LEGO MINDSTORMS

Compiled by Michiel, v0.1, 2013

Introduction

Welcome to the LEGO MindStorms Ultimate Builders Set.

With the seven projects in this set you will learn about some of the skills needed to become a Master Builder.

You will learn about the Technical, Programming, Functionality and Design aspects in creating complex models in an efficient and modular way.

There will be step-by-step building instructions for all of these projects which each display aspects of these four skills.

The four main projects are:

- The **Tabletop Cleaner**. This robot will be handy to have around in your room, when need to clean your table. Not only is it practical, it looks cool too. We will use this project to highlight design.
- The **Plotter** is a perfect showcase for our module system. Although it is a complex model with a complex function it is easy to build once you have constructed all the modules. We are going to use this model to illustrate the technical aspect of a model.
- As the **Wall Climber** requires a complicated program to make it work properly we will use this model to demonstrate the programming skills of a Master Builder.
- And finally, the **Disc Shooter** will focus on model functionality.

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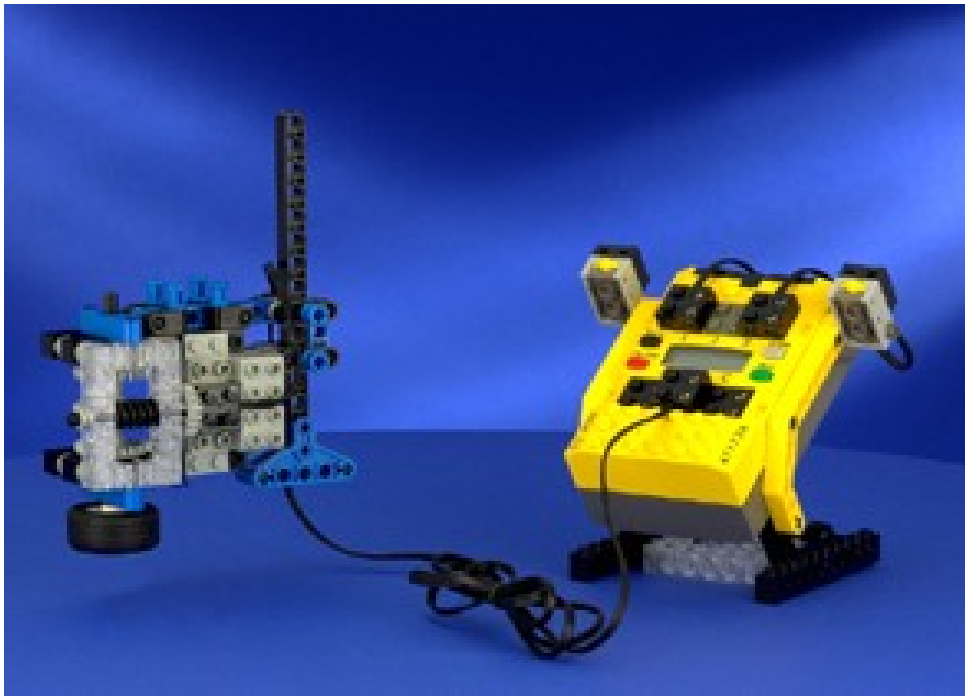
Volume Control

Required modules: Motor module 3



Make sure you have built Motor Module 3 before you start to put the Volume Control together.

Once you have done this it is a simple matter of building a base for the RCX and sensors, then a holder for the Motor Module to allow you to attach it to the device you want to control.

Click on "Build" to get step by step building instructions.

The tire on the Motor Module must rest on the volume control of your stereo or other device, which must be of the rotary kind. Use some tape or modeling clay to fix the blue "foot' of the motor holder. You can then move the motor module up or down the Technic Beam by removing the blue pins sliding the motor to where you want and replacing the pins.

You will then be ready to program your creation. Click on the "Program" button to get started. You can find an example program for this model on the CD-ROM if you need some ideas.

You should be able to control the volume of your device by pressing the sensors attached to the RCX.

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View
1 2 3
On-Off
Prgm
A B C
Run
RCX 2.0
471716

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View
1 2 3
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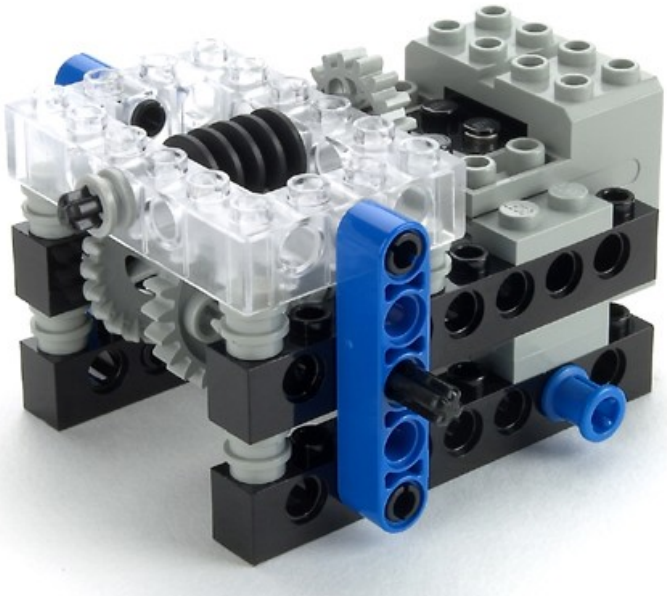

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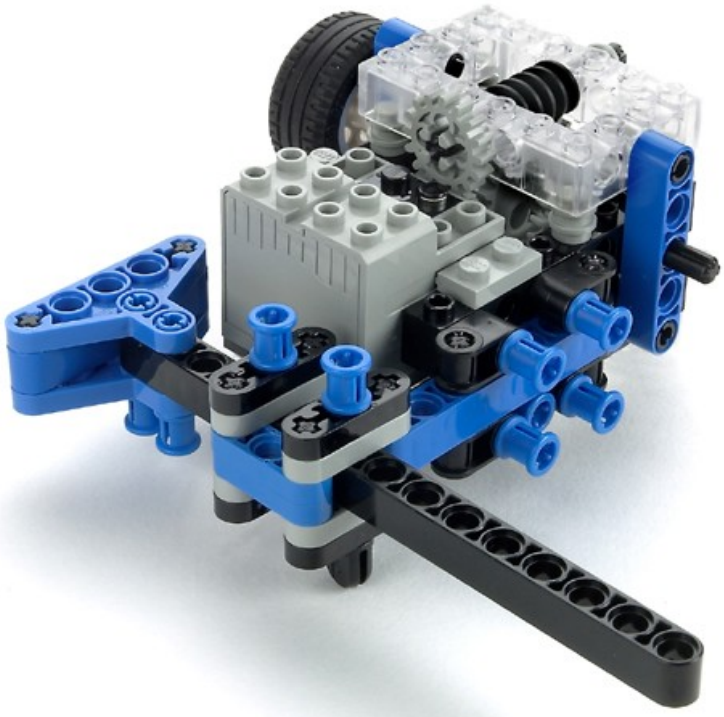

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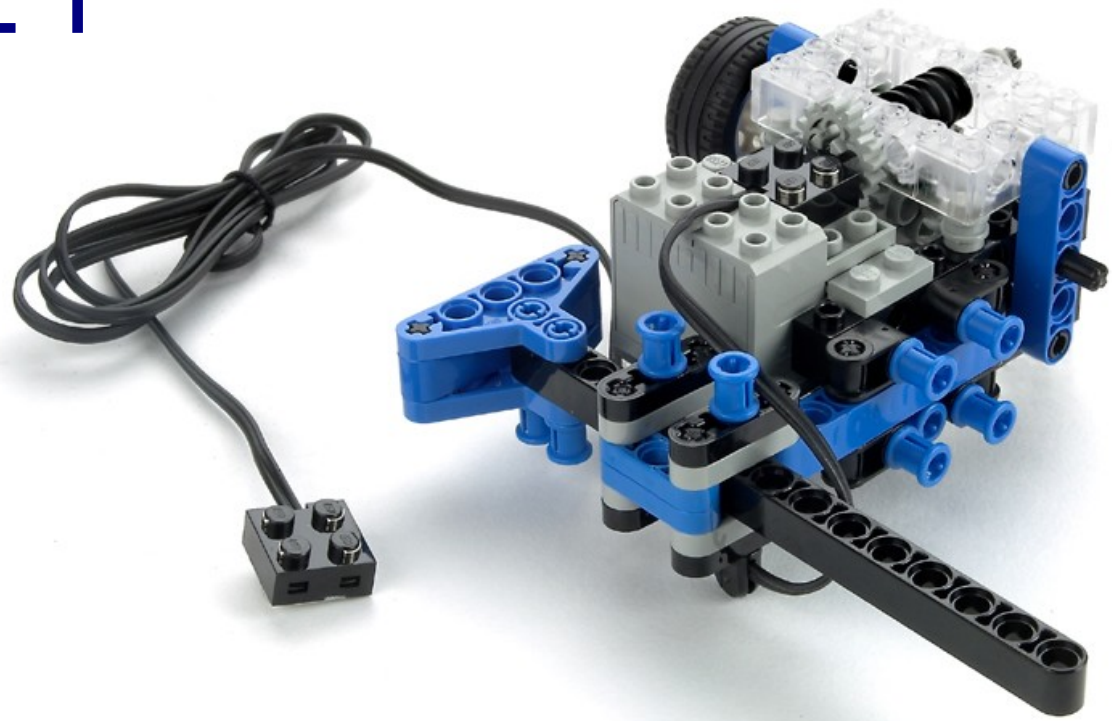

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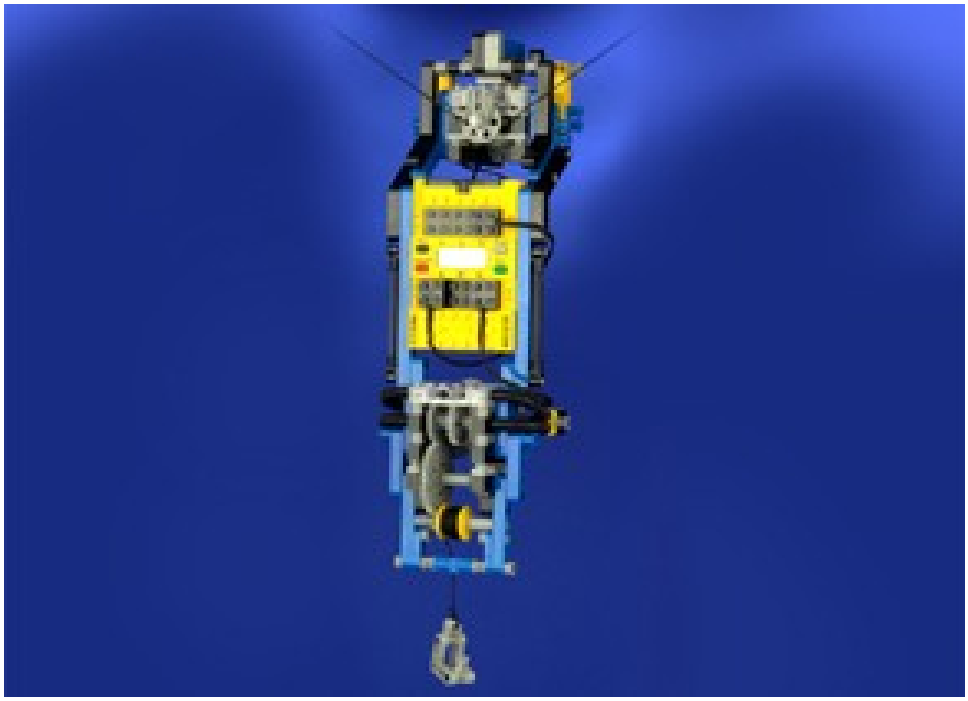
Aerial Tram with Winch

Required modules: Motor Module 1, Motor Module 3, Tram Sensor Module, Winch Module



Make sure you have built all four of the needed modules before you start this step.

Once you have completed the Tram you can hang it on a cable by the small Tractor Tire attached to Motor Module 1.

You will then be ready to program your creation. Click on the "Program" button to get started. You can find an example program for this model on the CD-ROM if you need some ideas.

The Tram needs to be able to move along the cable and stop or reverse if it gets to an end. You can set a timer to control Motor Module 3 as it lowers the winch, this way you will know how far to bring it up again.

Alternatively you might want to replace the 24 tooth gear in Motor Module 3 that is driven by the Worm Gear with a White Clutch gear.

This way it will not matter if the motor continues to run after the winch is all the way up as the clutch will slip.

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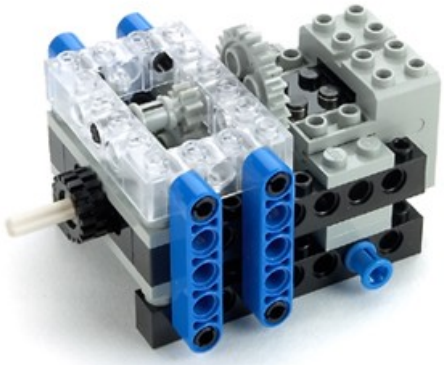

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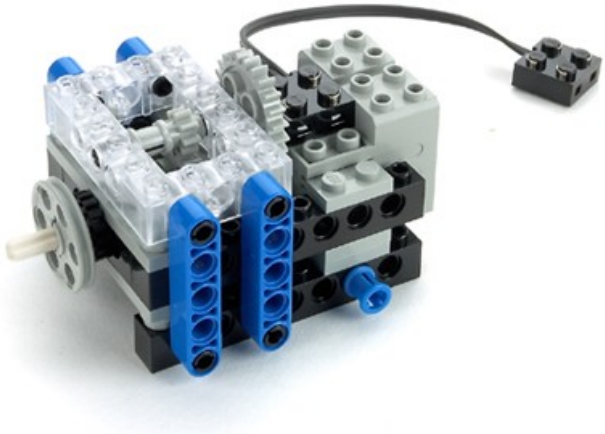

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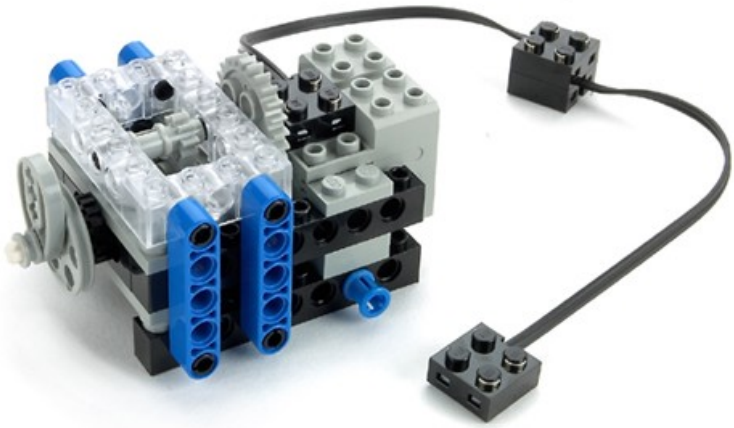

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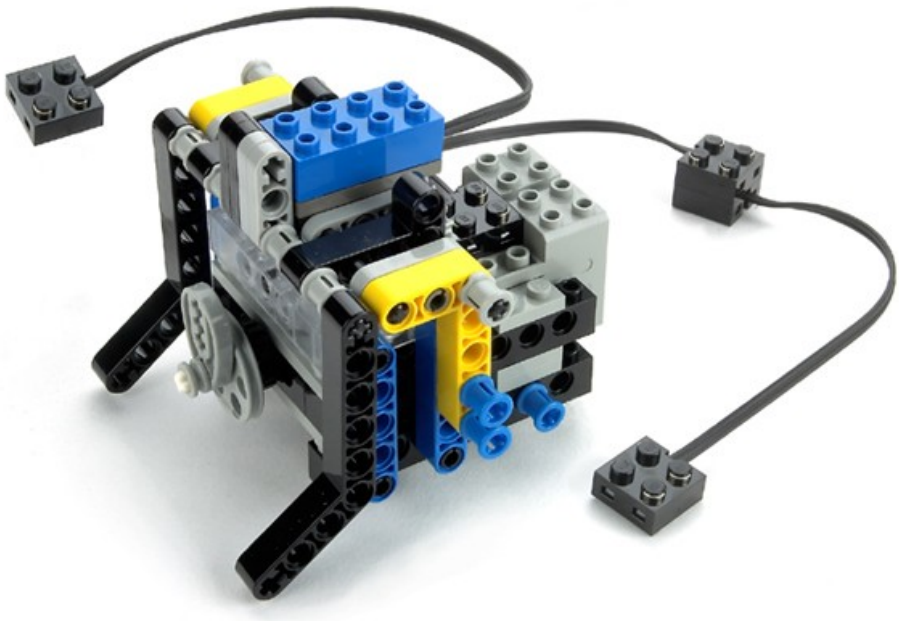

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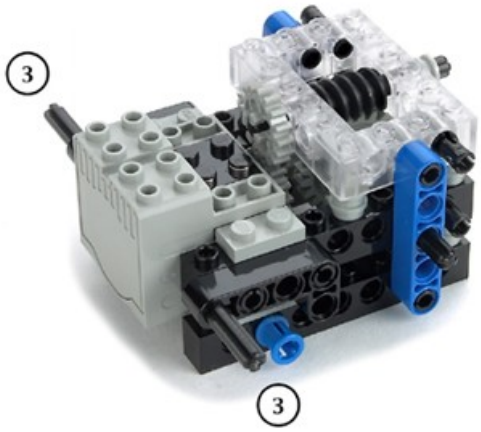

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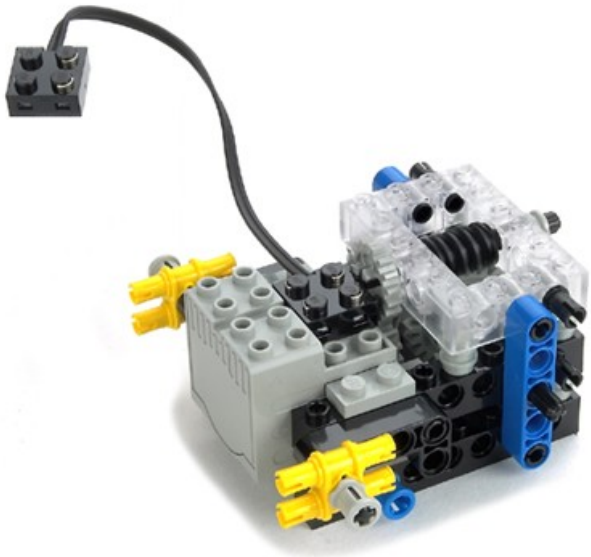

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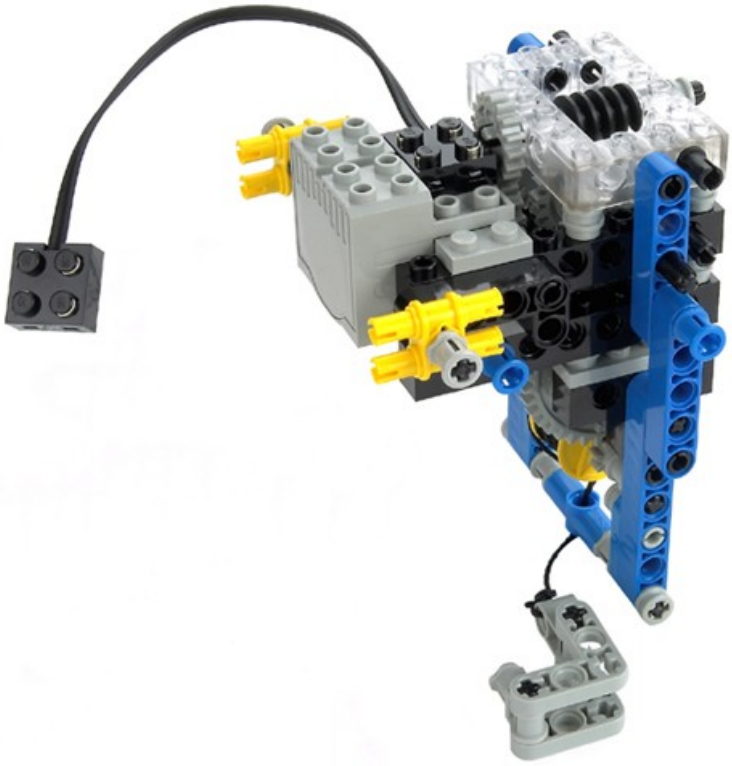

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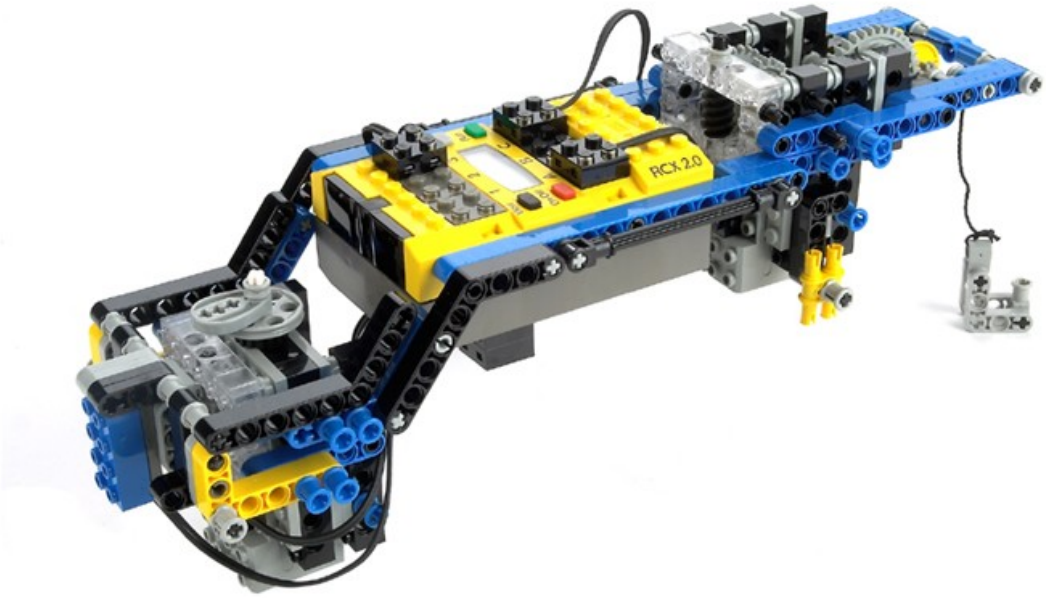

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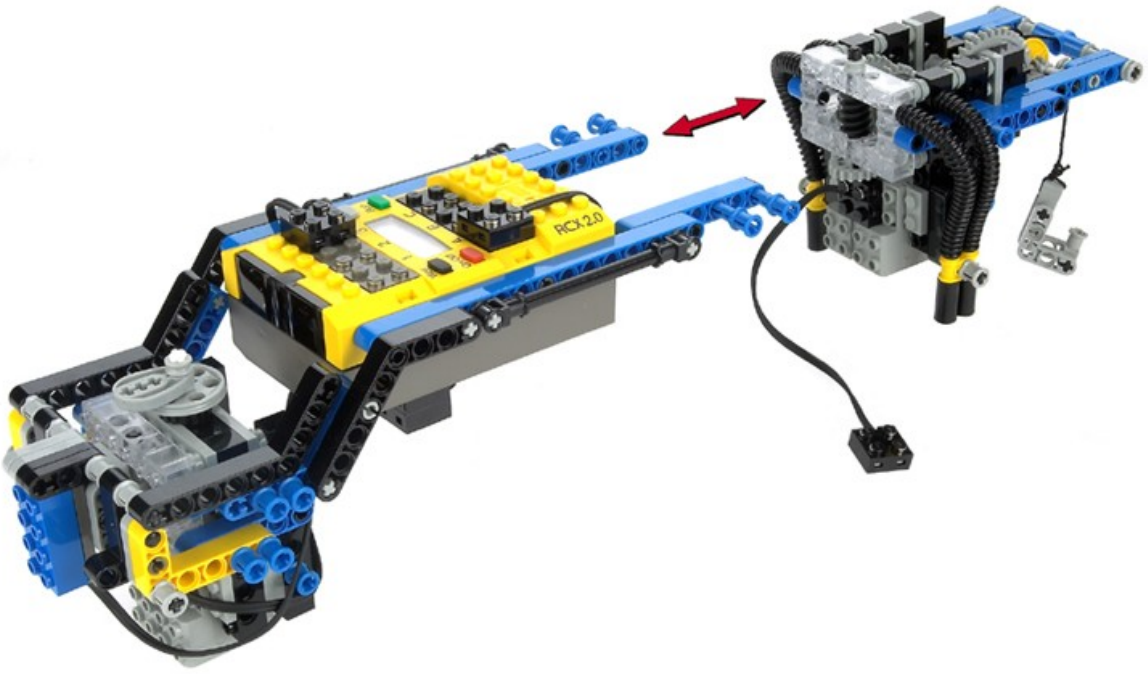

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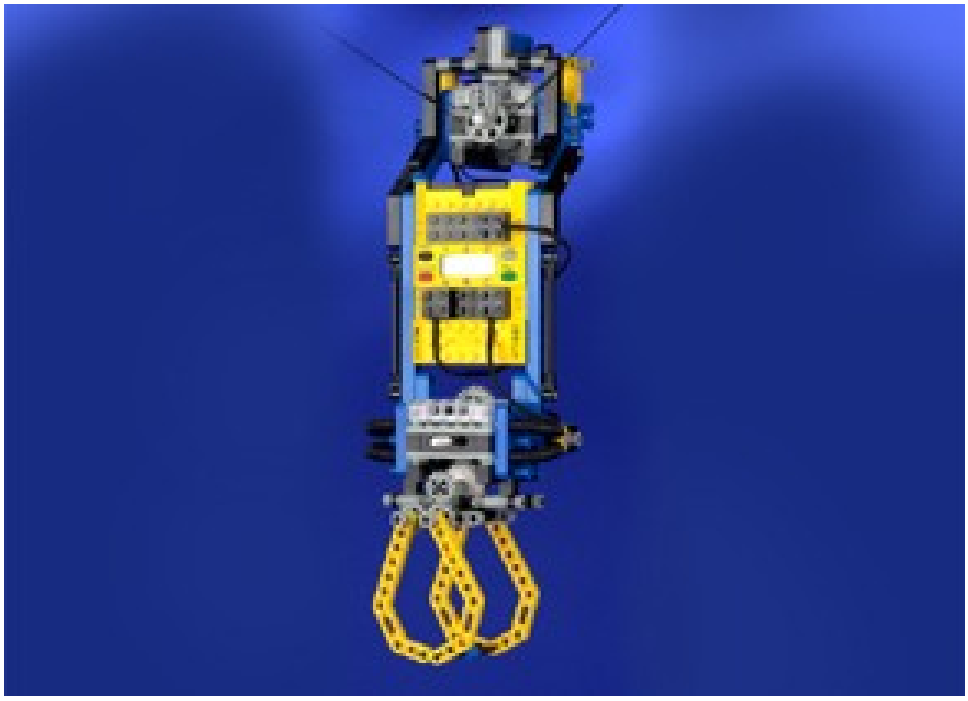
Aerial Tram with Grabber

Required modules: 2 x Motor Module 1, Tram Sensor Module, Grabber Module



This version of the Tram replaces Motor Module 3 with a second Motor Module 1 and the winch module with a Grabber. Make sure you build these modules before you start this step.

When the Modules are ready Click on "Build" to get step by step building instructions for the final assembly.

You will then be ready to program your creation. Click on the "Program" button to get started. You can find an example program for this model on the CD-ROM if you need some ideas.

This time the Tram cannot lower a winch so the Tram itself must be low enough to the object you want to pick up.

Try setting up your cable at an angle with an object to pick up at the low end.

Then program your Tram to move down the cable, pick up the object and take it back to the top. Here it could drop it into a container like a waste paper bin.

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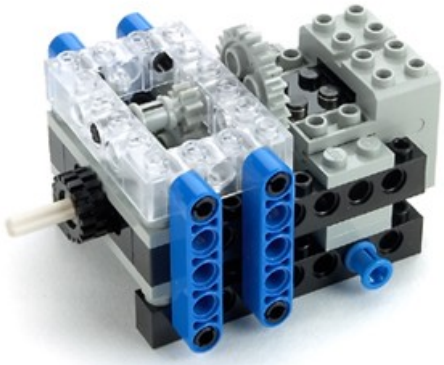

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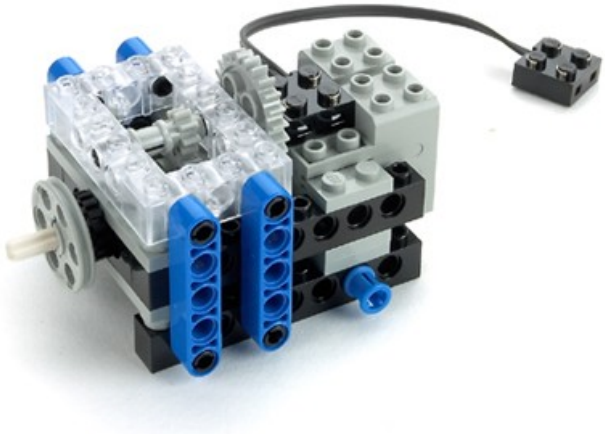

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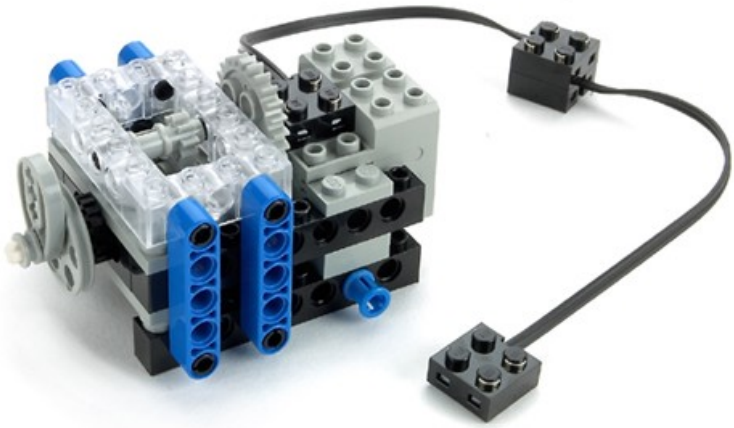

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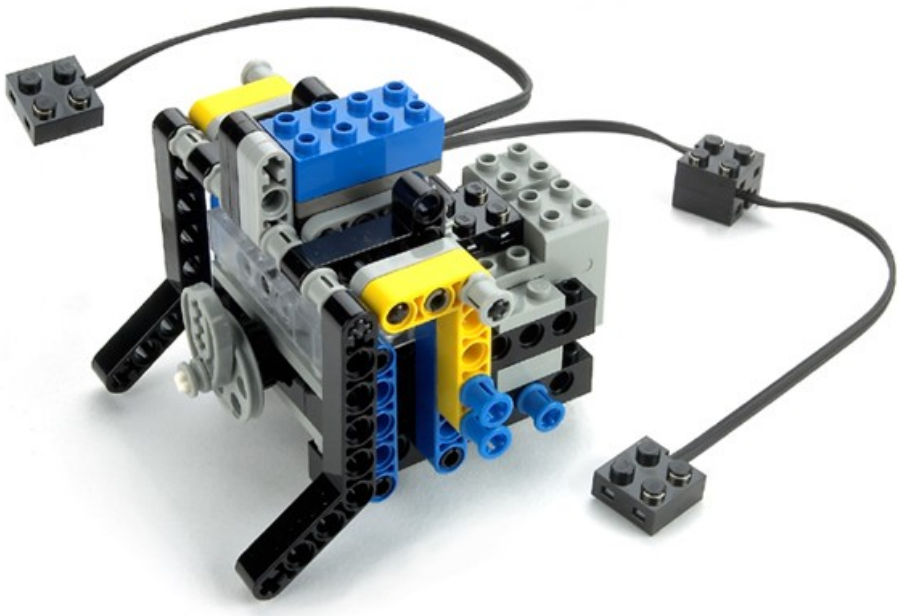

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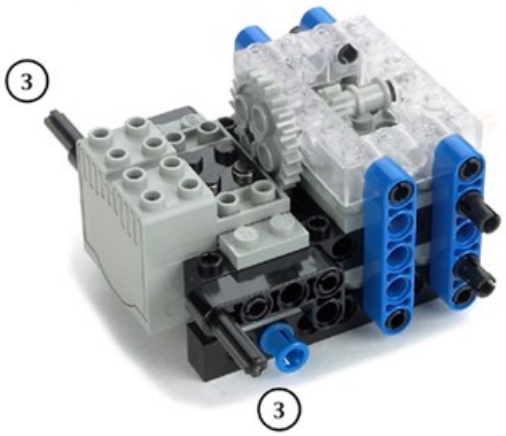

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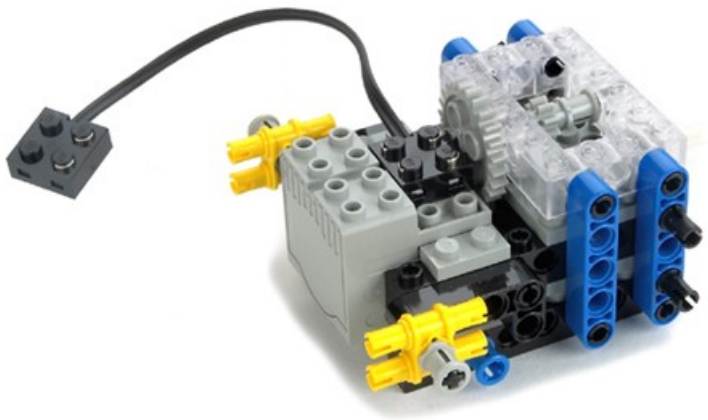

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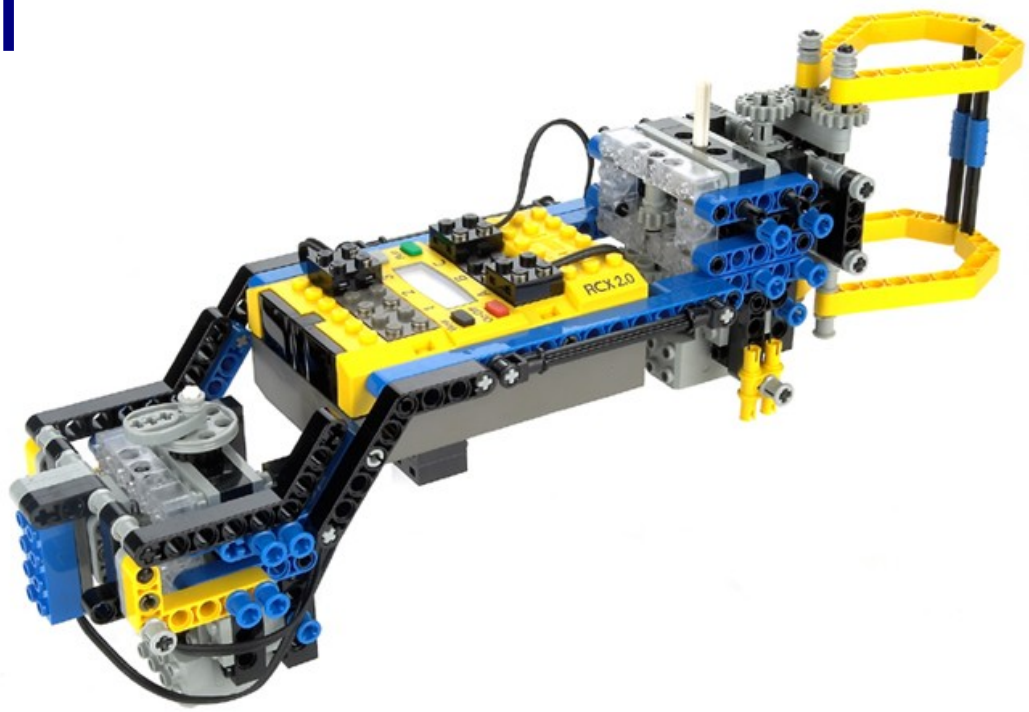

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Wall Climber

Required modules: Motor Module 1, Motor Module 3

The Wall Climber uses only two pre-made modules and the rest of the construction is contained in these steps.

Make sure you build Motor Modules 1 and 3 first and follow the final assembly carefully.

When the Modules are ready Click on "Build" to get step by step building instructions for the final assembly.

You will then be ready to program your creation. Click on the "Program" button to get started. You can find an example program for this model on the CD-ROM if you need some ideas.

The climber is more of a ladder climber than a wall climber, you will need something for your climber to climb up such as a baking rack, the rungs should be no more than 1 or 2 inches apart.

You will also need to program your Climber carefully. It needs to swing its "tail" section with the RCX to balance itself before it moves an arm. Then reverse the swing for the other arm.

See if you can make your Robot climb to the top of your ladder and then back down.

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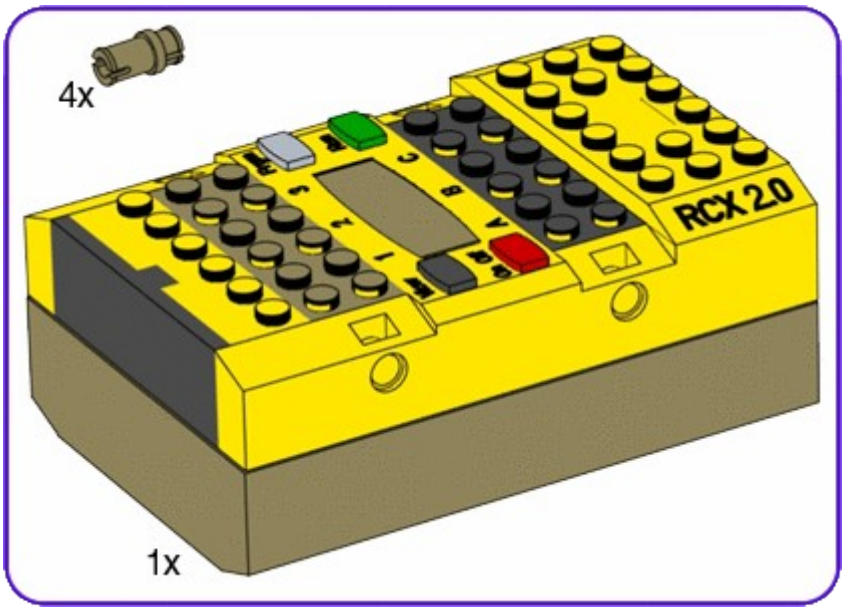

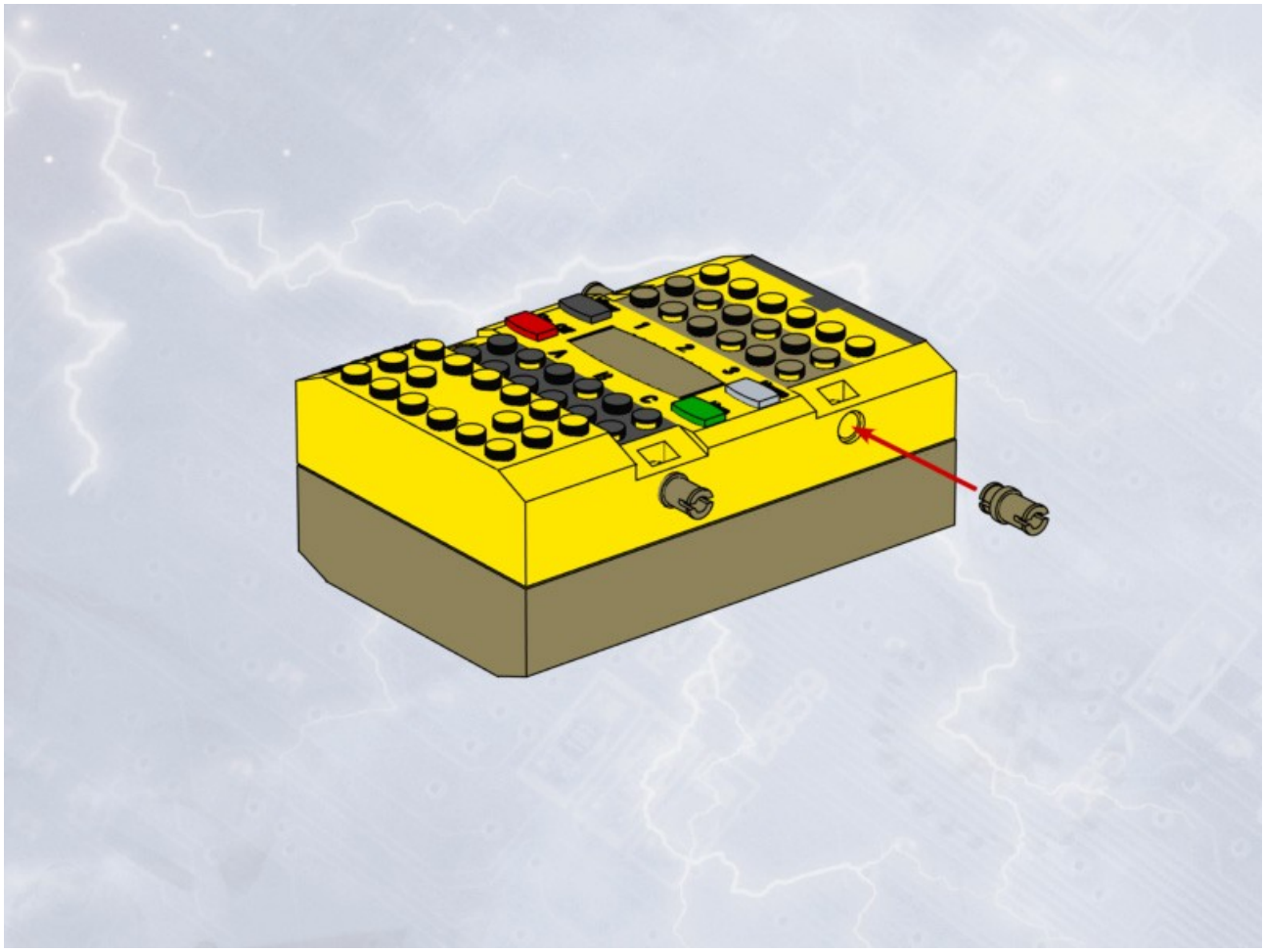

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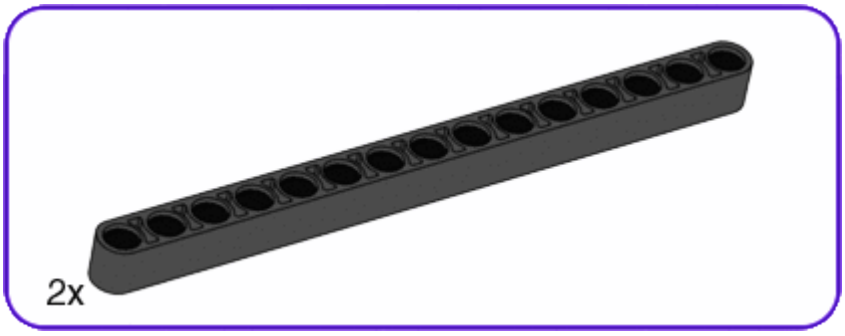

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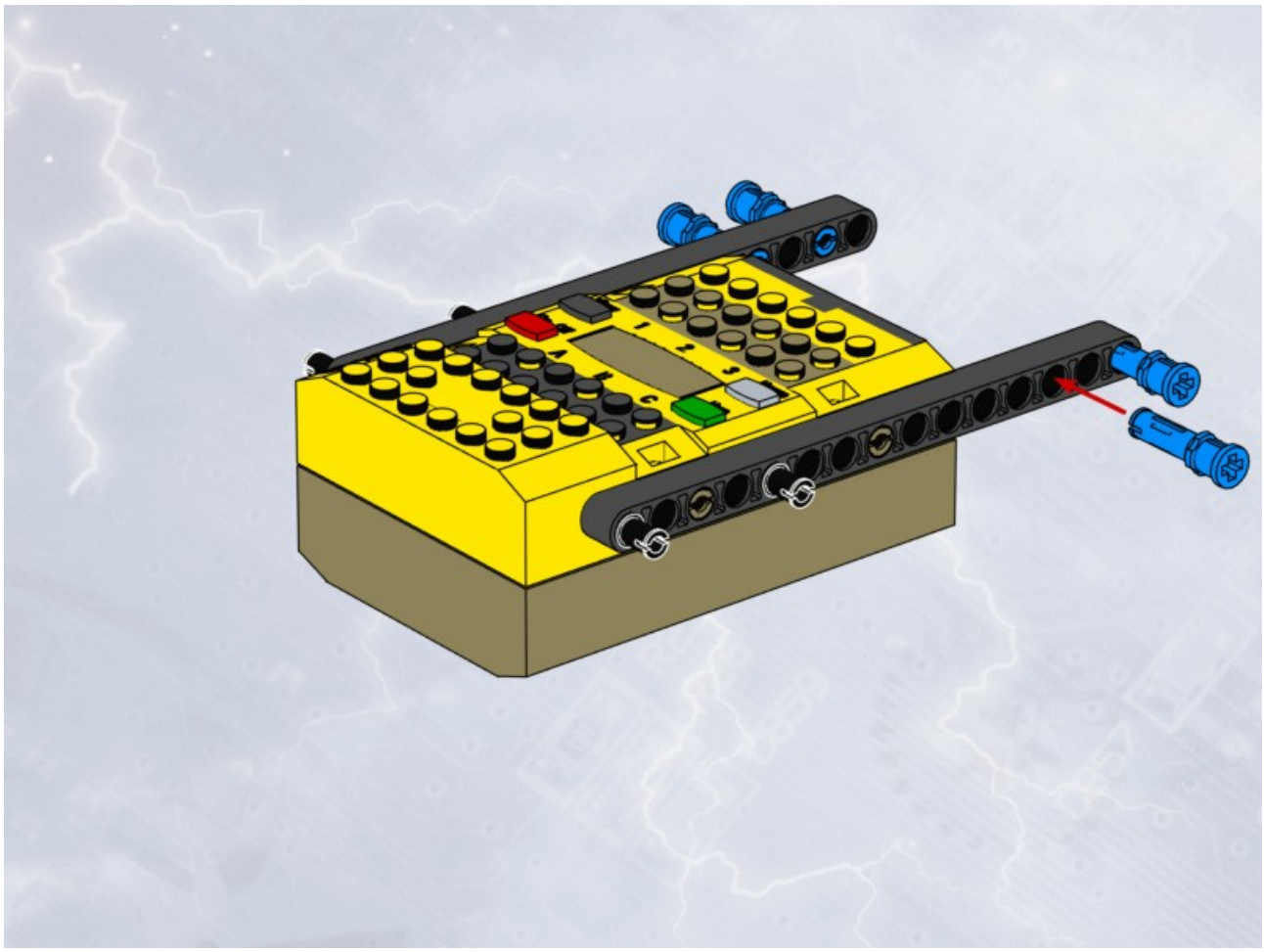

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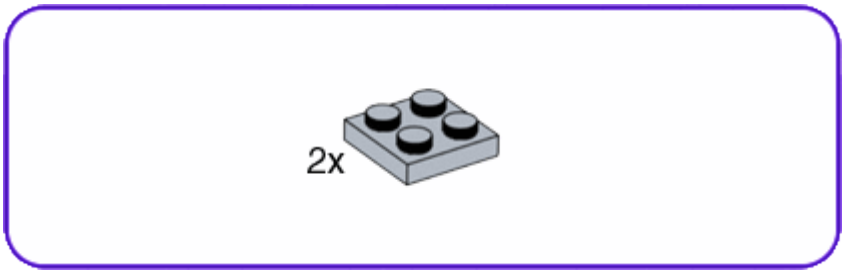

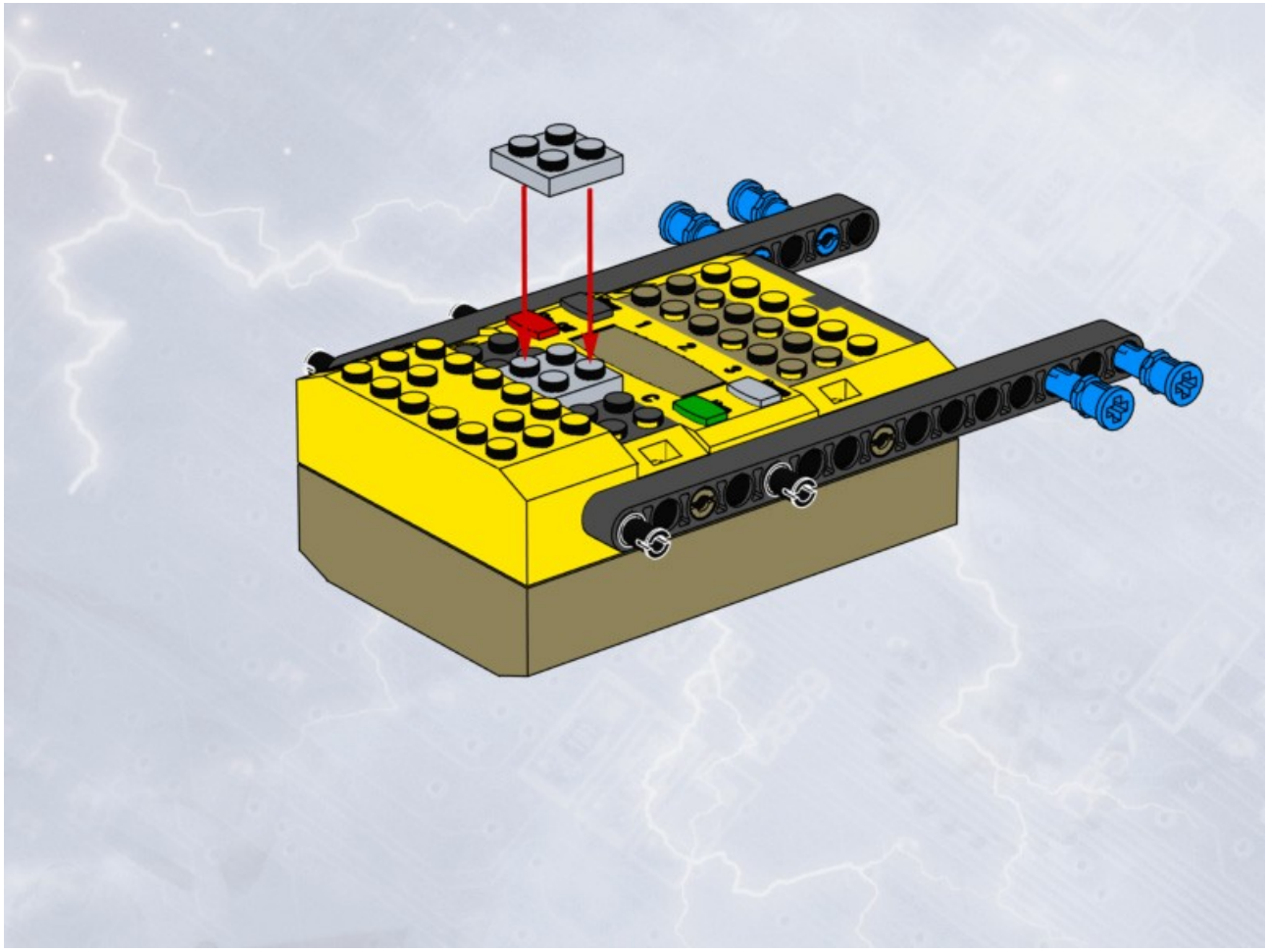

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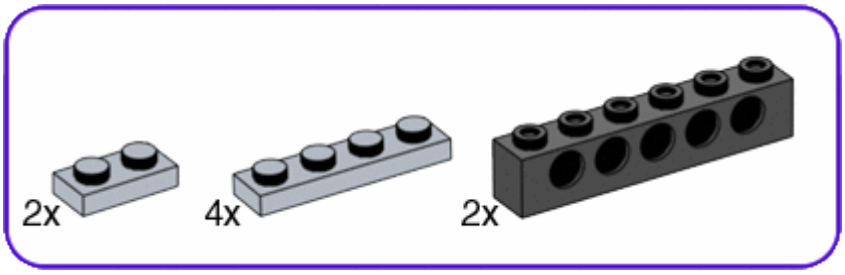

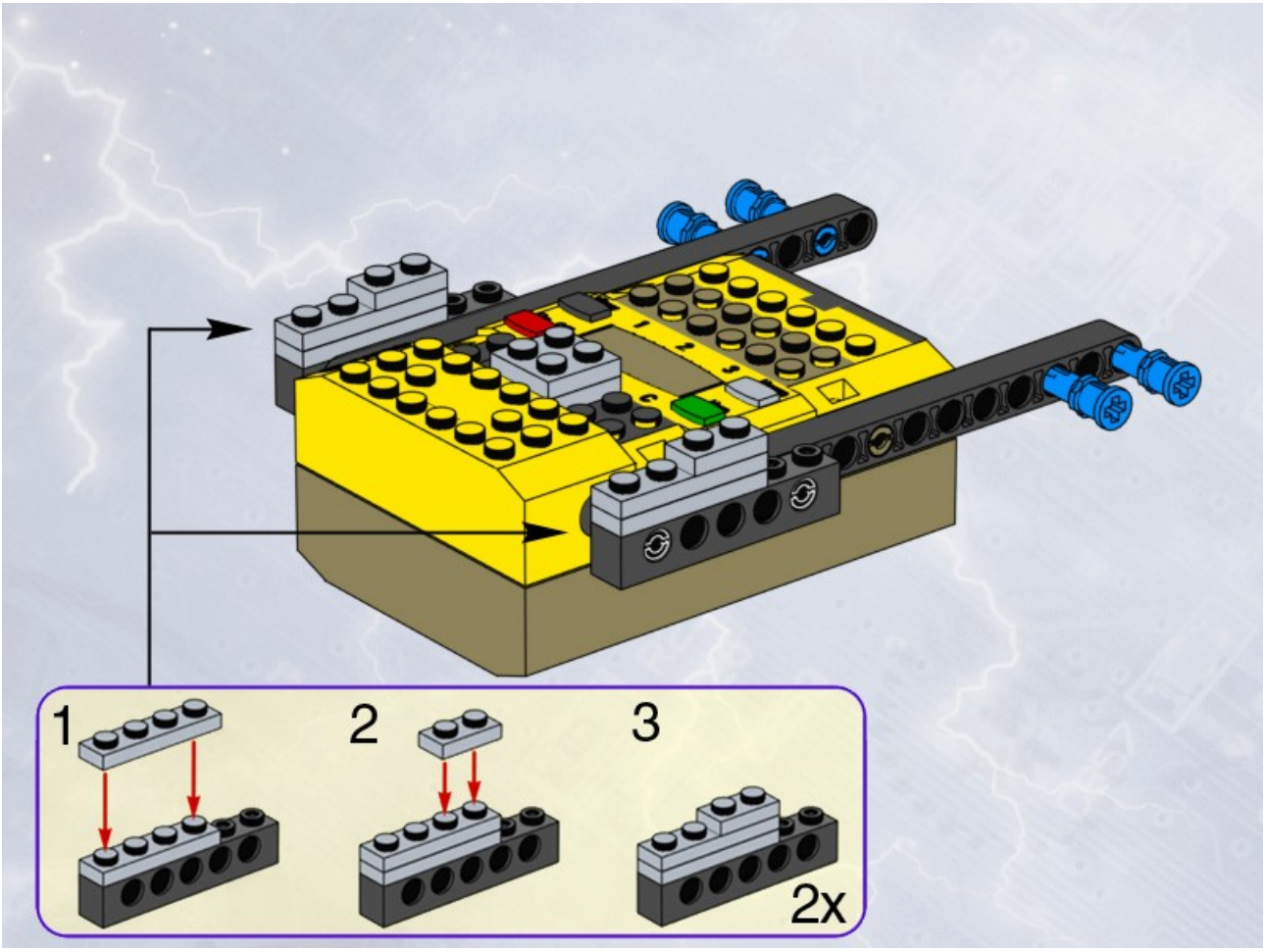

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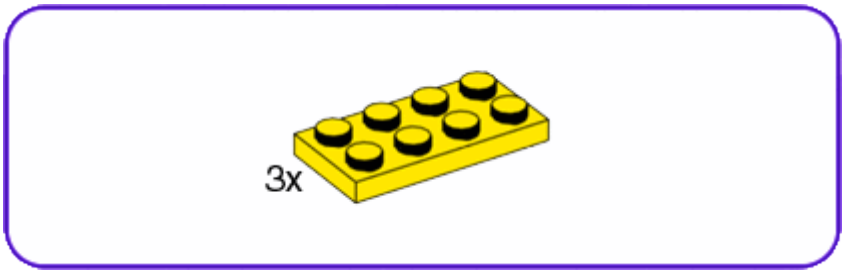

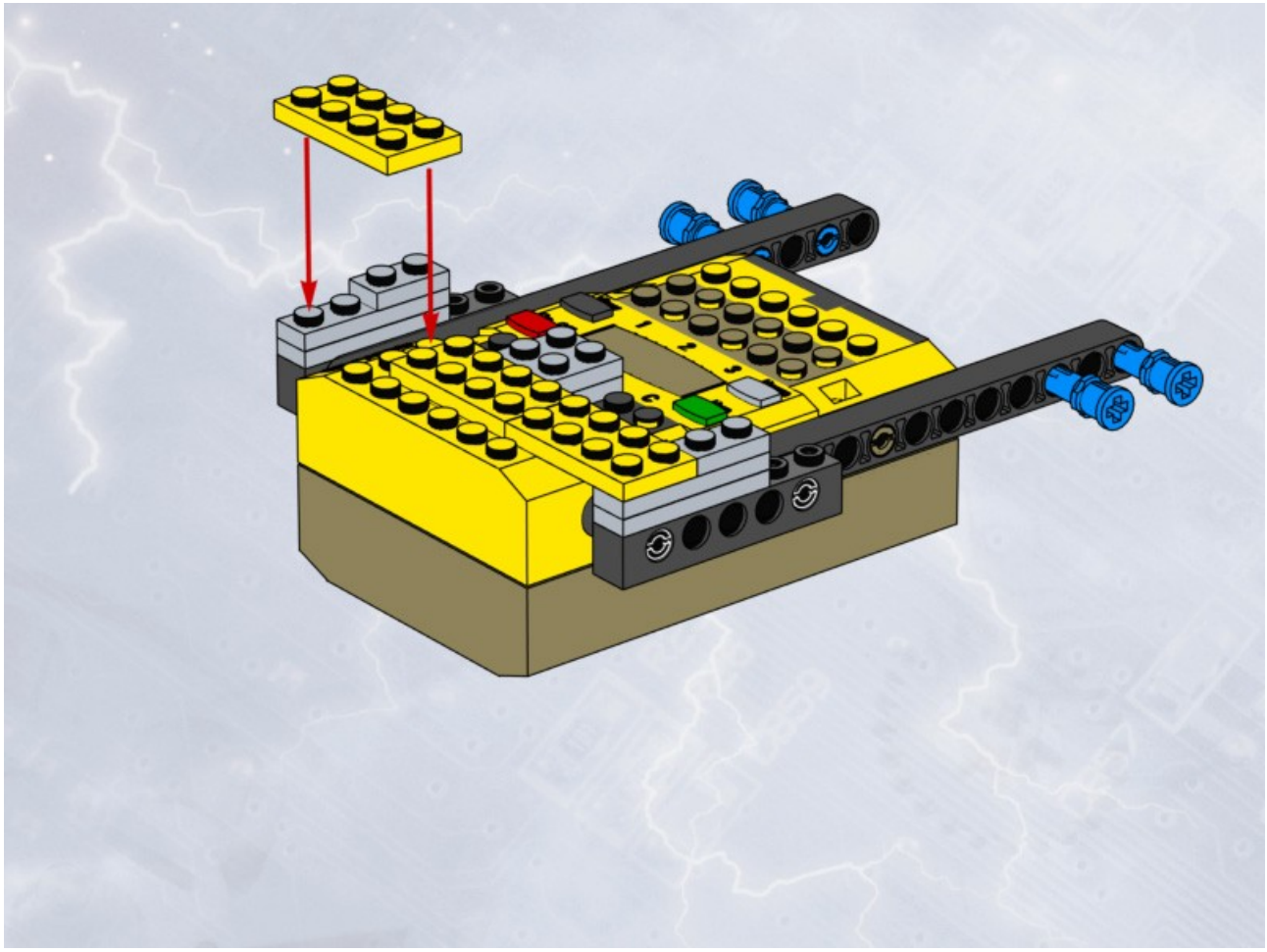

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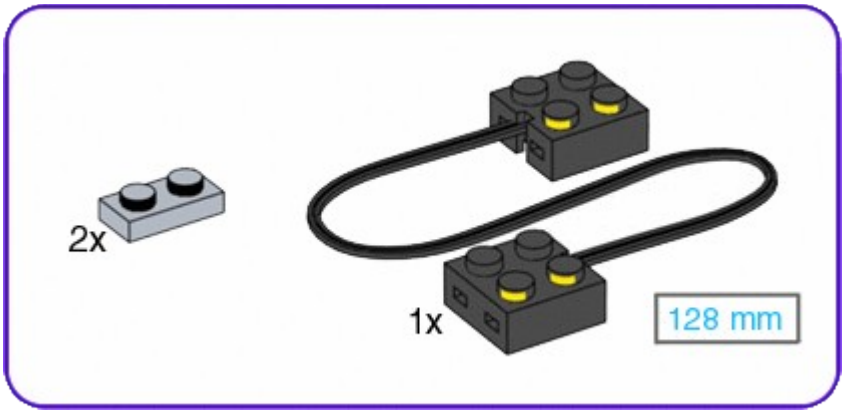

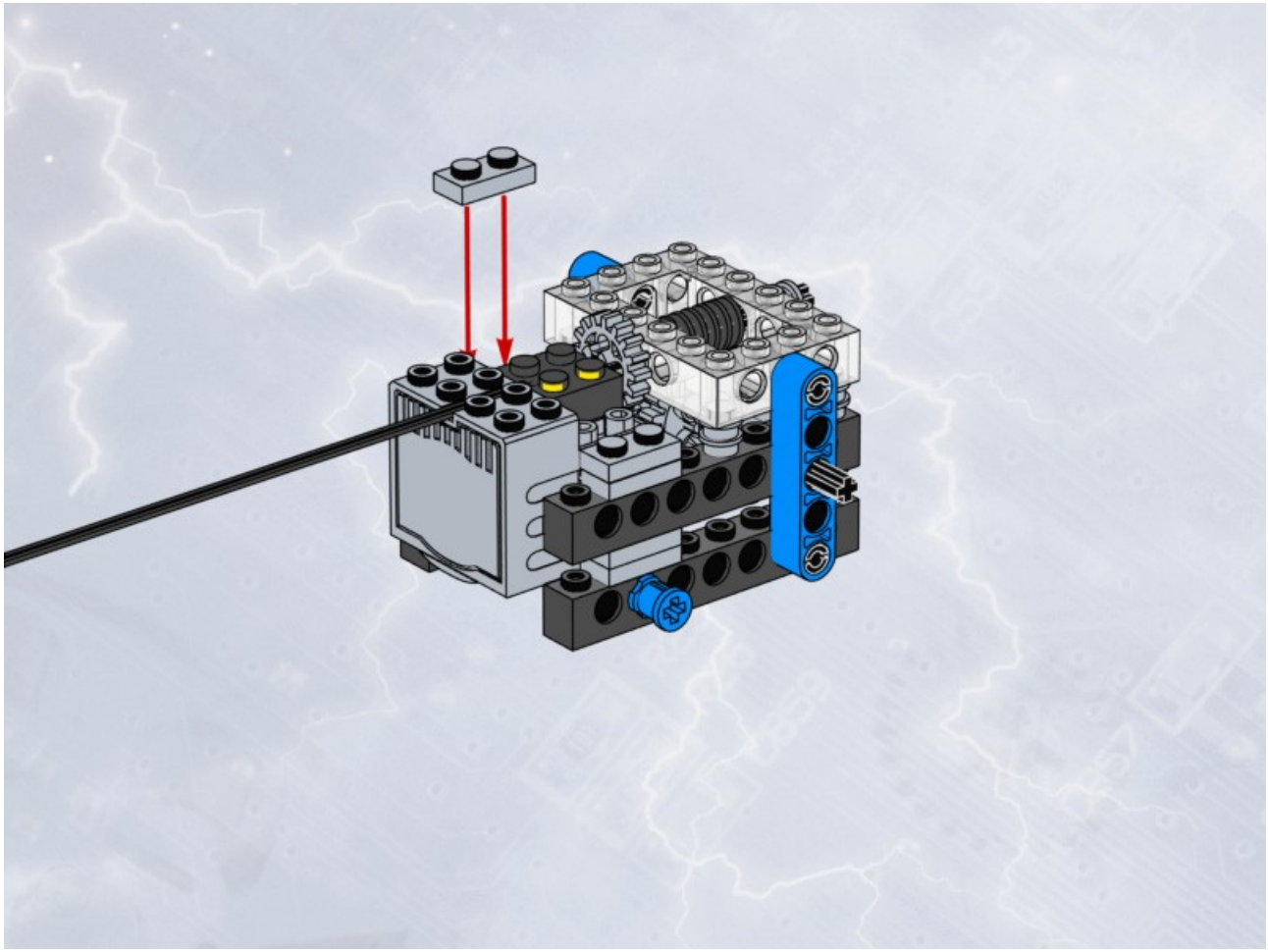

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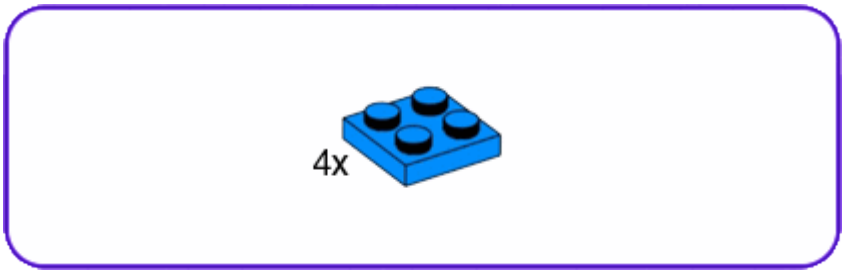

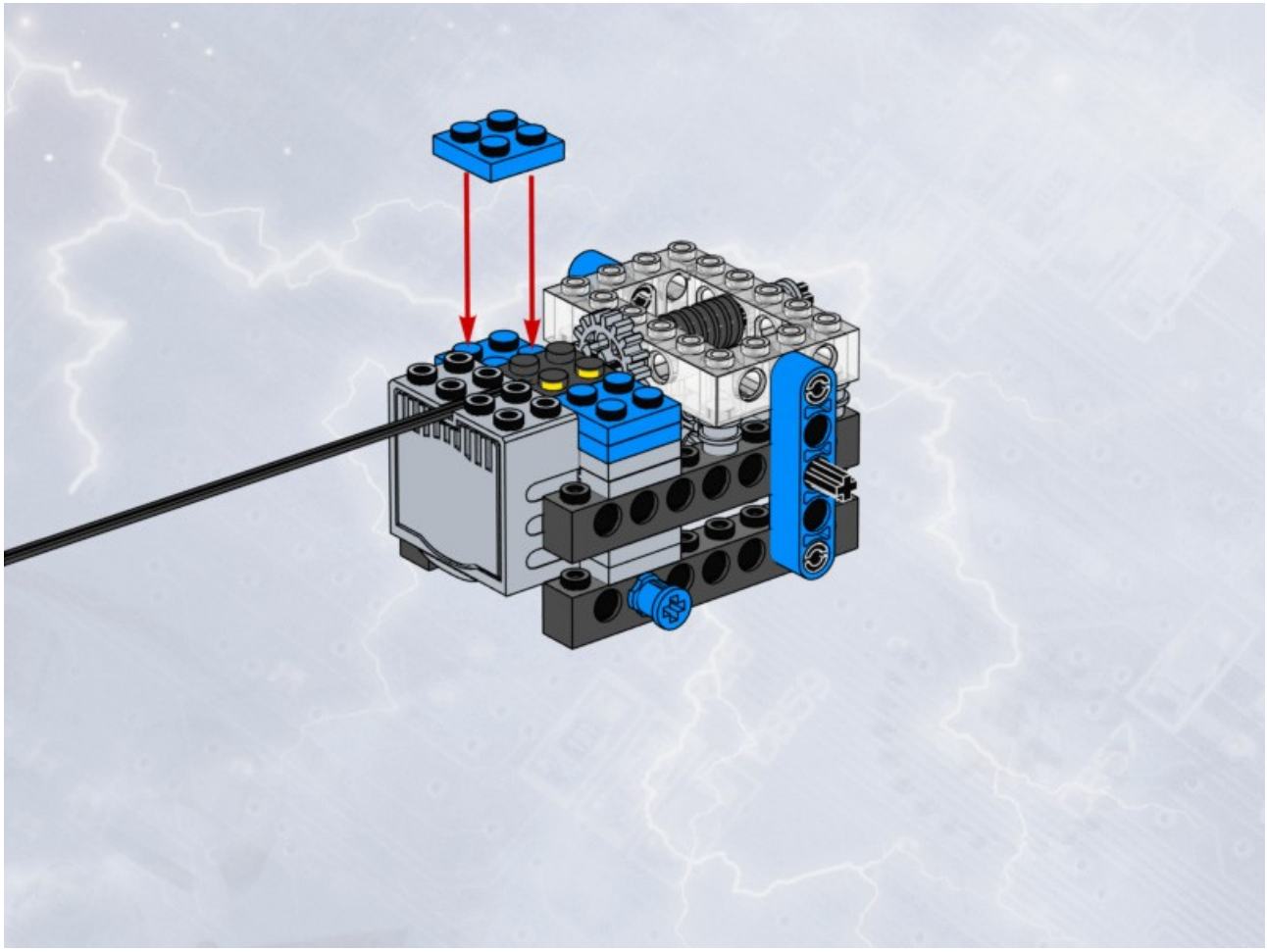

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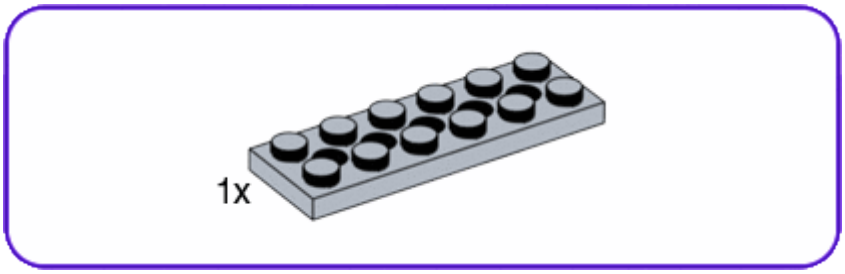

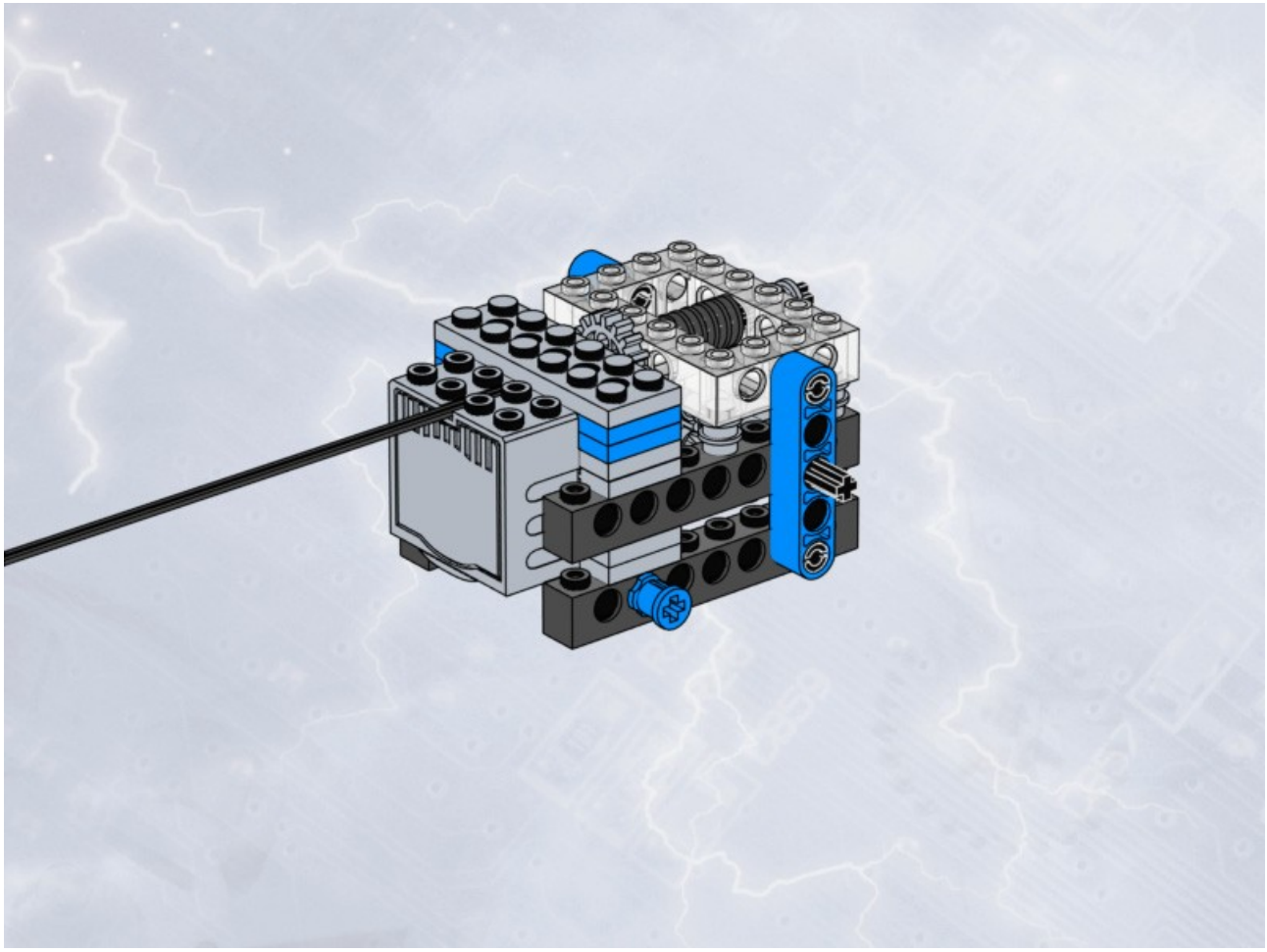

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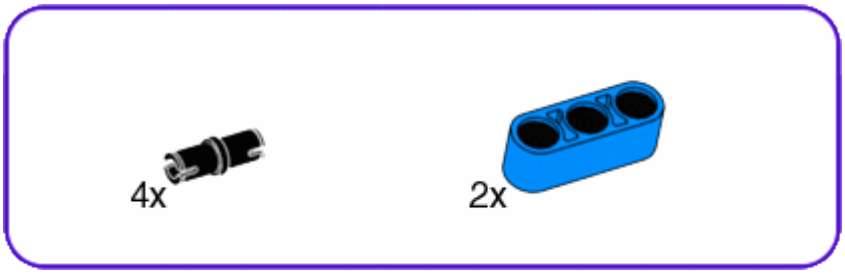

