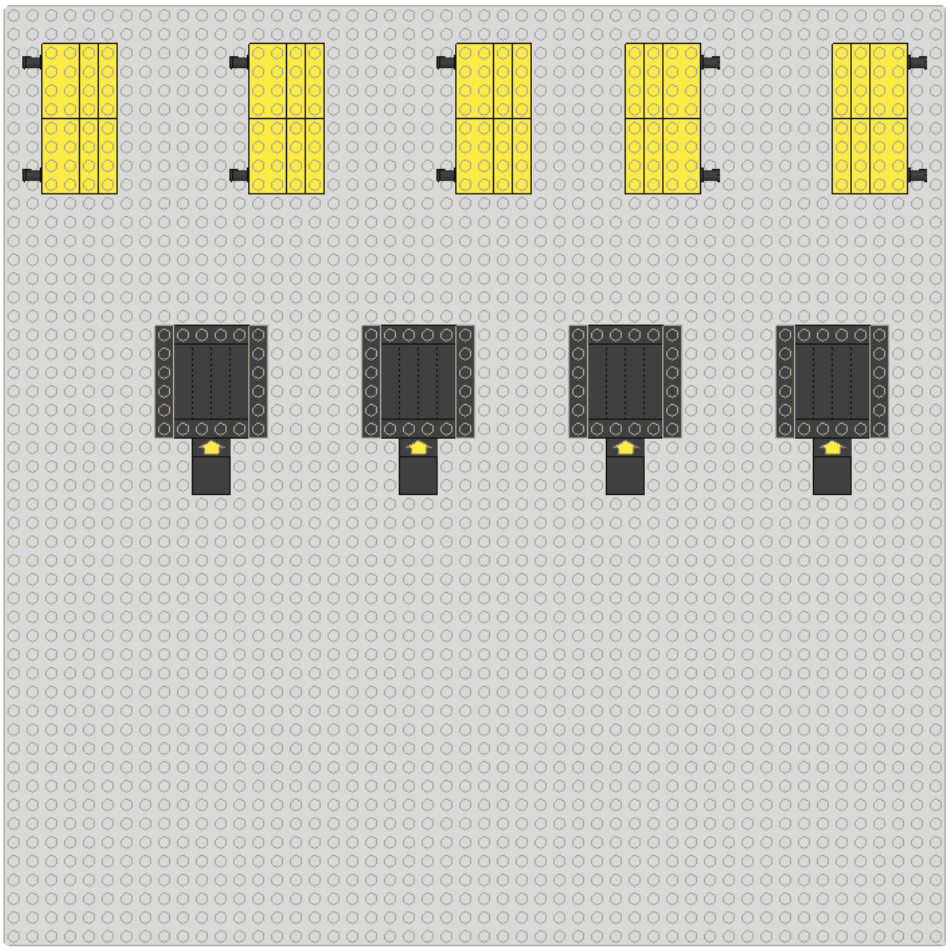

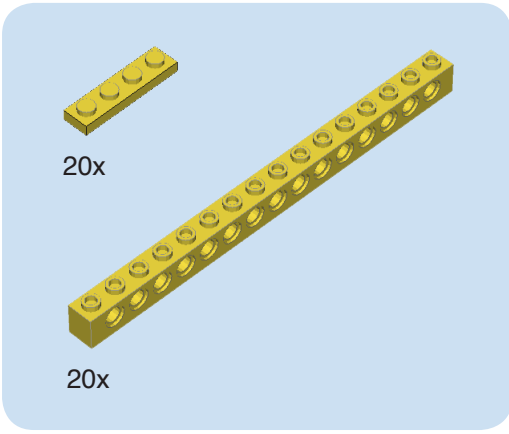

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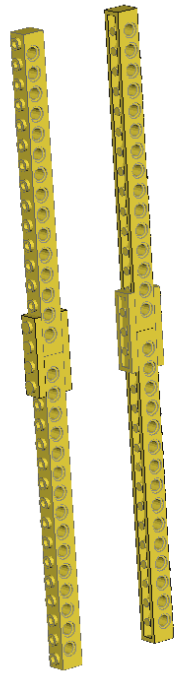

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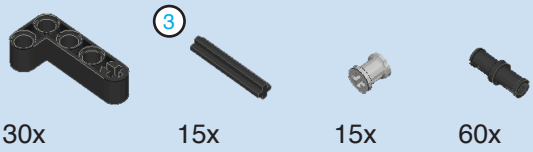

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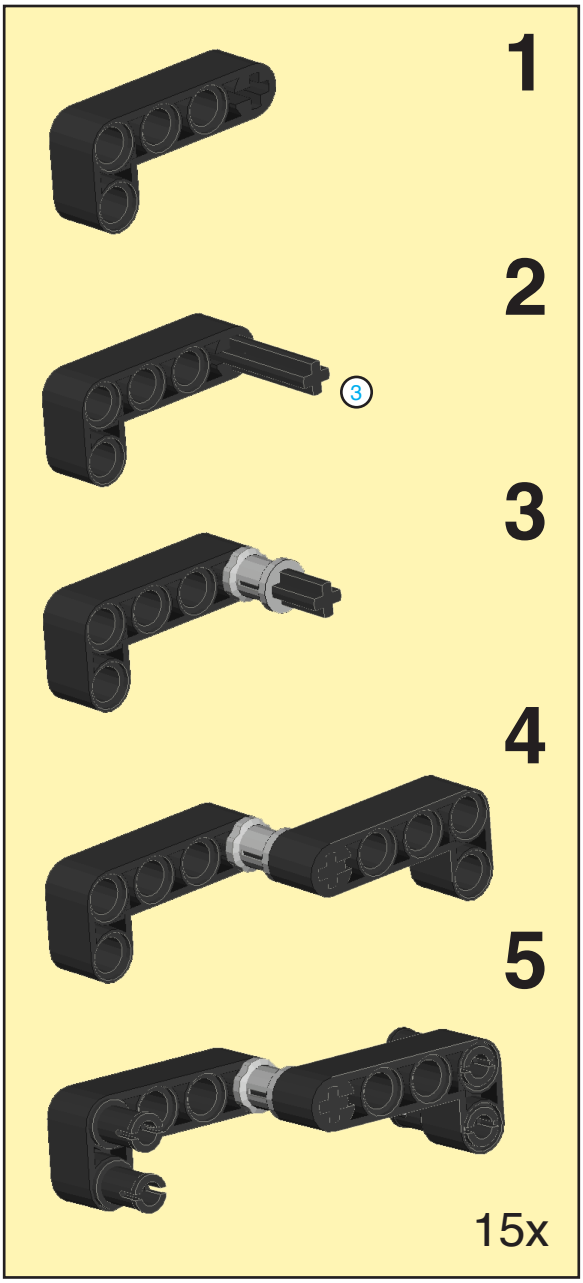

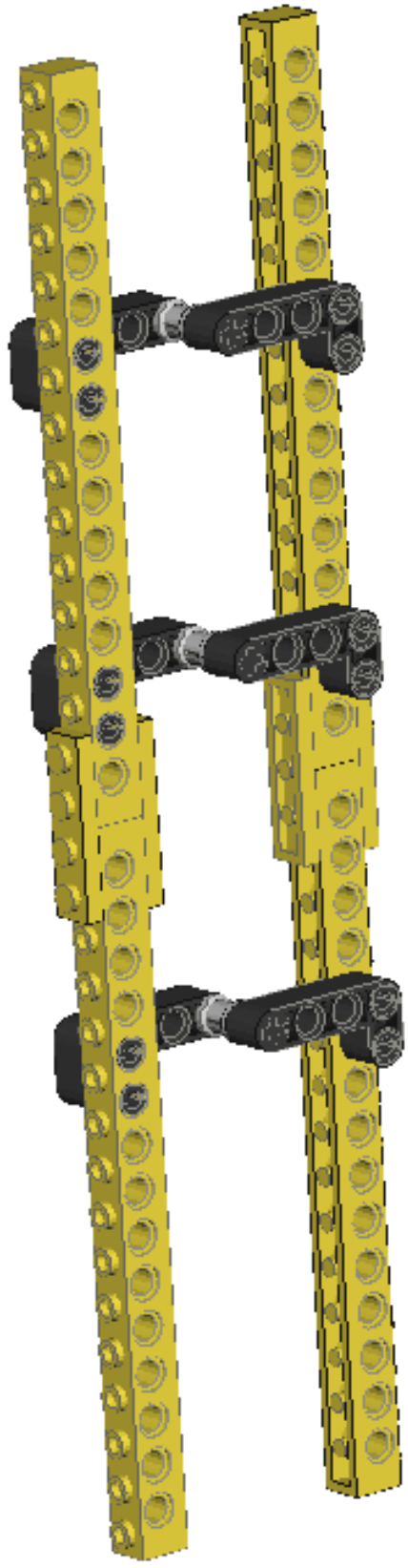

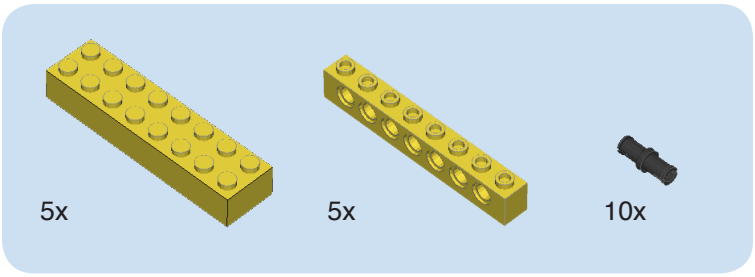

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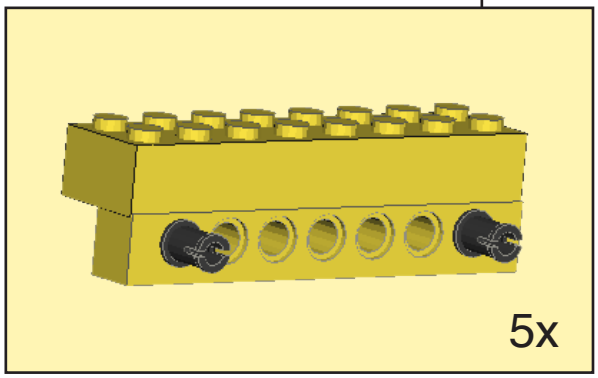

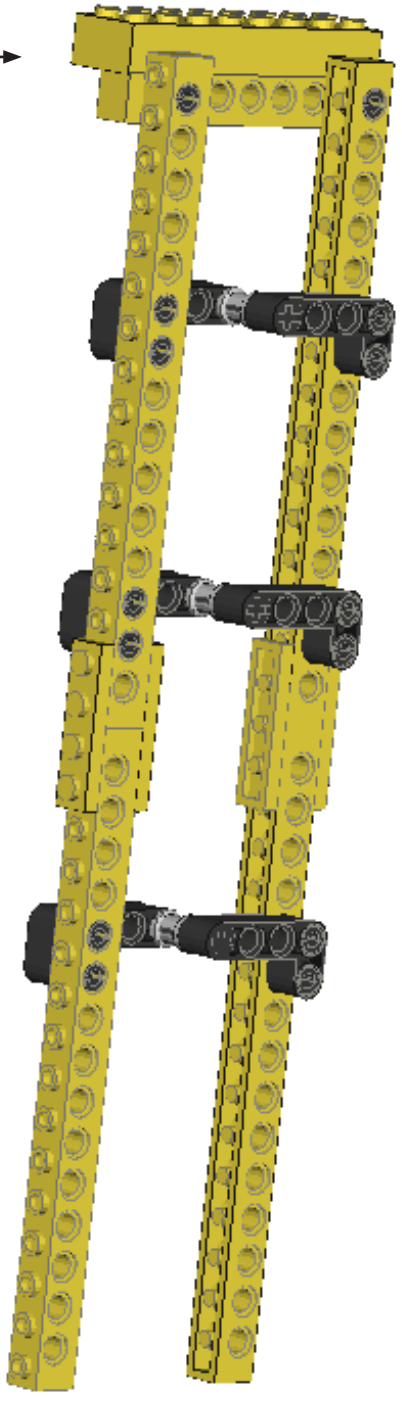

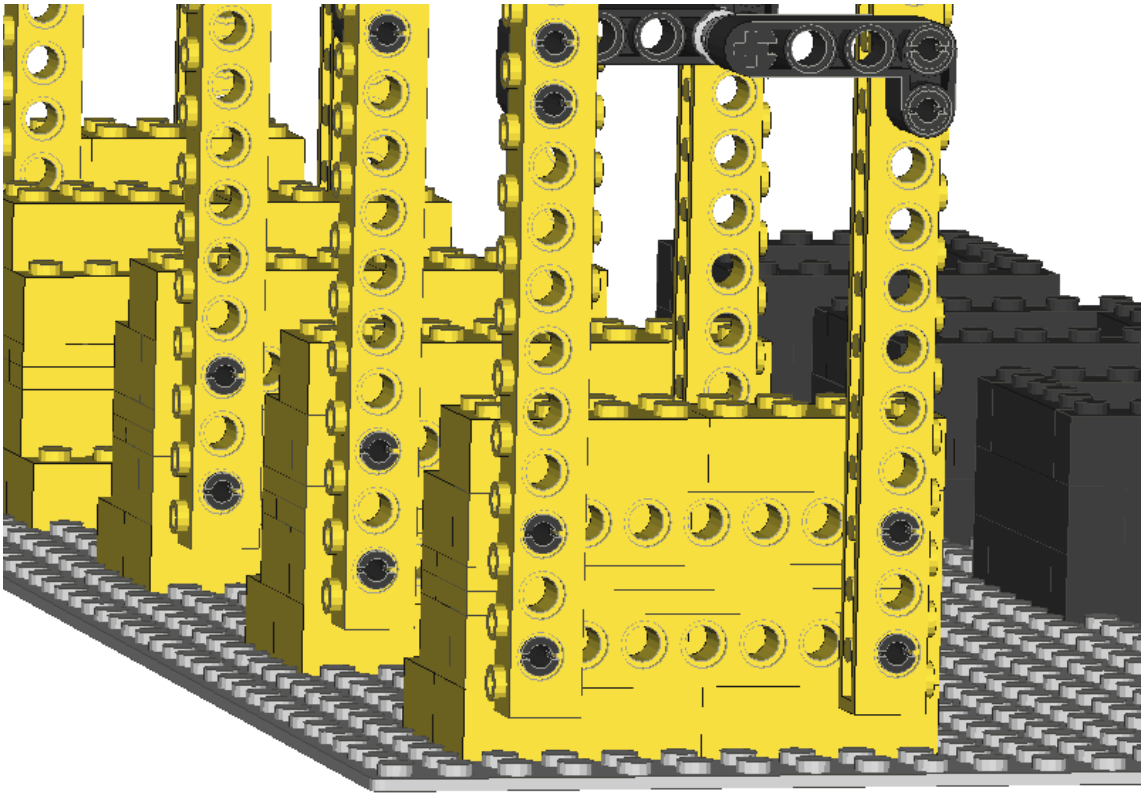

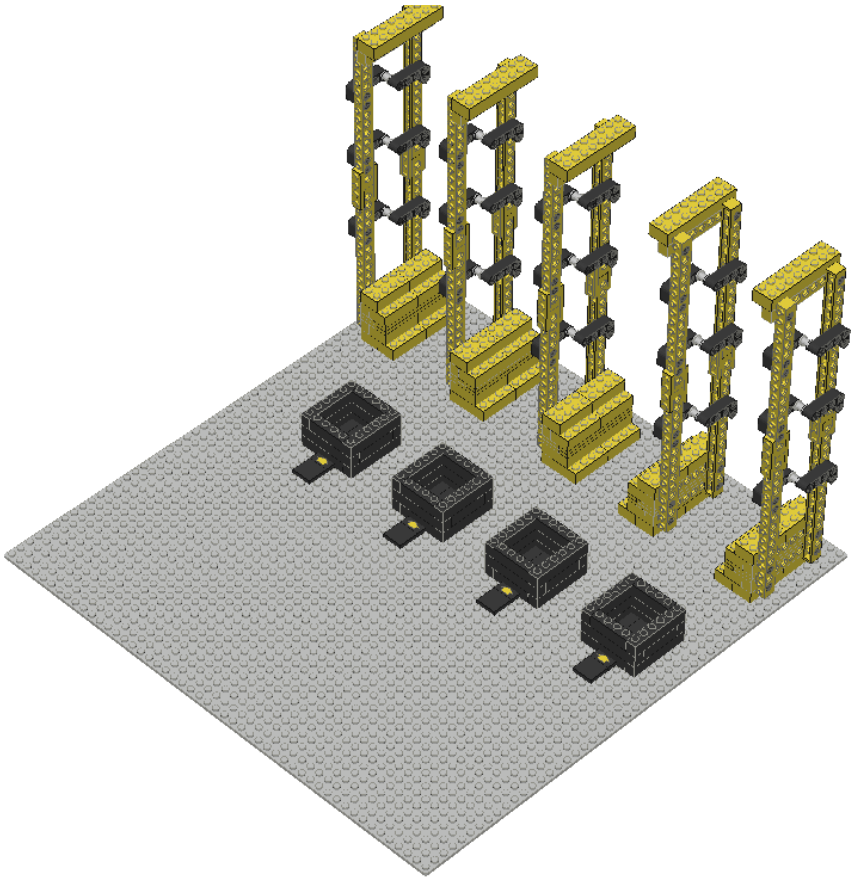

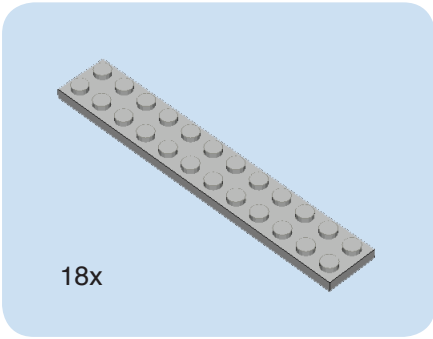

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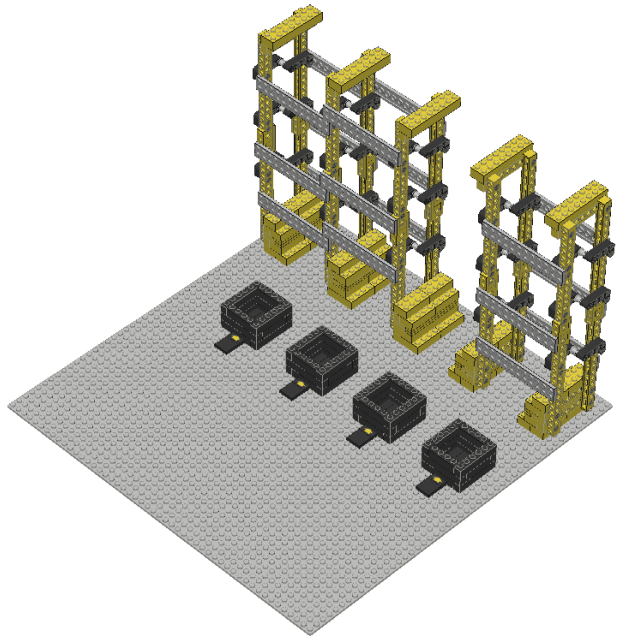

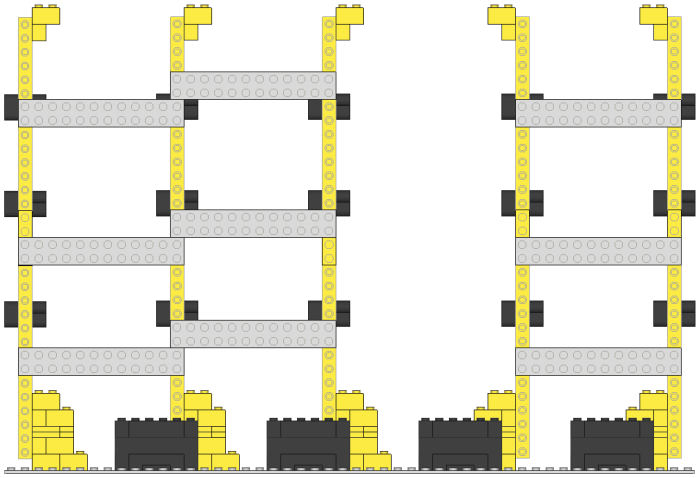

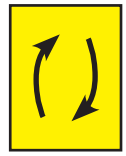

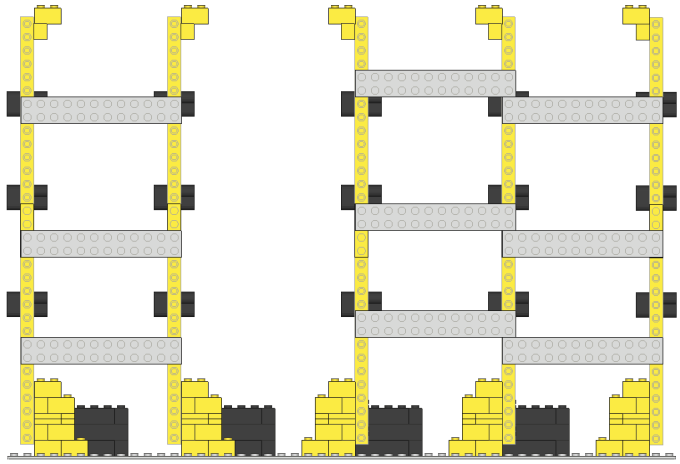

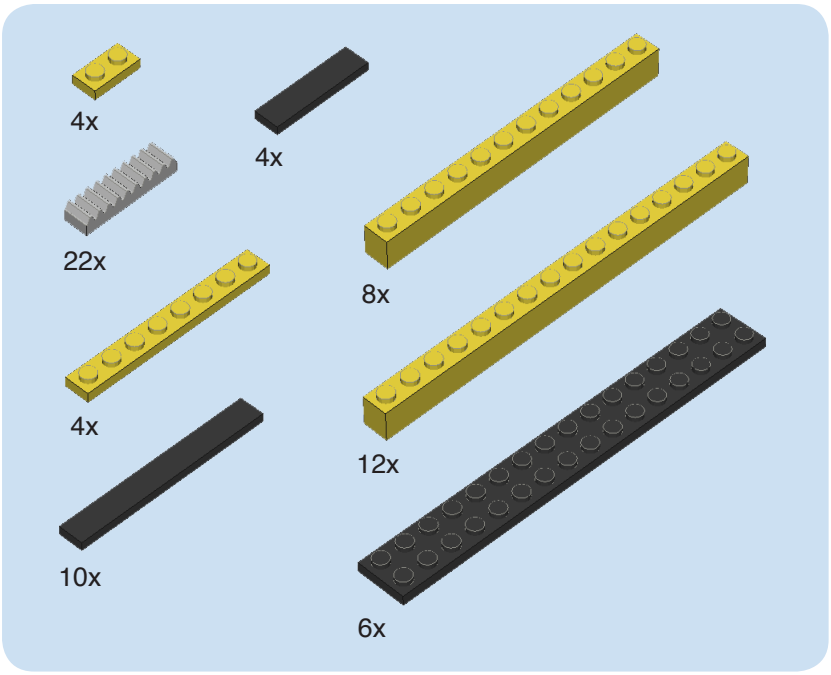

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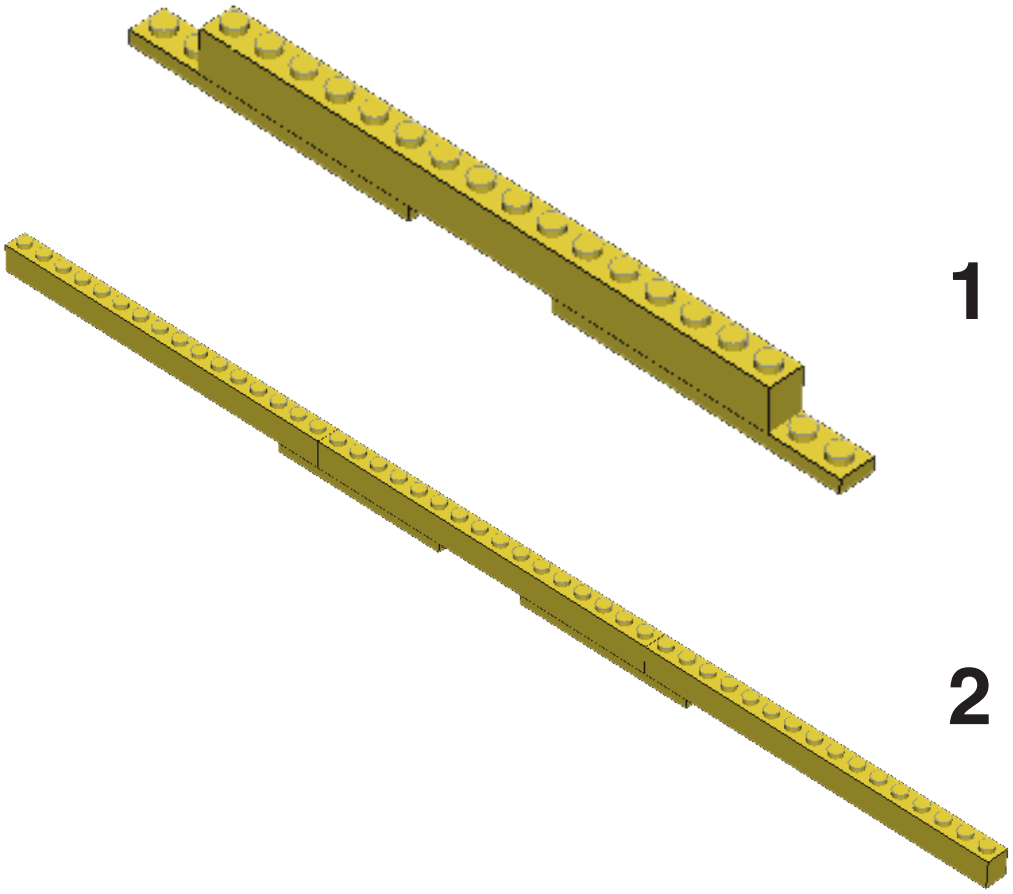

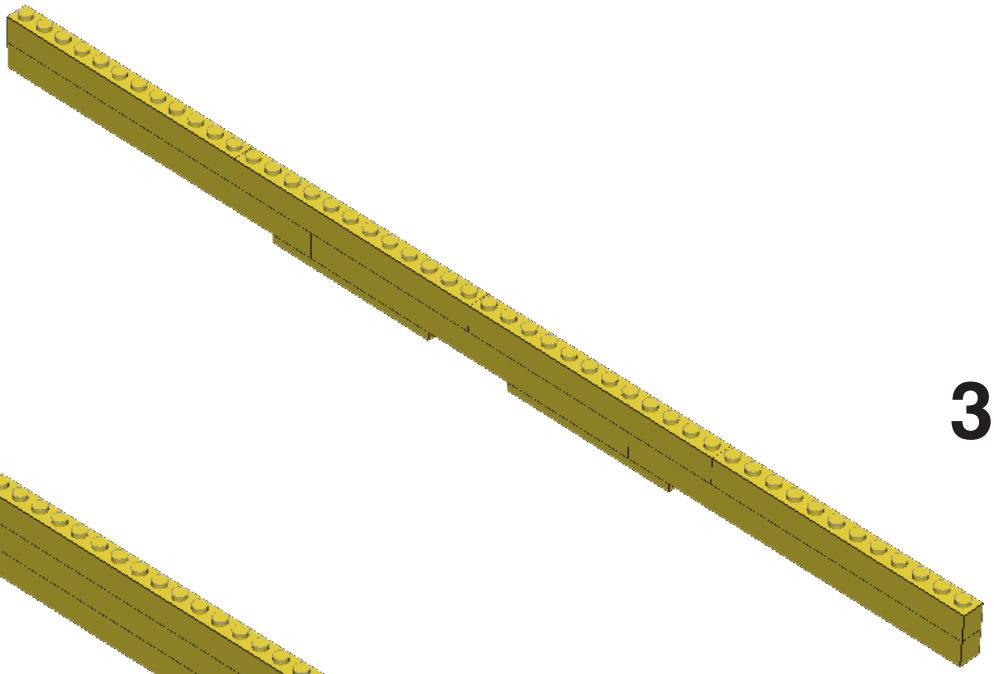

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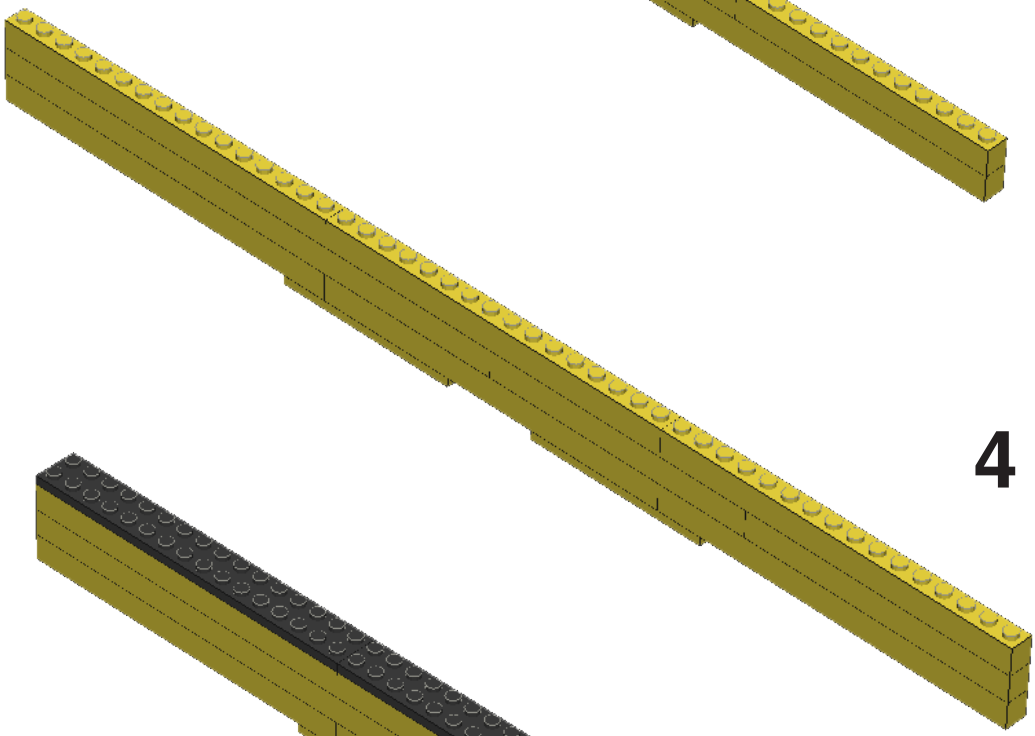

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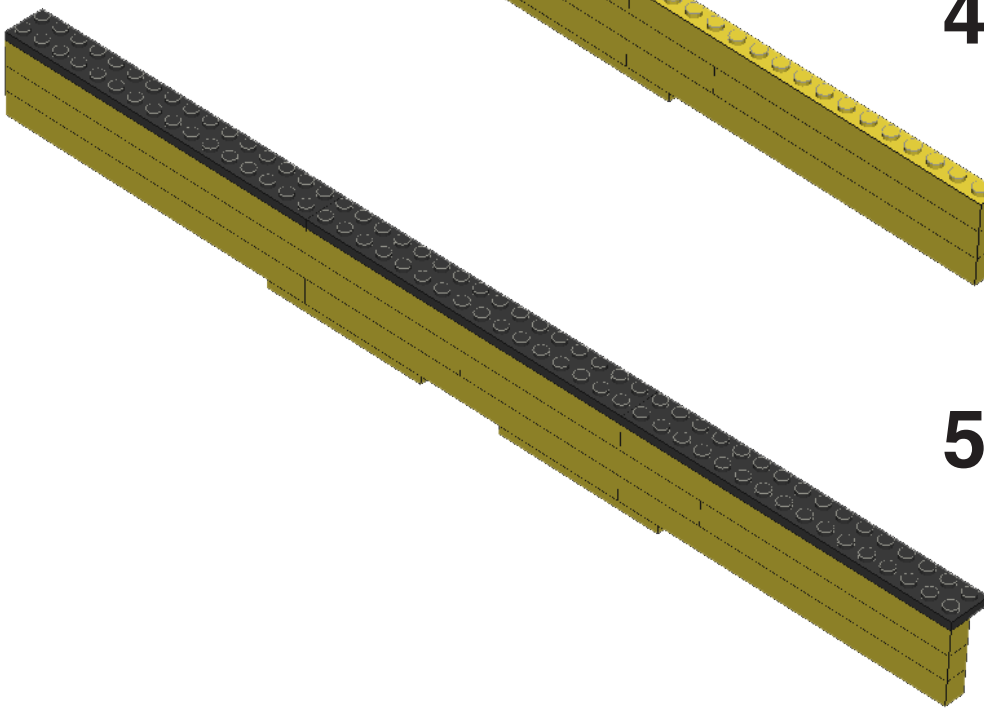

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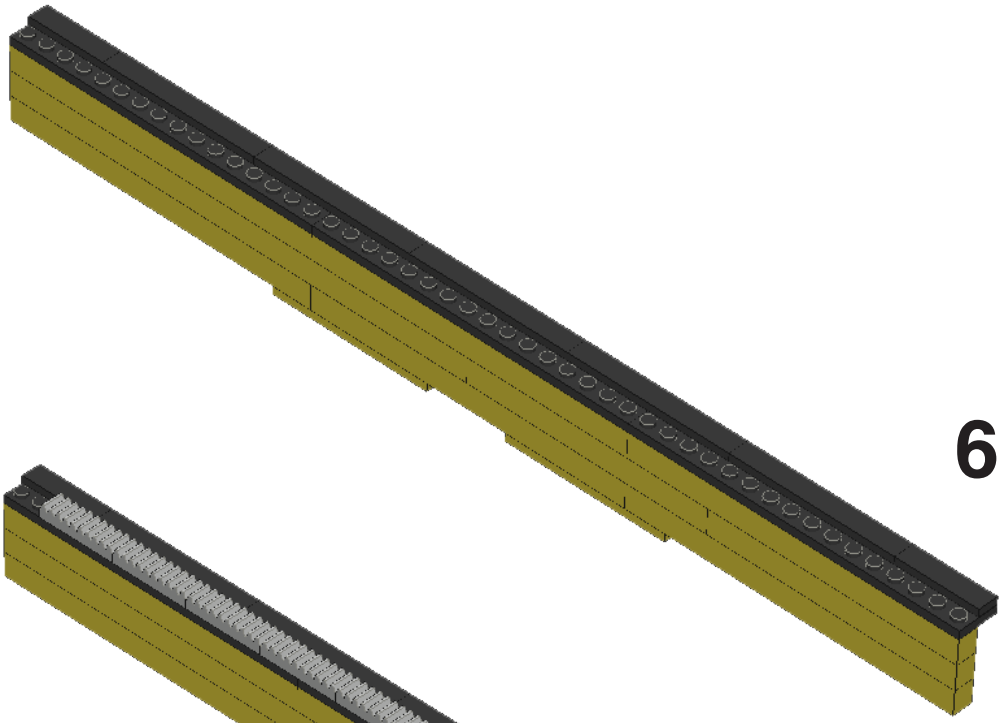

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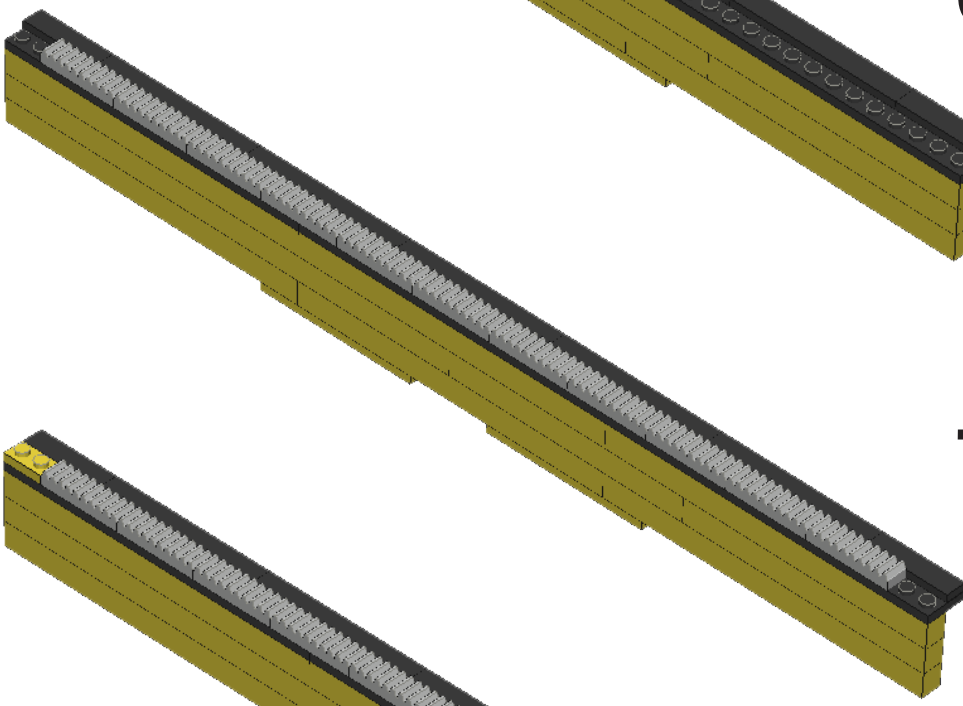

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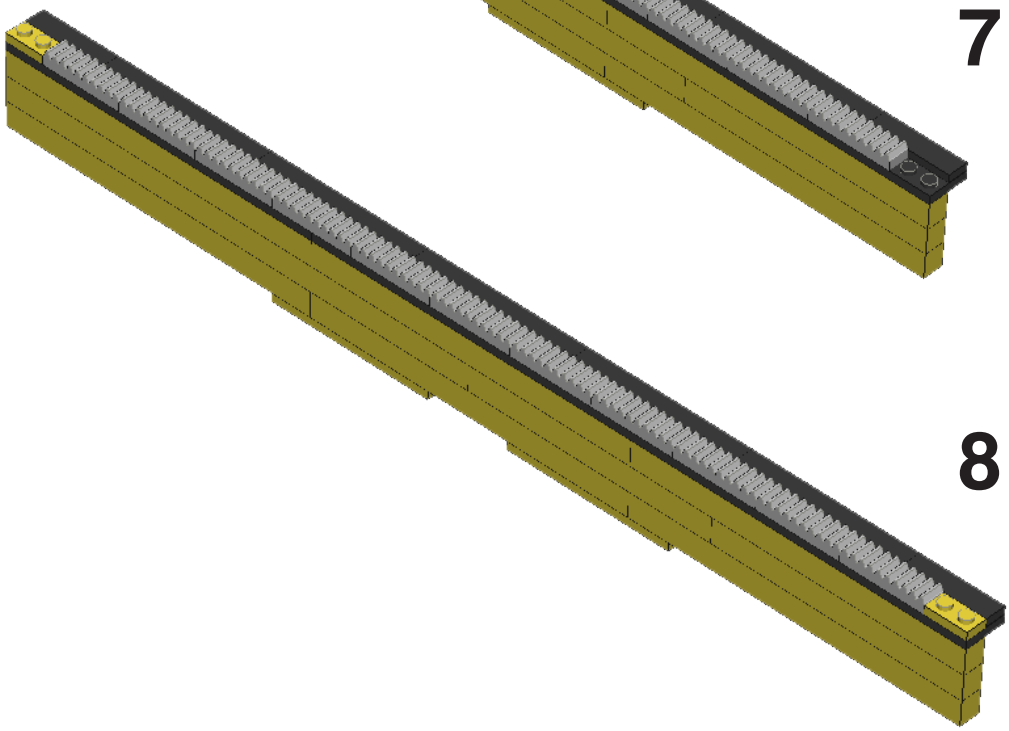