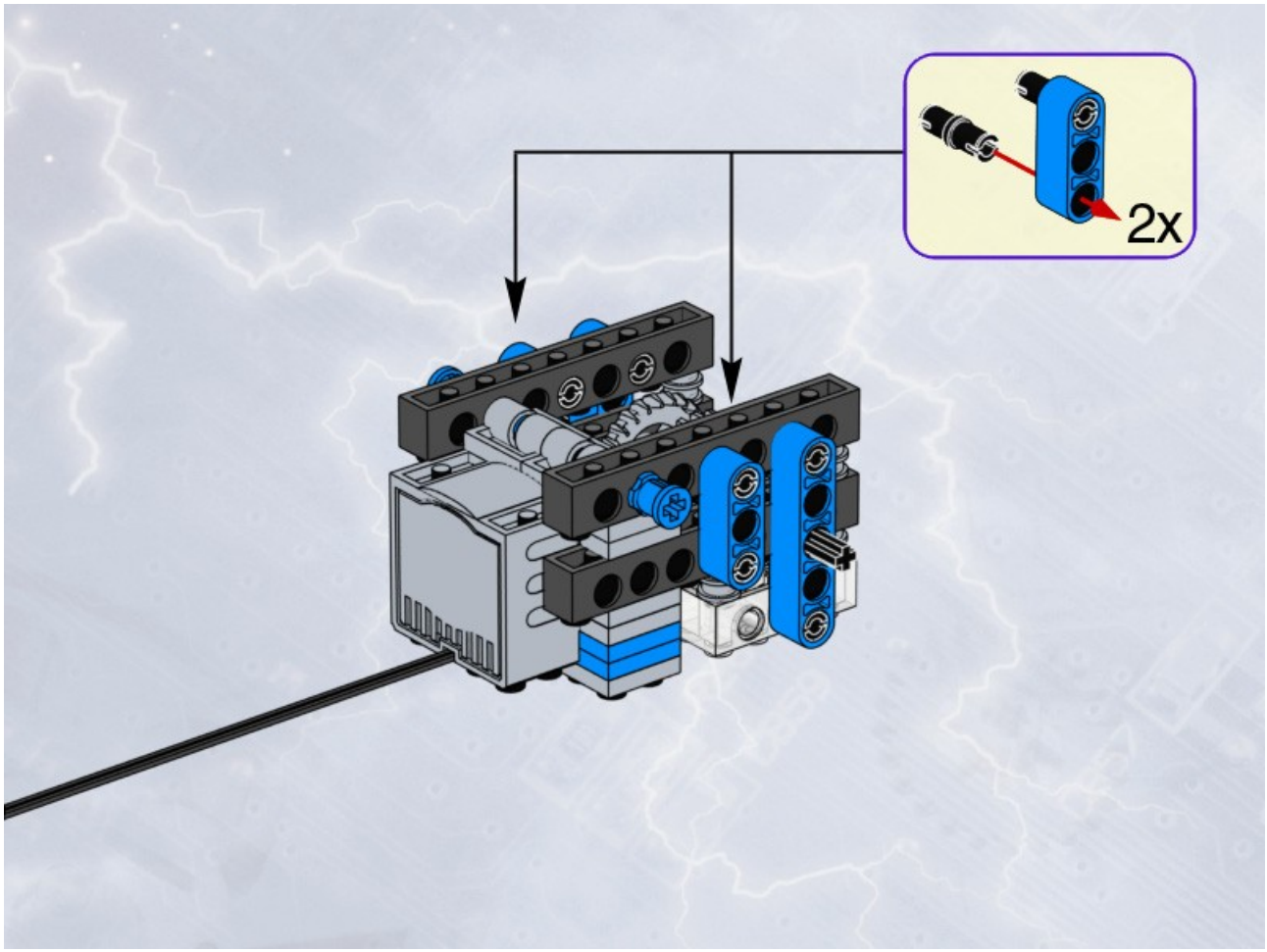

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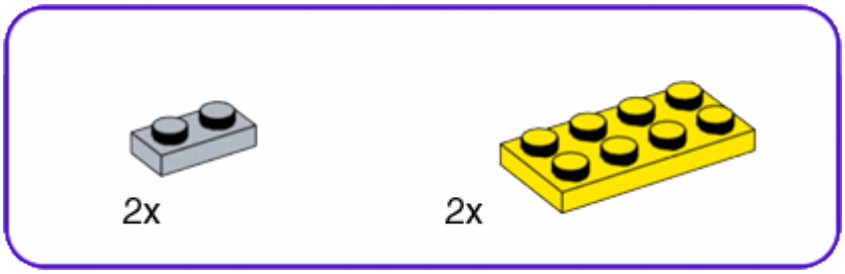

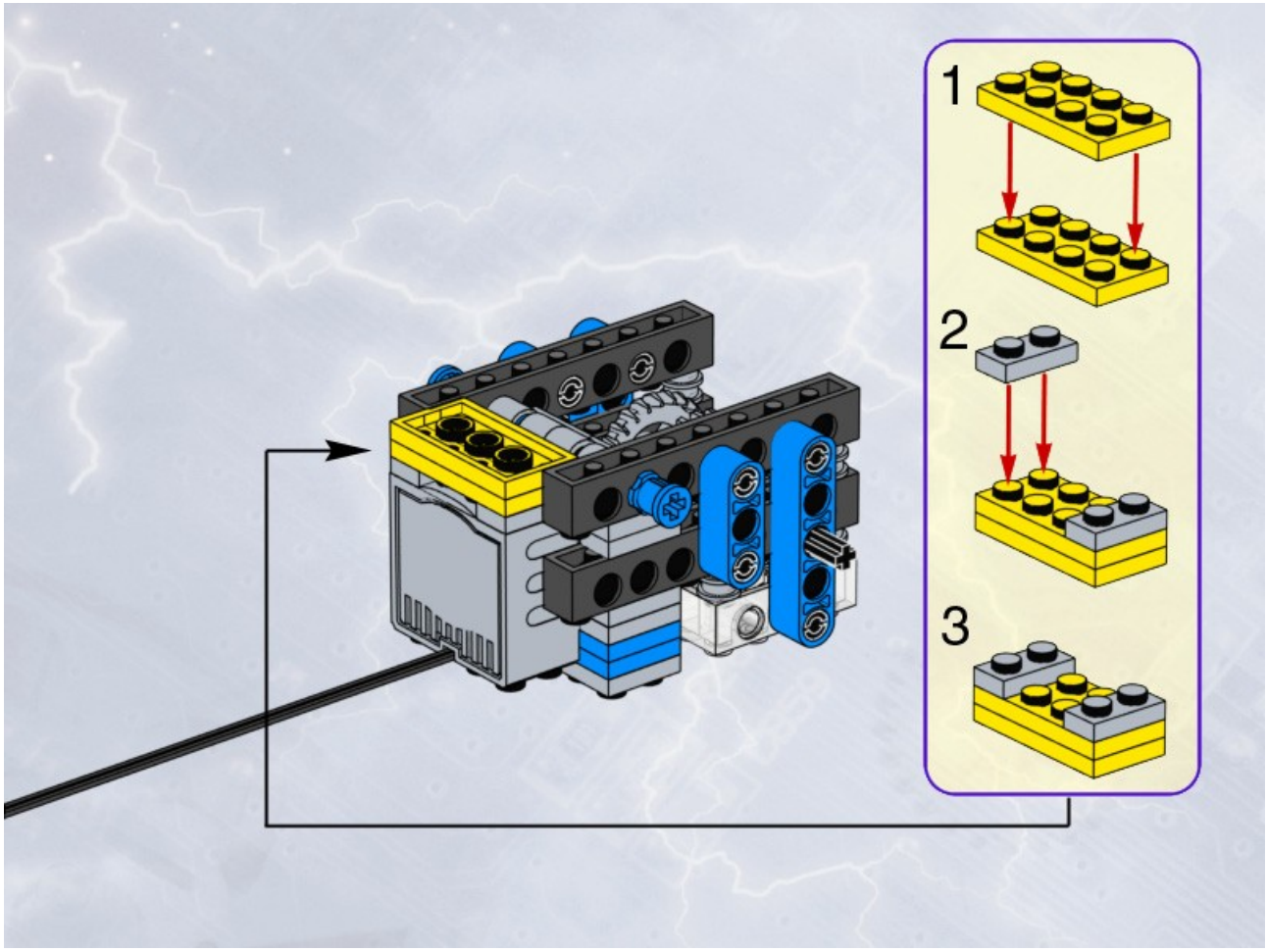

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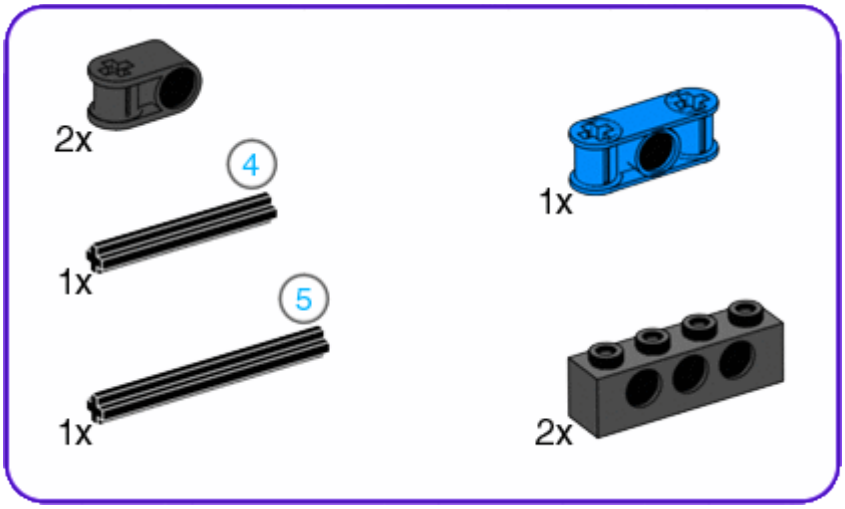

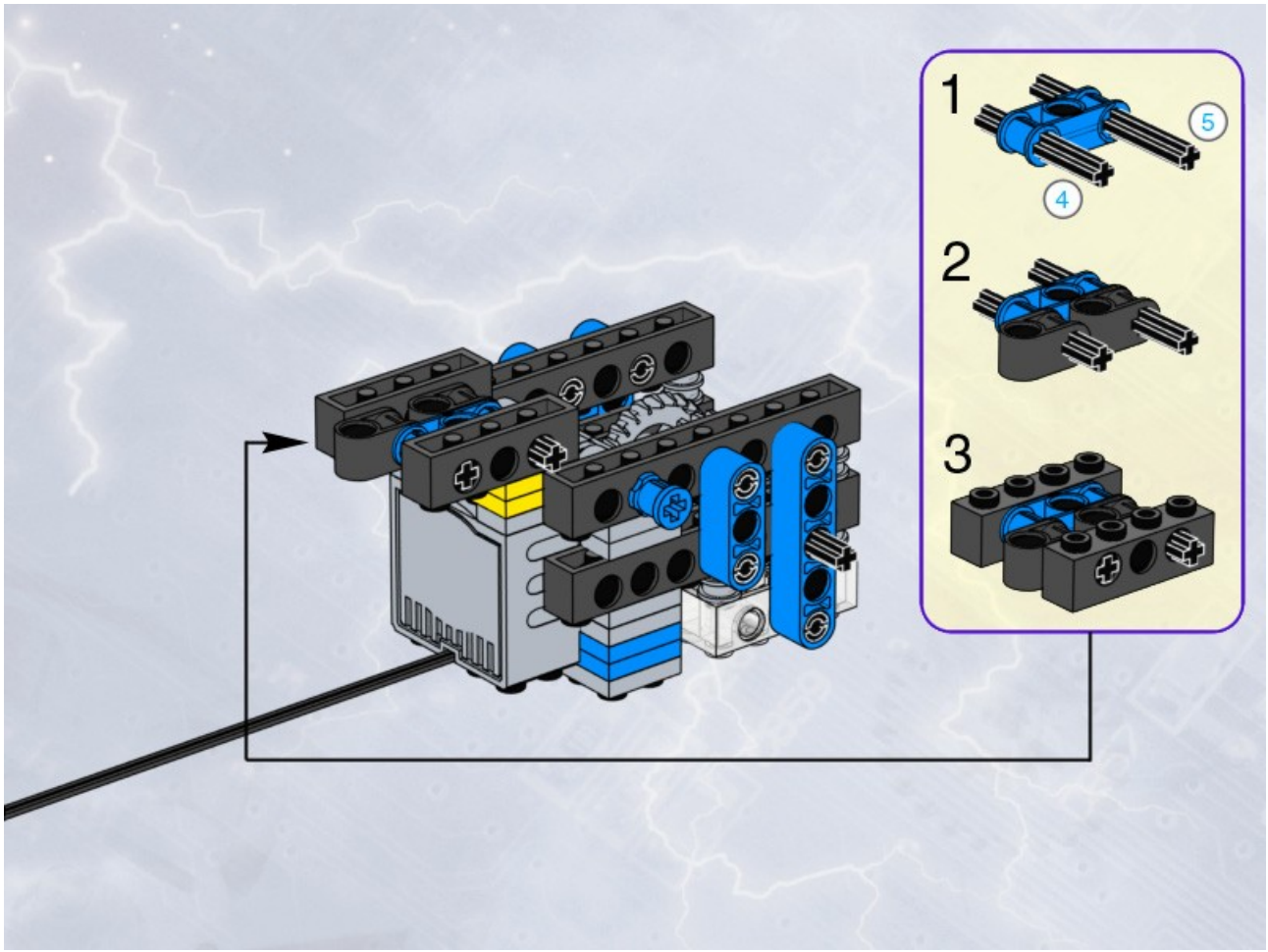

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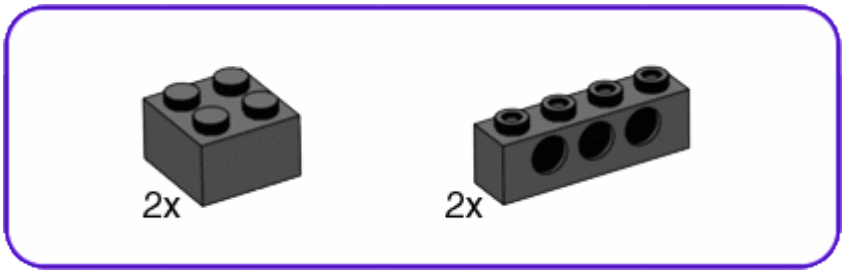

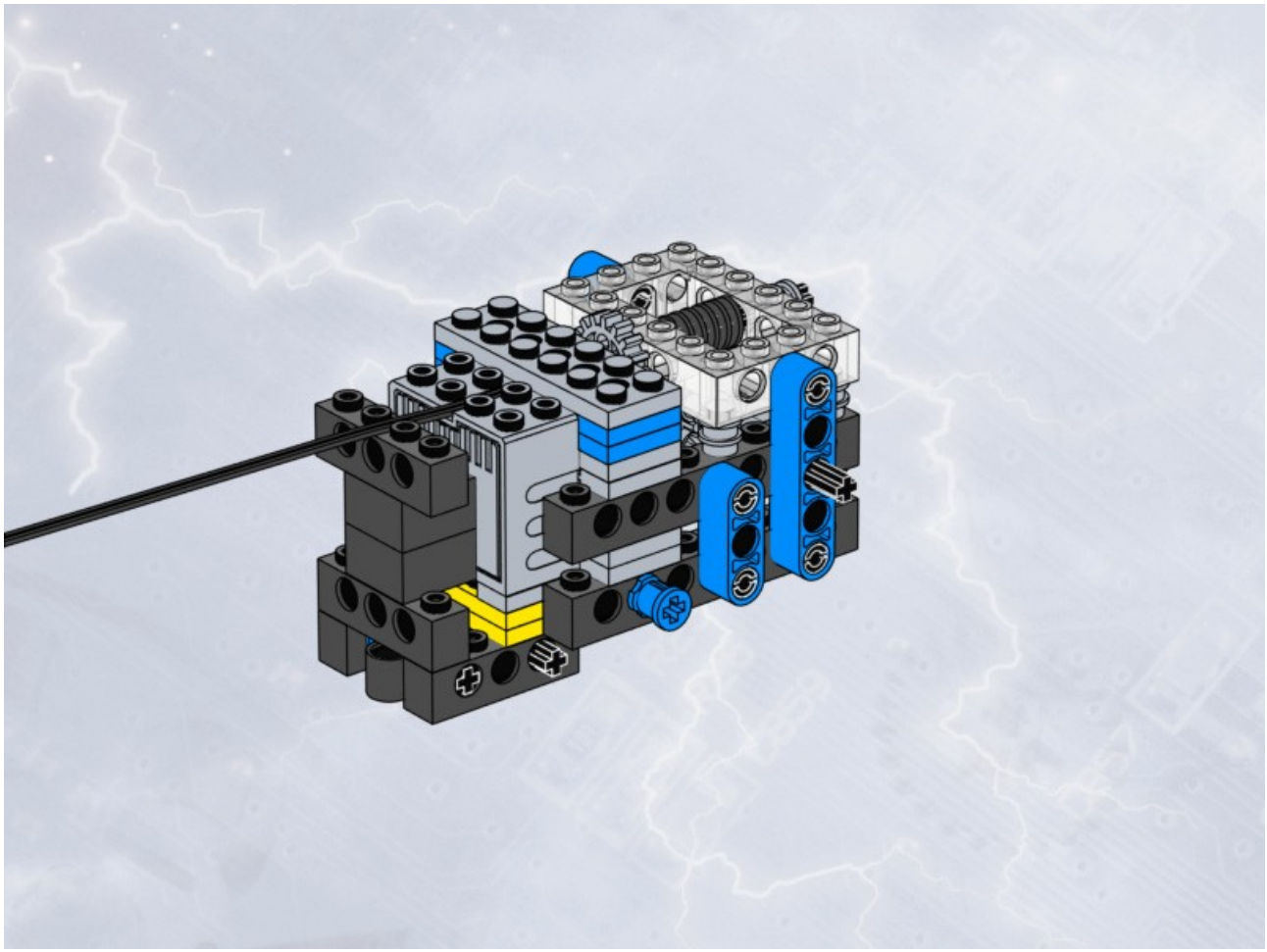

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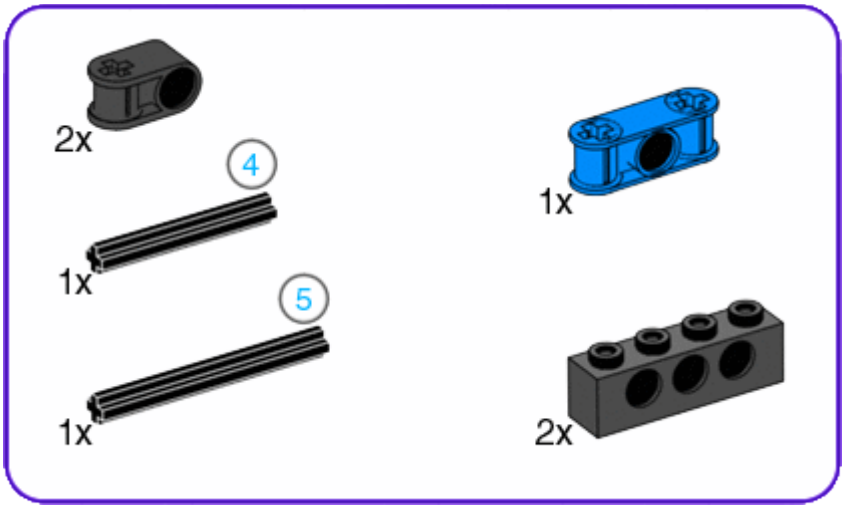

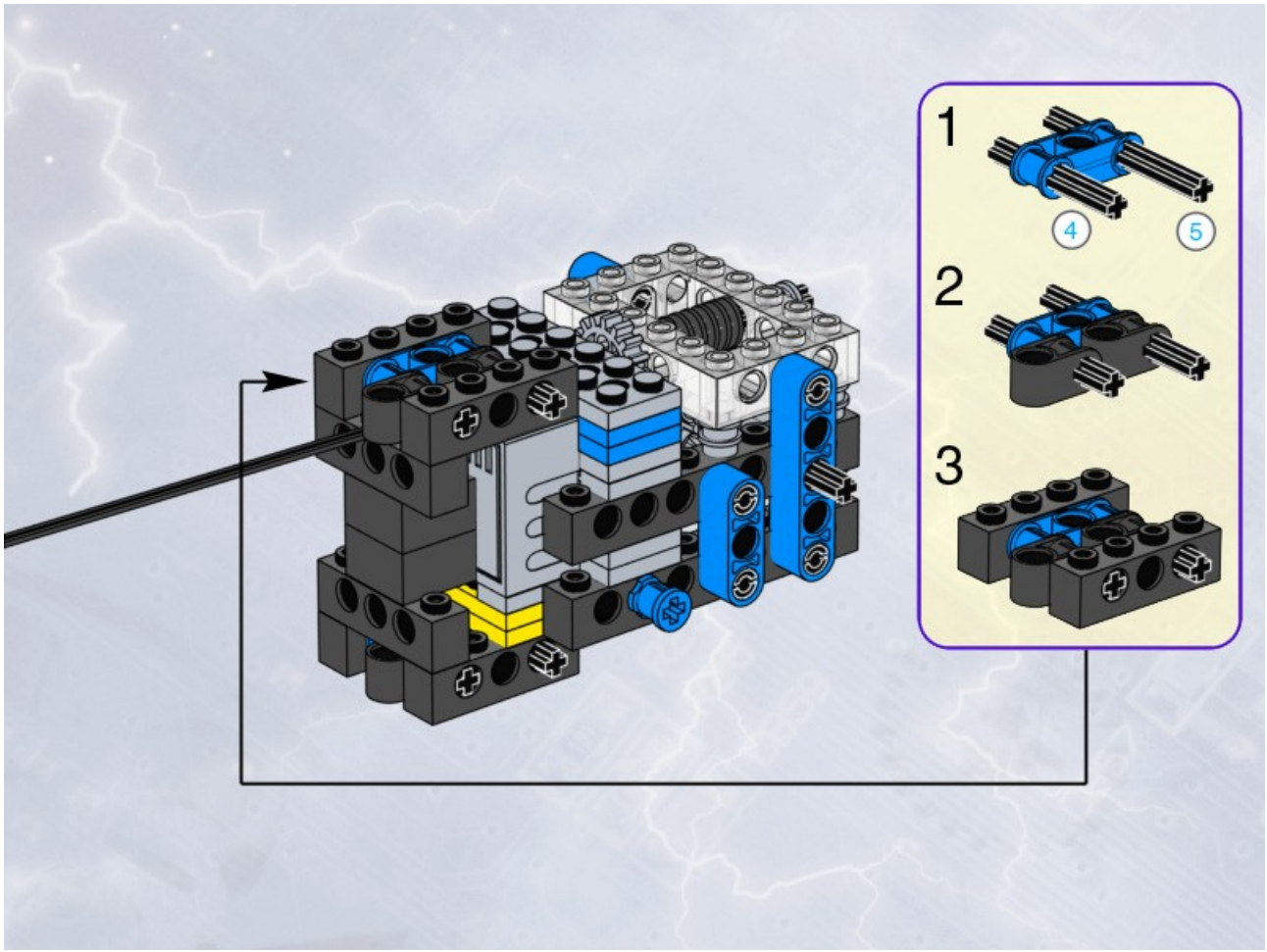

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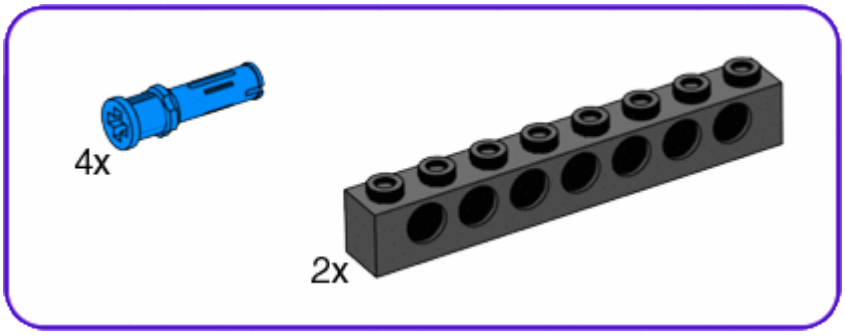

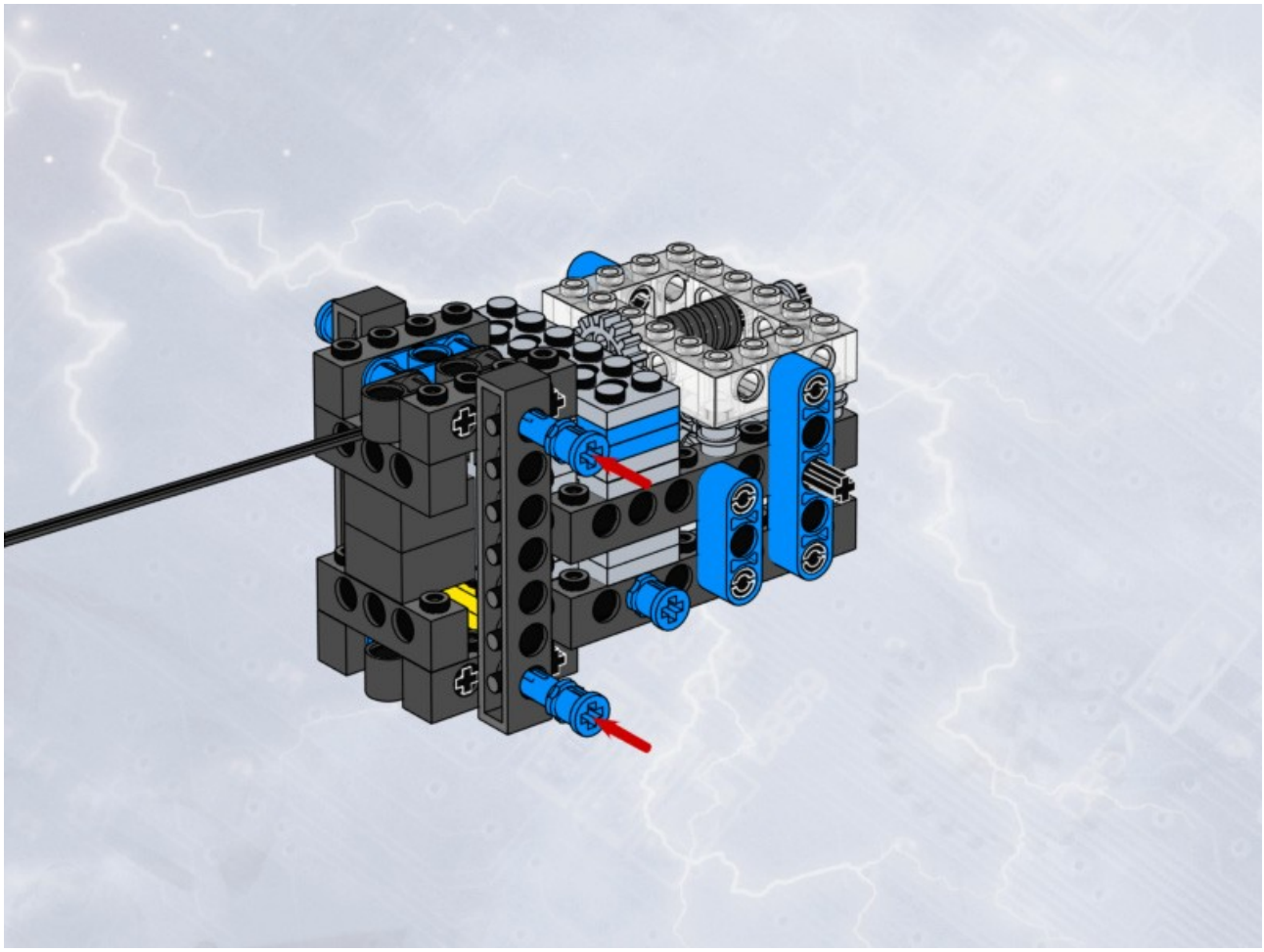

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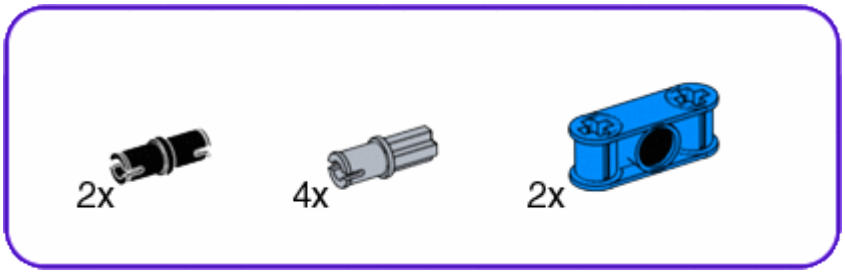

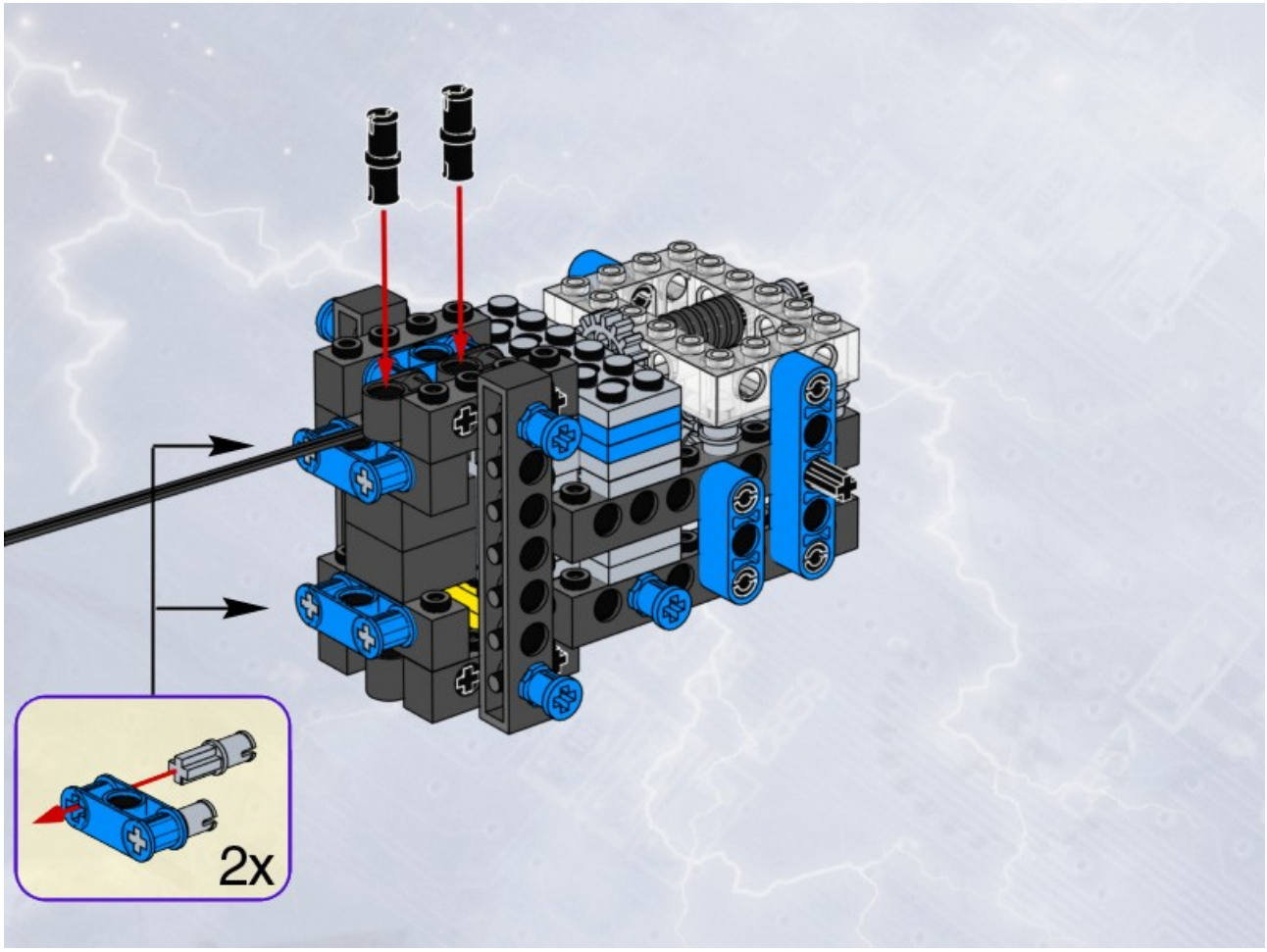

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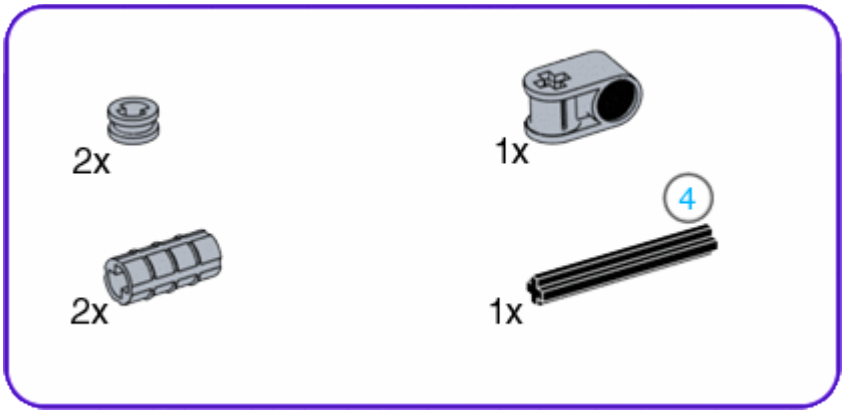

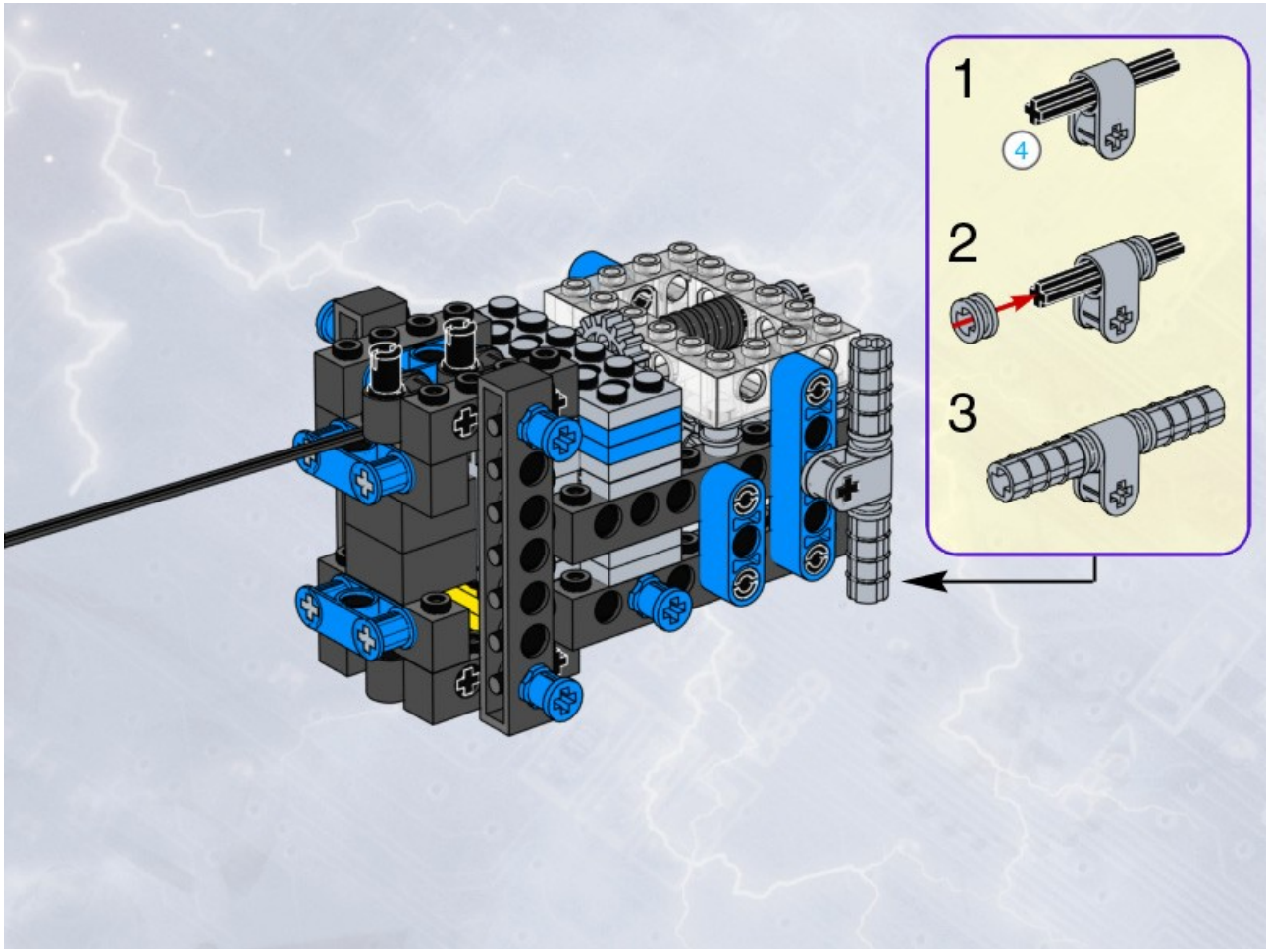

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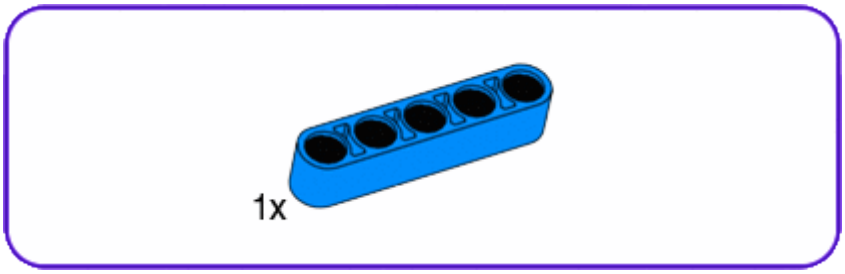

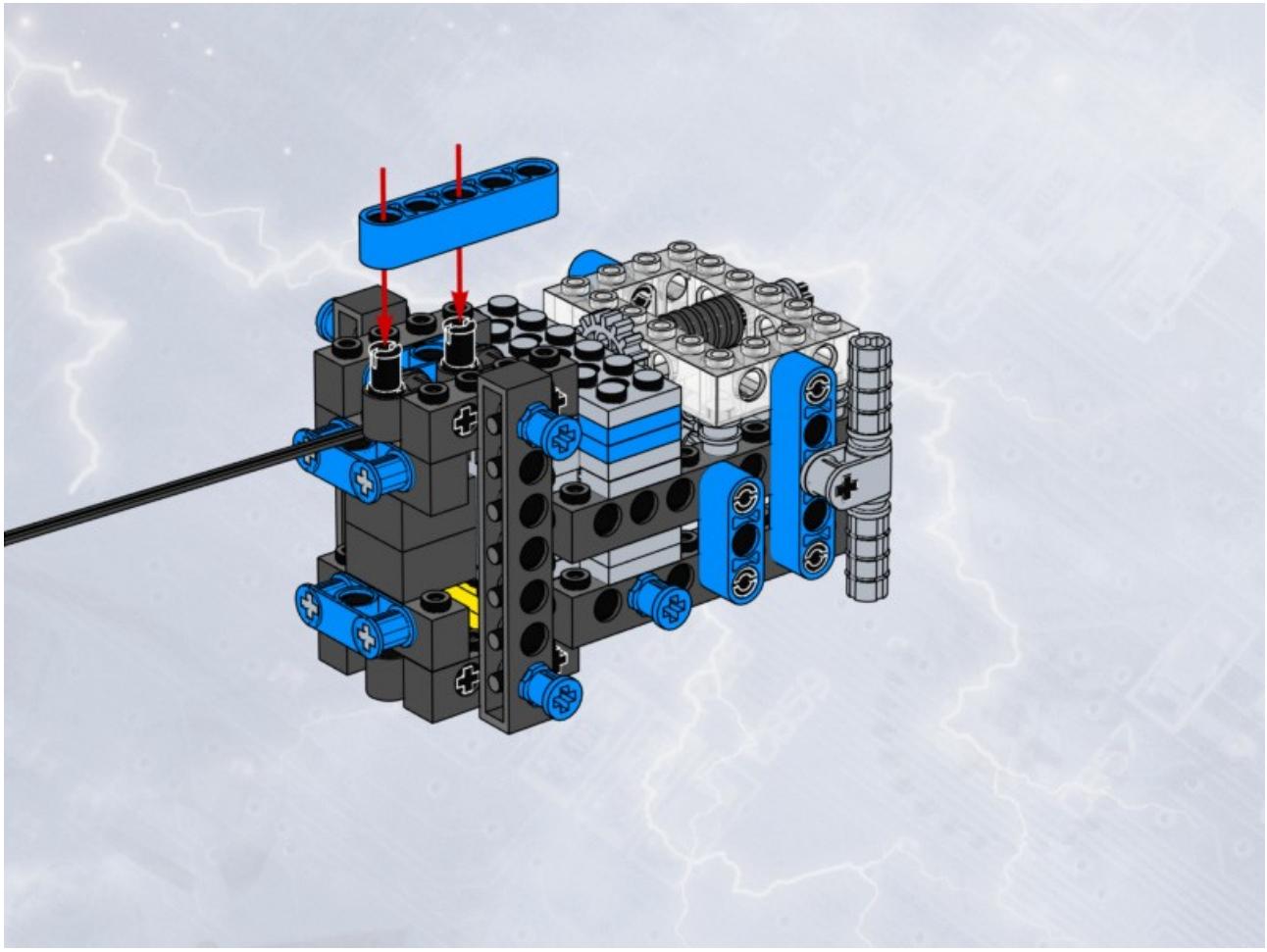

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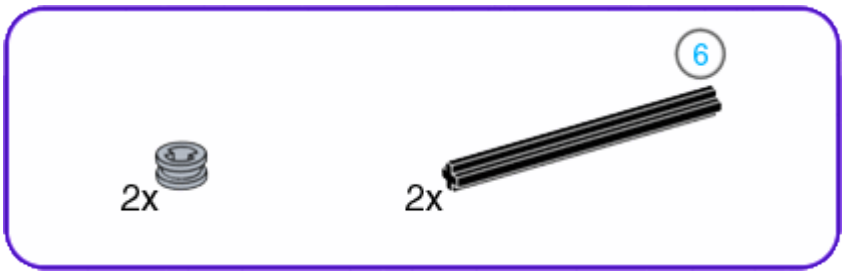

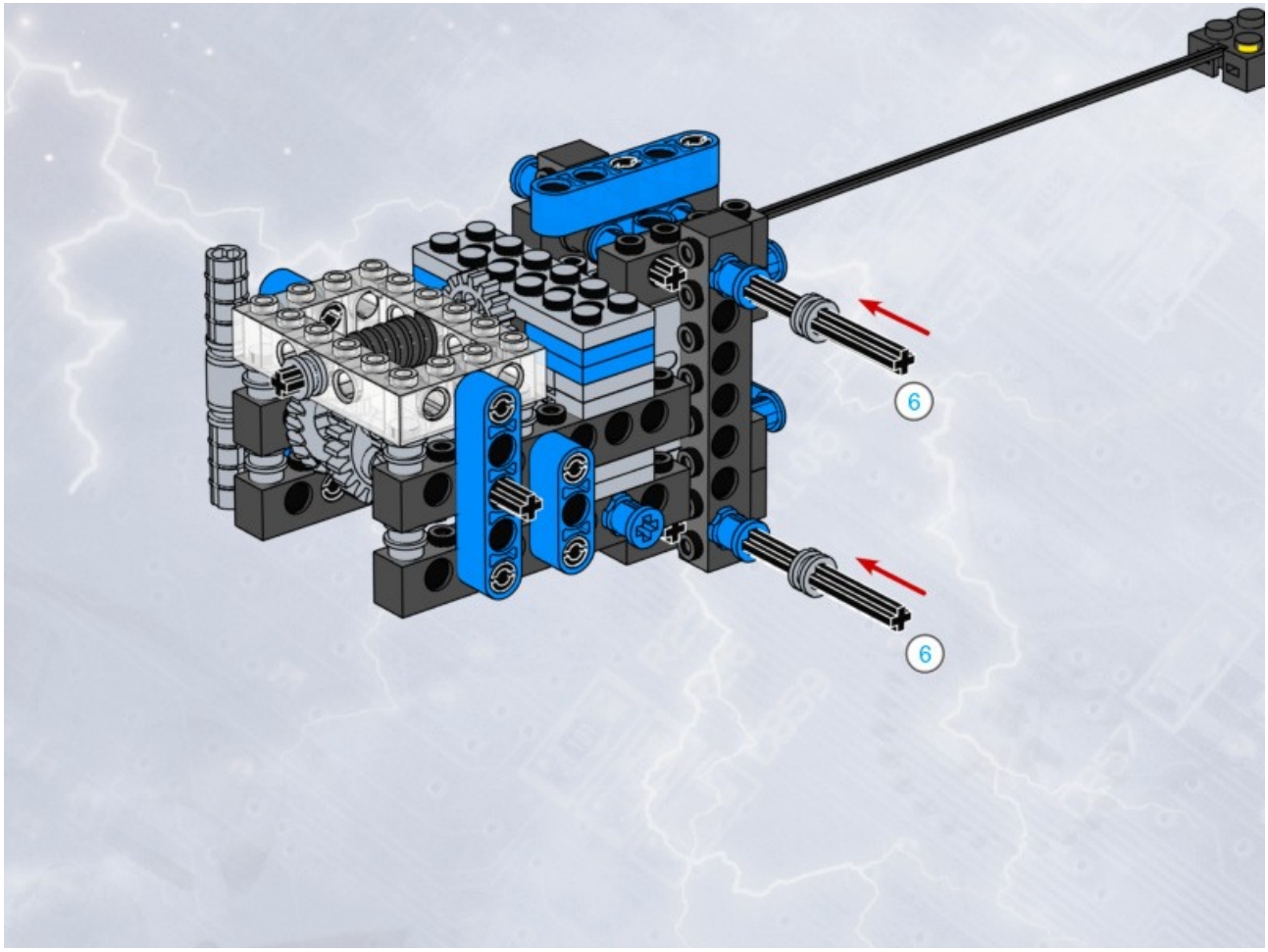

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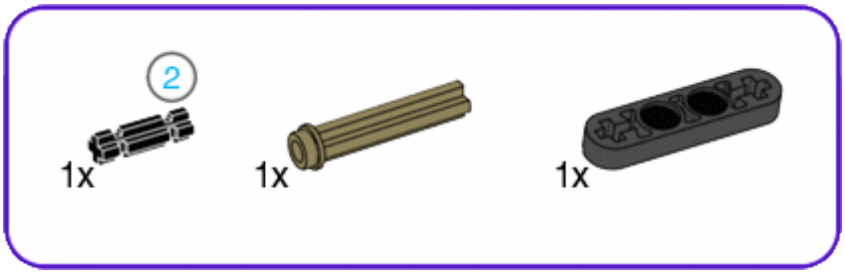

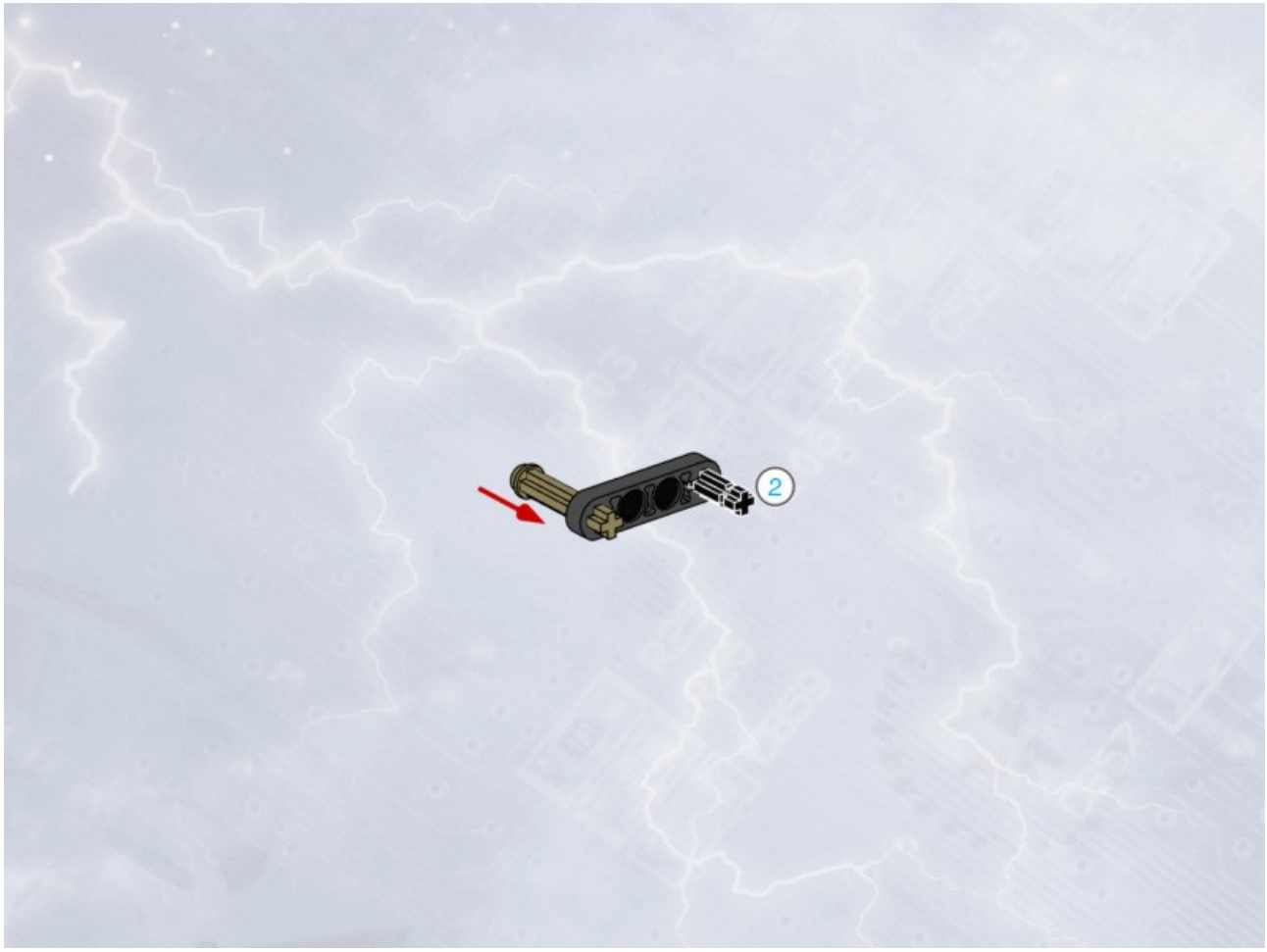

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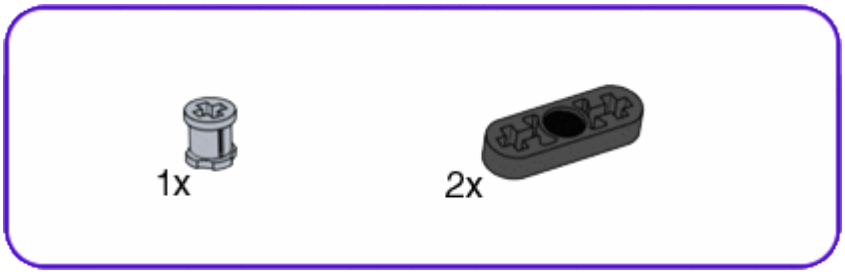

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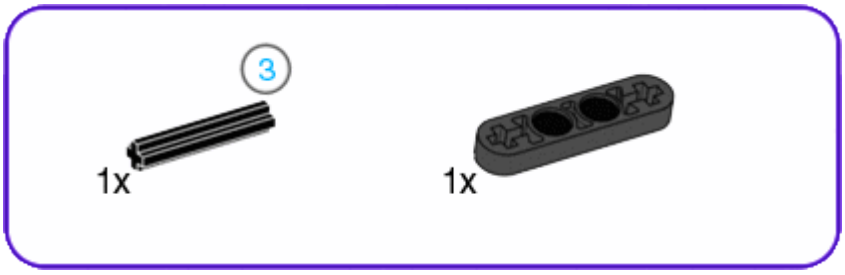

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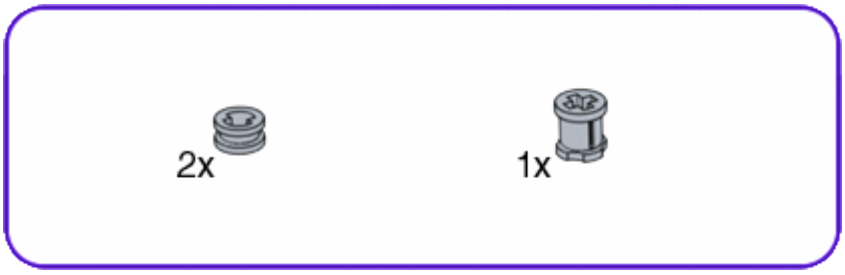

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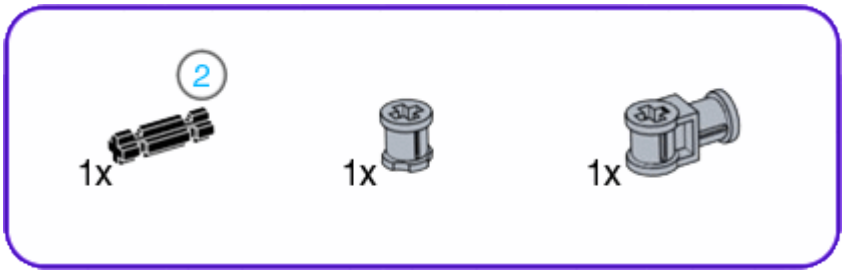

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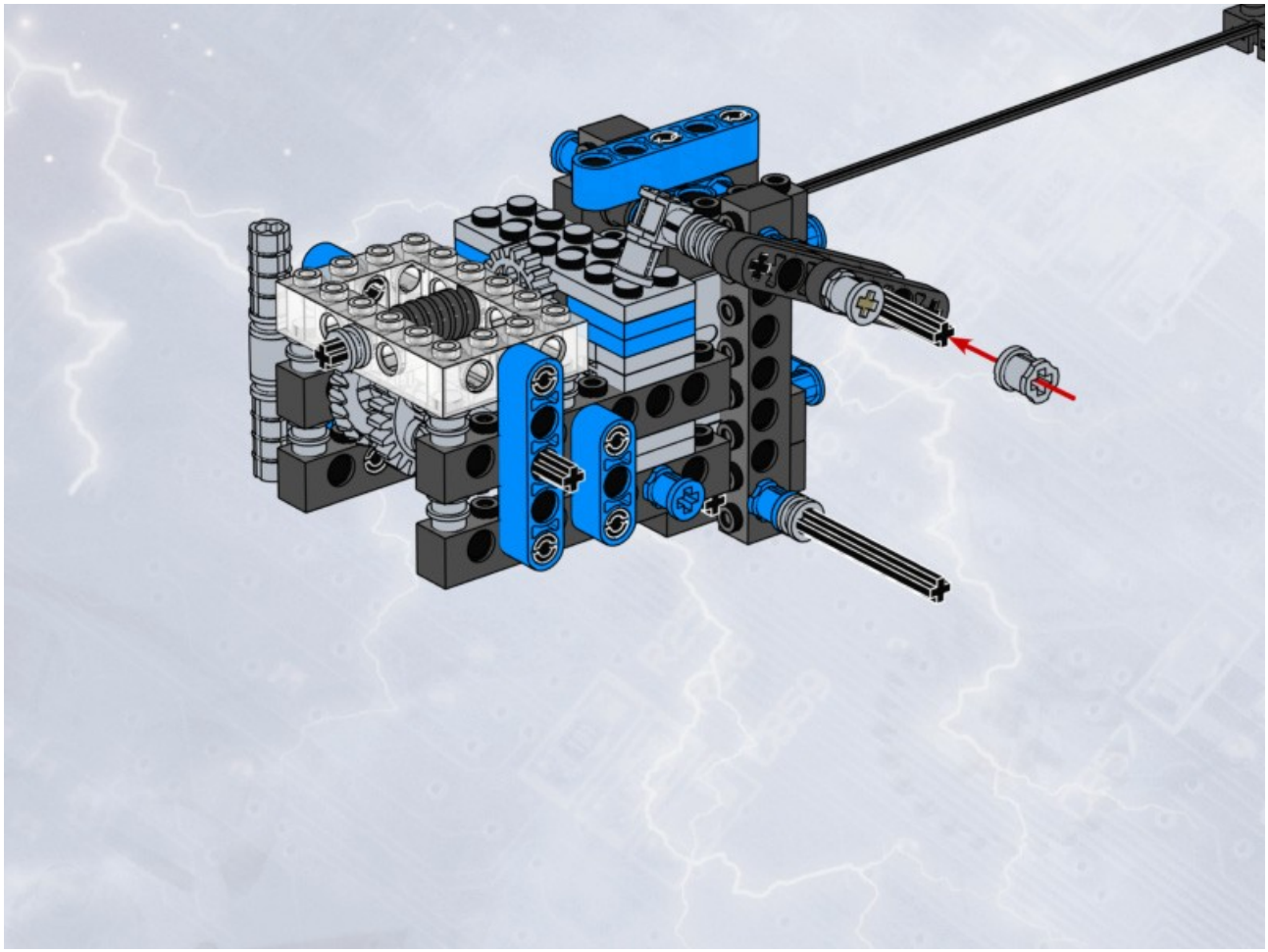

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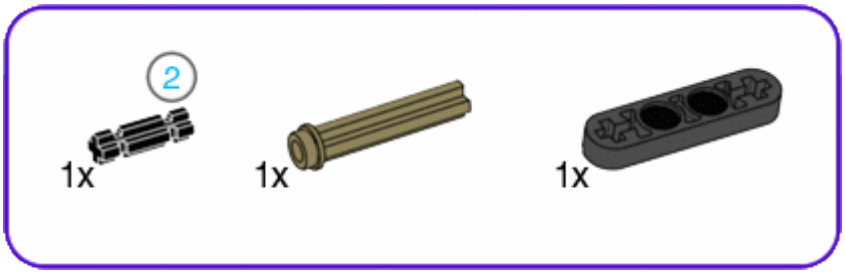

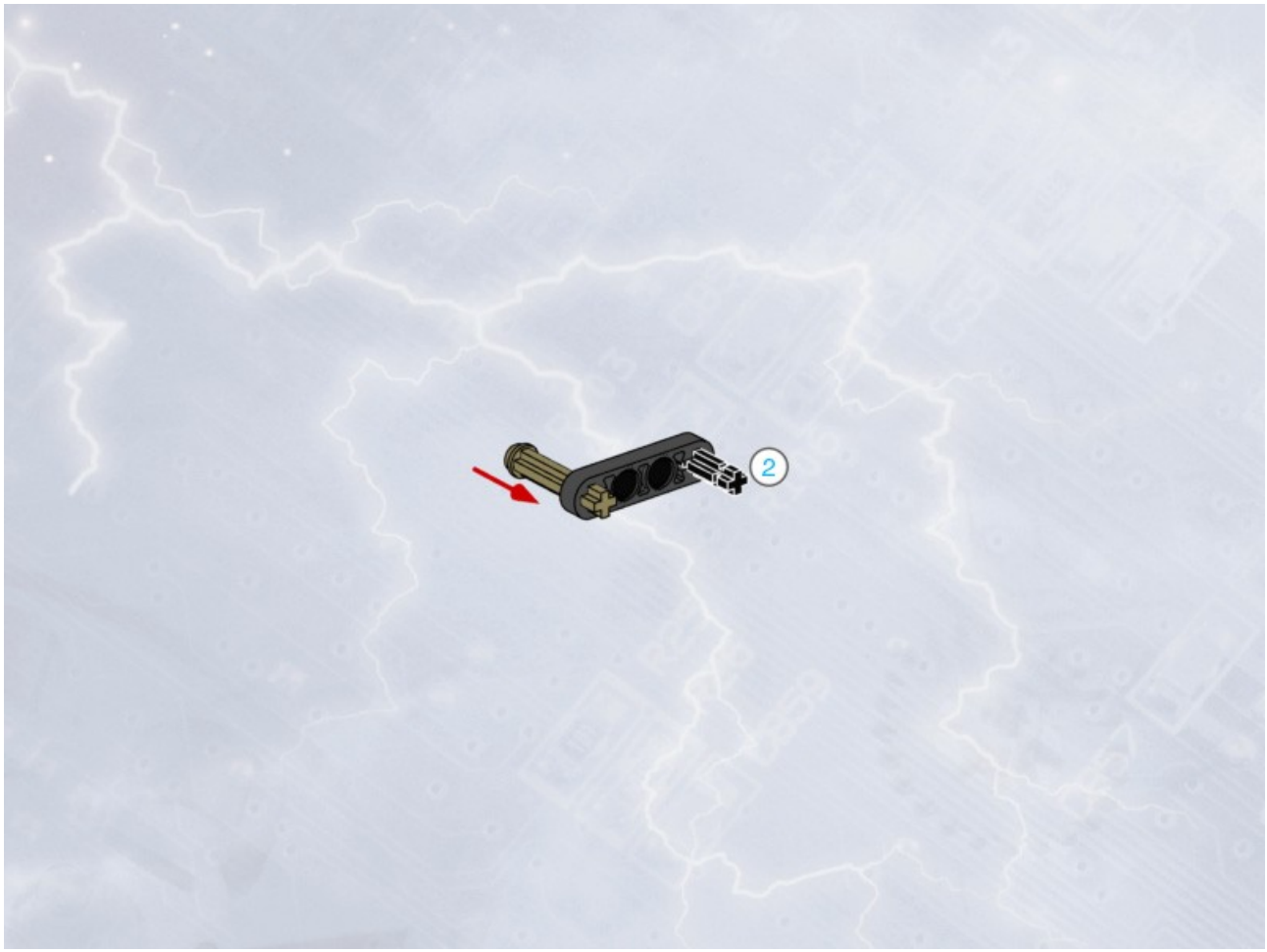

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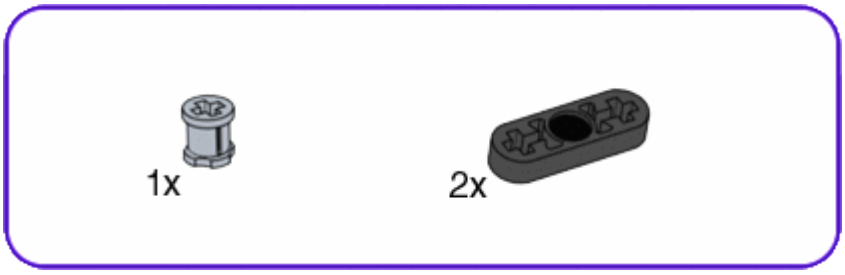

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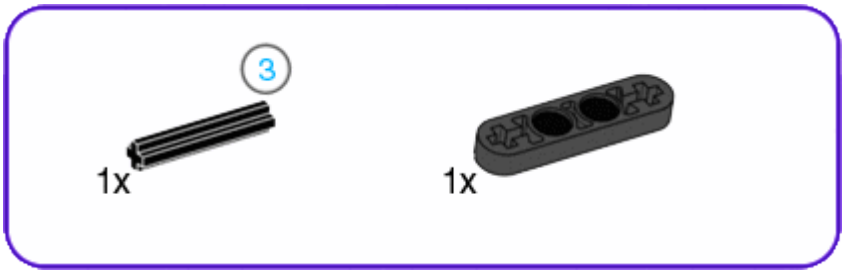

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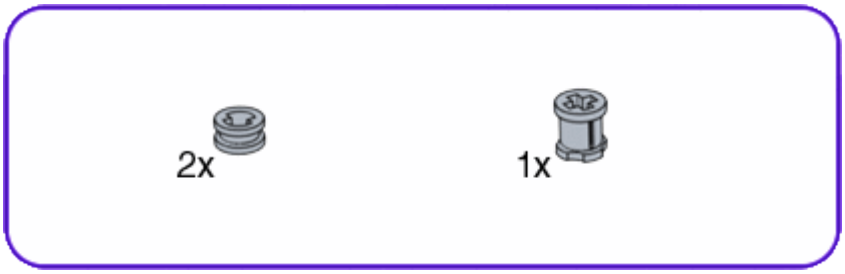

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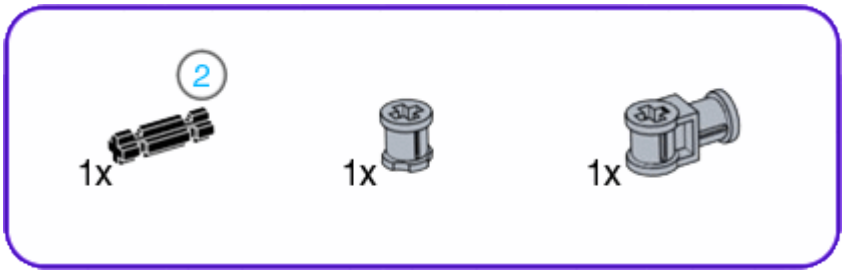

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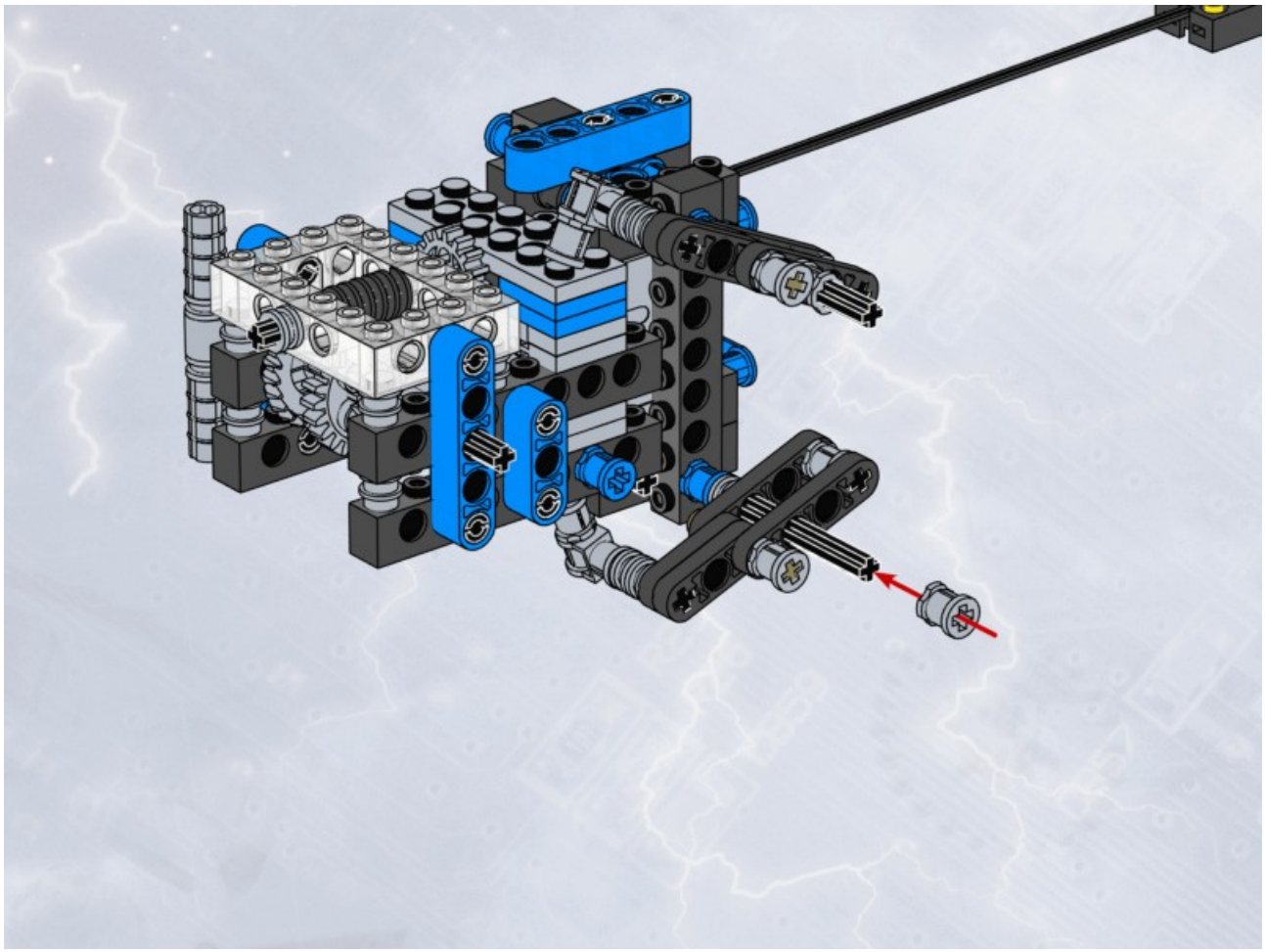

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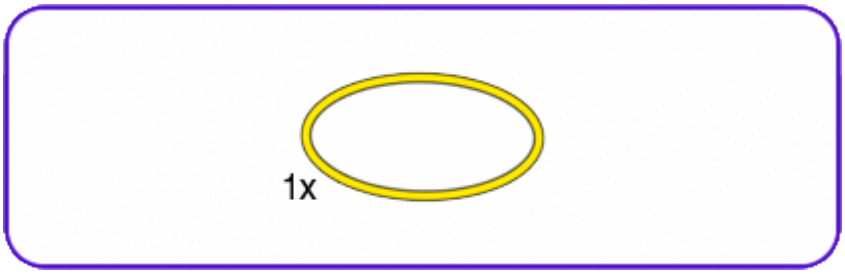

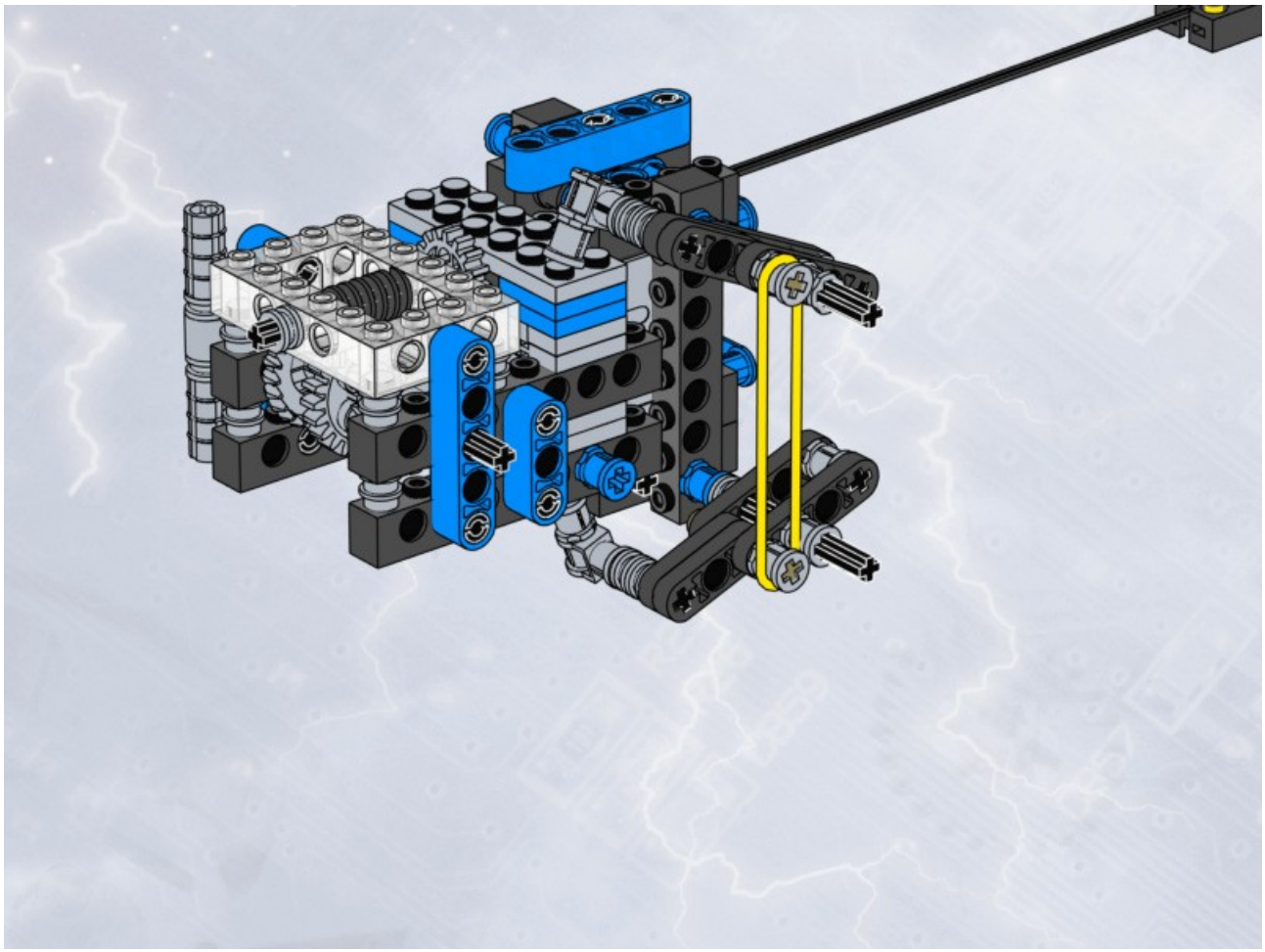

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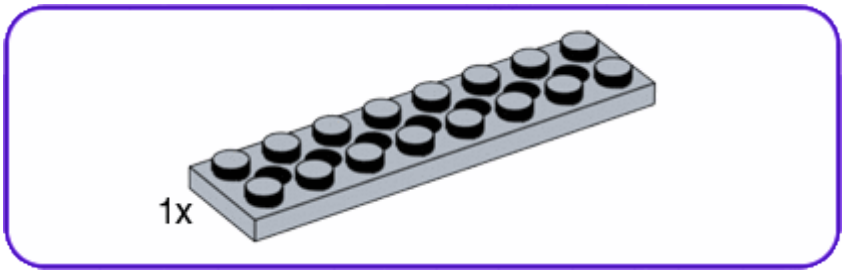

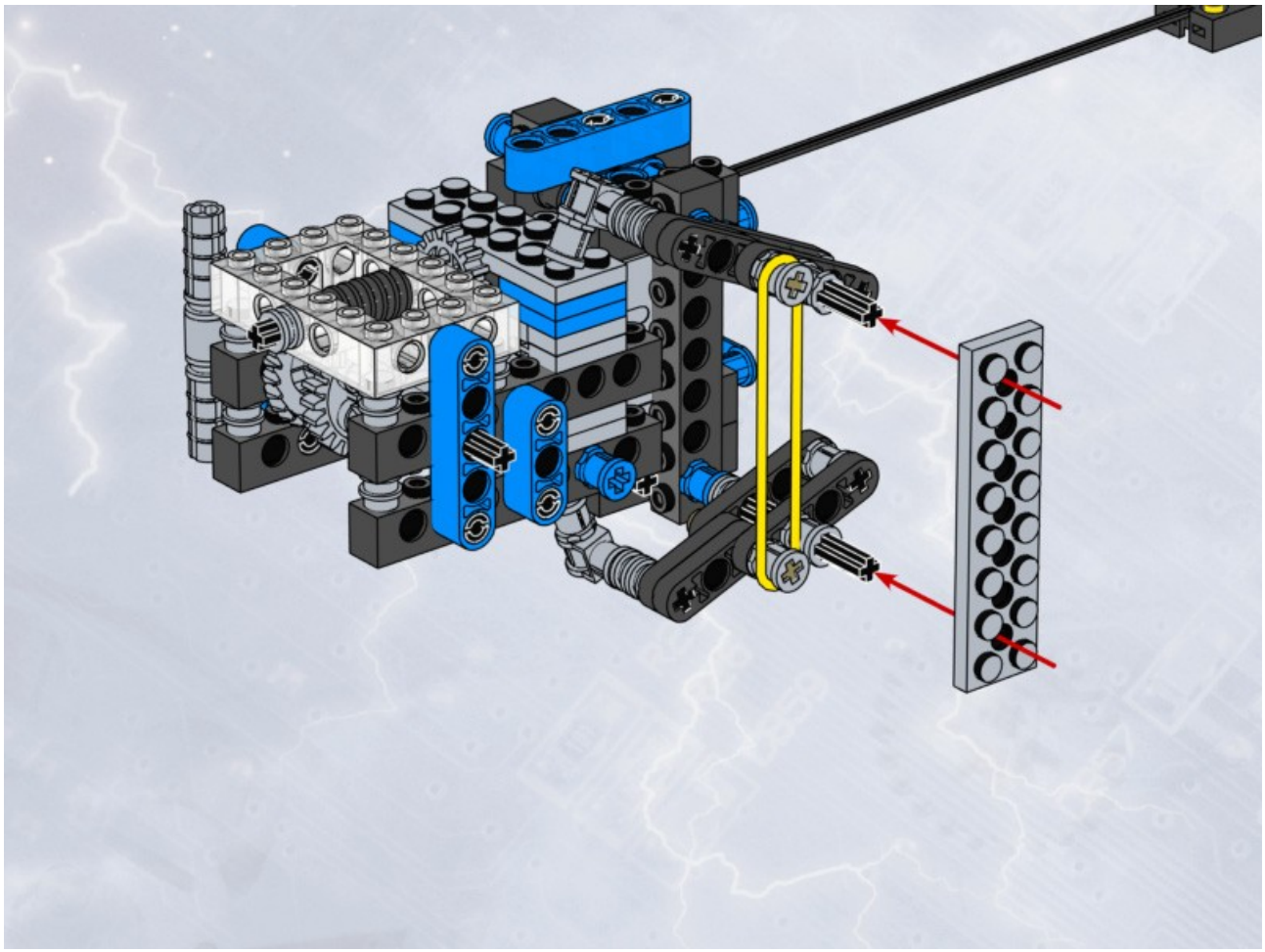

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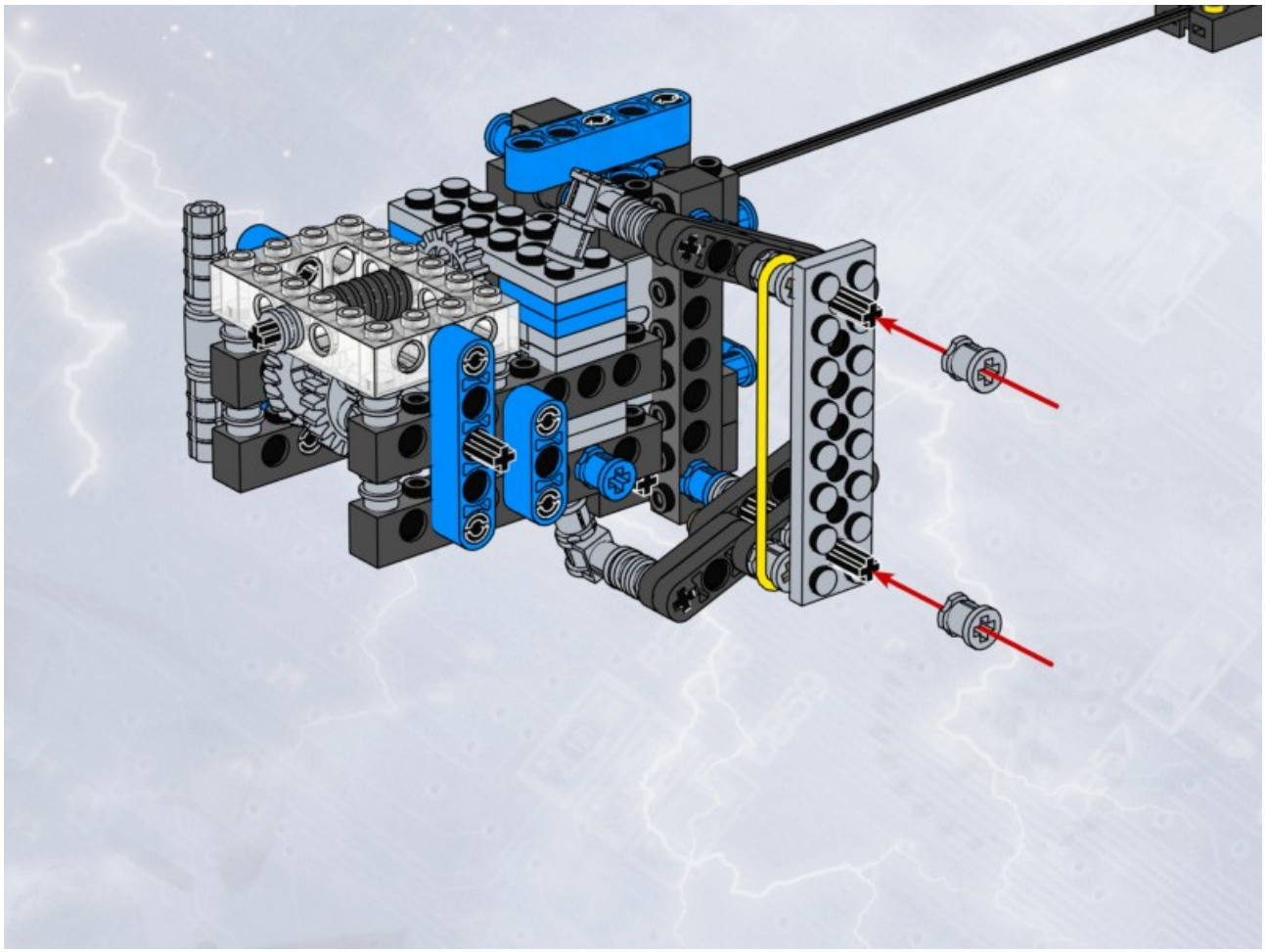

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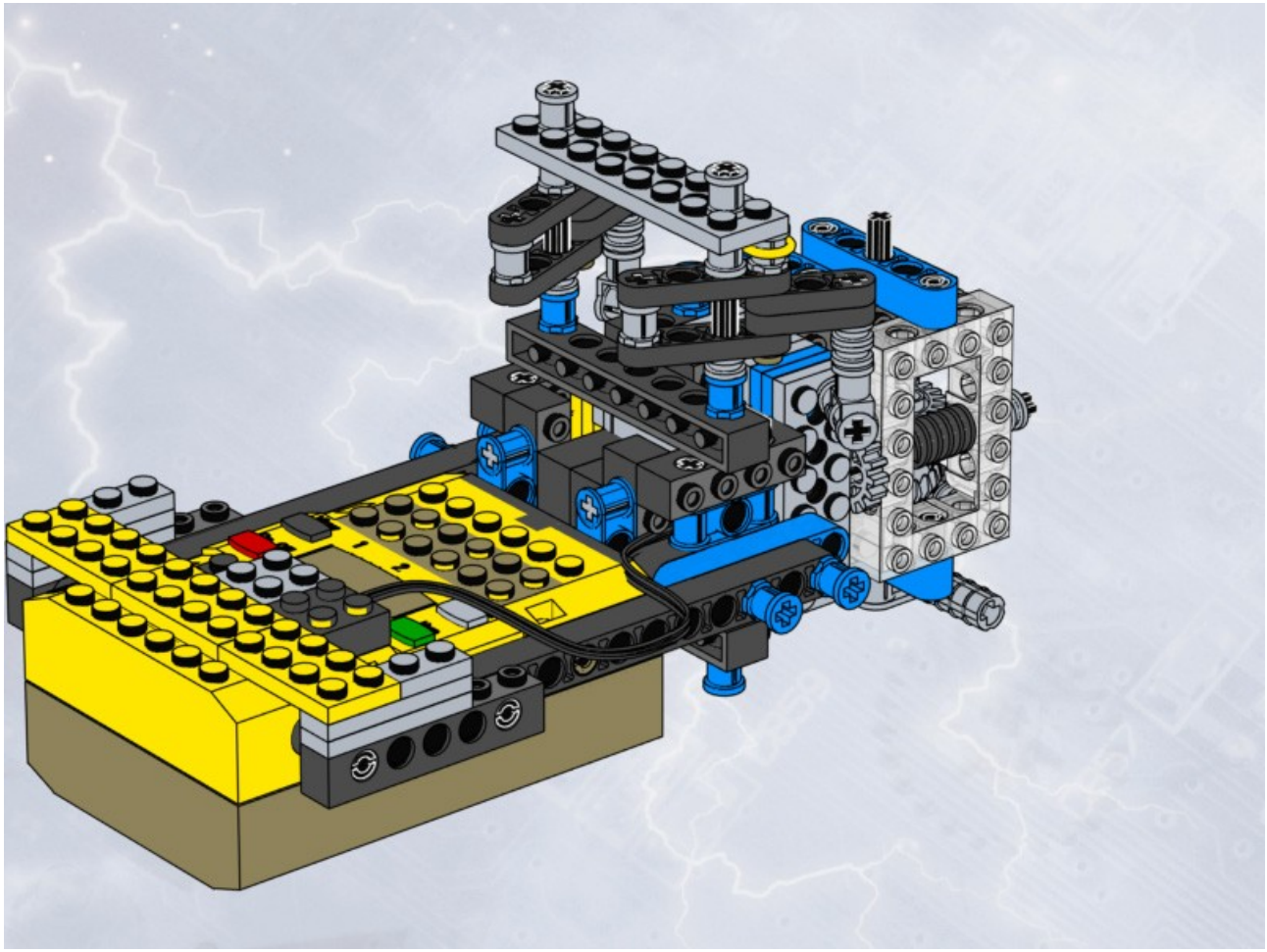

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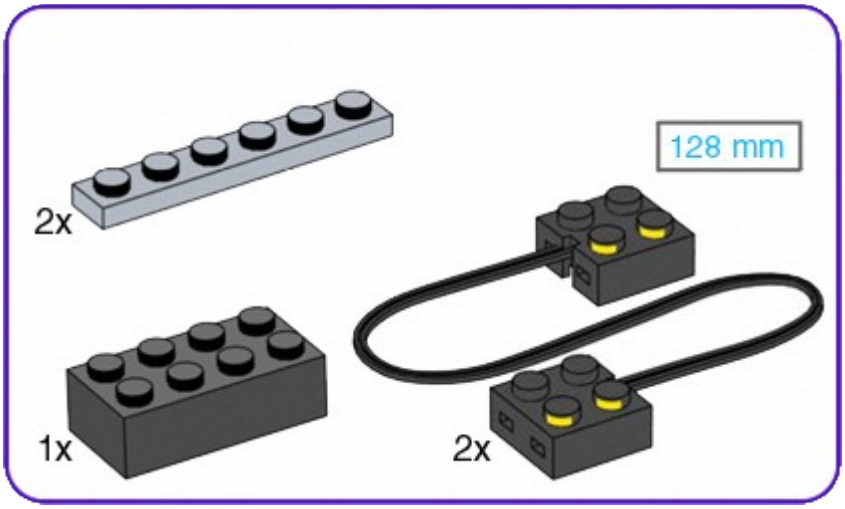

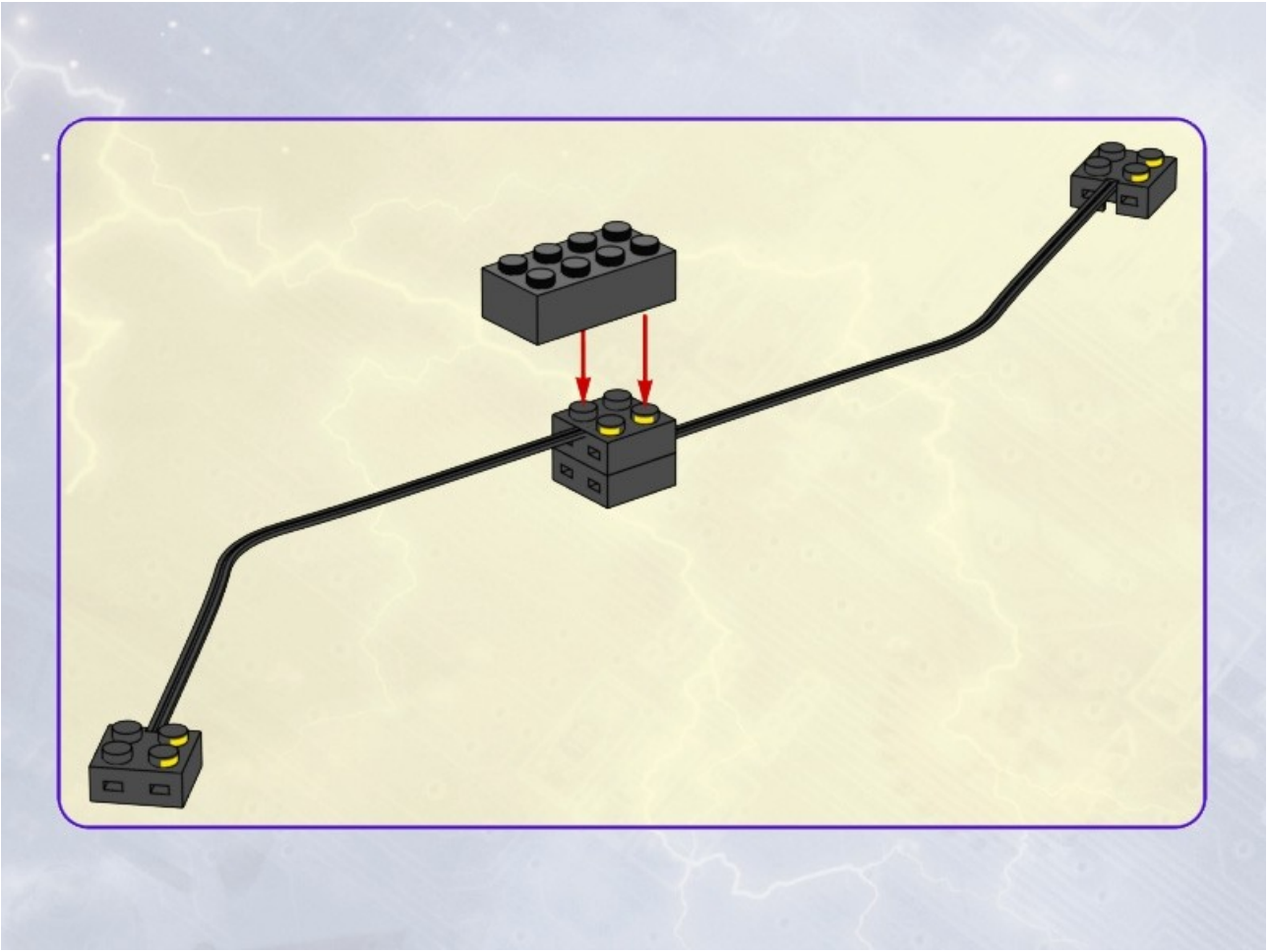

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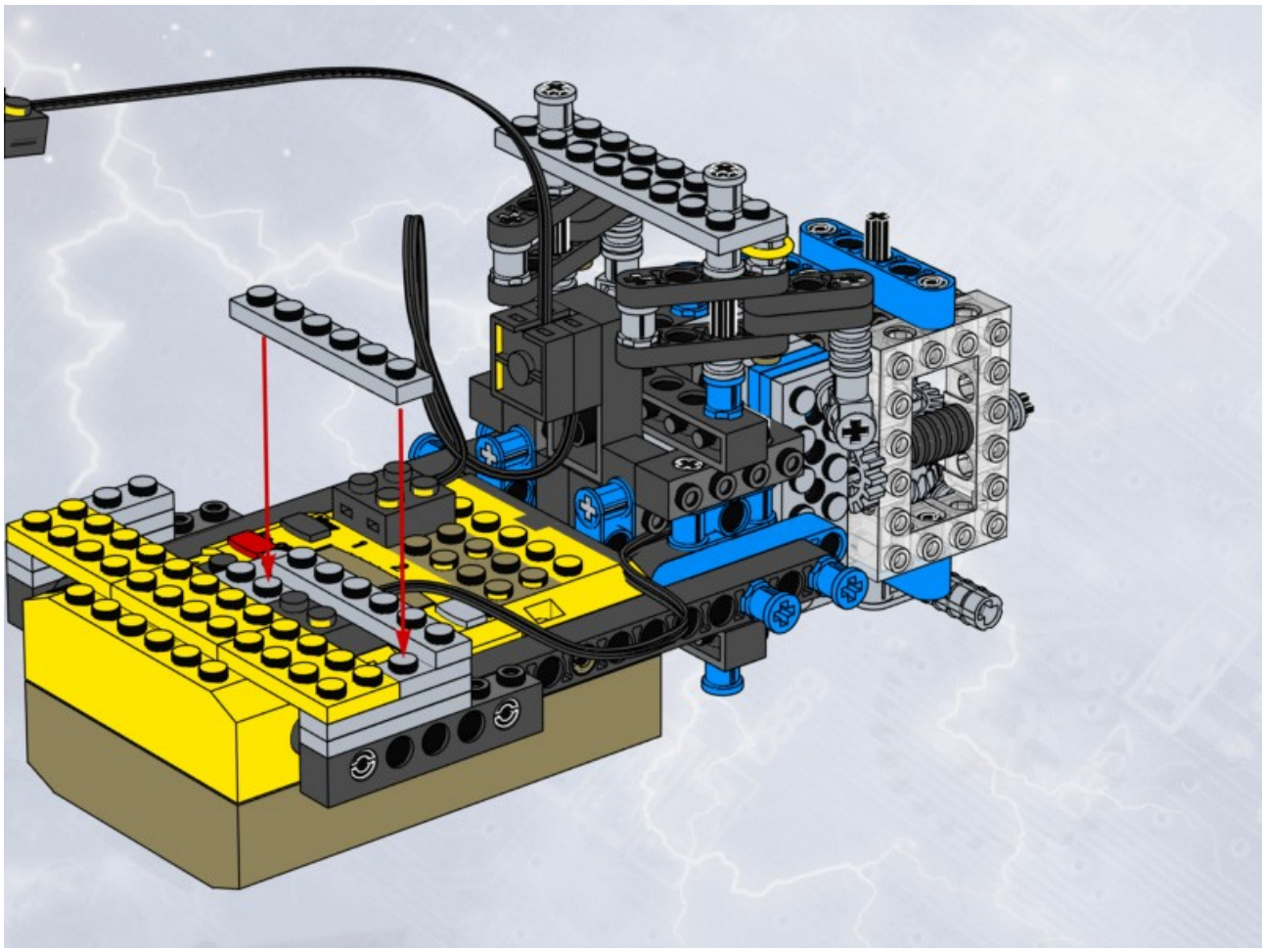

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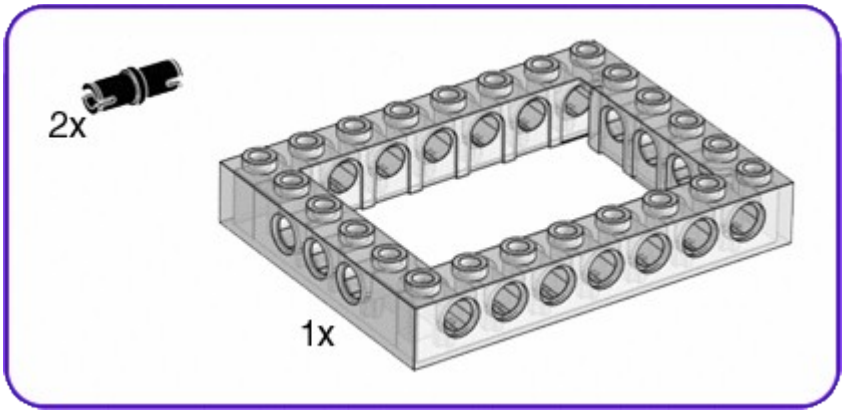

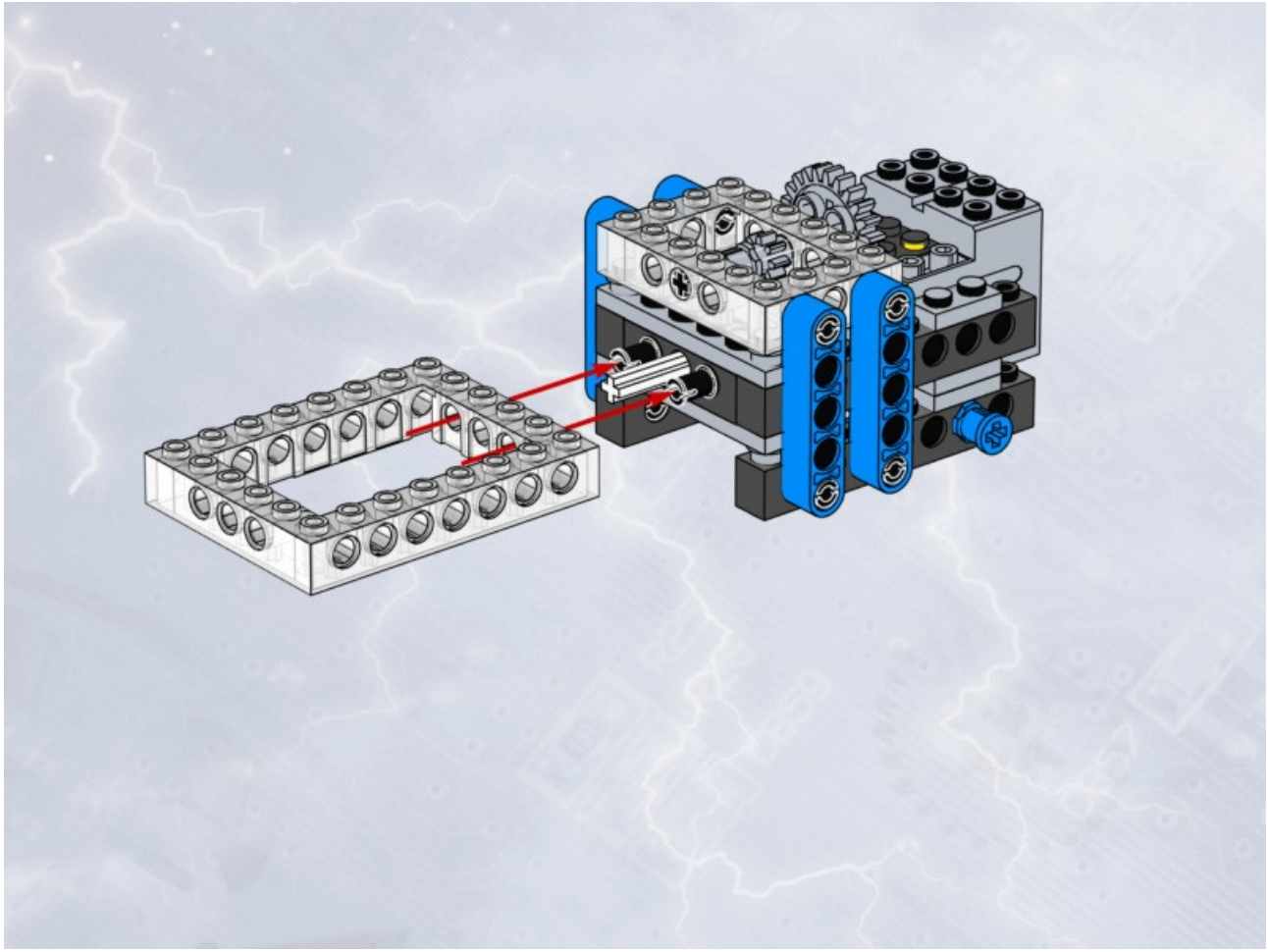

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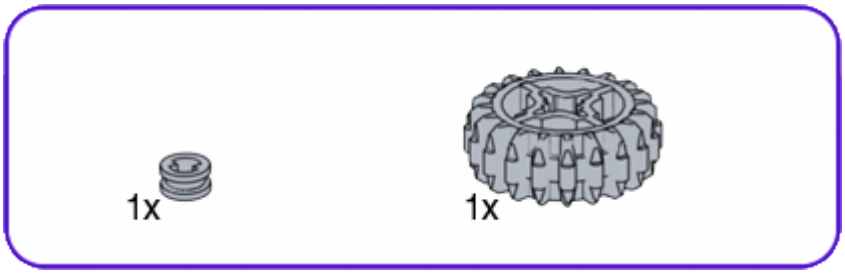

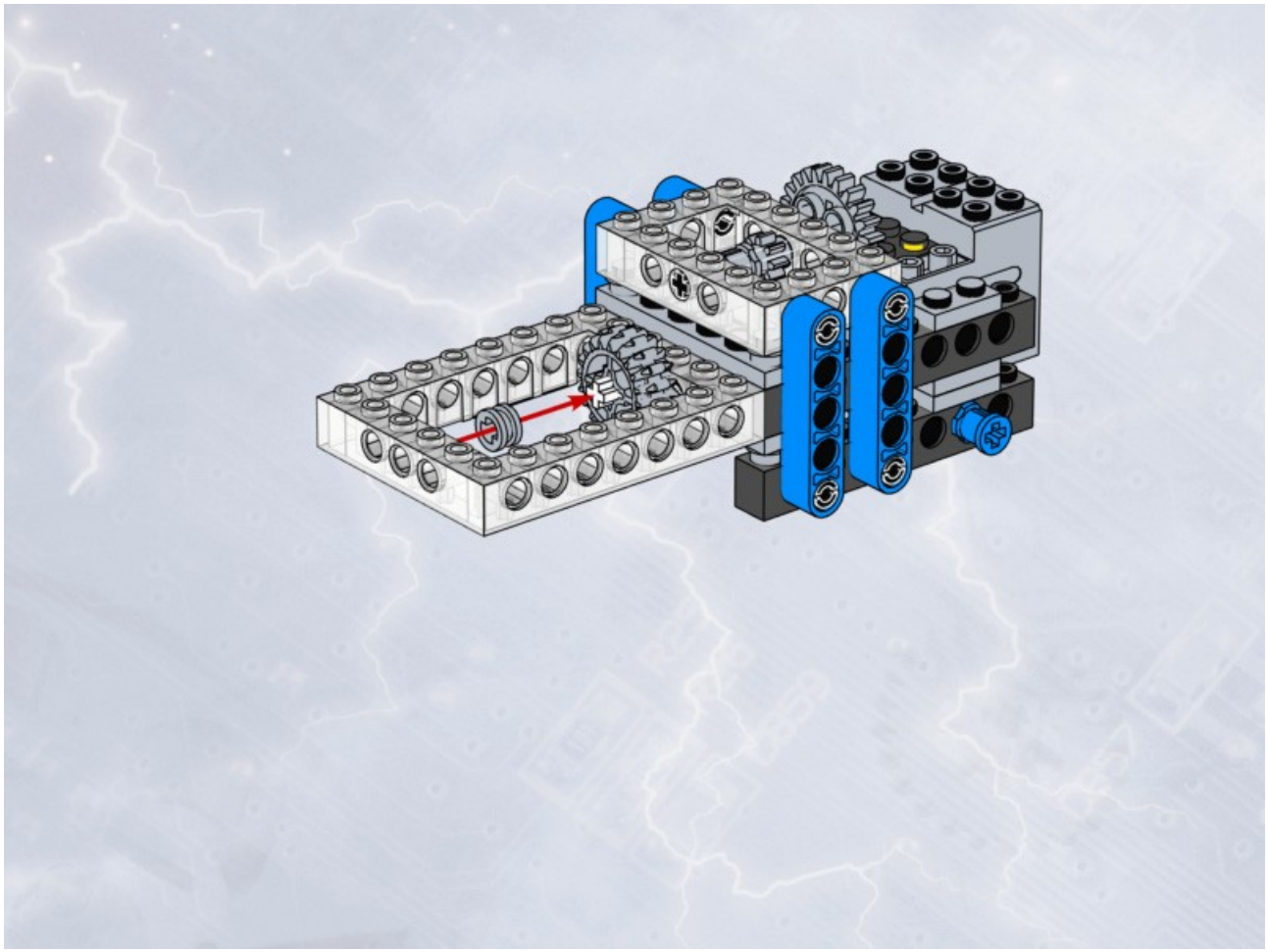

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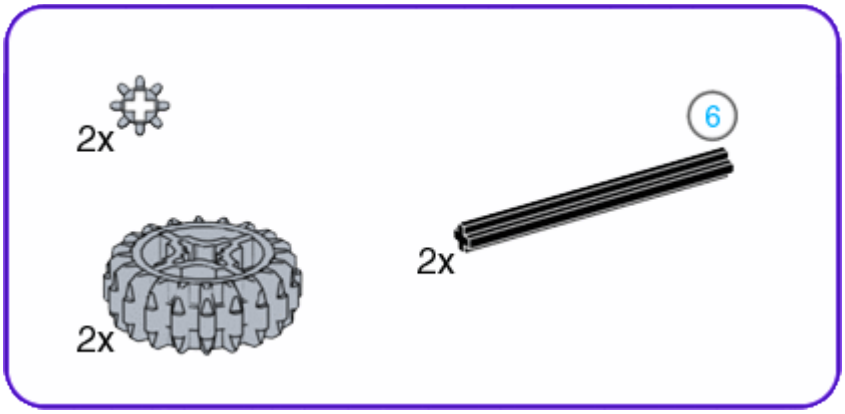

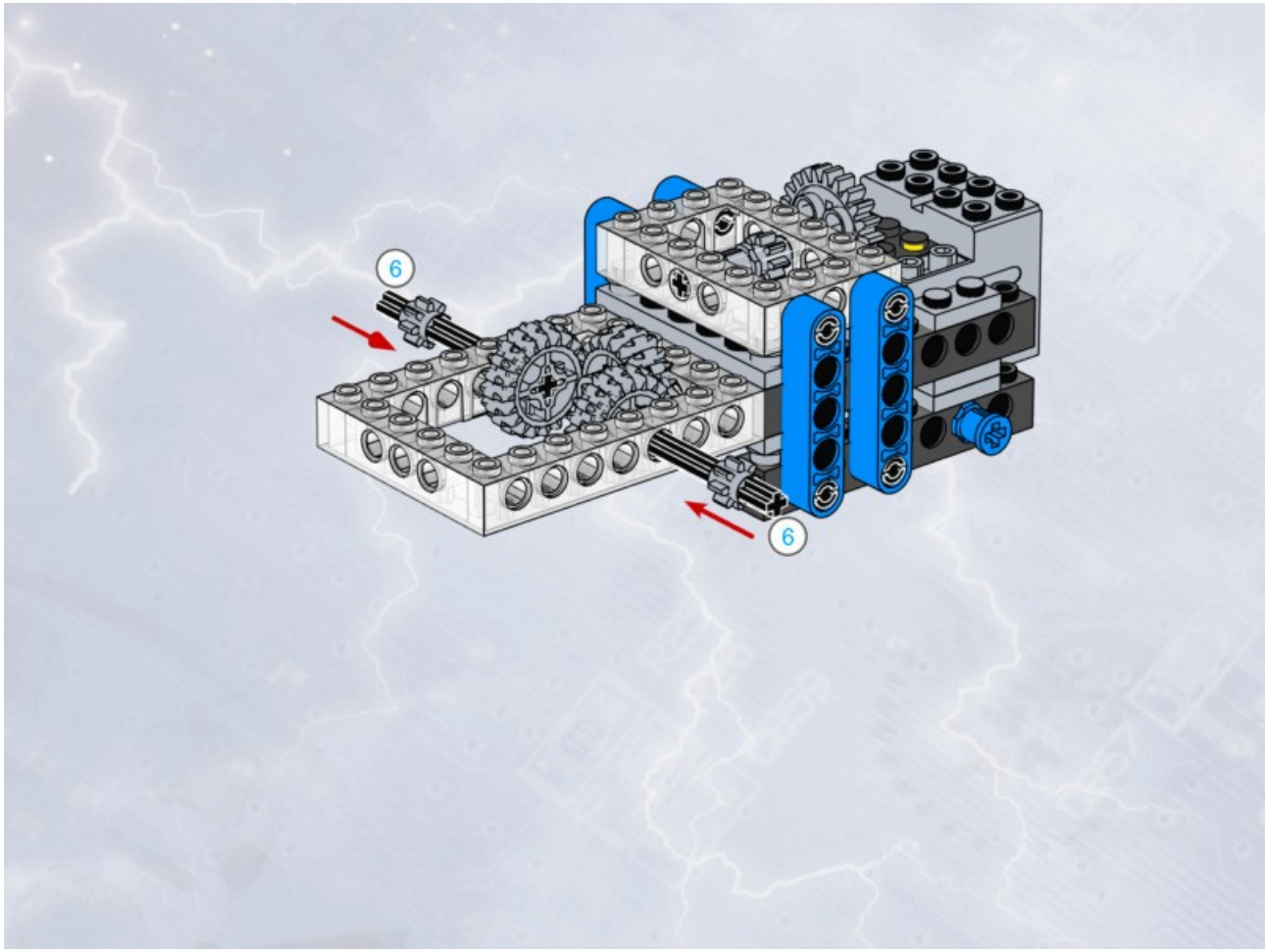

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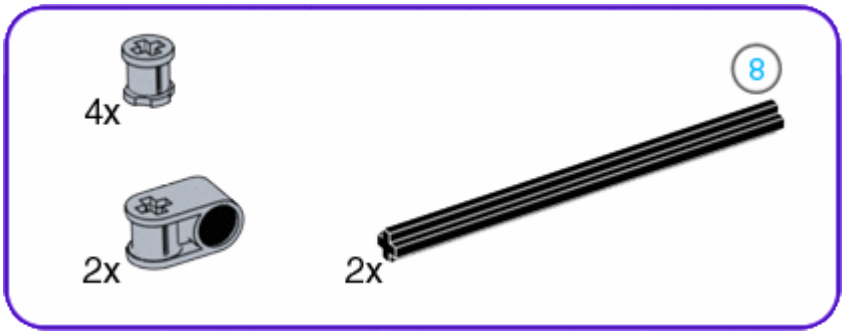

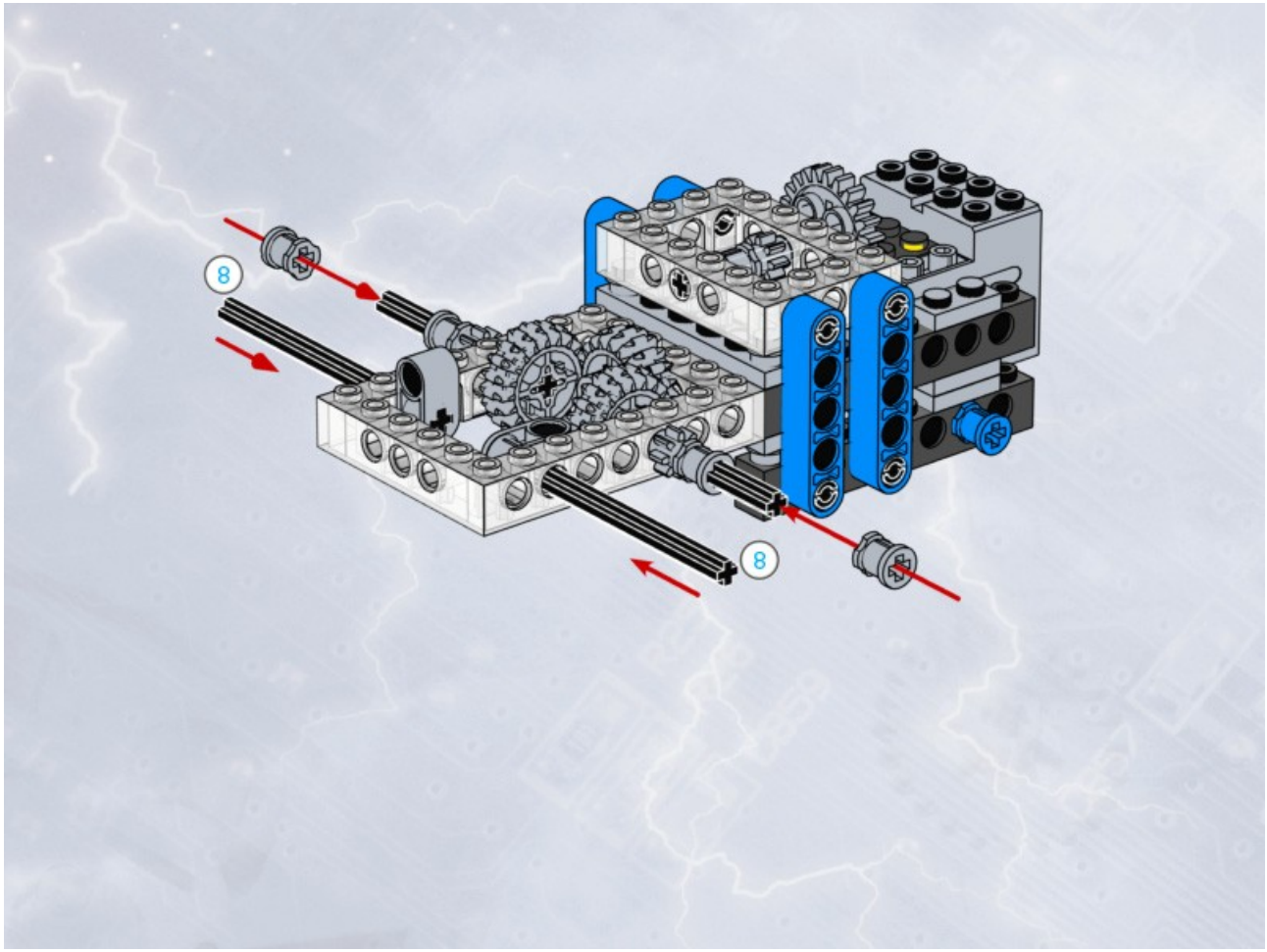

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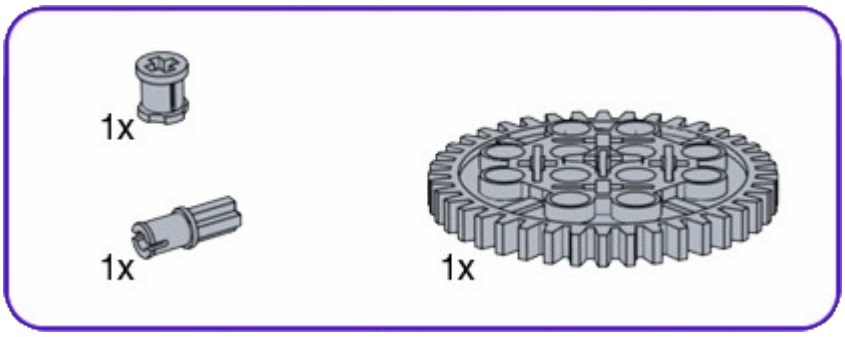

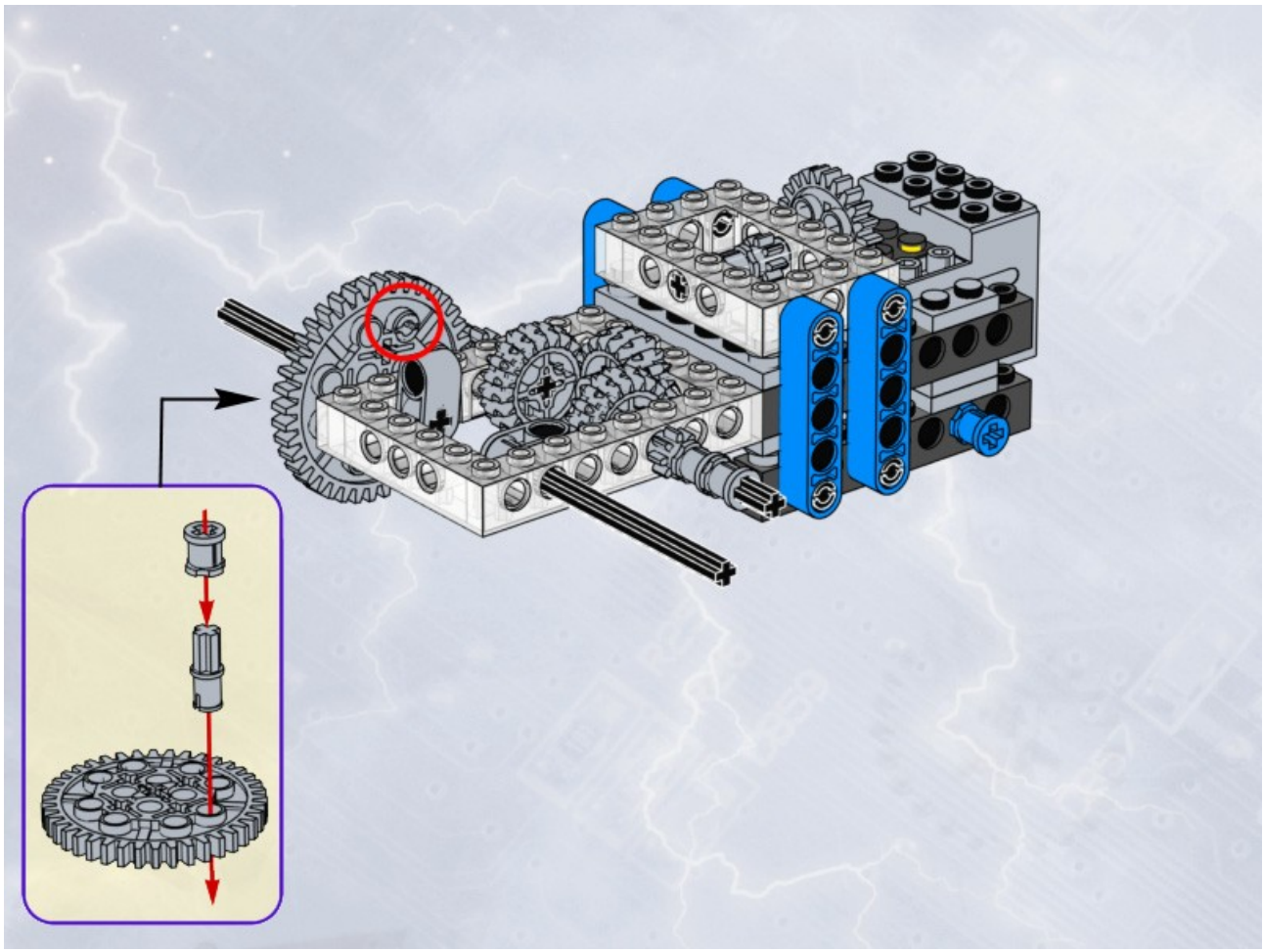

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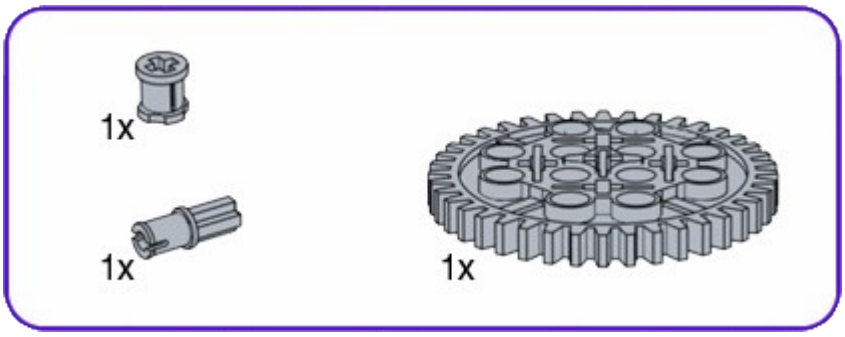

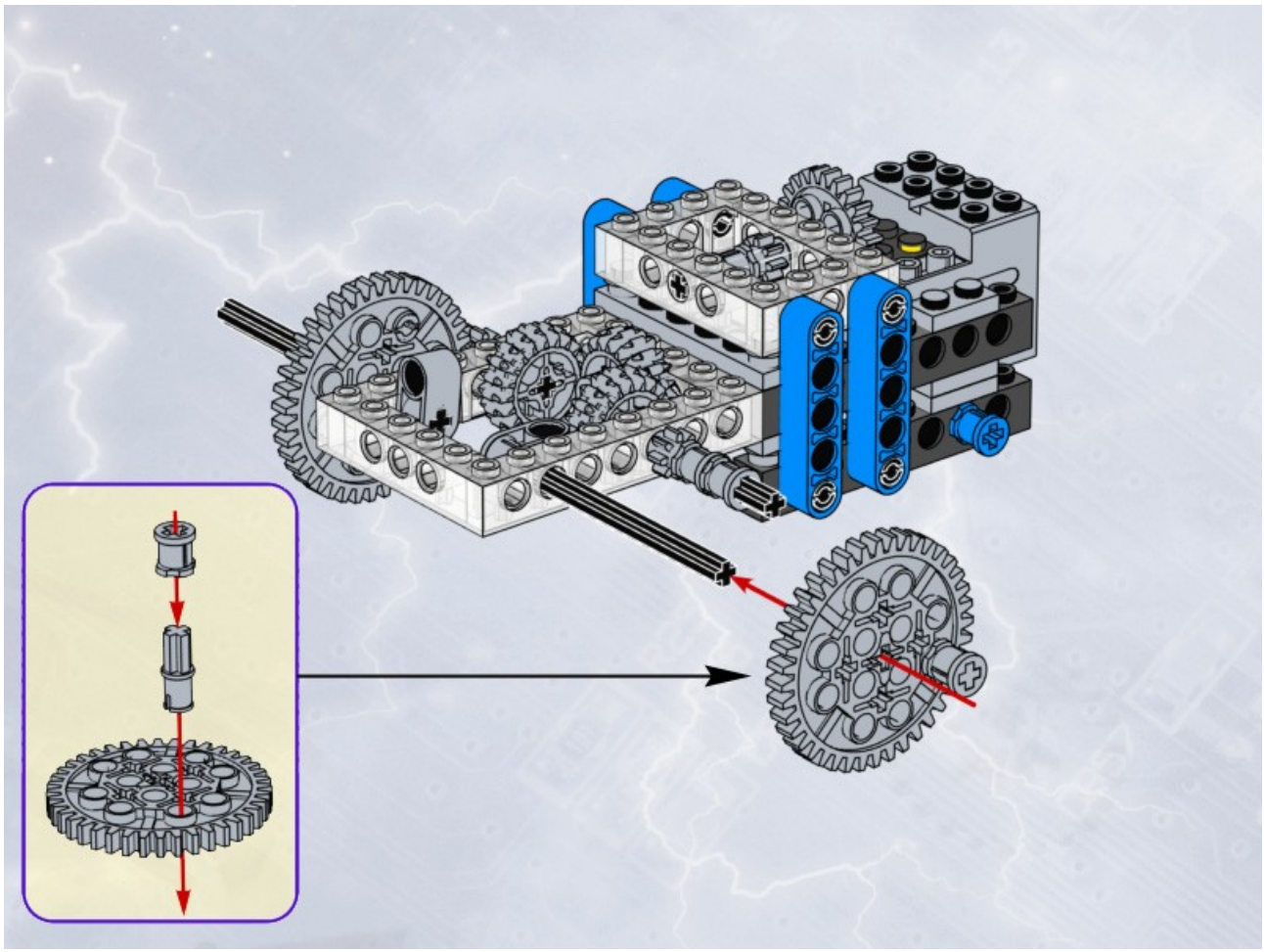

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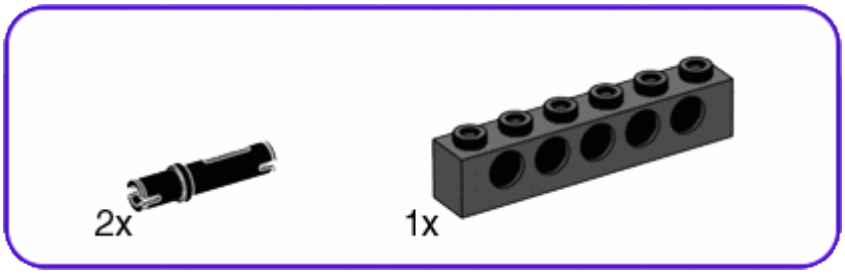

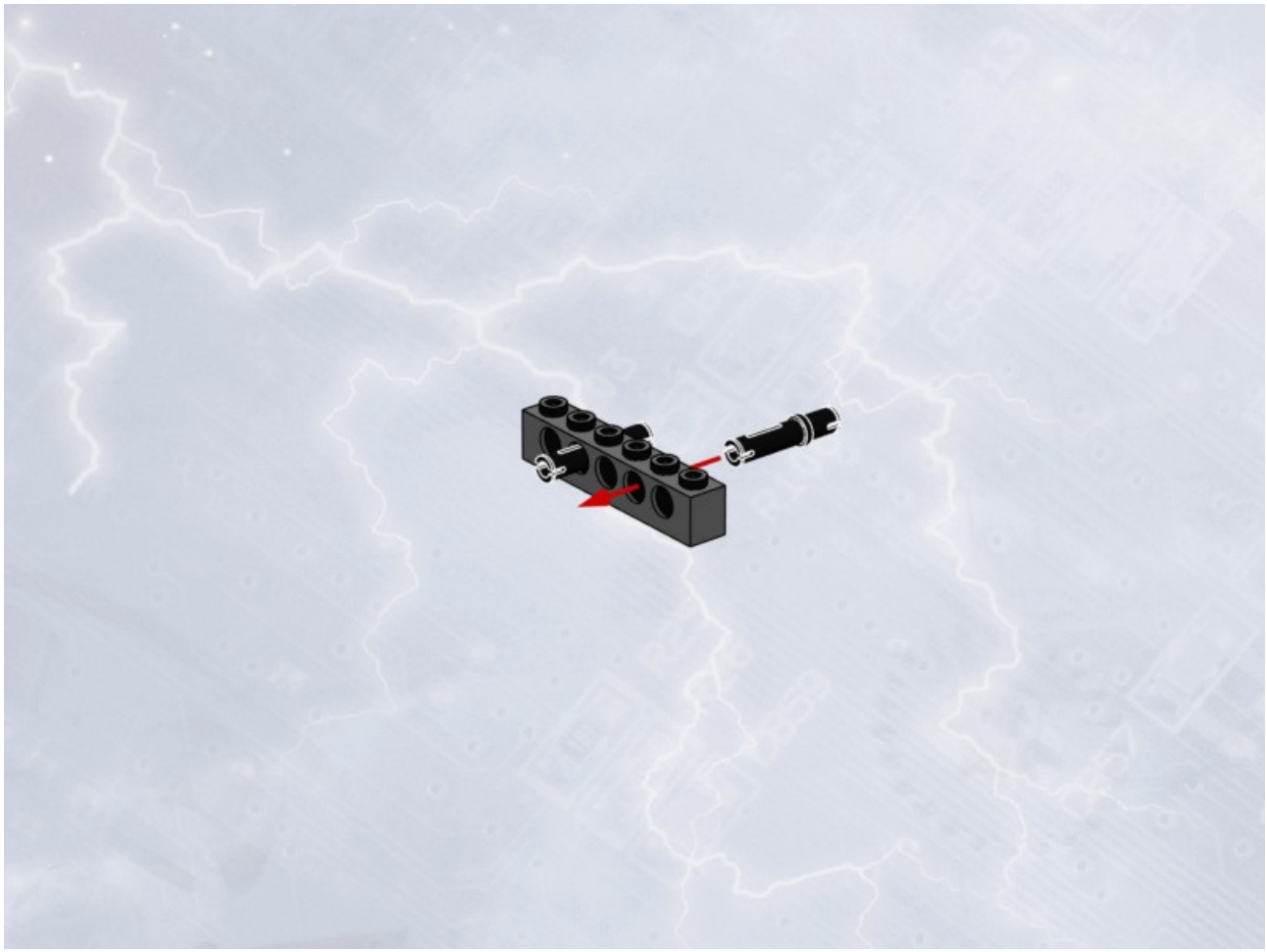

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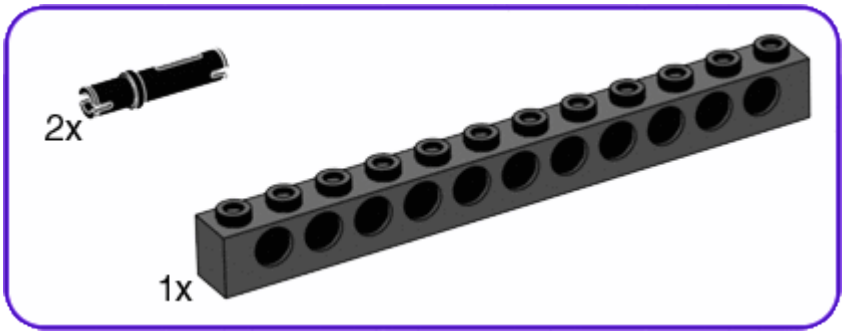

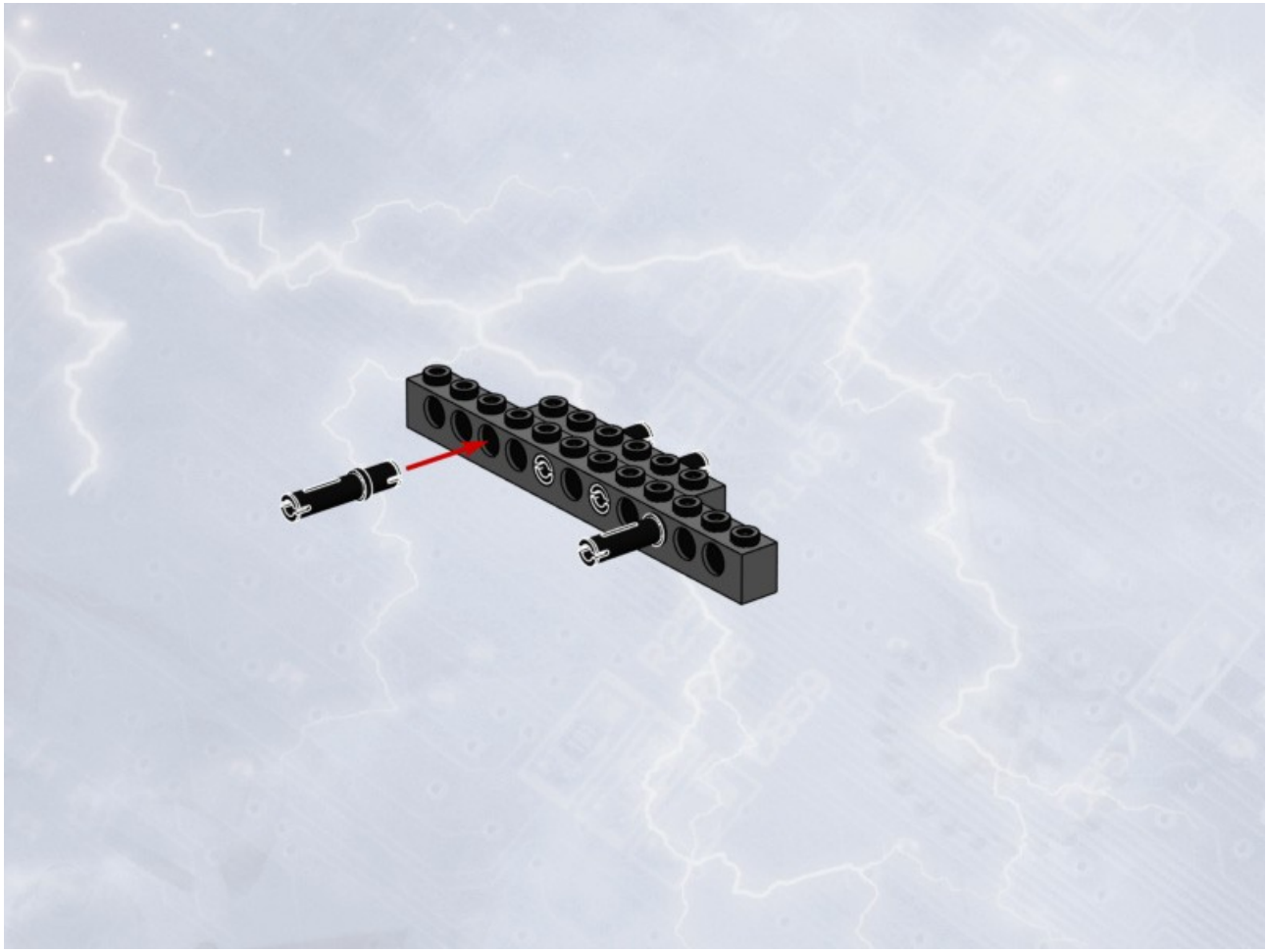

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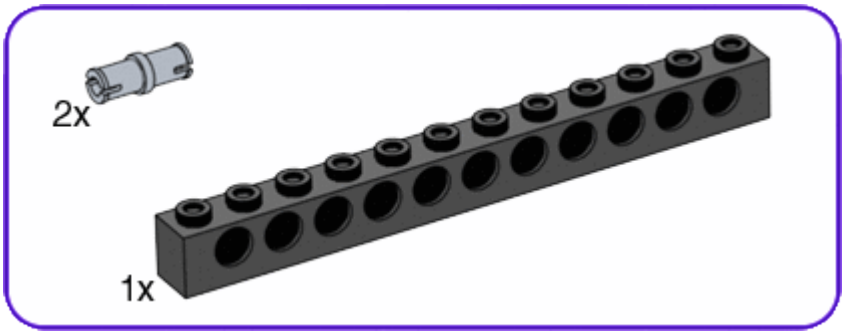

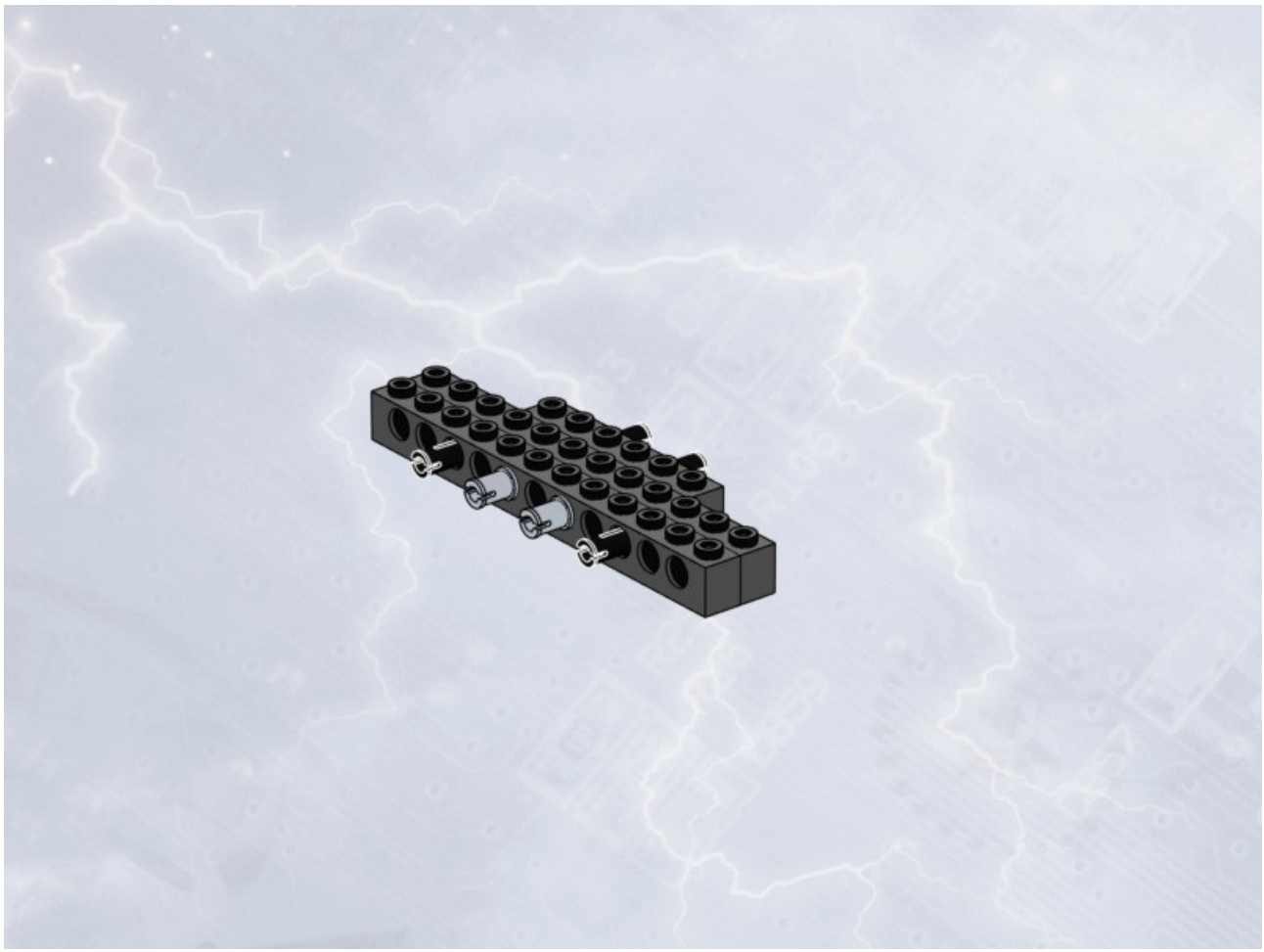

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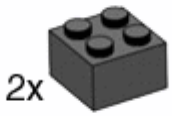

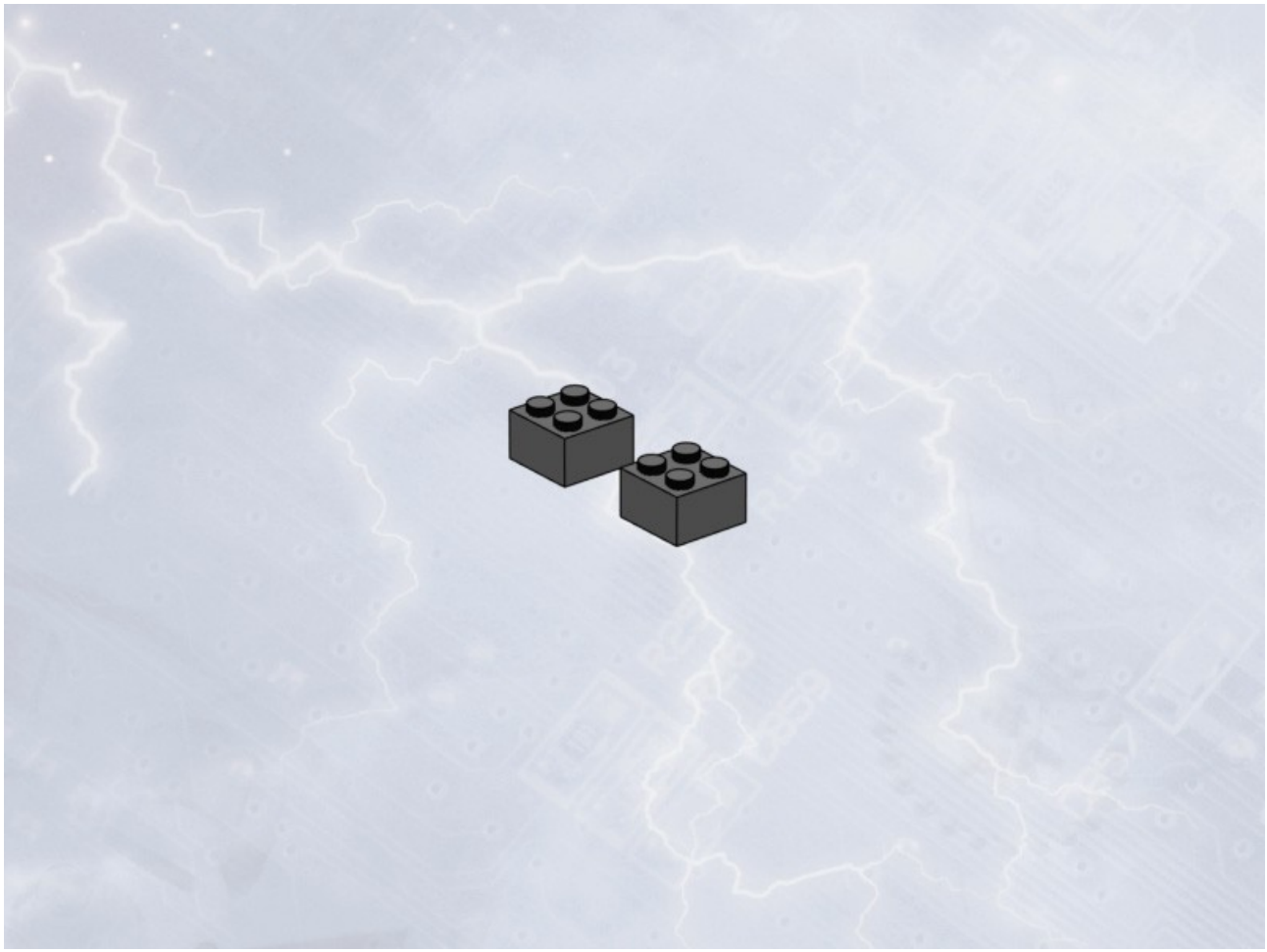

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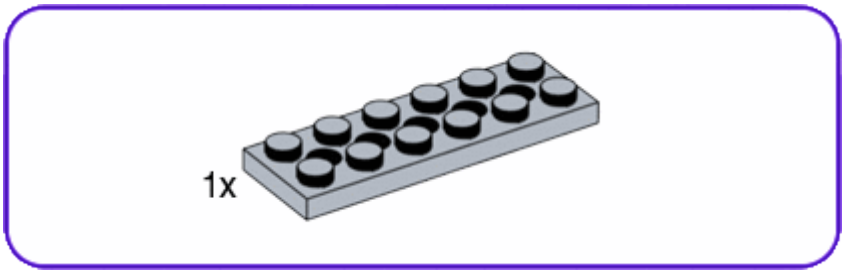

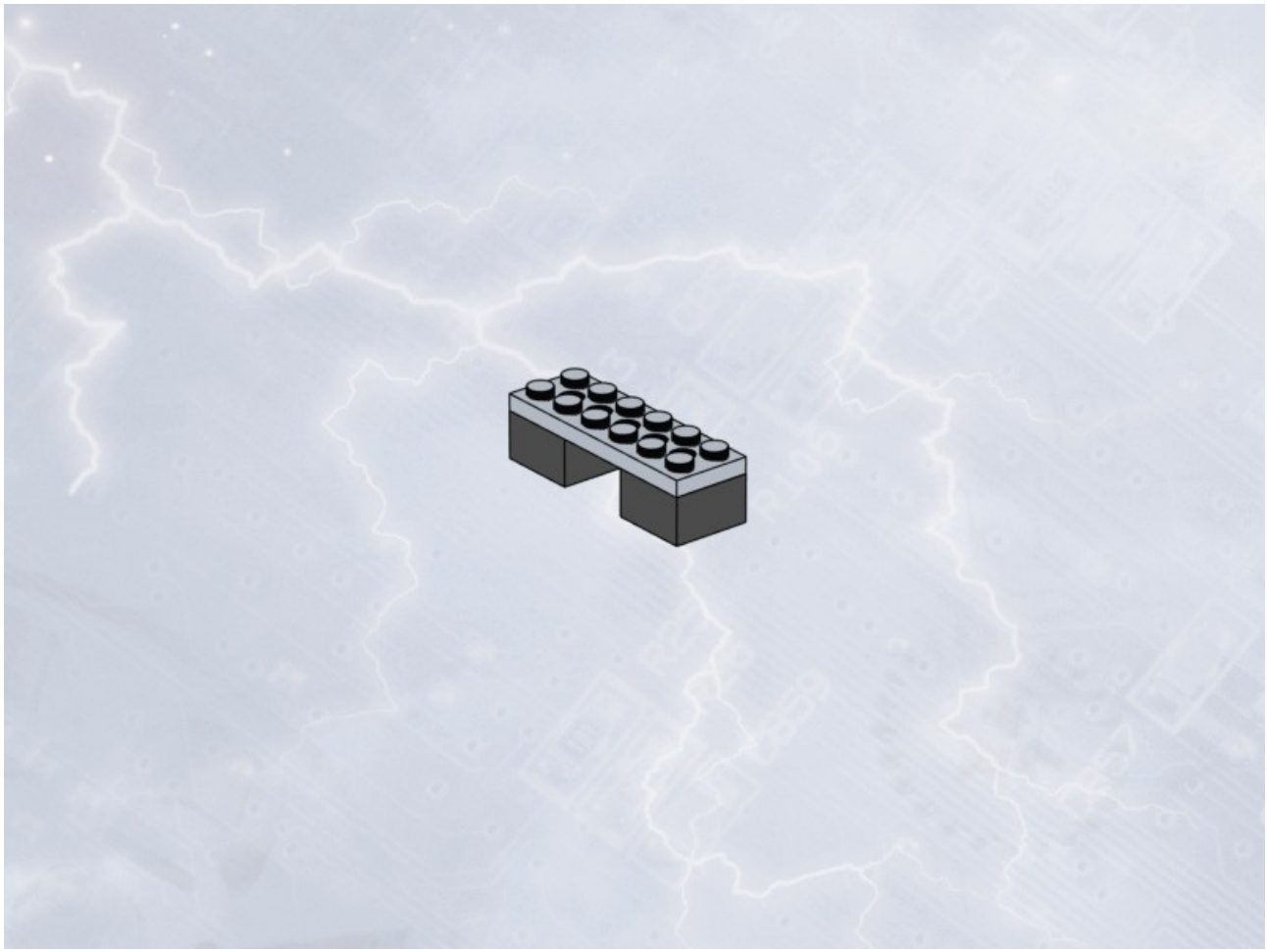

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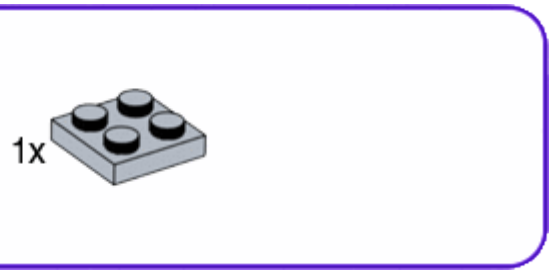