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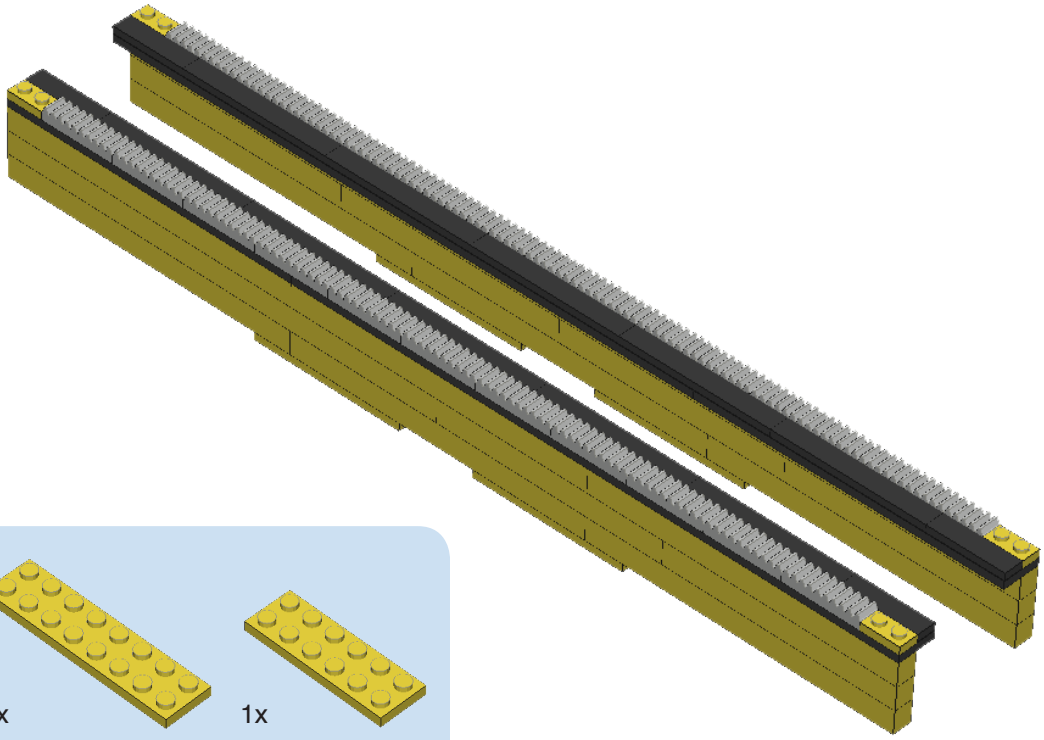

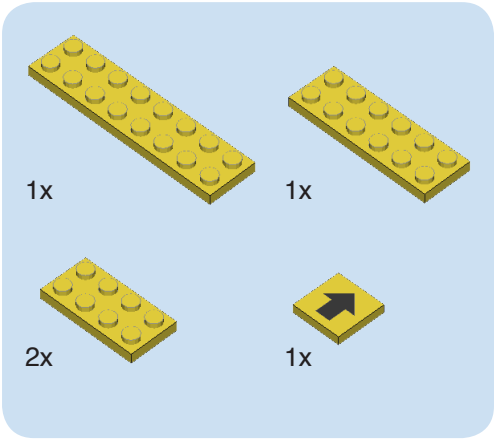

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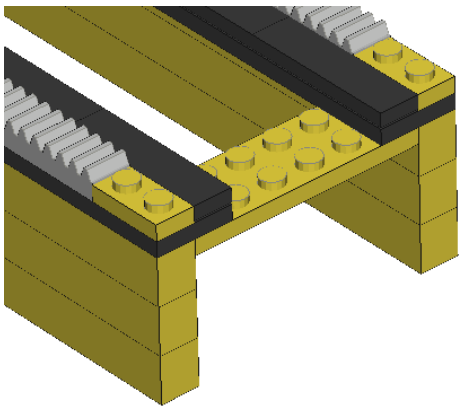

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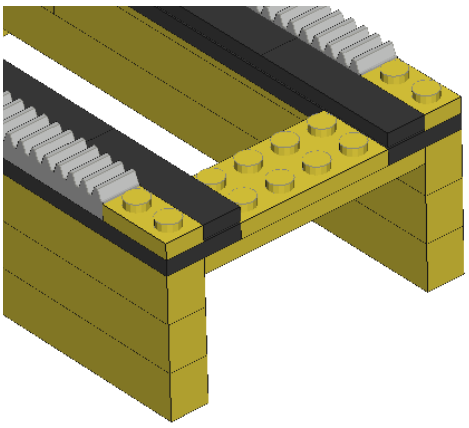

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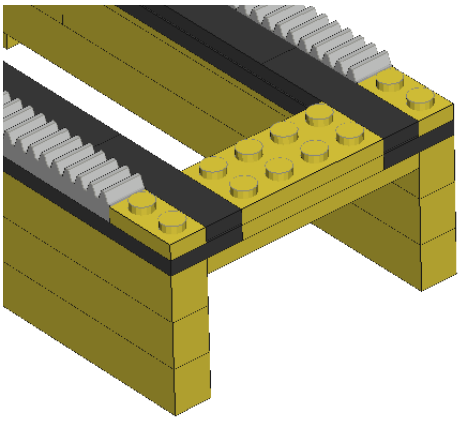

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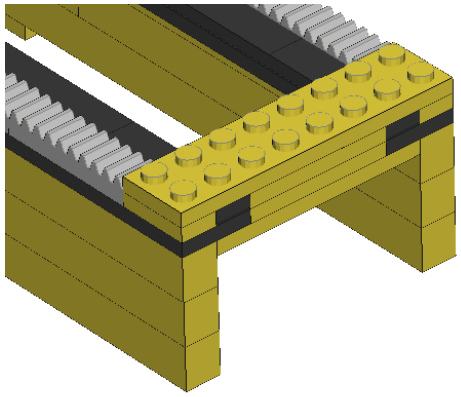

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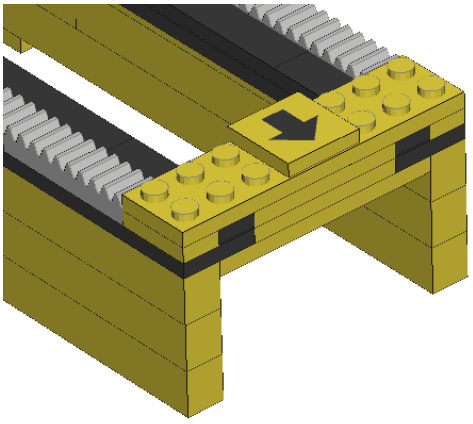

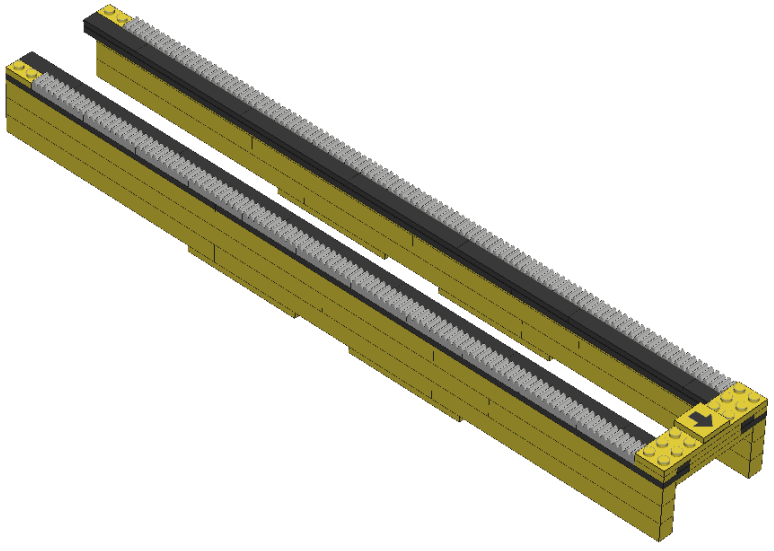

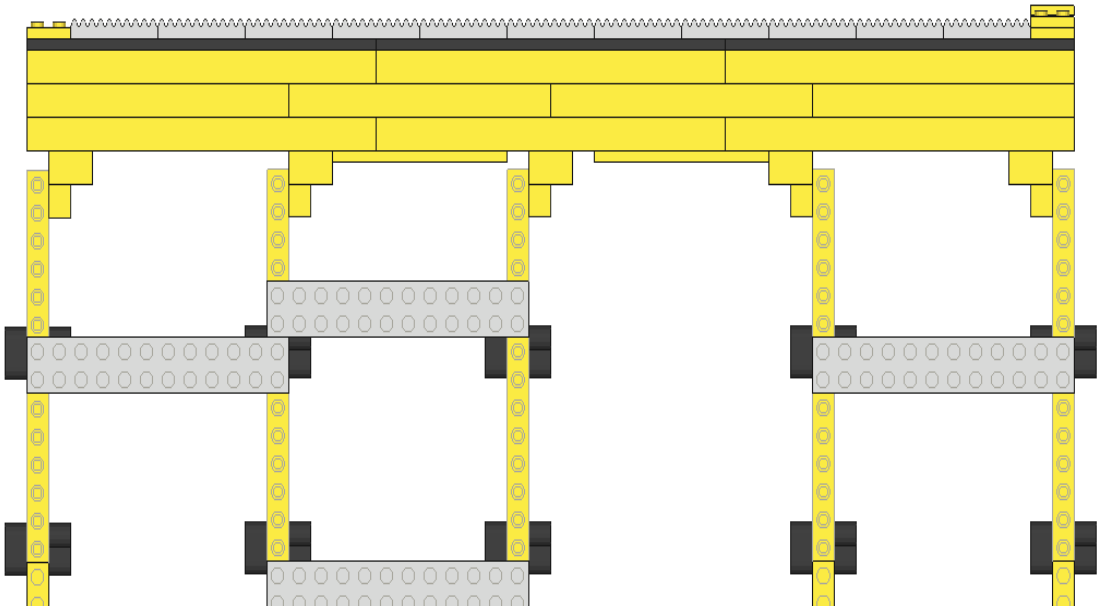

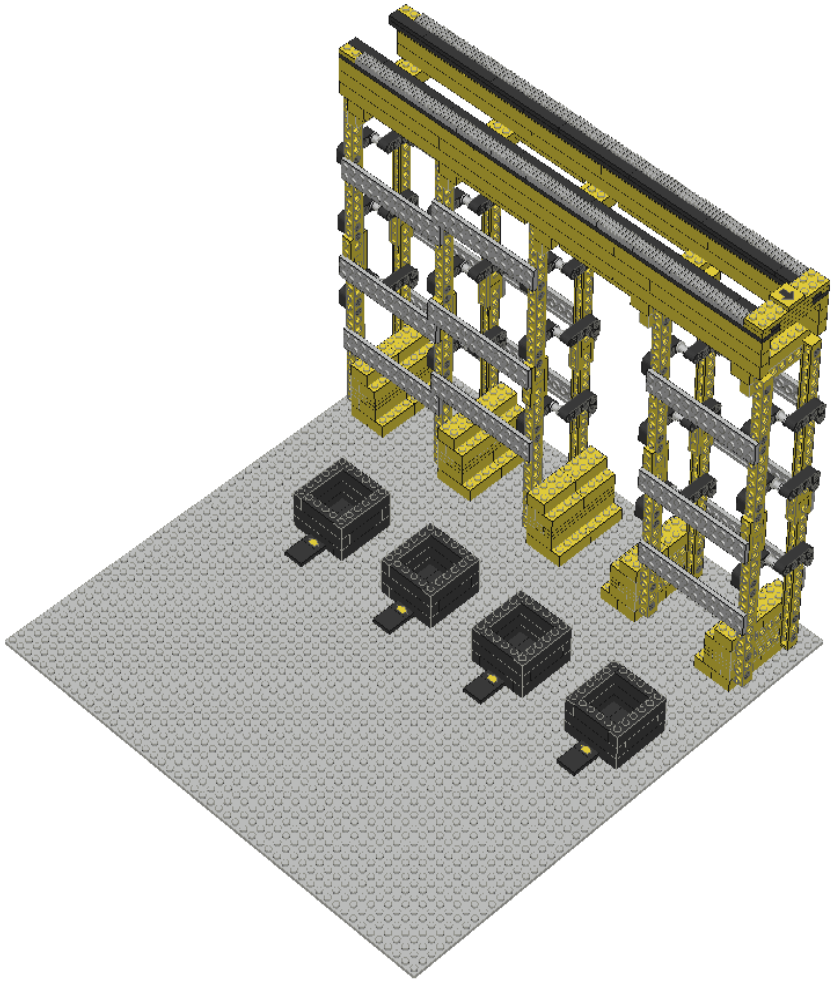

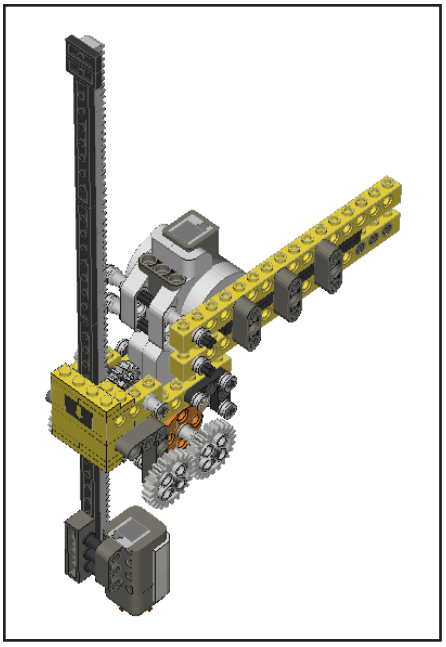

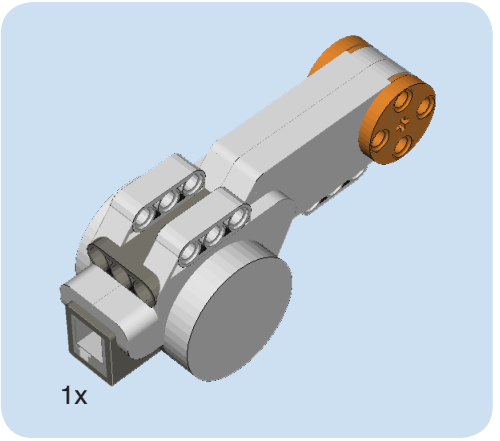

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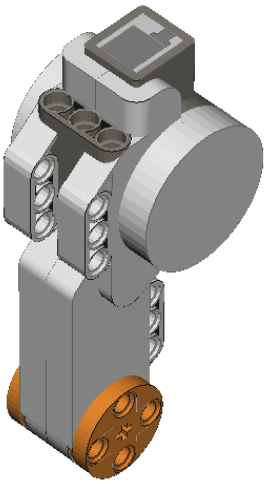

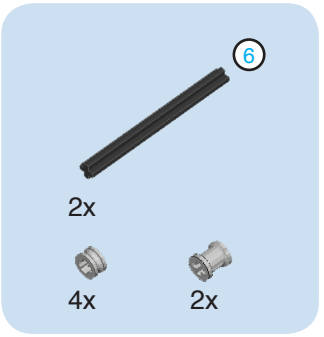

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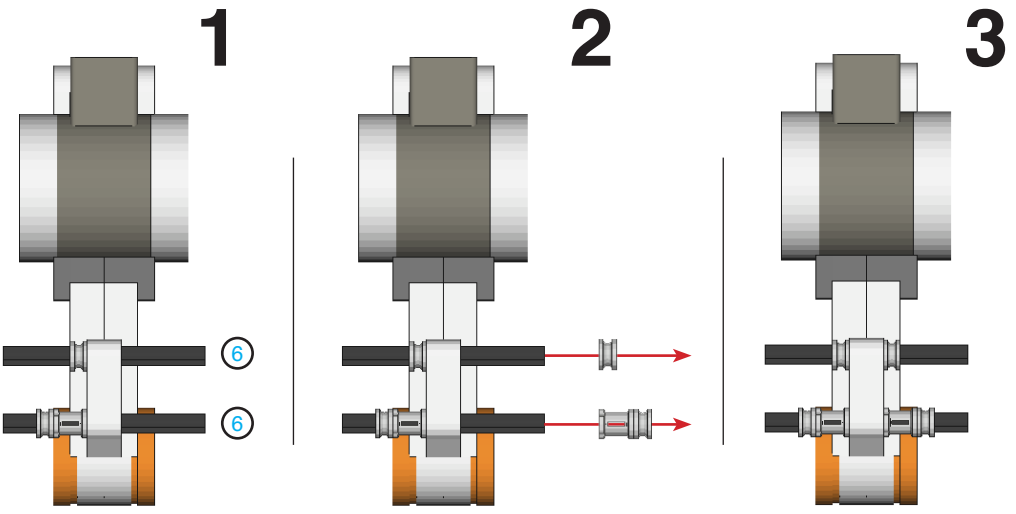

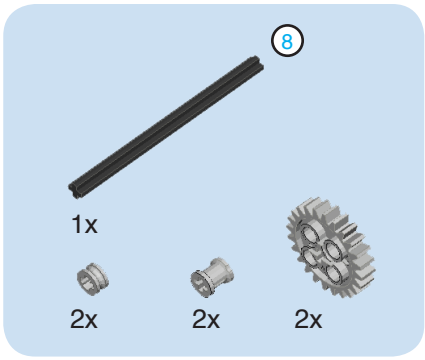

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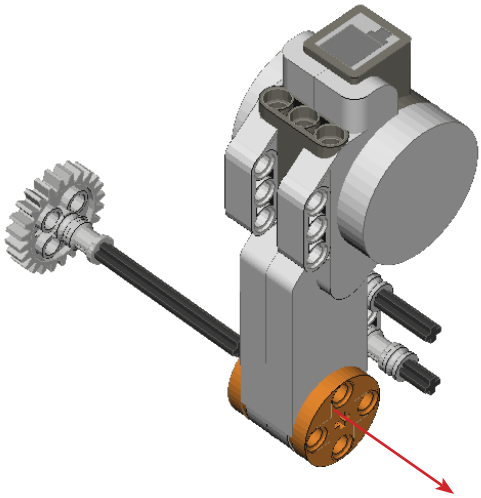

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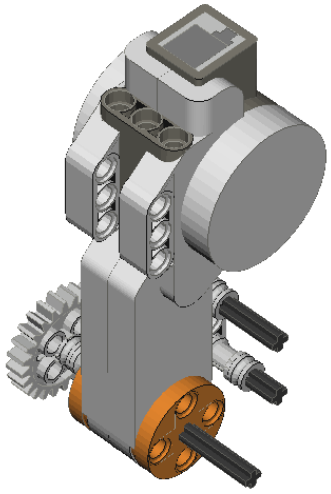

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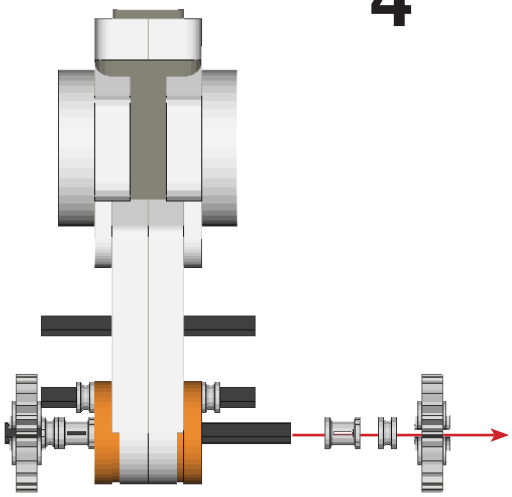

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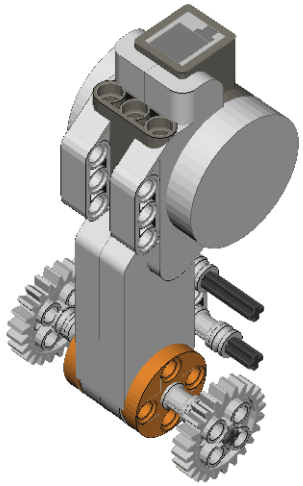

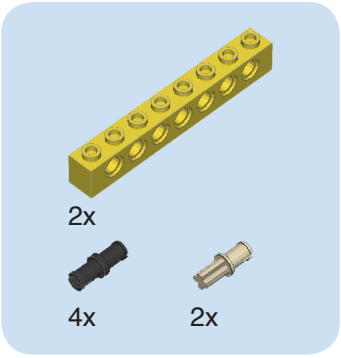

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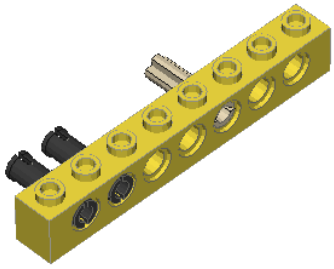

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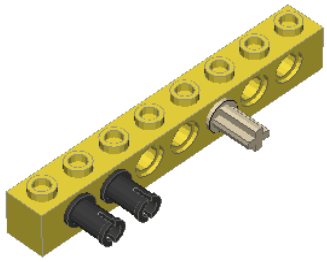

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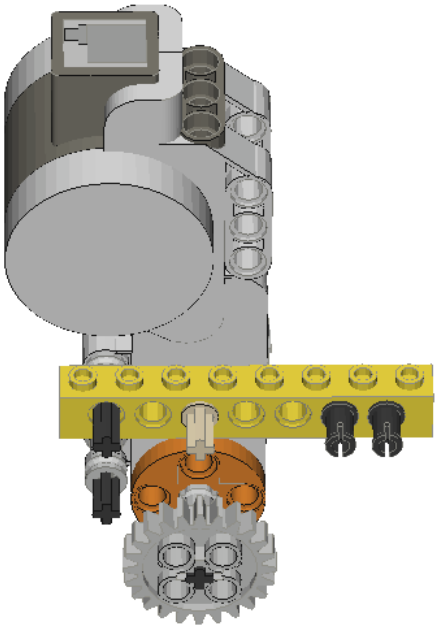

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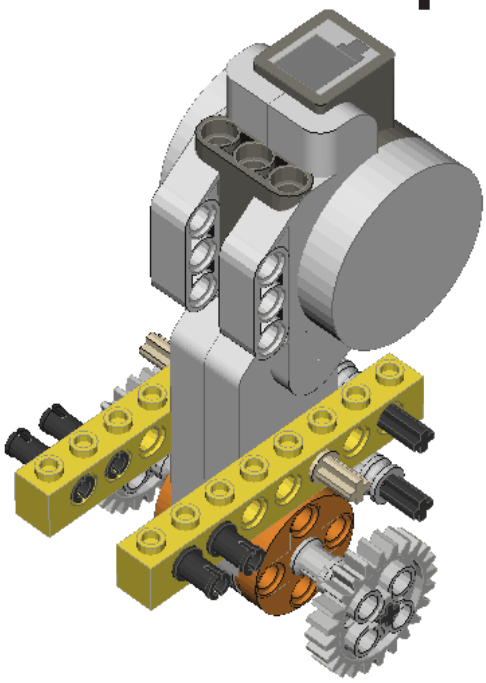

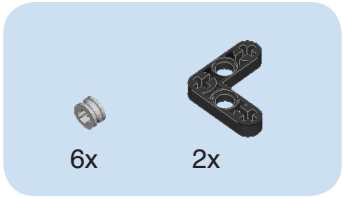

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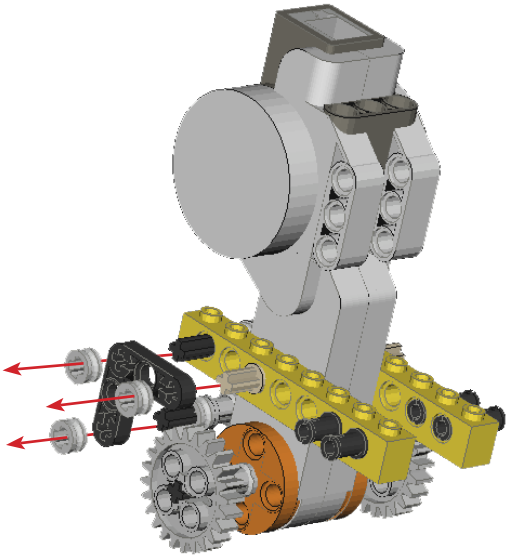

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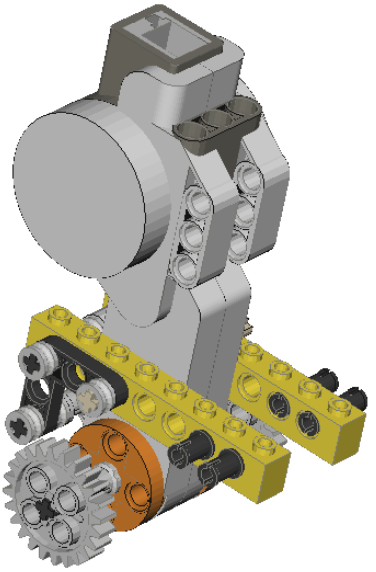

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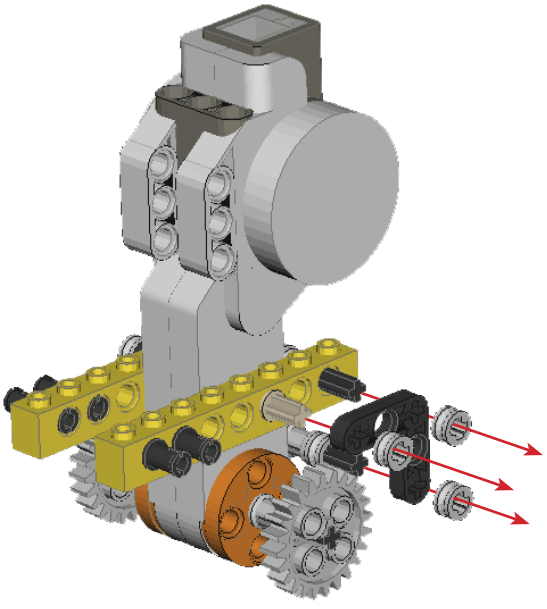

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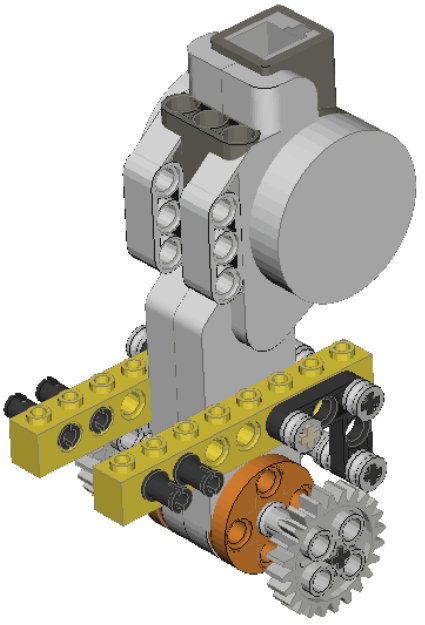

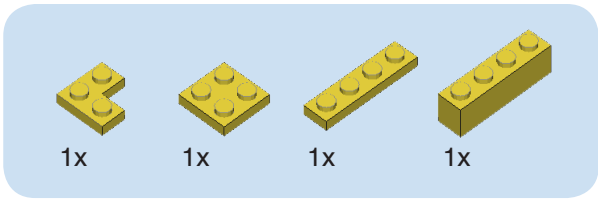

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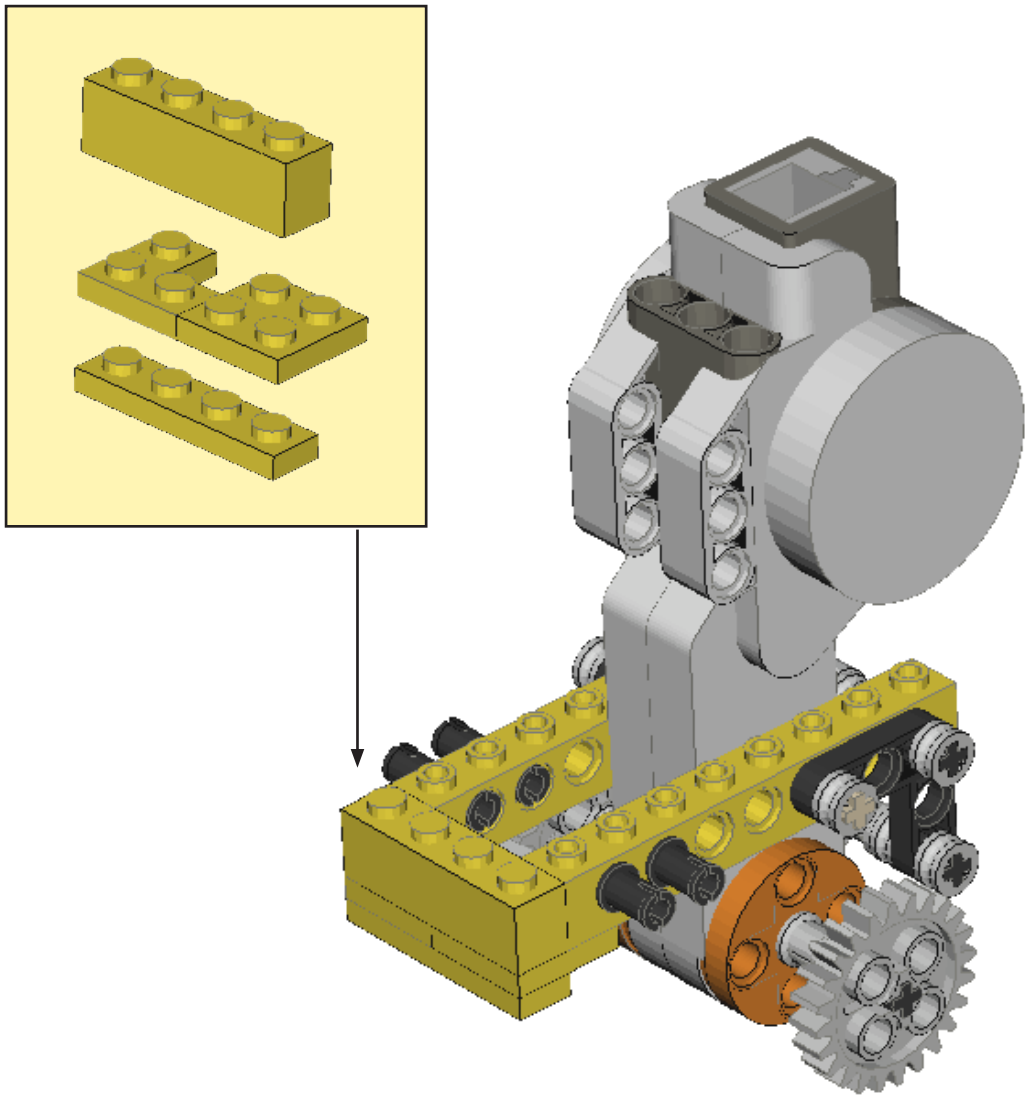

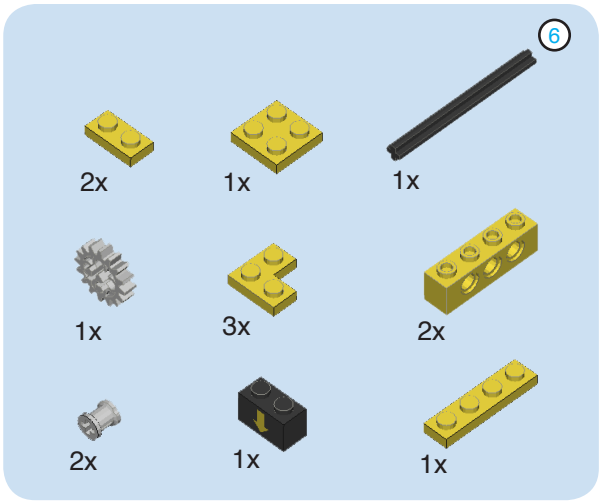

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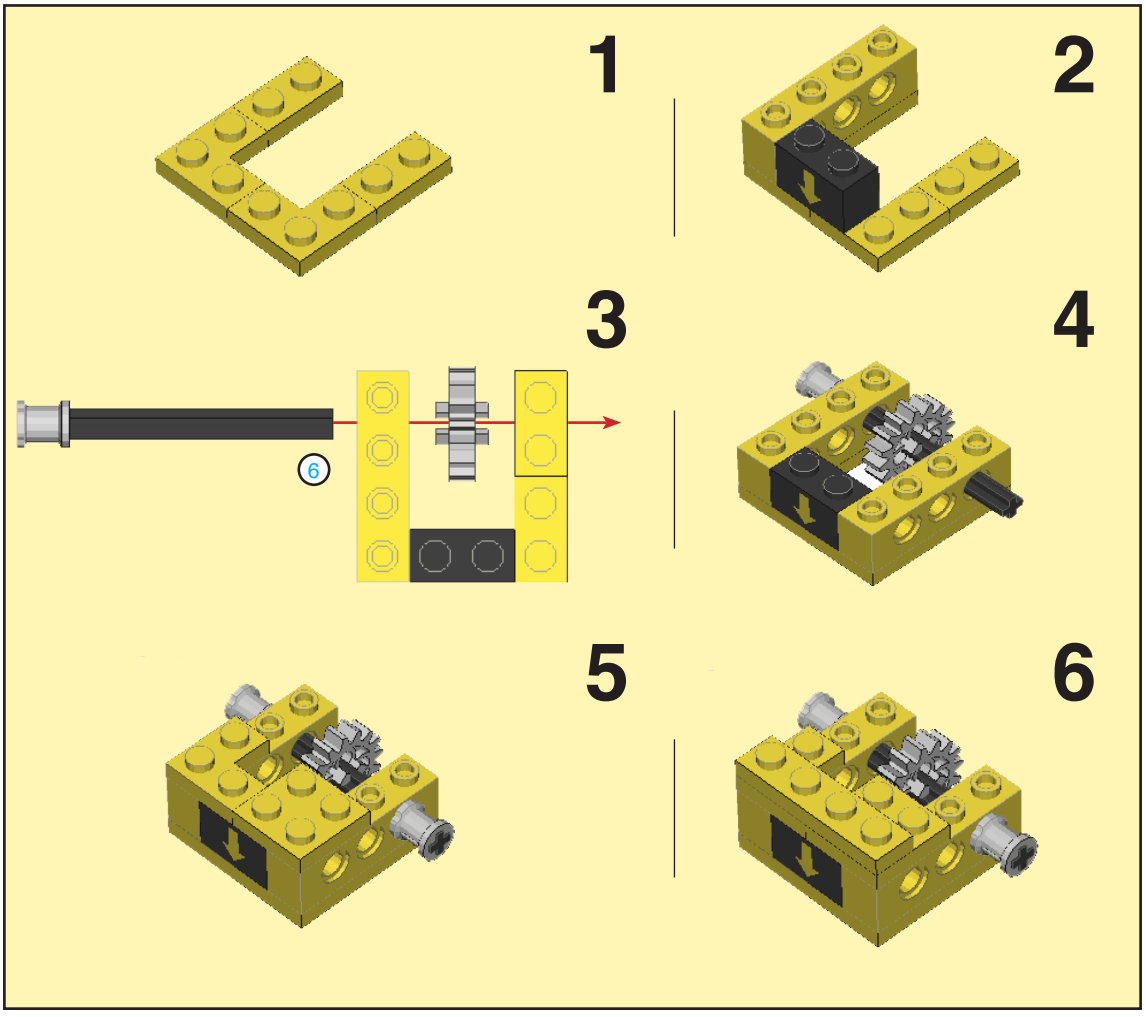

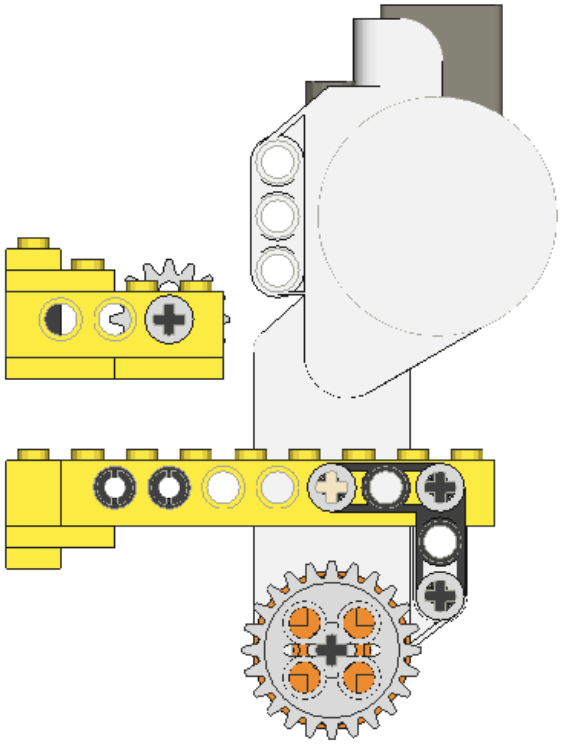

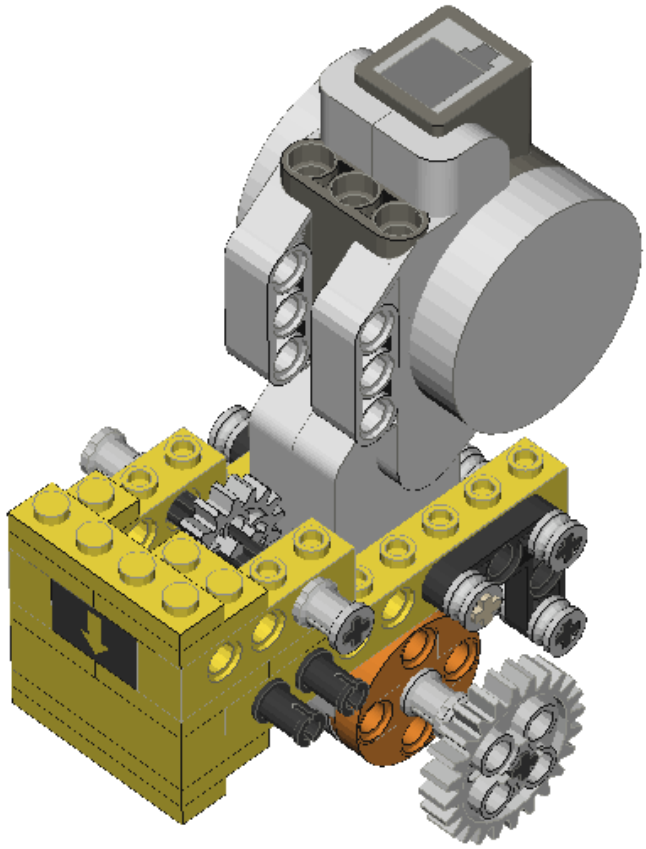

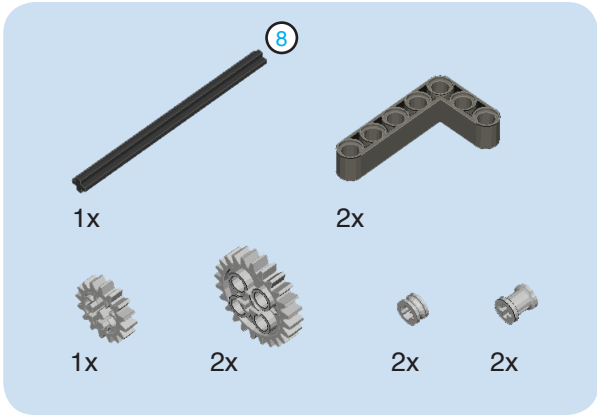

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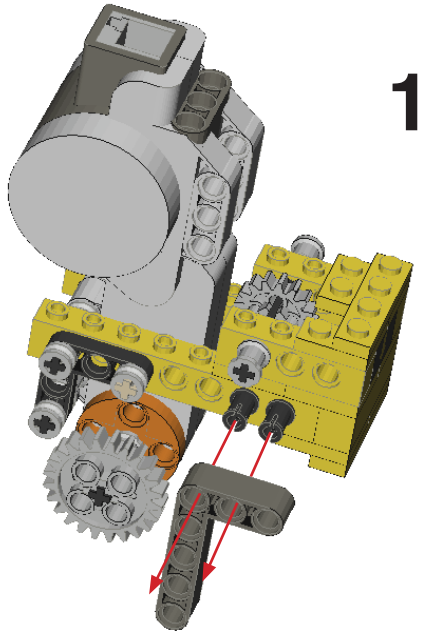