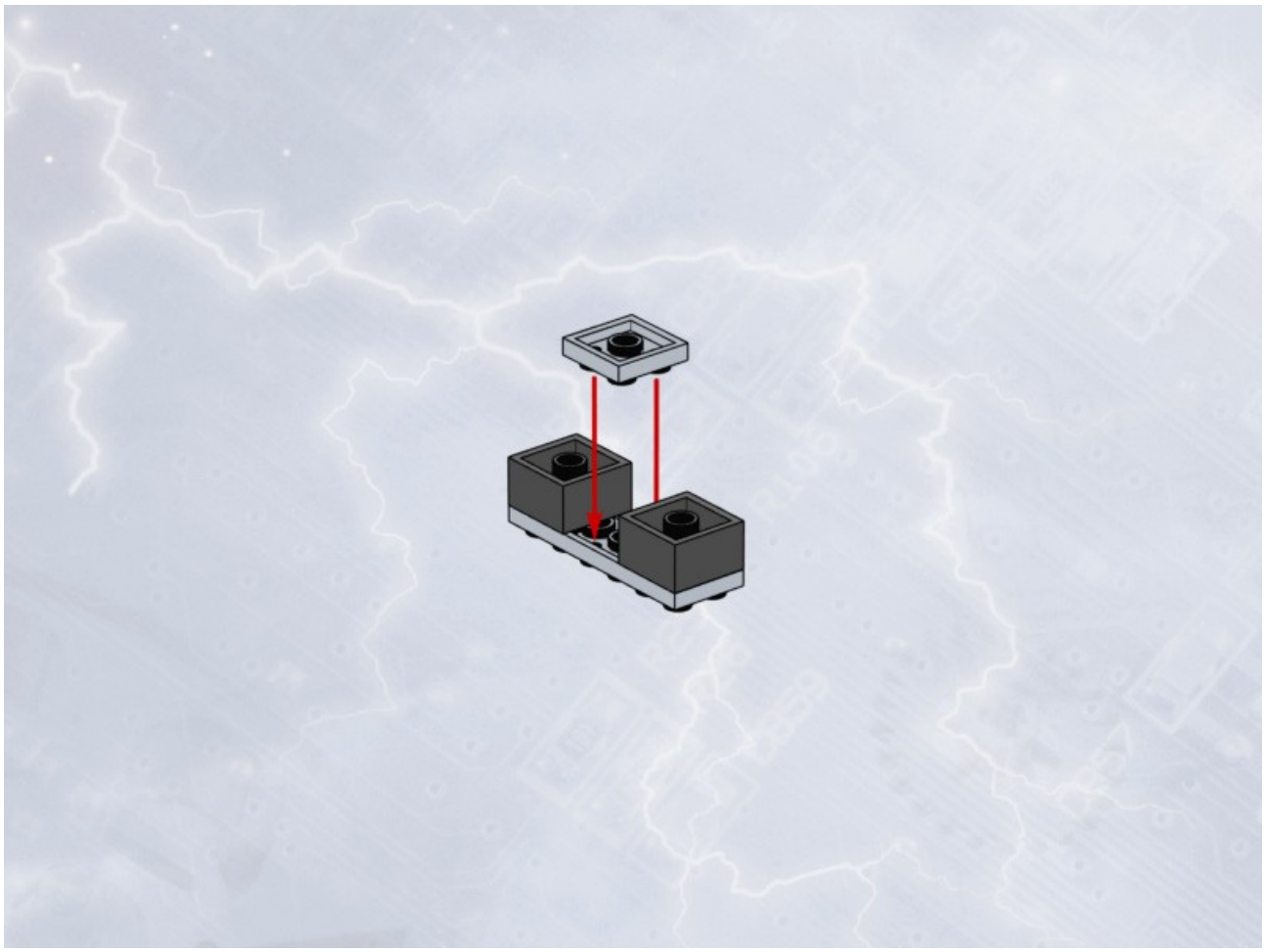

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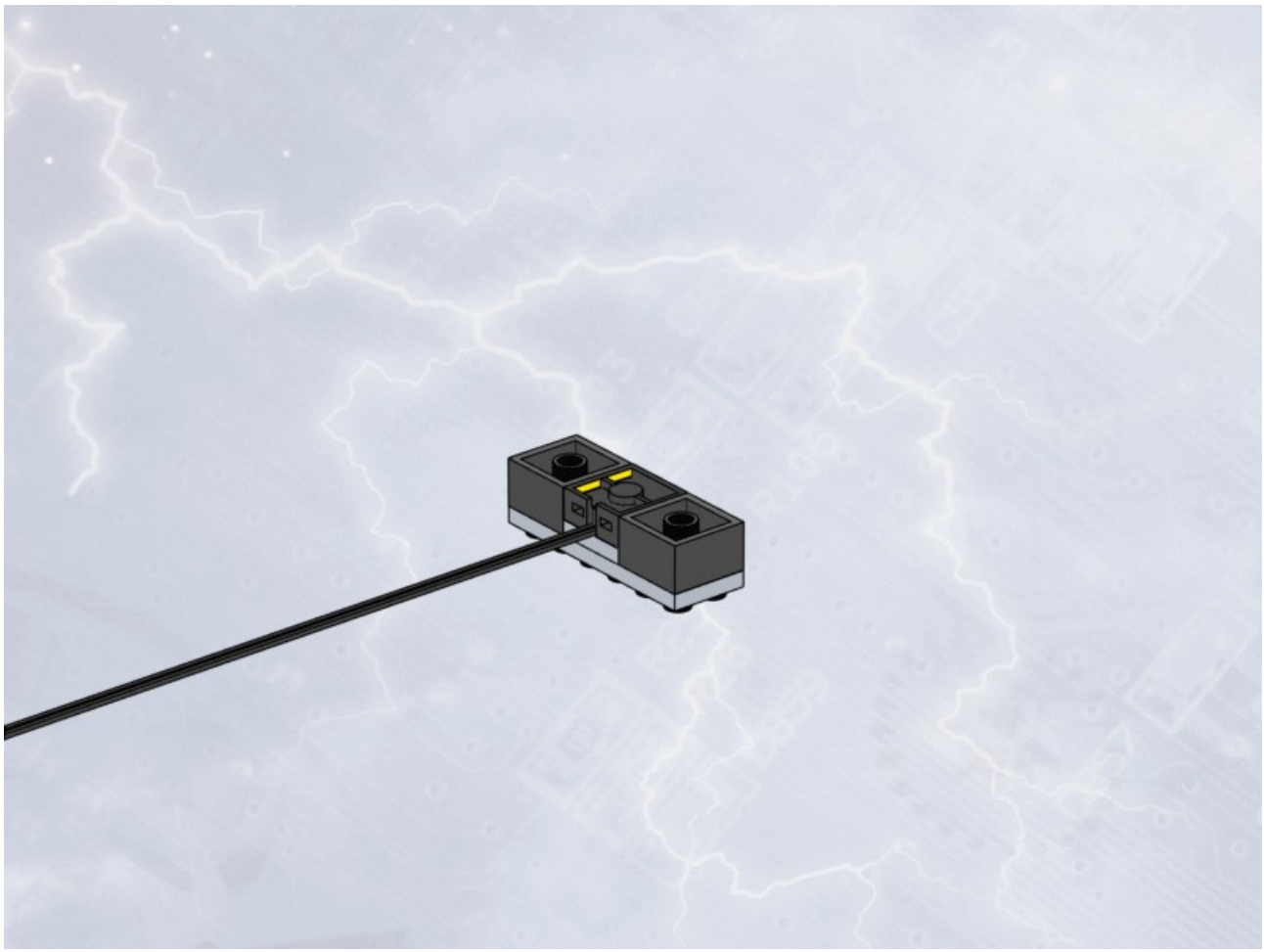

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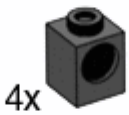

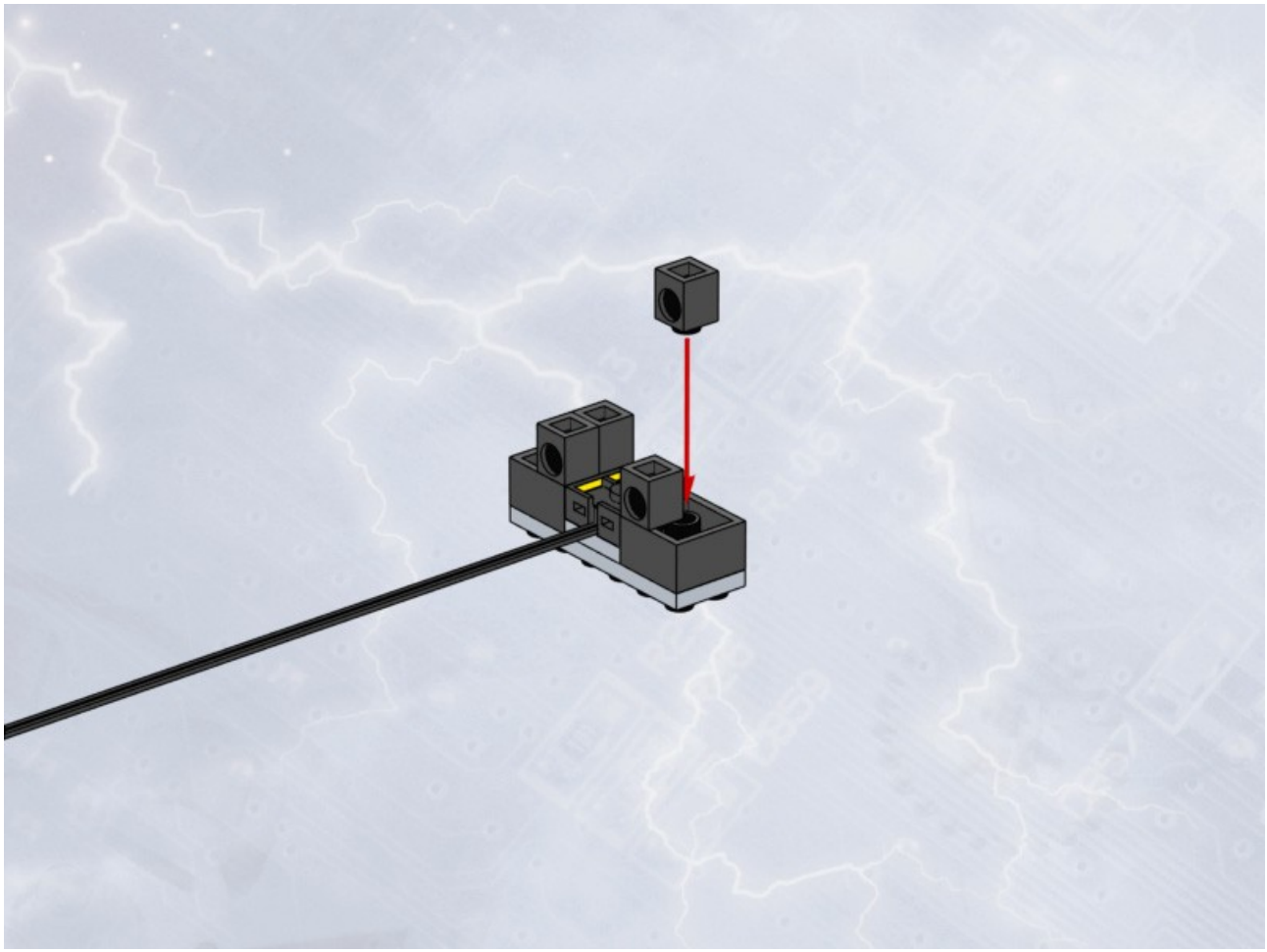

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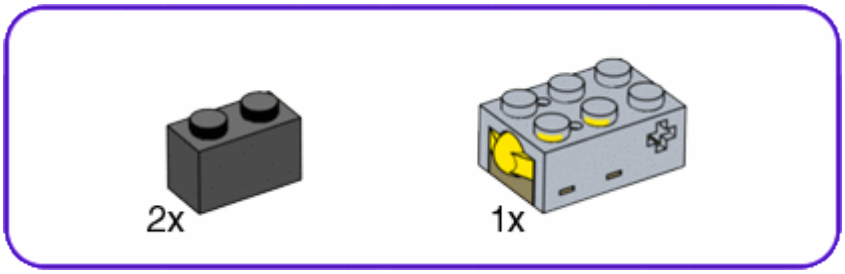

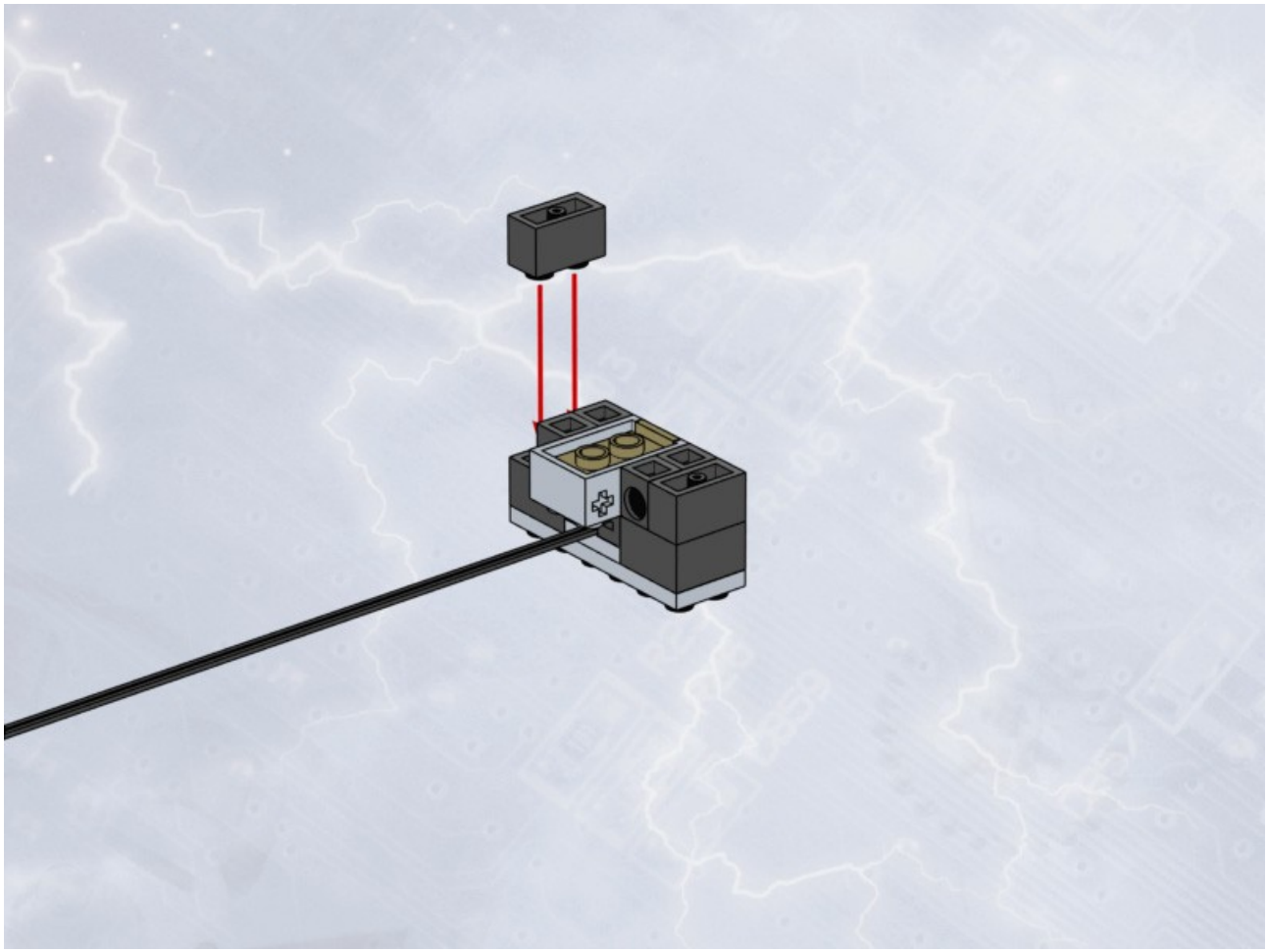

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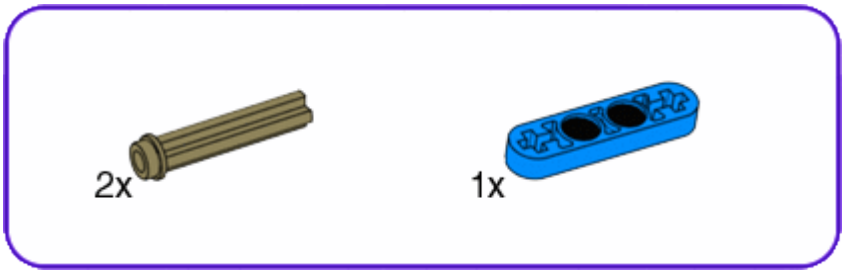

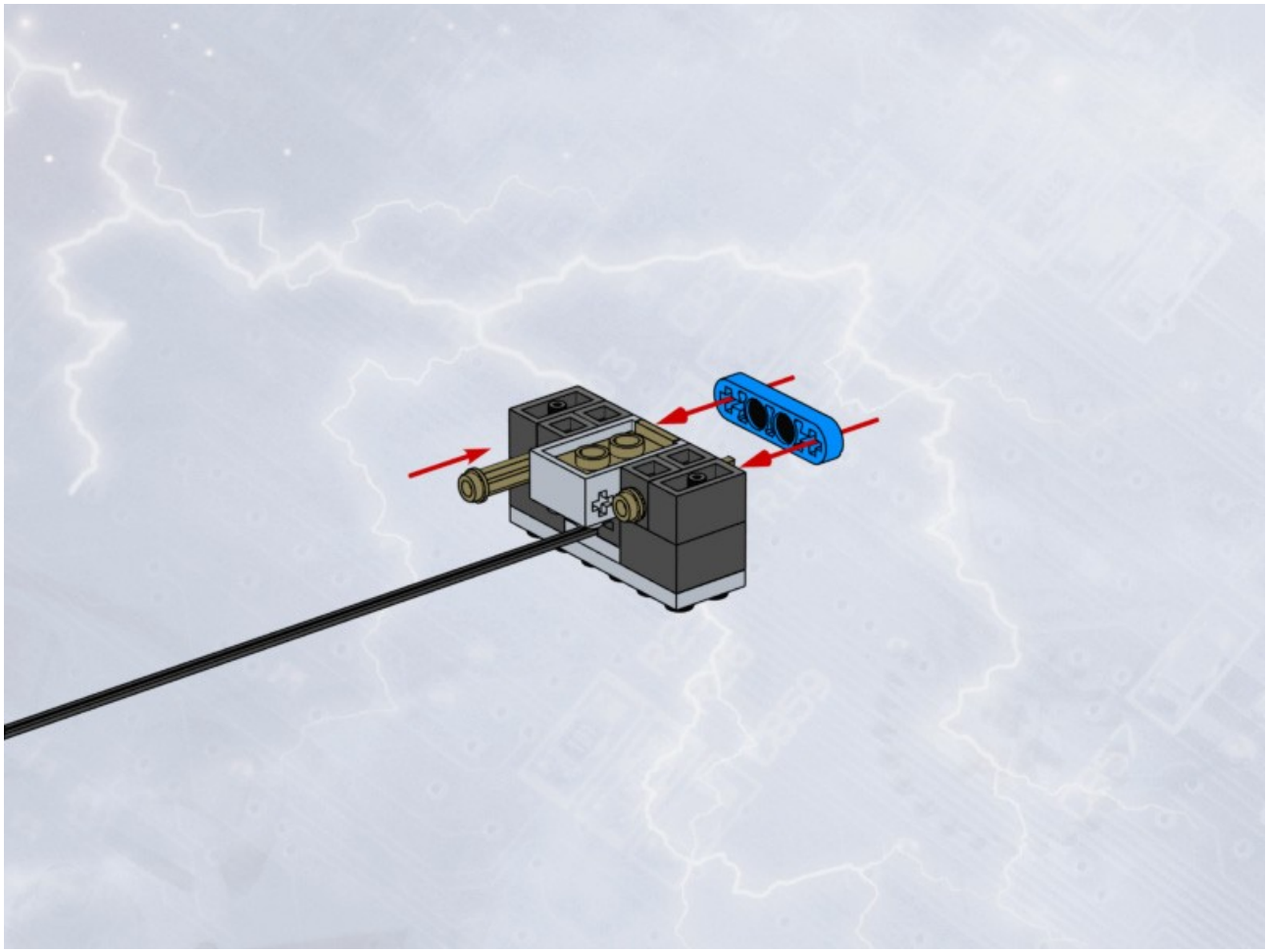

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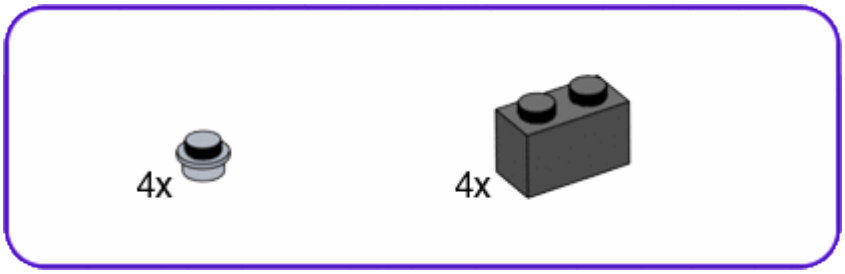

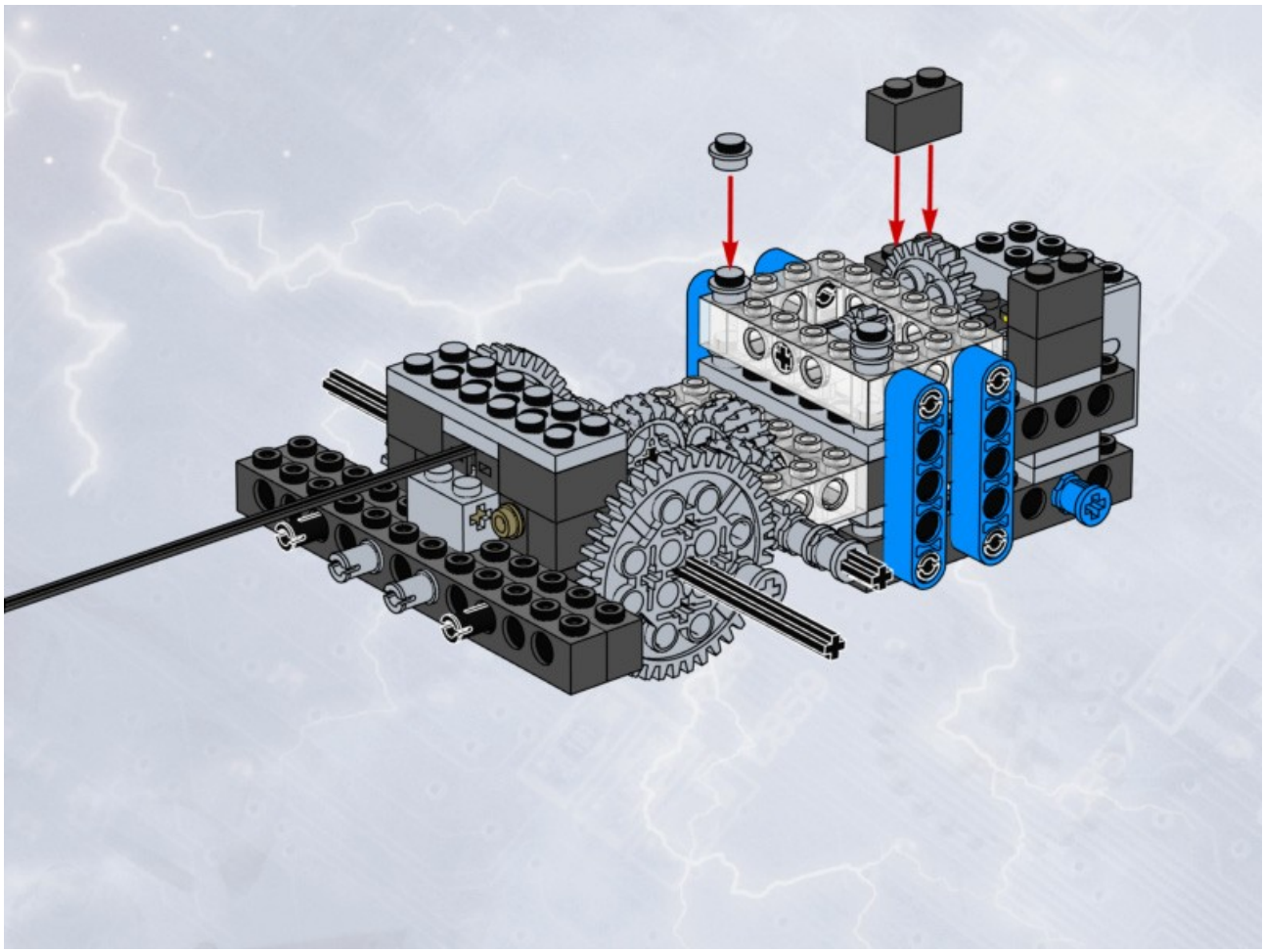

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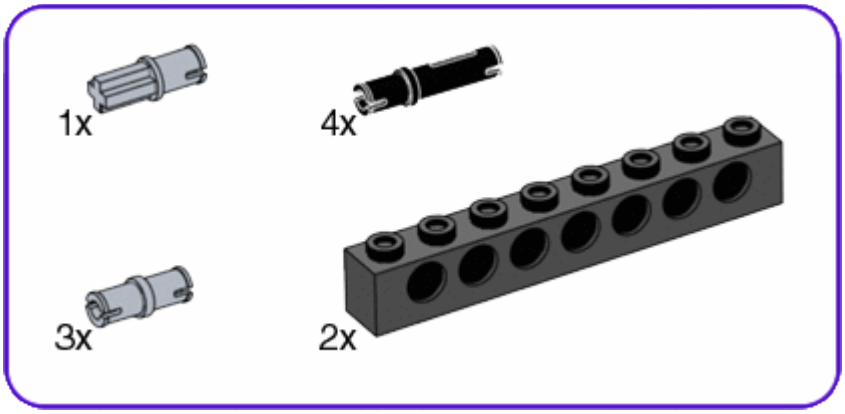

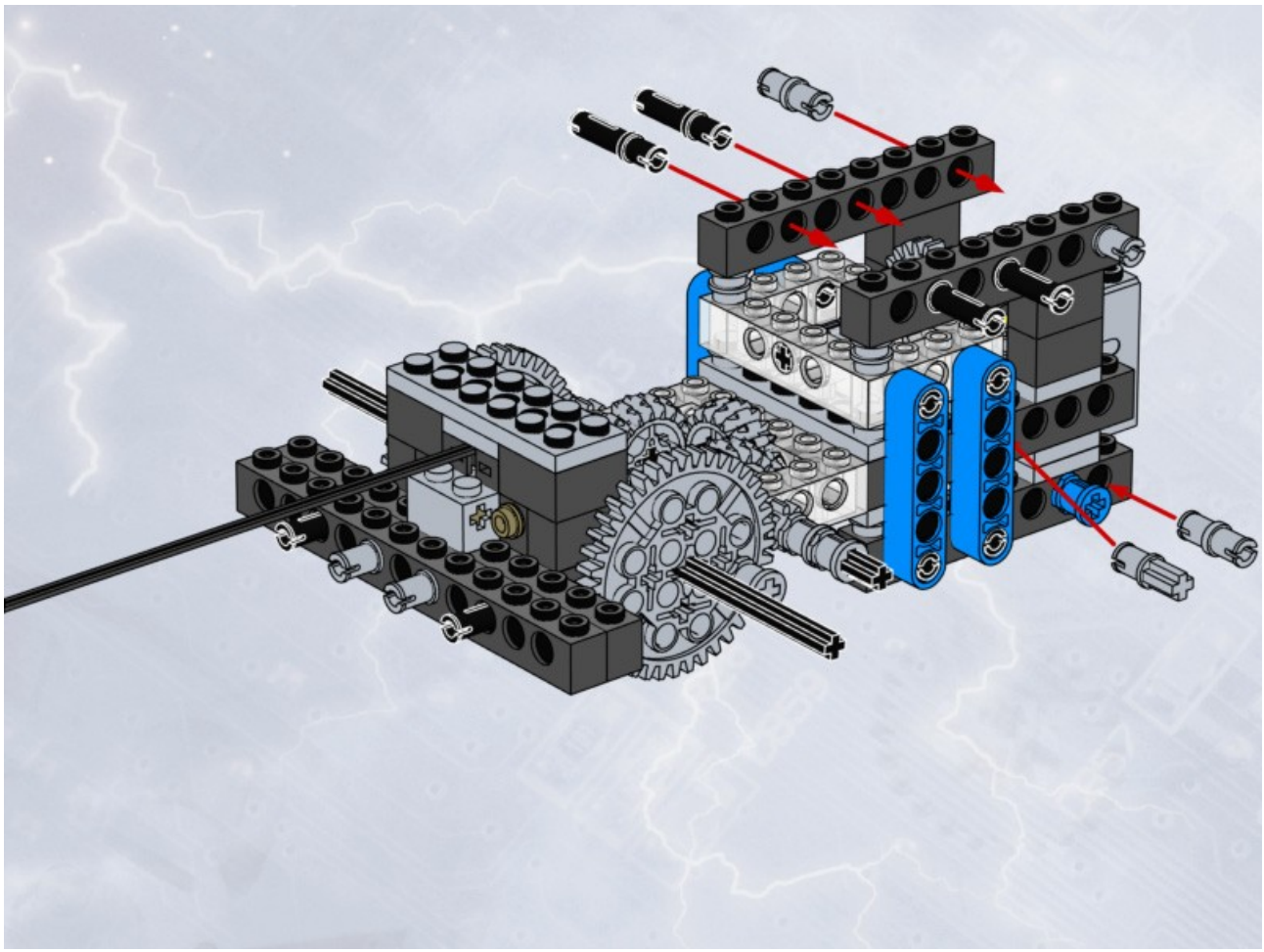

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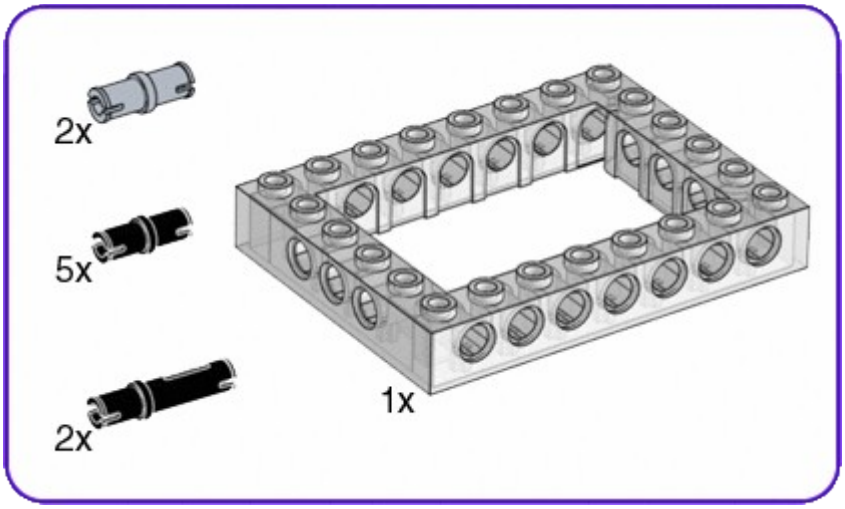

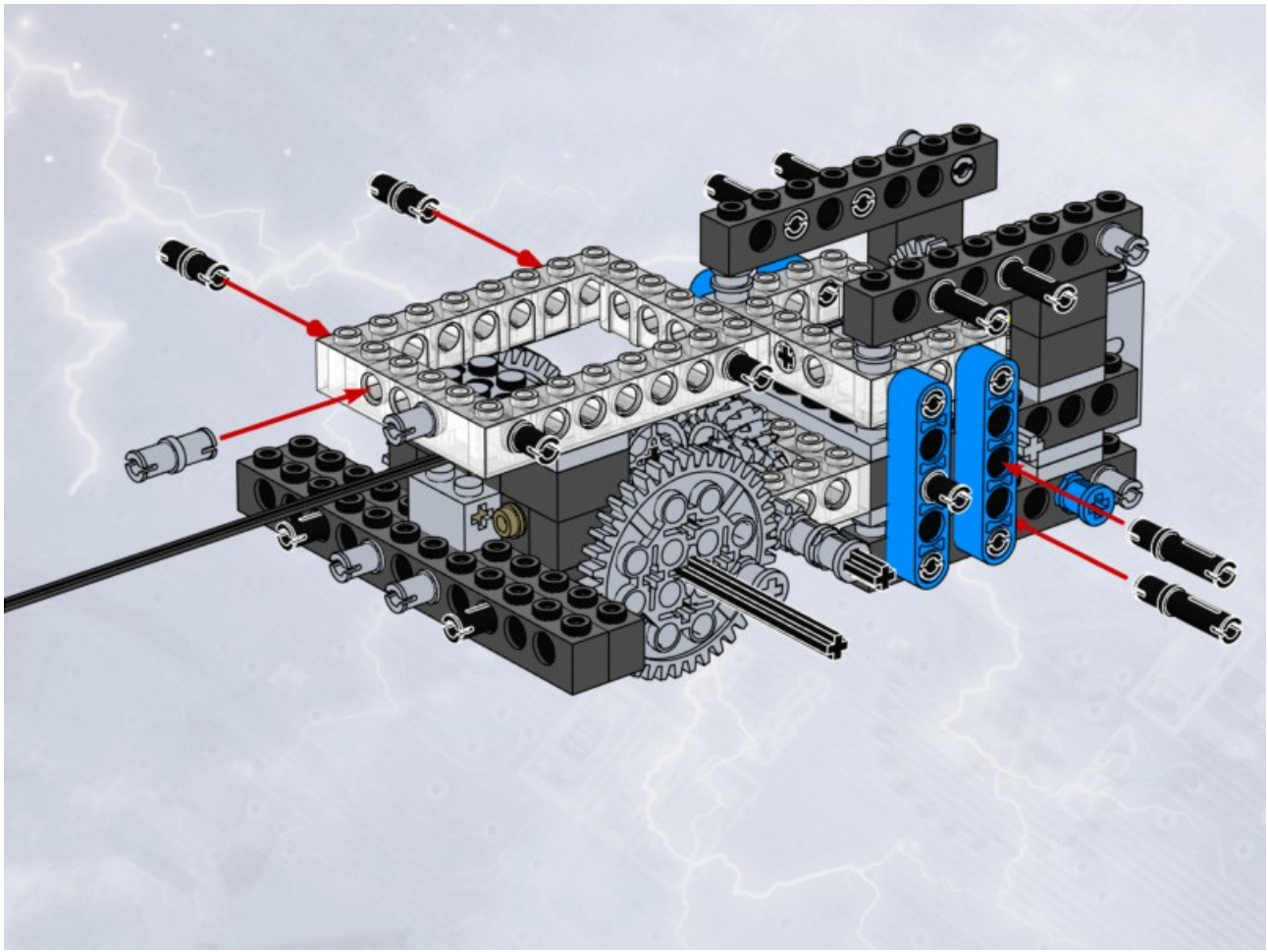

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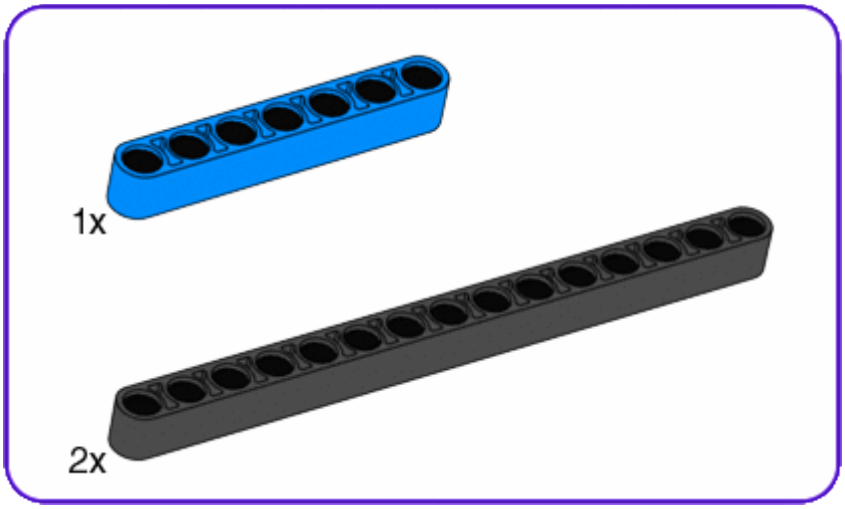

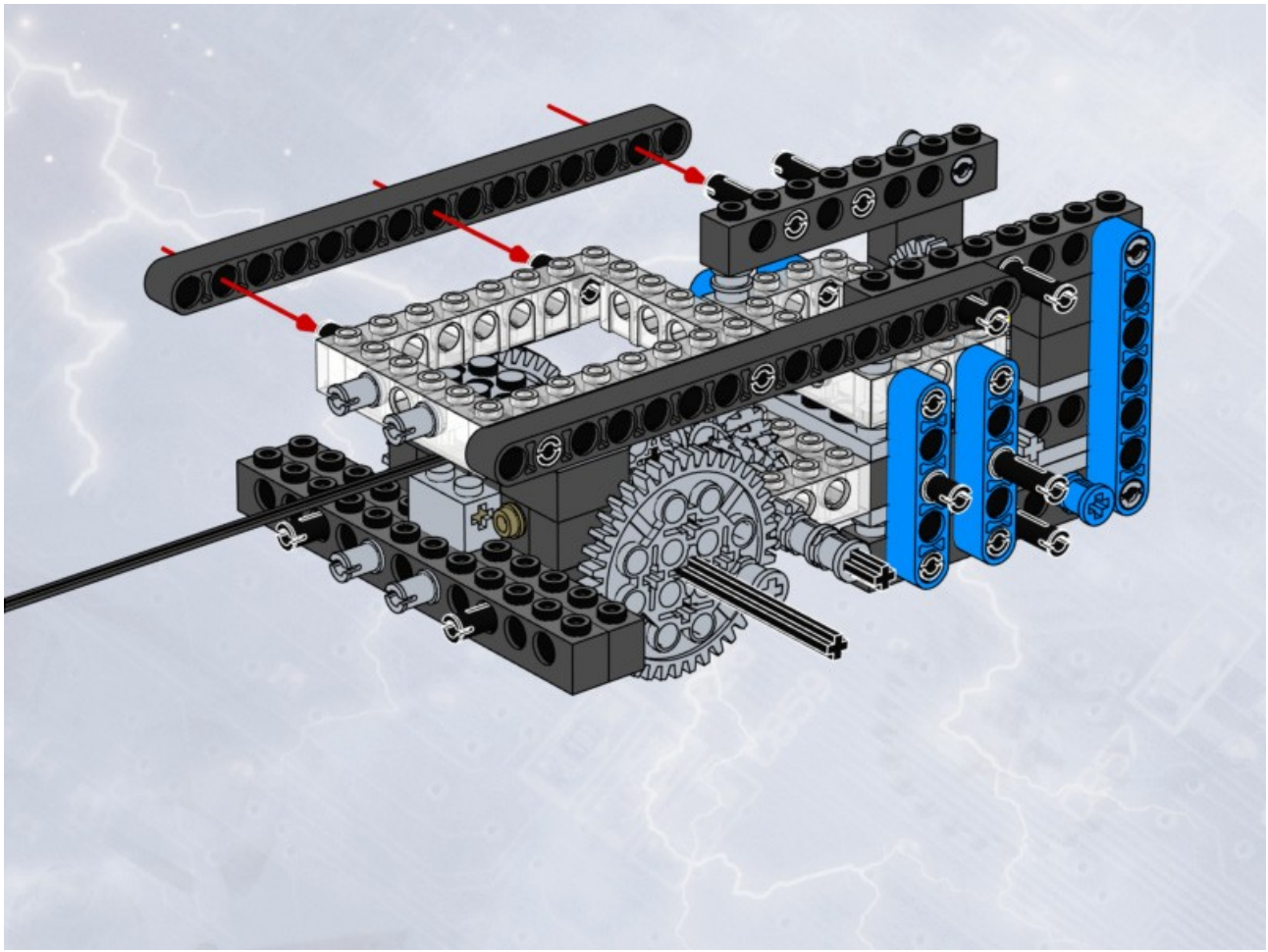

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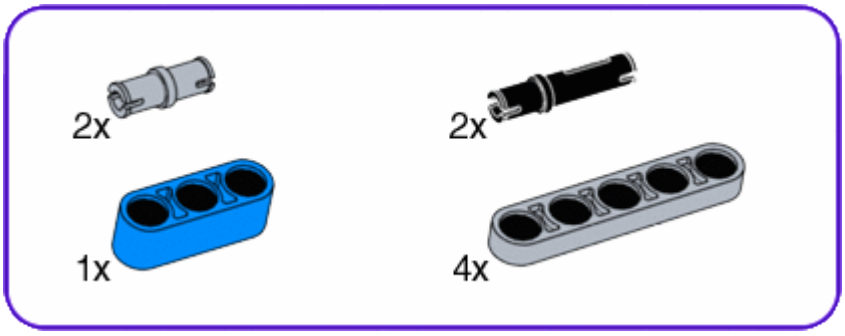

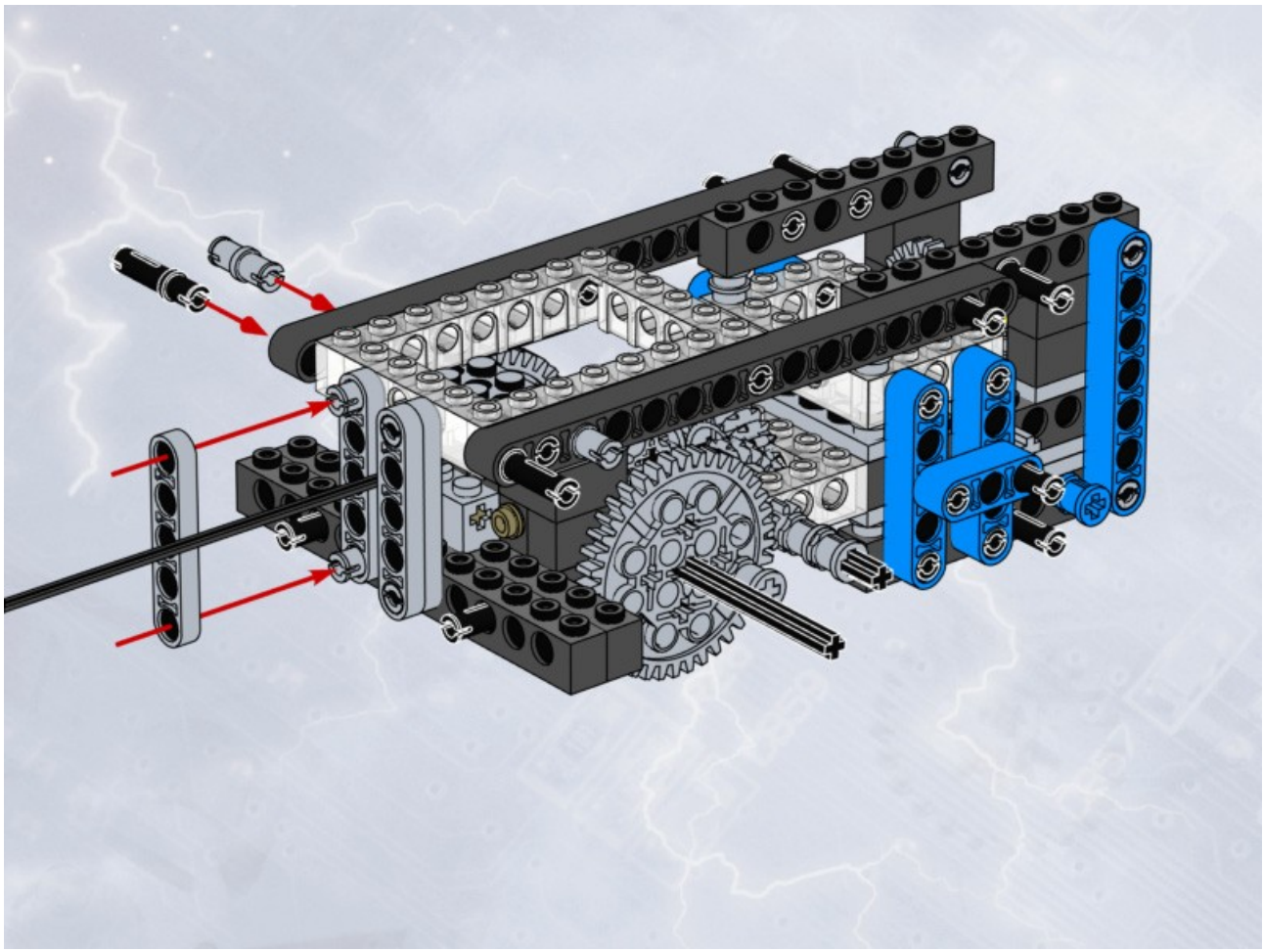

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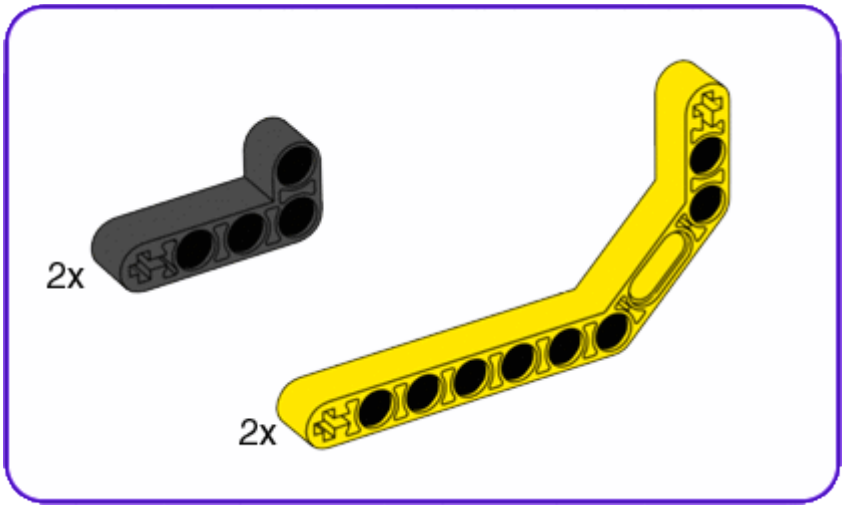

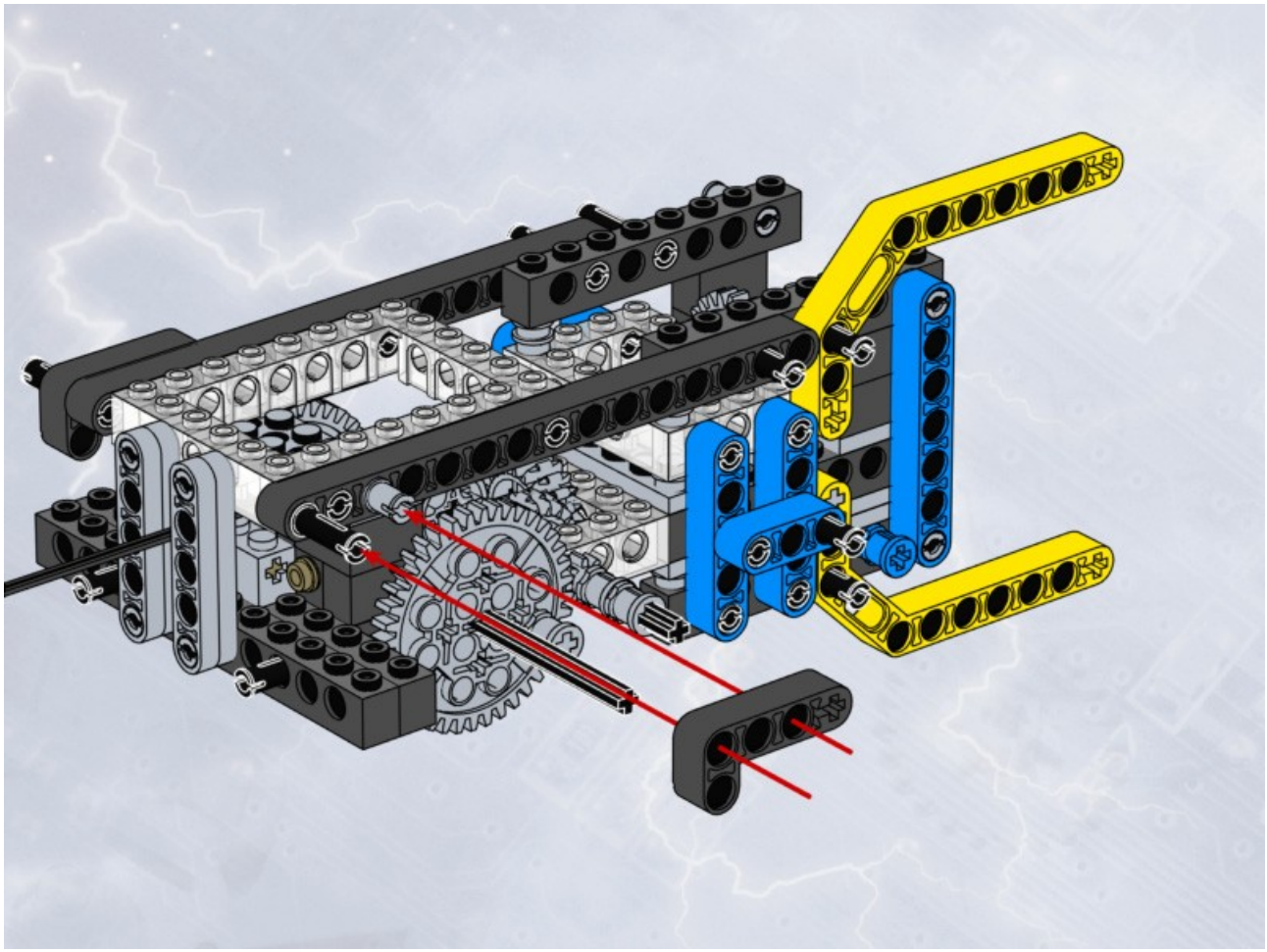

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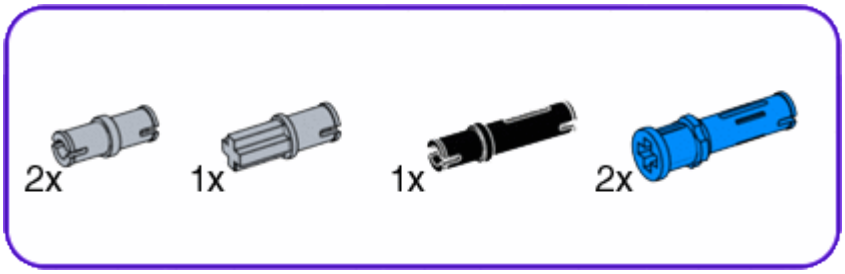

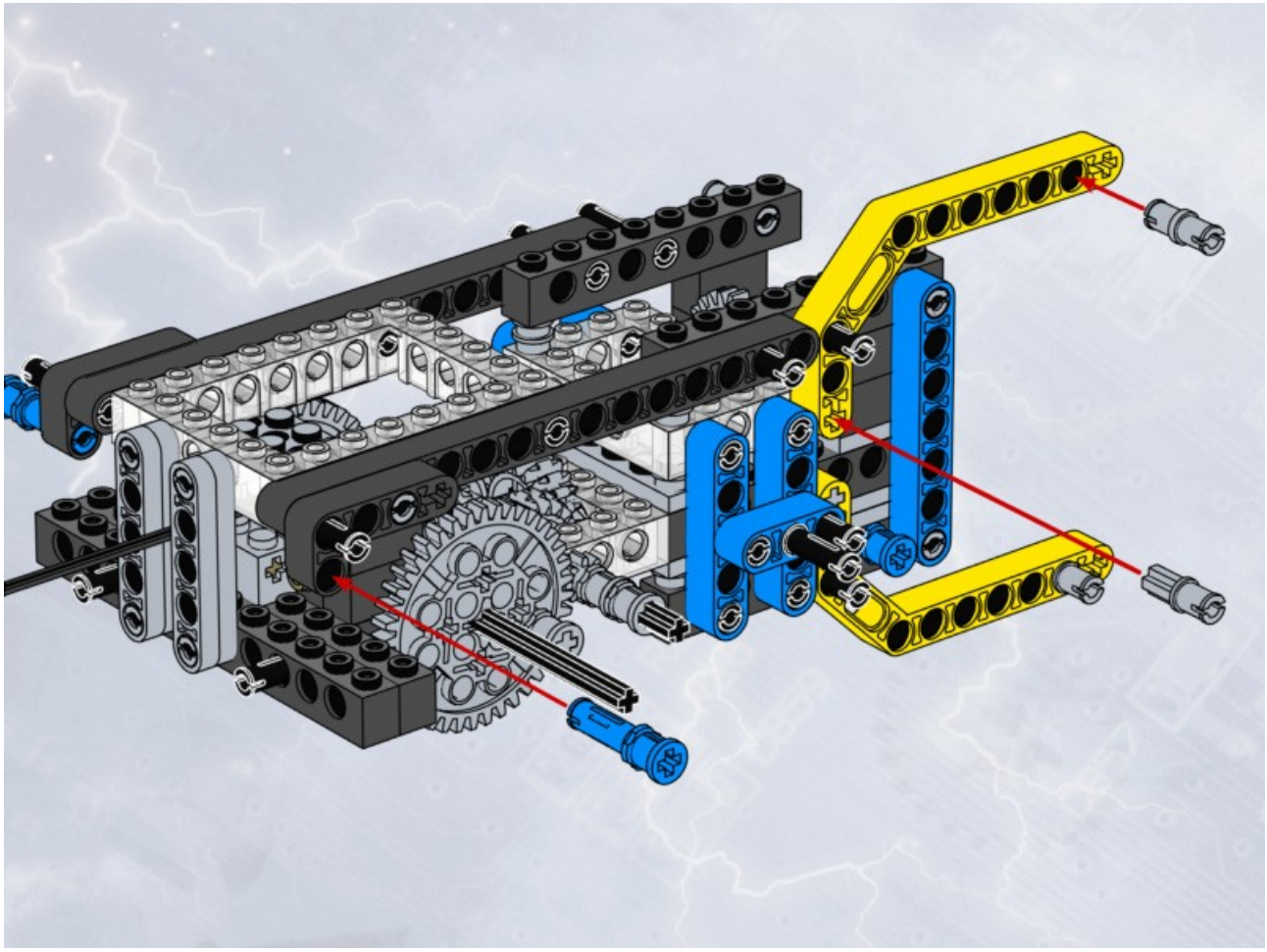

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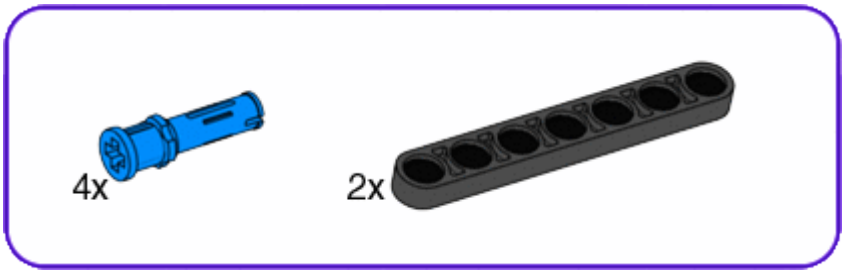

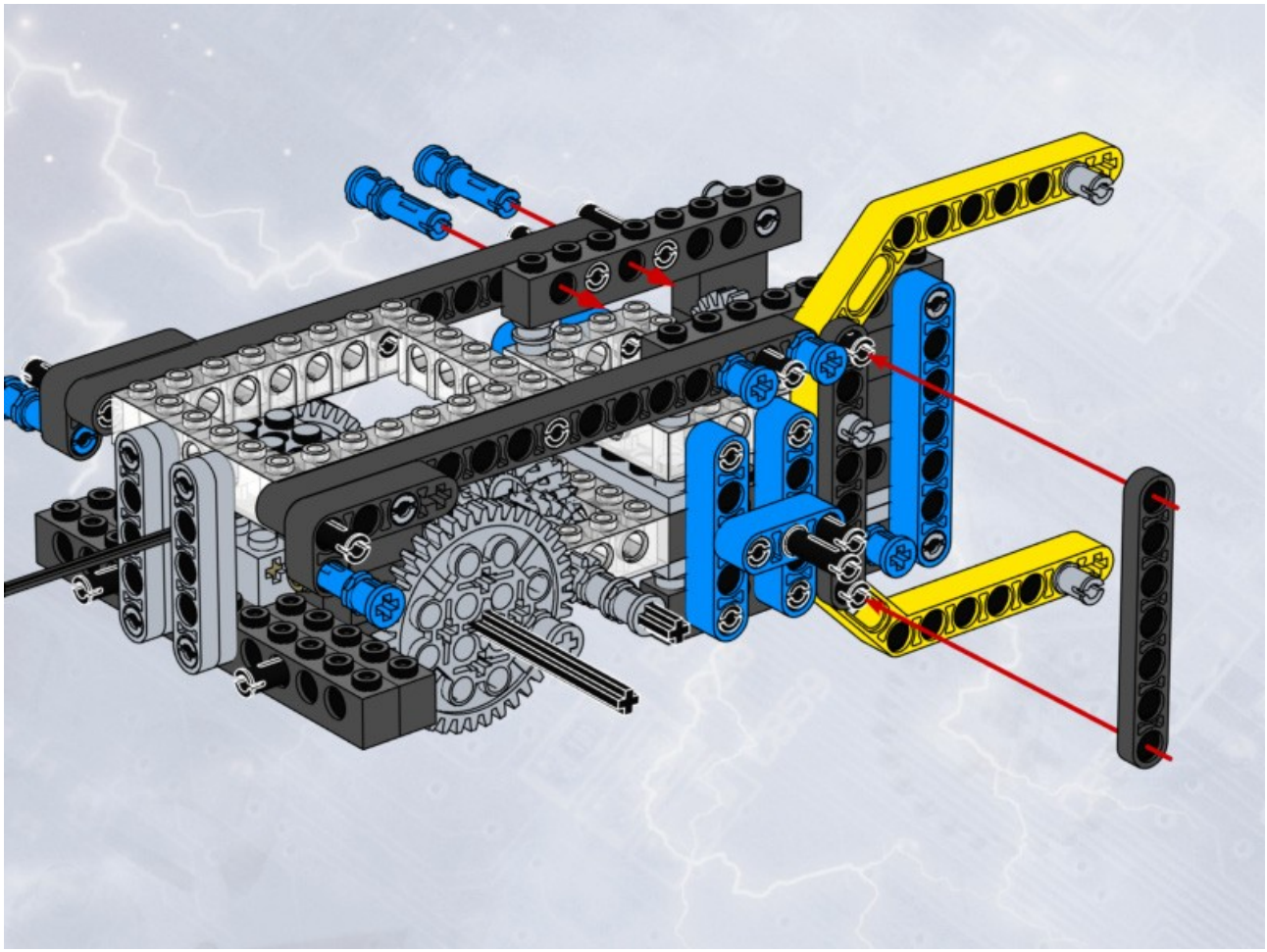

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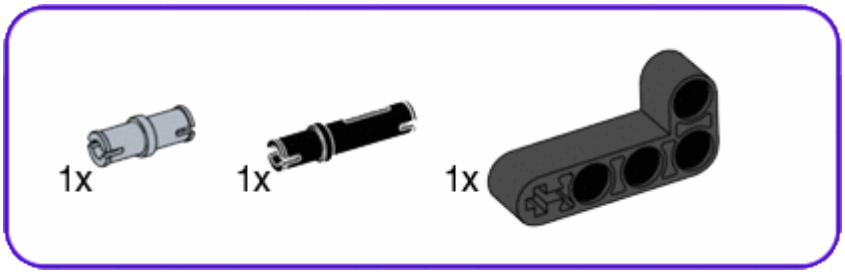

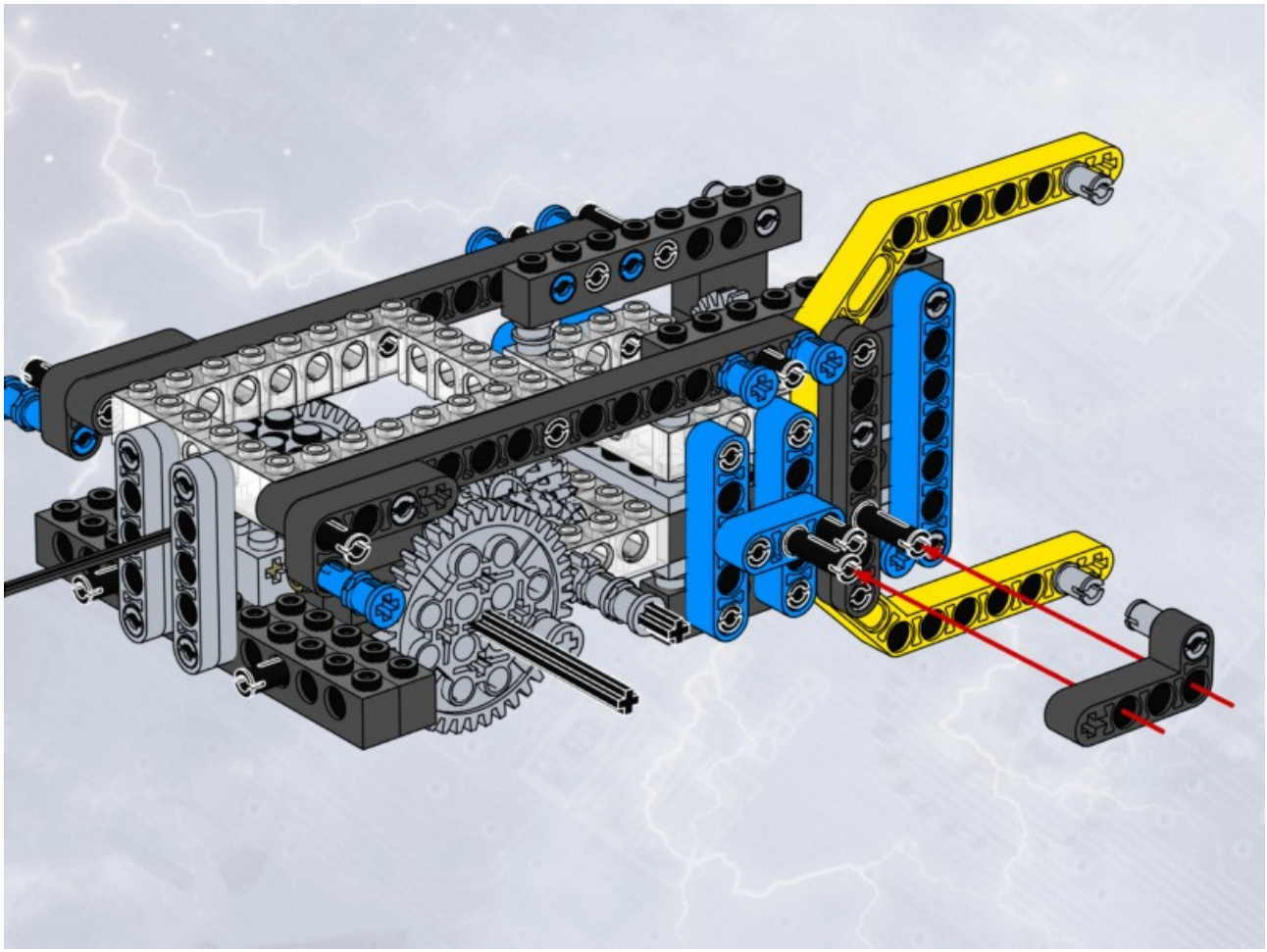

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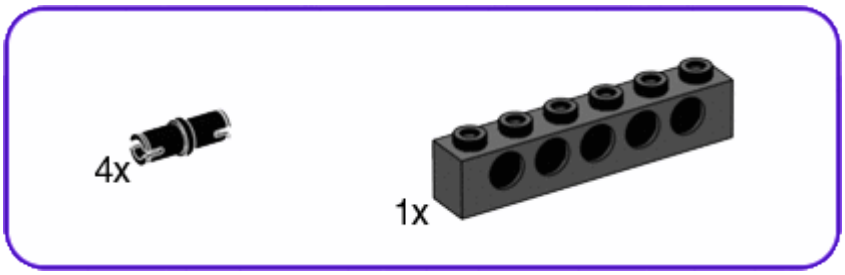

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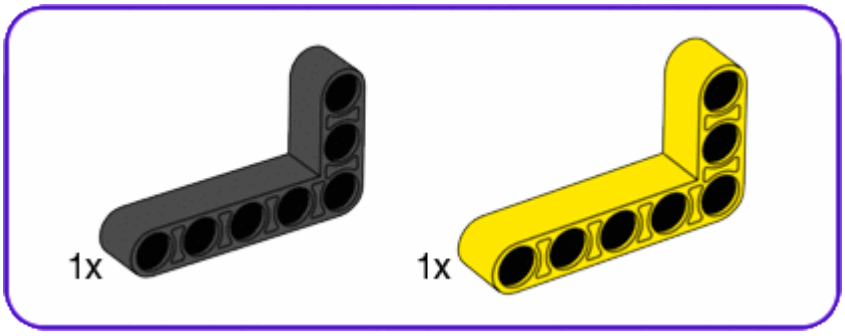

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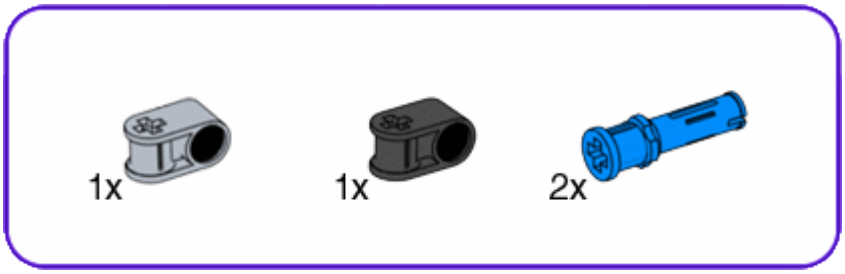

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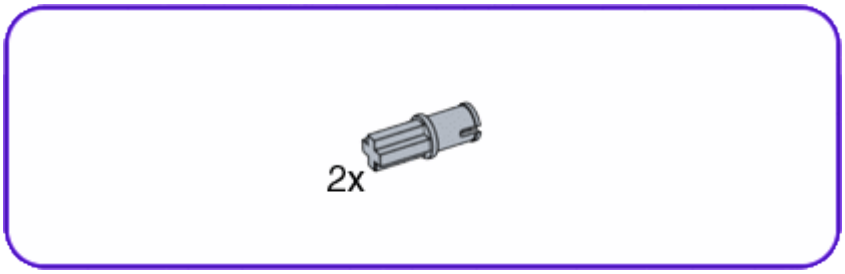

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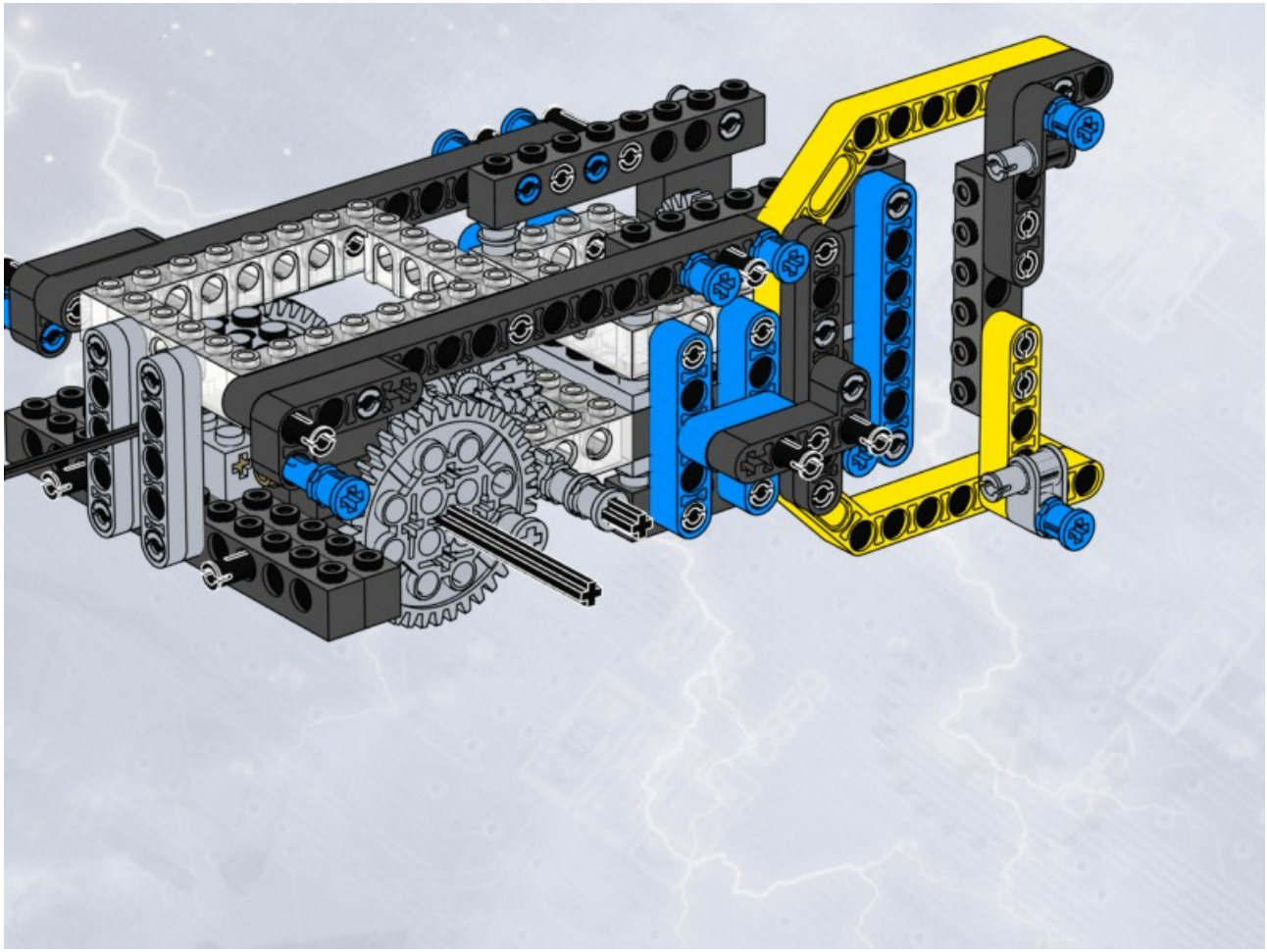

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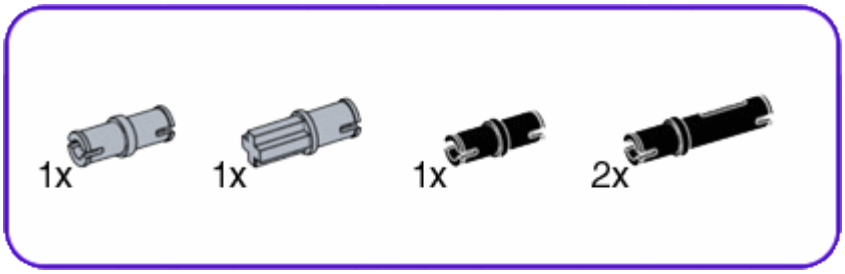

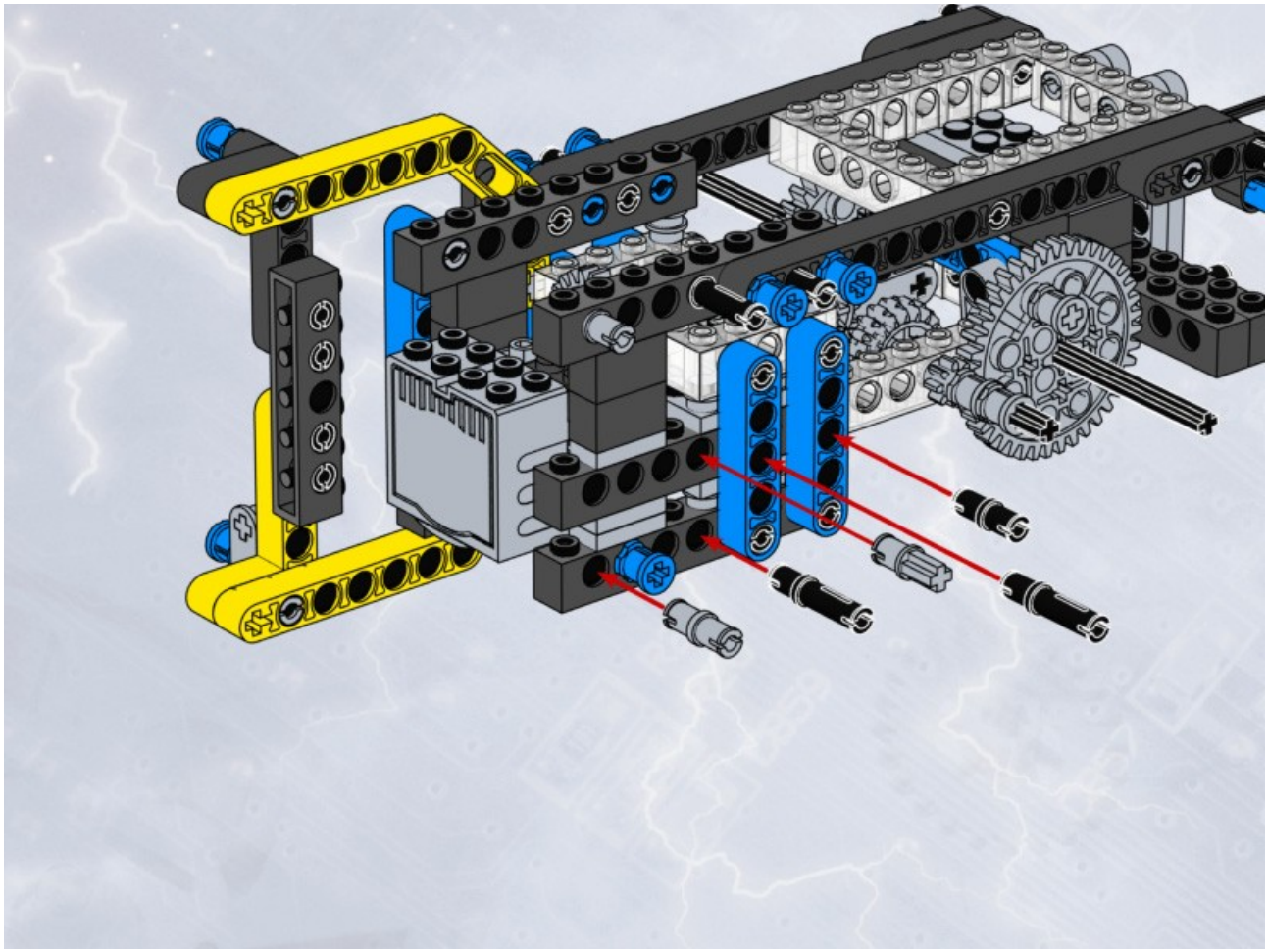

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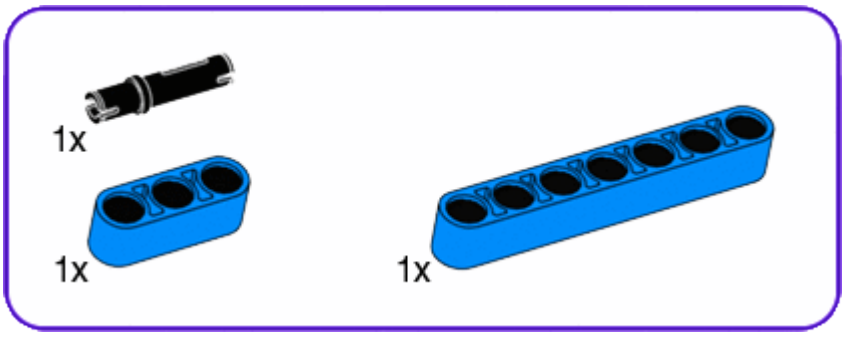