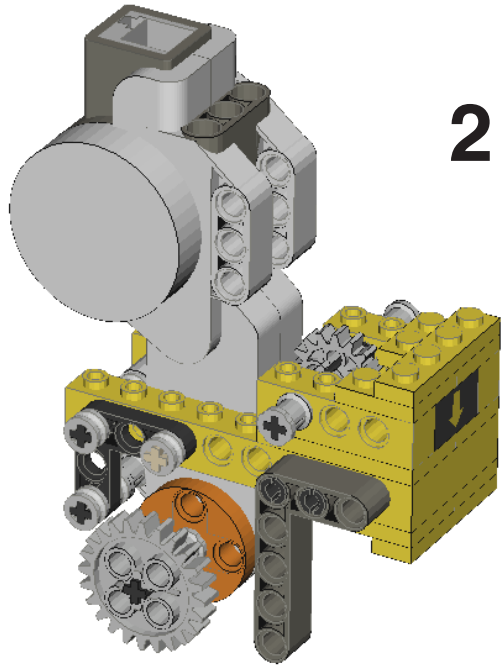

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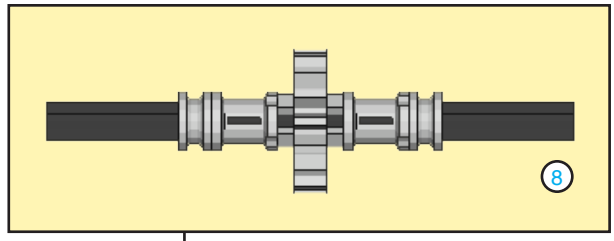

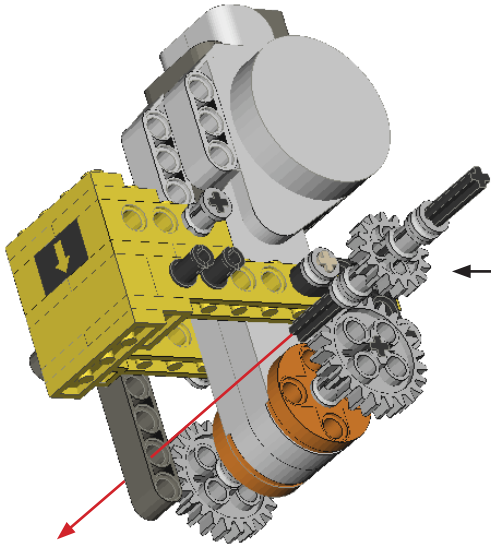

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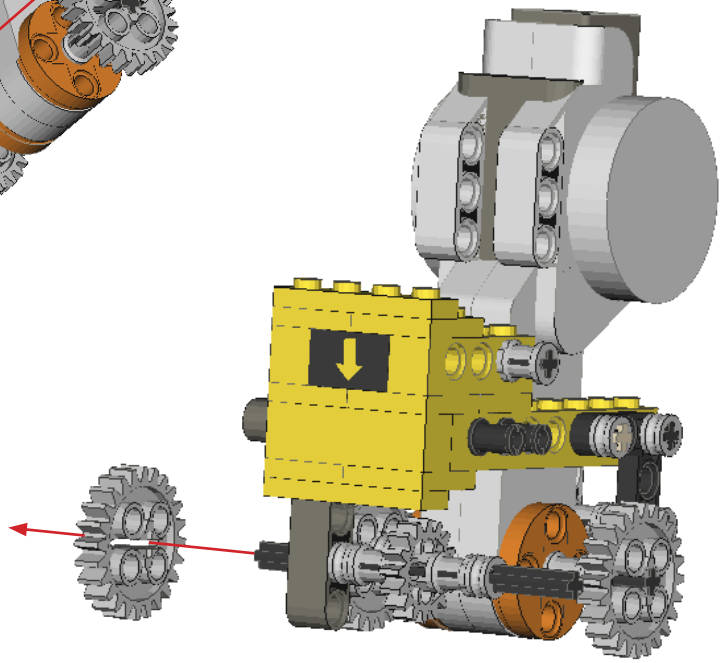

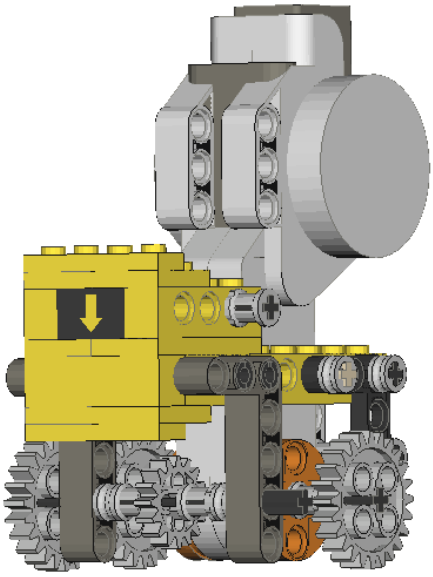

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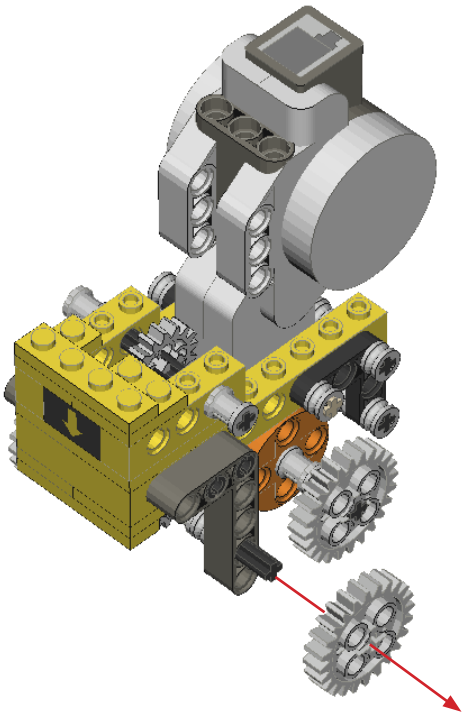

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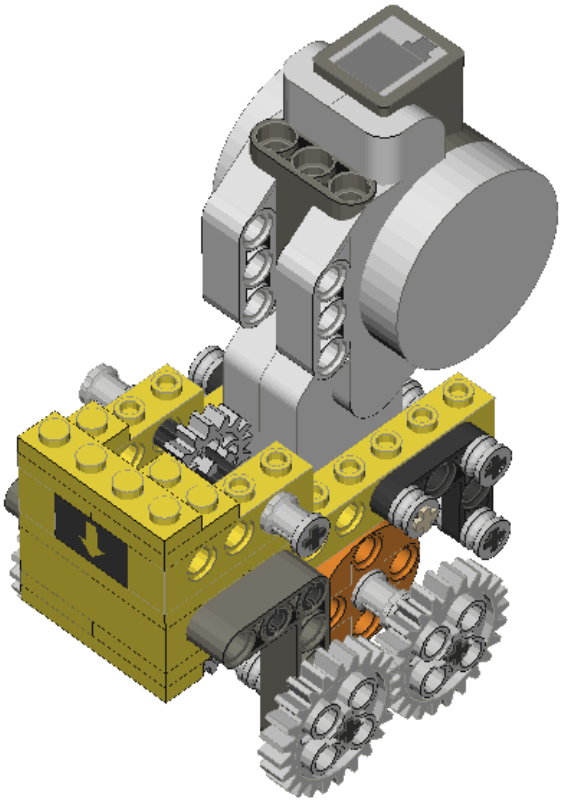

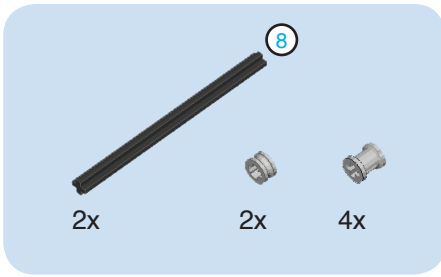

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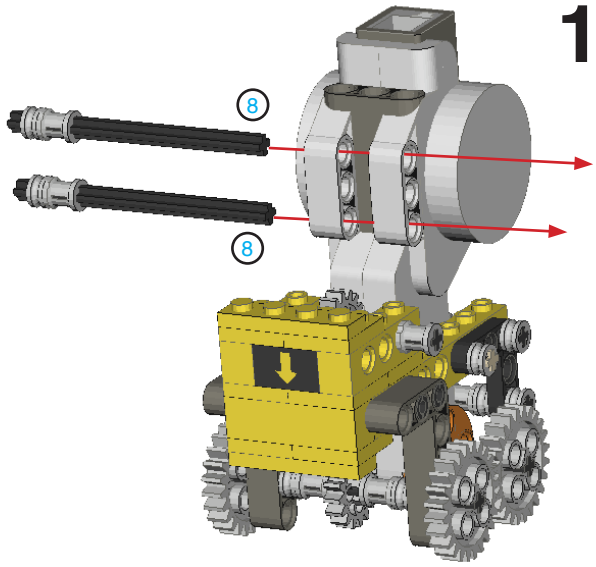

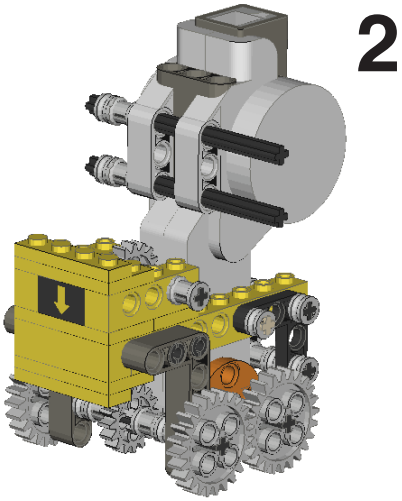

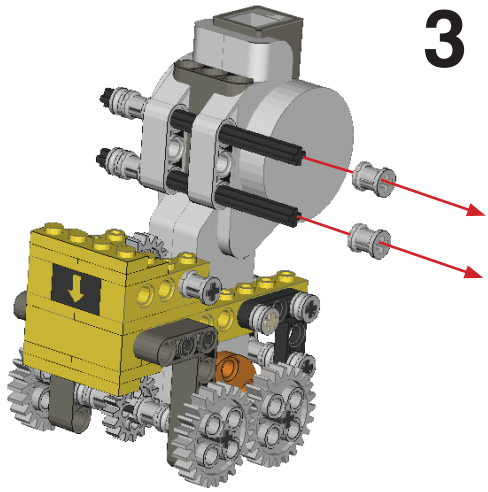

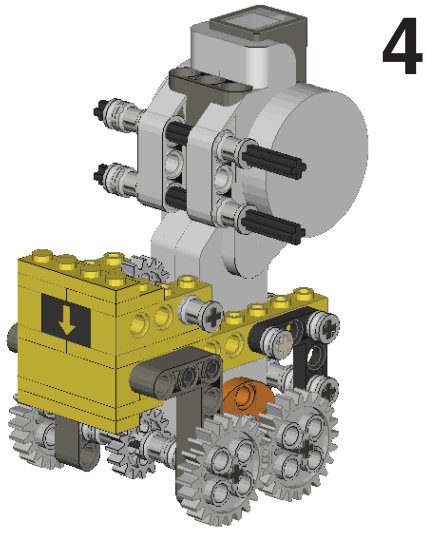

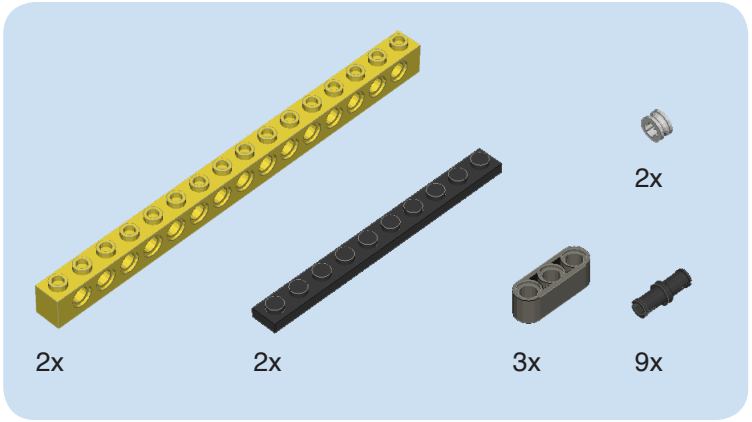

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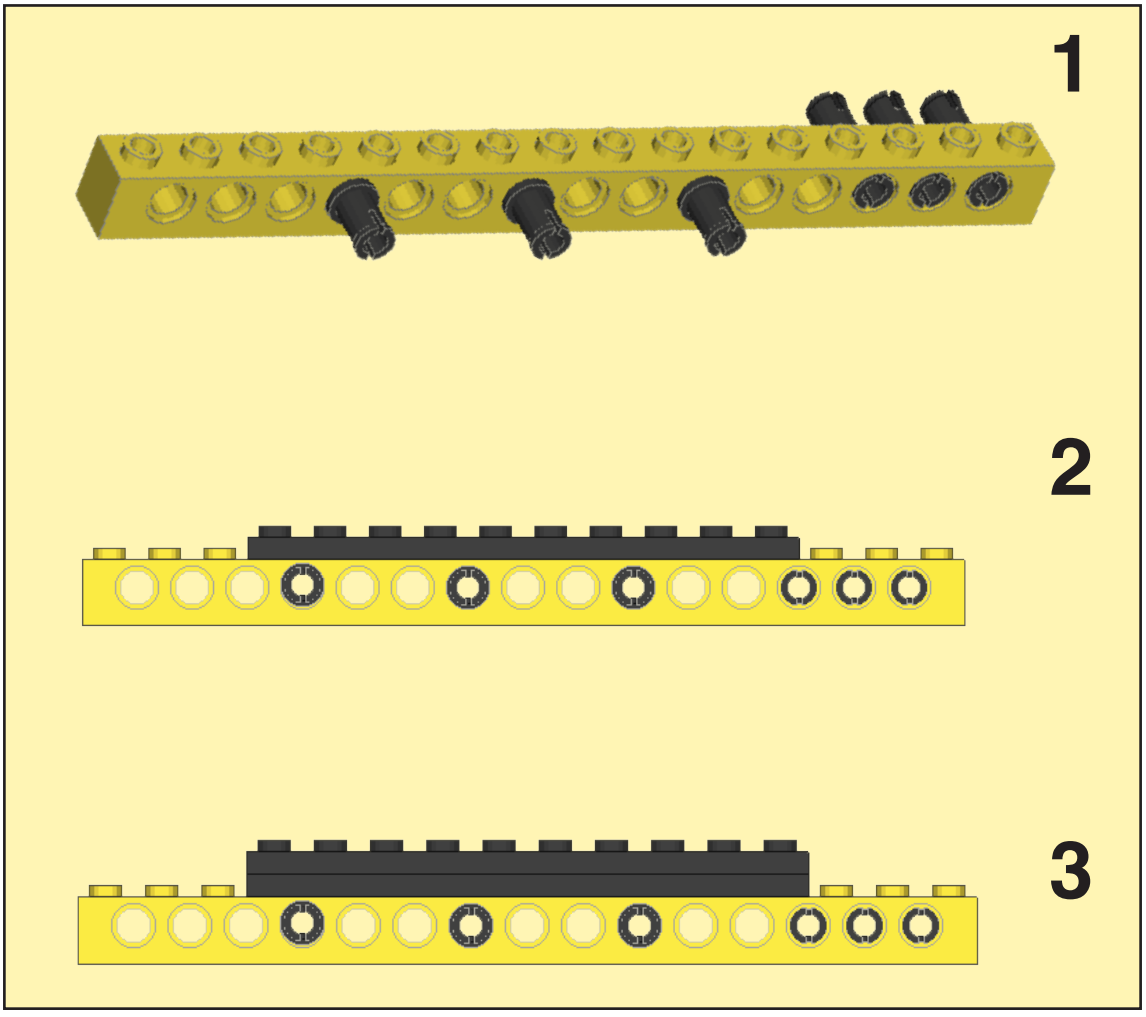

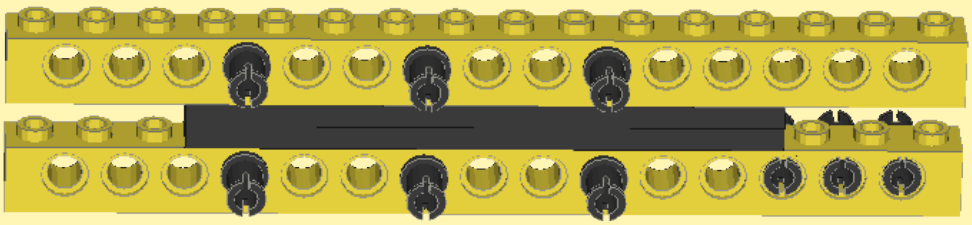

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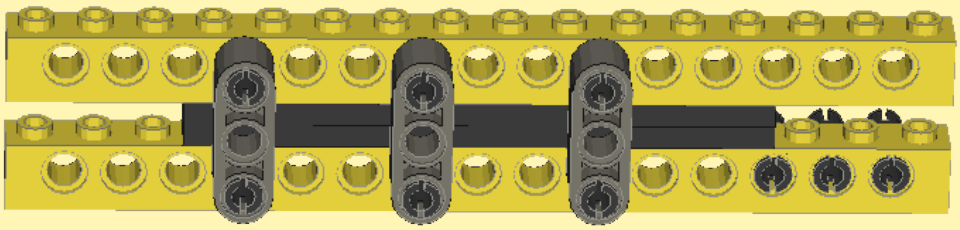

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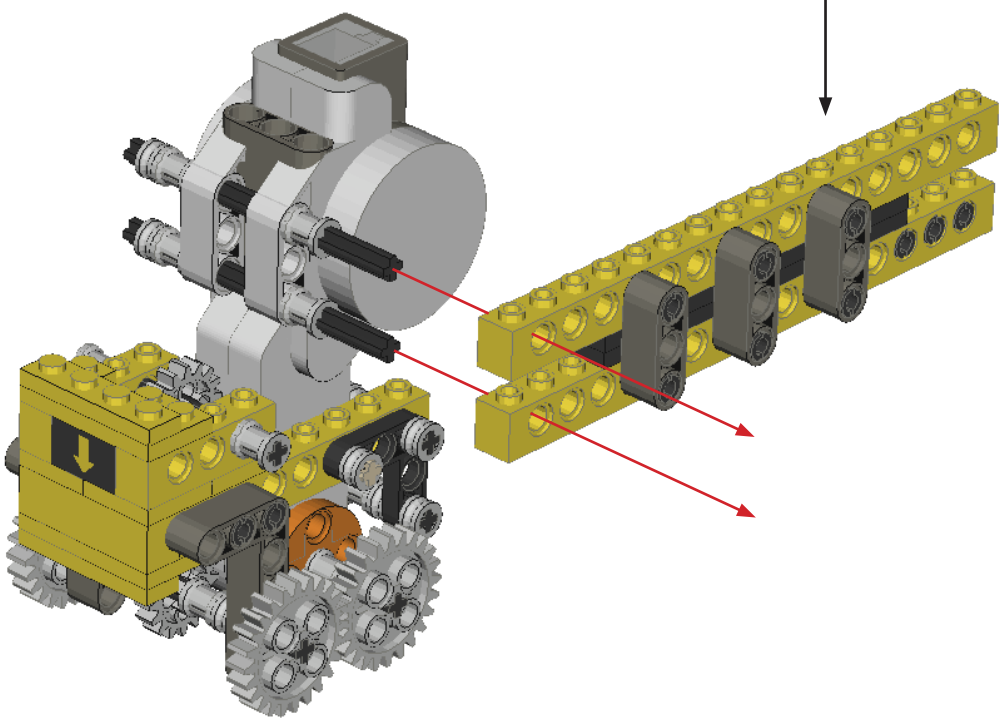

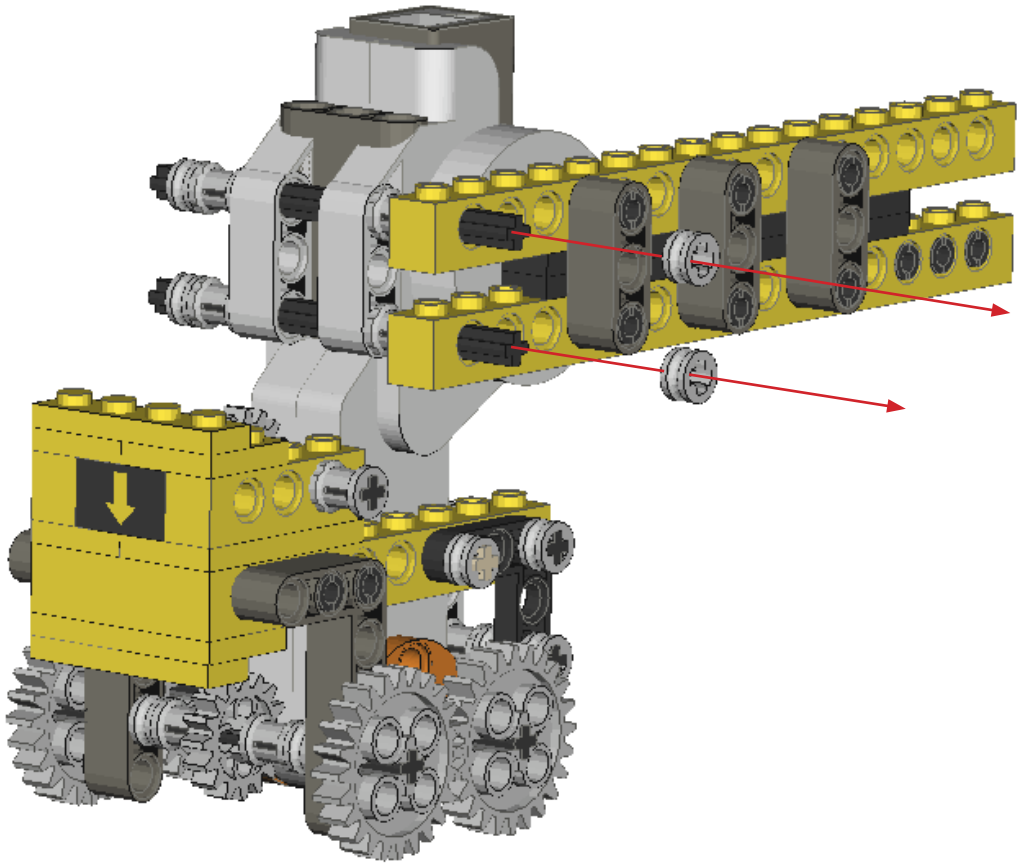

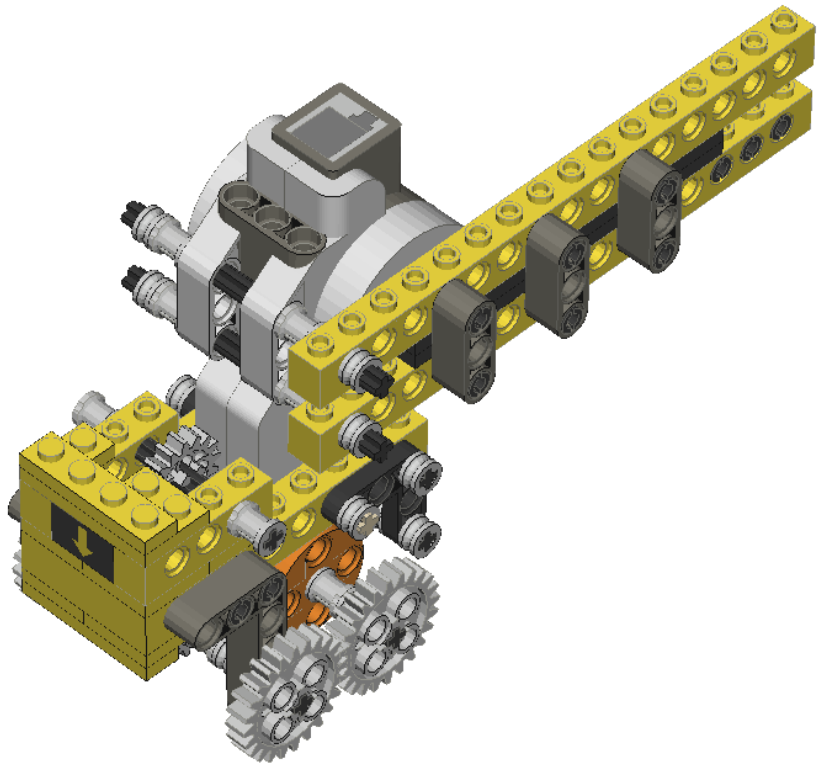

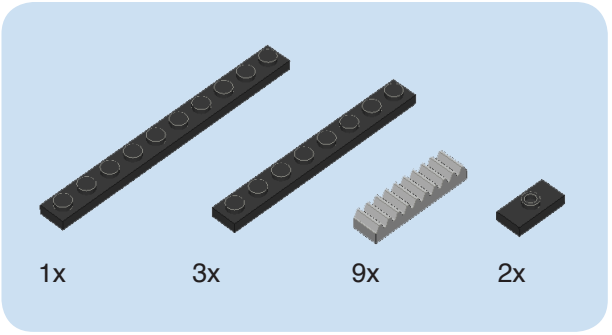

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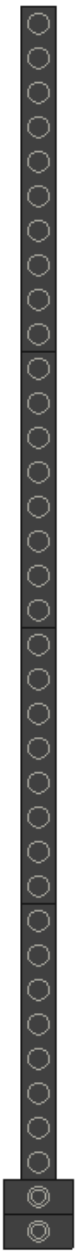

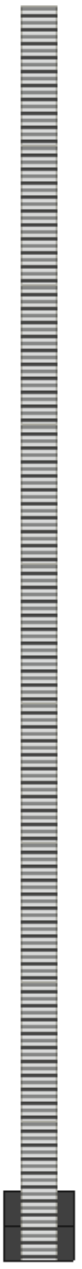

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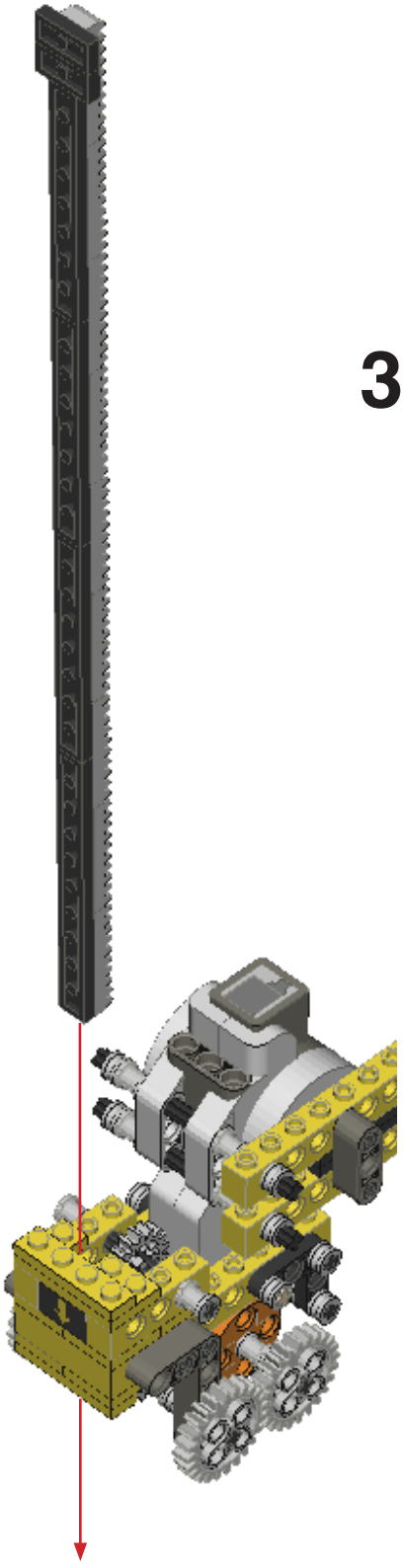

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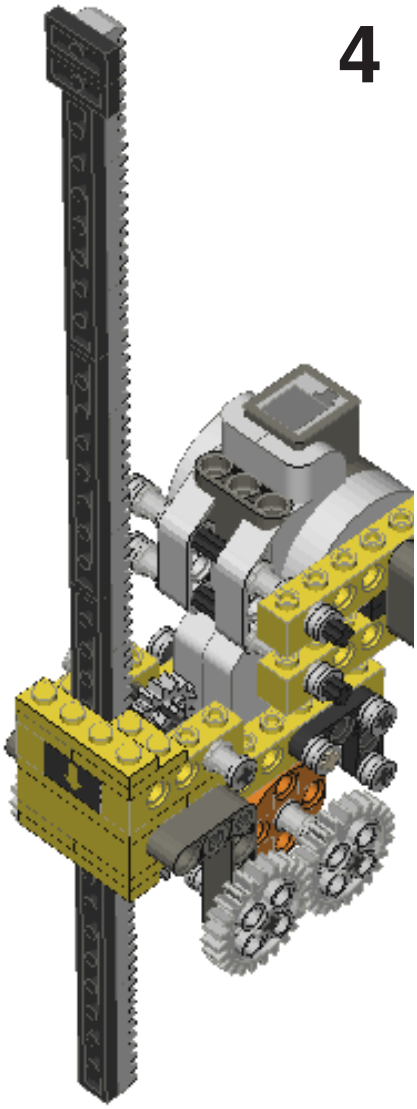

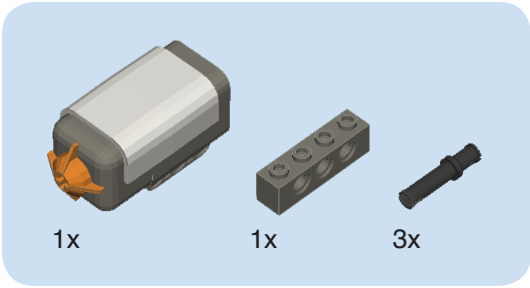

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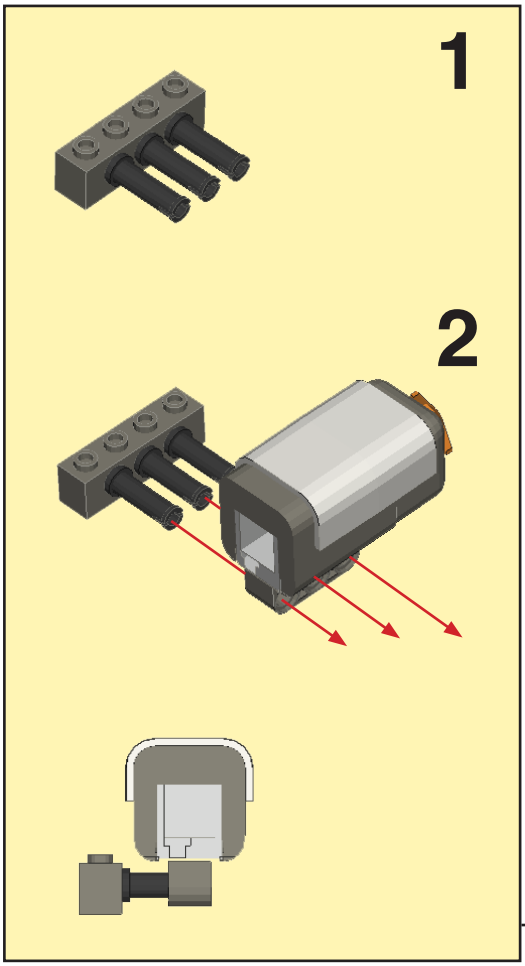

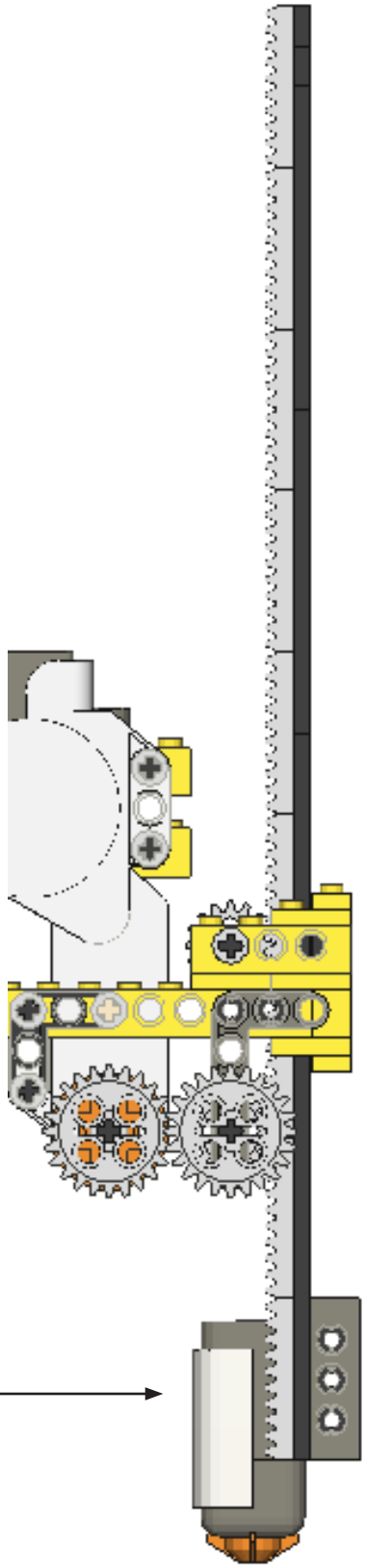

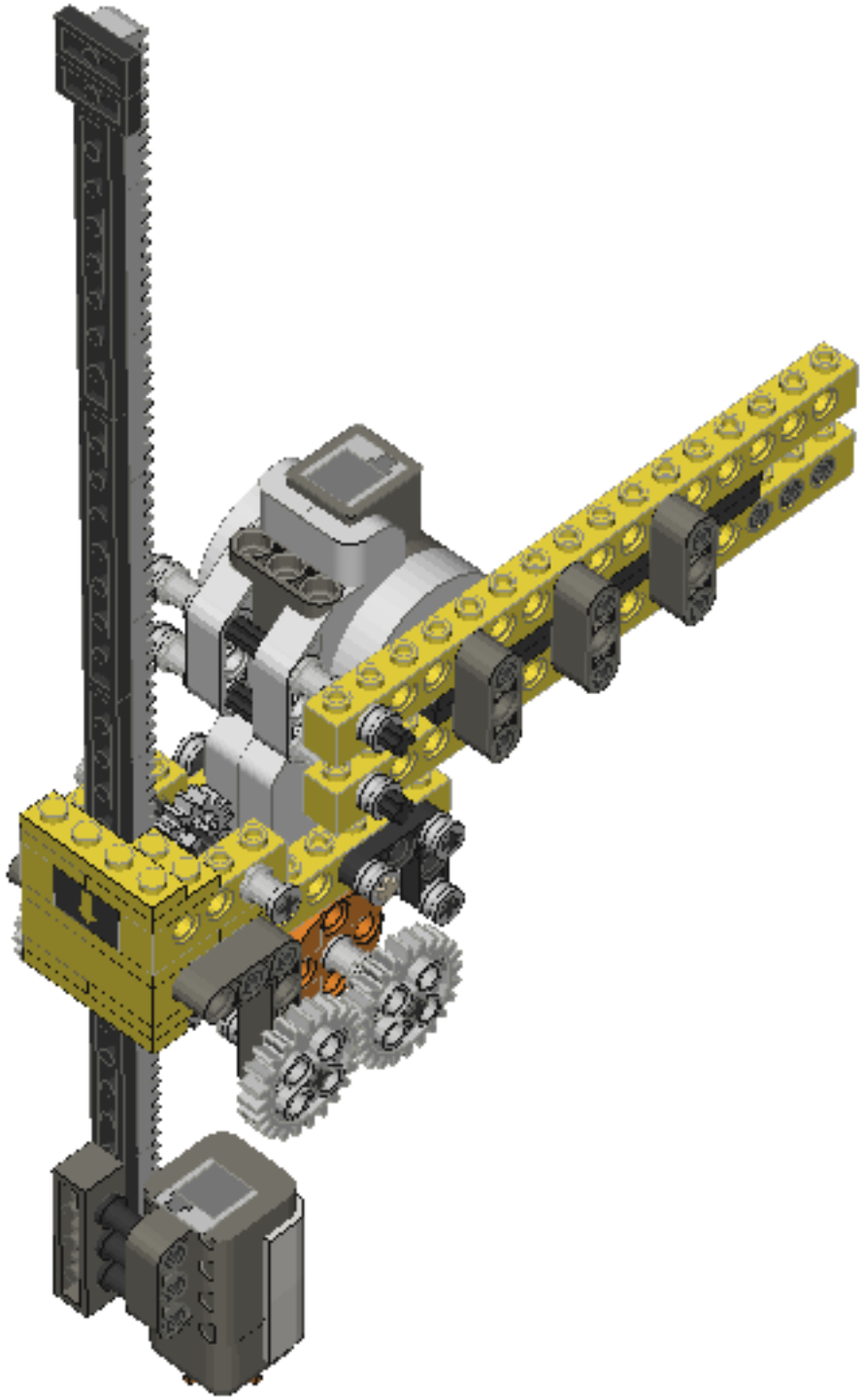

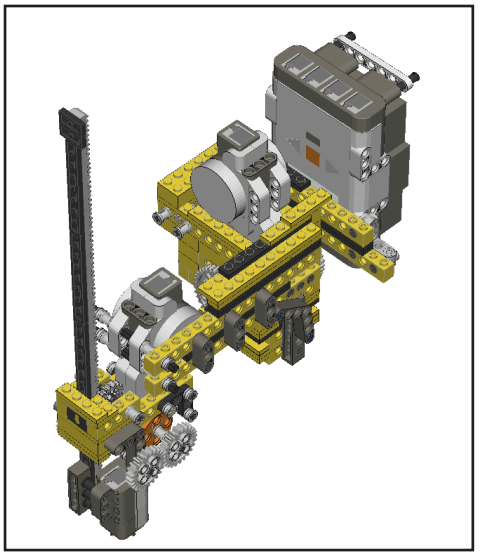

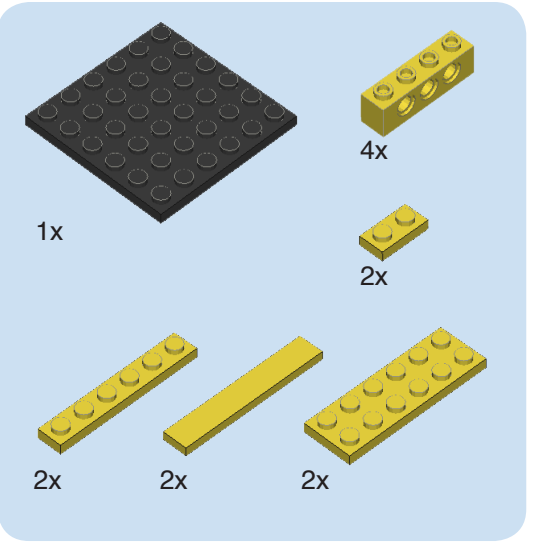

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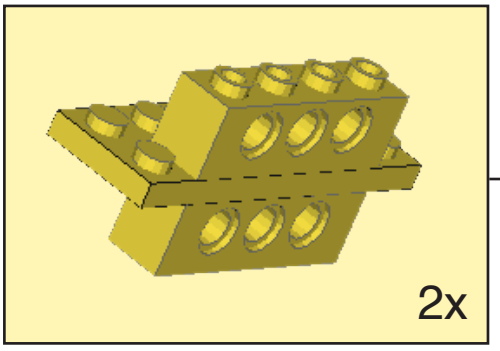