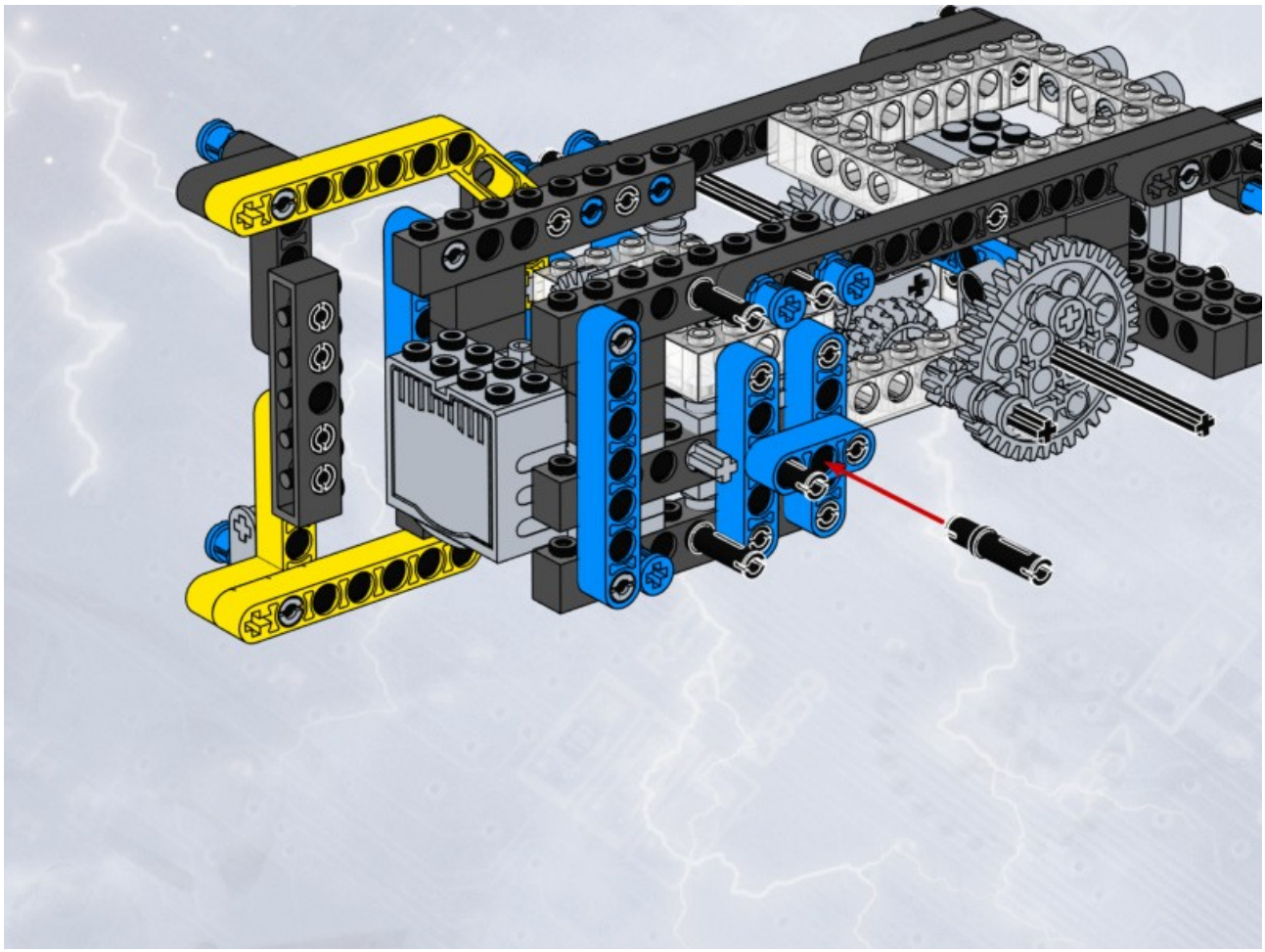

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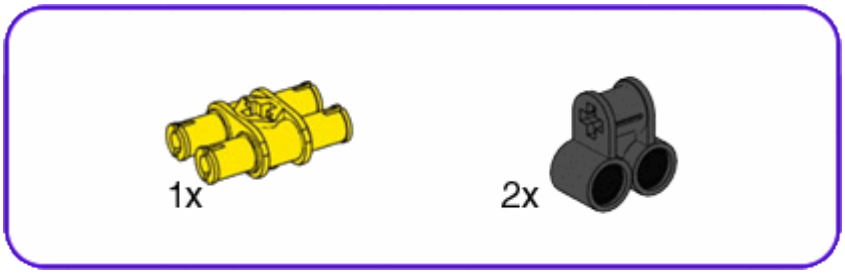

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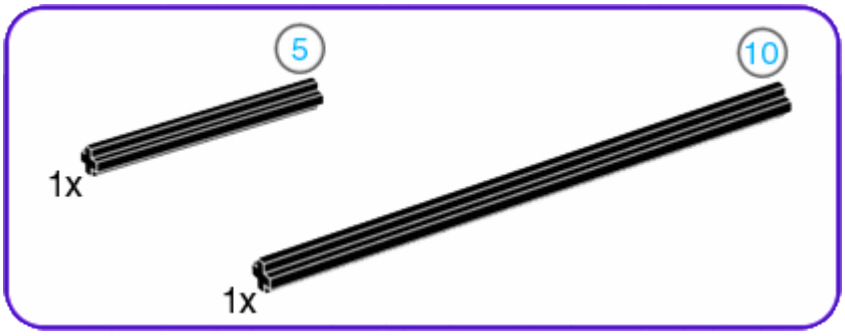

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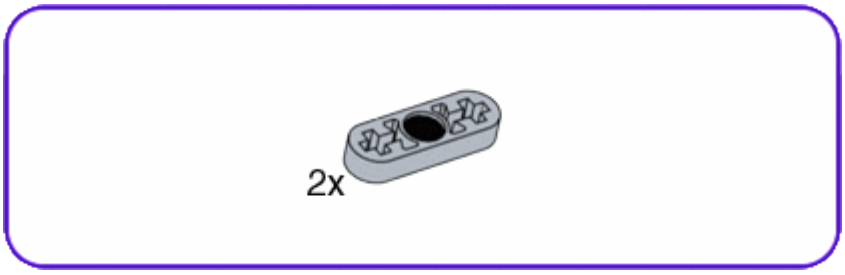

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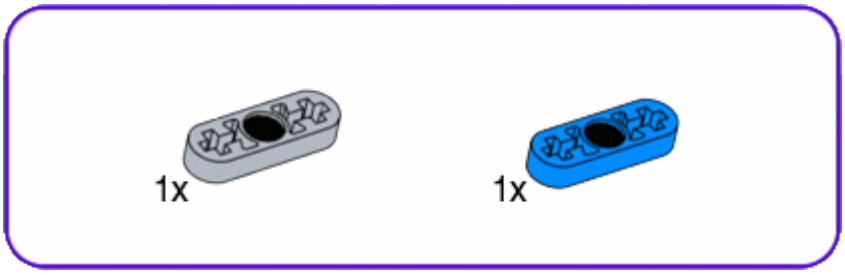

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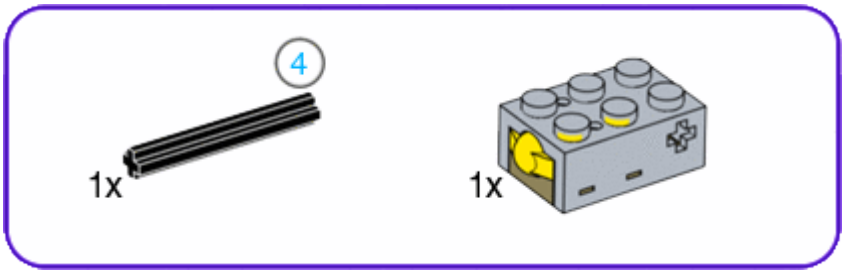

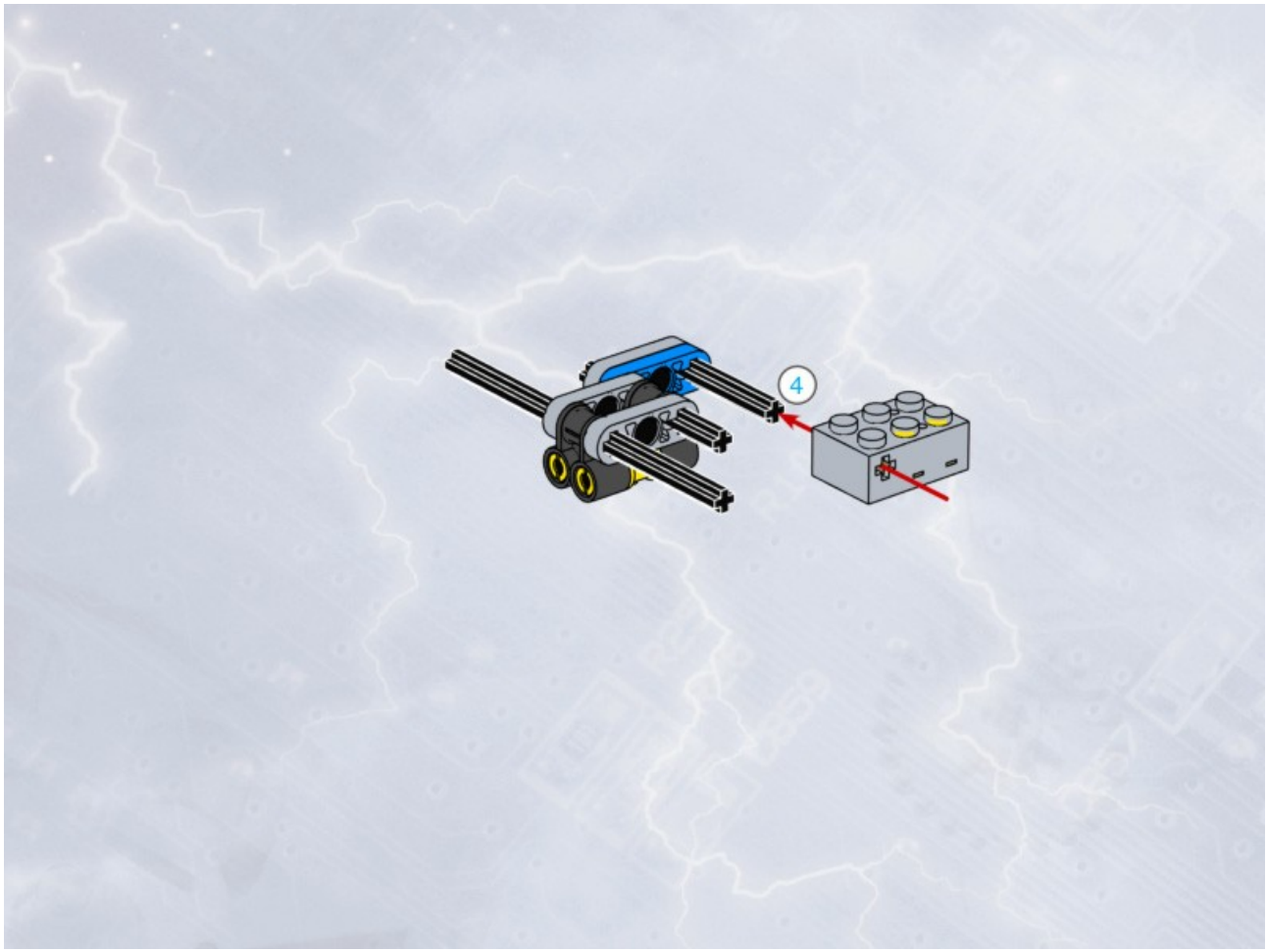

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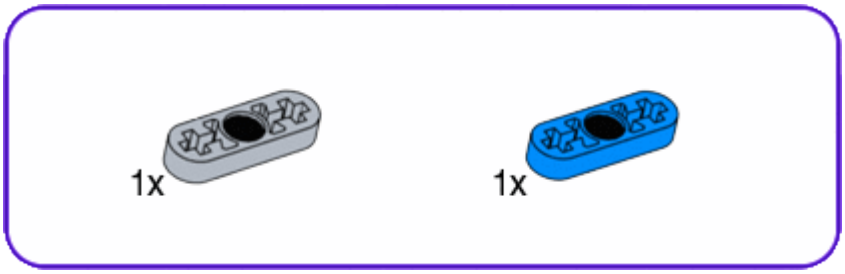

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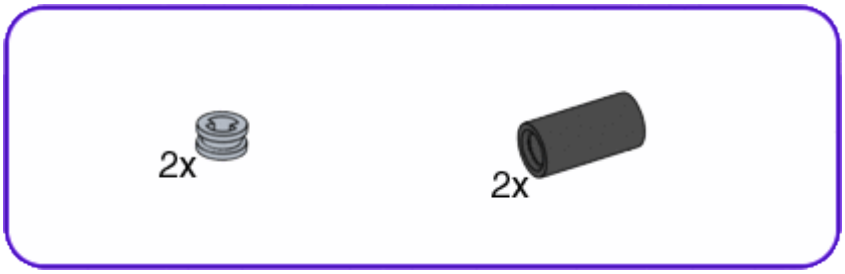

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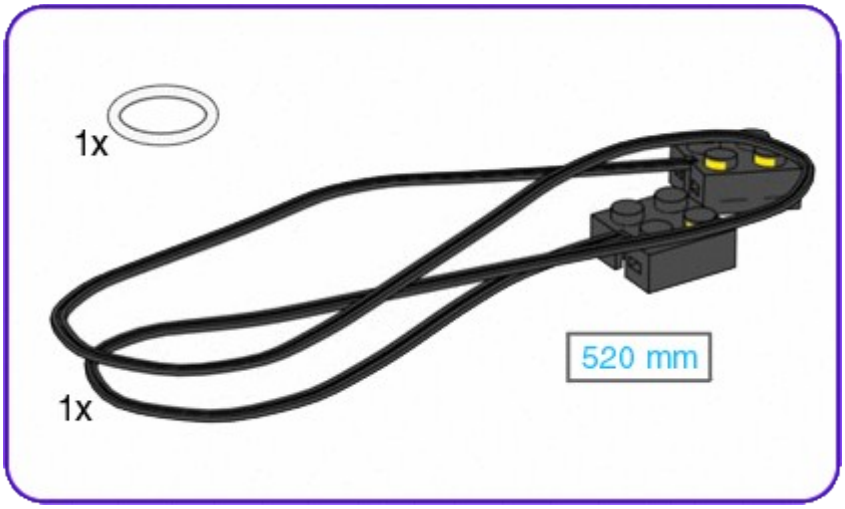

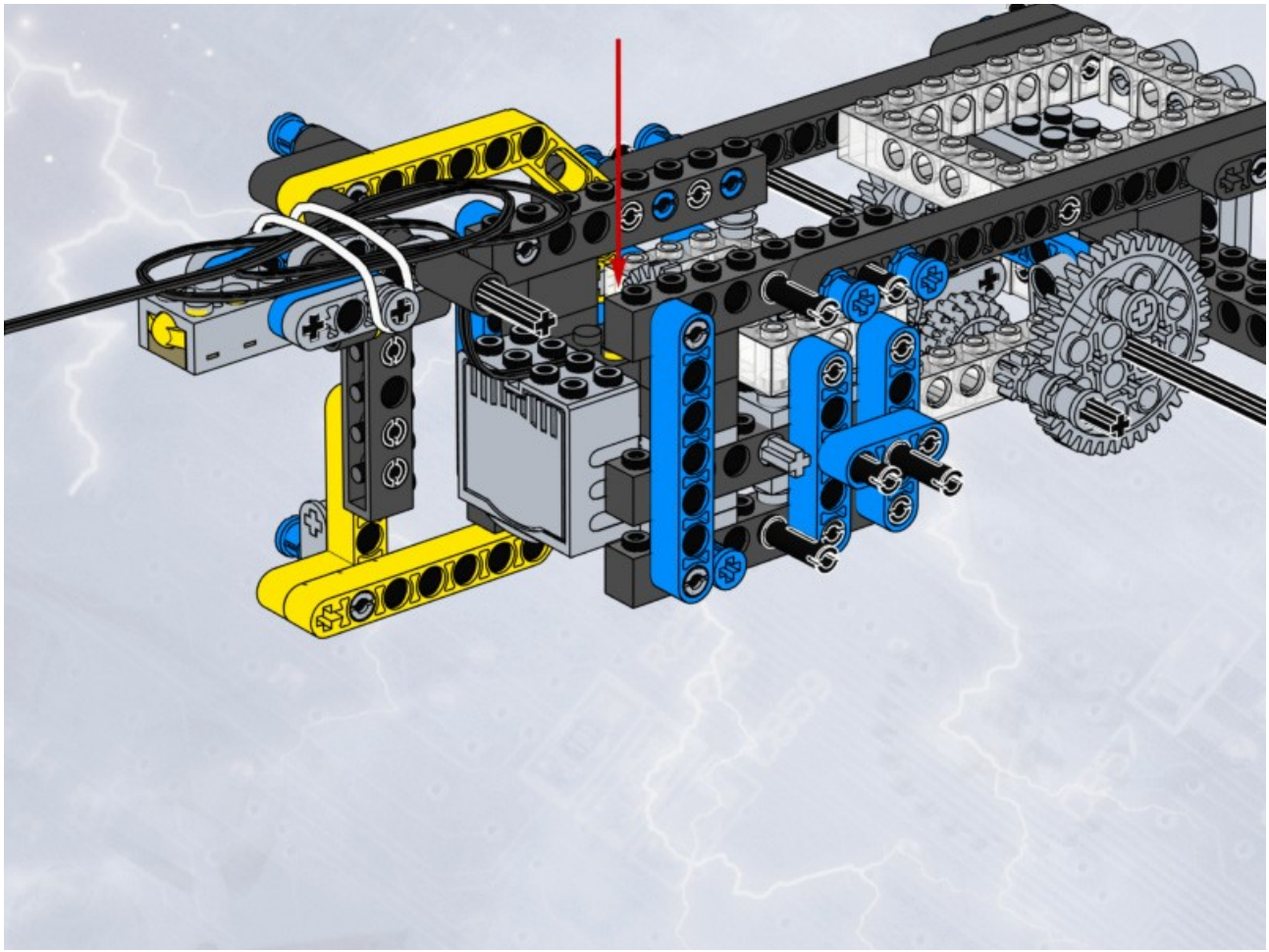

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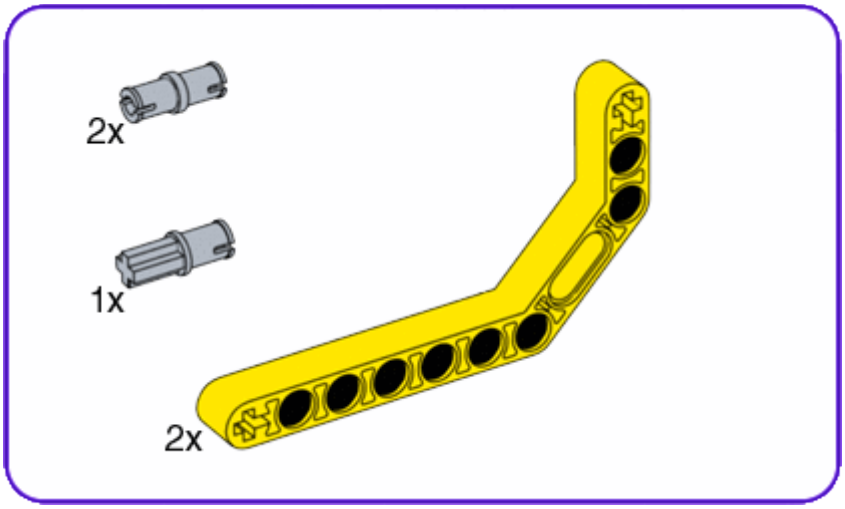

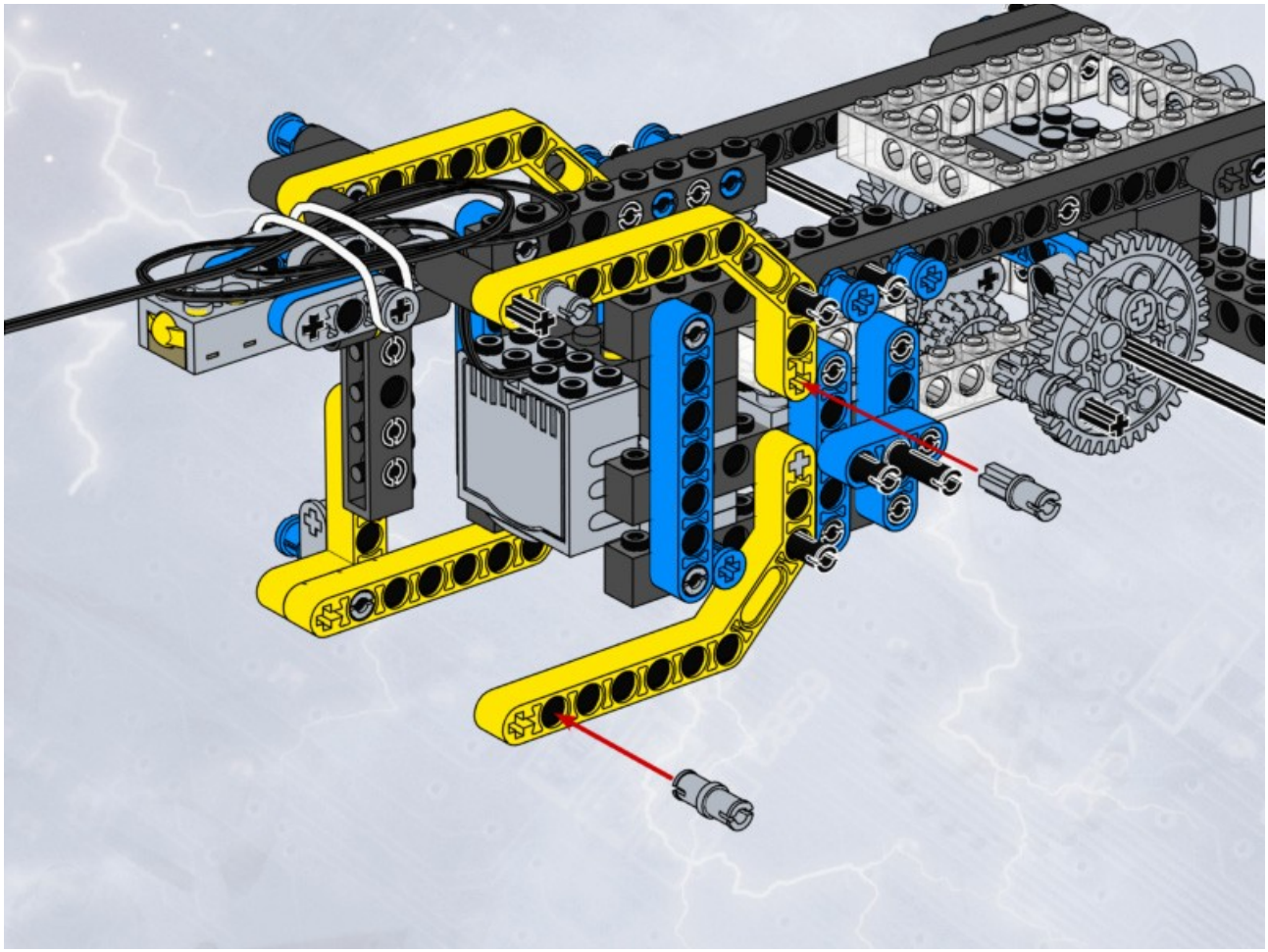

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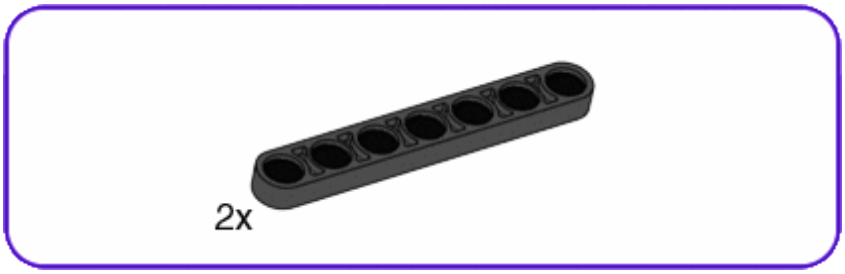

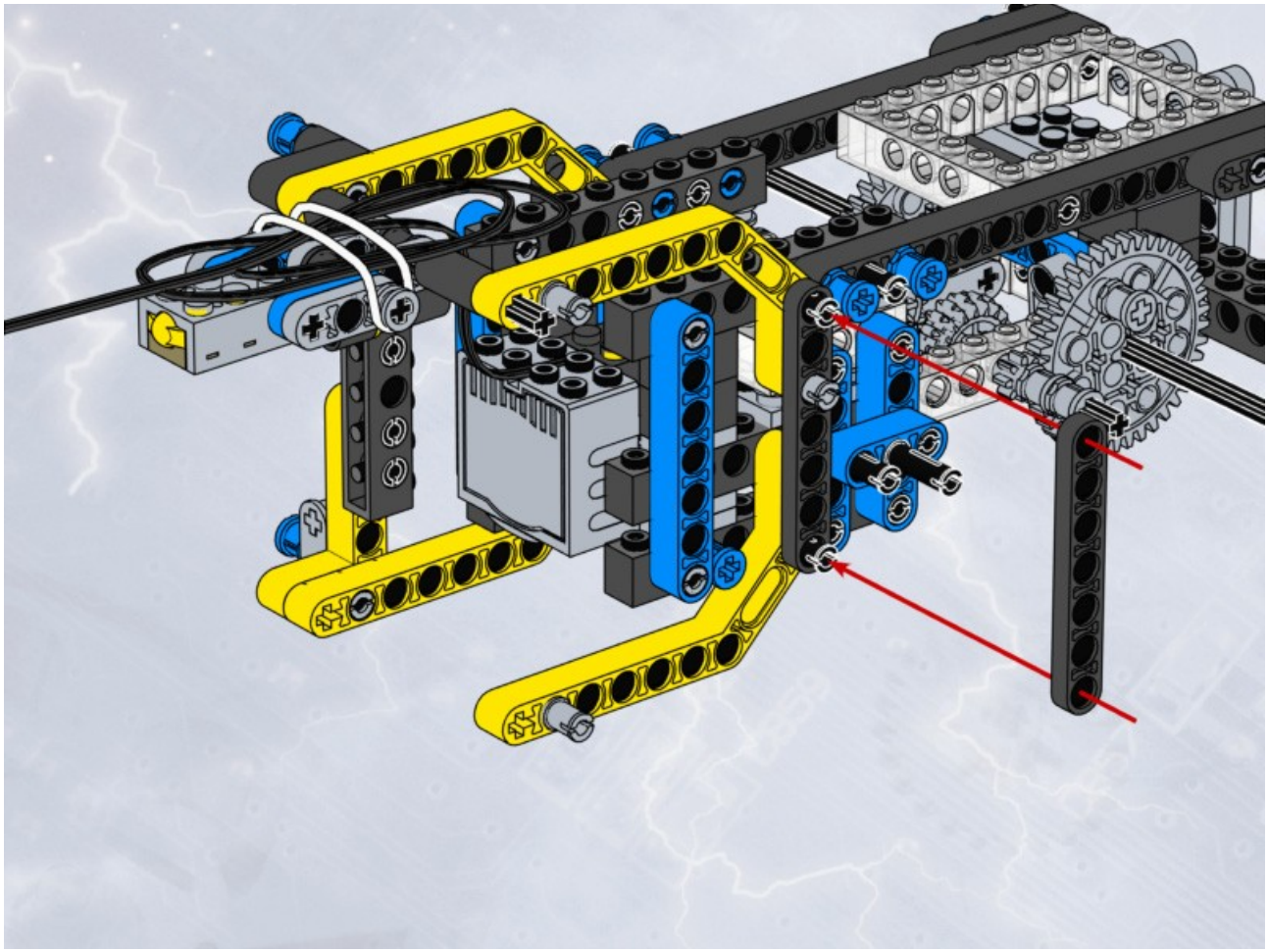

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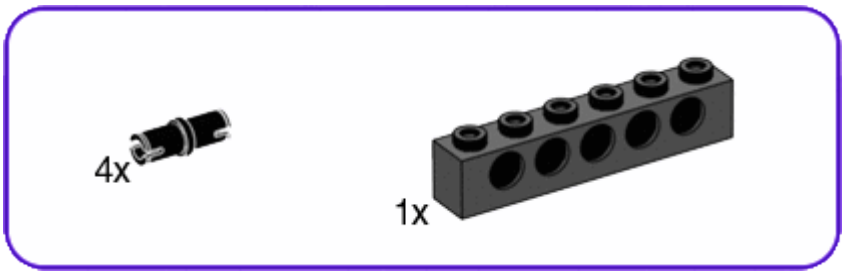

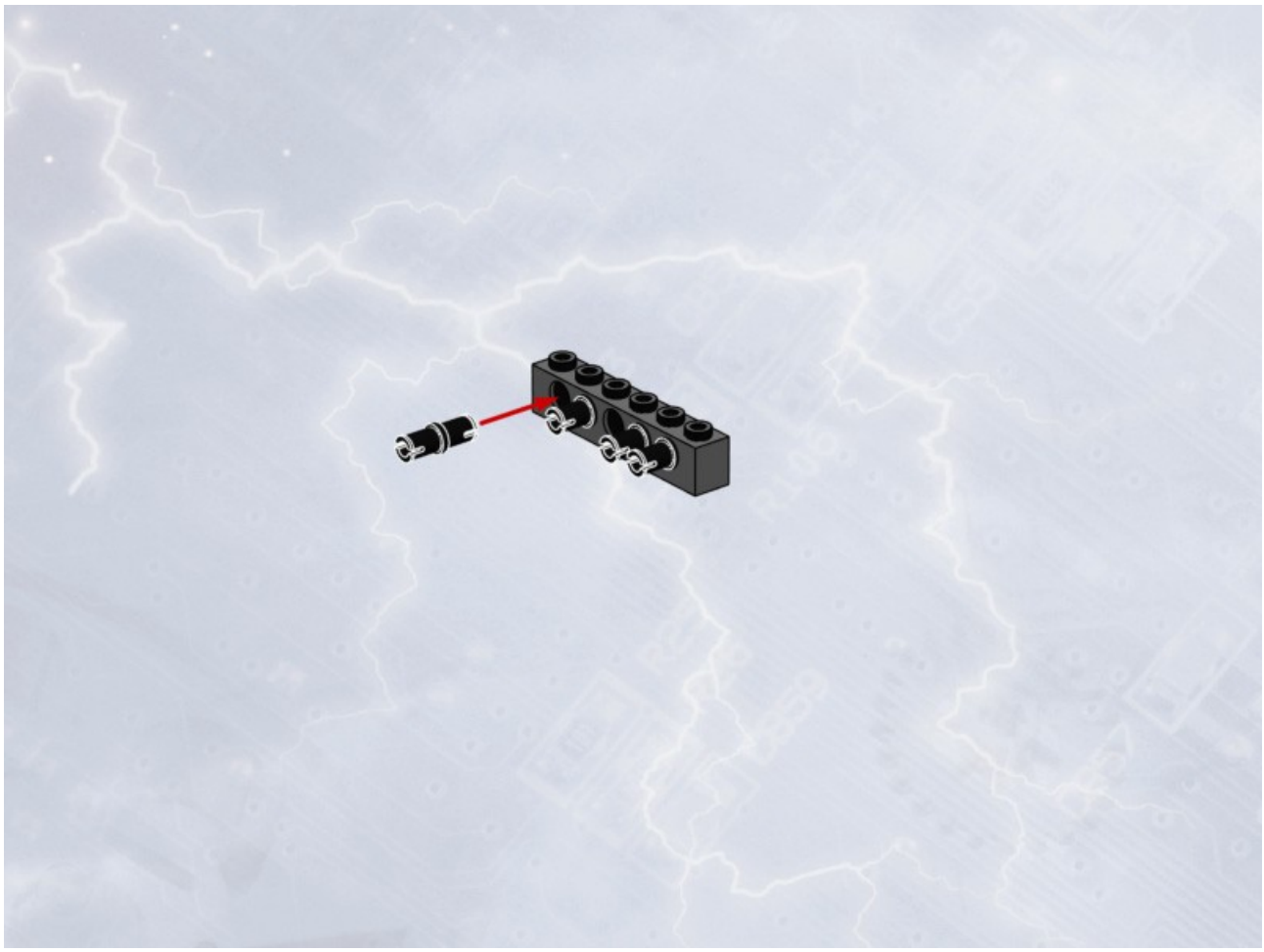

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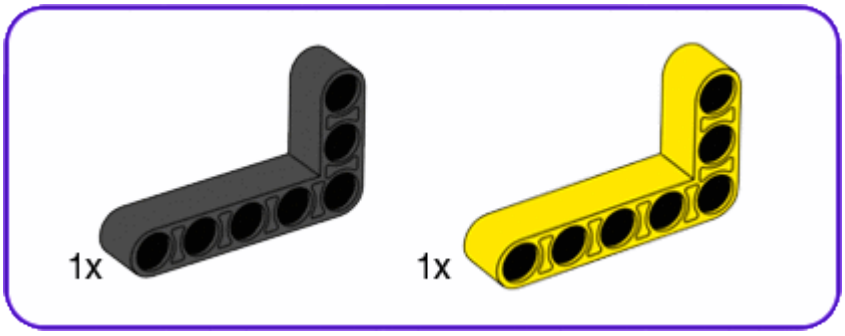

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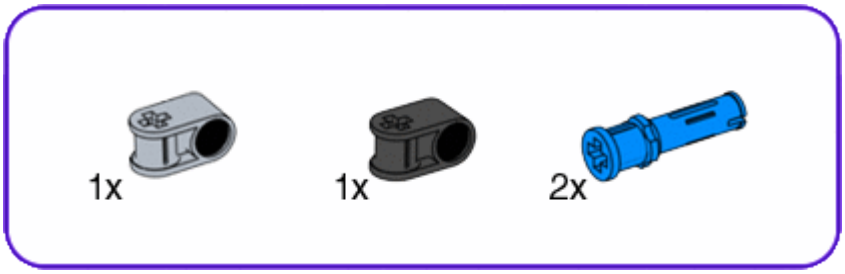

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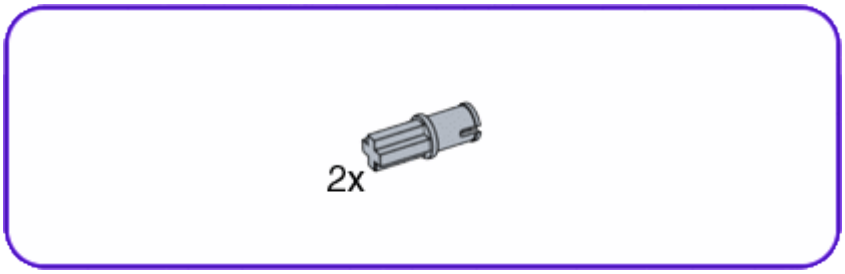

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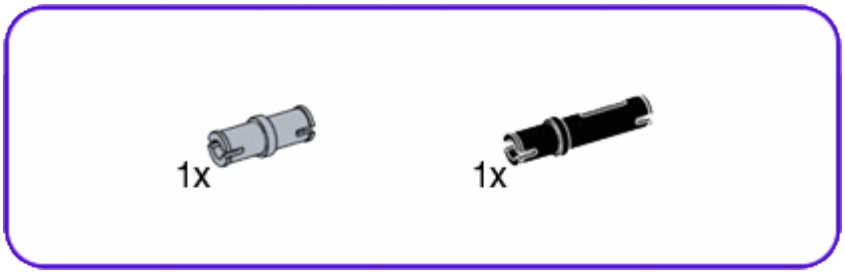

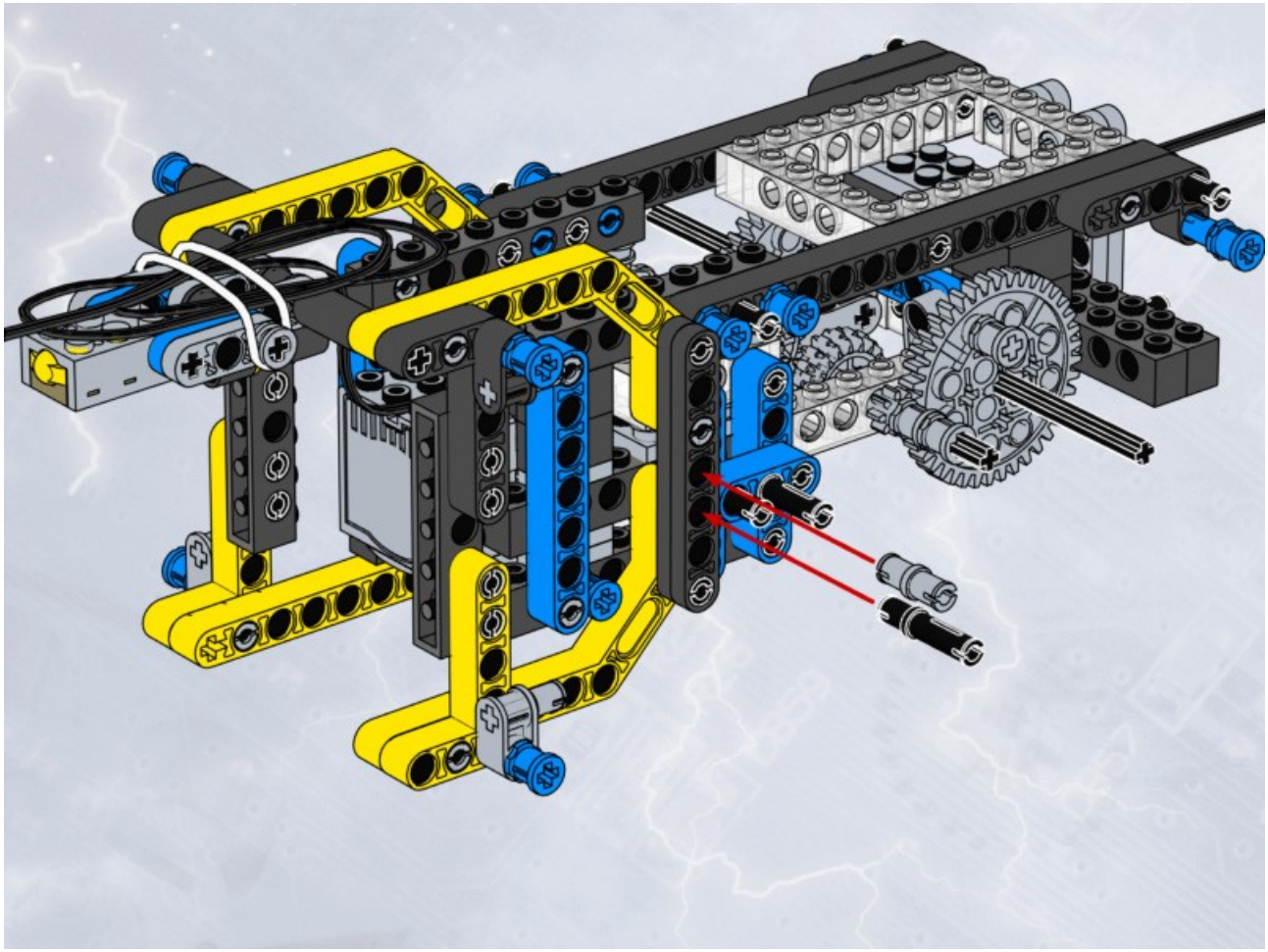

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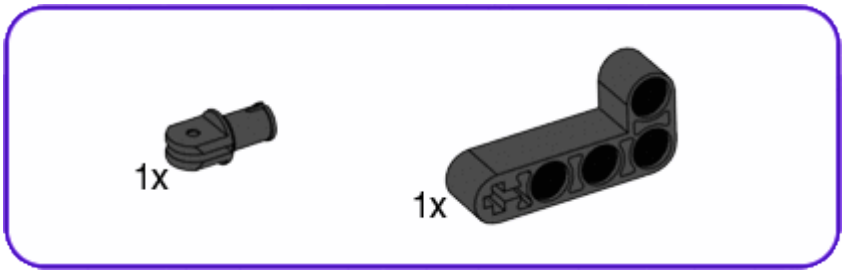

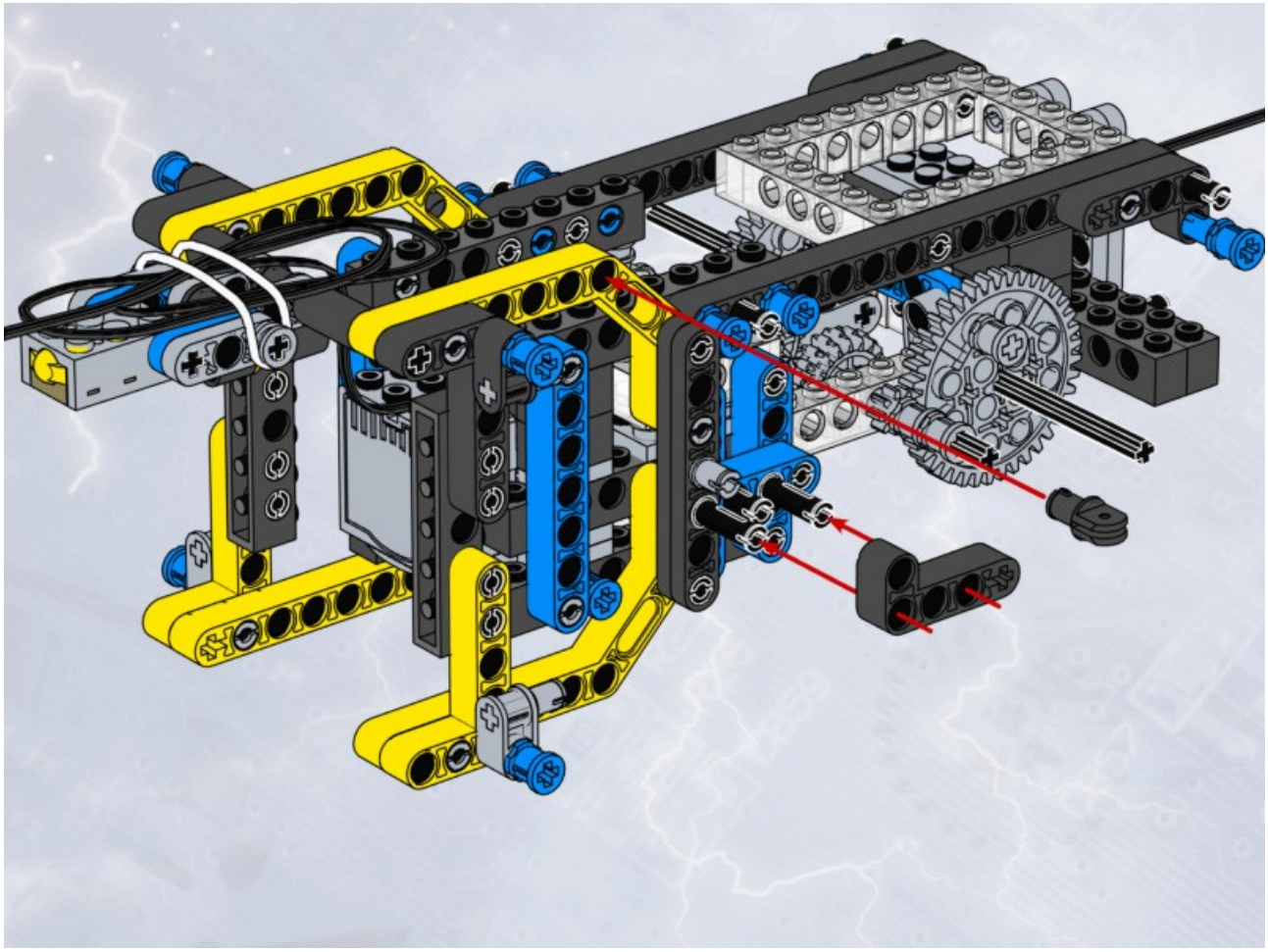

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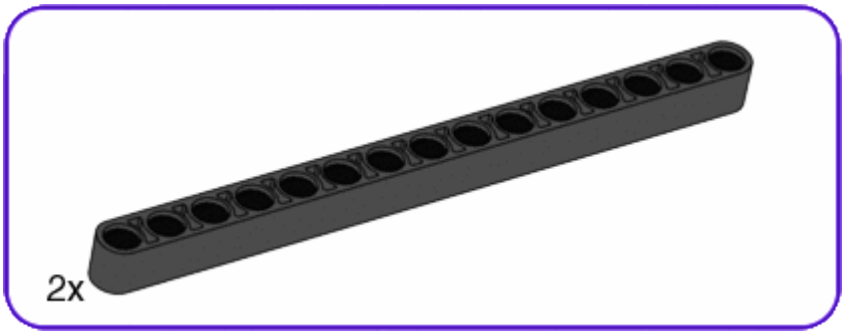

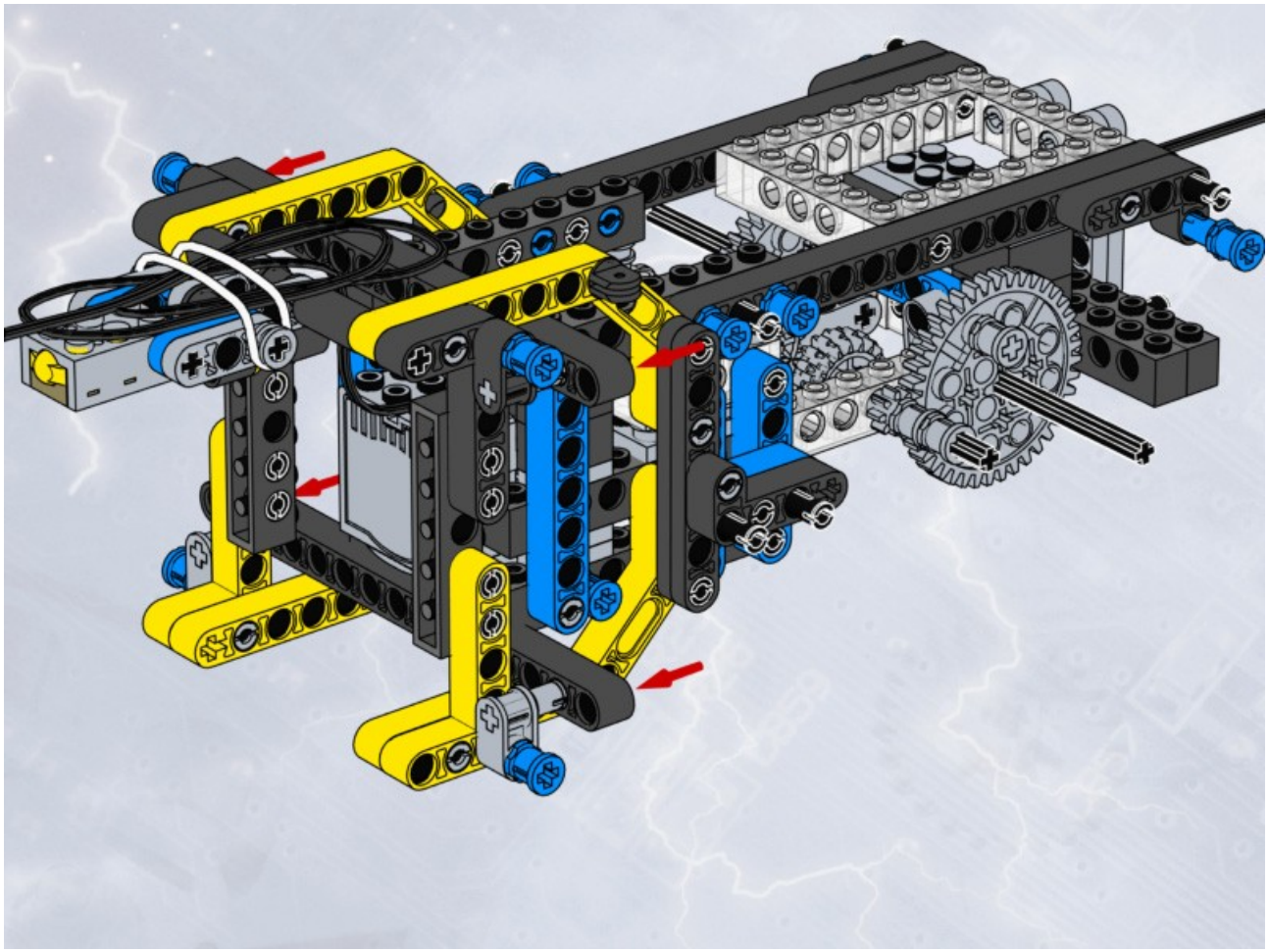

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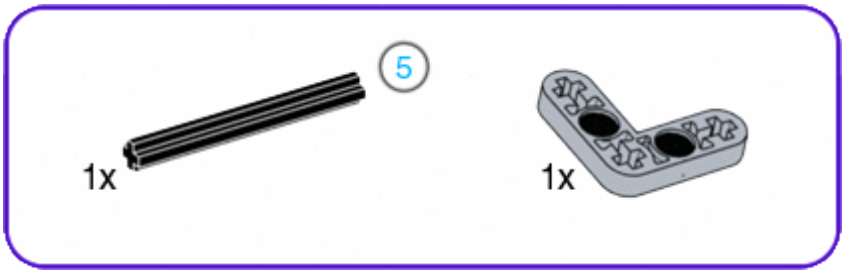

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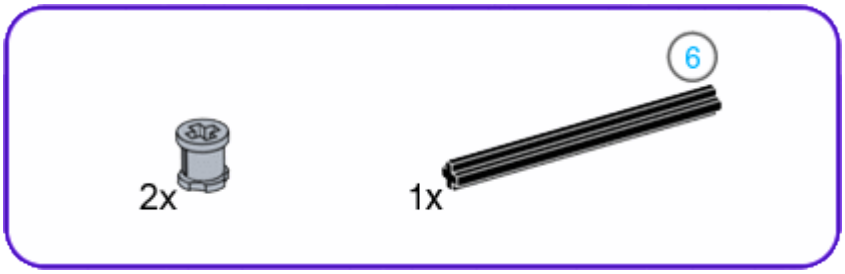

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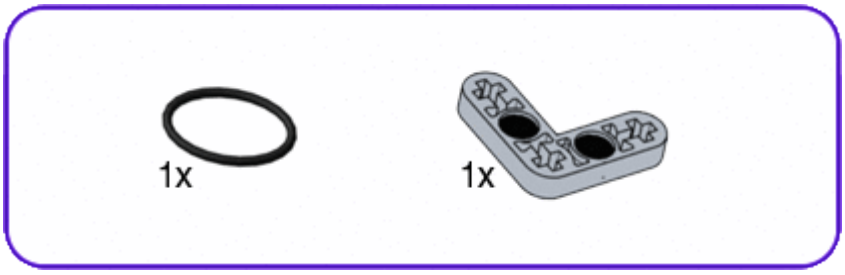

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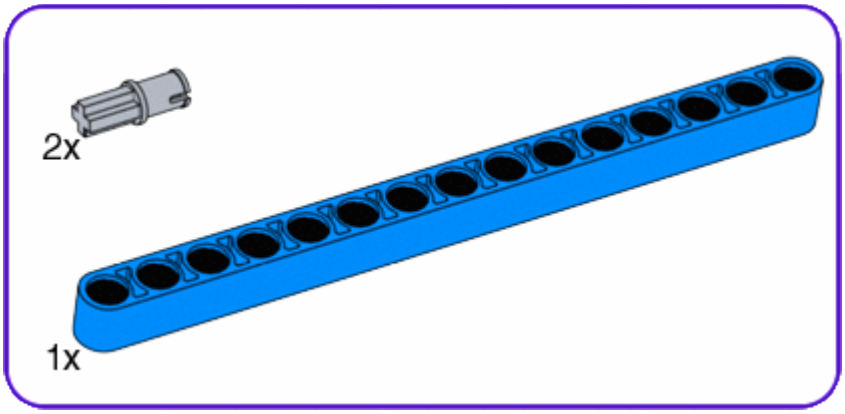

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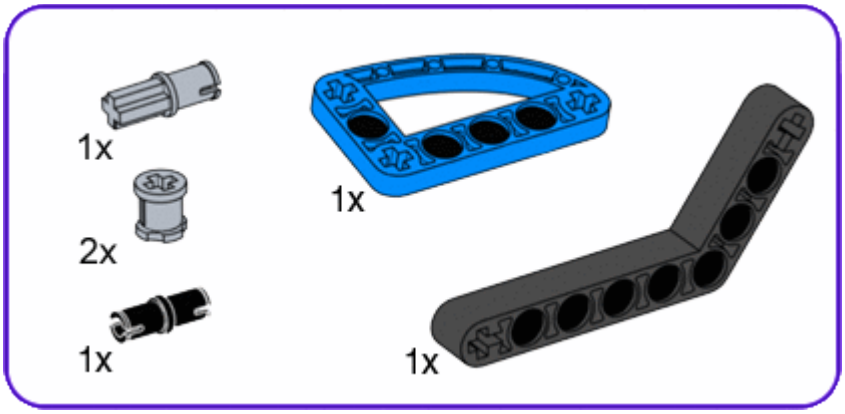

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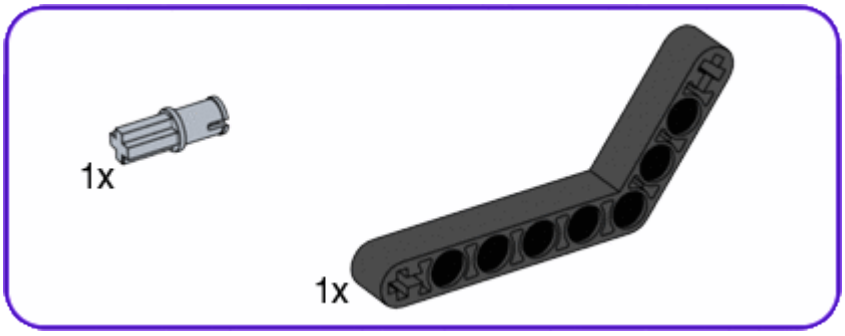

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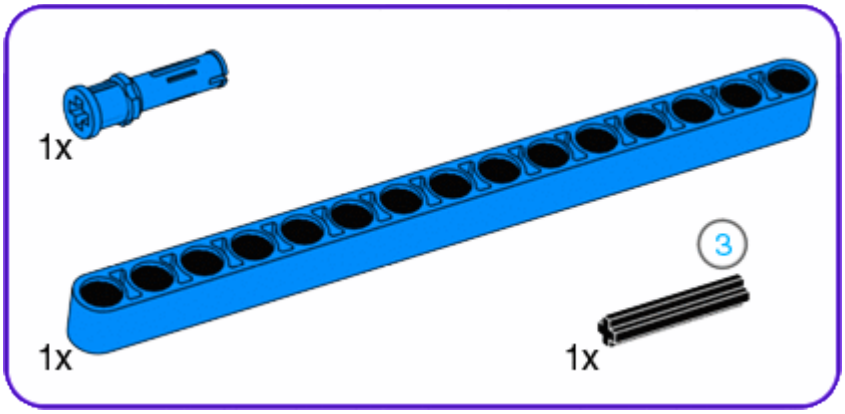

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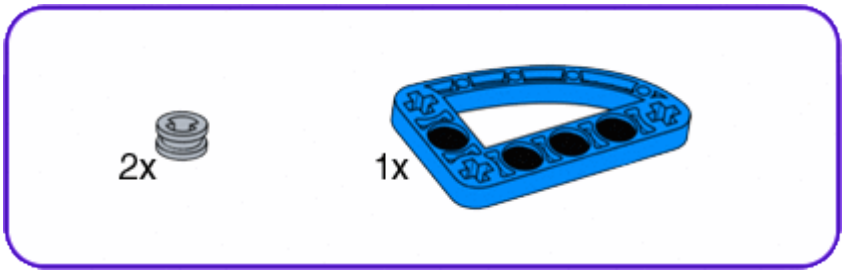

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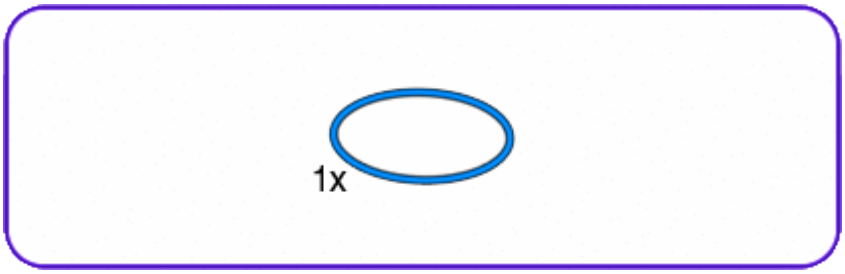

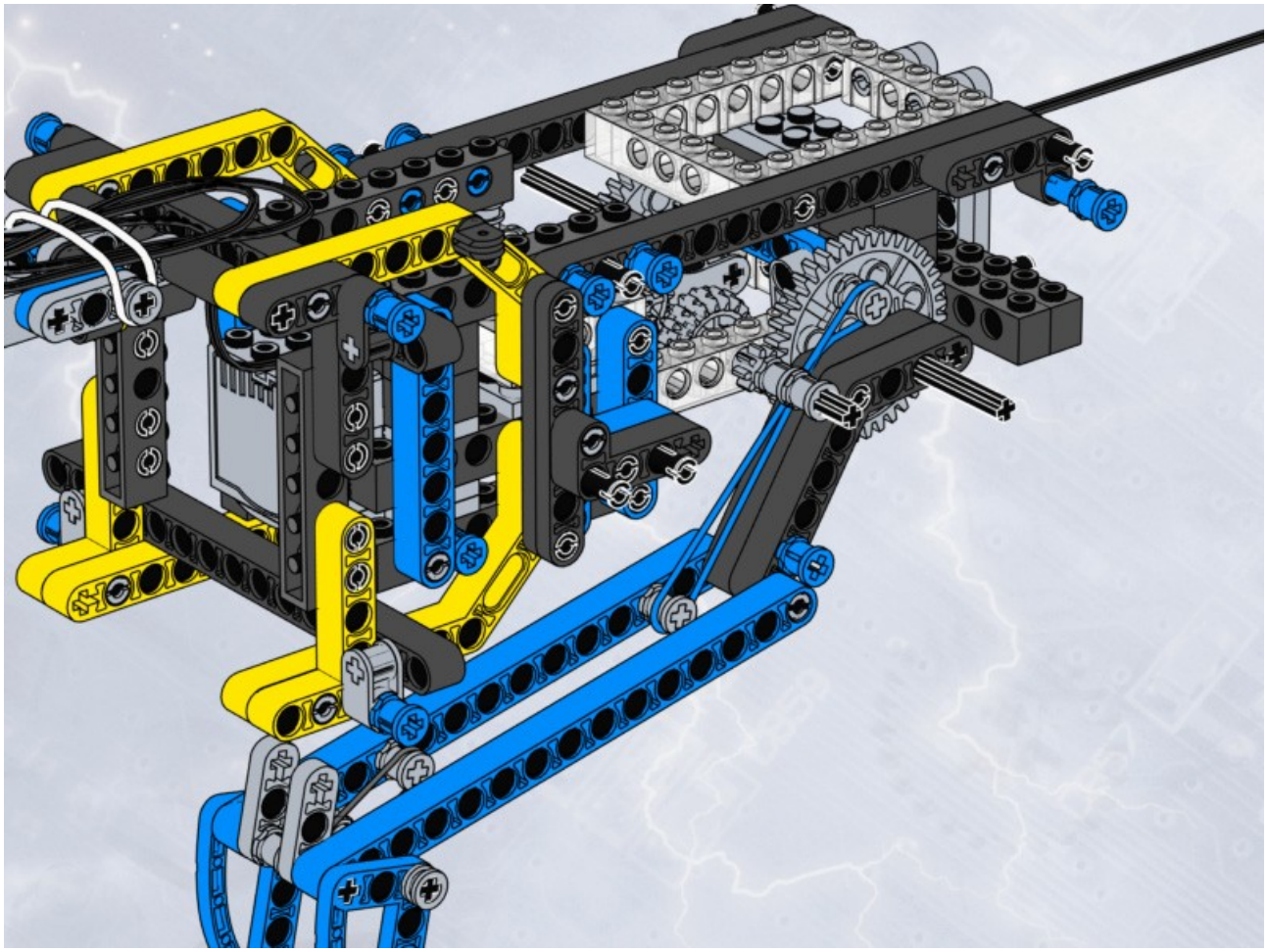

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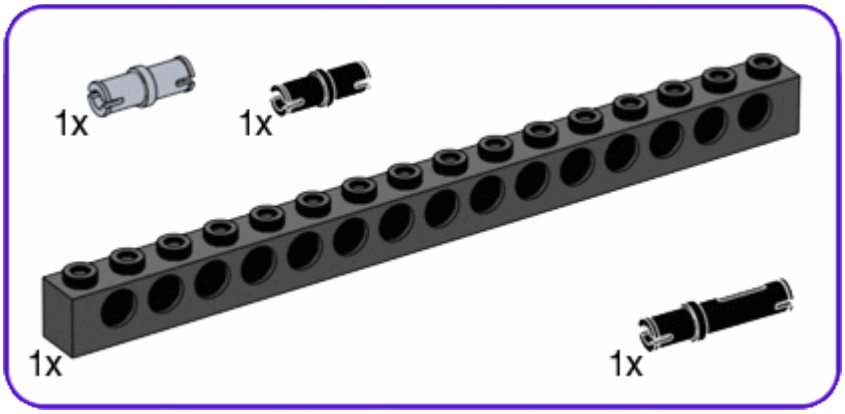

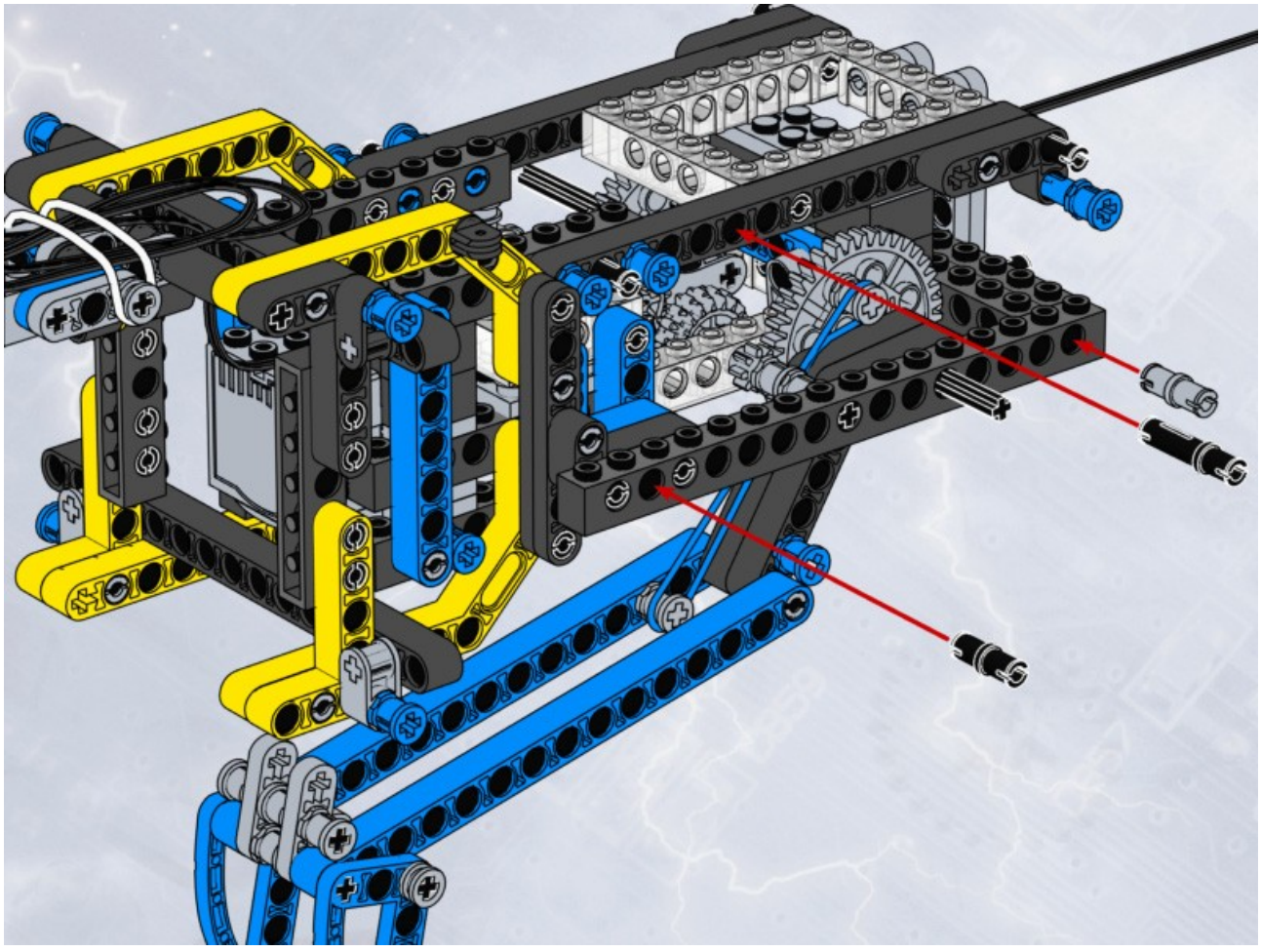

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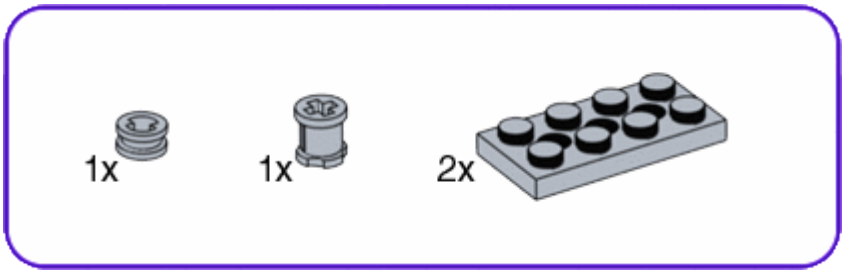

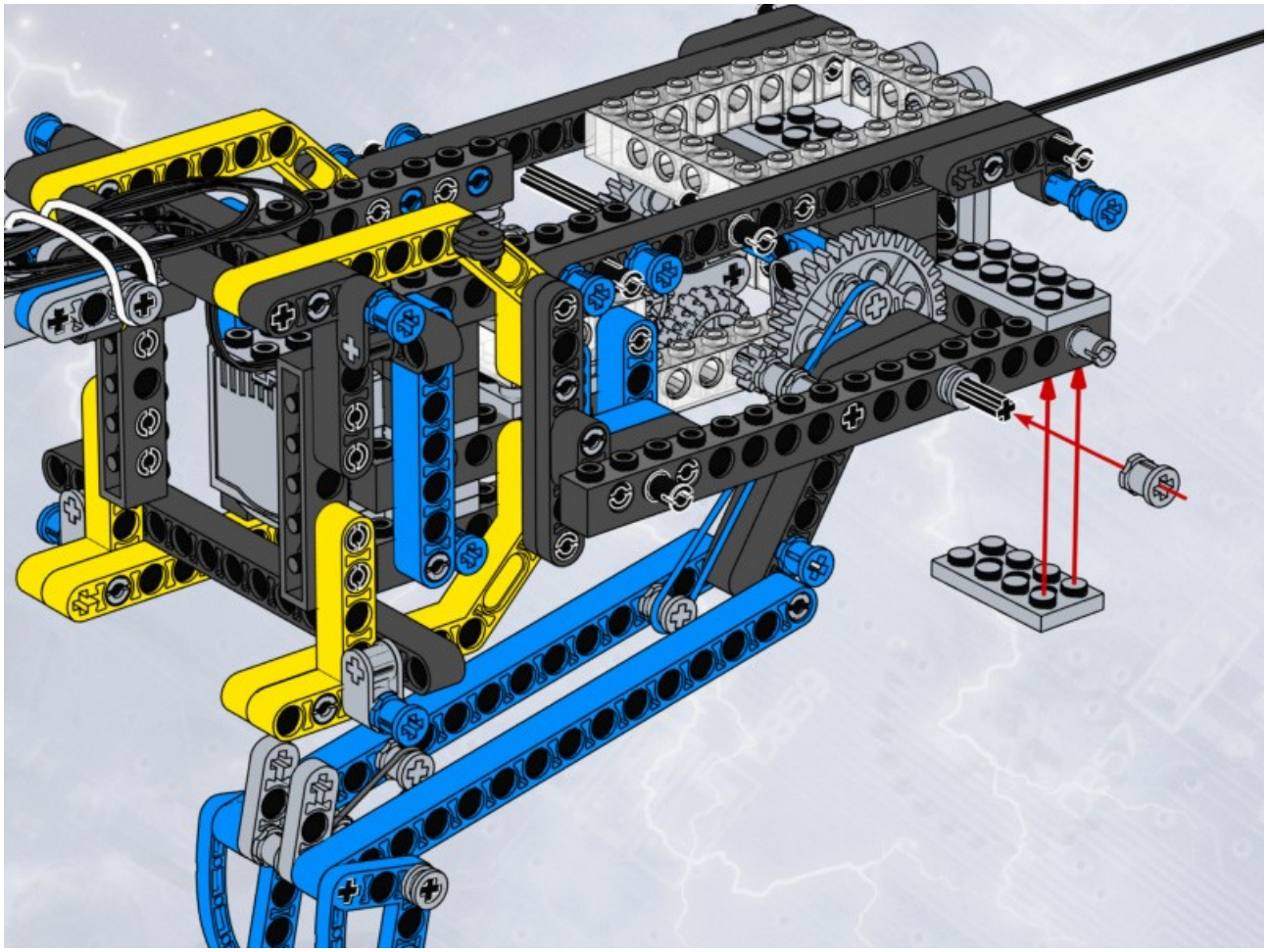

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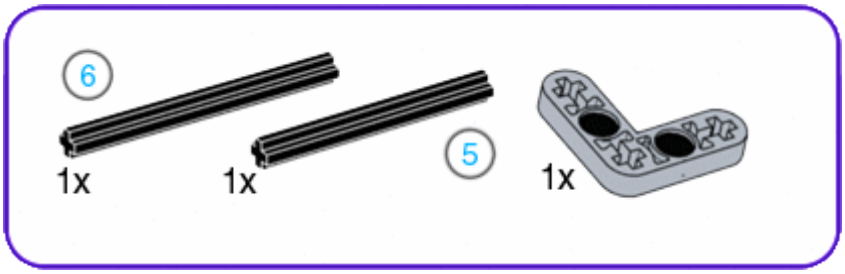

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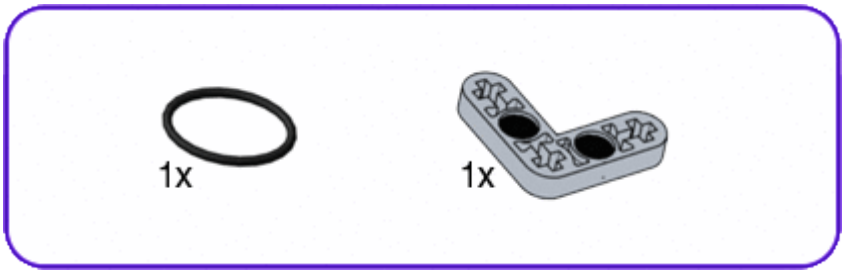

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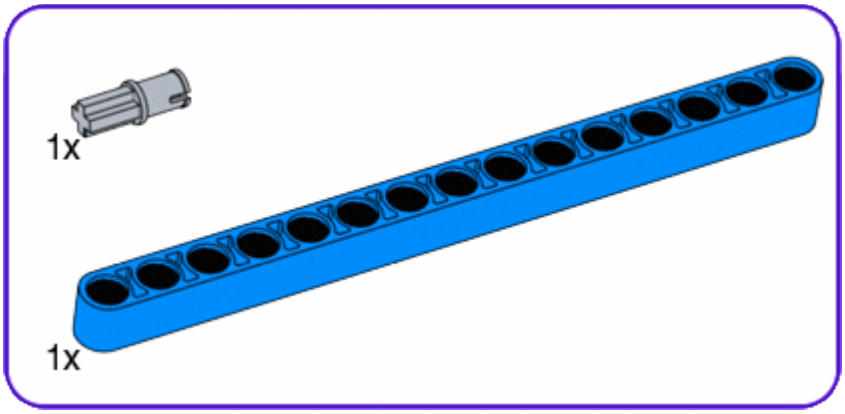

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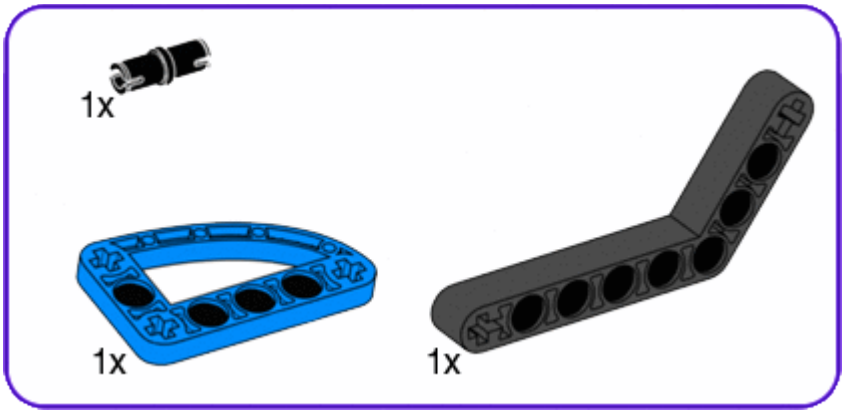

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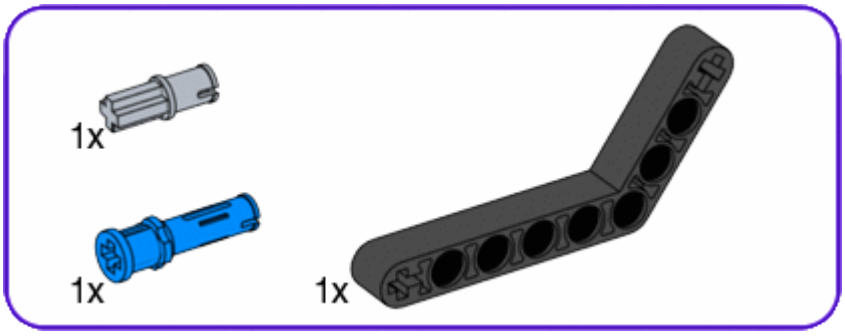