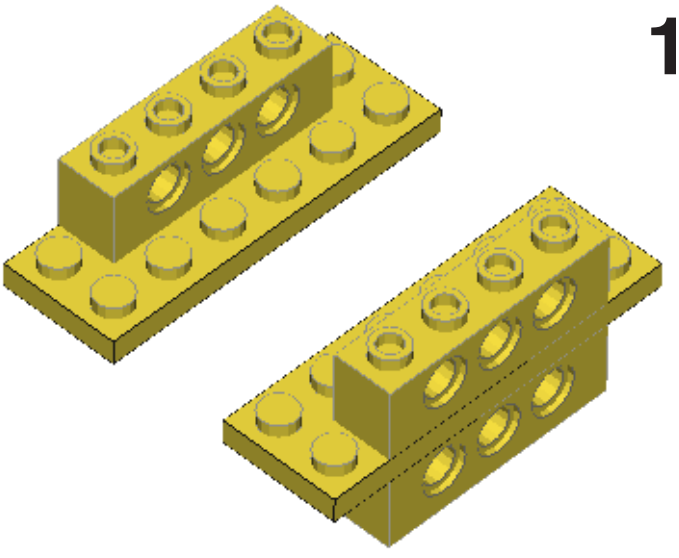

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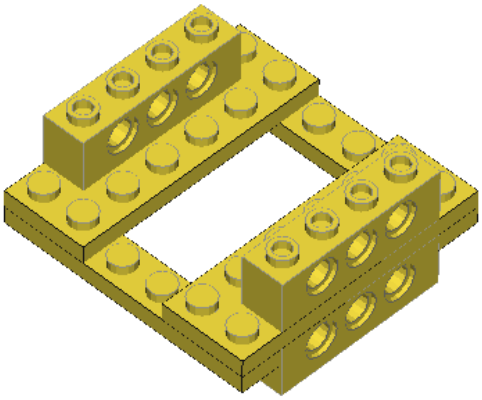

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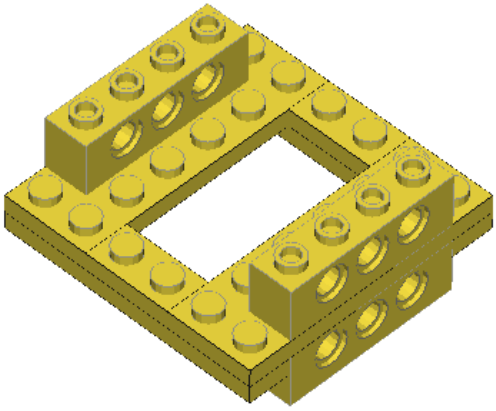

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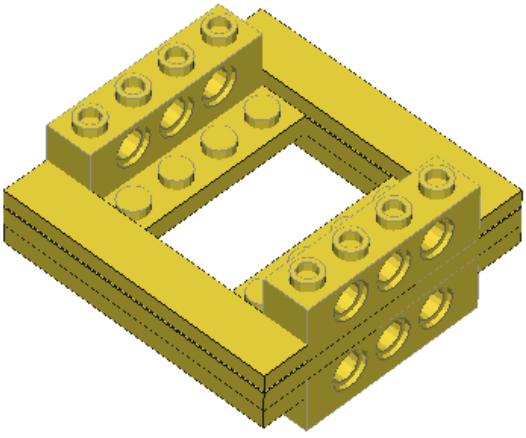

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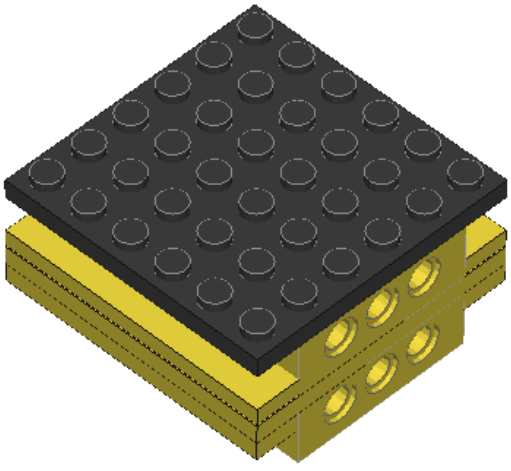

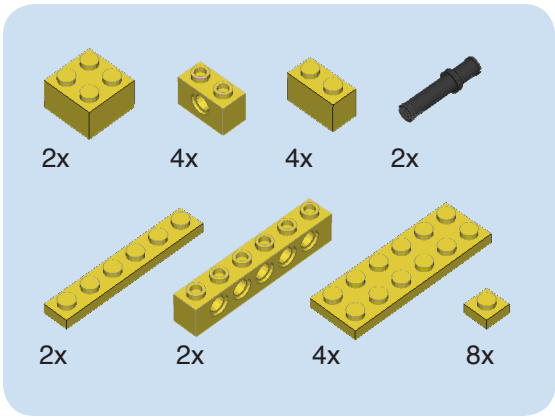

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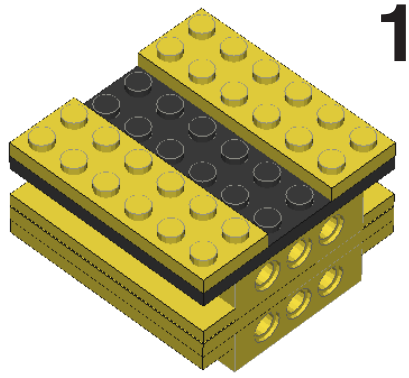

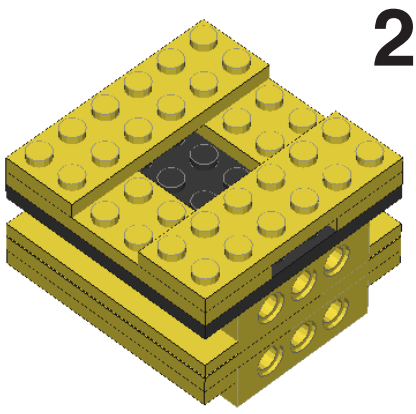

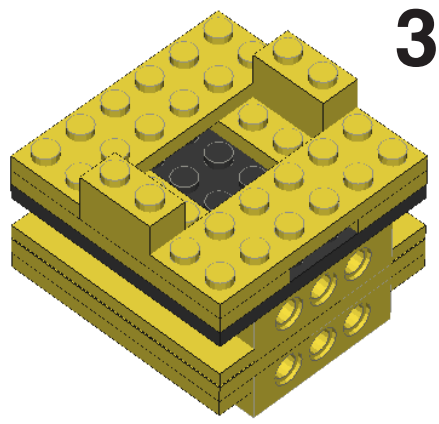

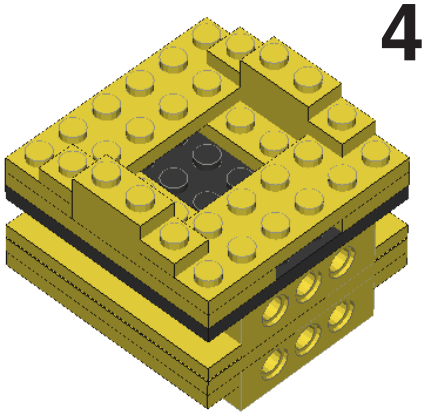

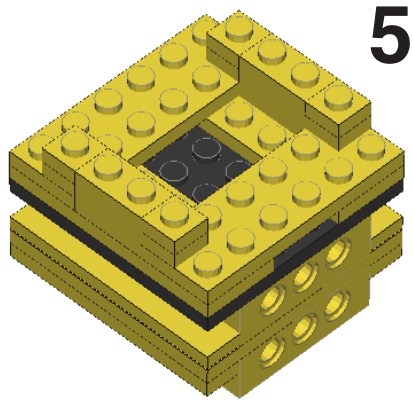

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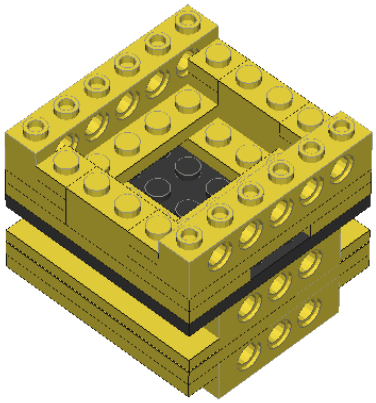

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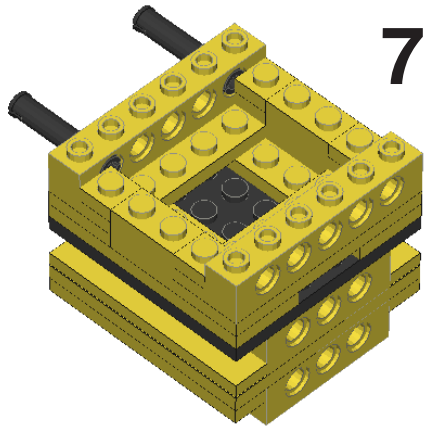

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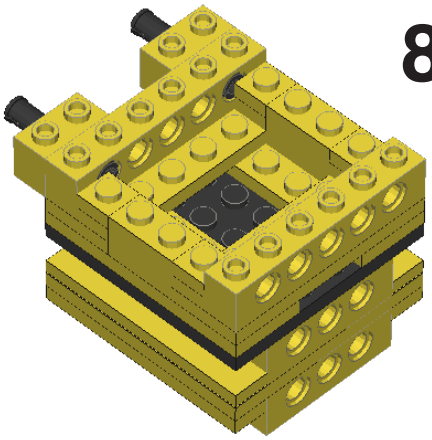

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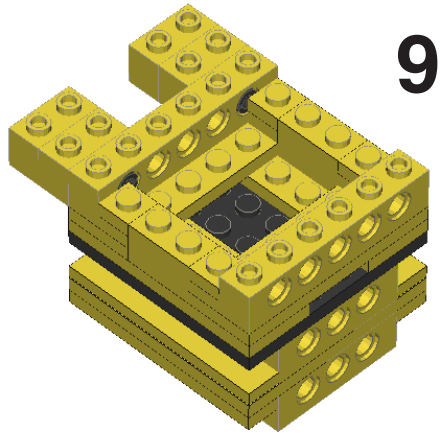

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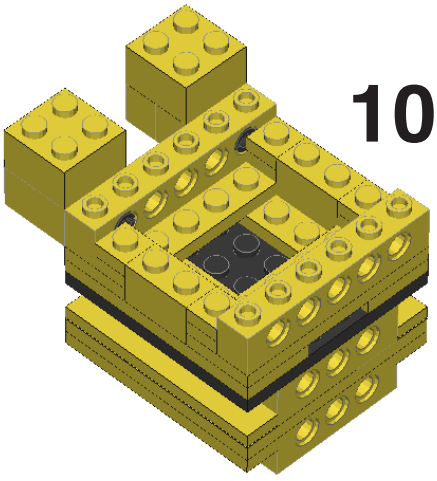

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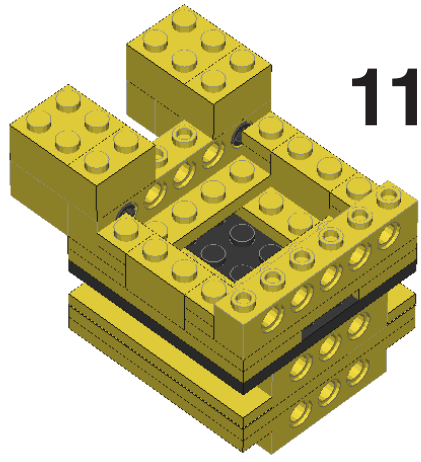

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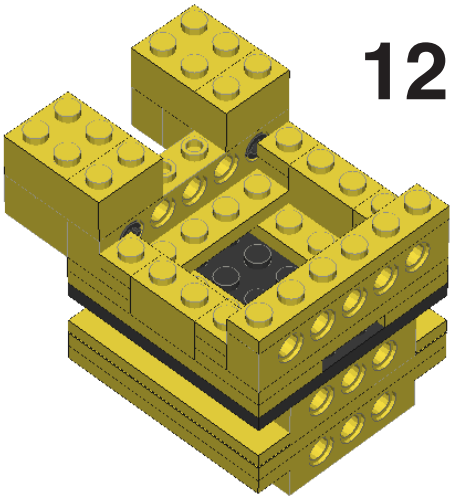

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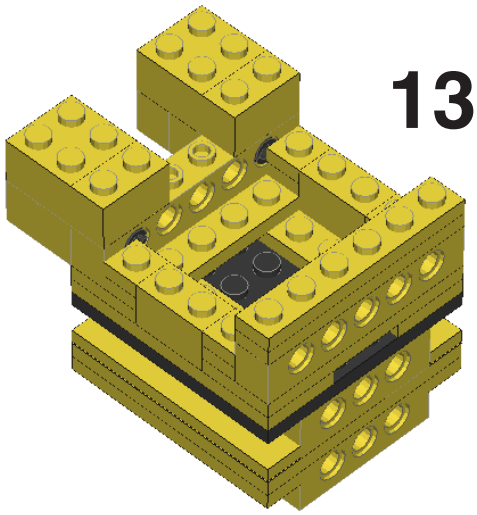

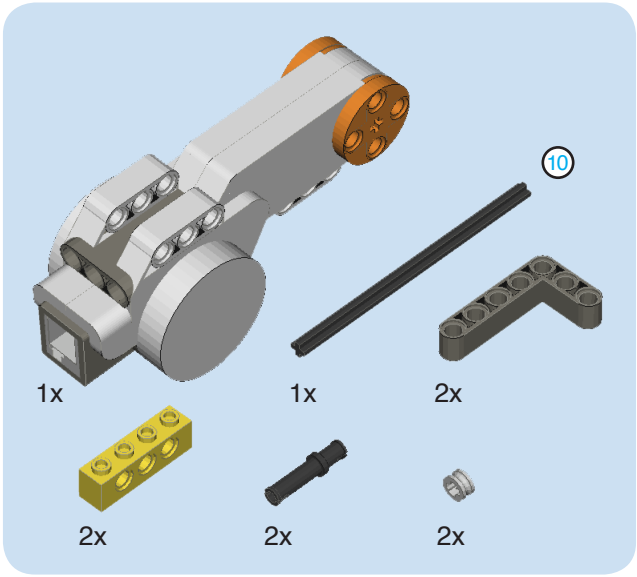

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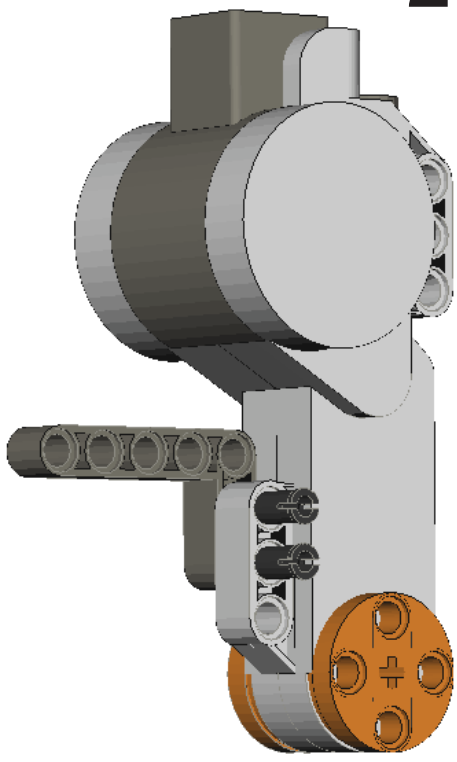

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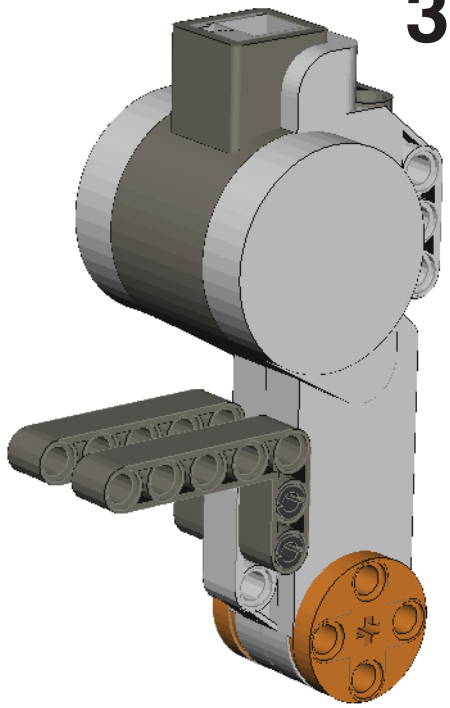

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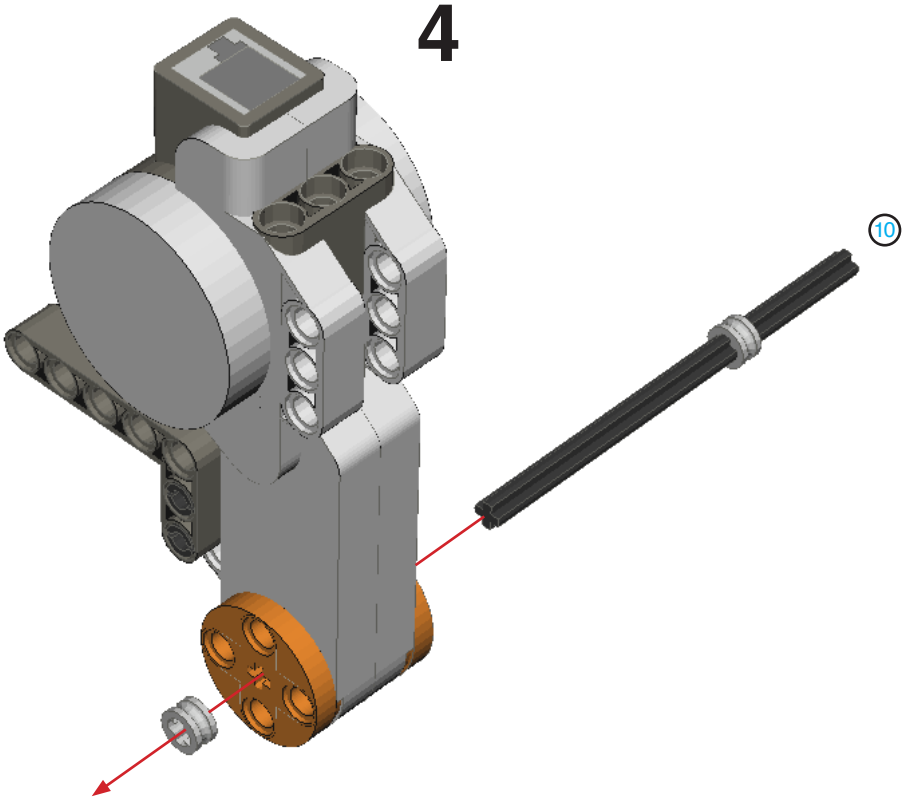

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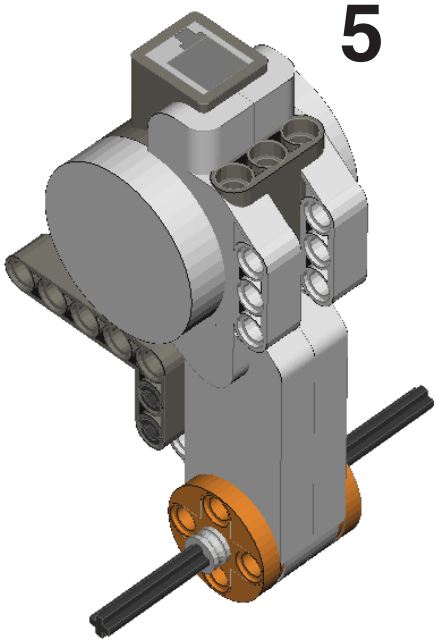

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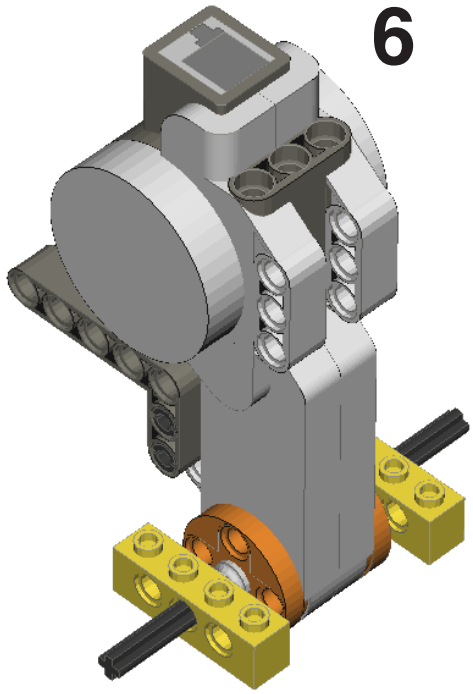

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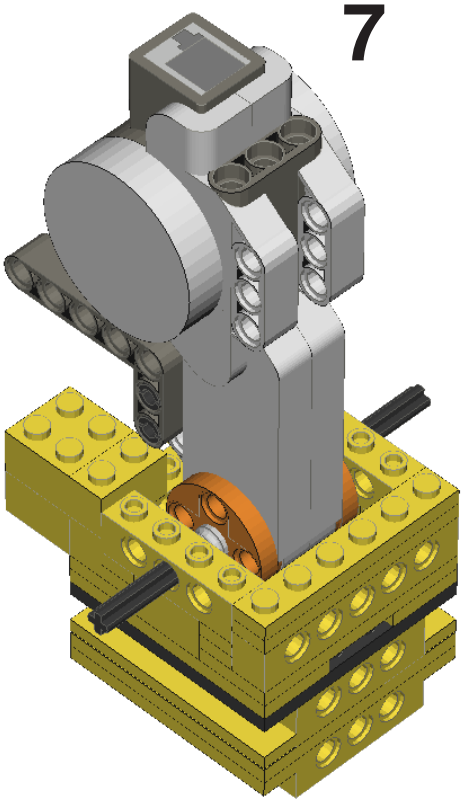

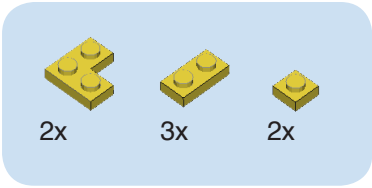

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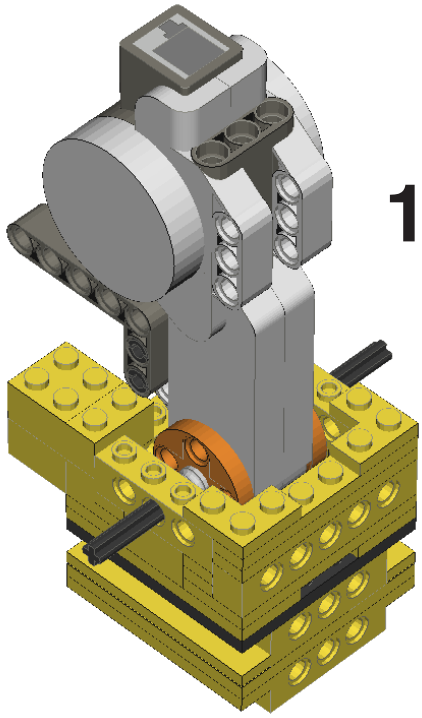

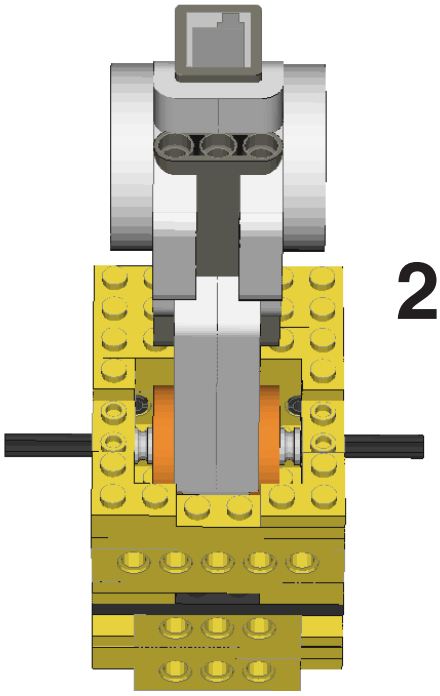

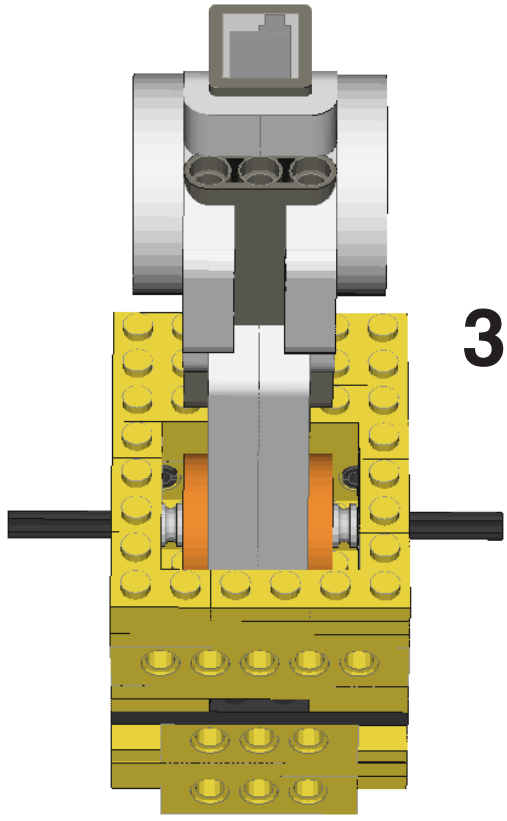

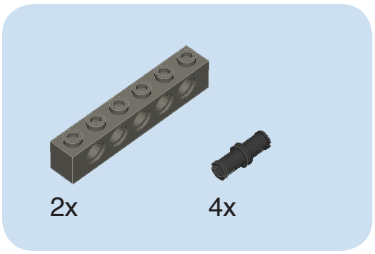

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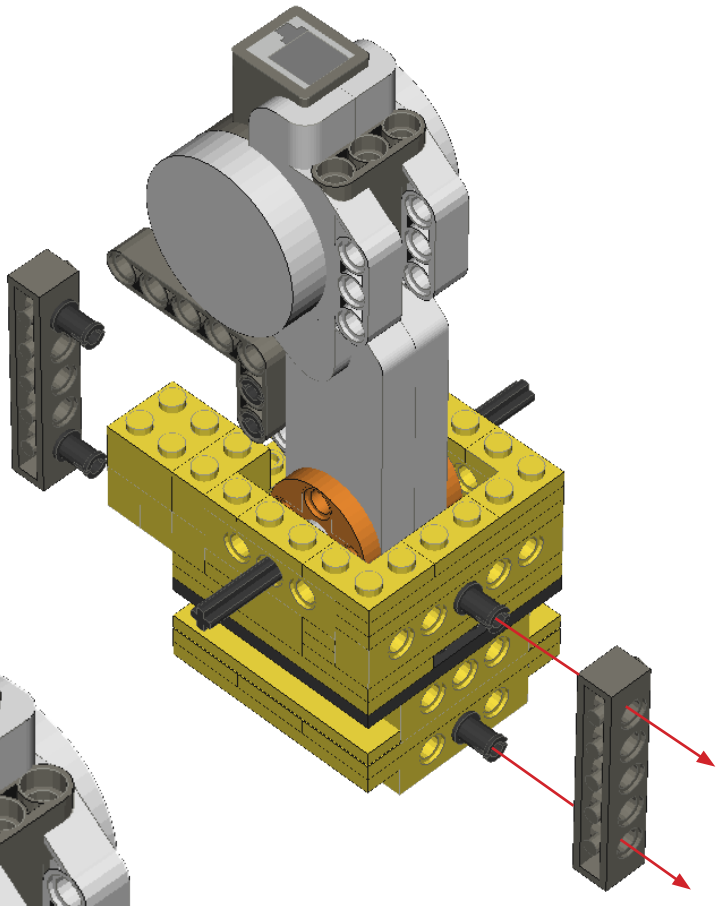

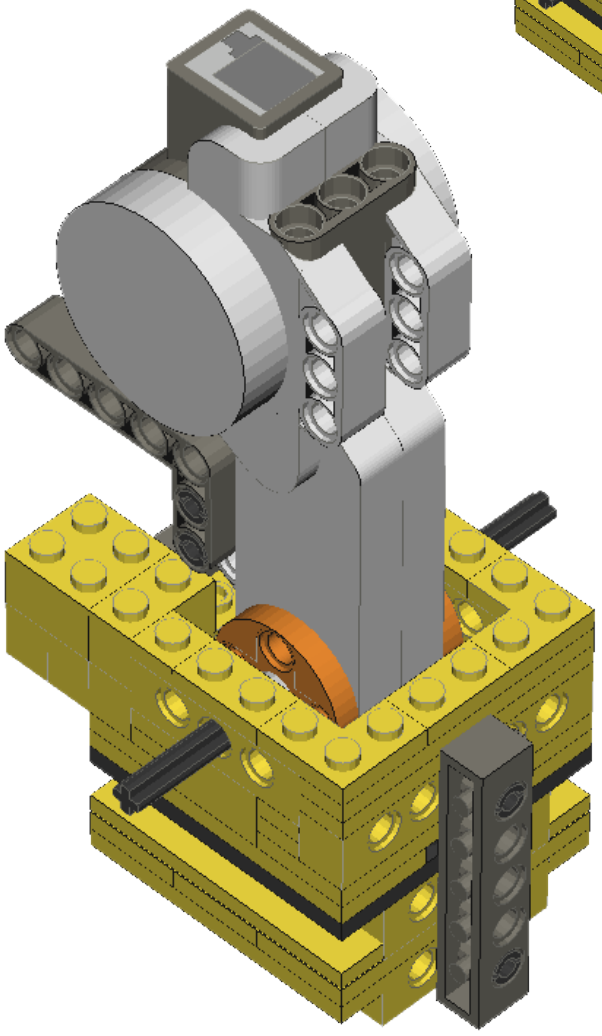

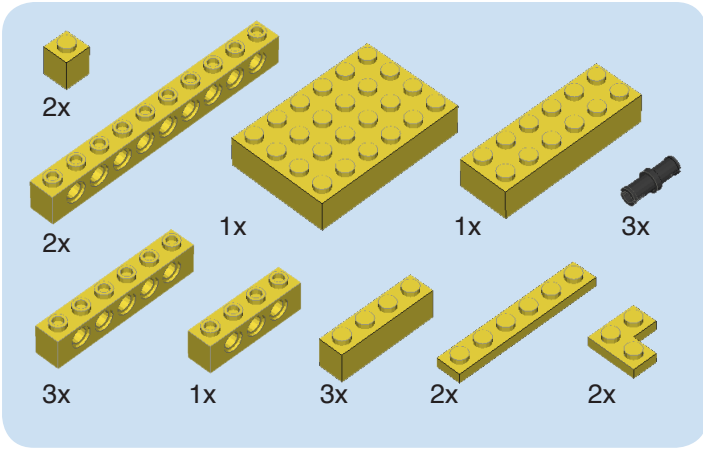

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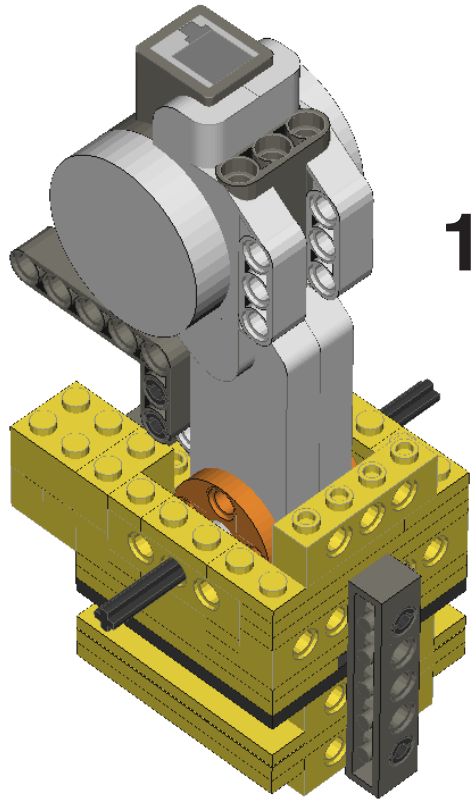

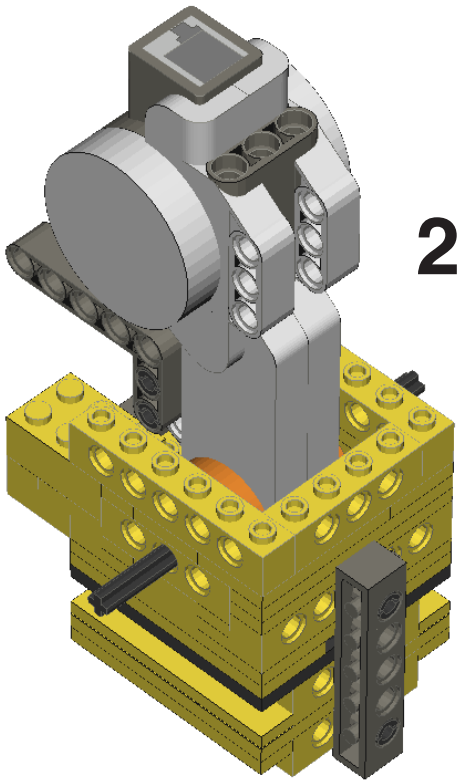

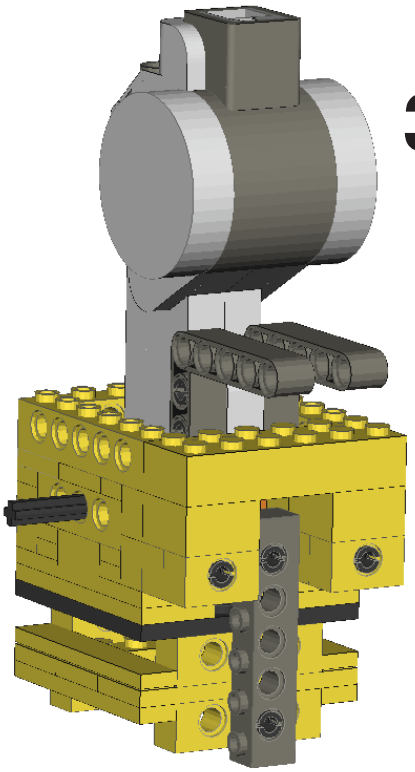

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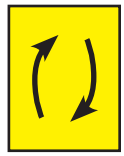

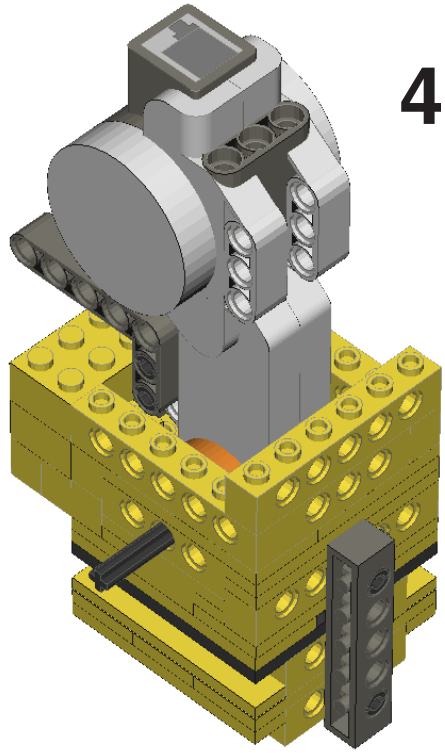

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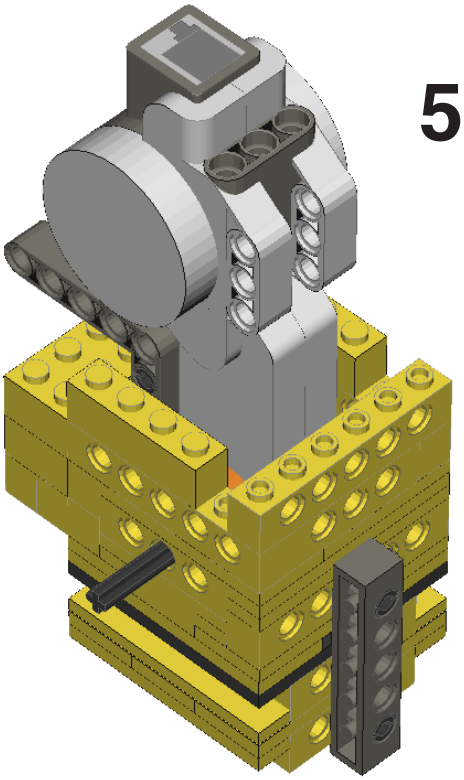

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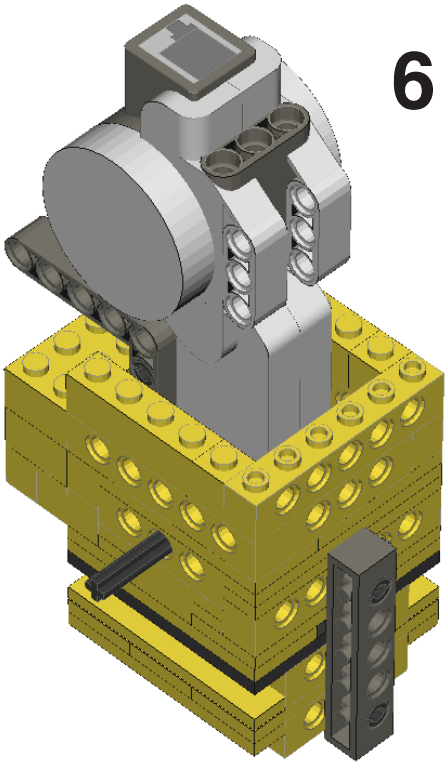

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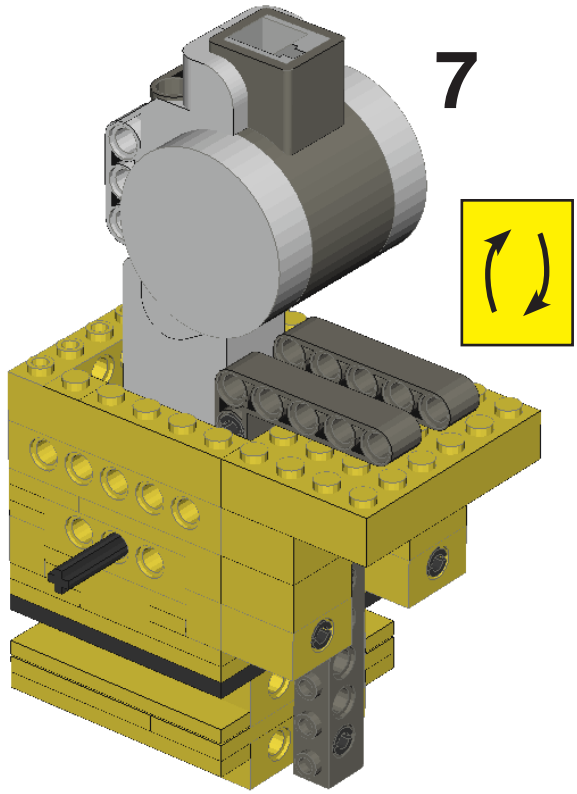

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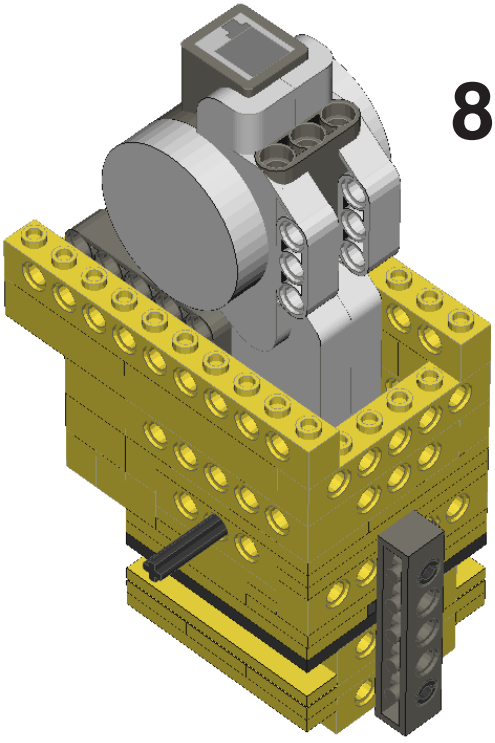

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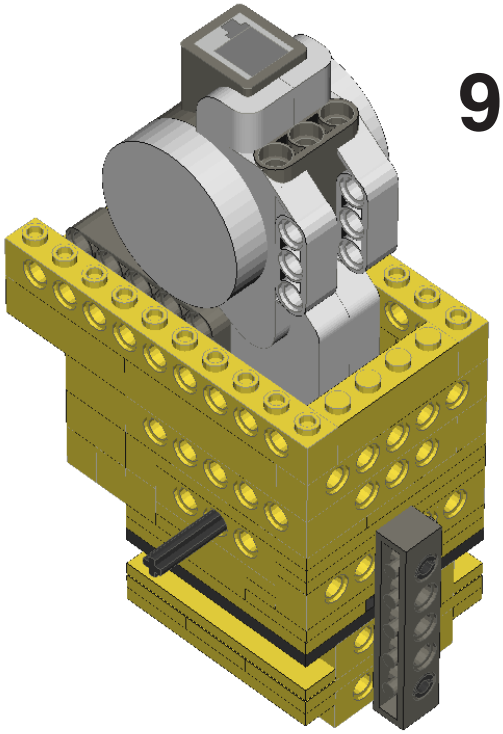

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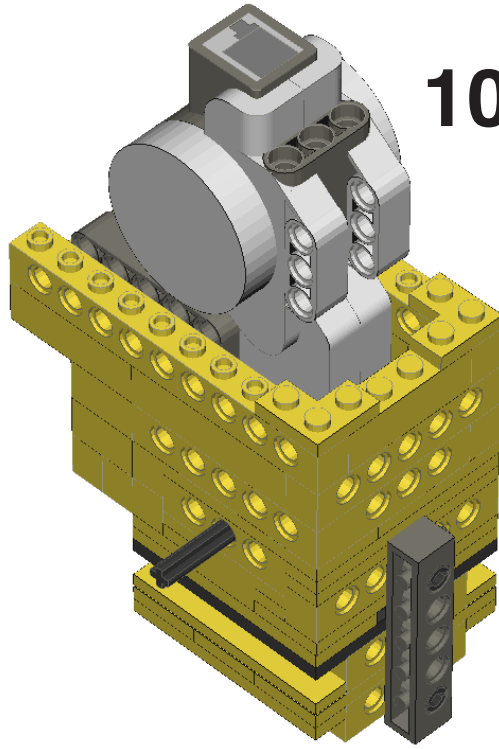

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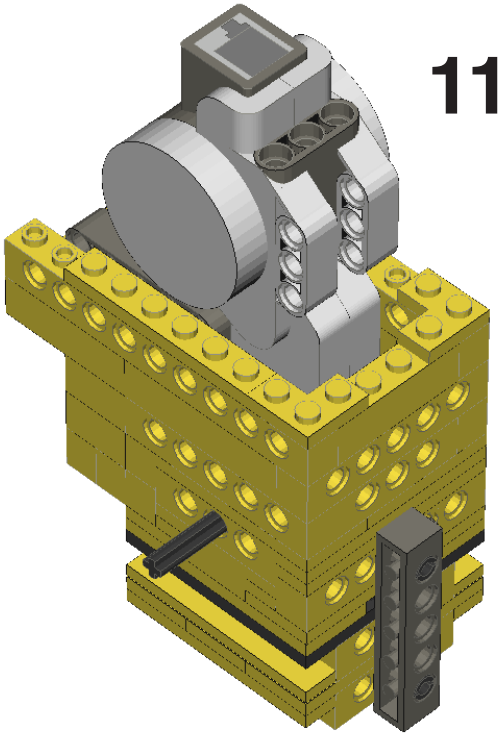

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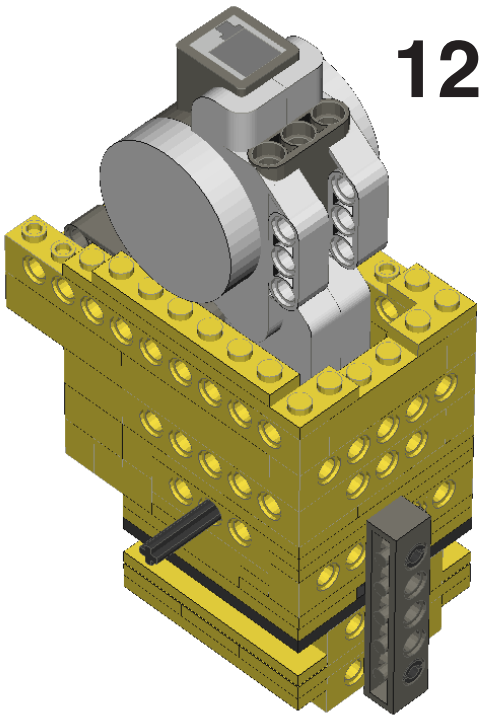

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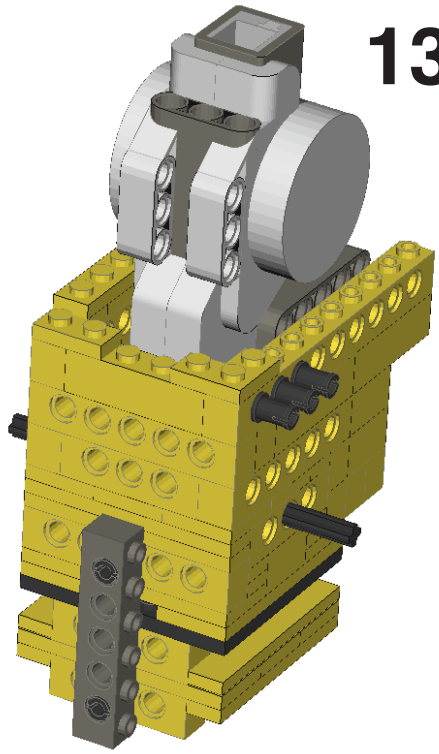

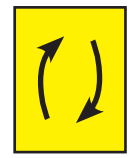

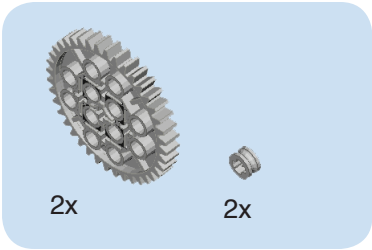

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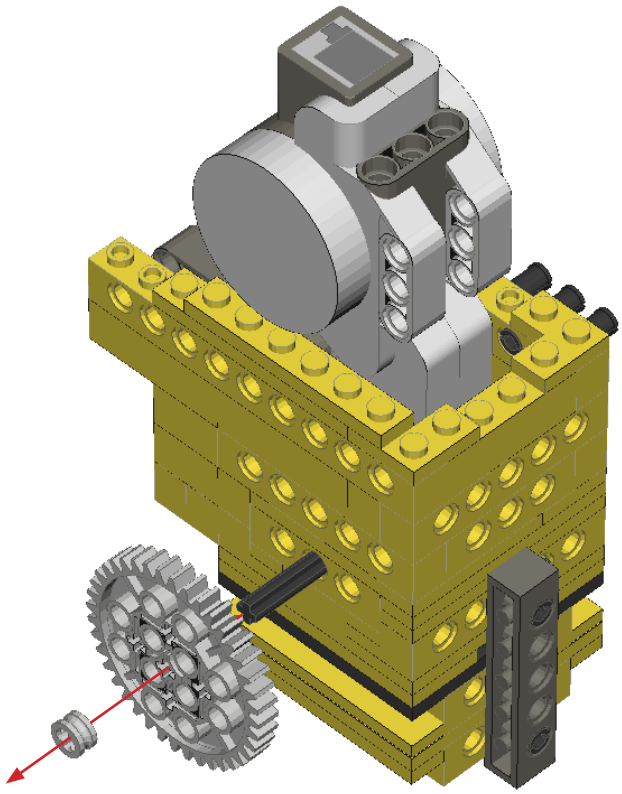

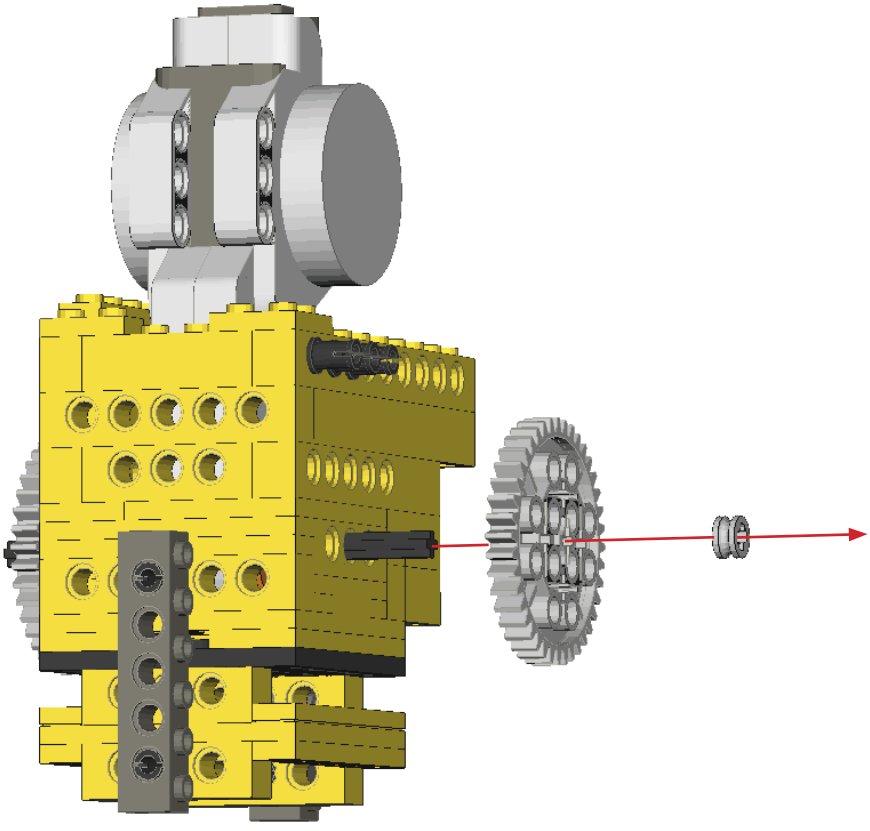

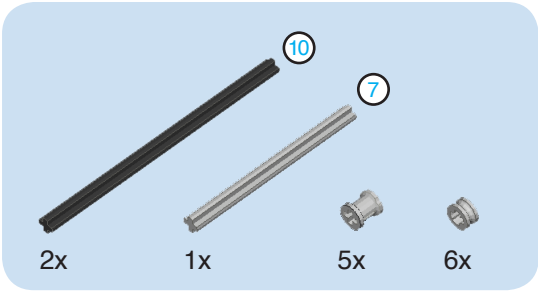

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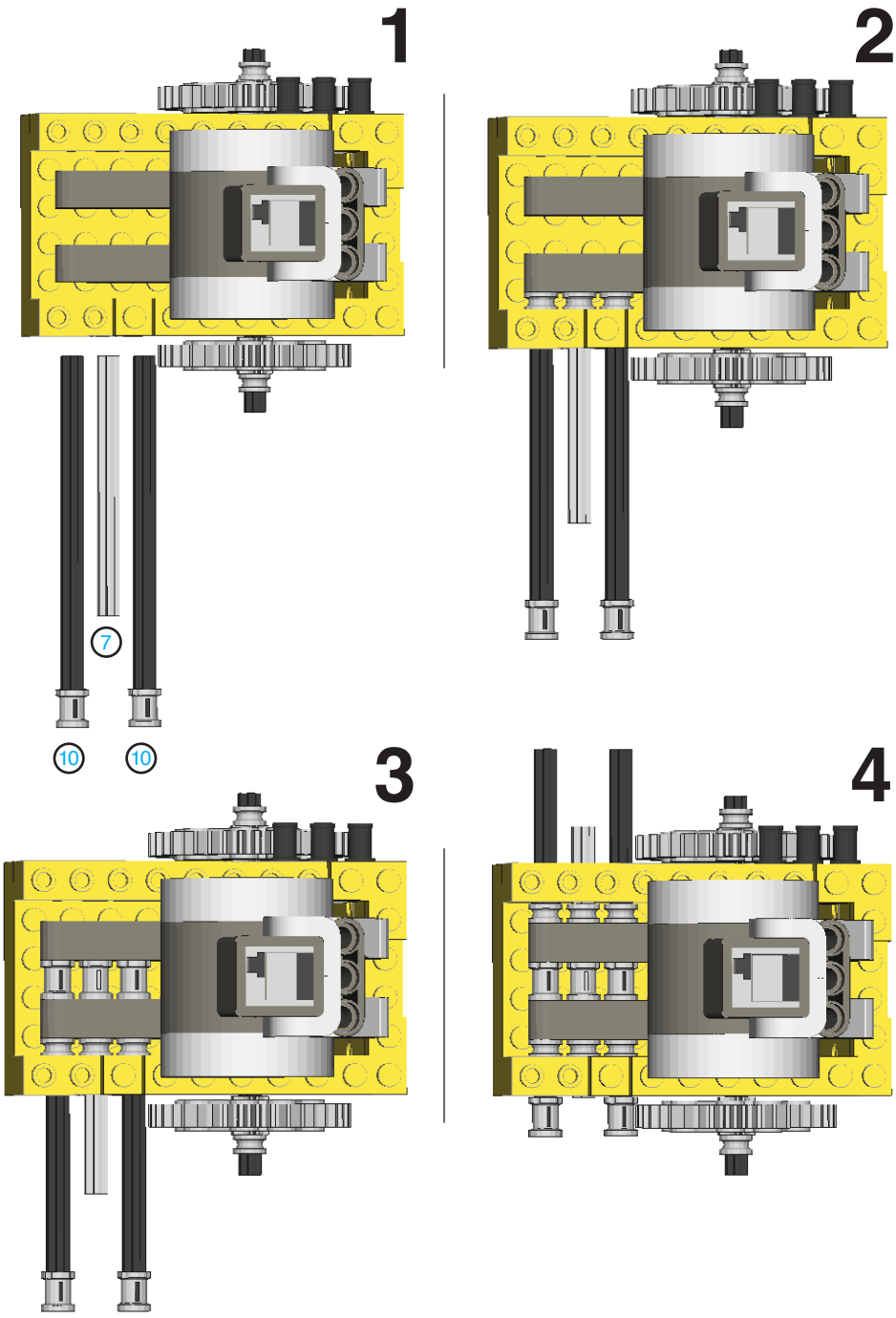

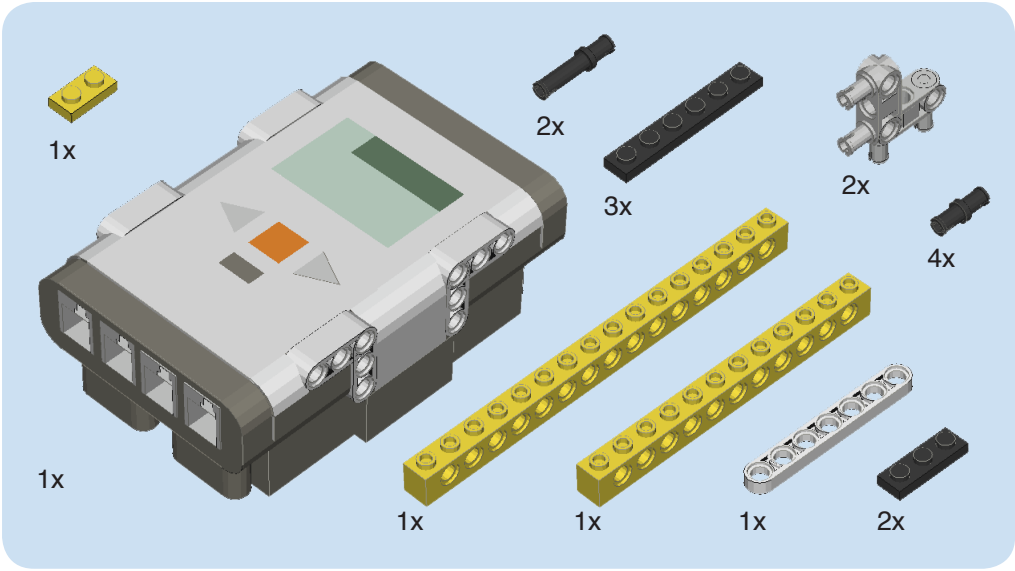

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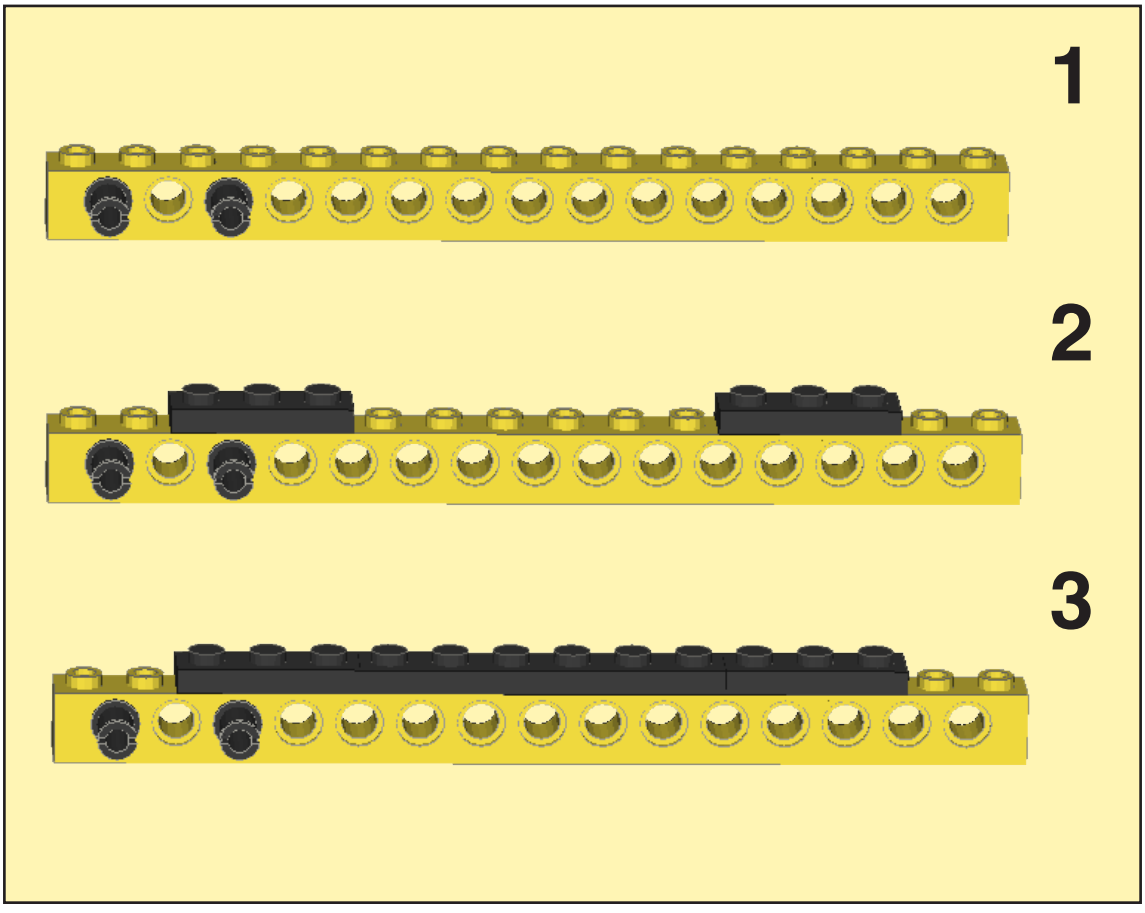

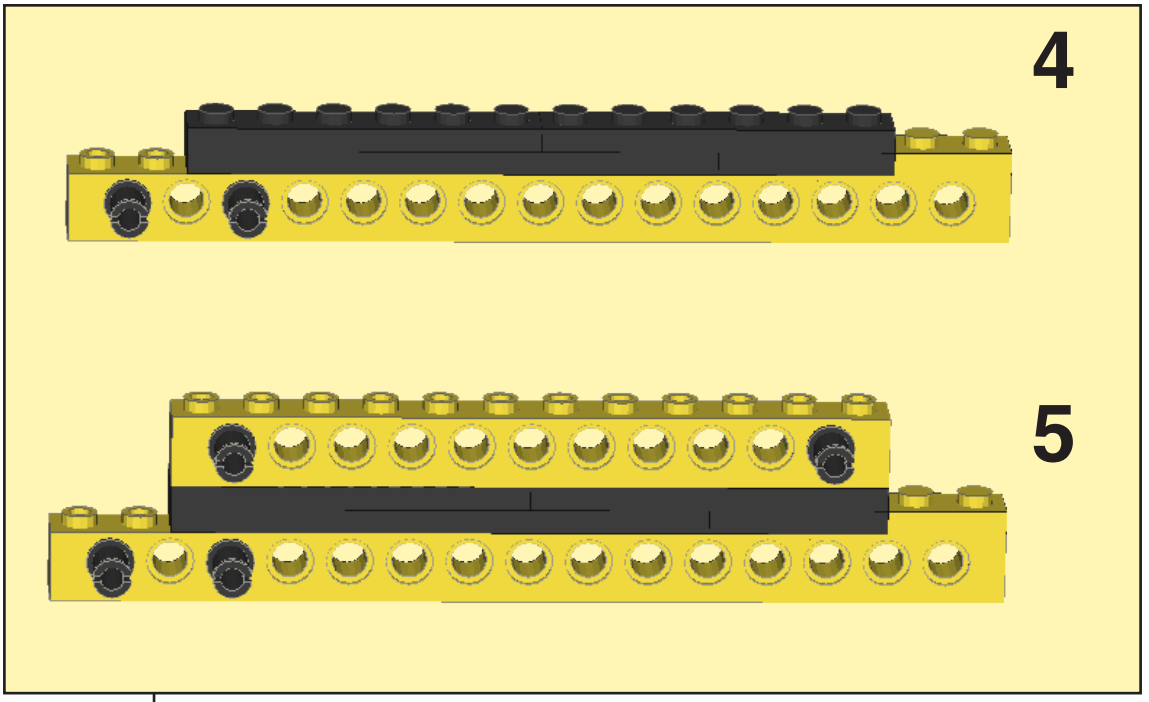
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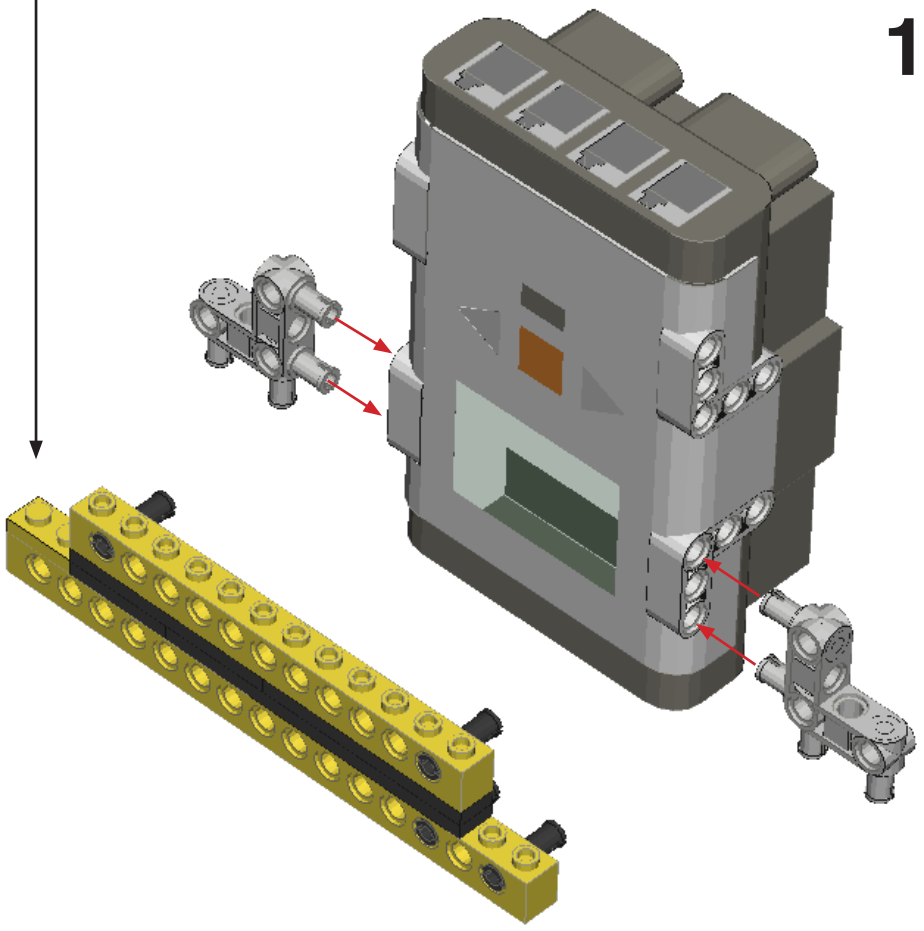
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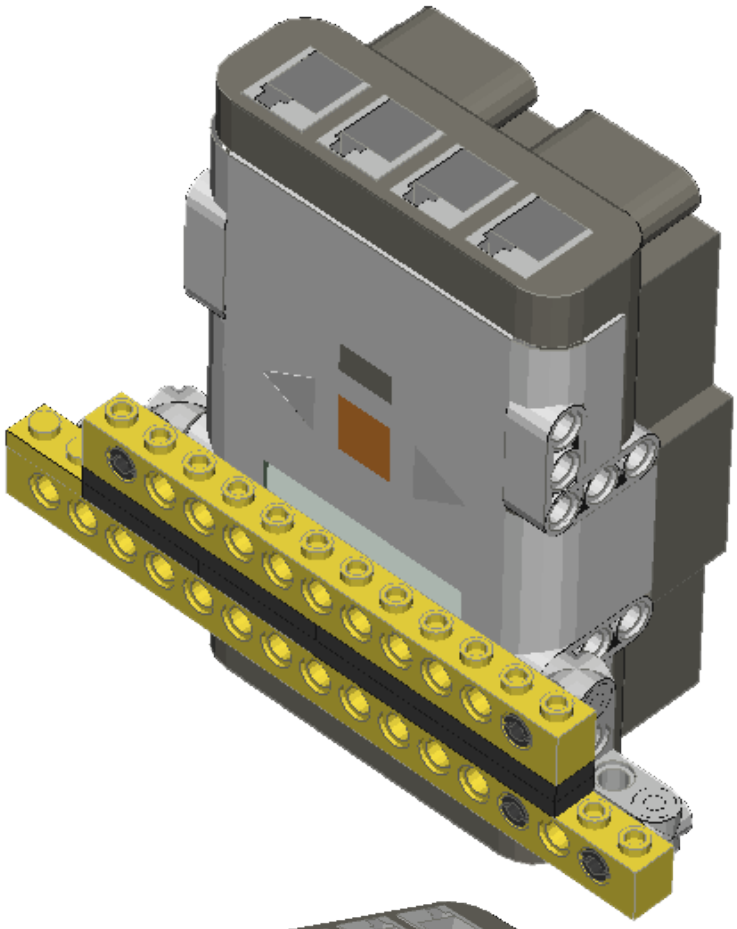

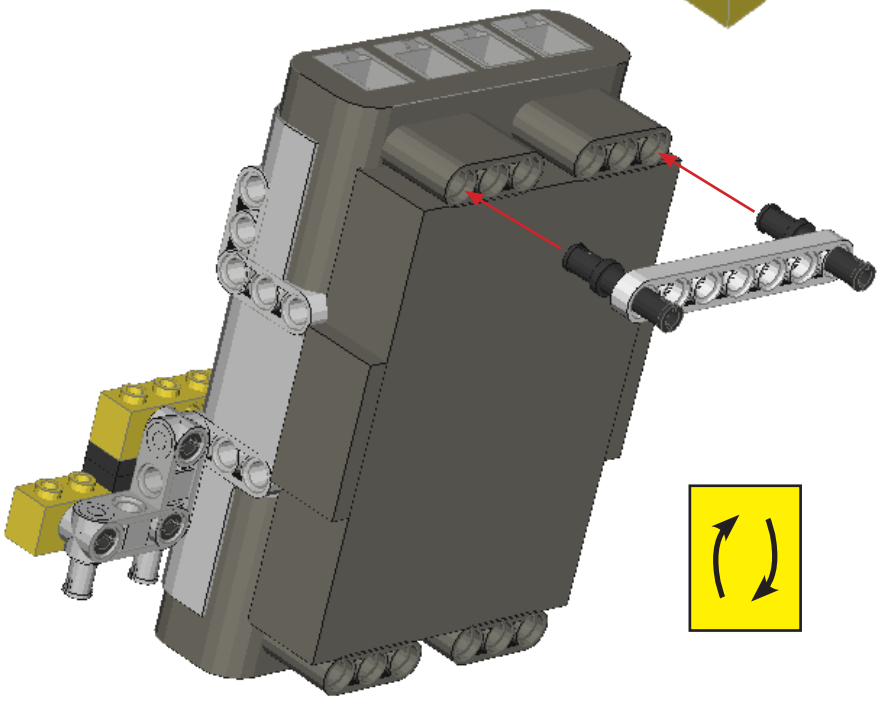

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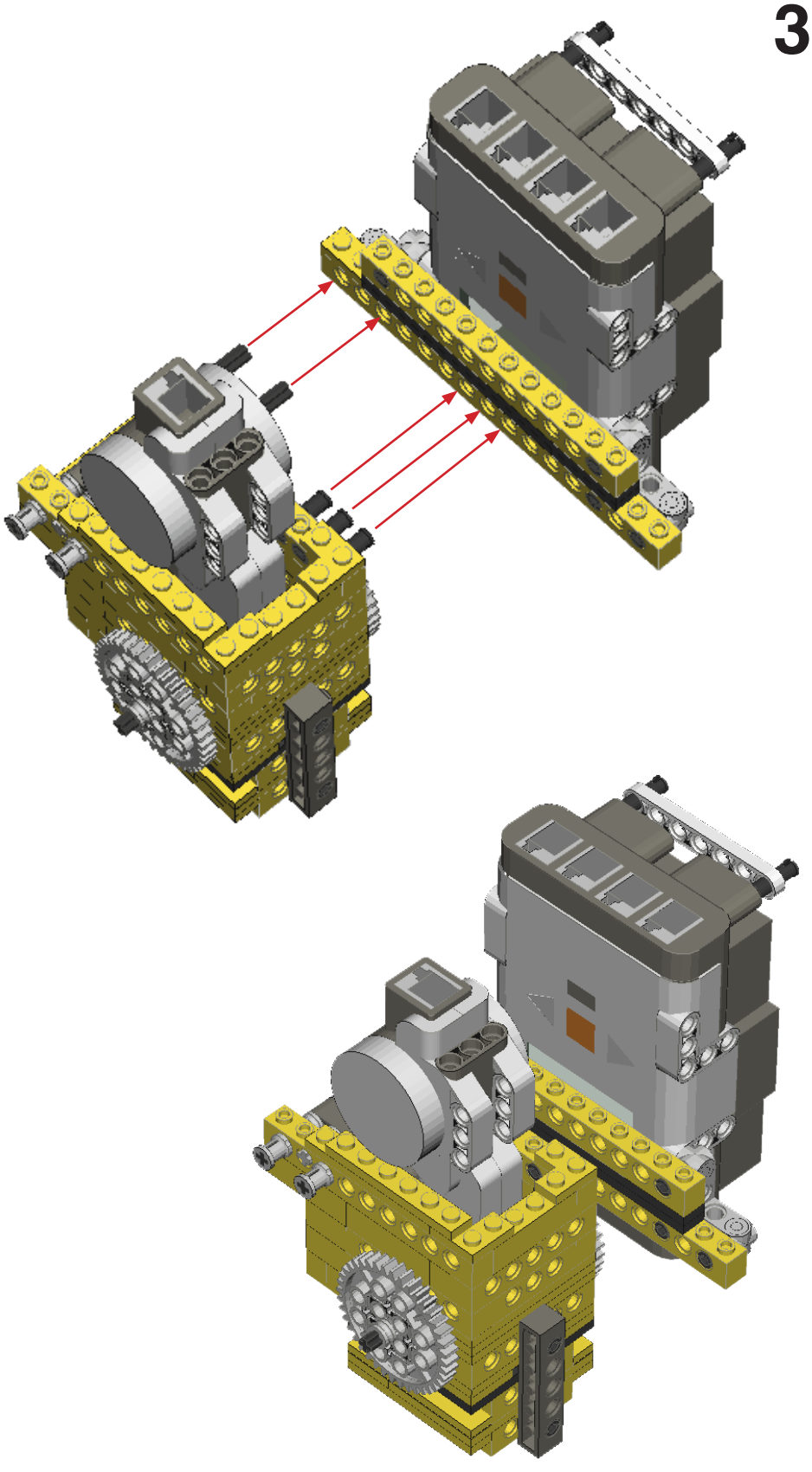

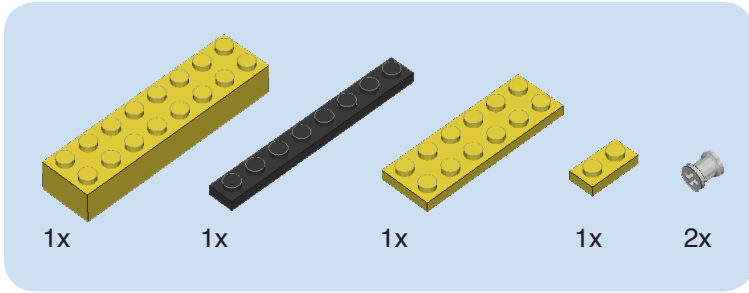

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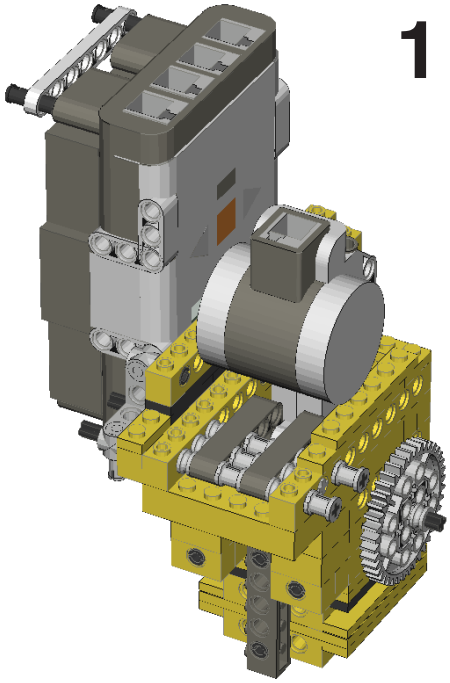