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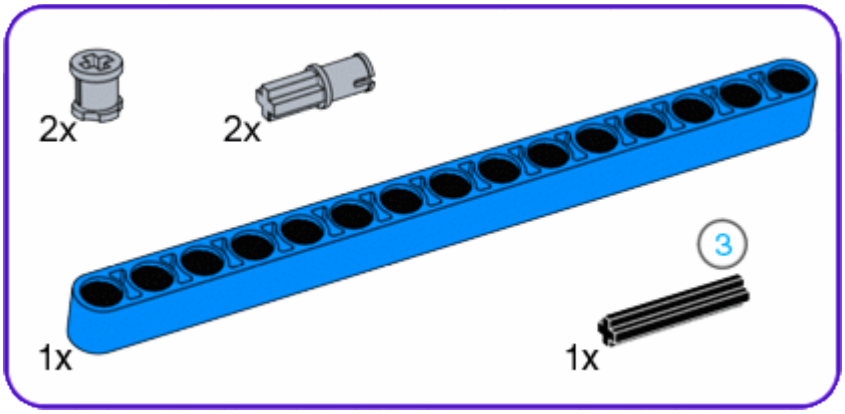

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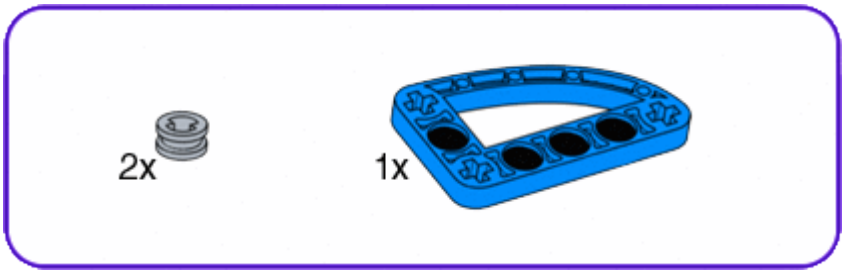

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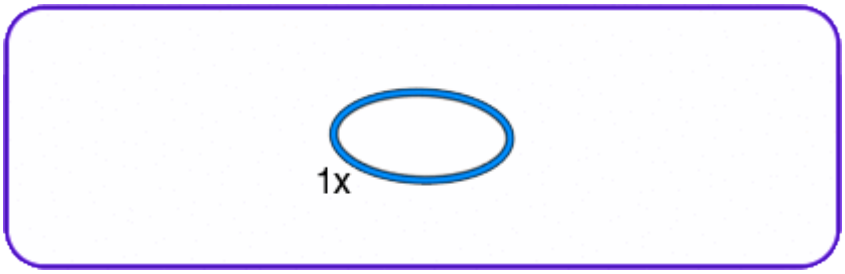

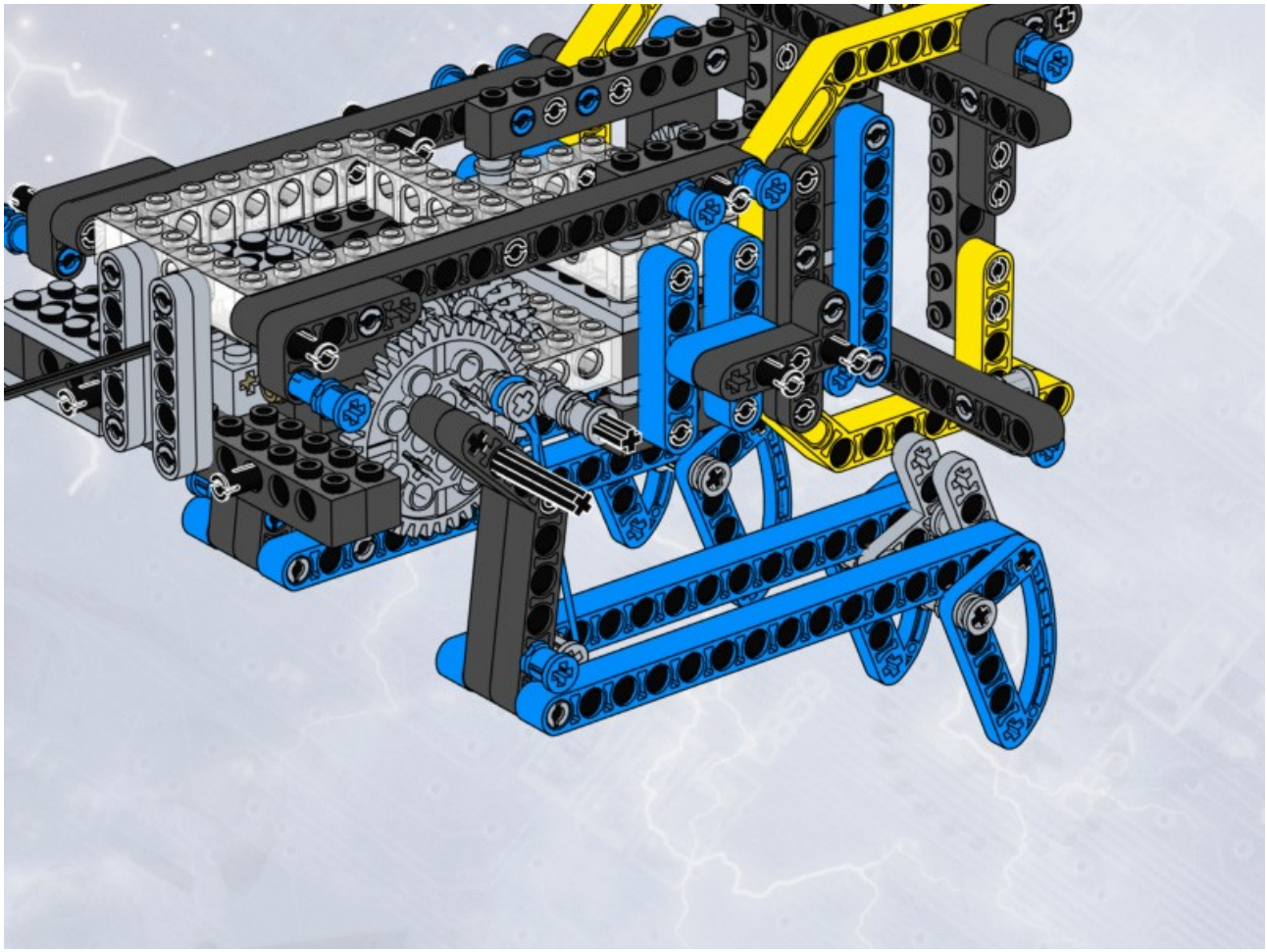

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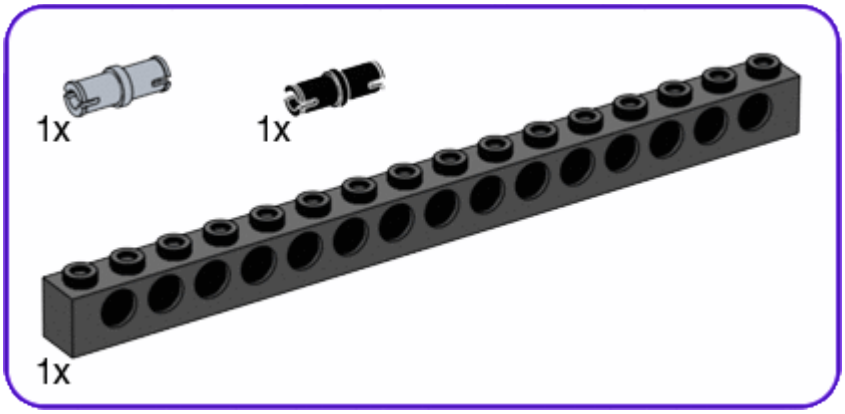

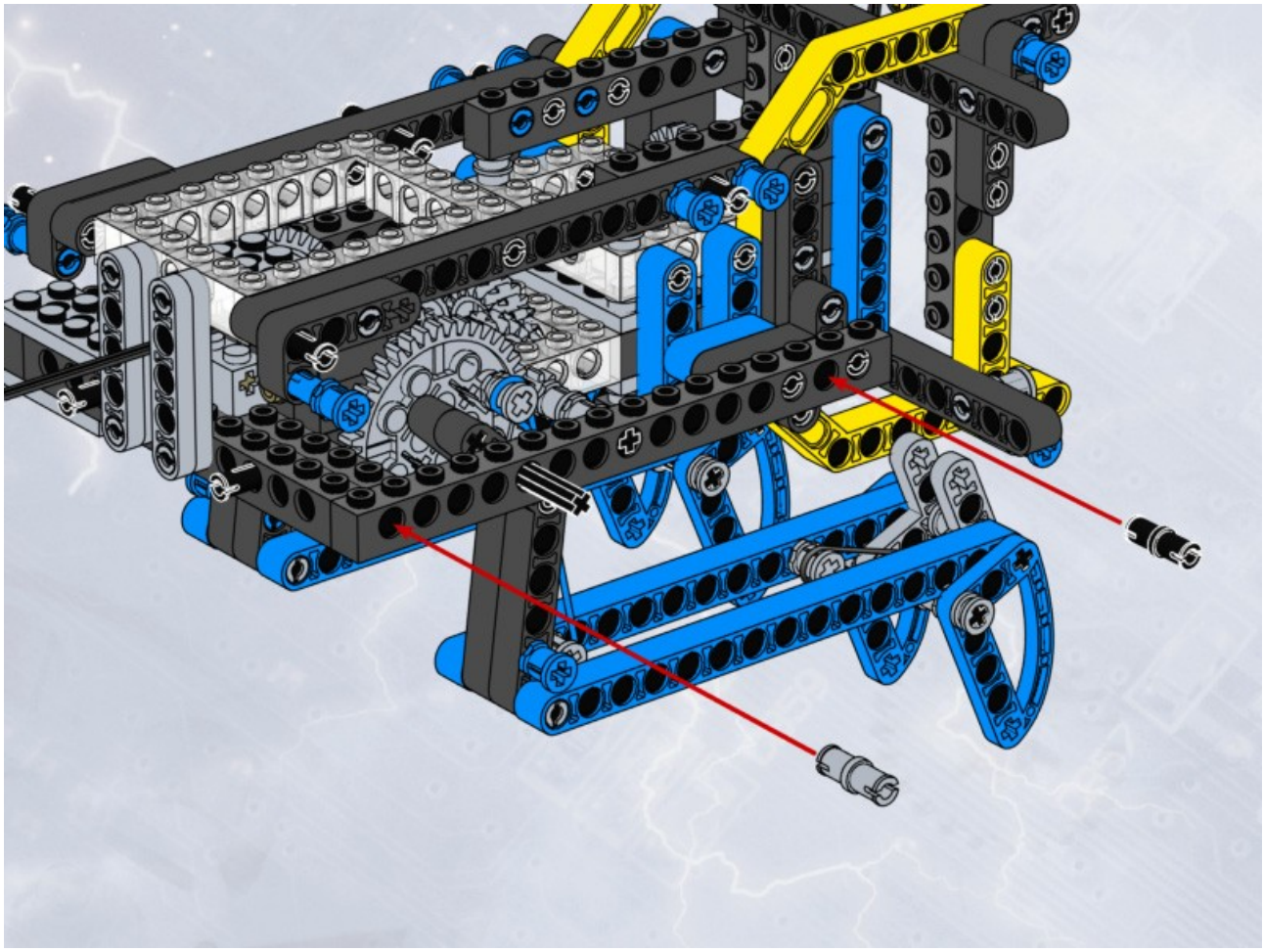

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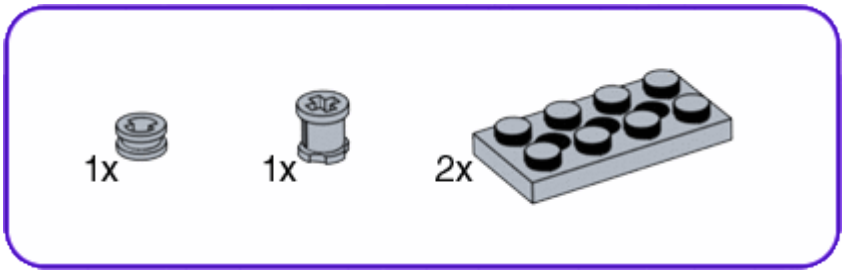

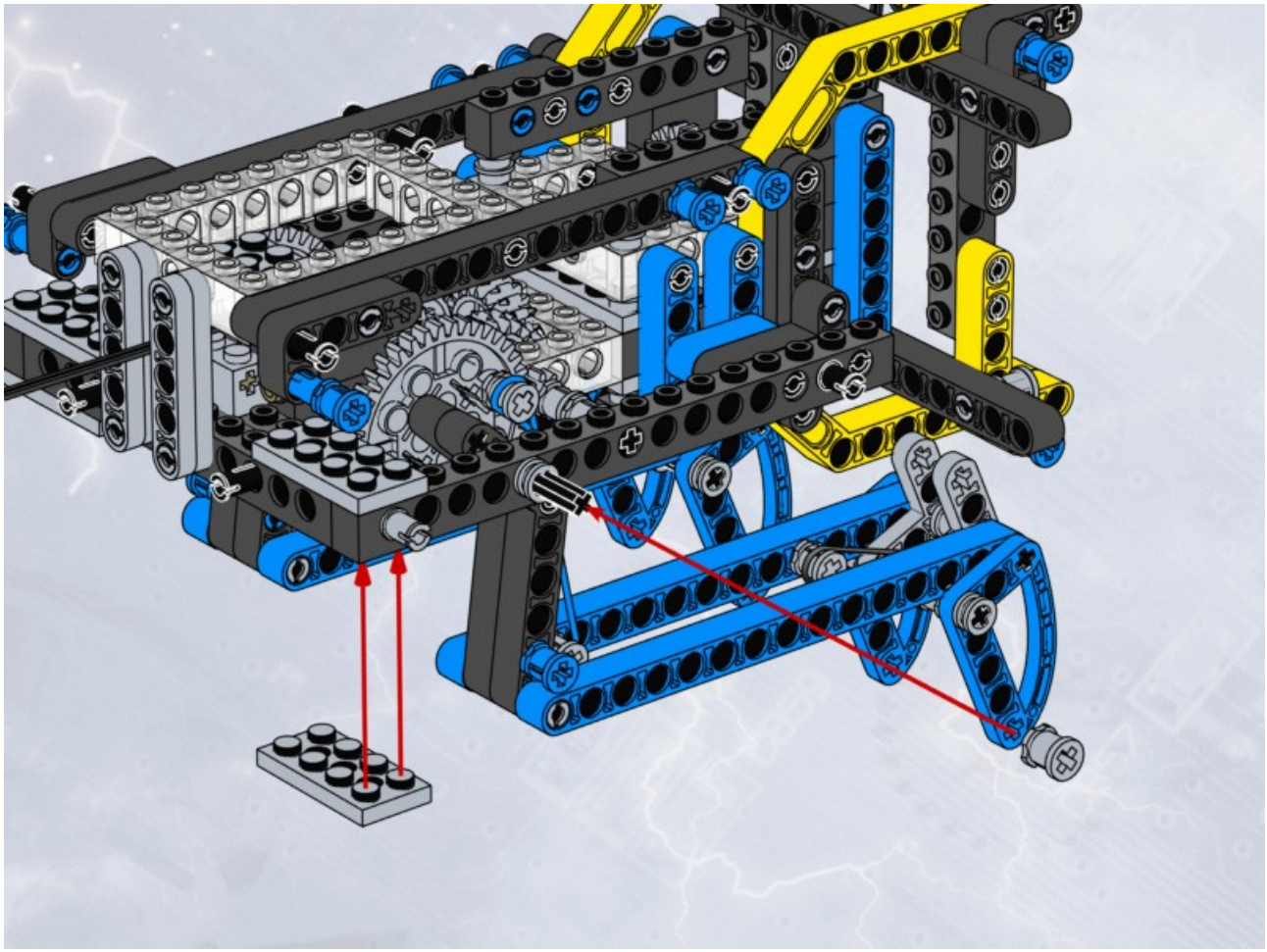

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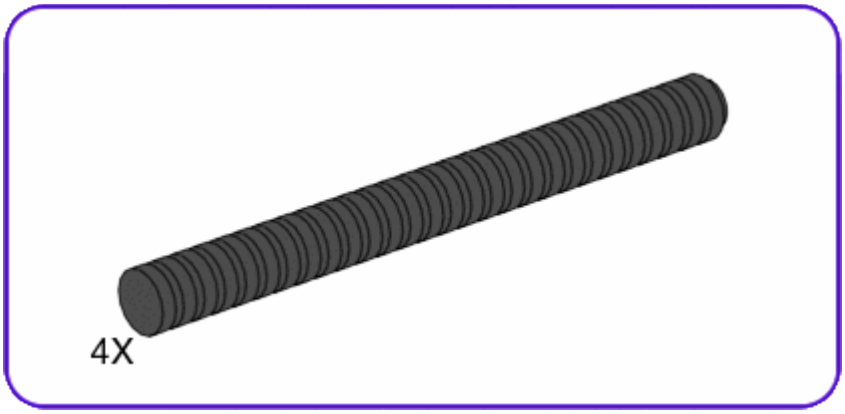

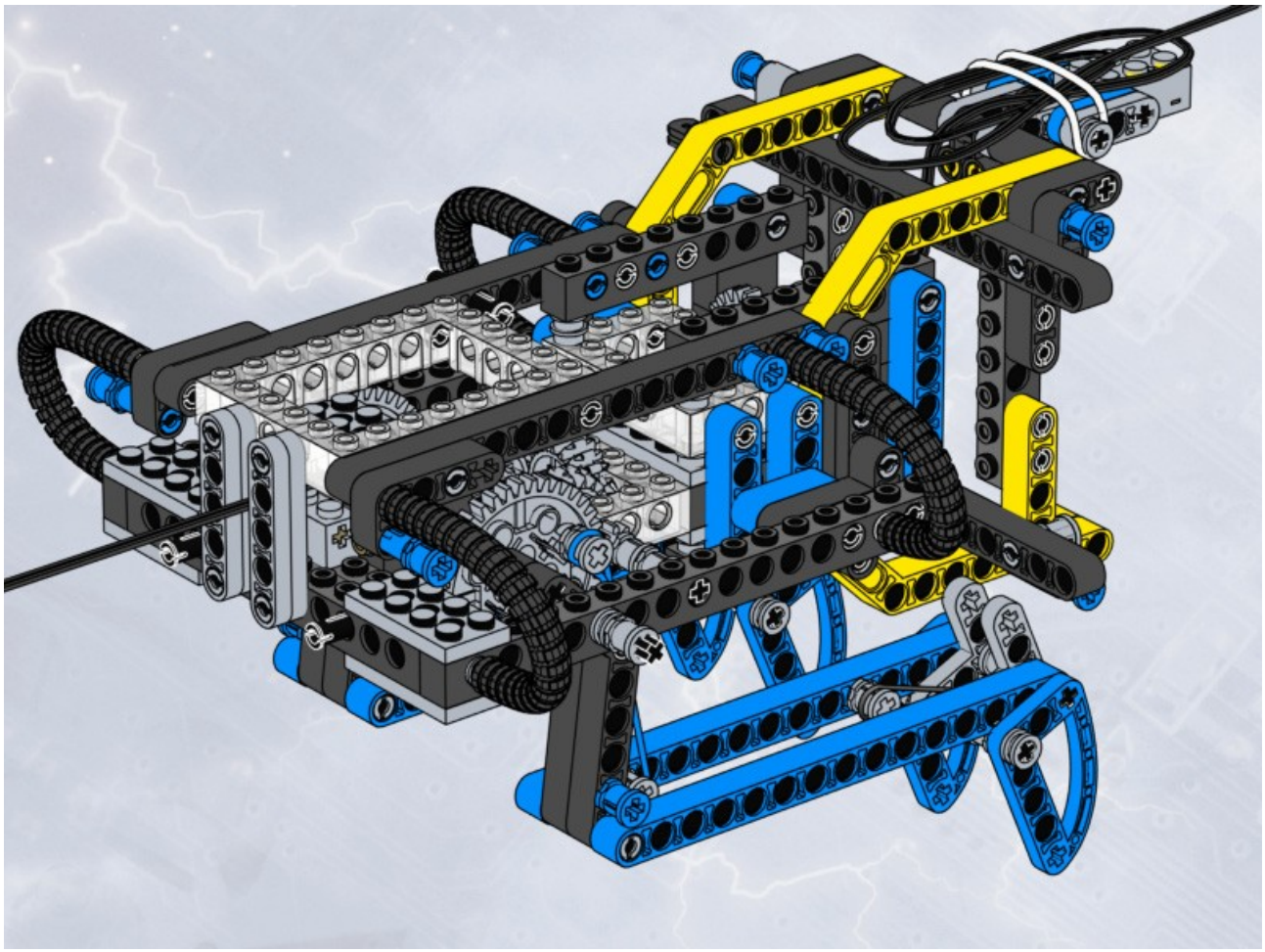

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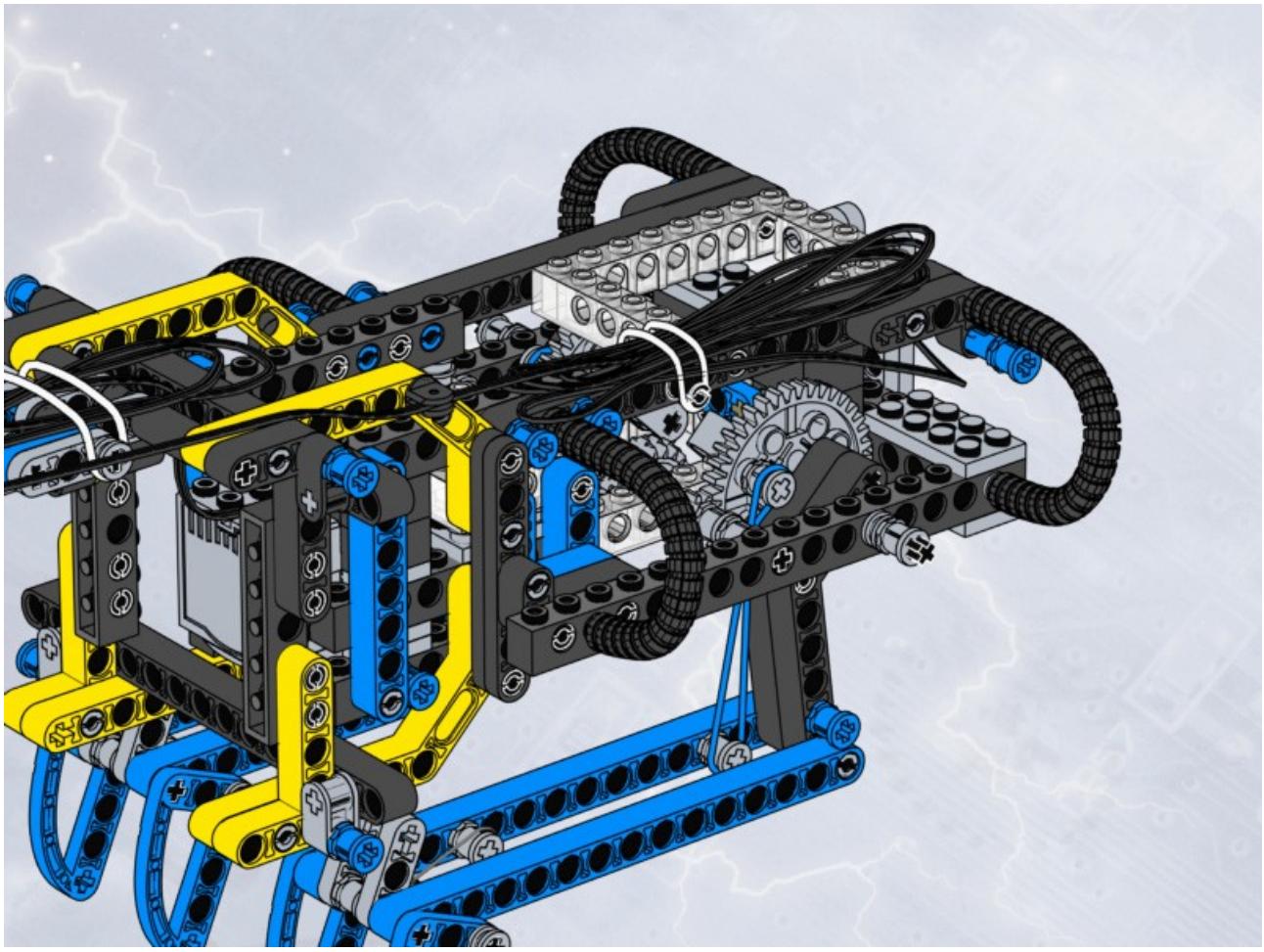

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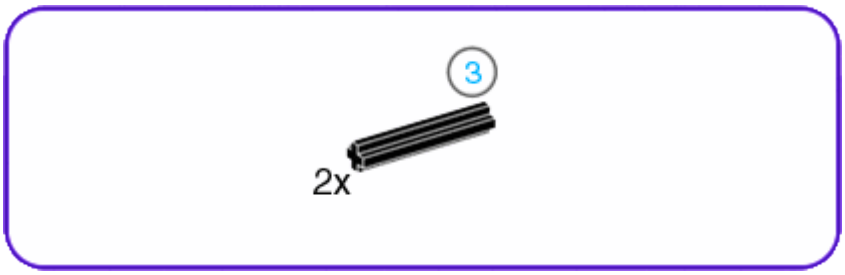

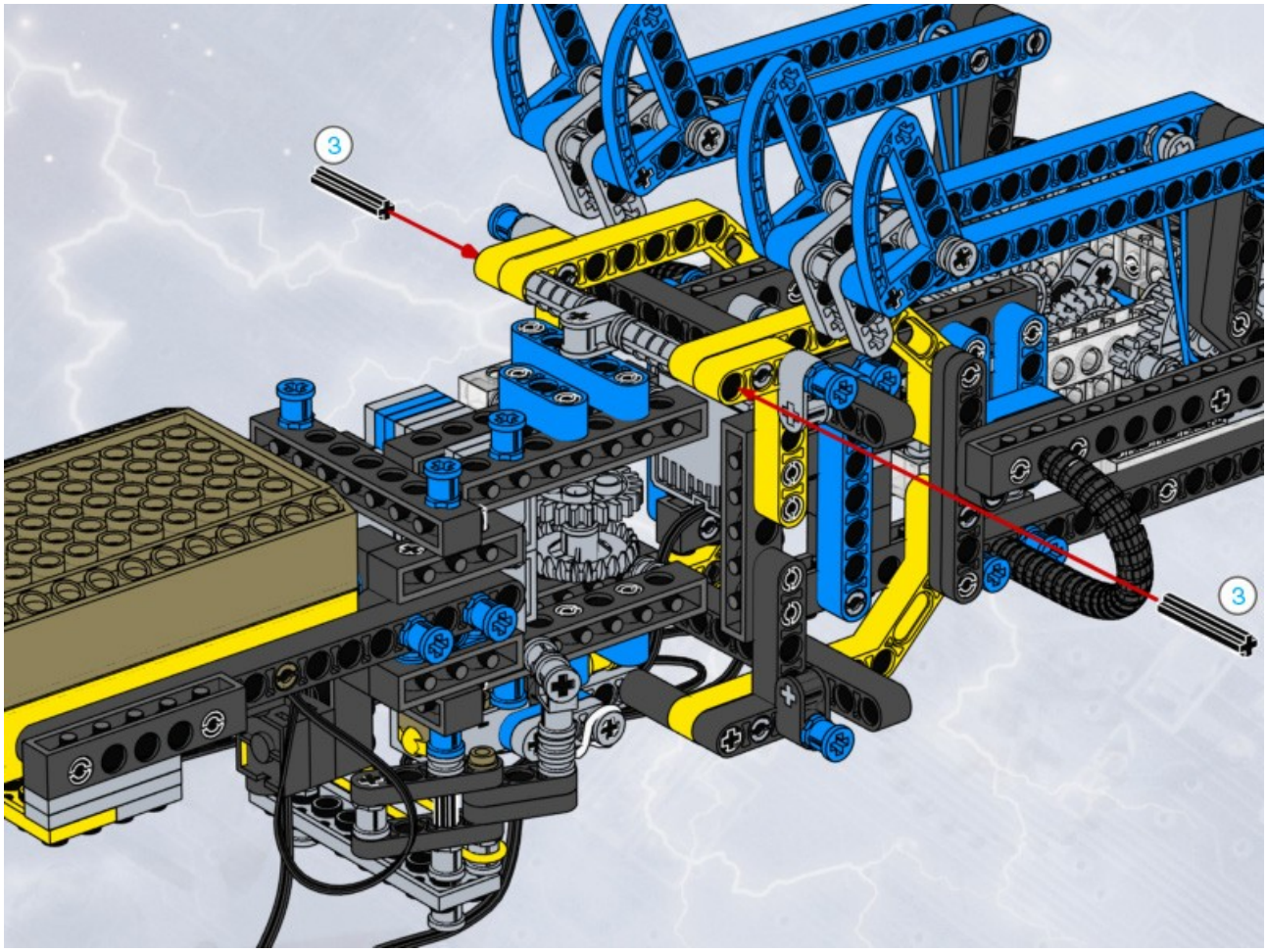

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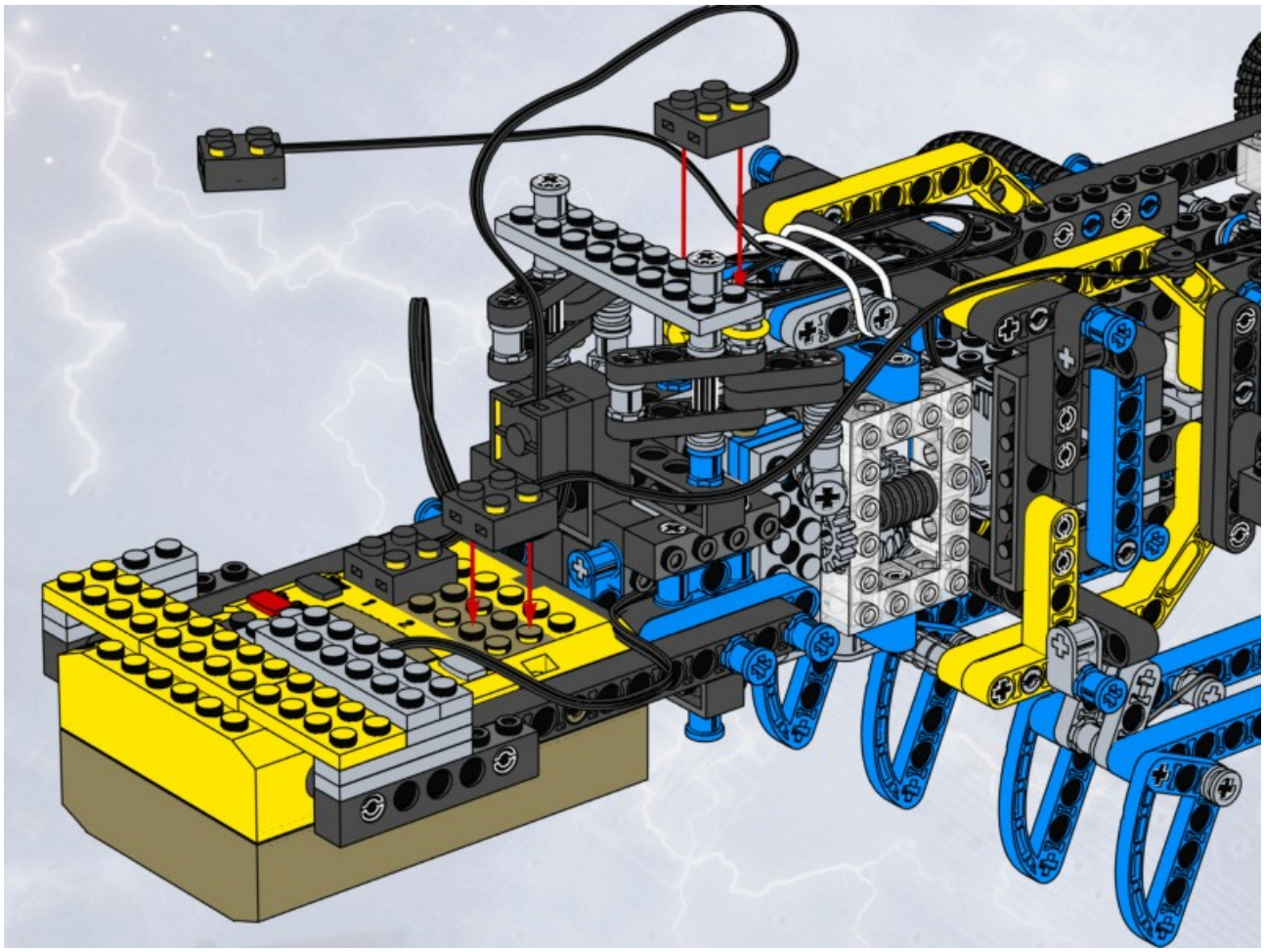

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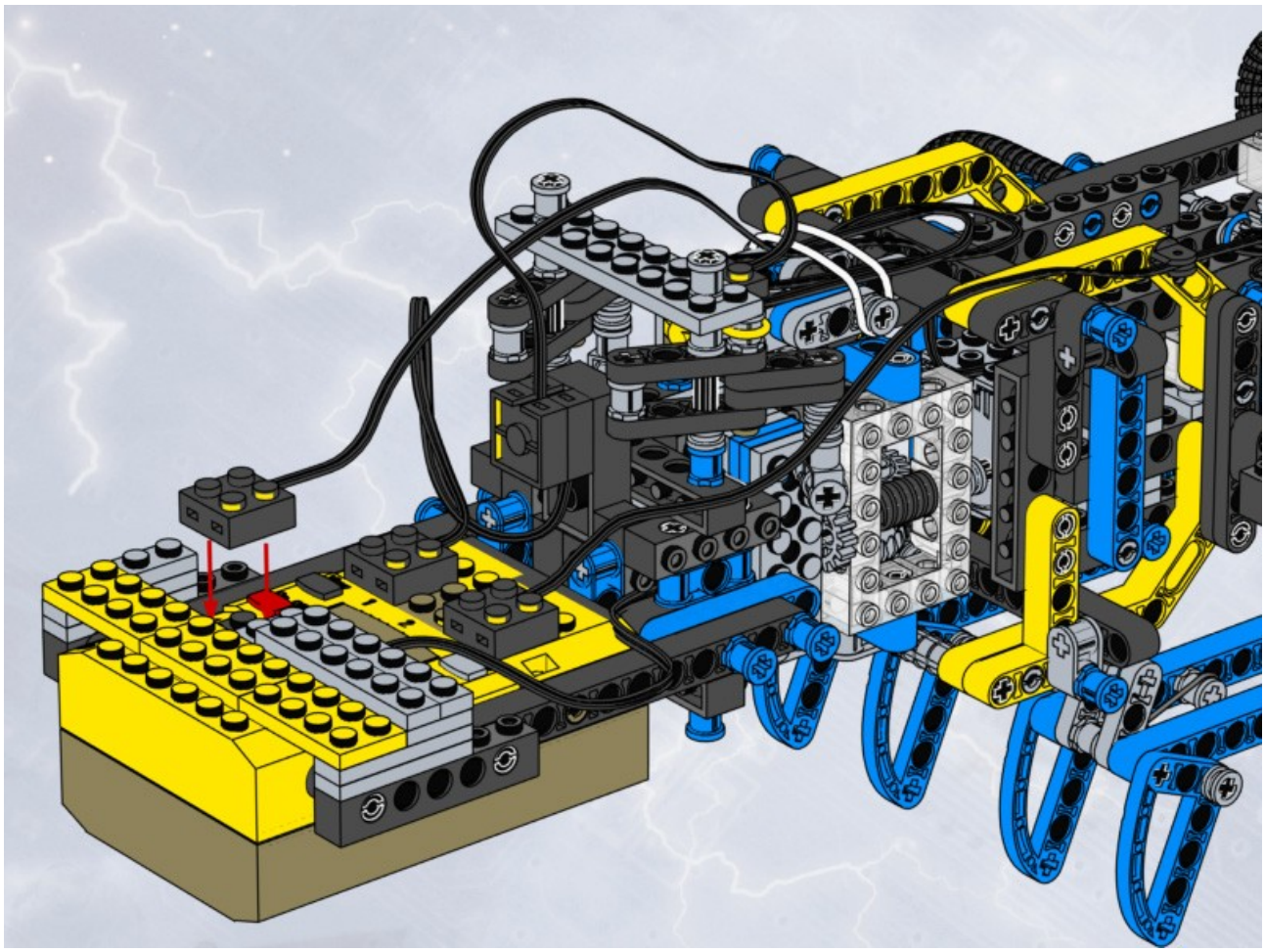

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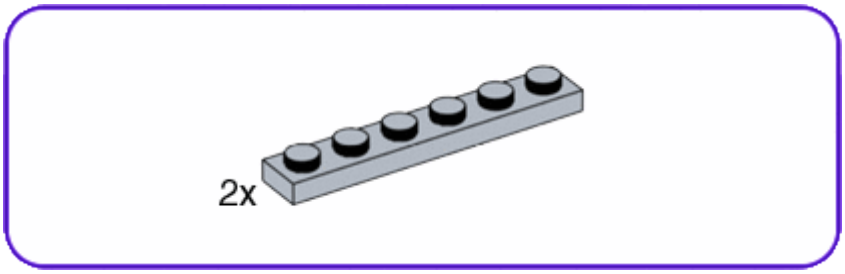

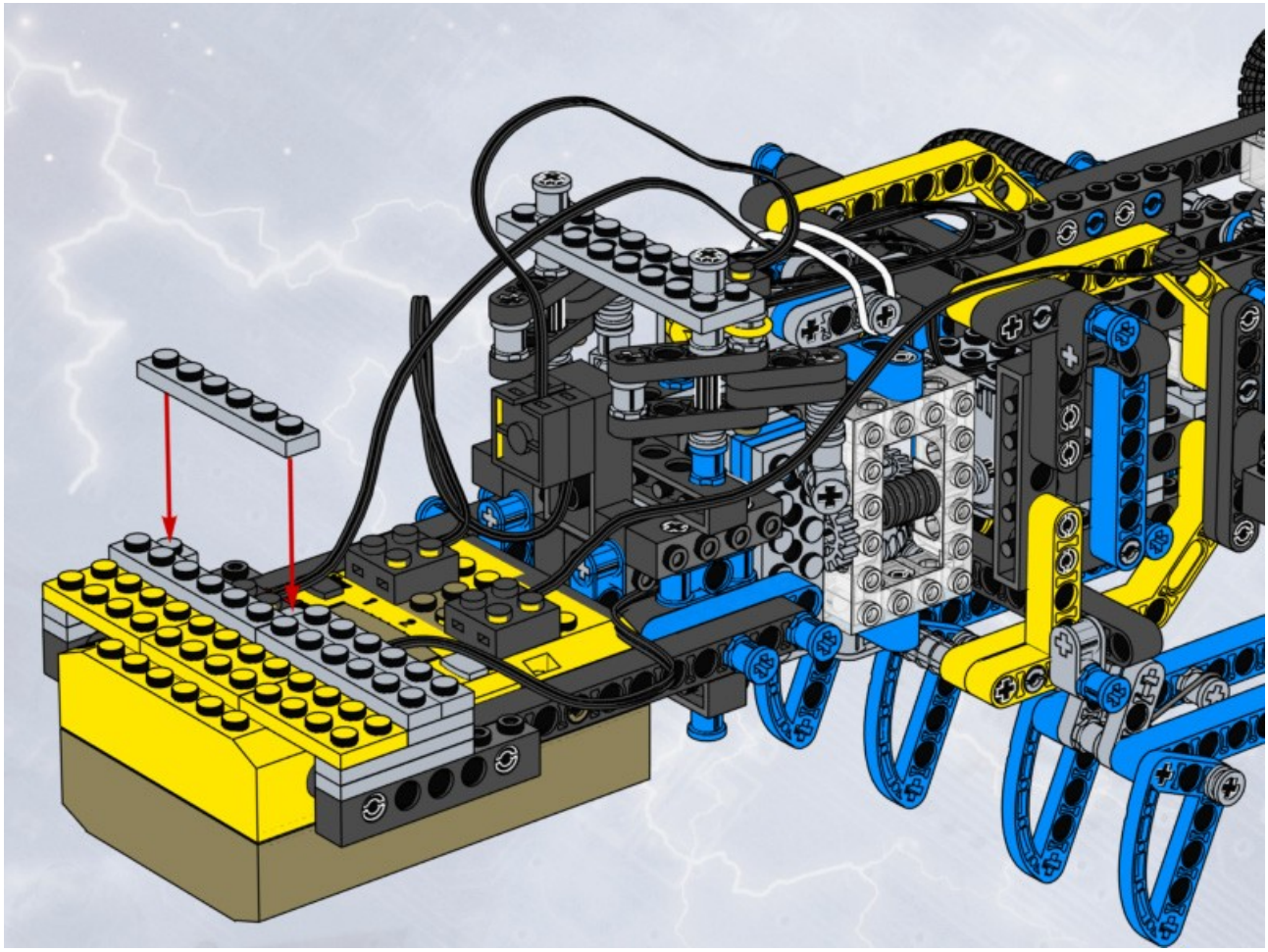

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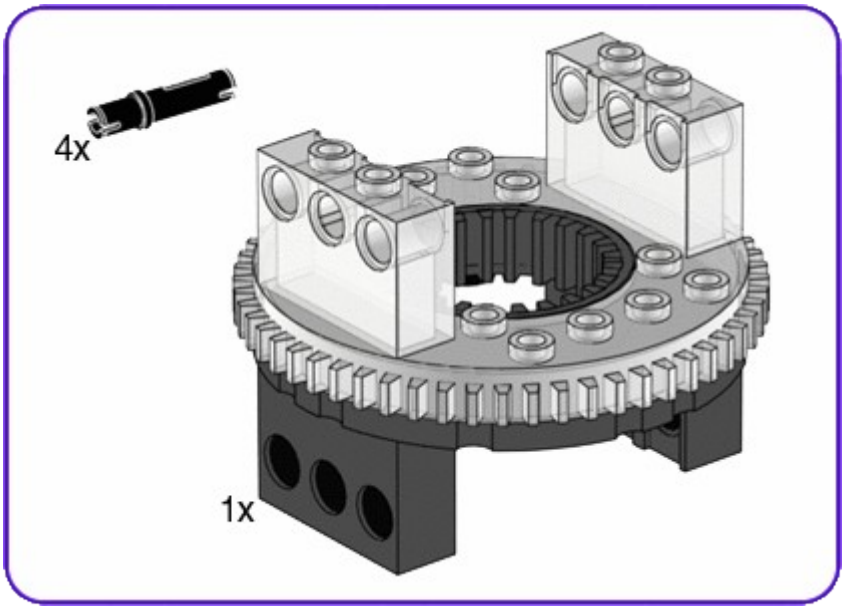

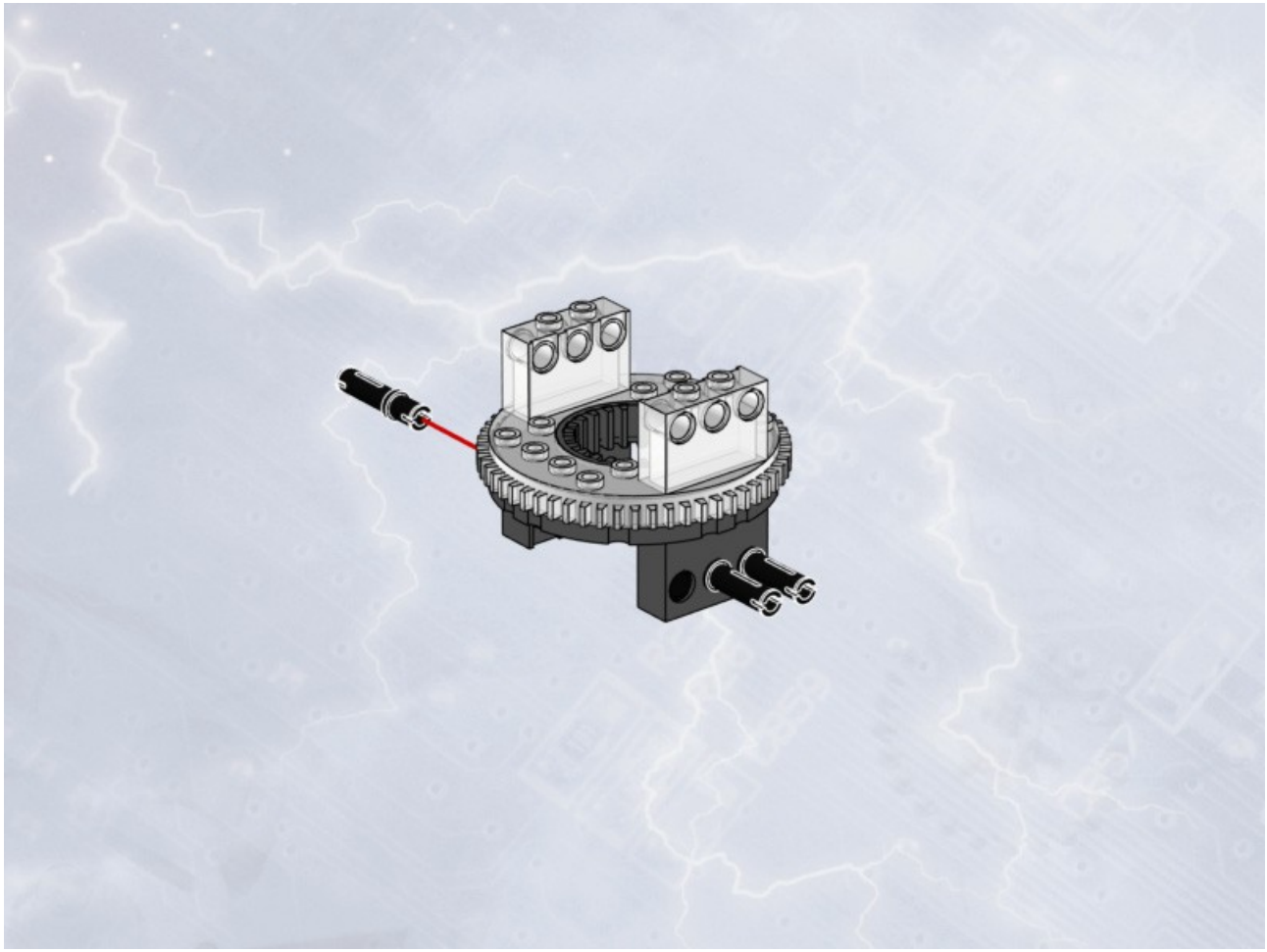

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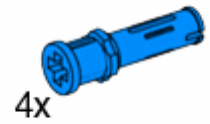

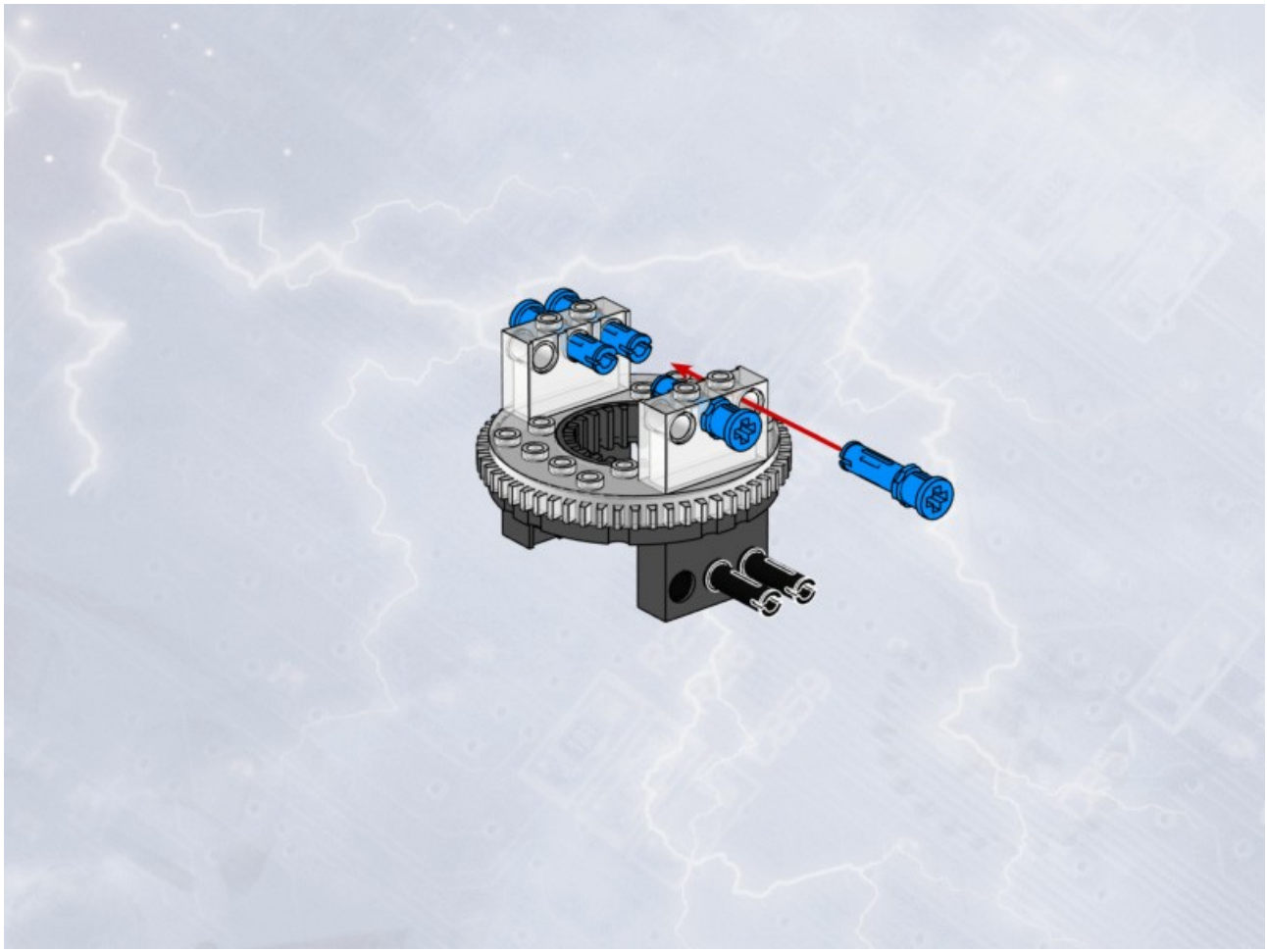

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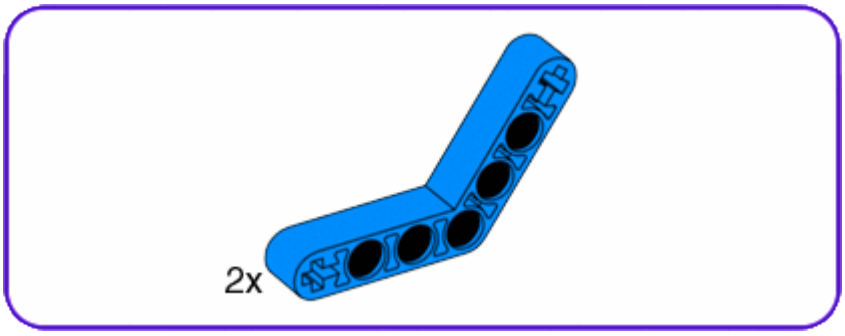

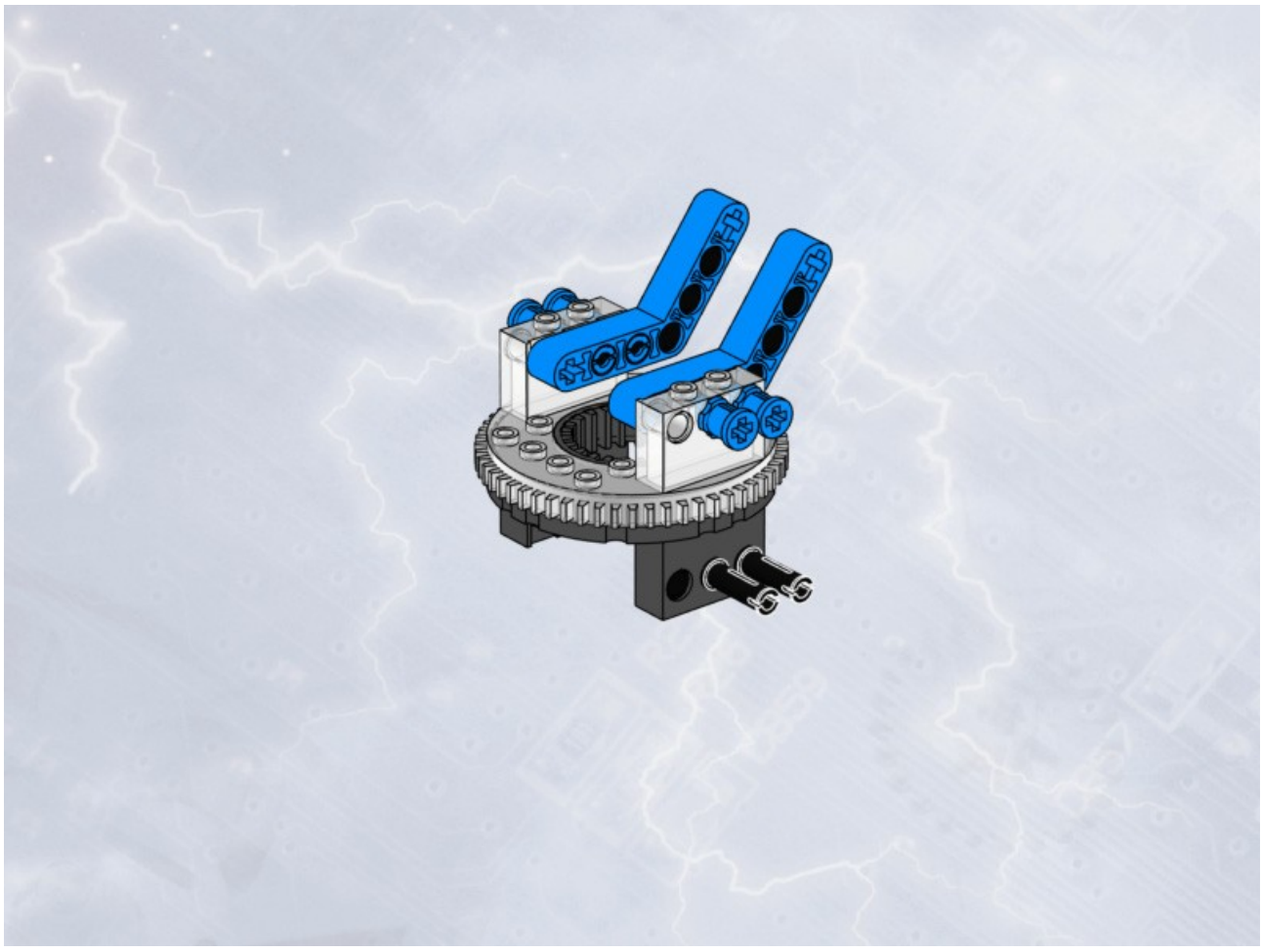

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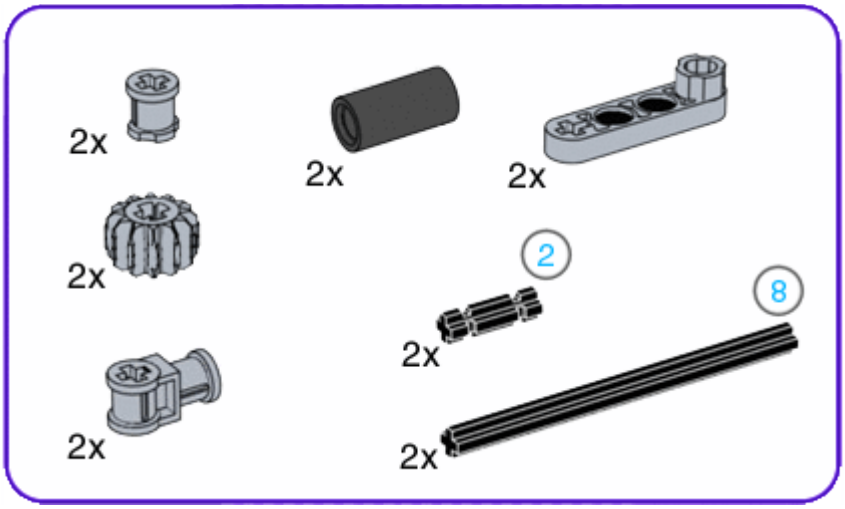

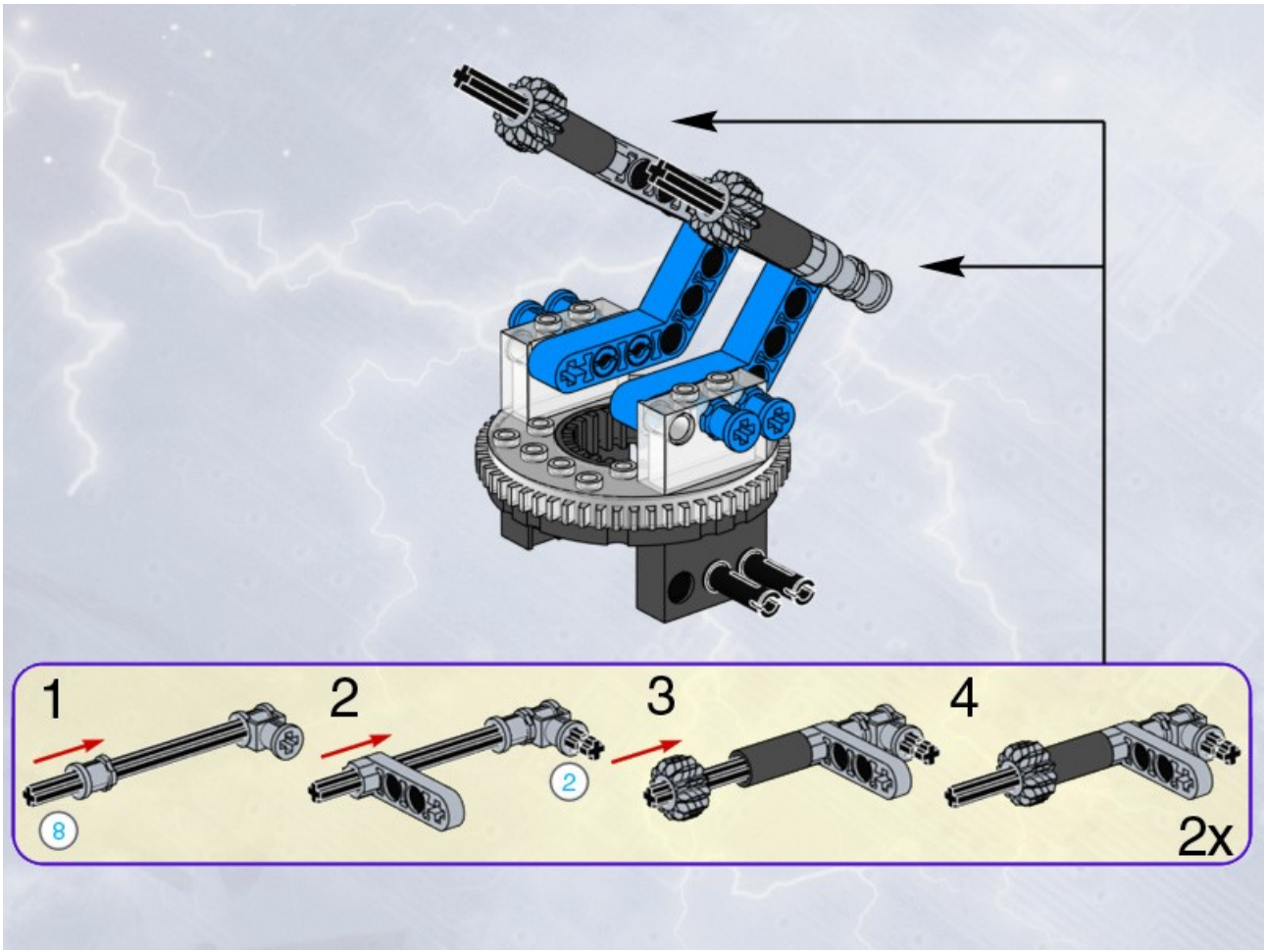

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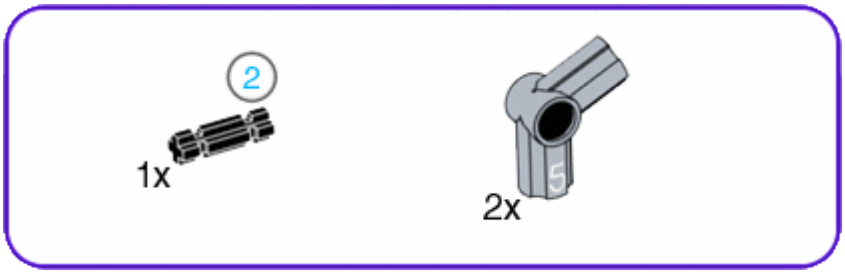

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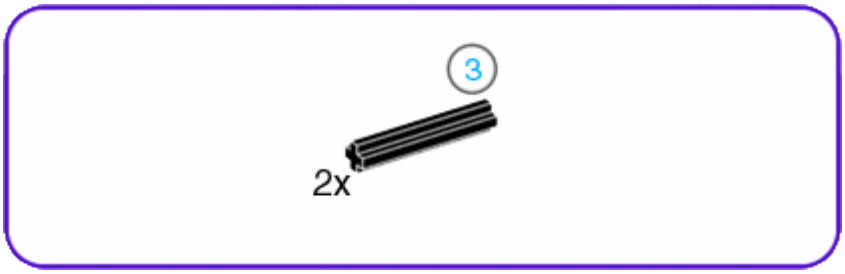

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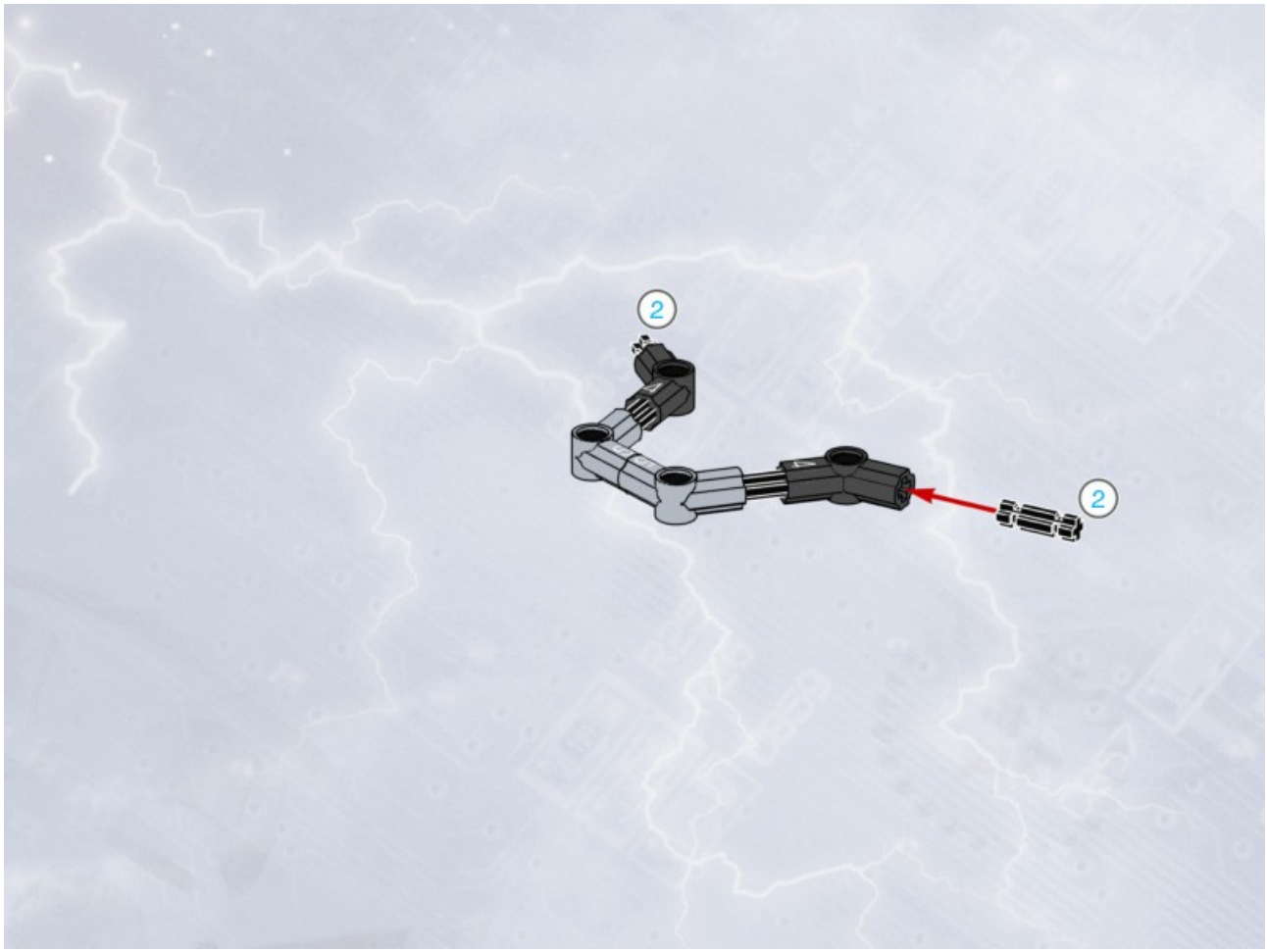

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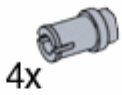

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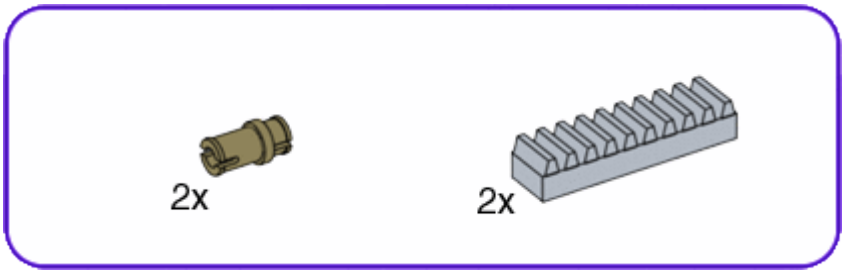

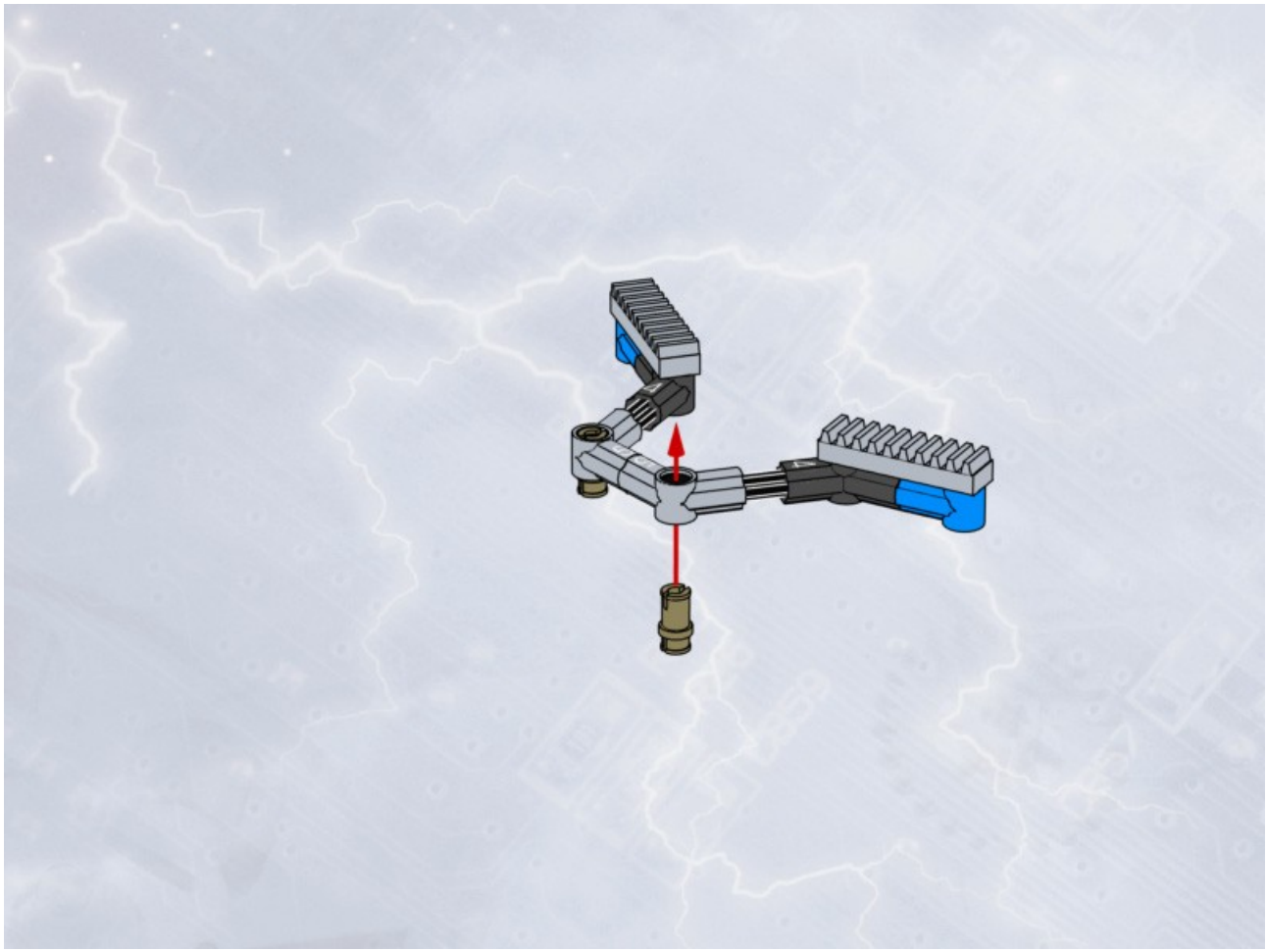

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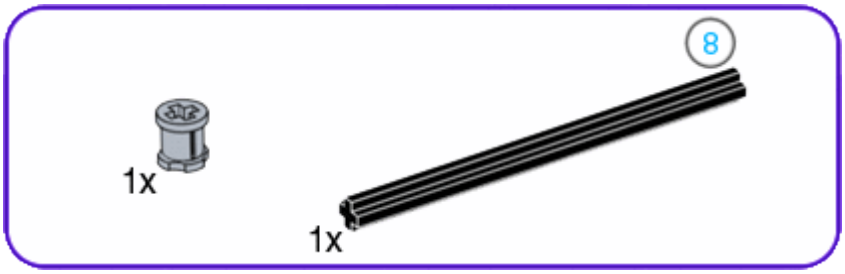

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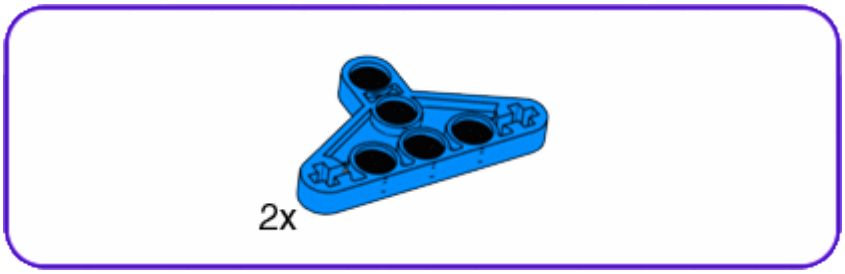

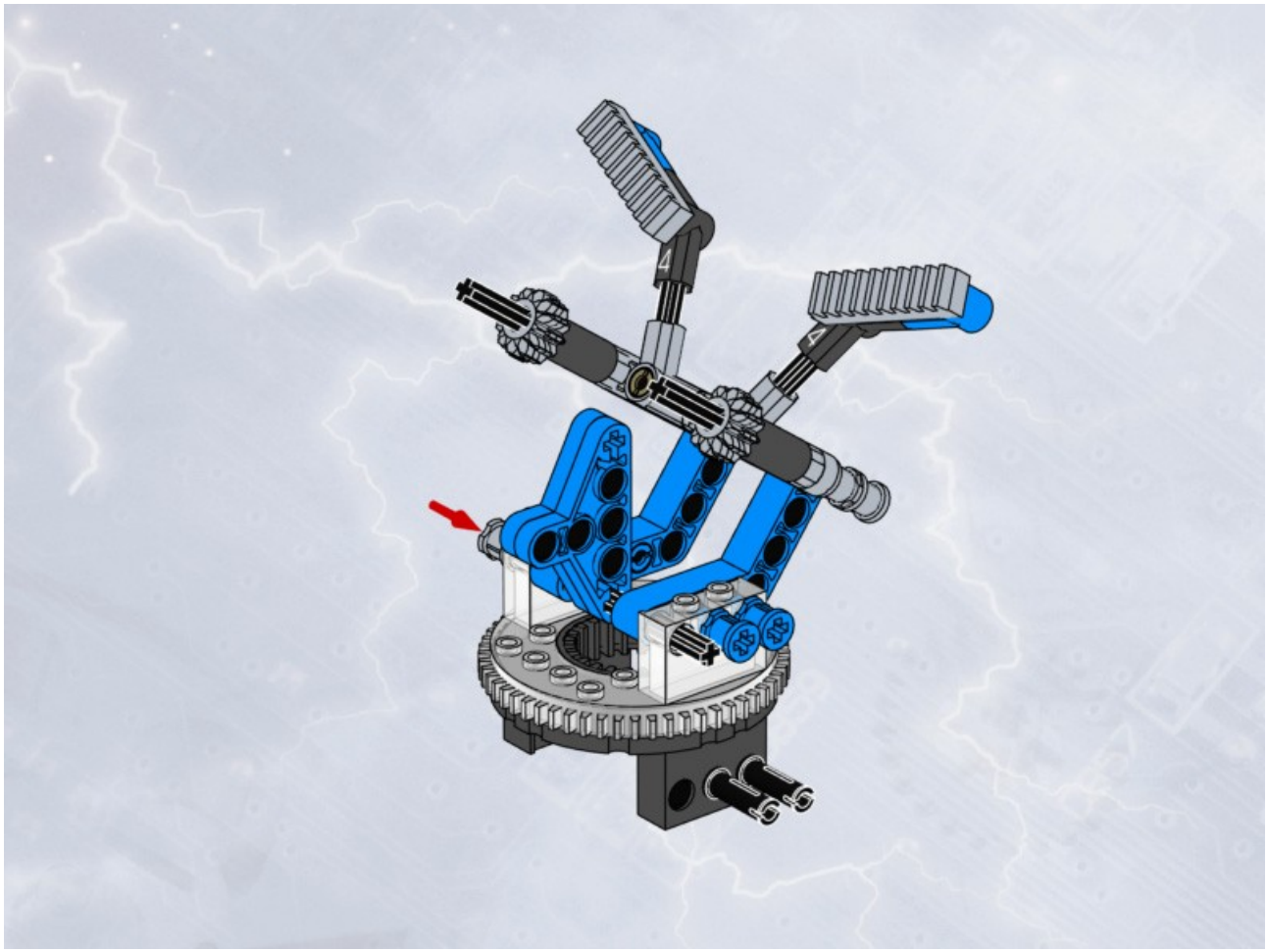

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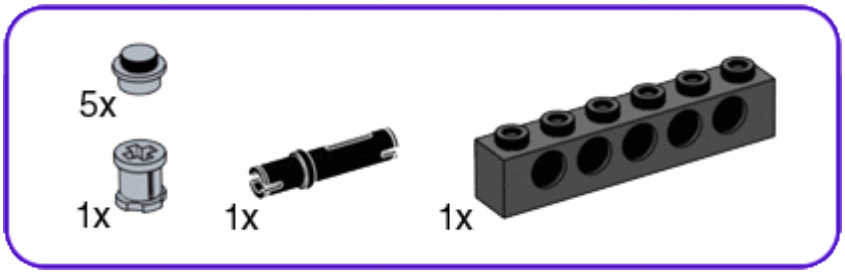