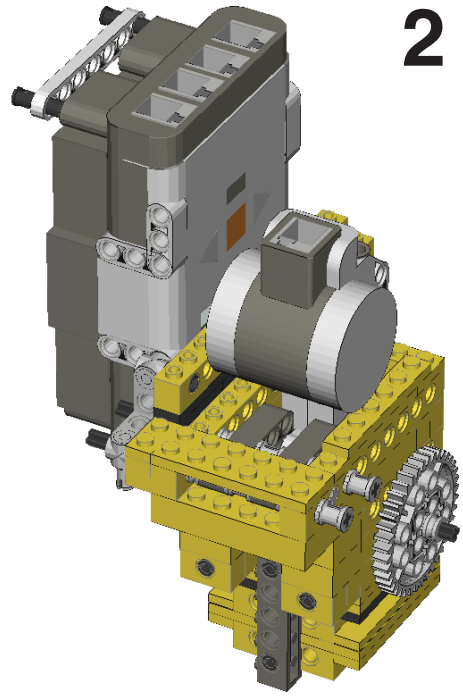

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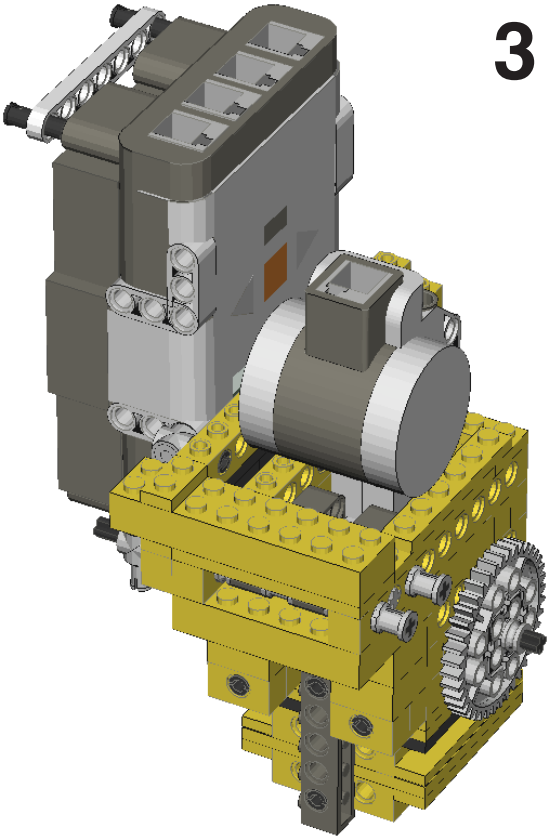

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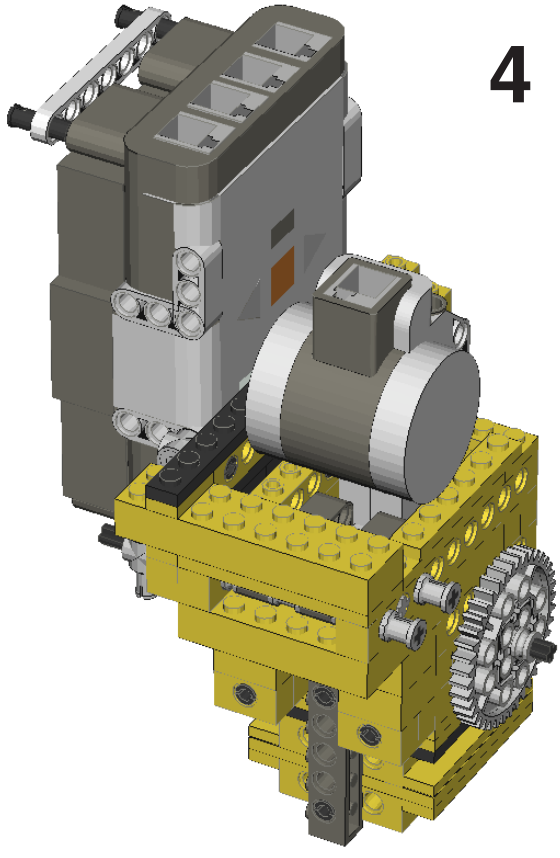

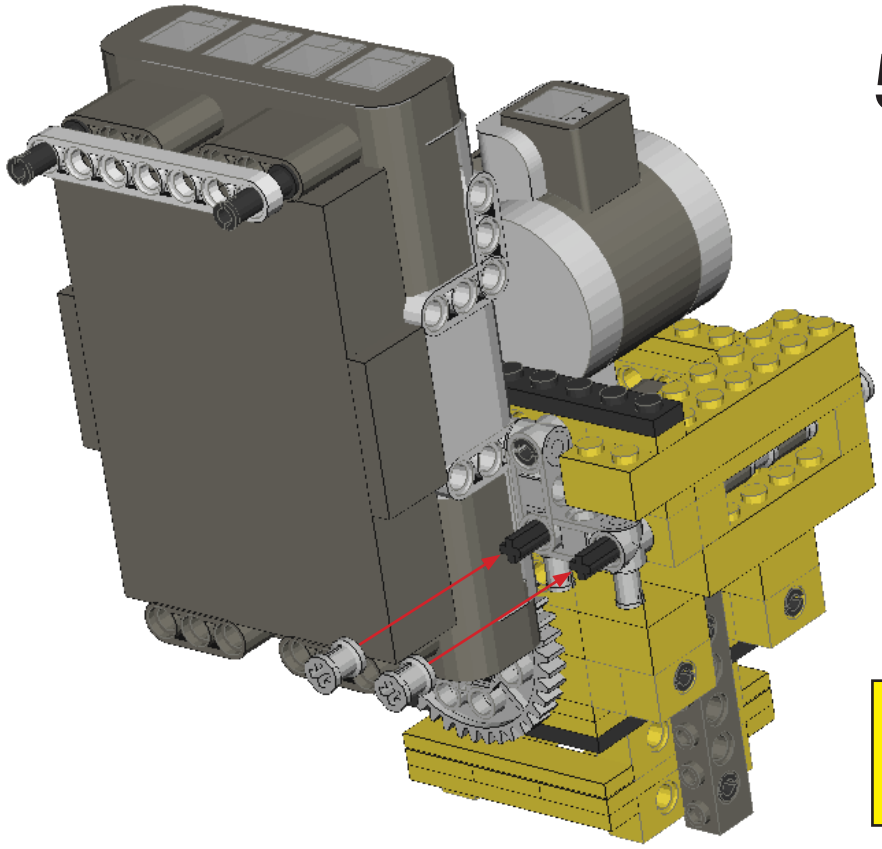
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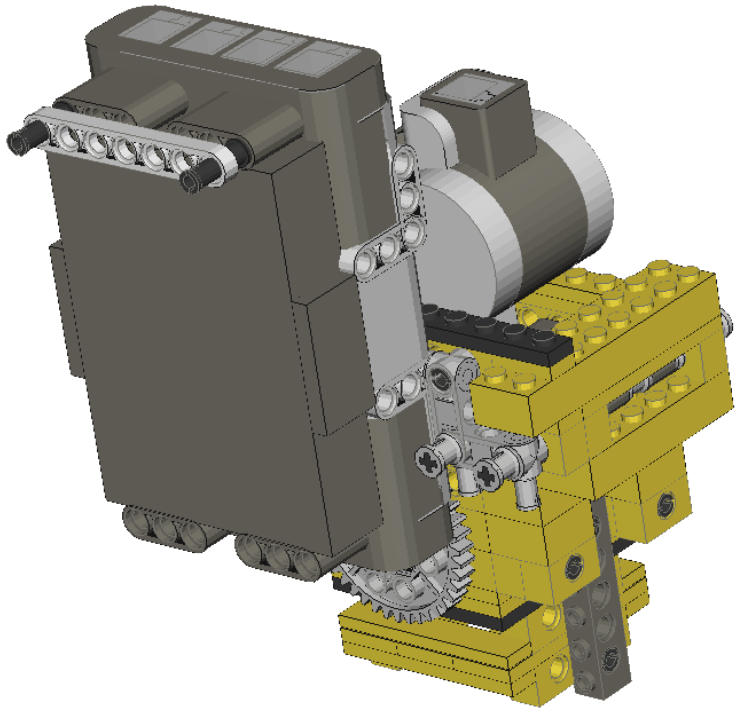

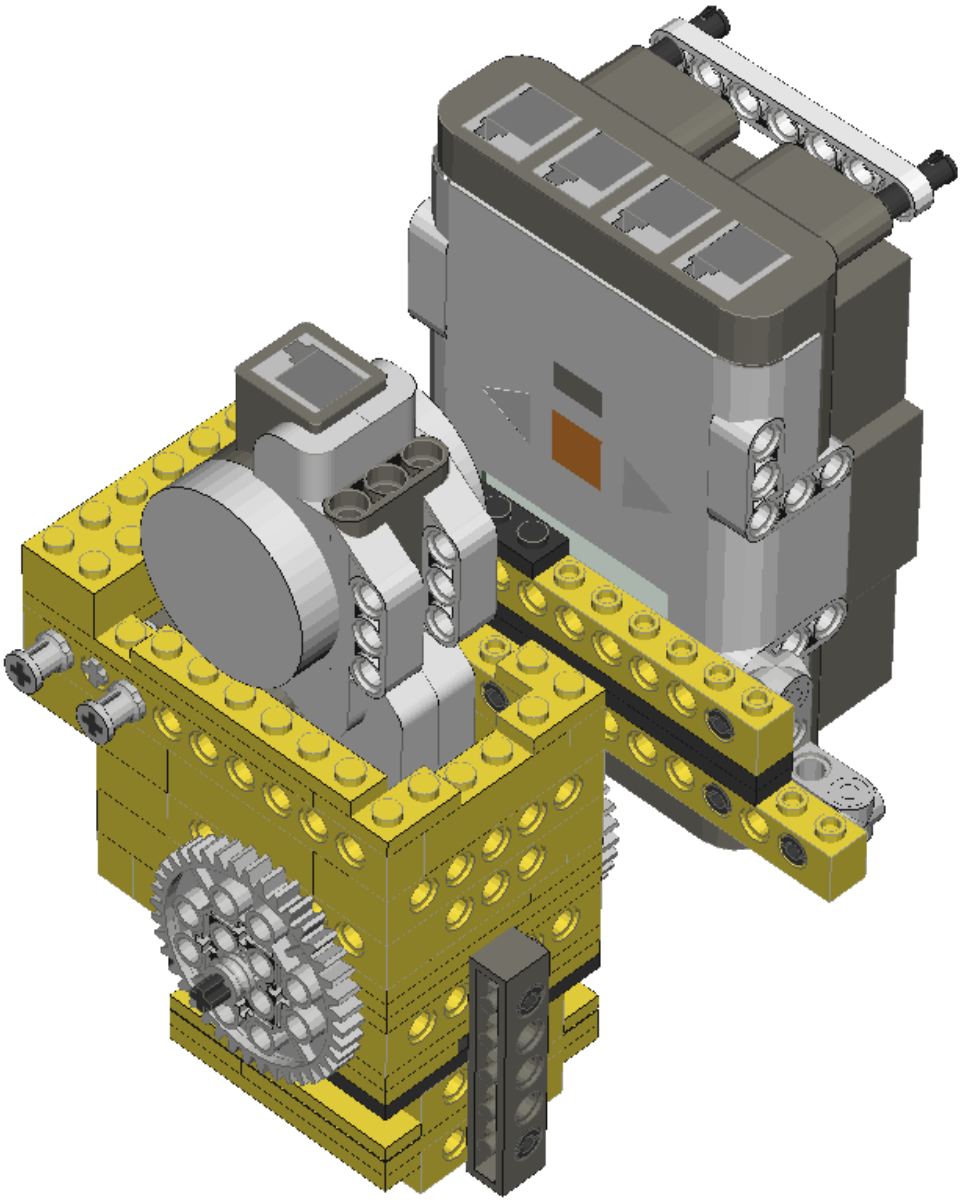

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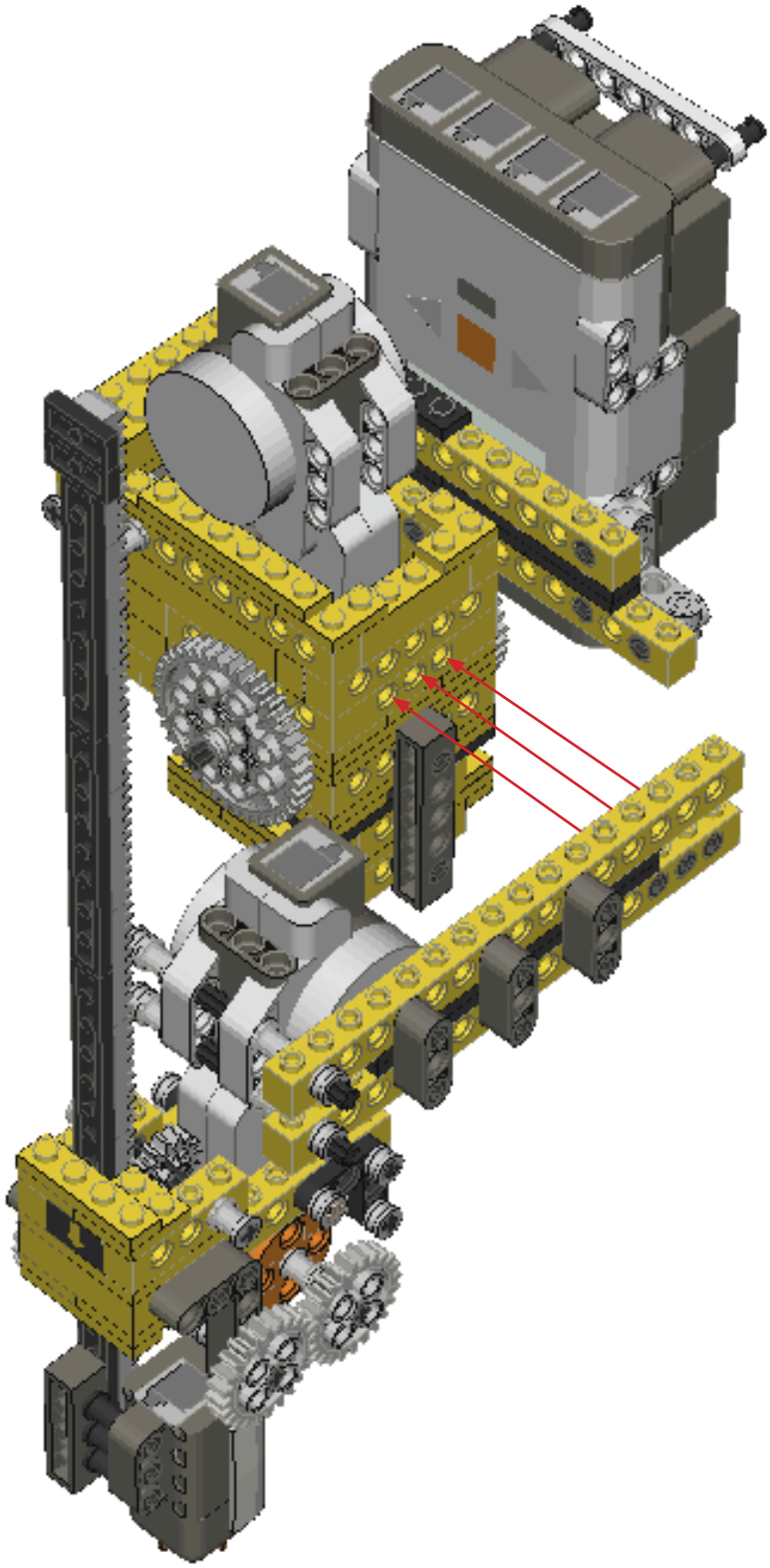

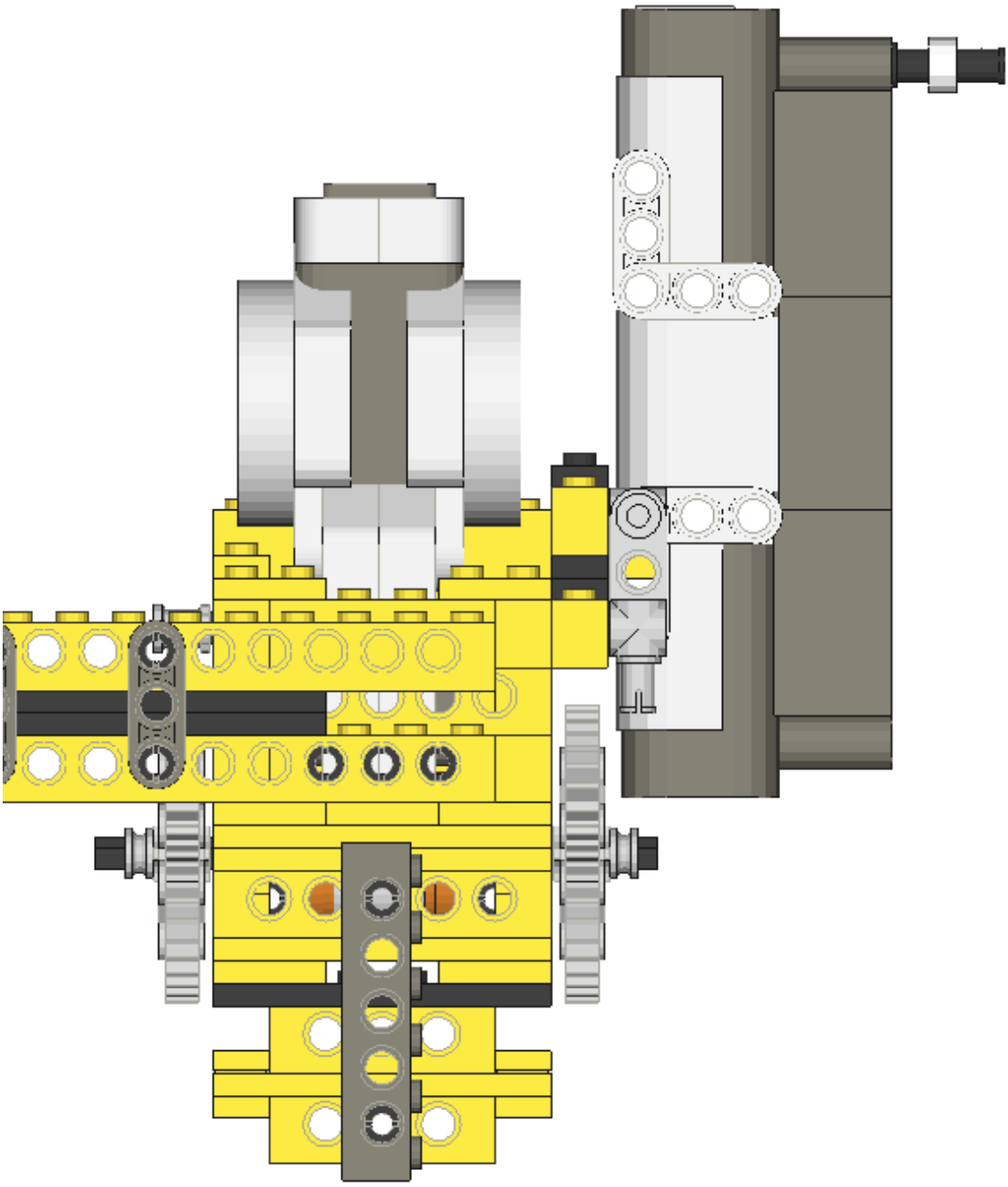

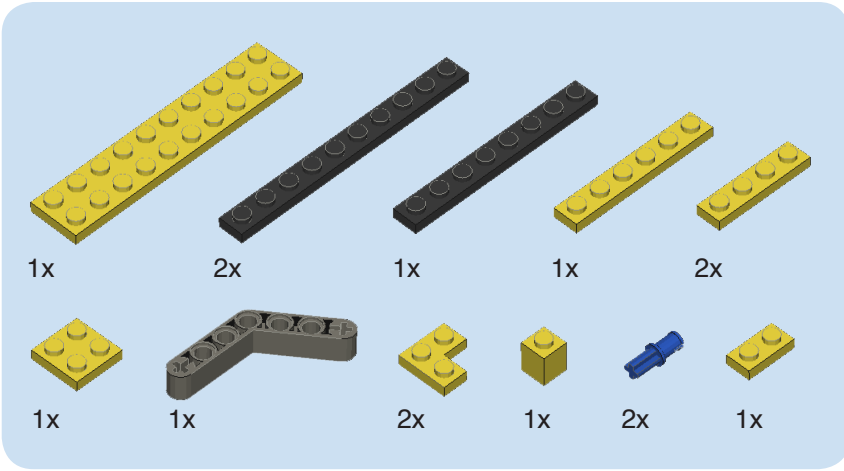

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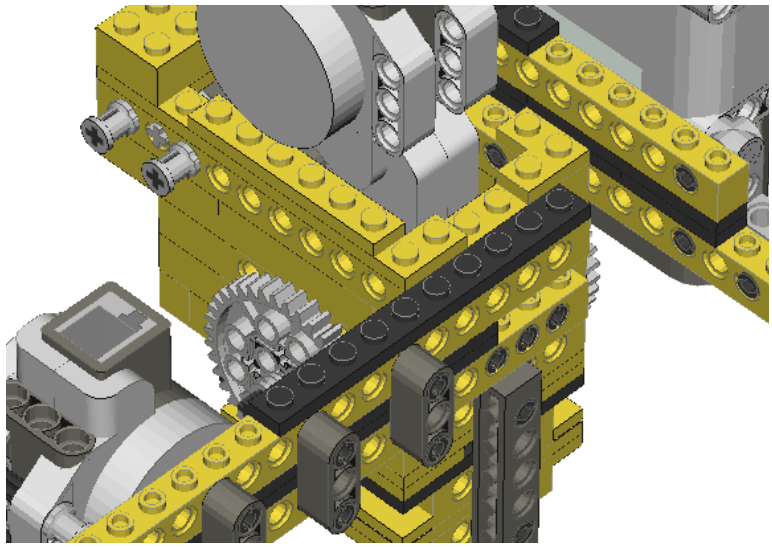

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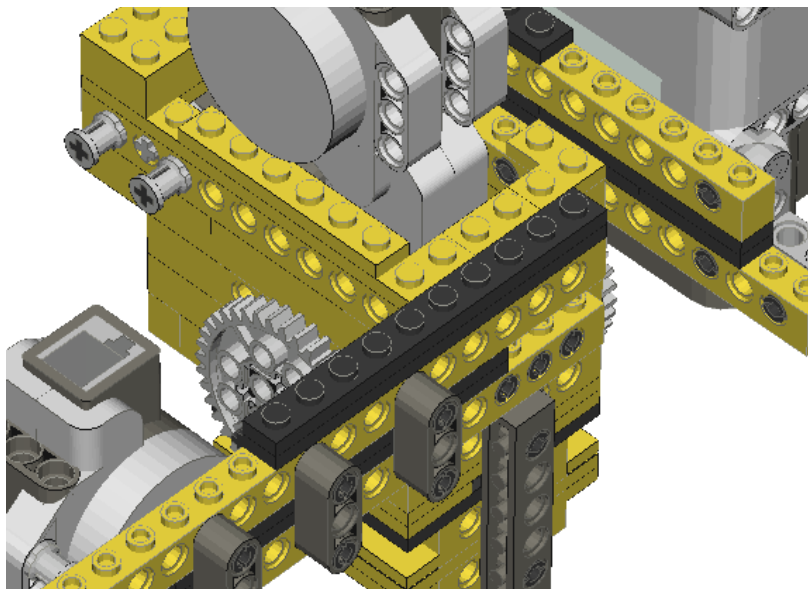

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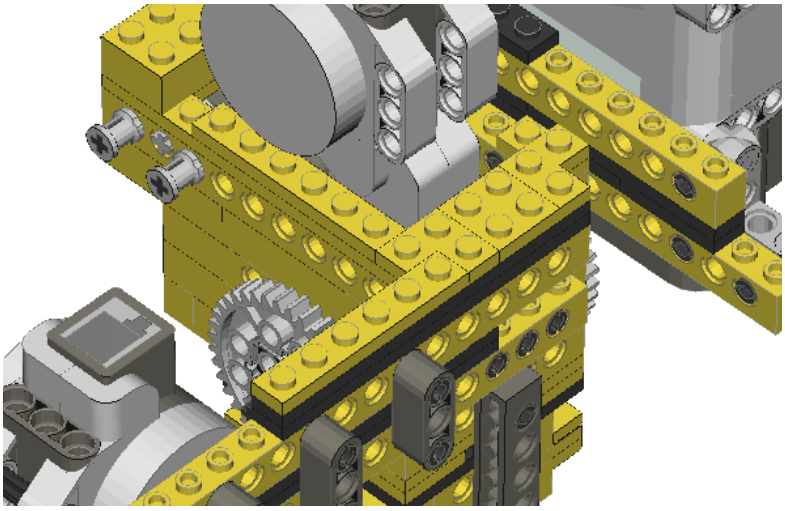

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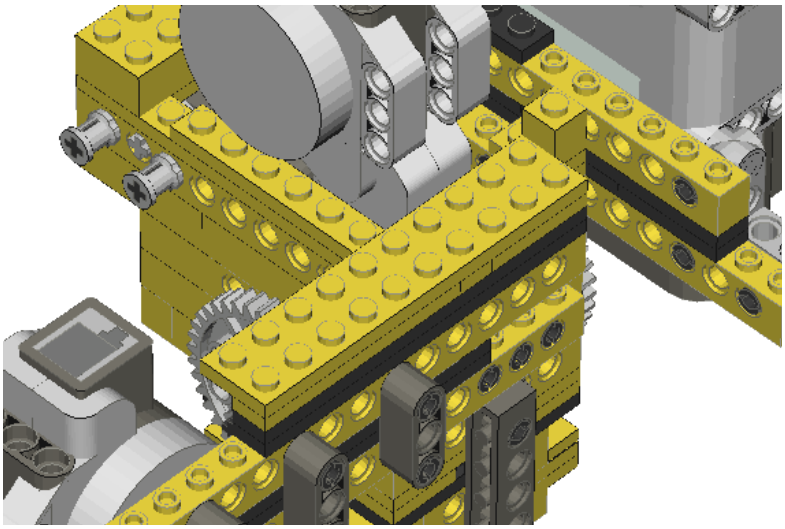

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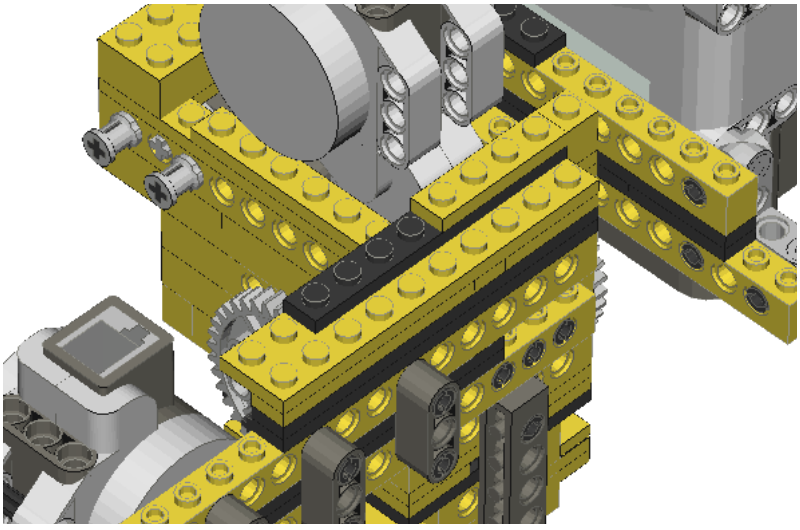

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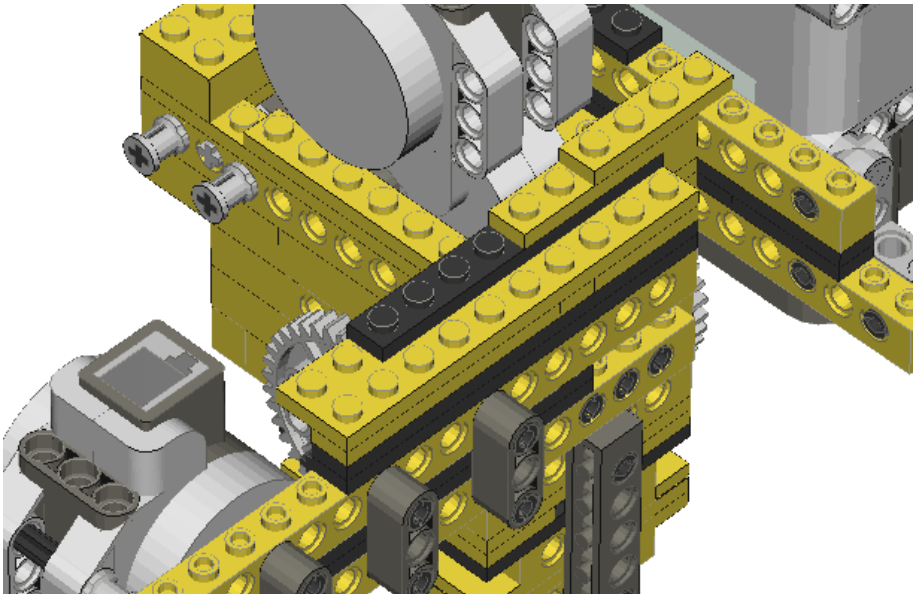

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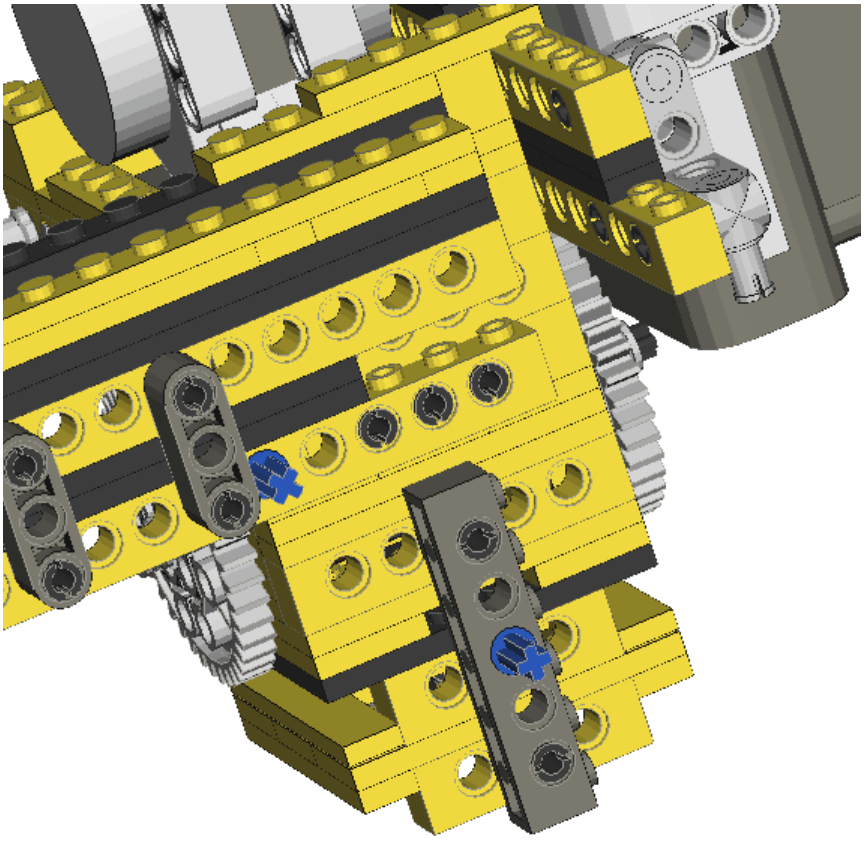

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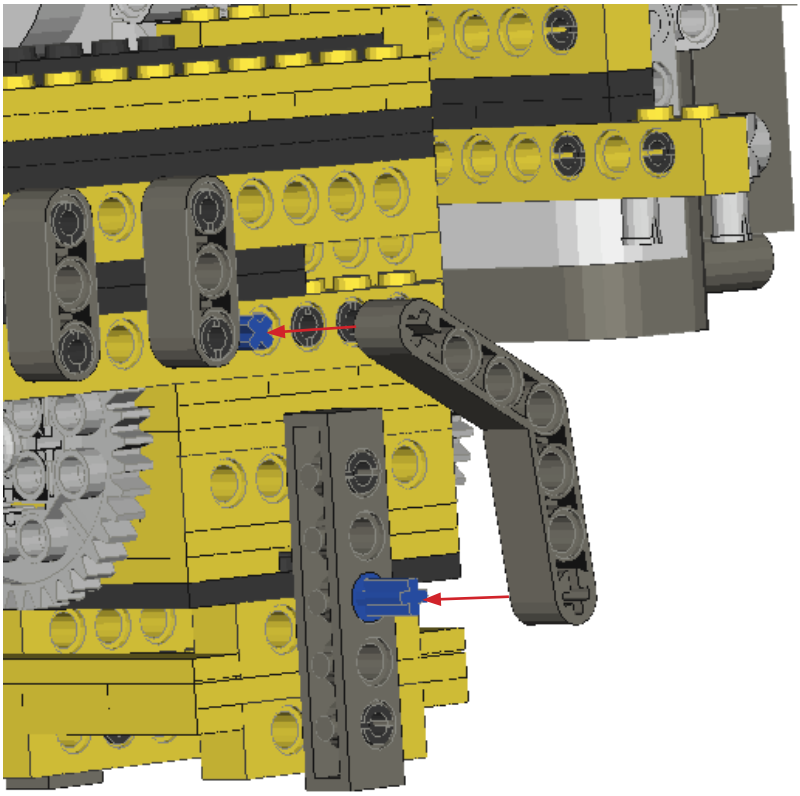

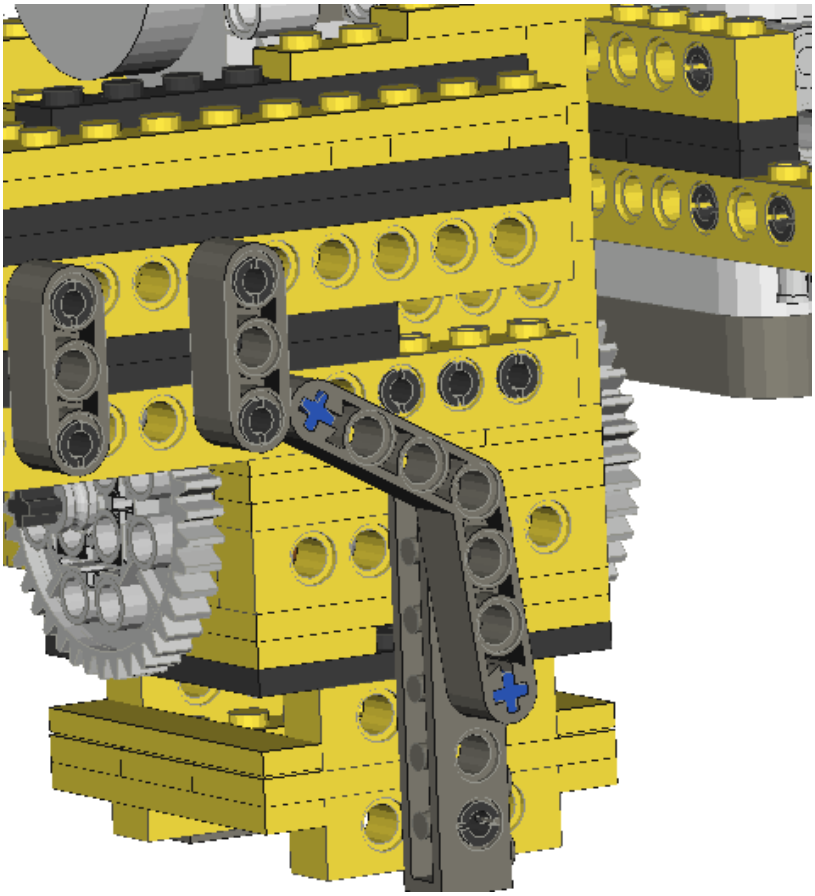

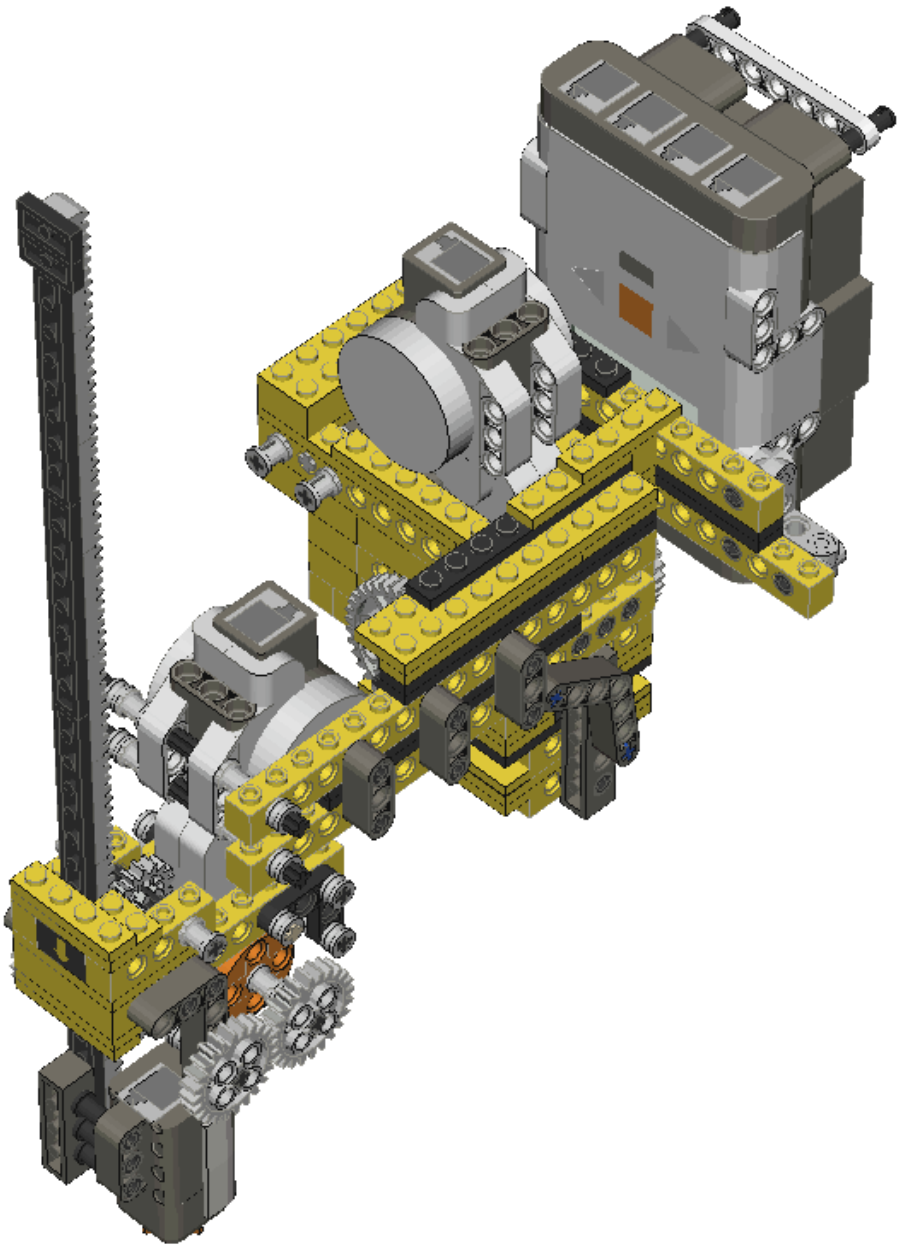

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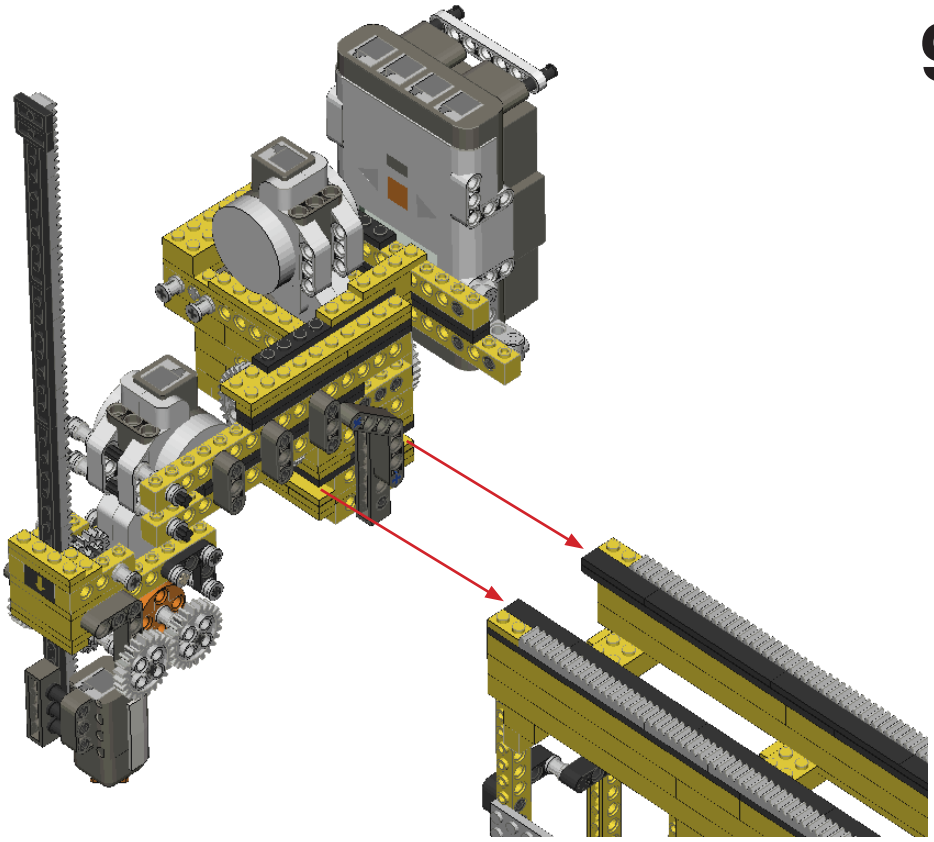

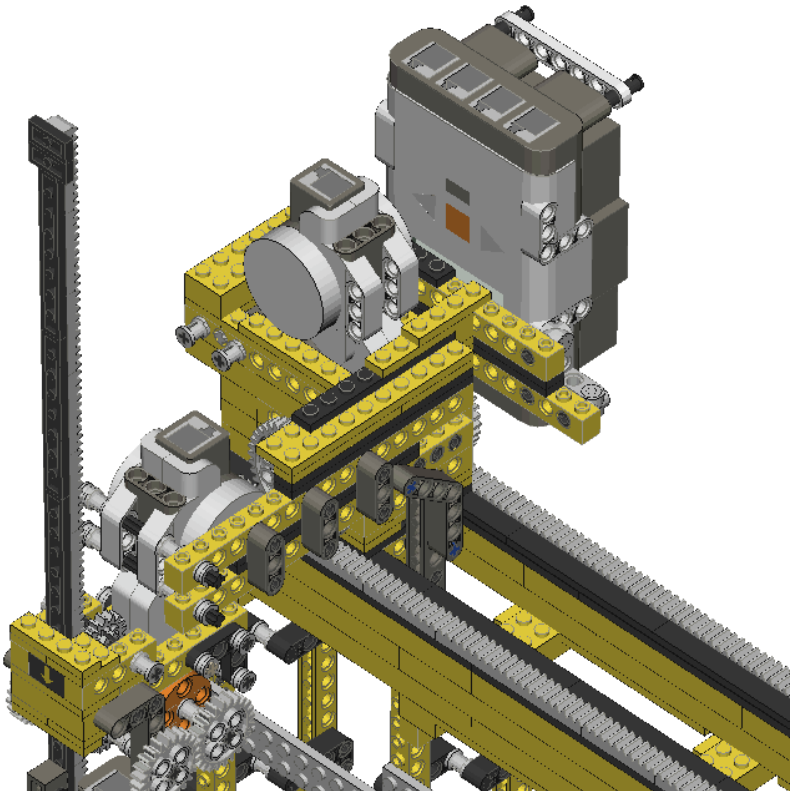

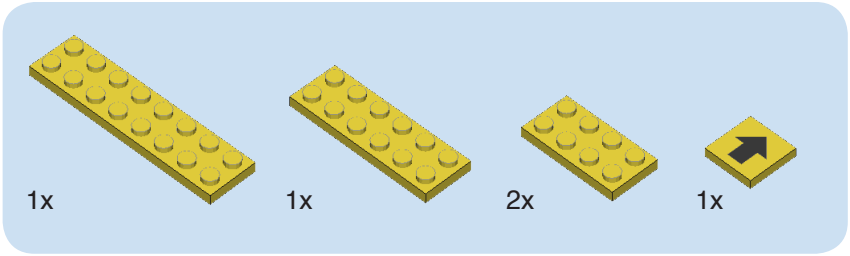

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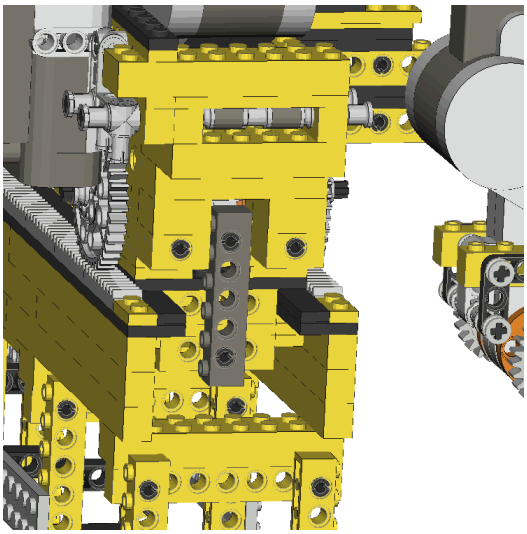

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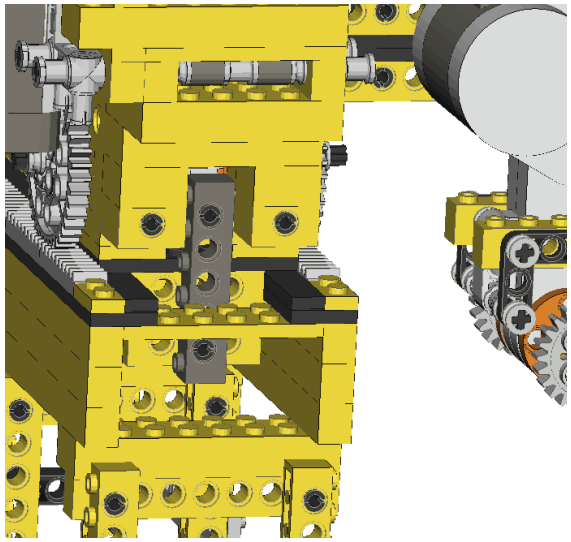

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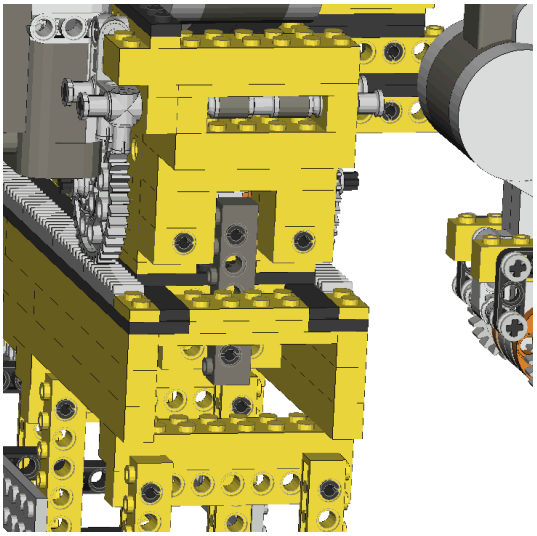

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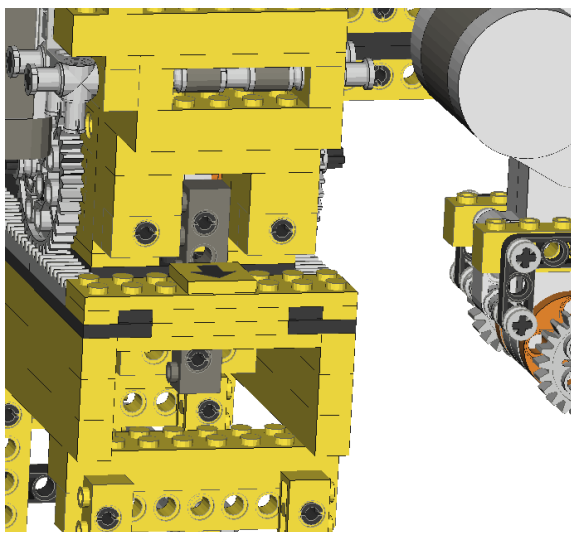

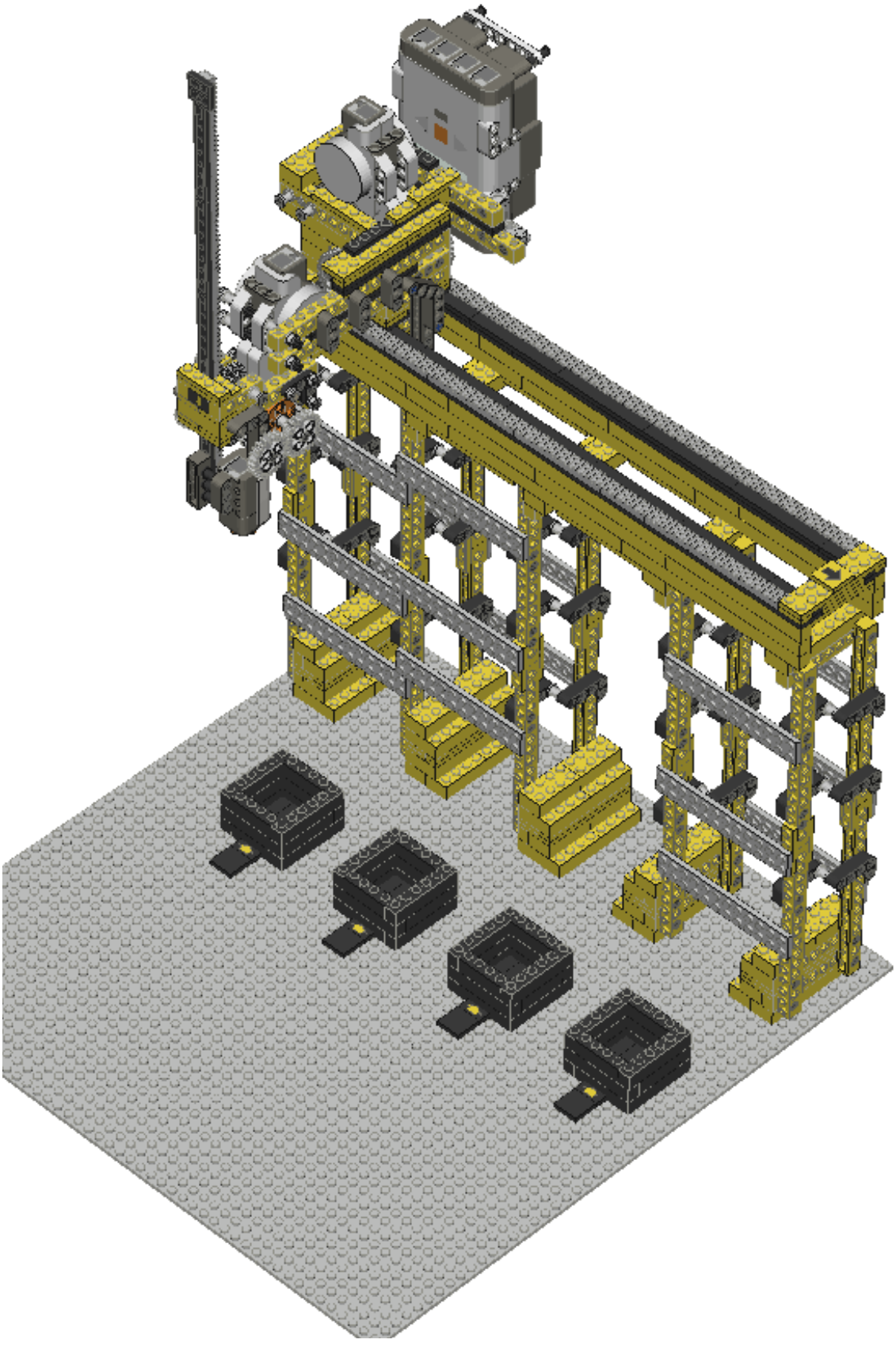

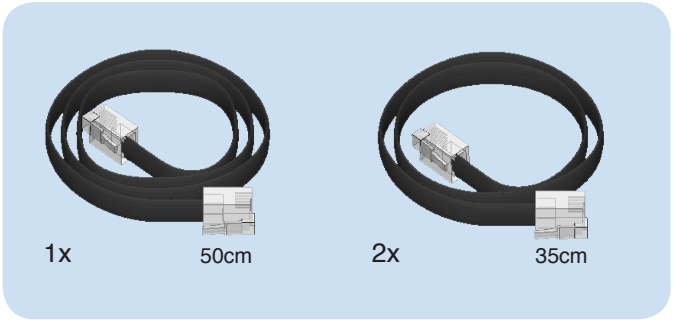

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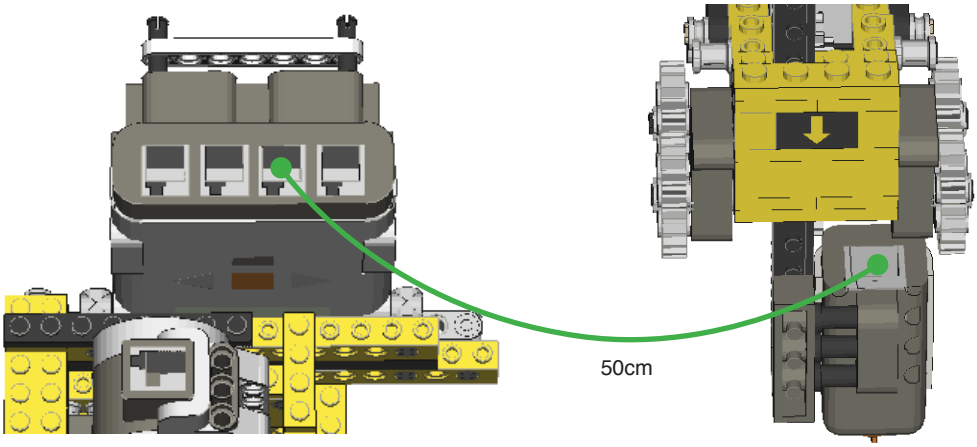

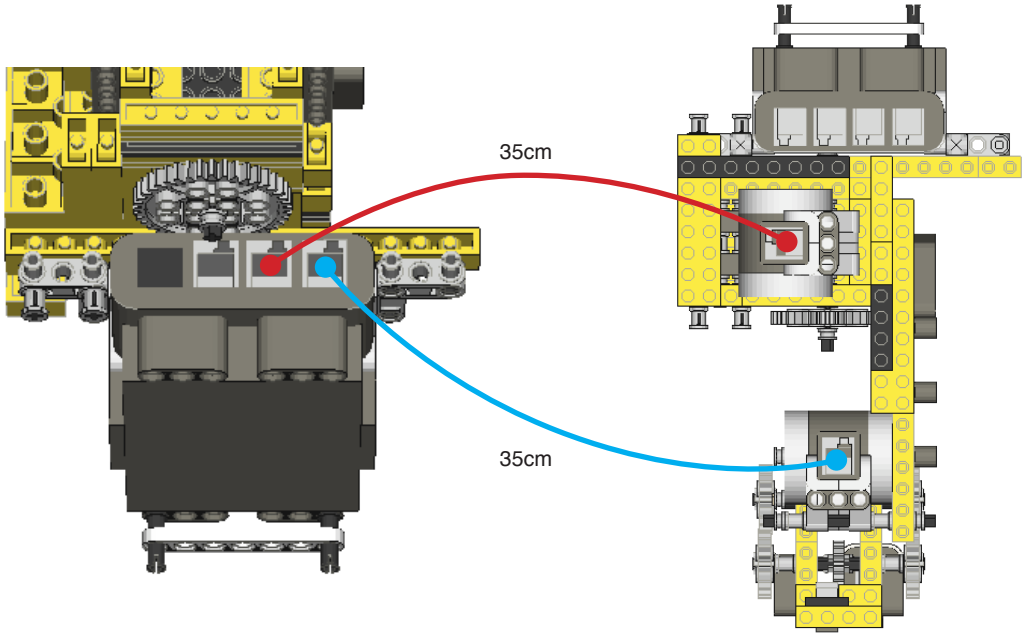

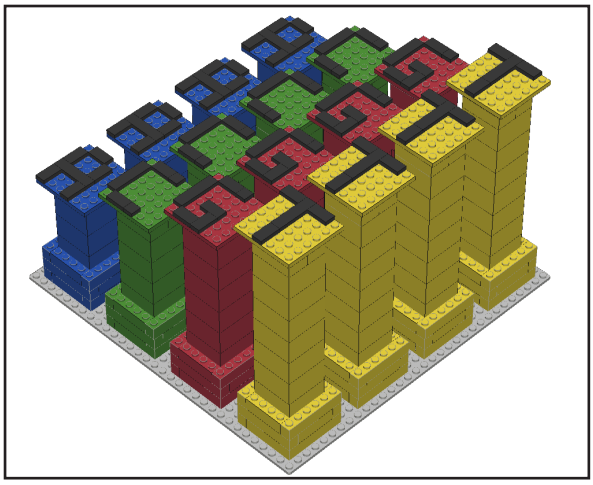

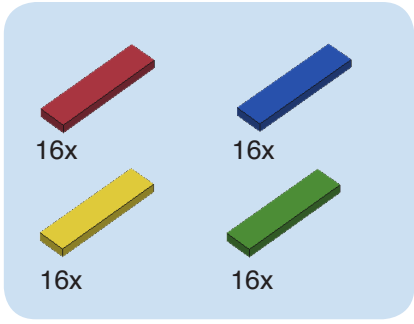

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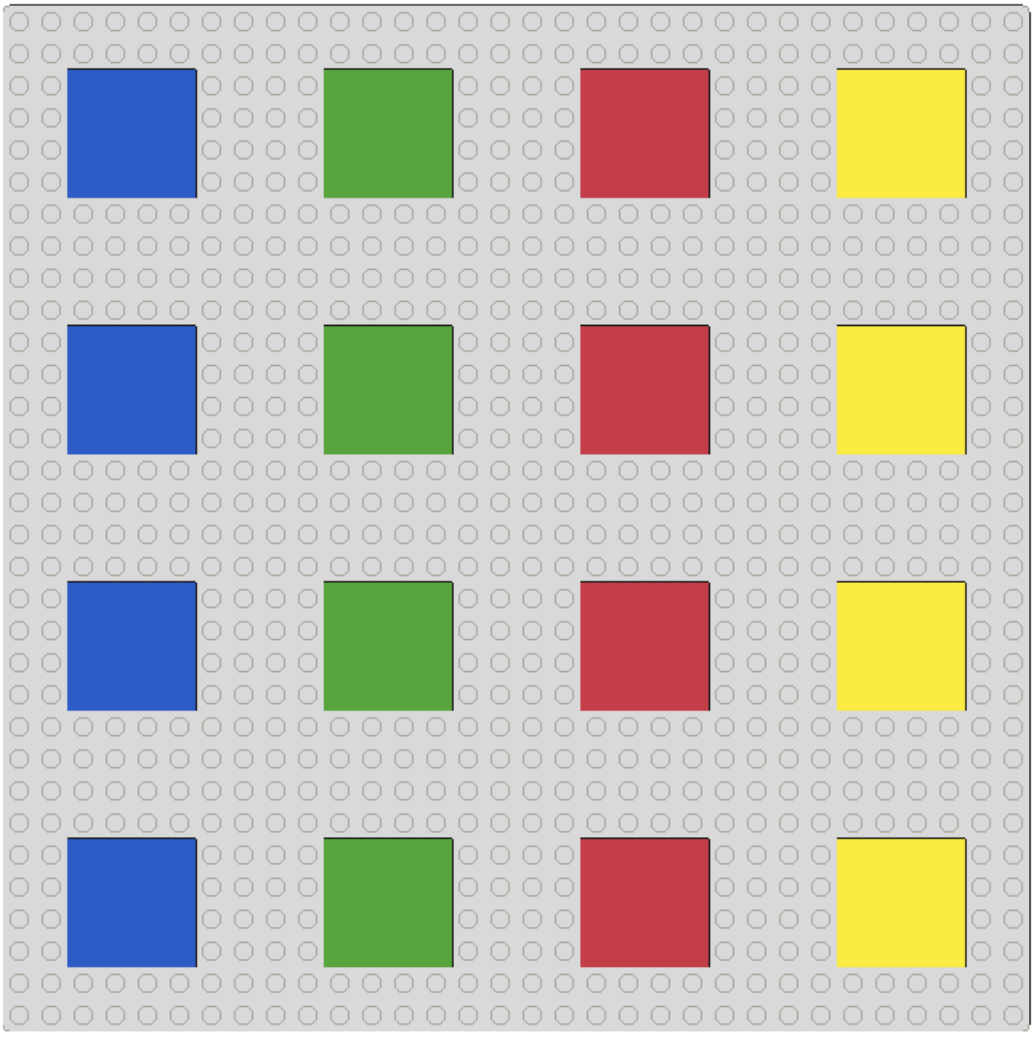

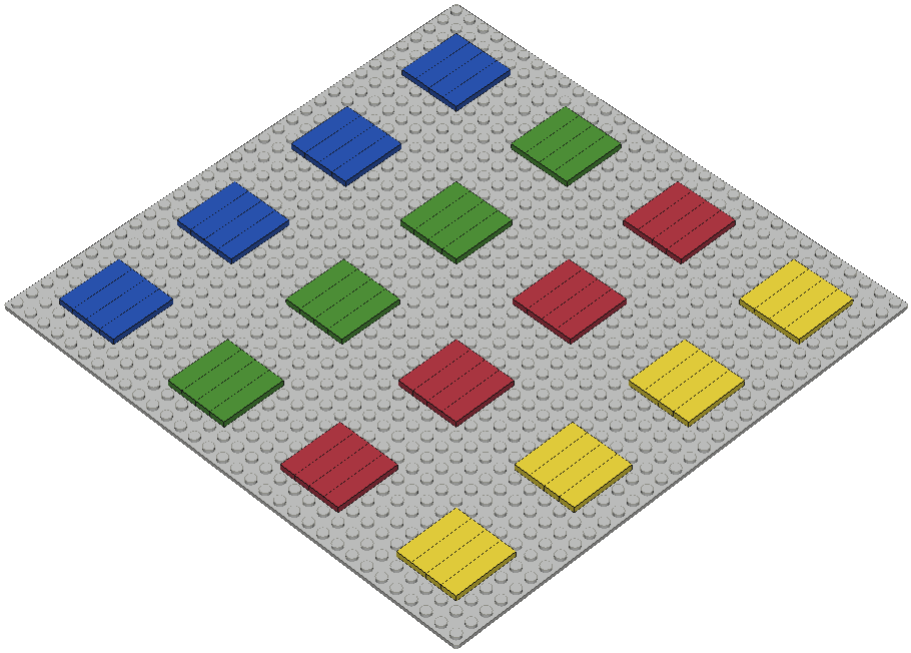

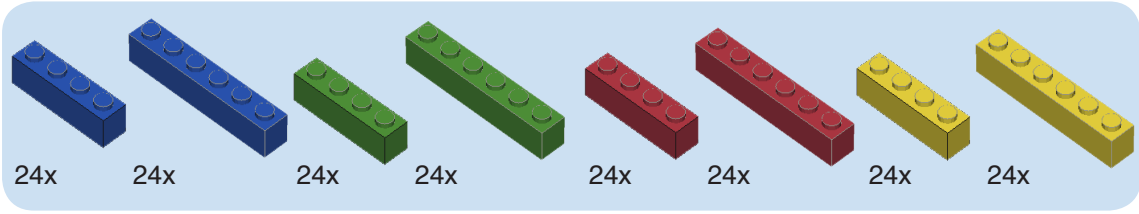

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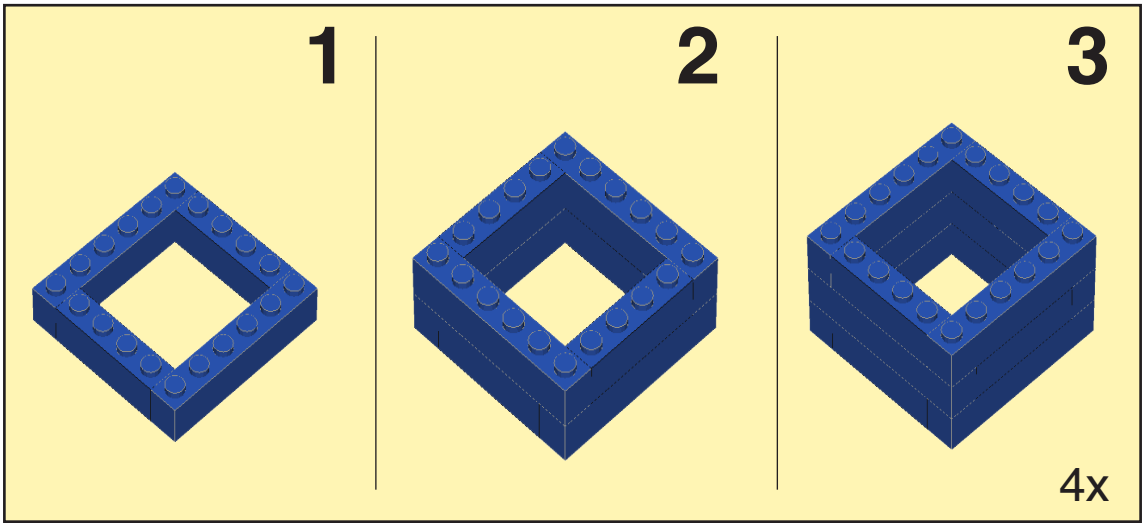

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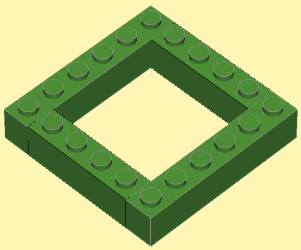

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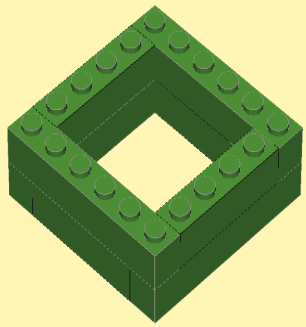

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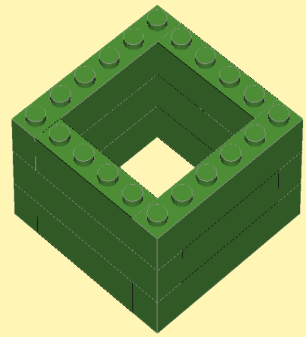

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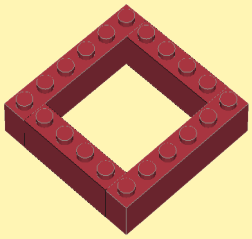

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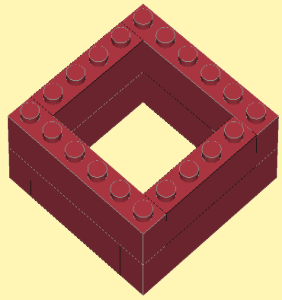

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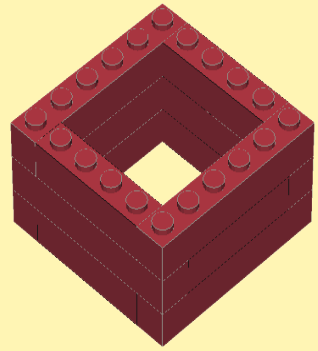

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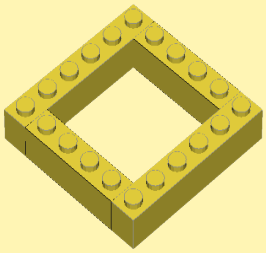

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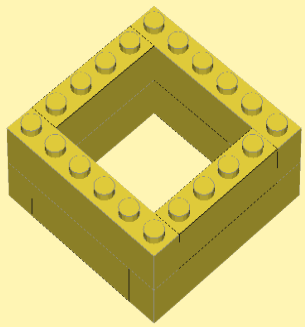

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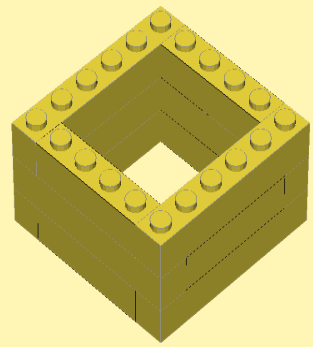

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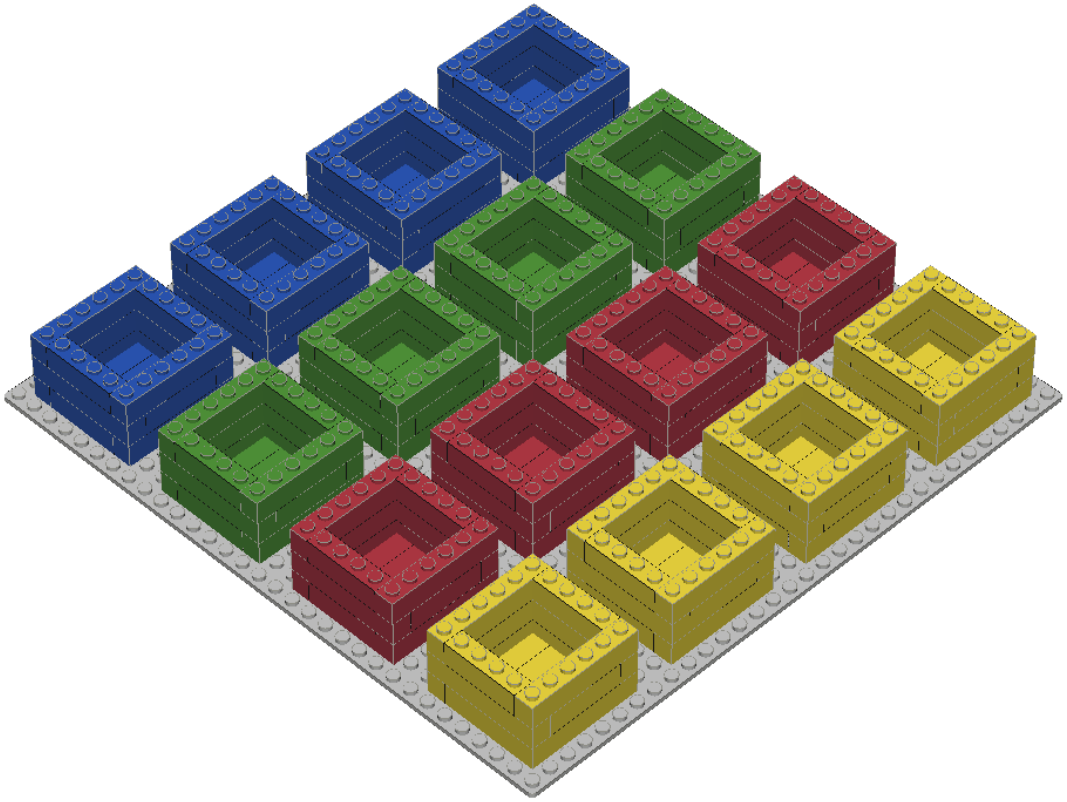

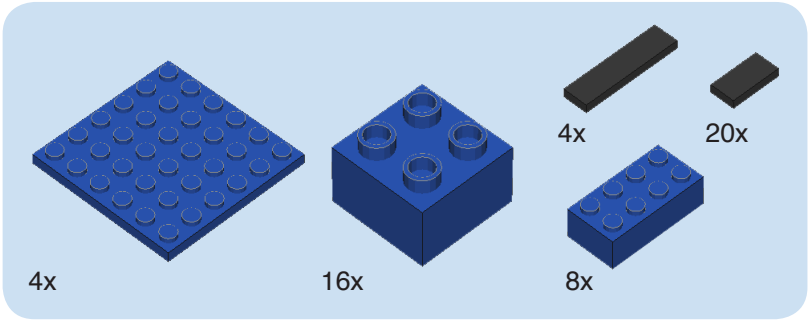

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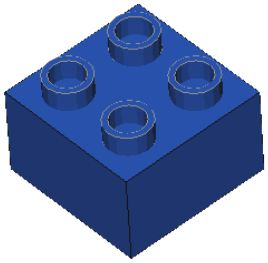

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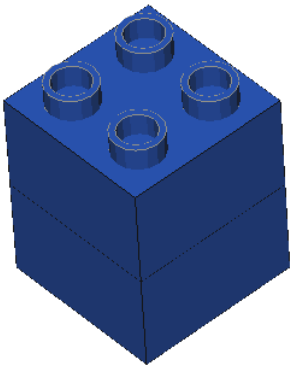

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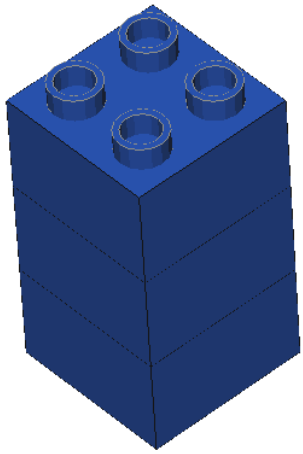

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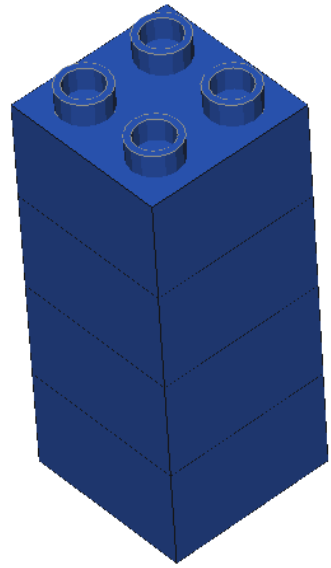

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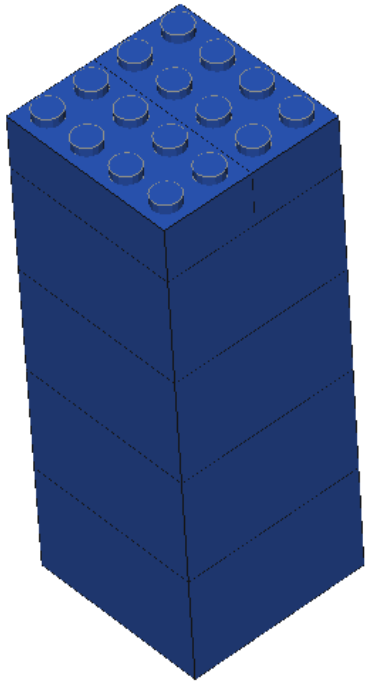

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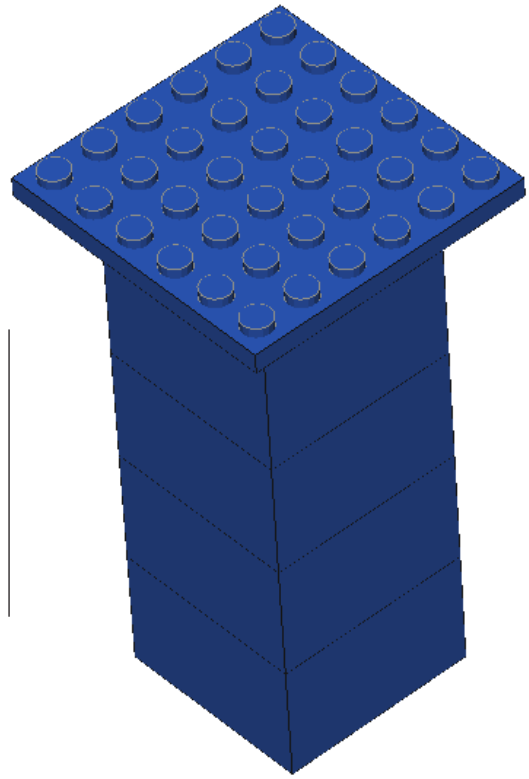