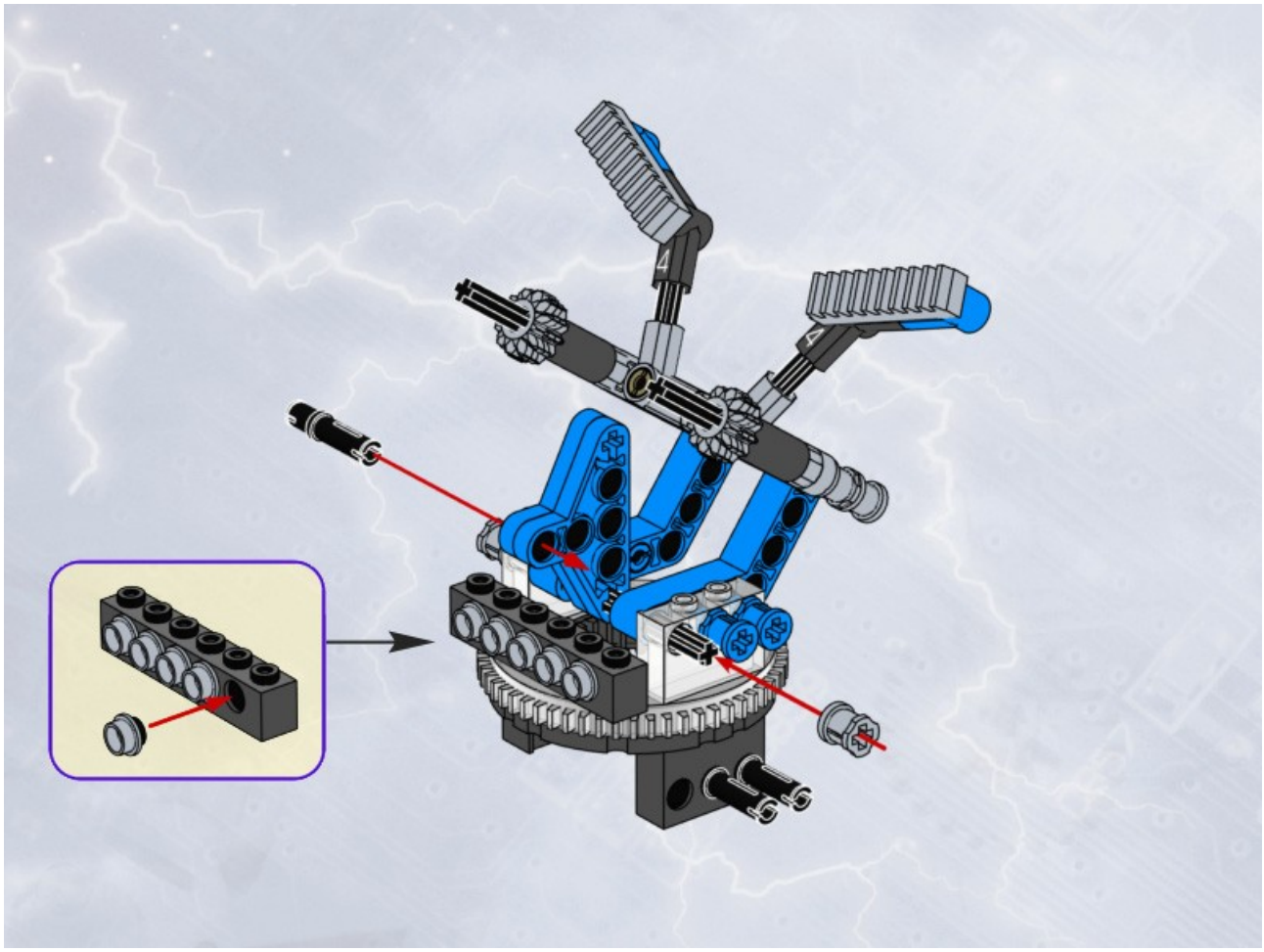

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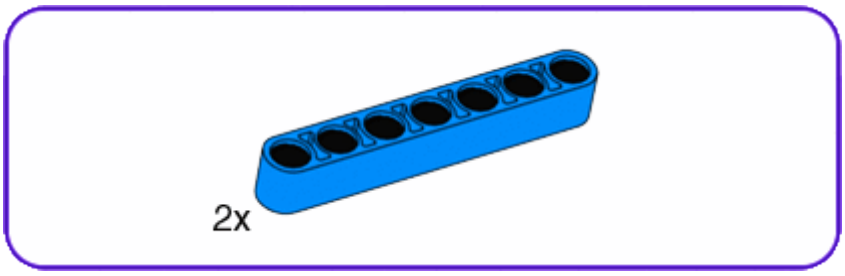

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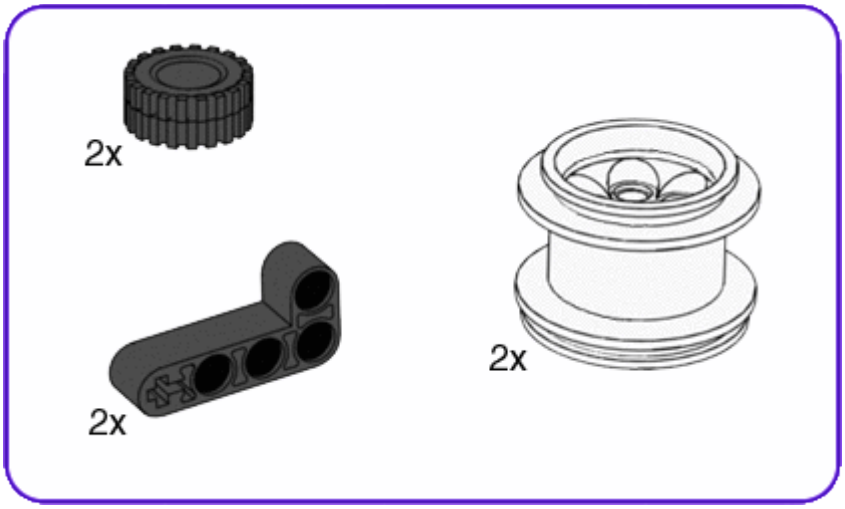

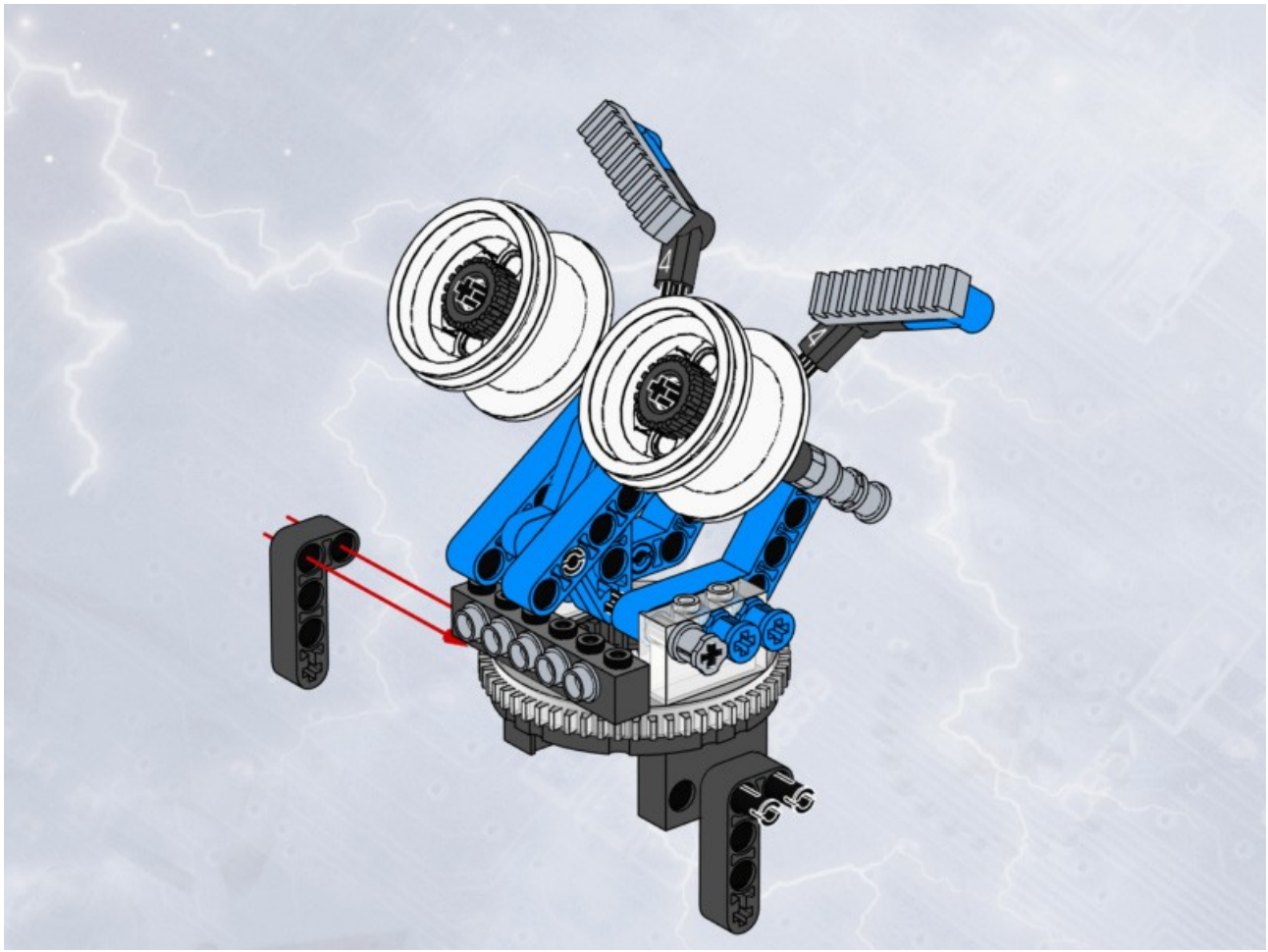

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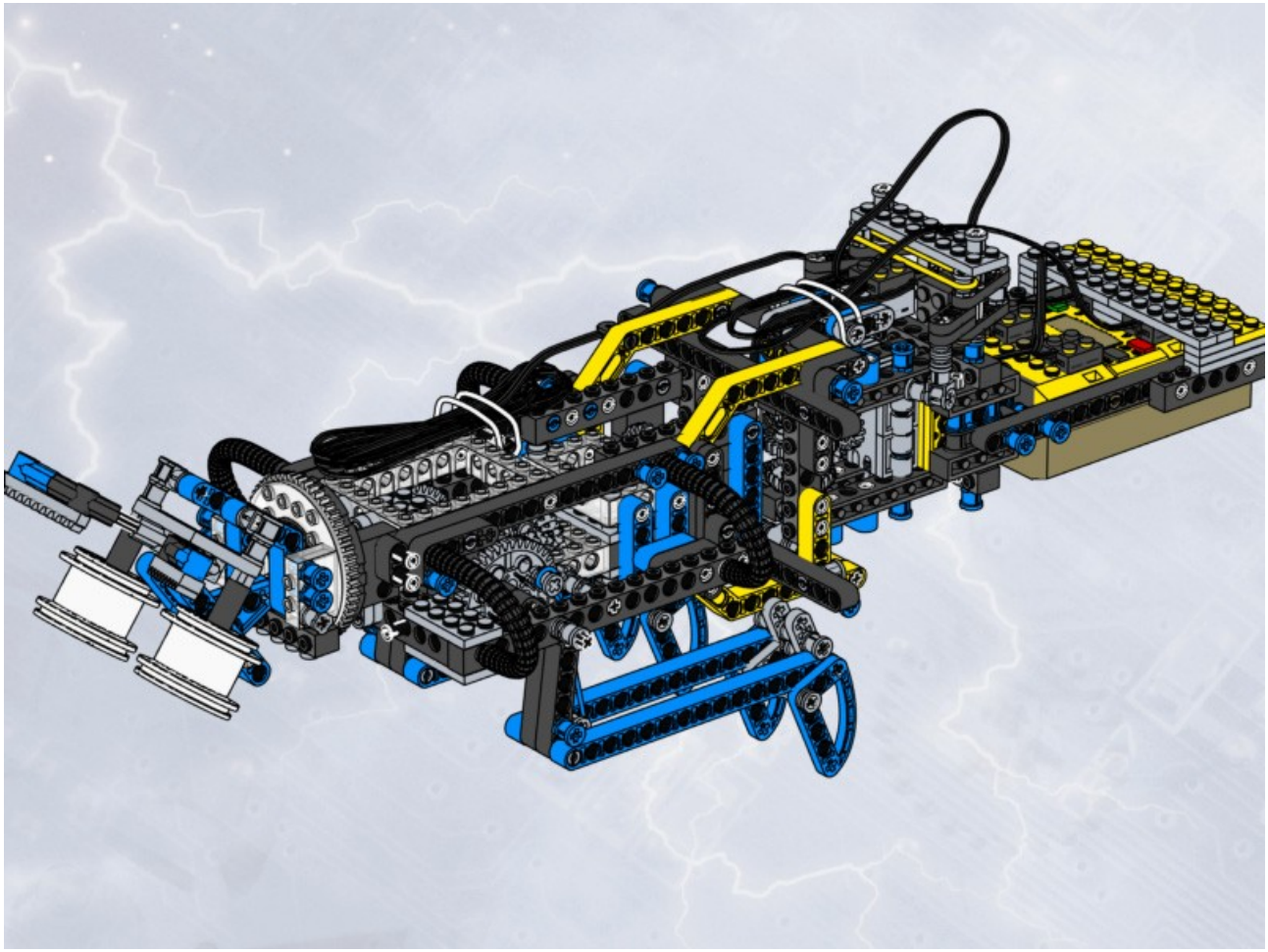


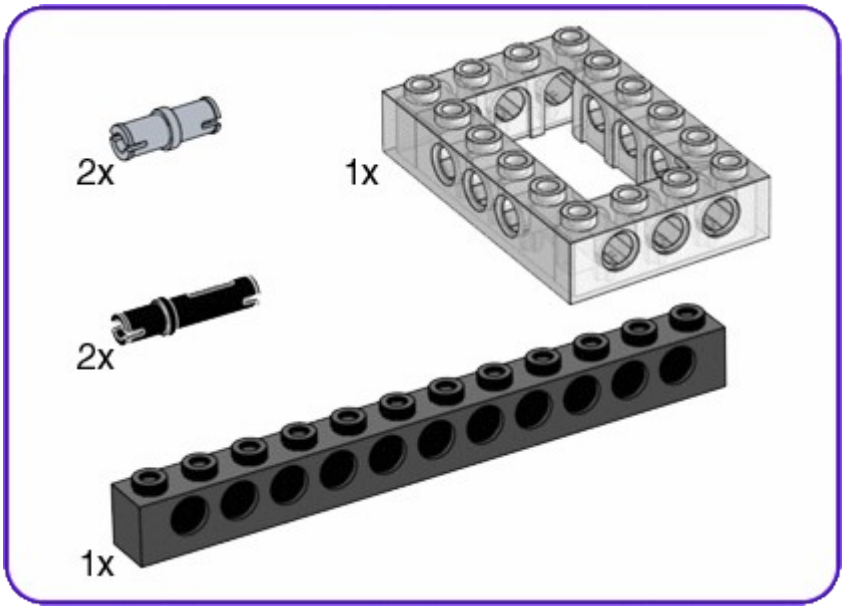
Disc Shooter

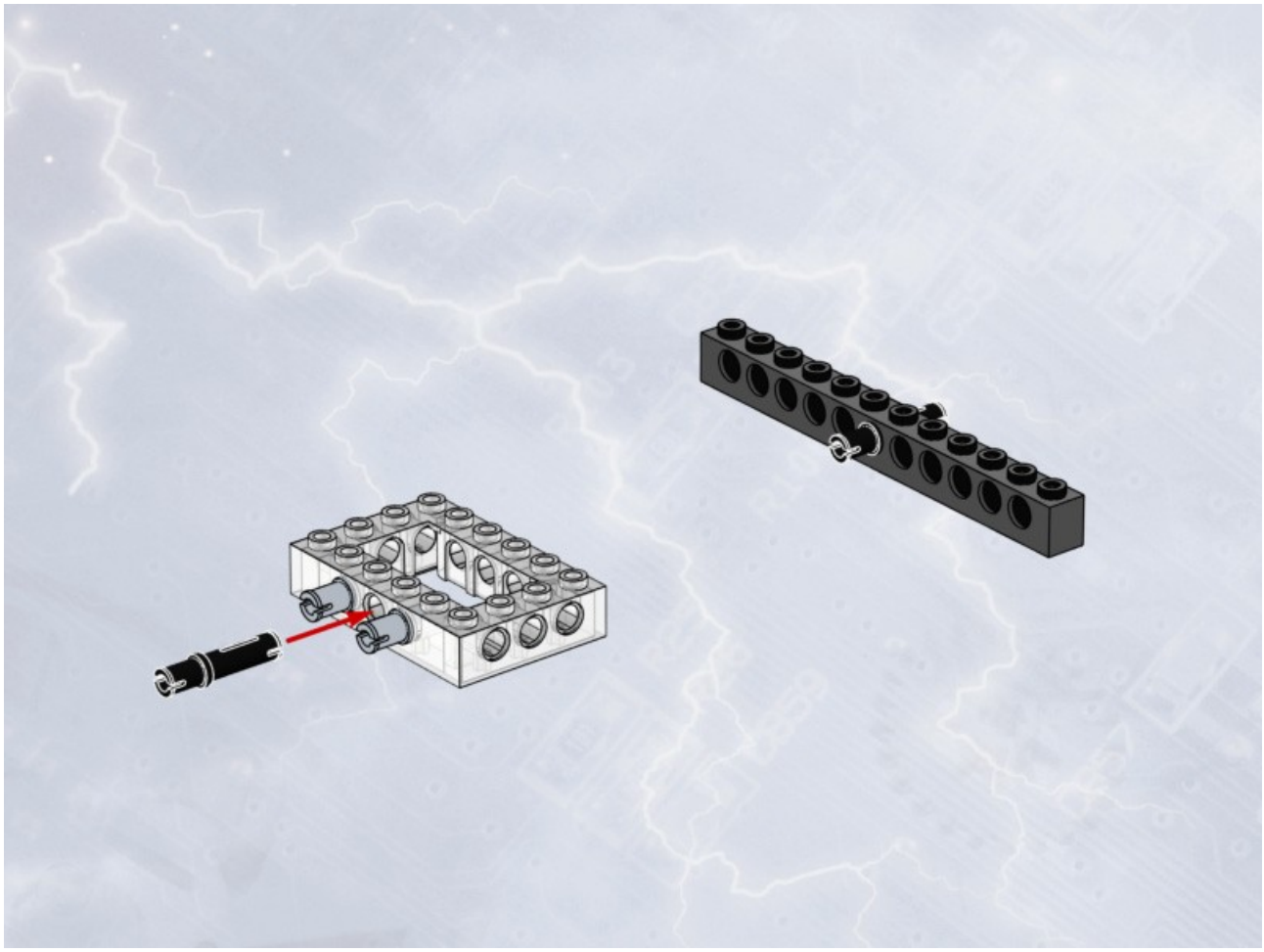
Required modules: 2 x Motor Module 2, Motor Module 4, Shooter Module, Shooter Track Module

Make sure you build all the modules before starting this step, note that you will need two Motor Modules 2s.

Try setting up six targets and see if you can program your disk shooter to hit all six.

1





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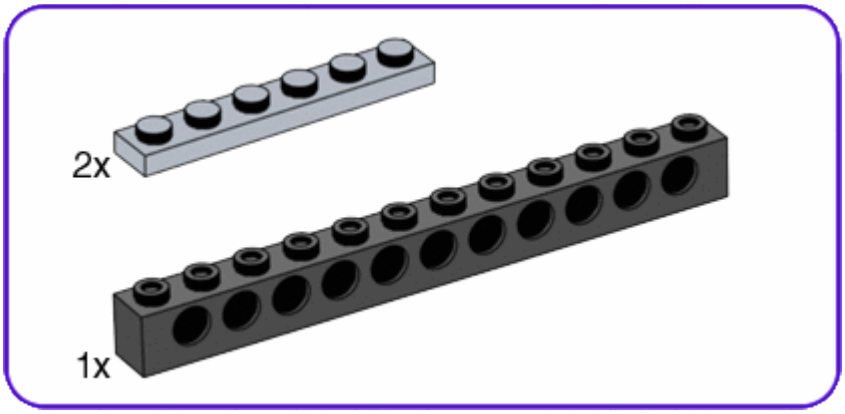

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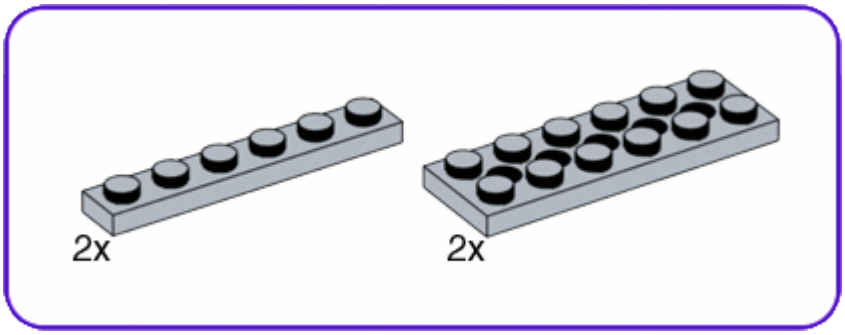

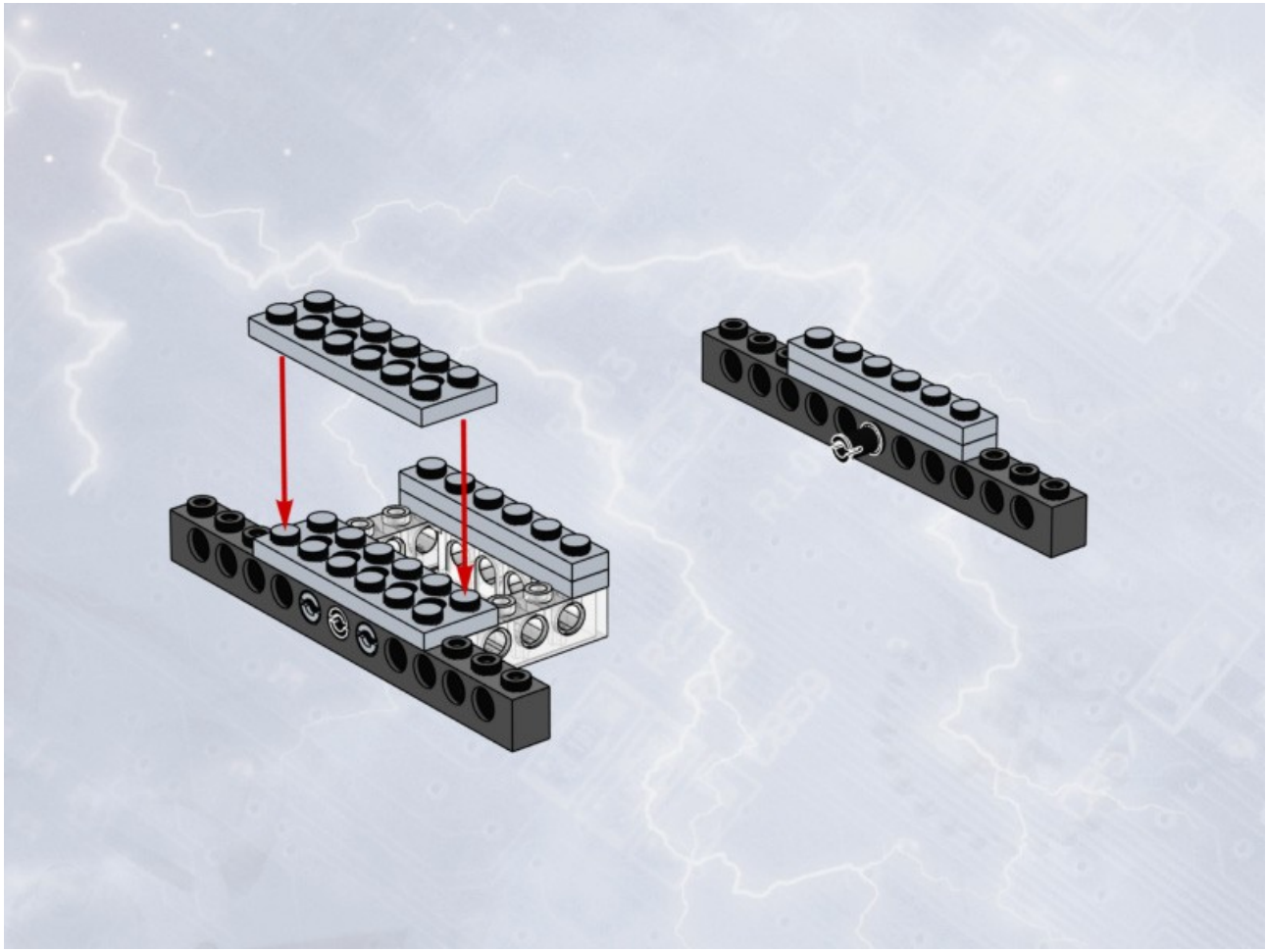

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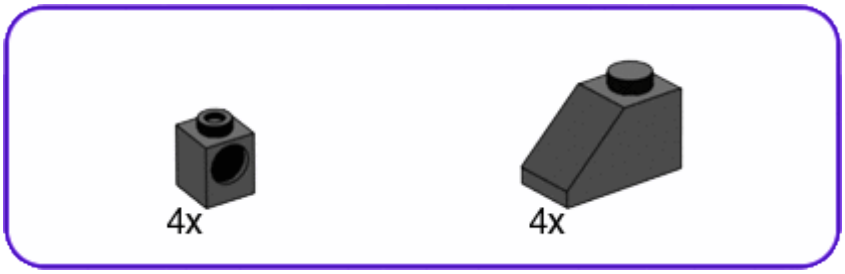

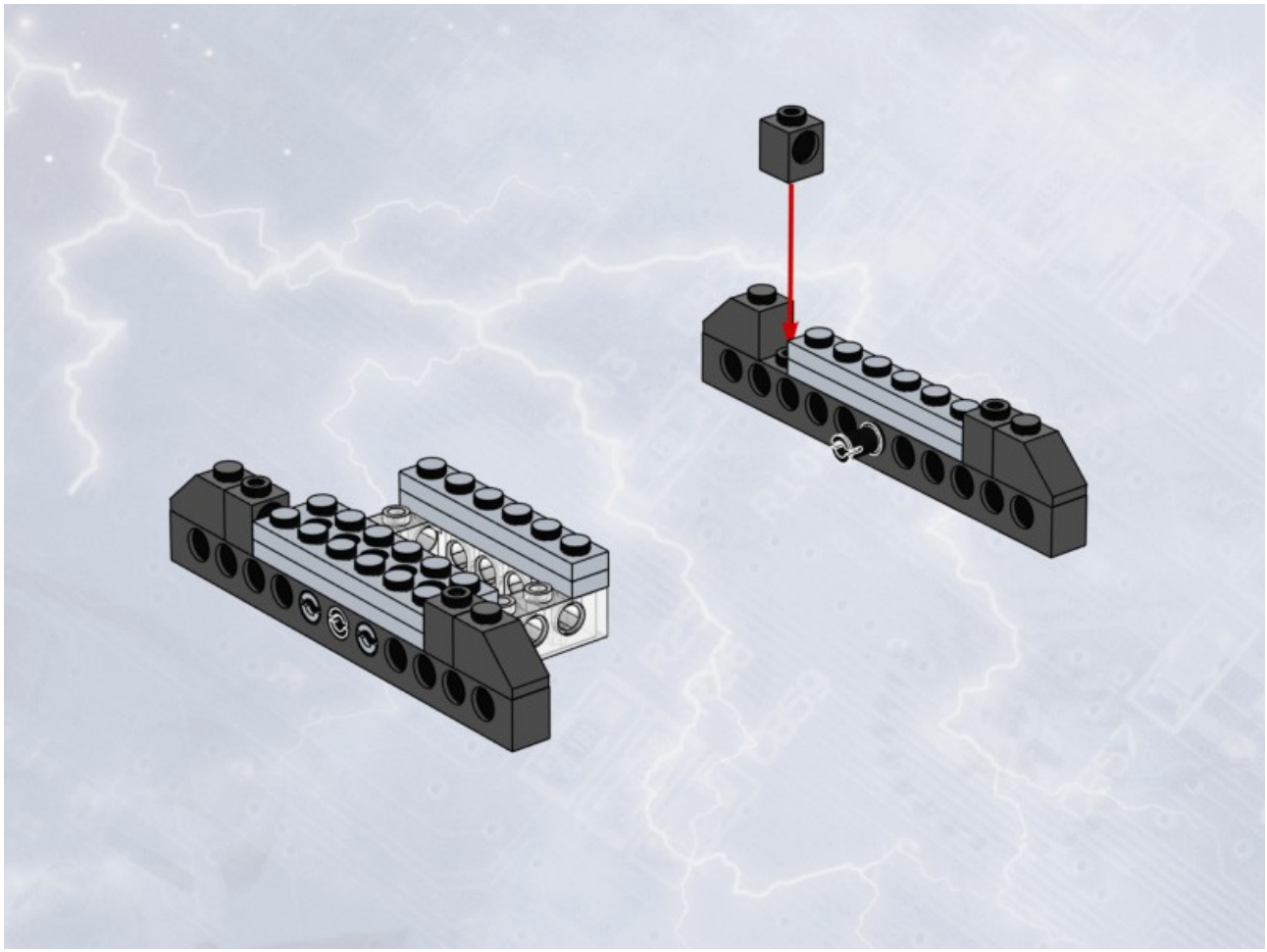

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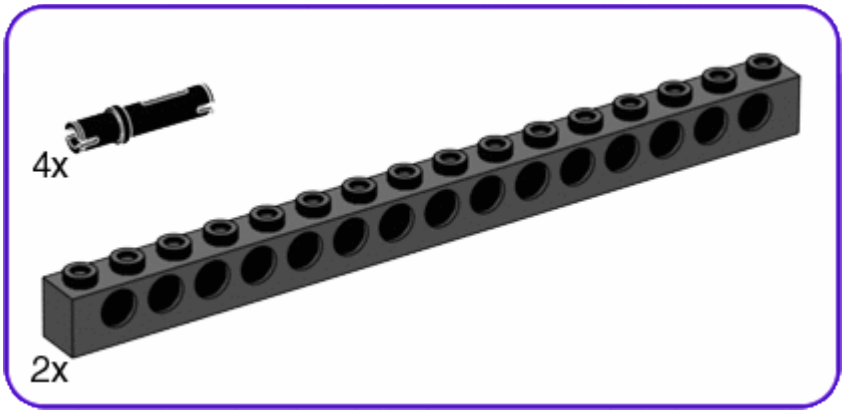

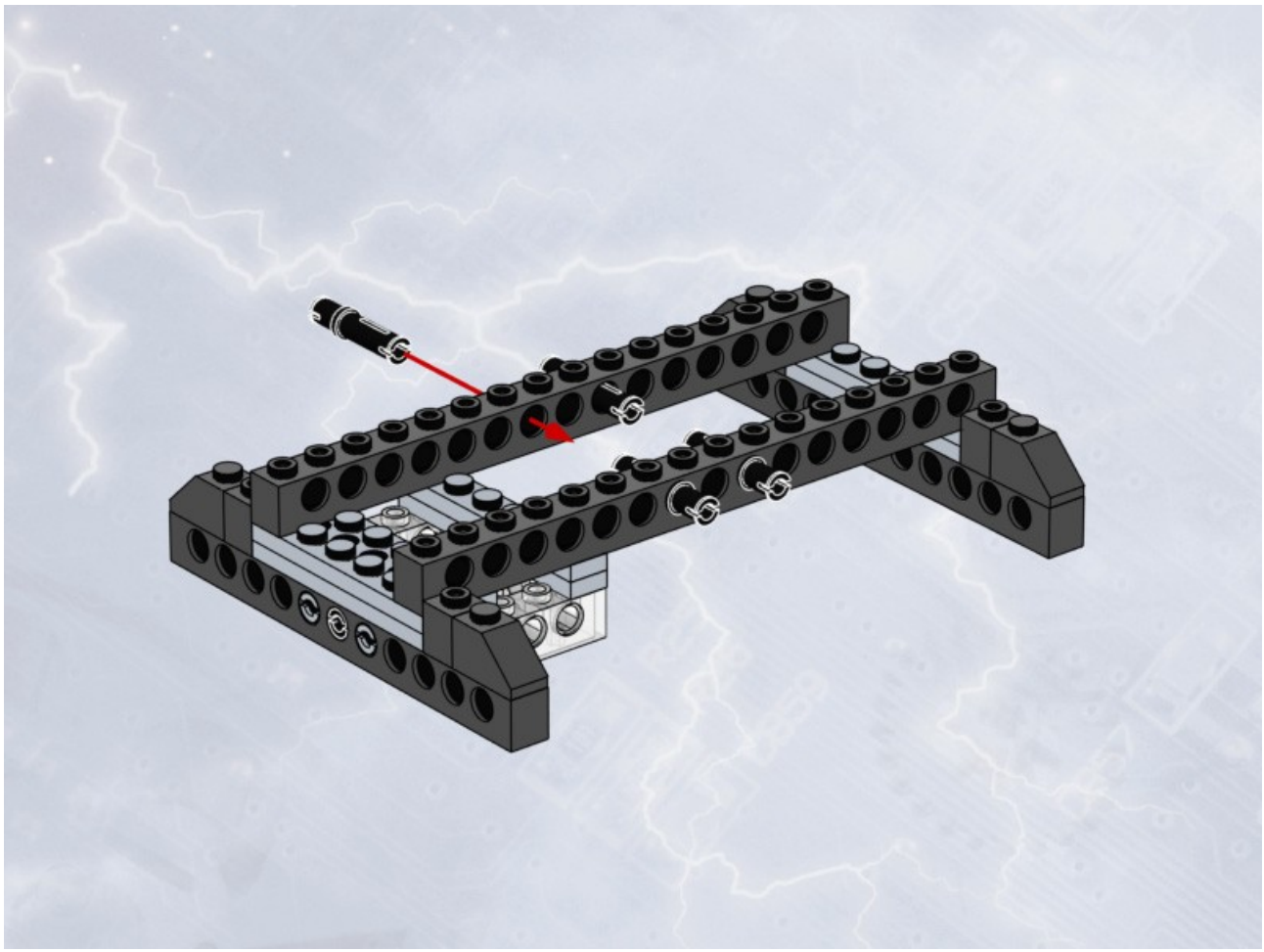

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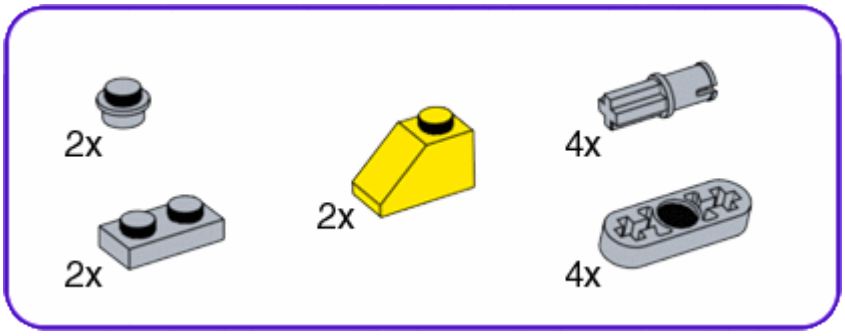

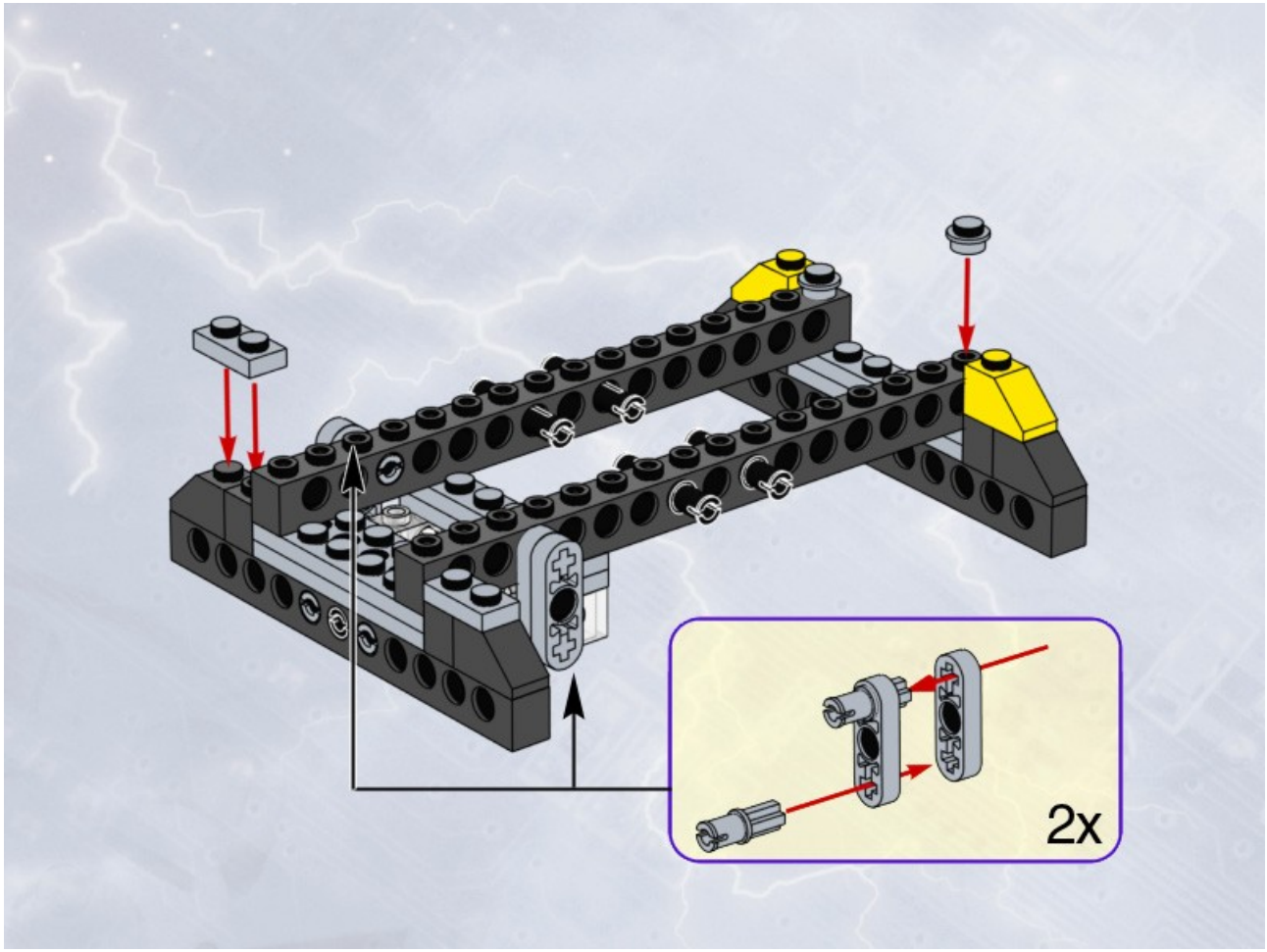

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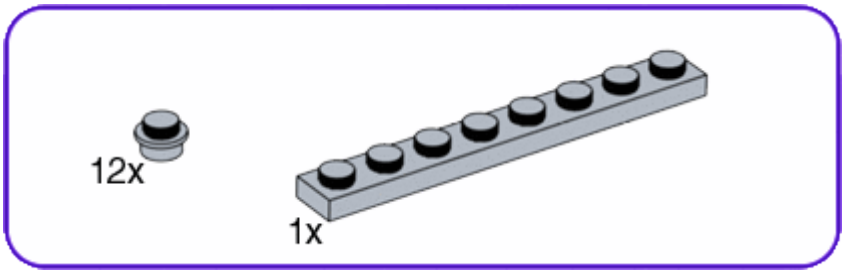

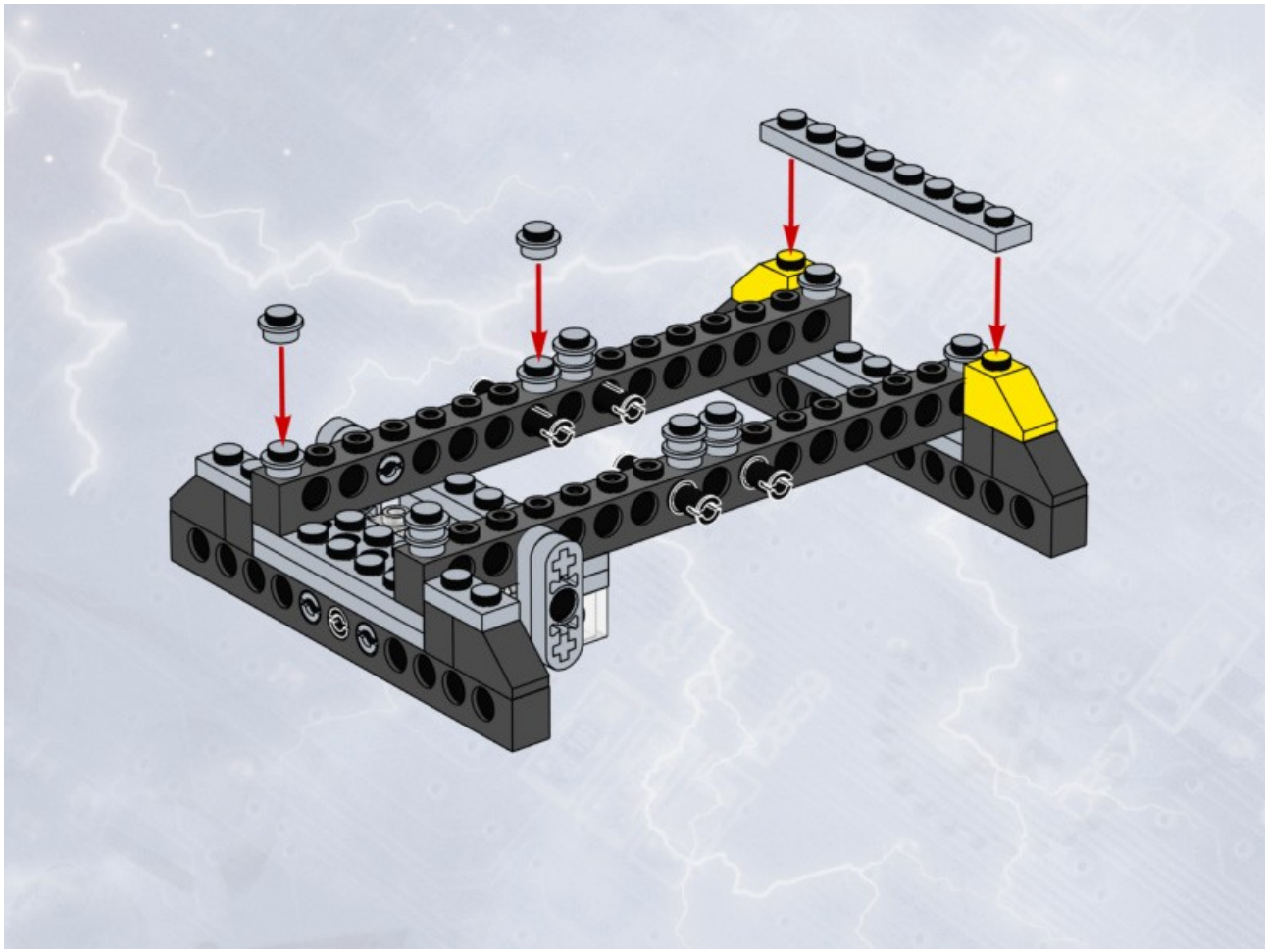

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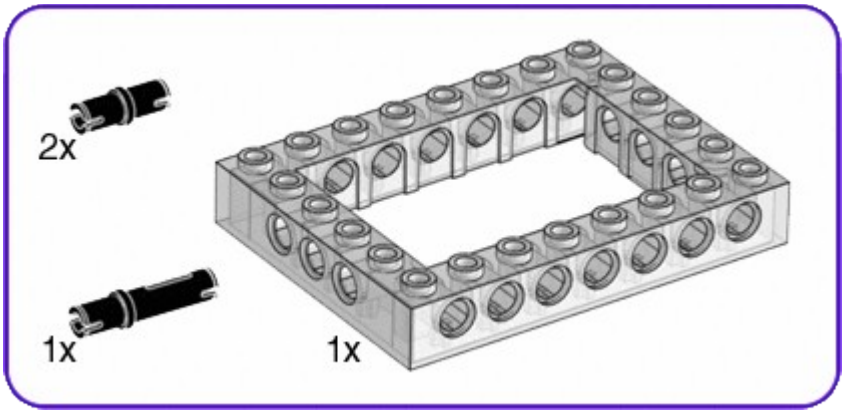

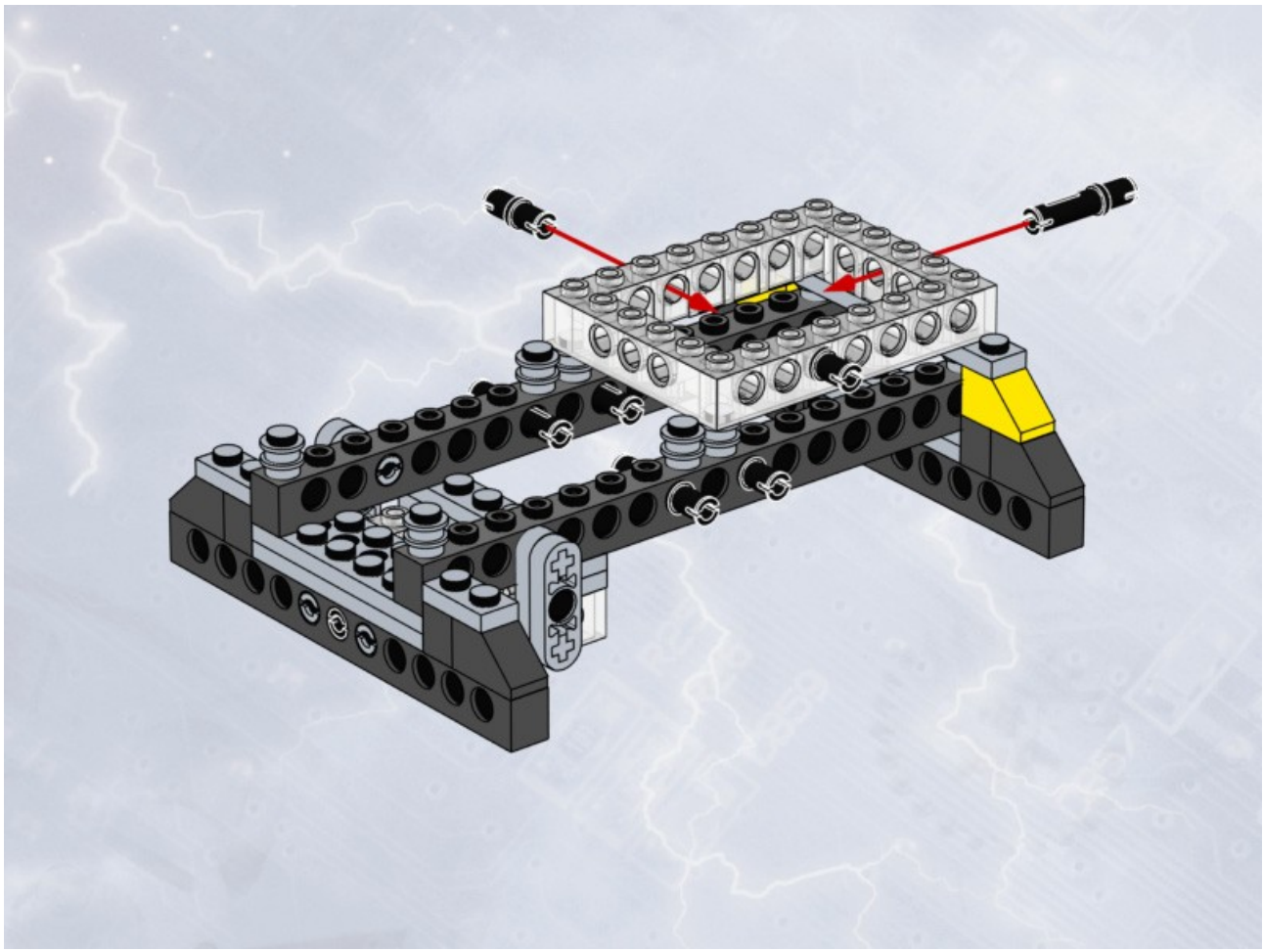

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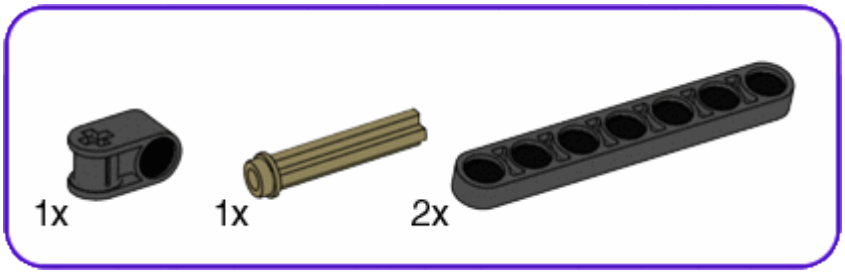

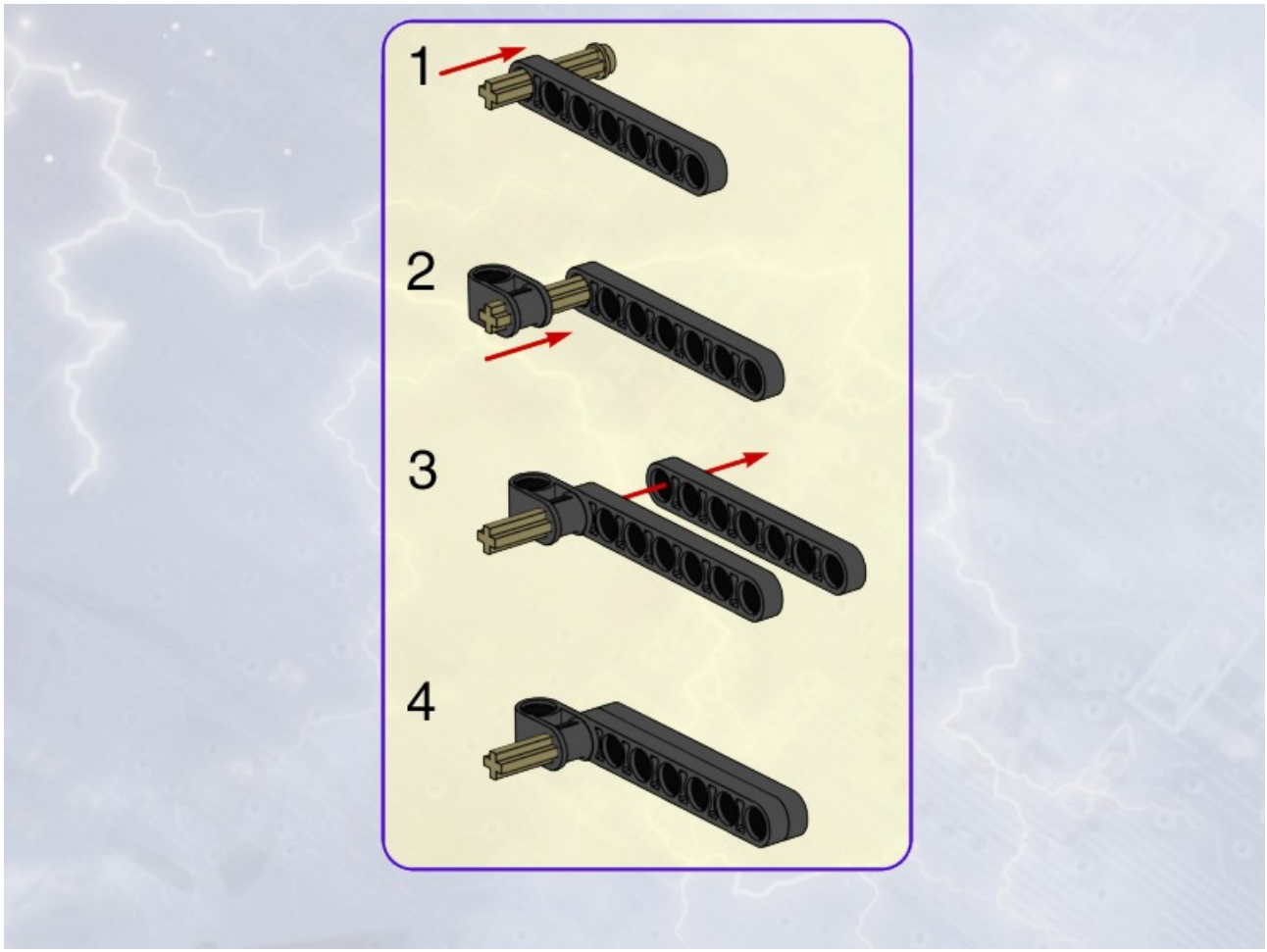

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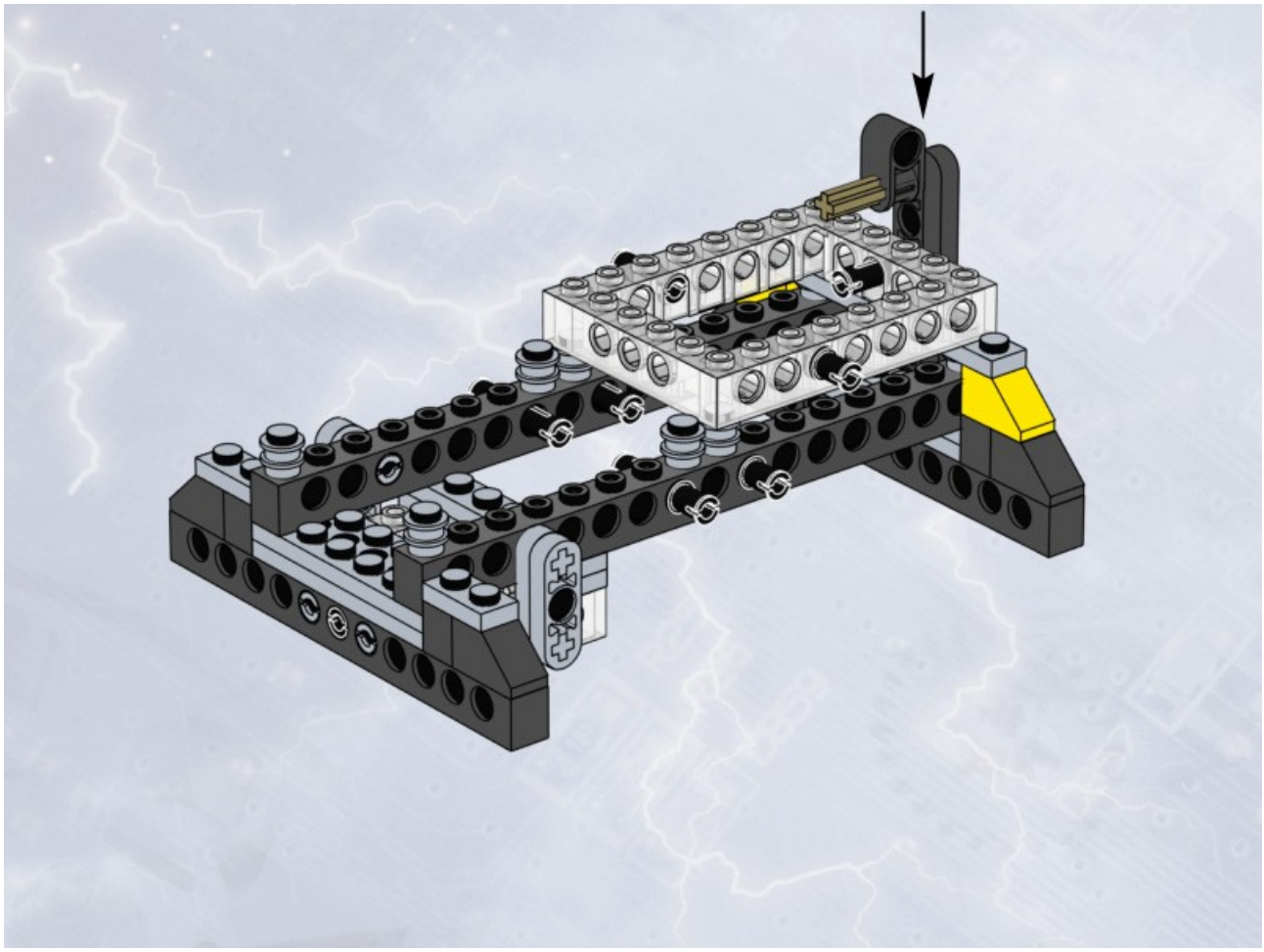

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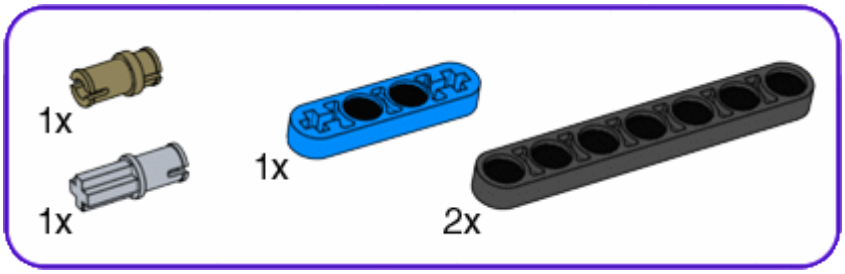

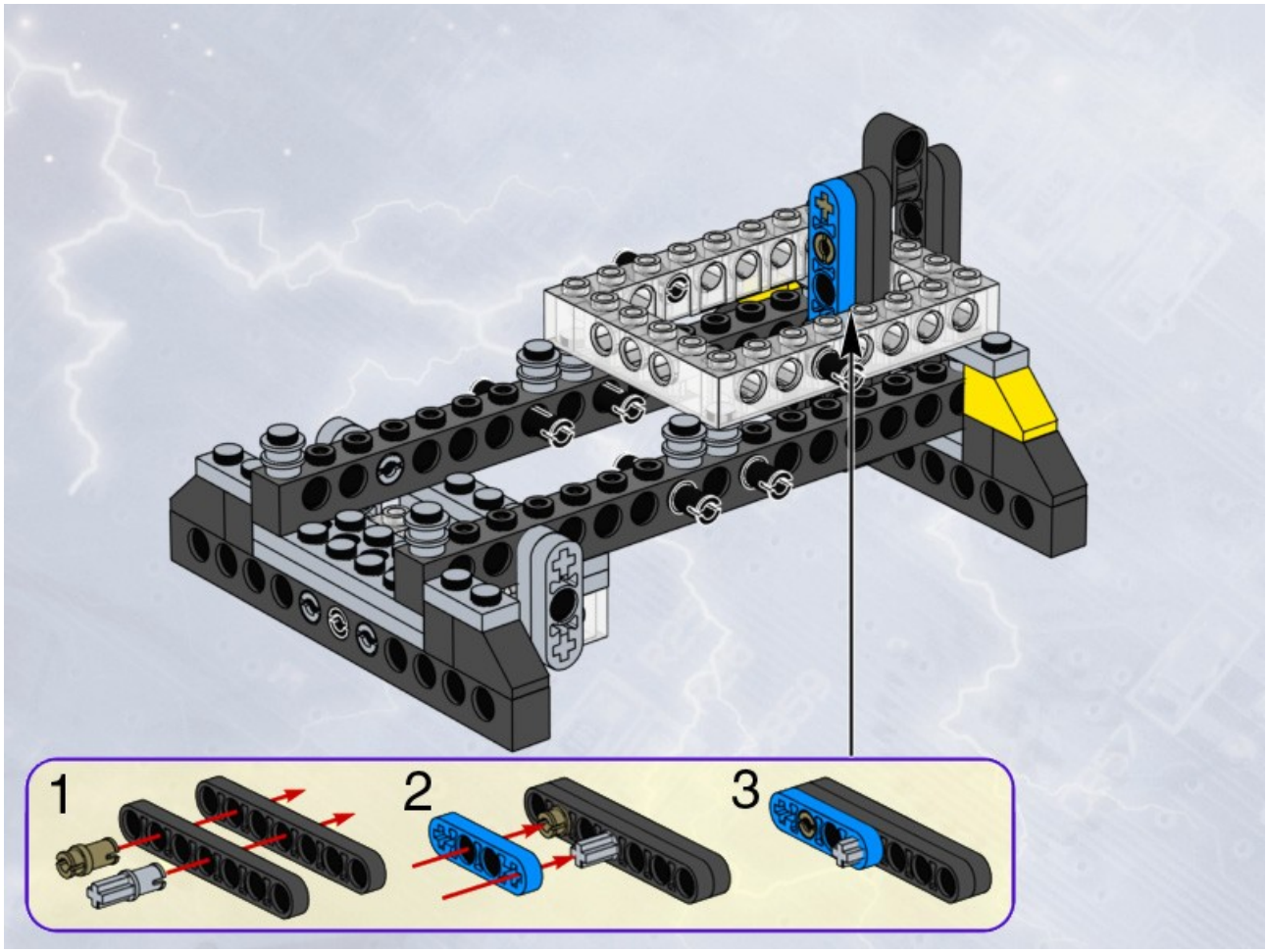

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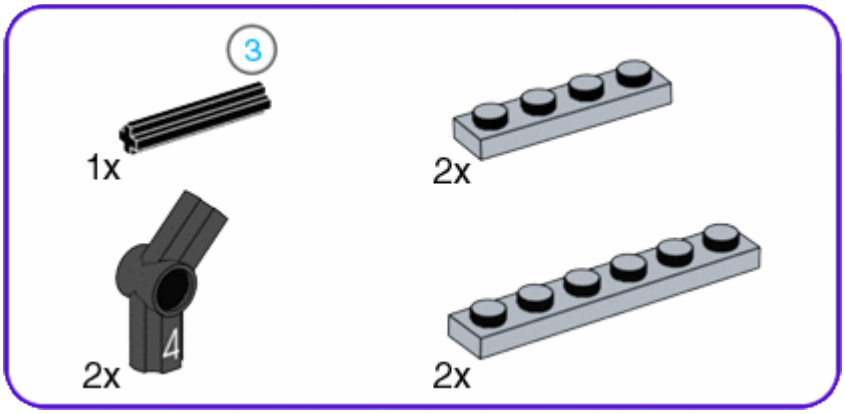

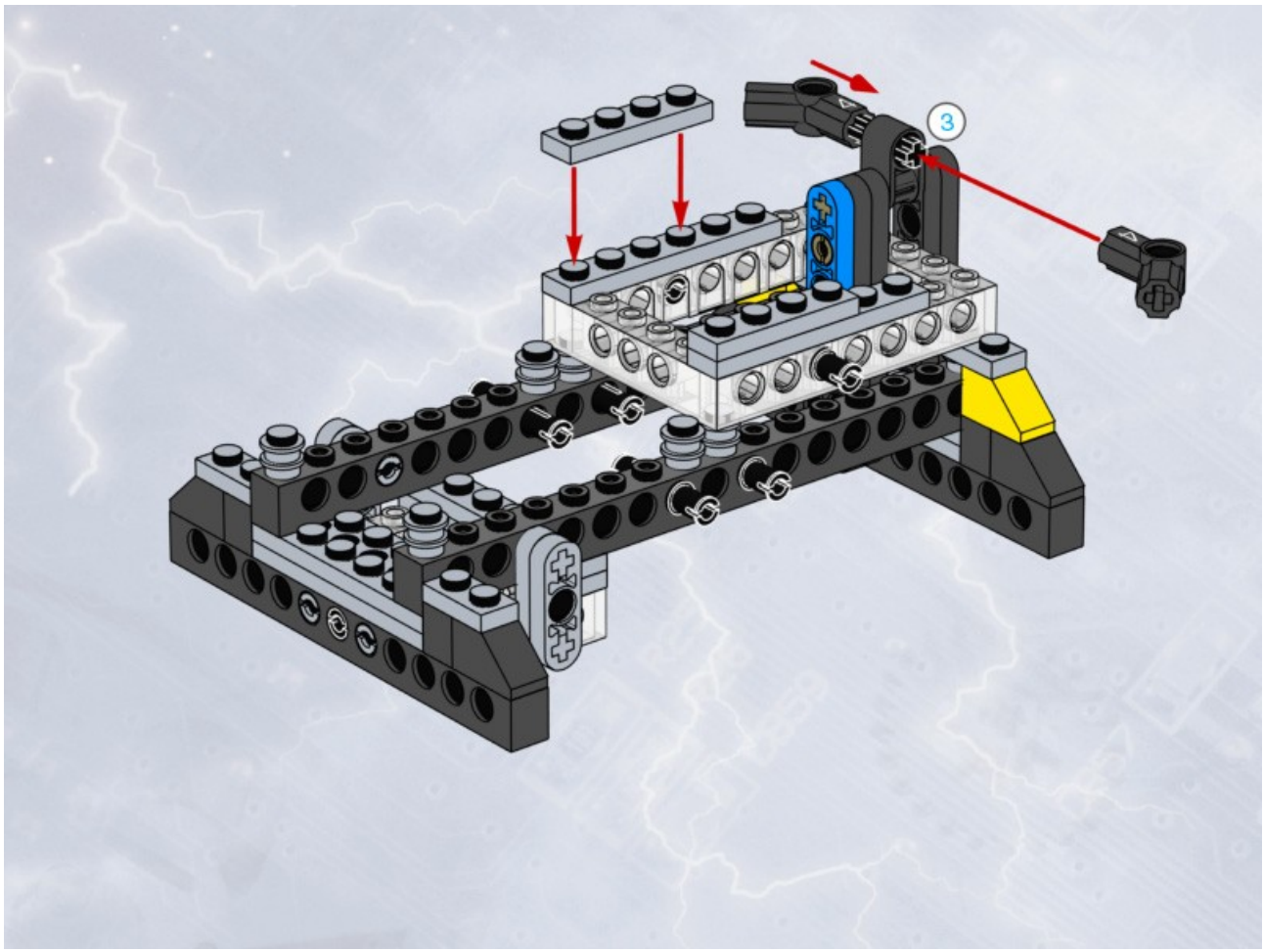

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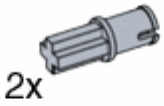

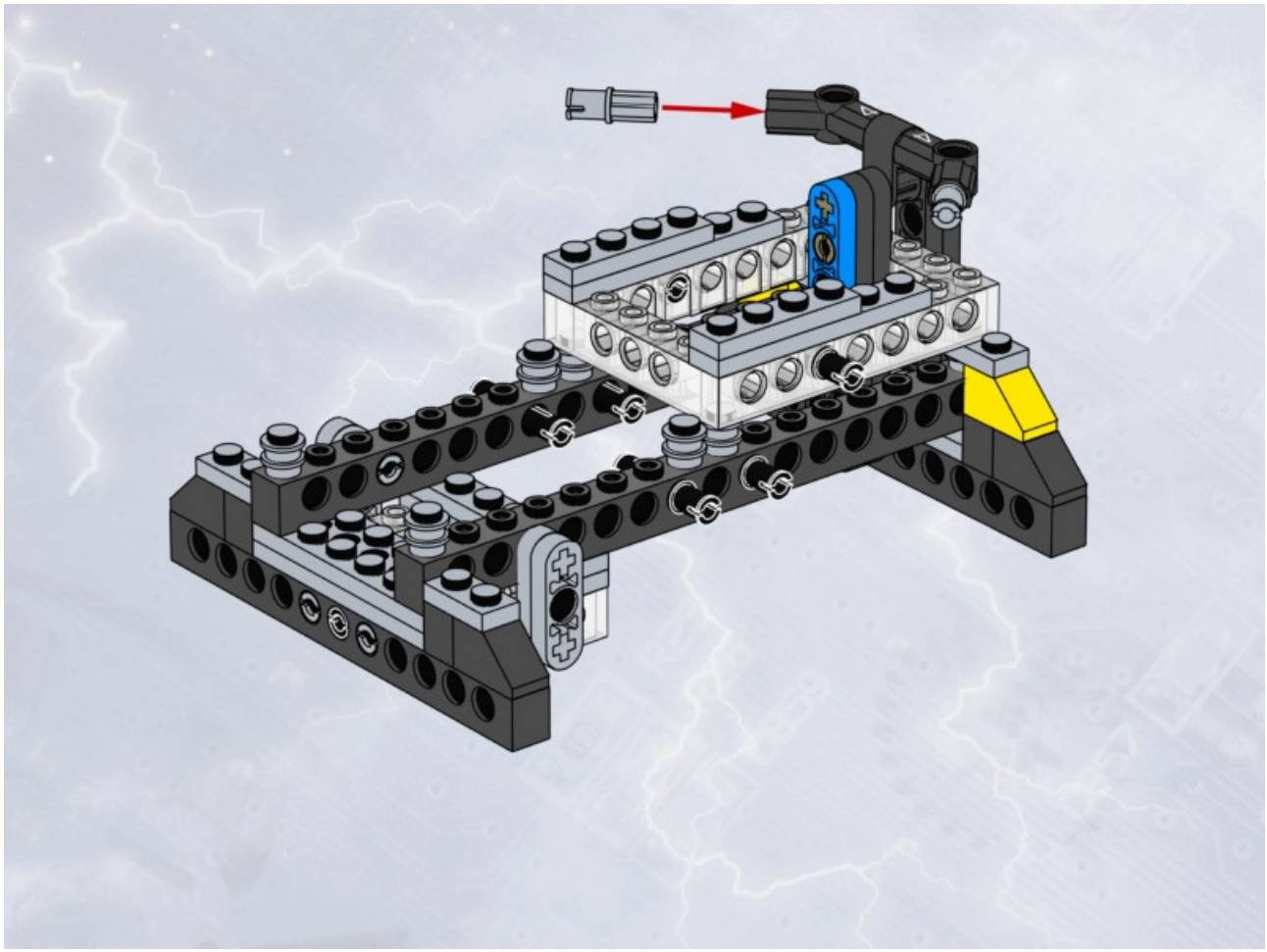

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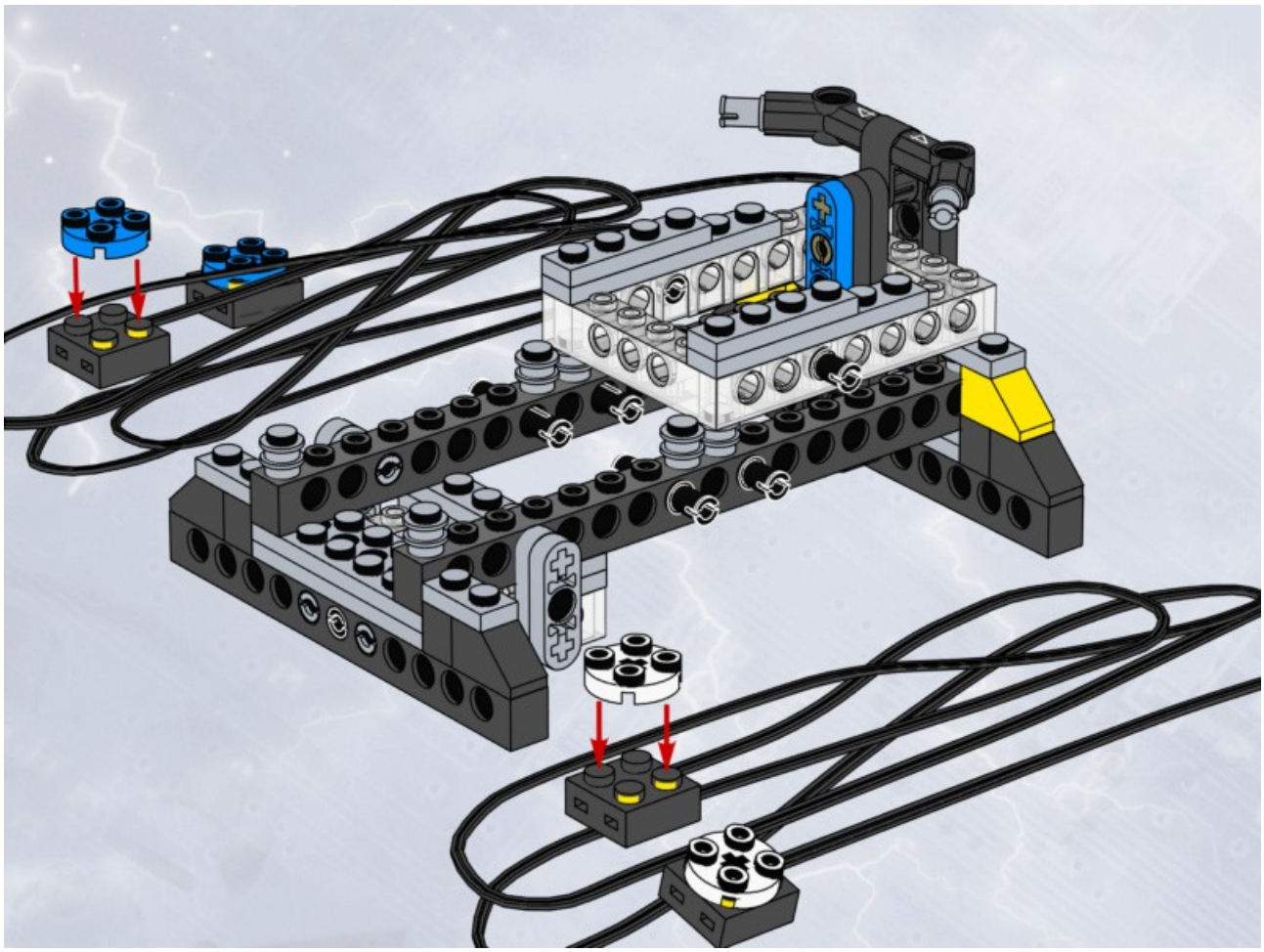