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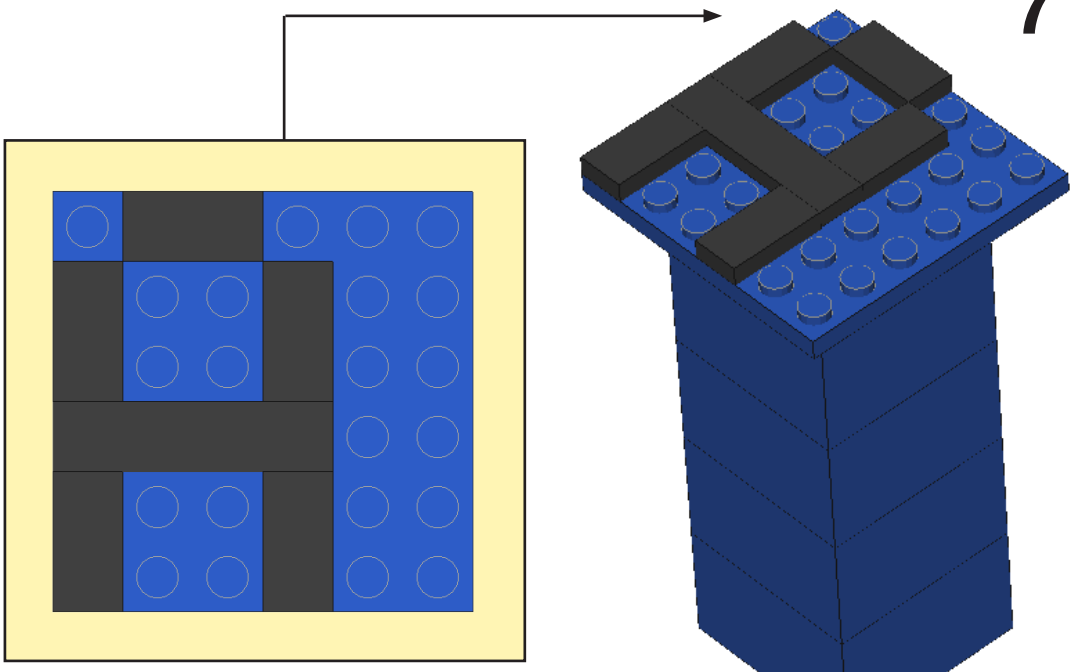

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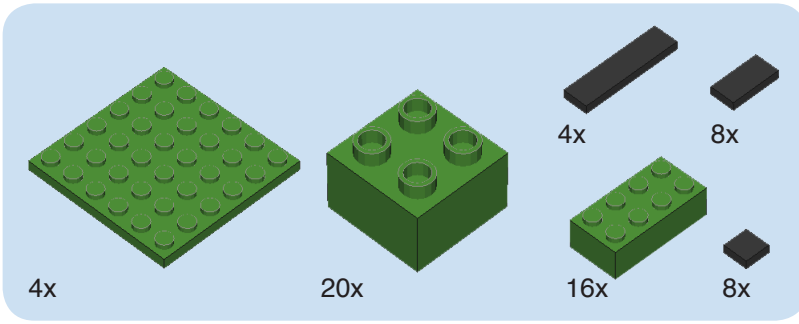

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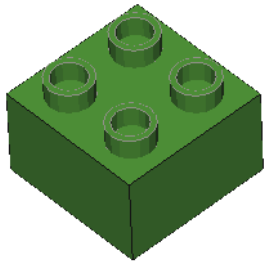

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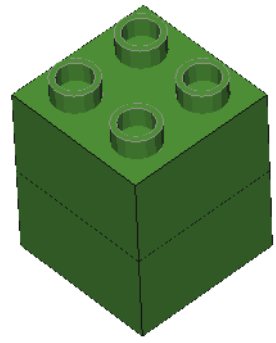

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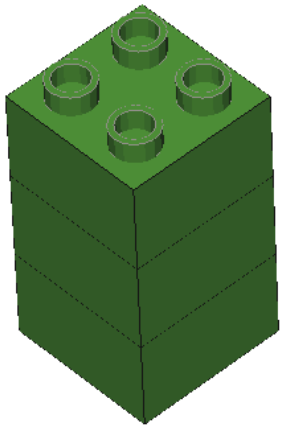

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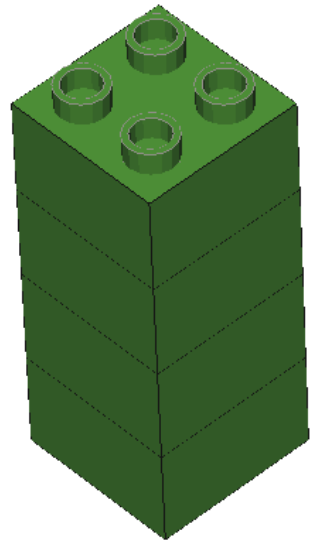

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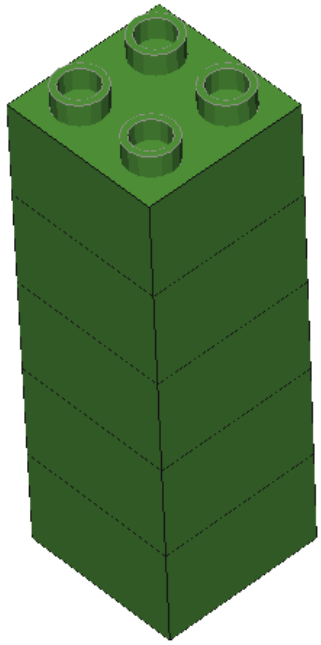

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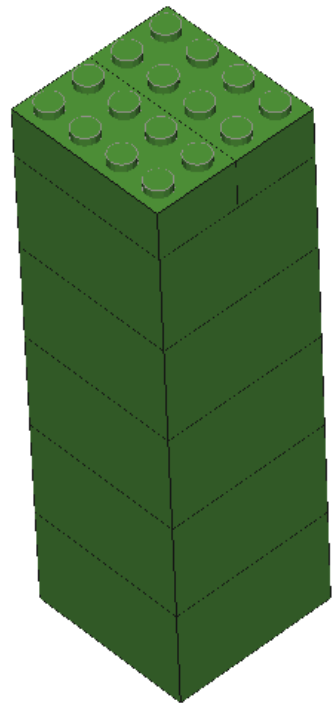

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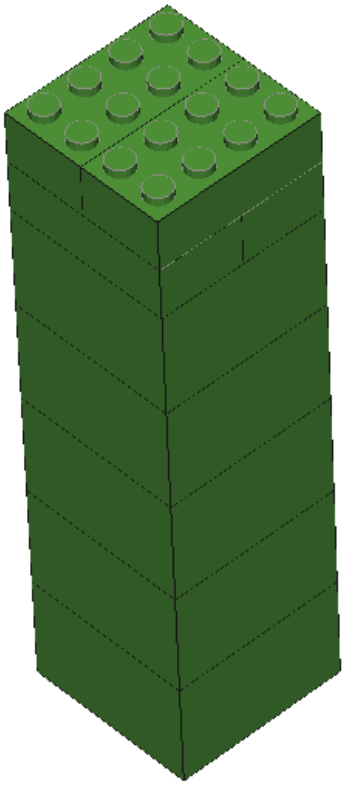

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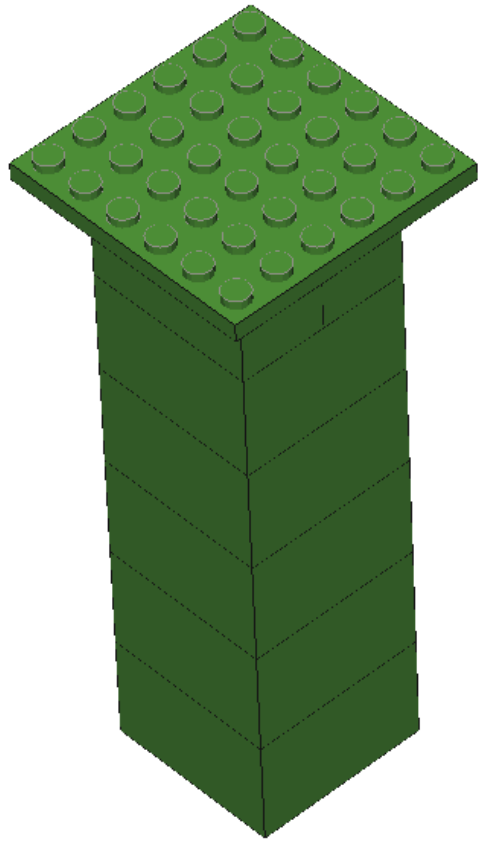

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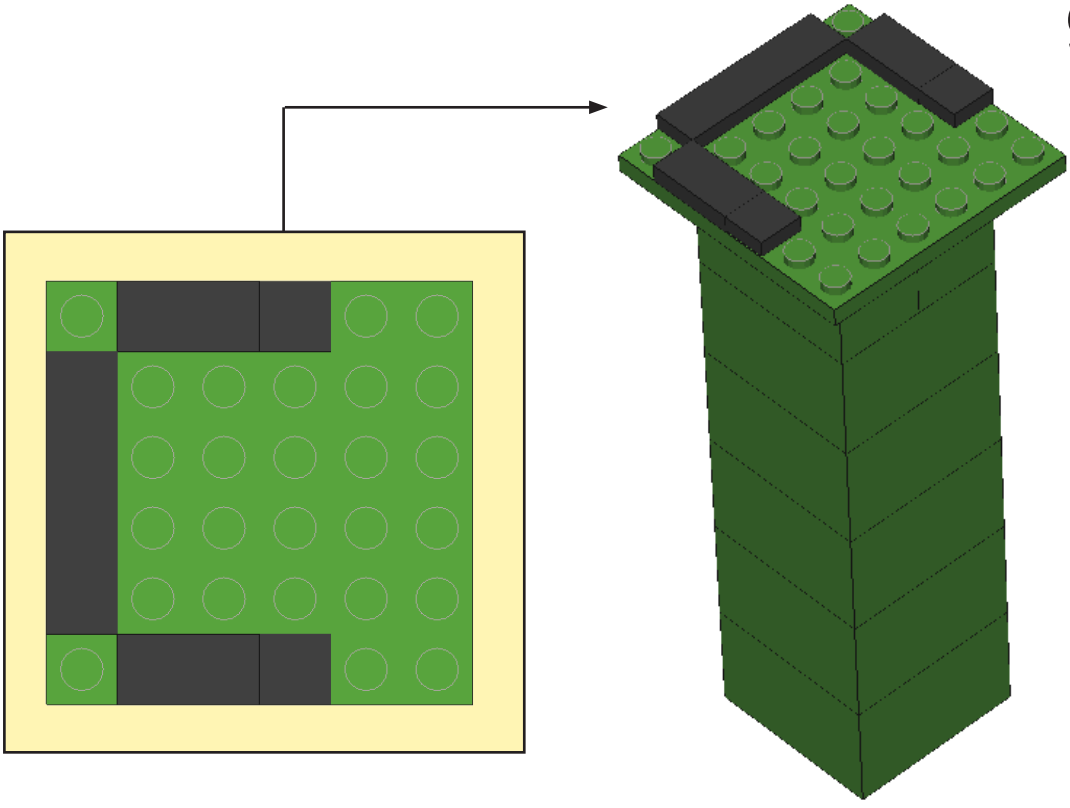

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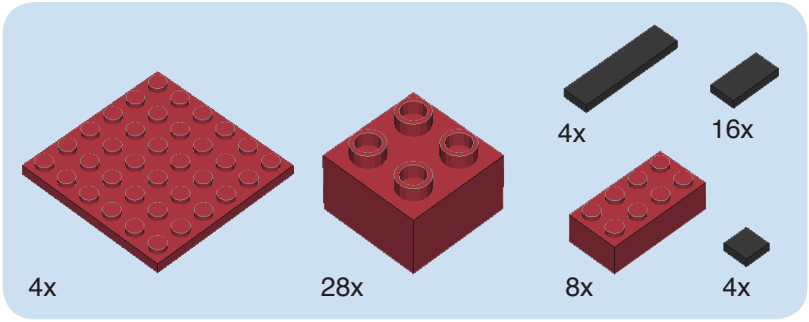

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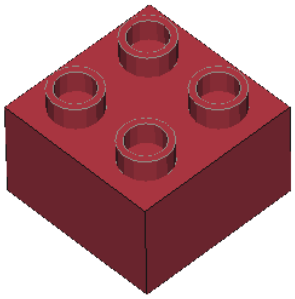

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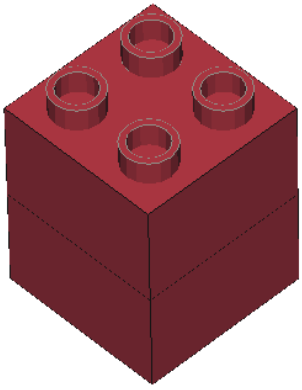

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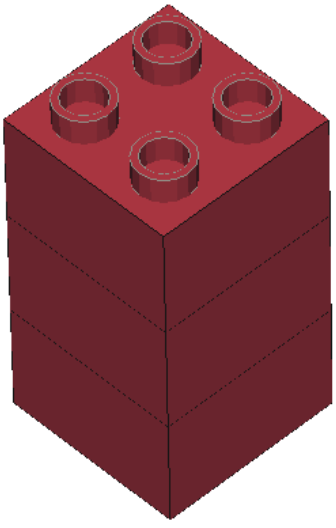

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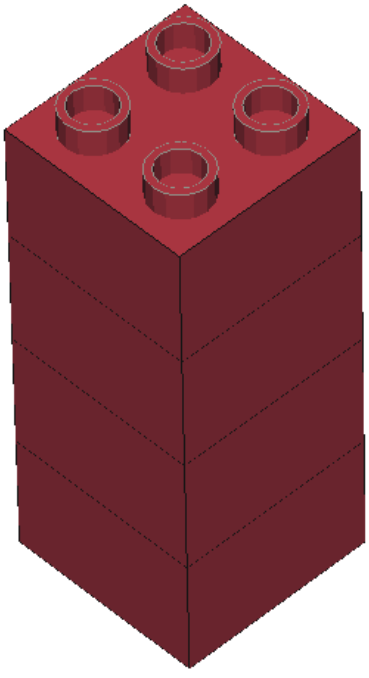

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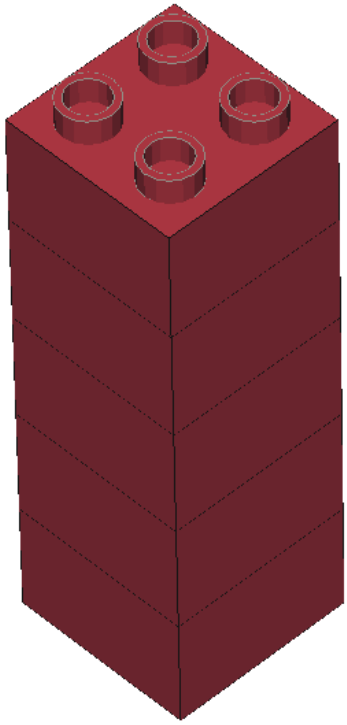

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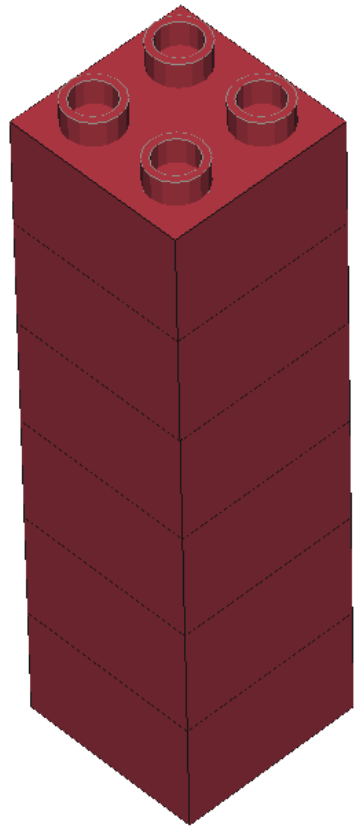

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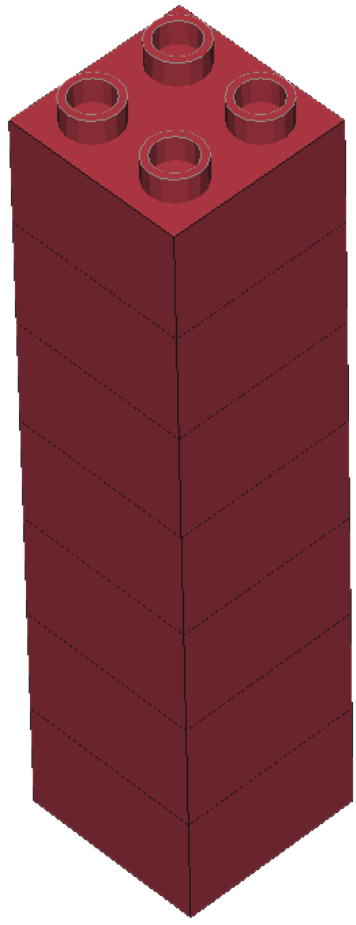

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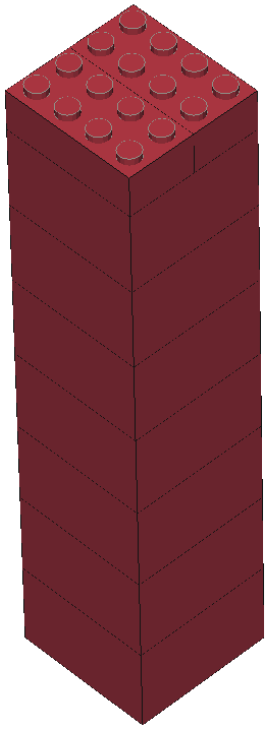

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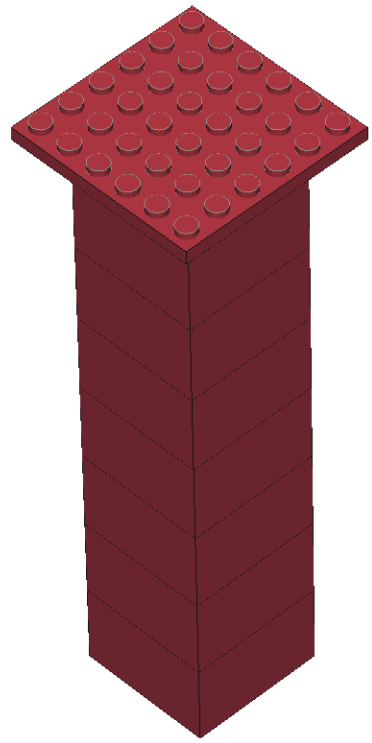

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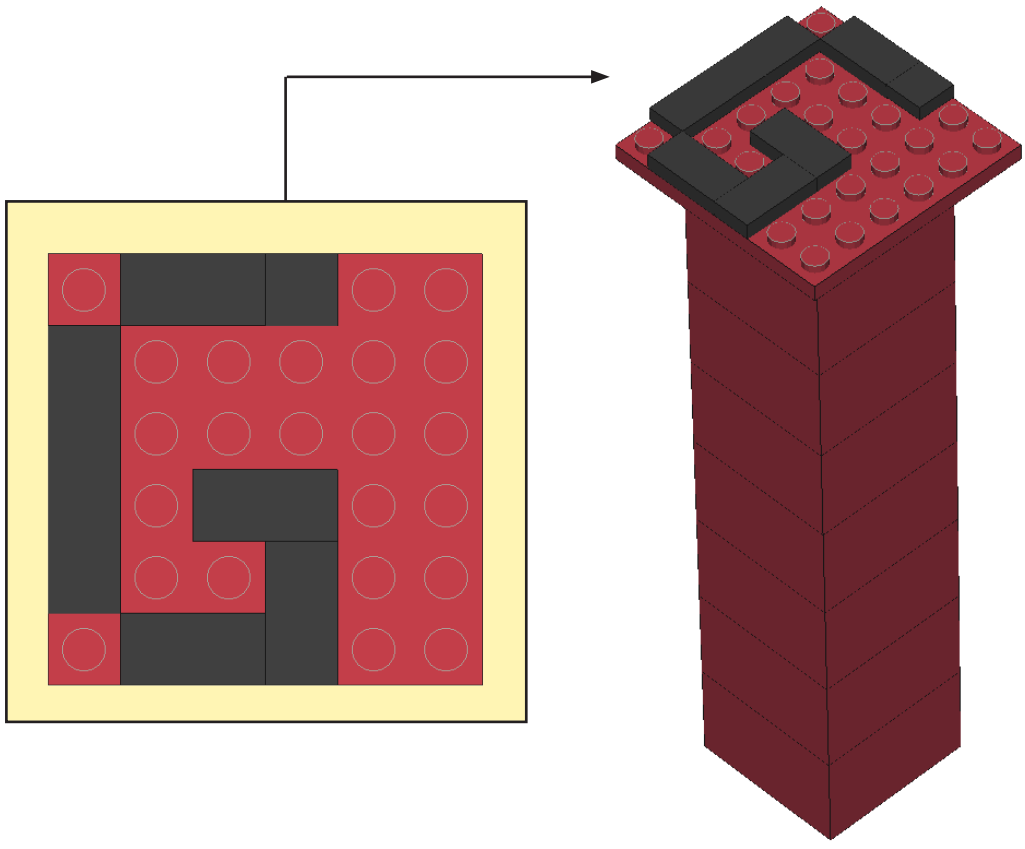

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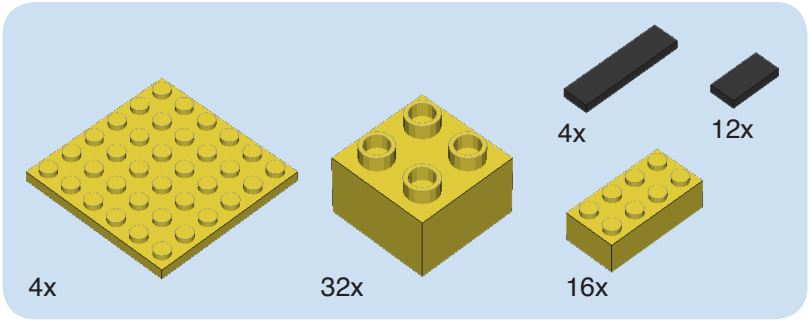

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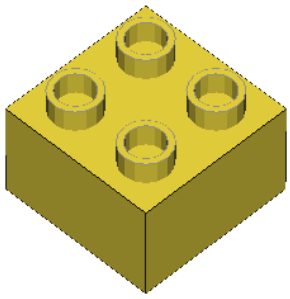

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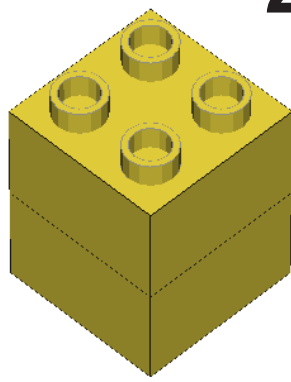

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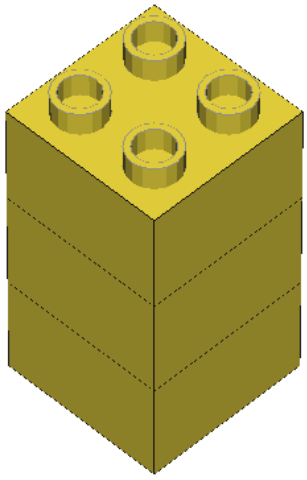

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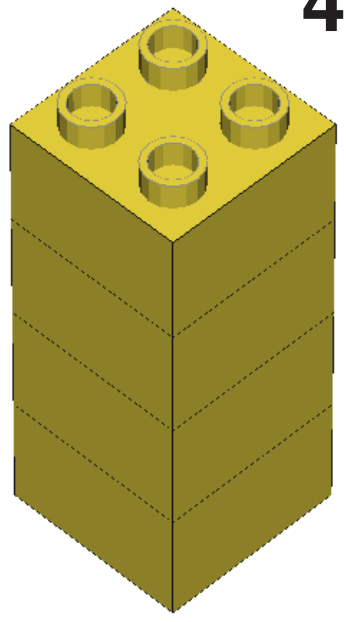

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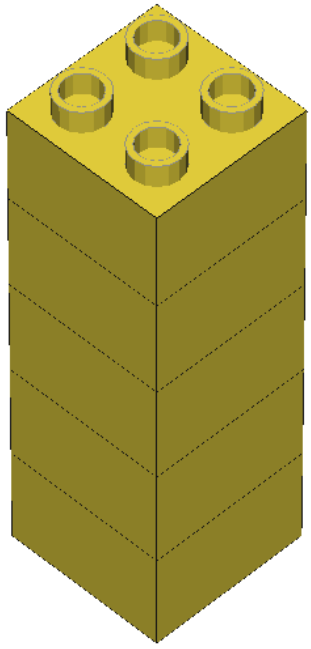

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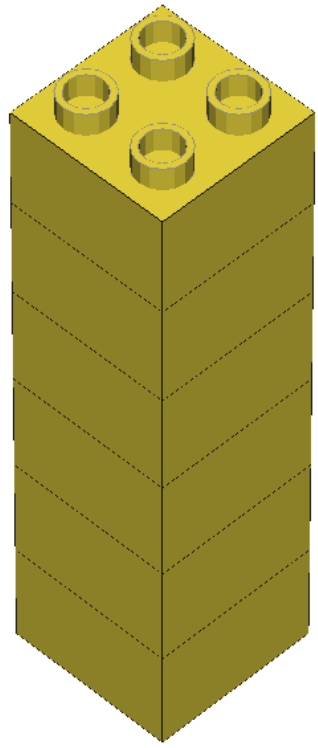

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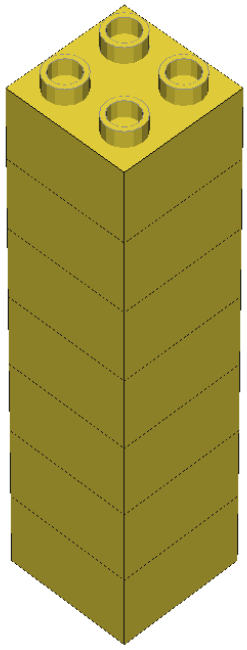

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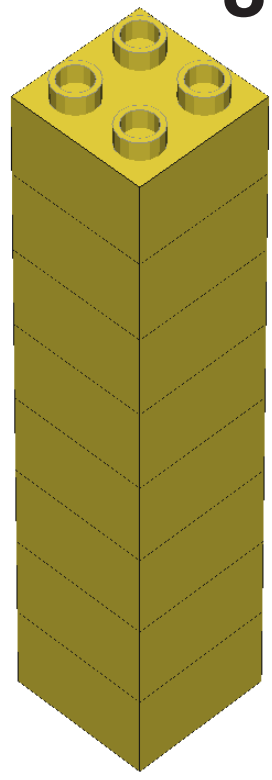

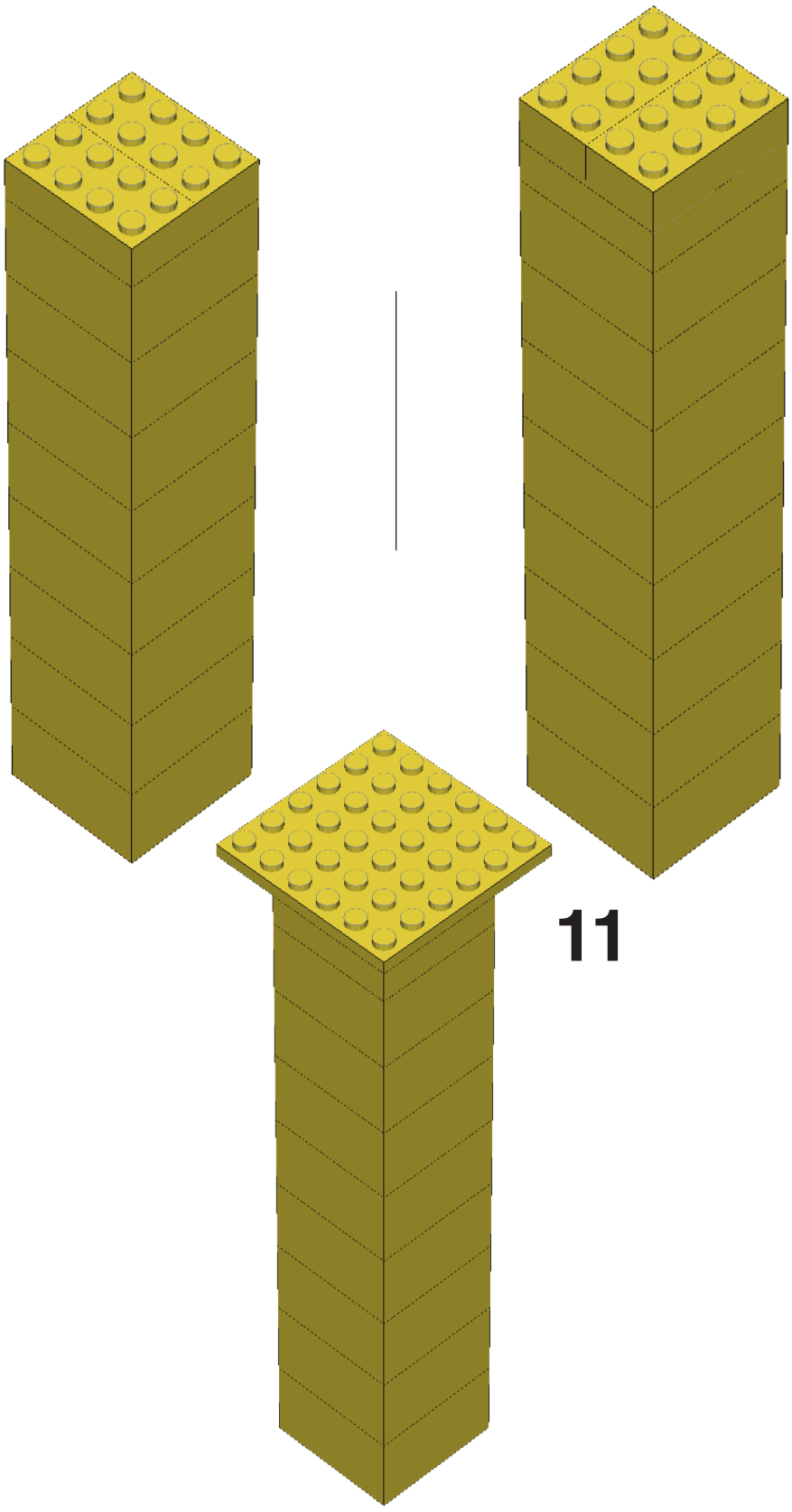
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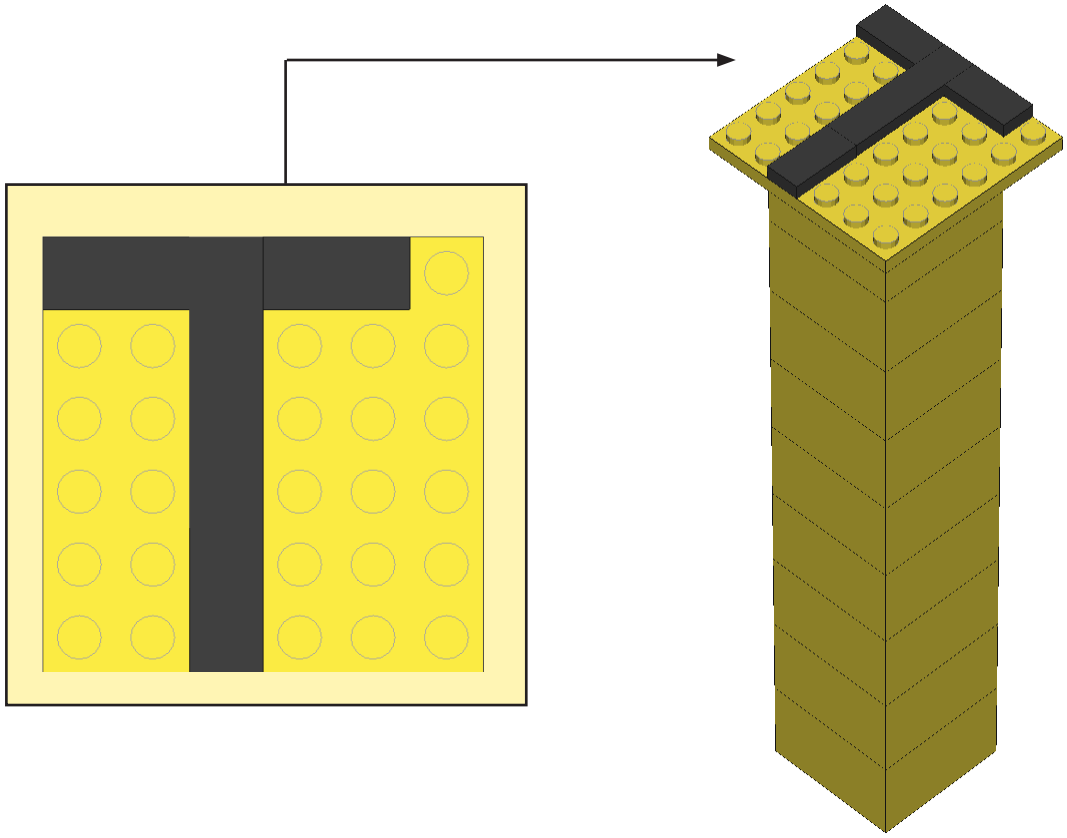
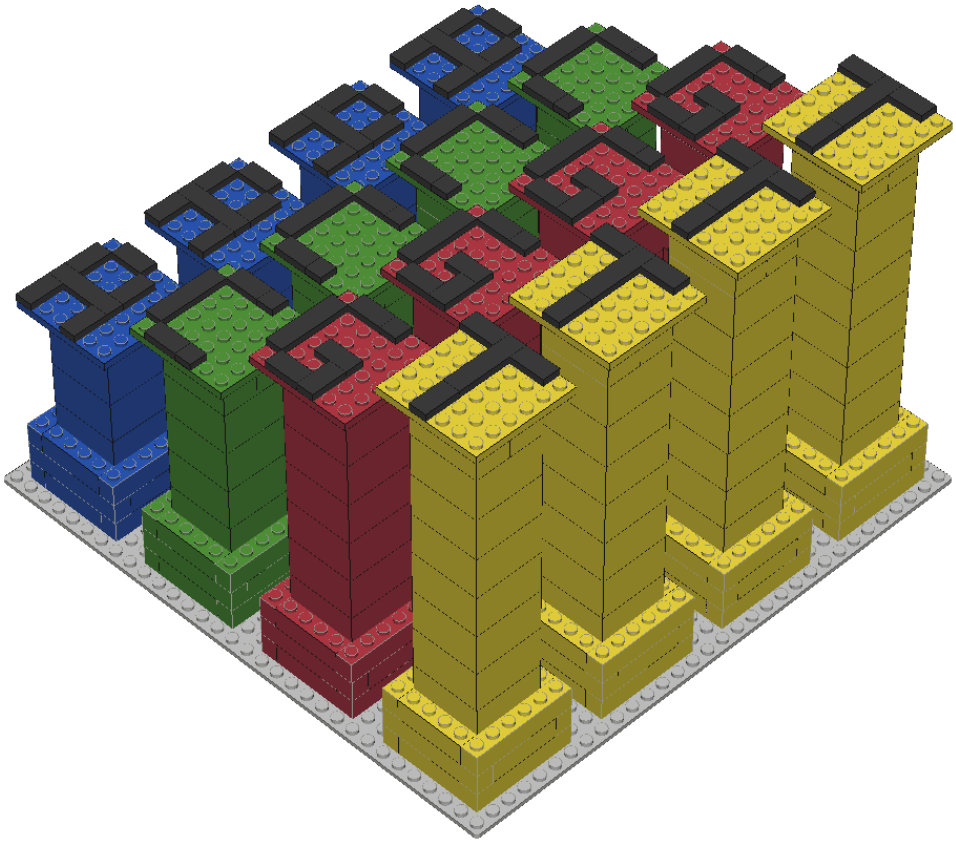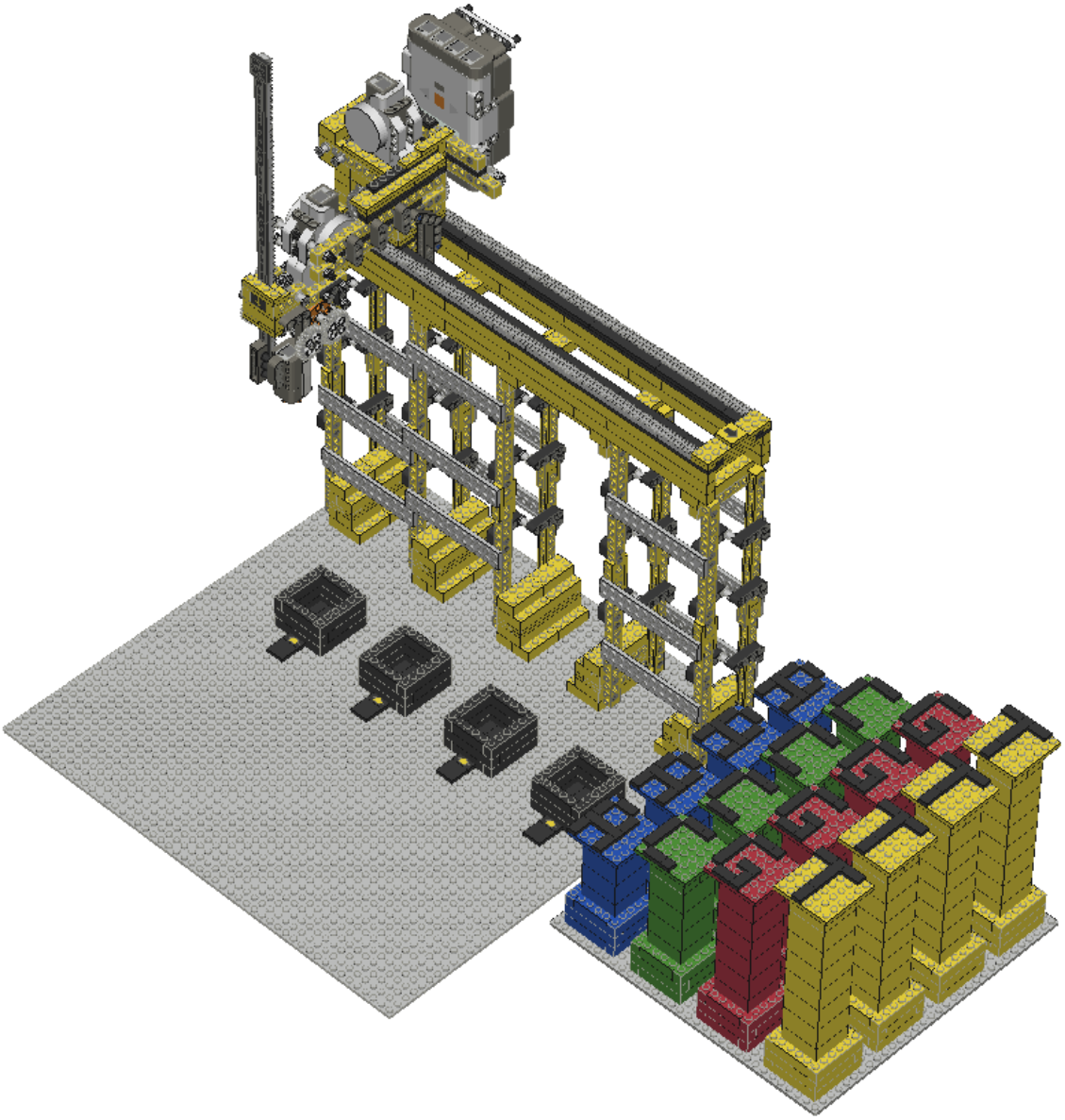
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