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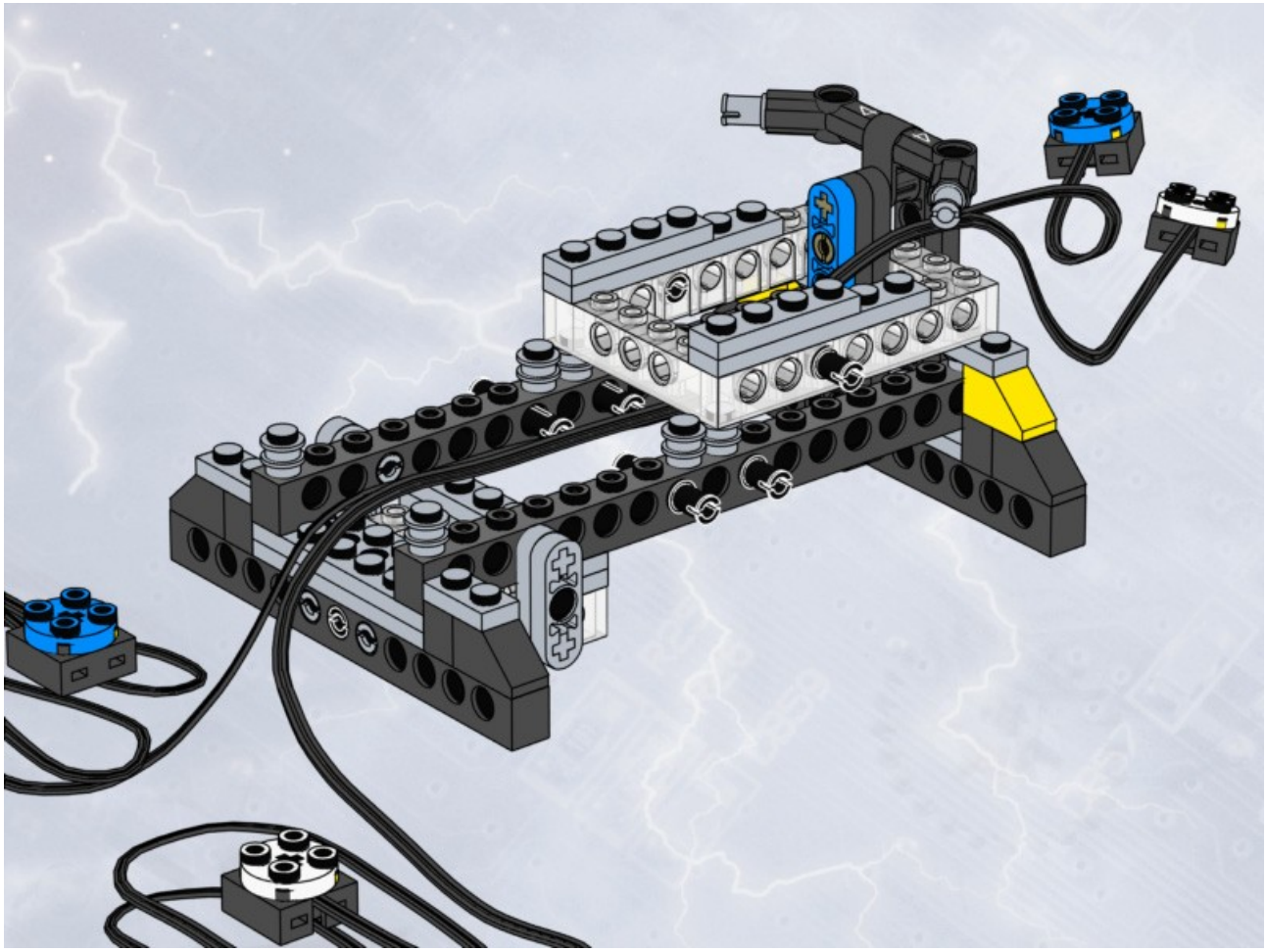

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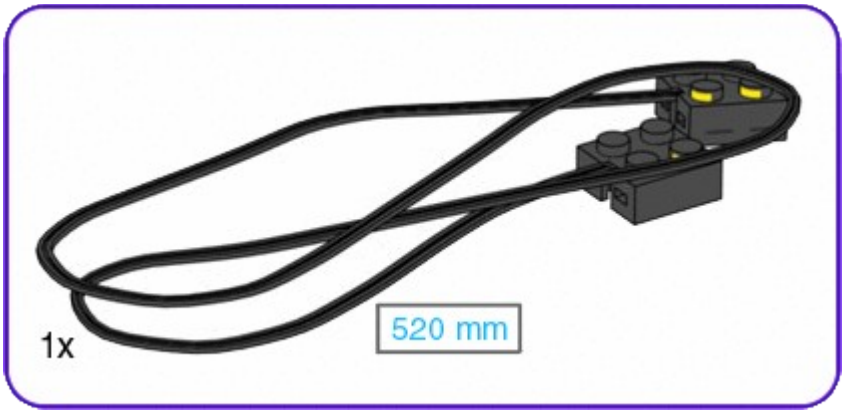

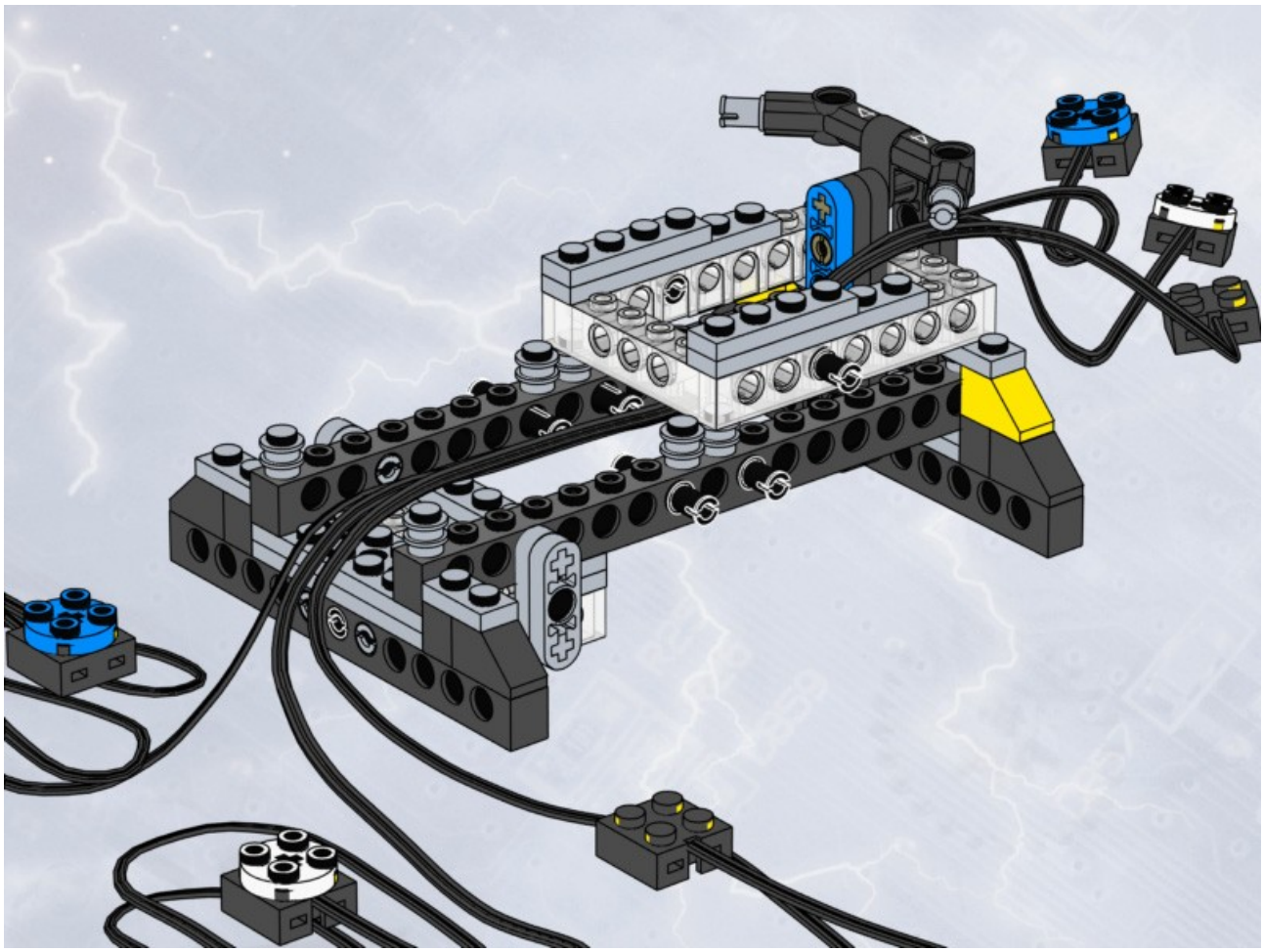

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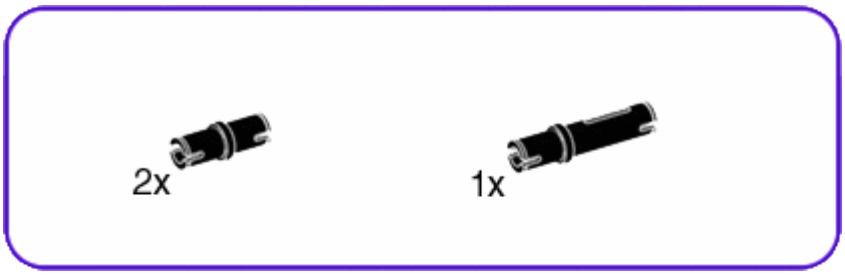

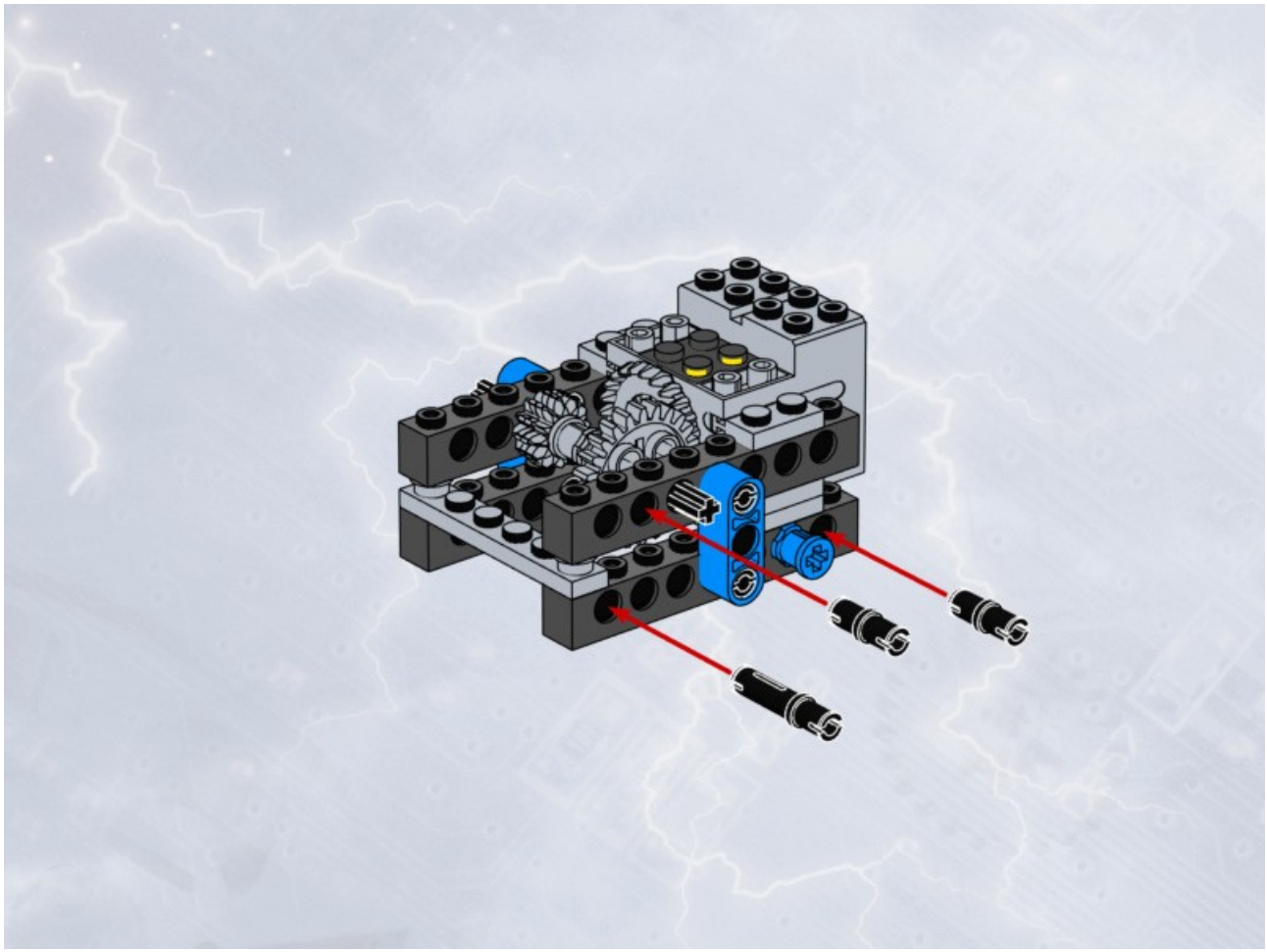

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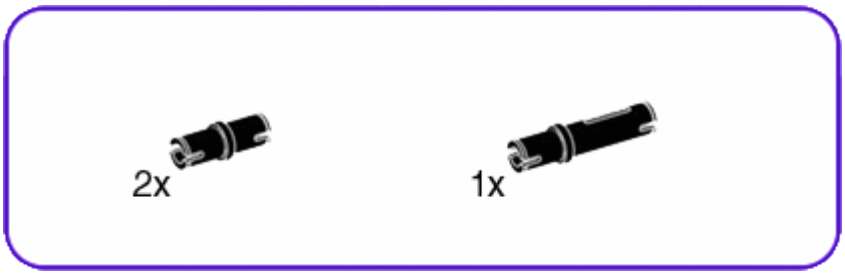

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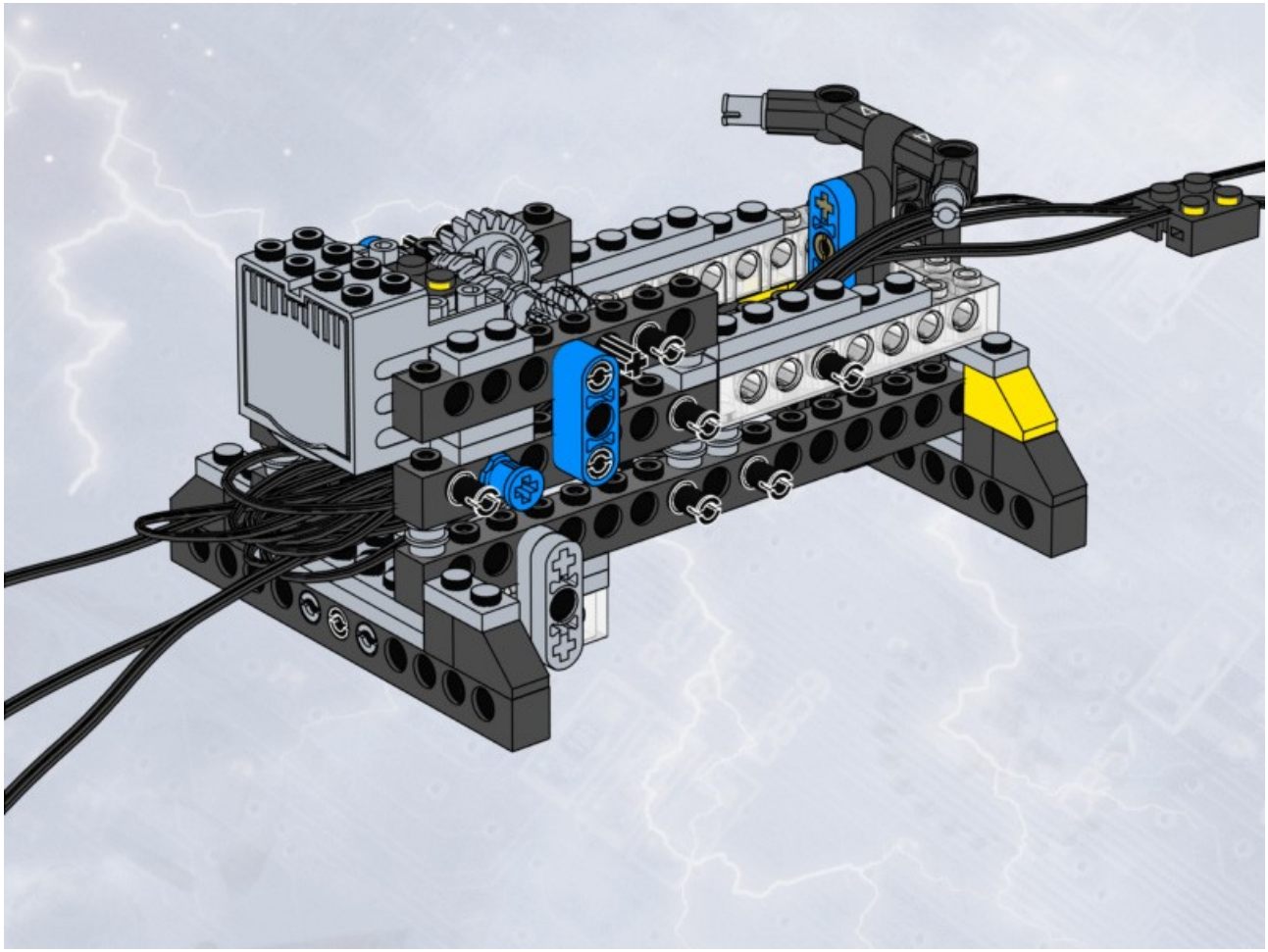

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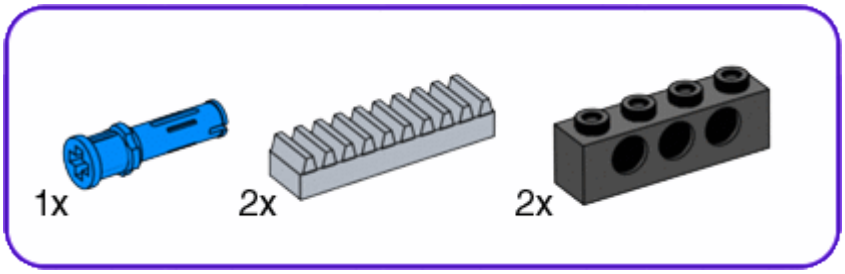

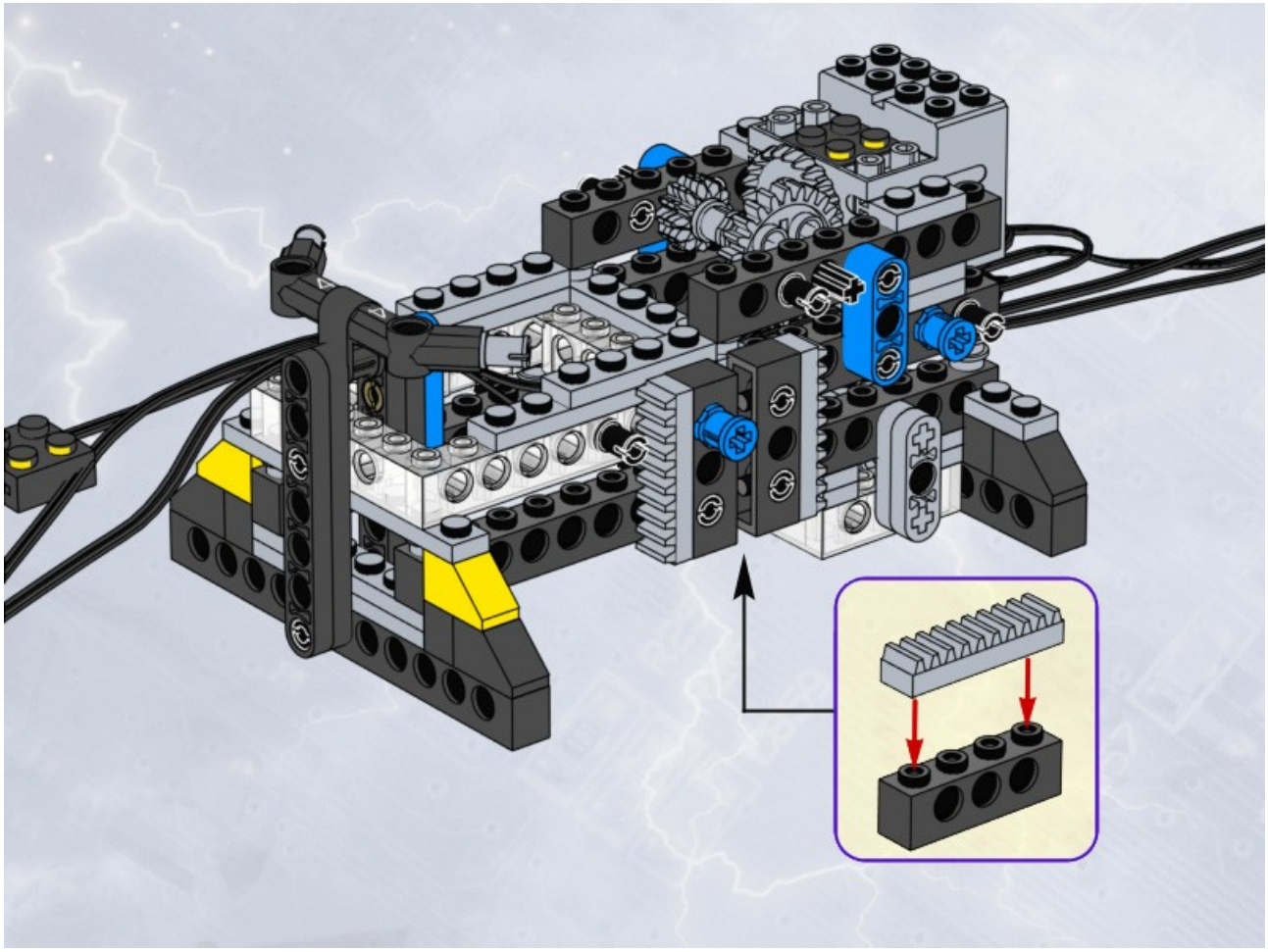

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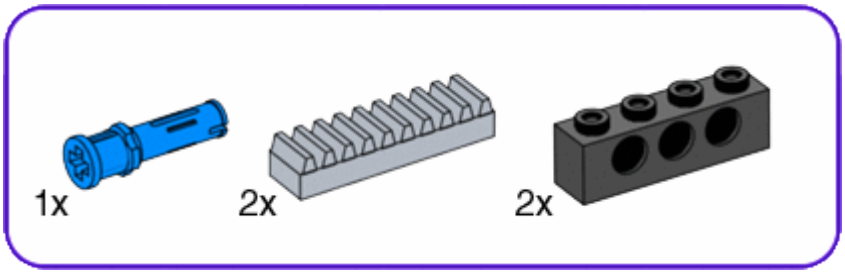

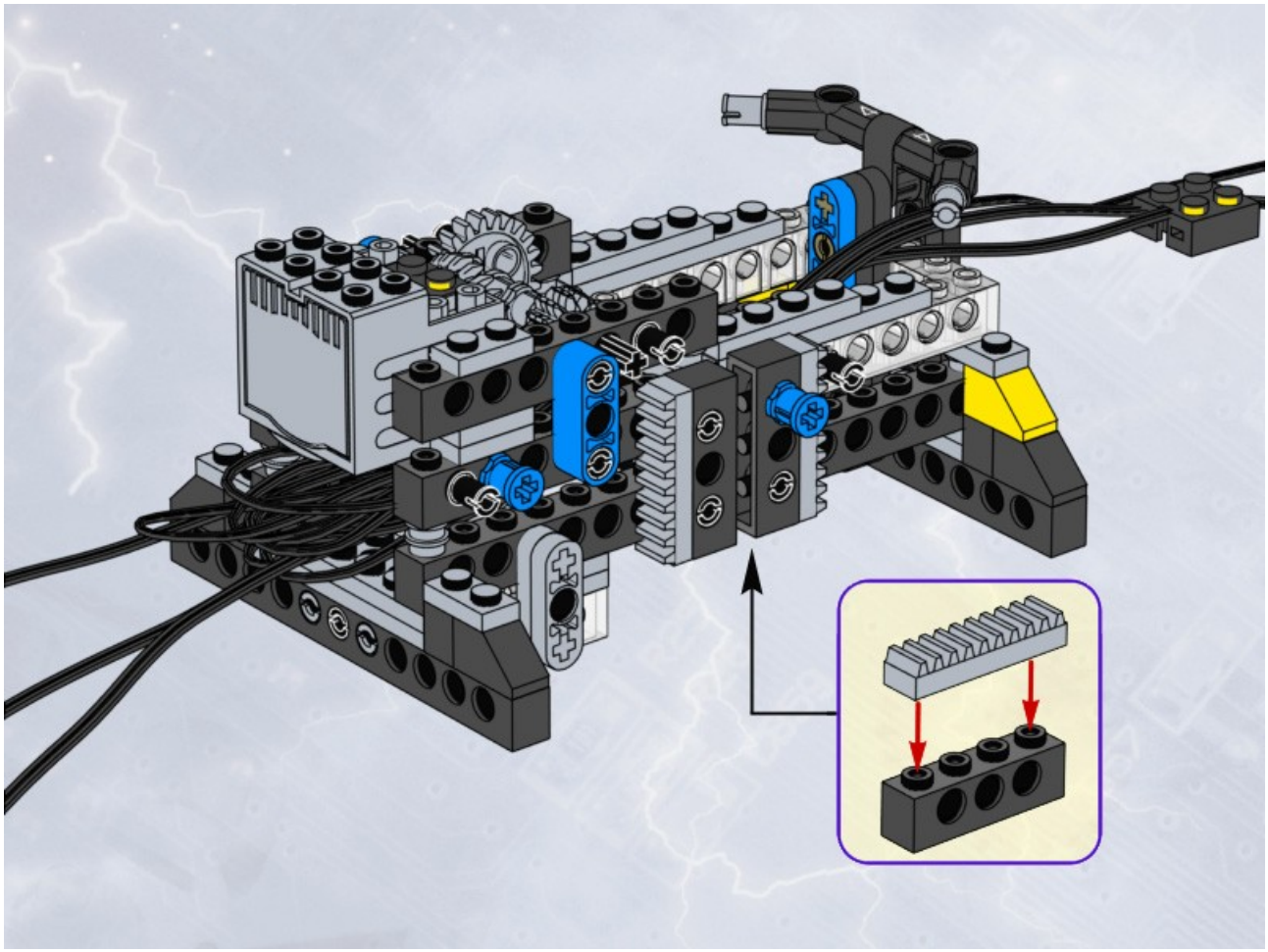

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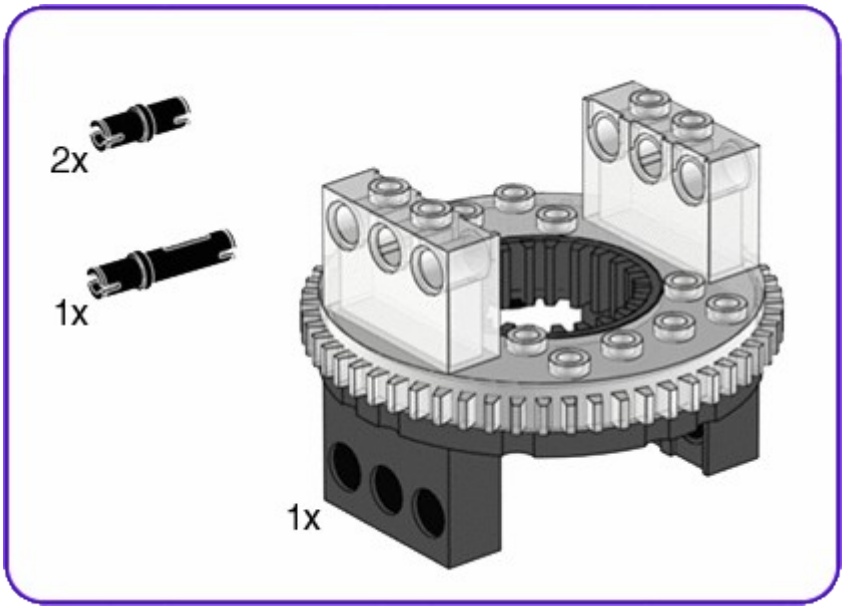

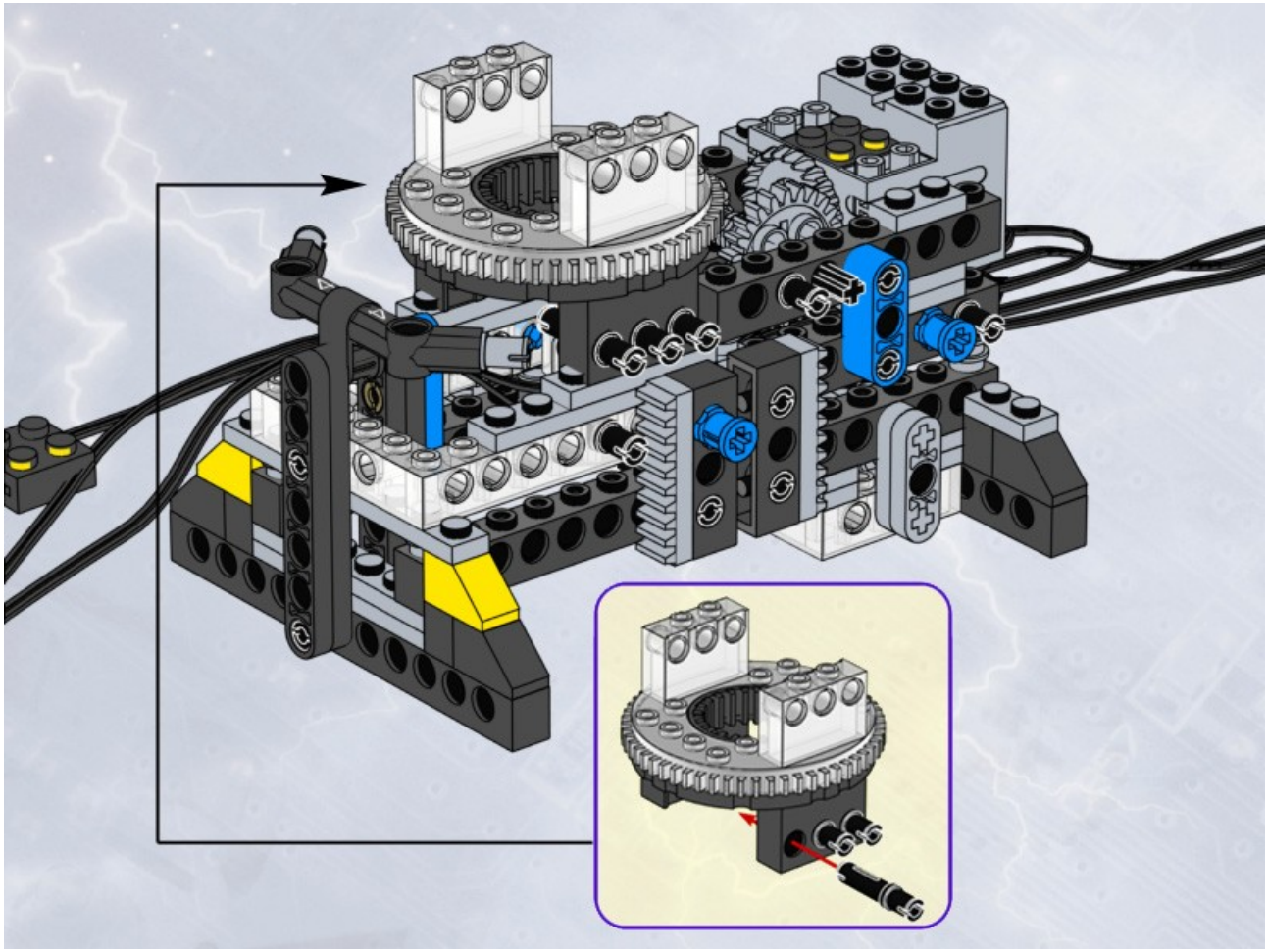

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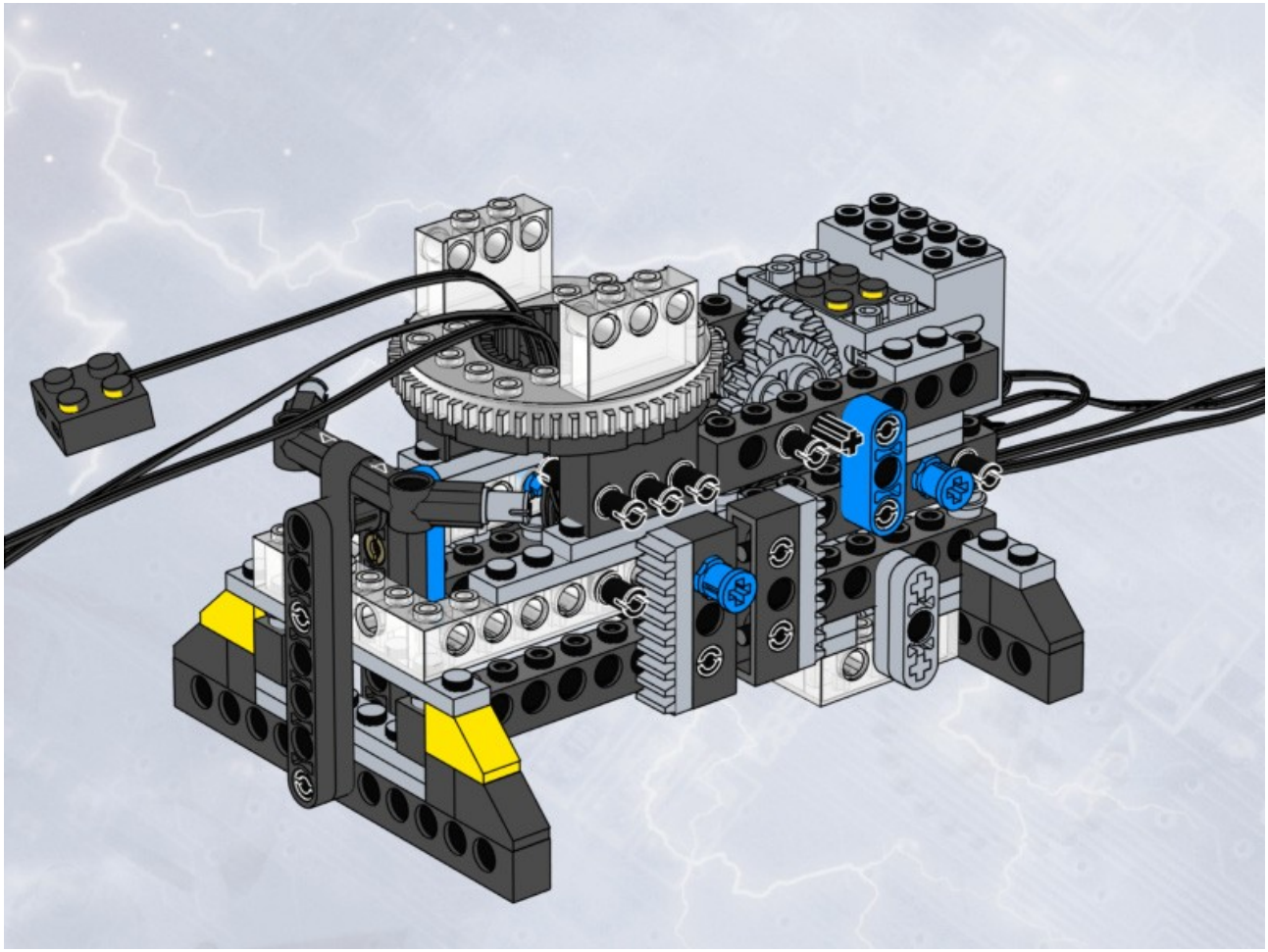

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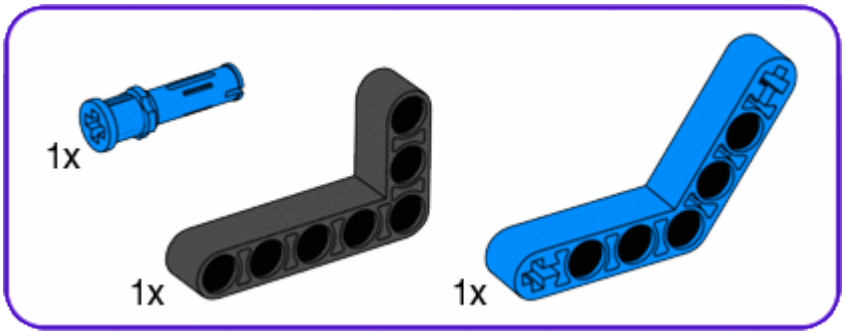

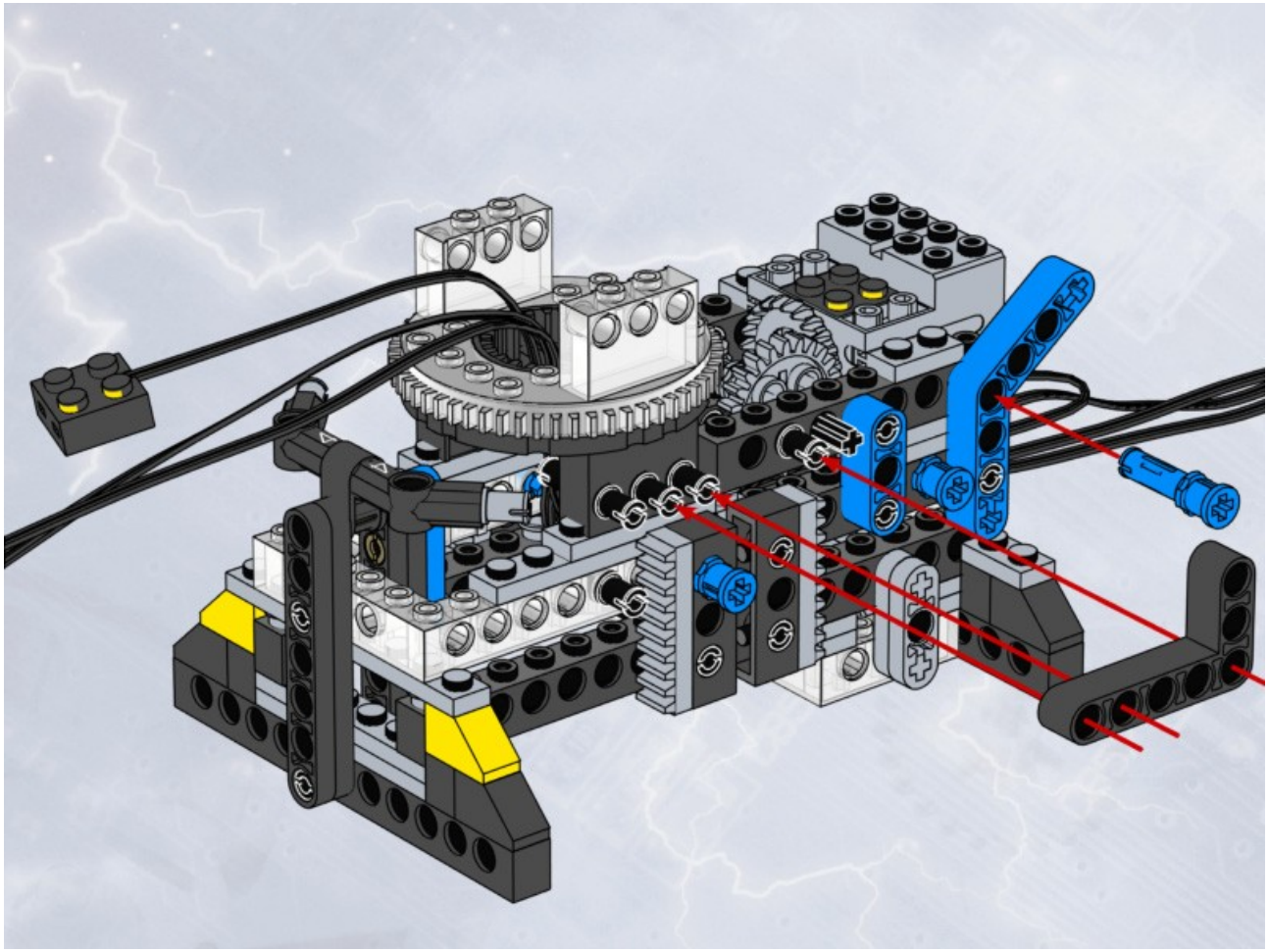

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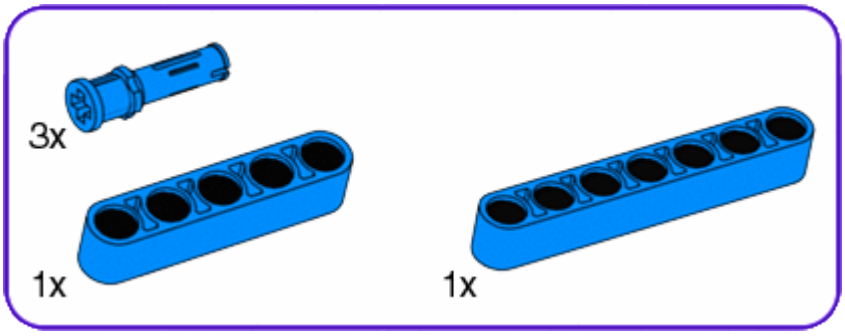

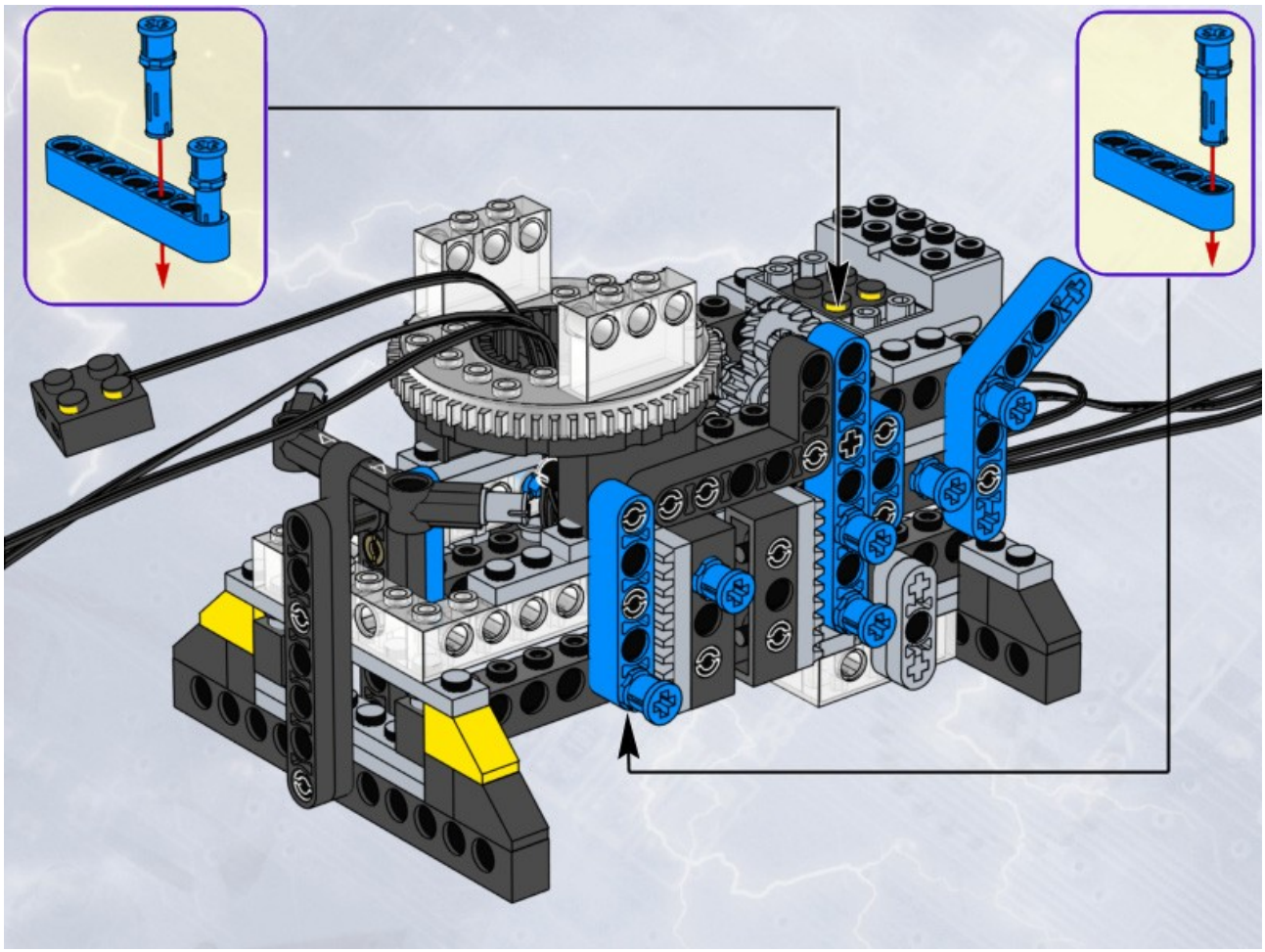

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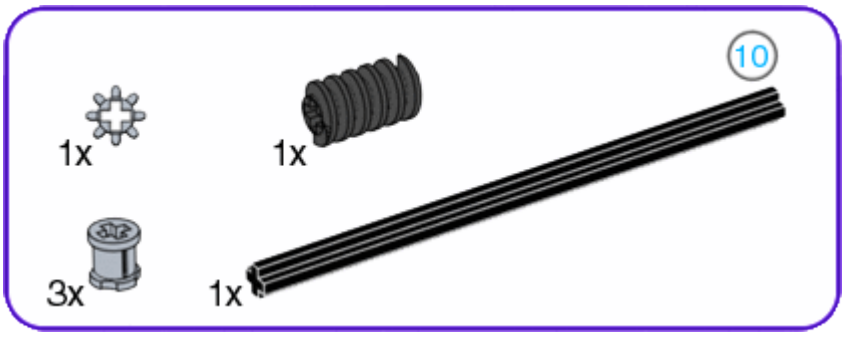

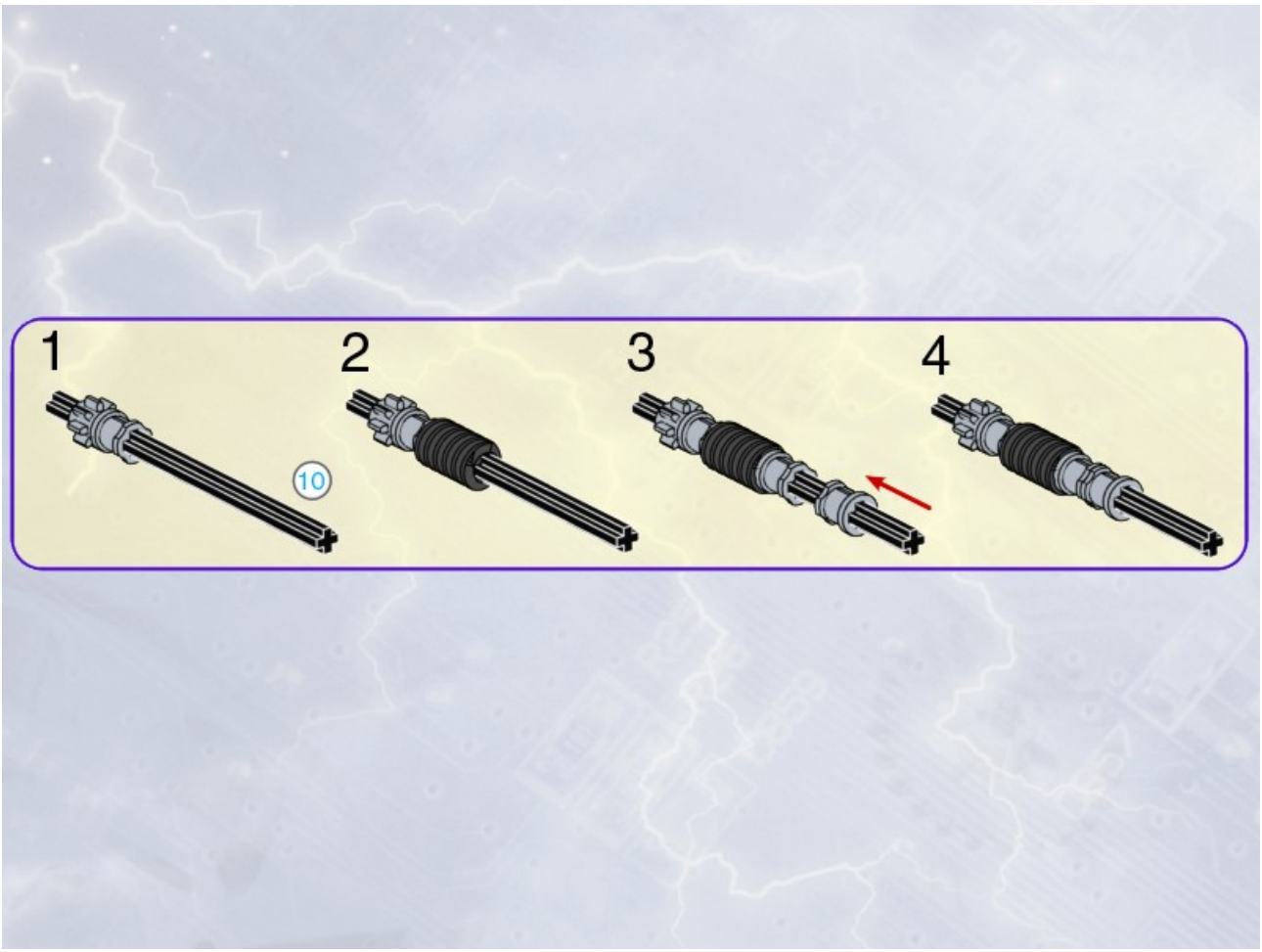

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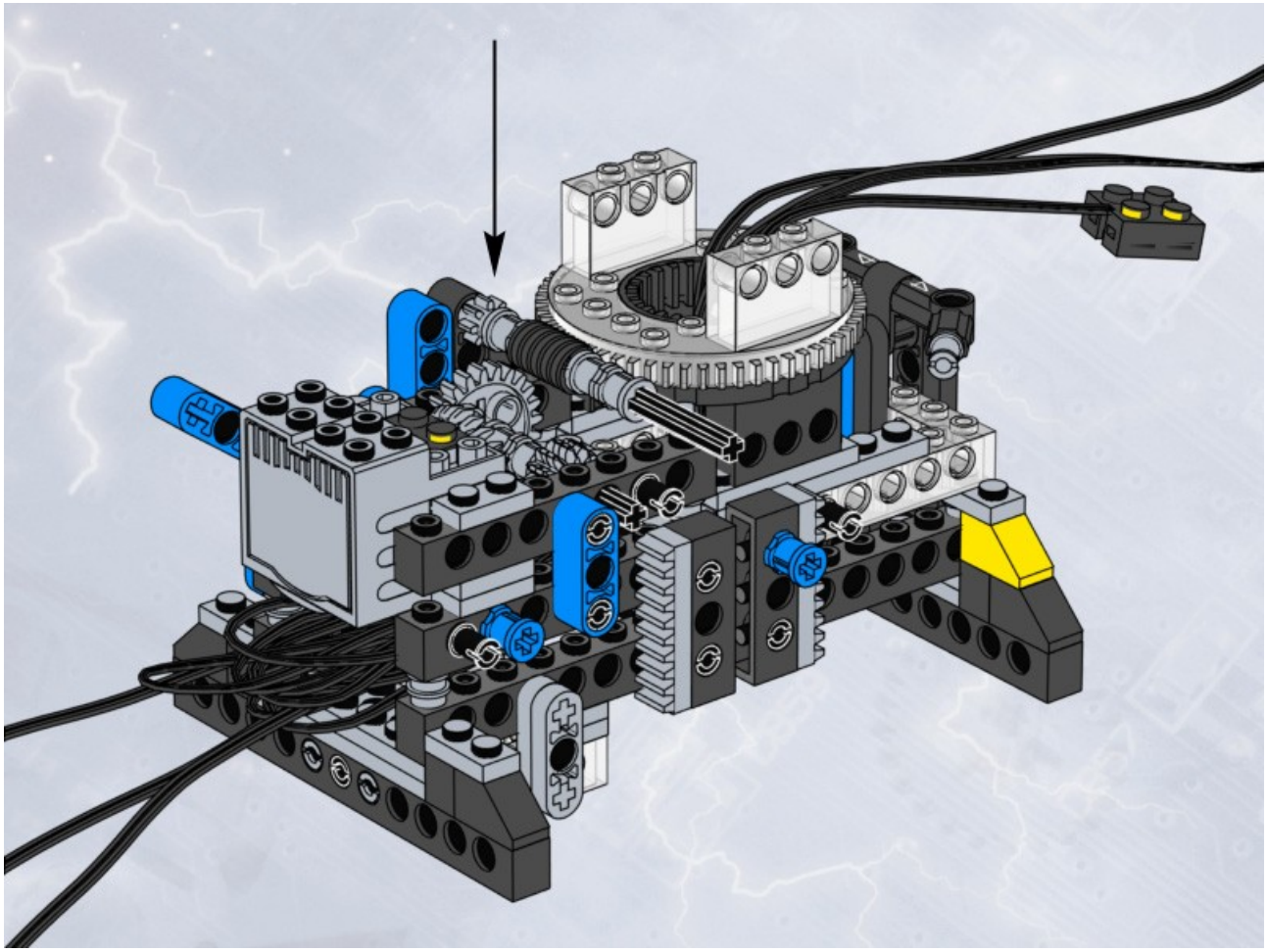

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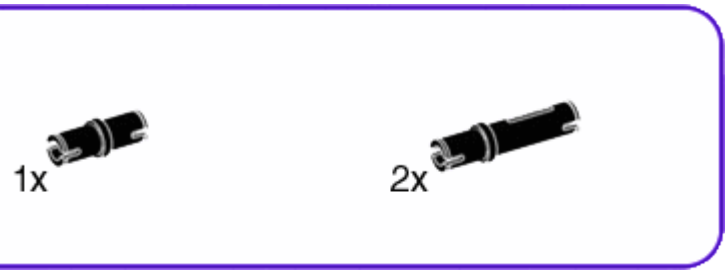

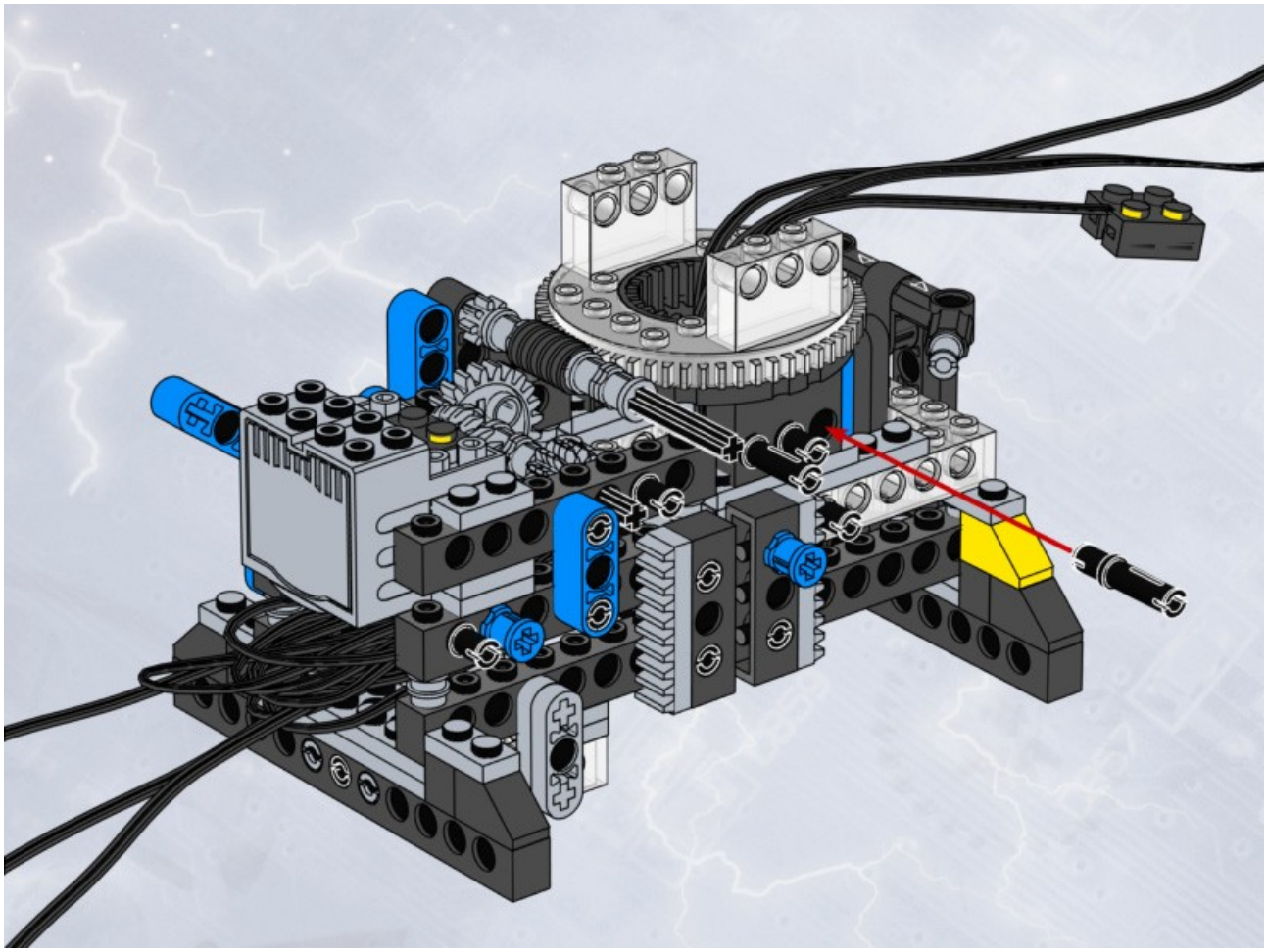

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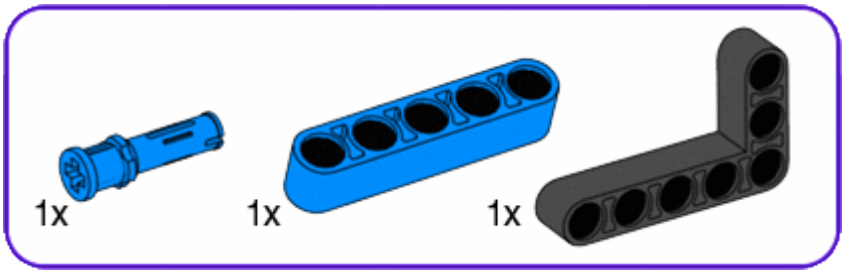

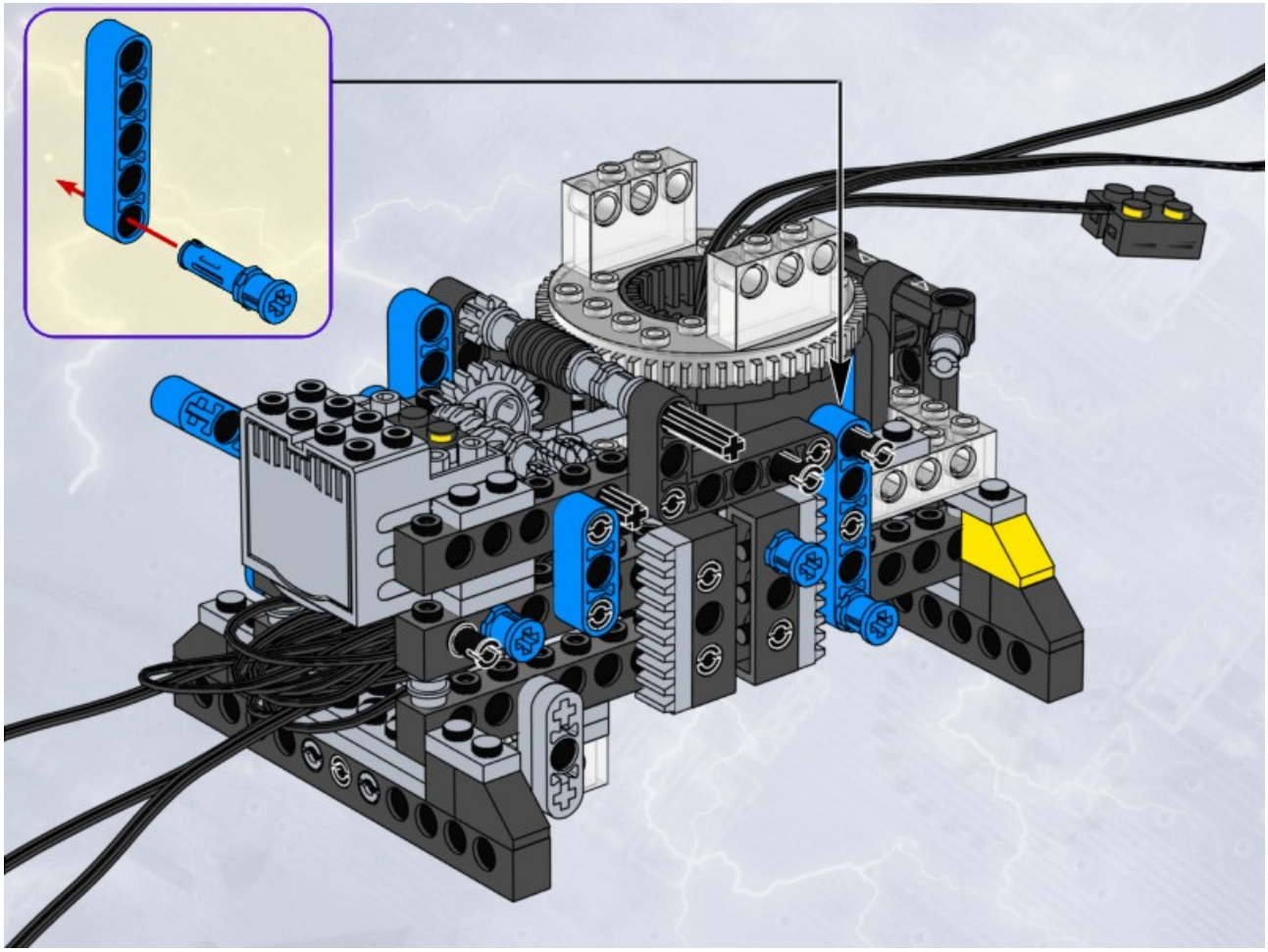

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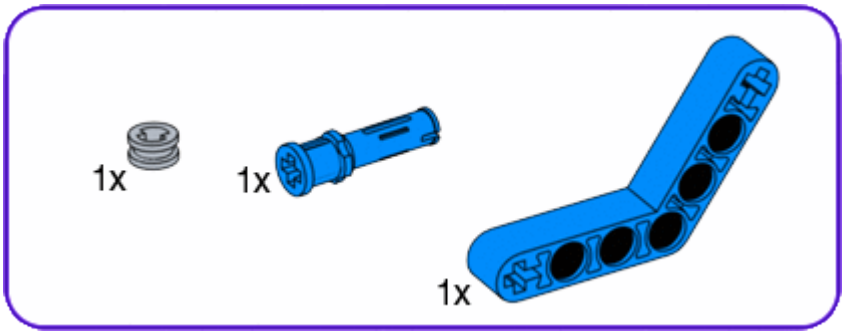

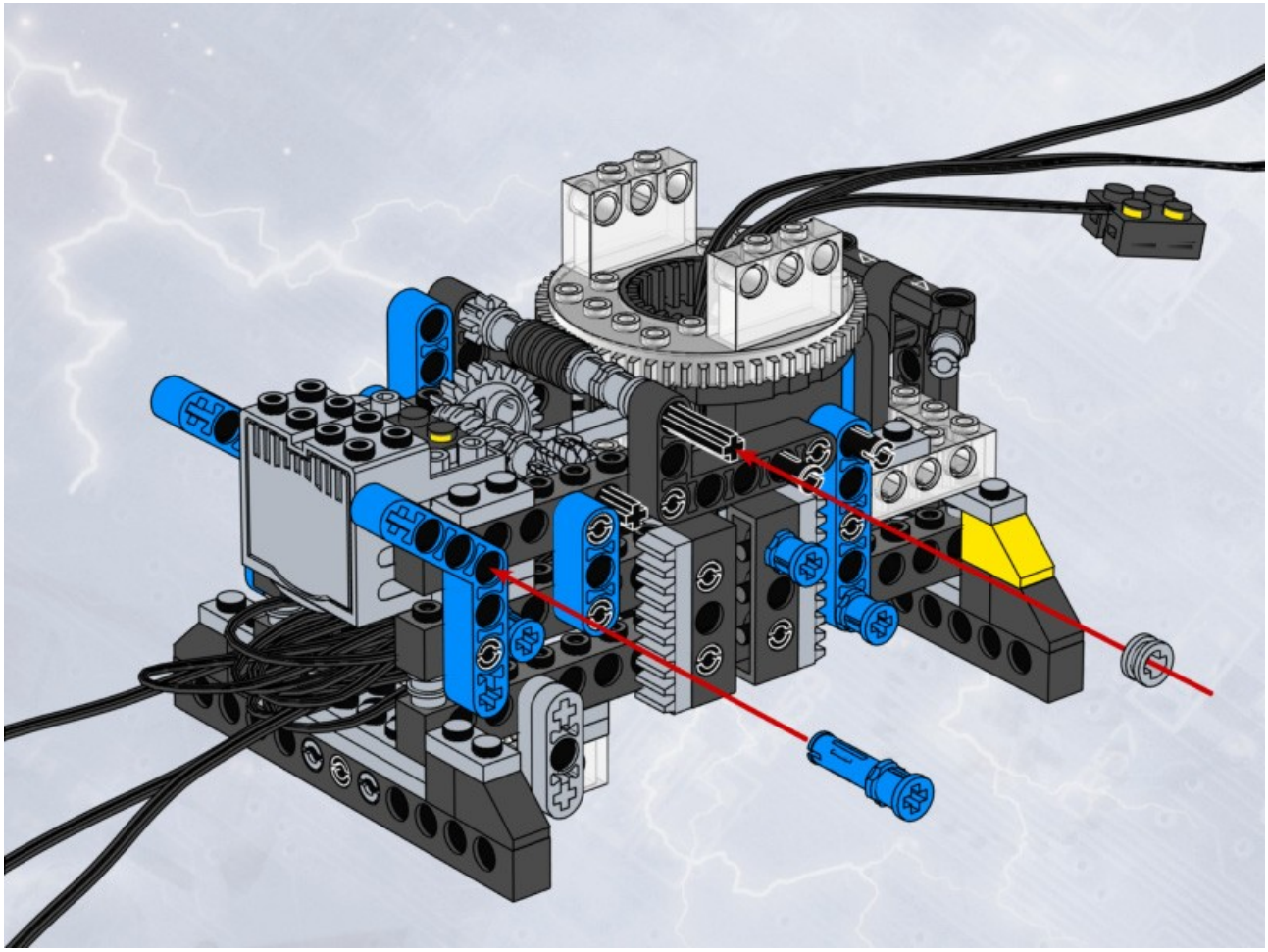

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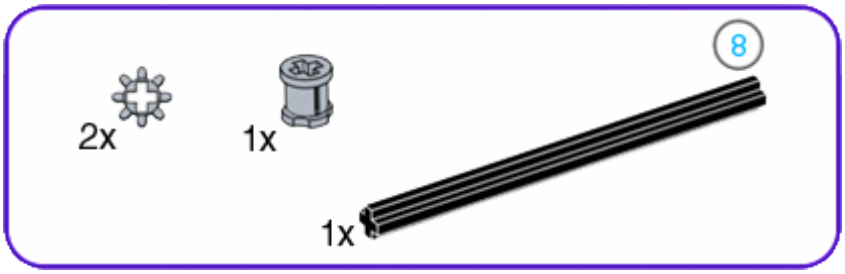

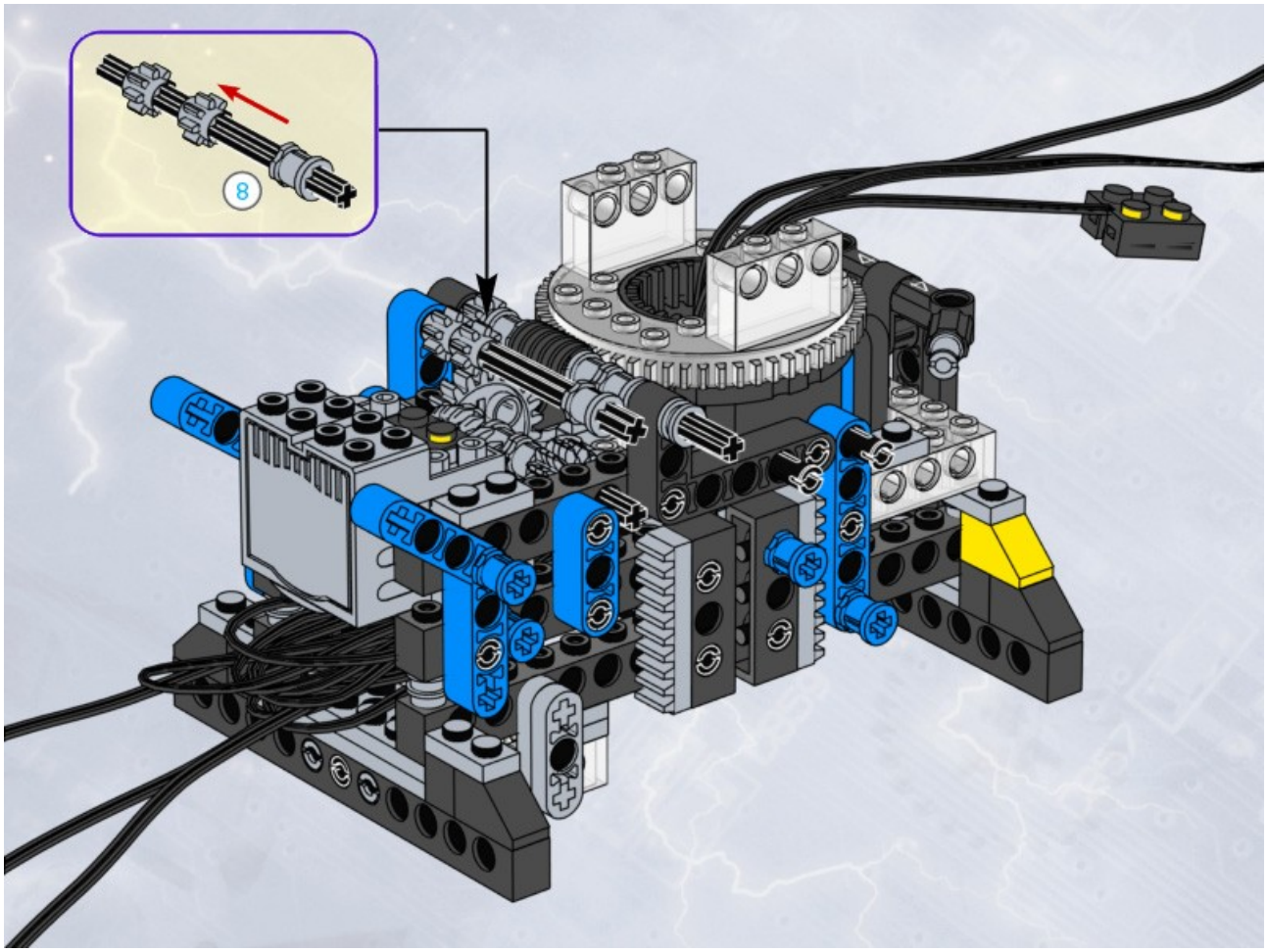

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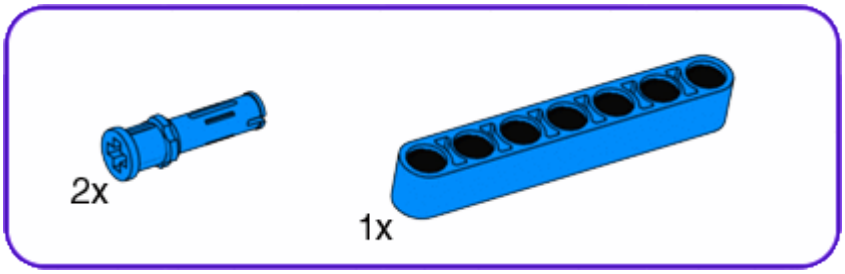

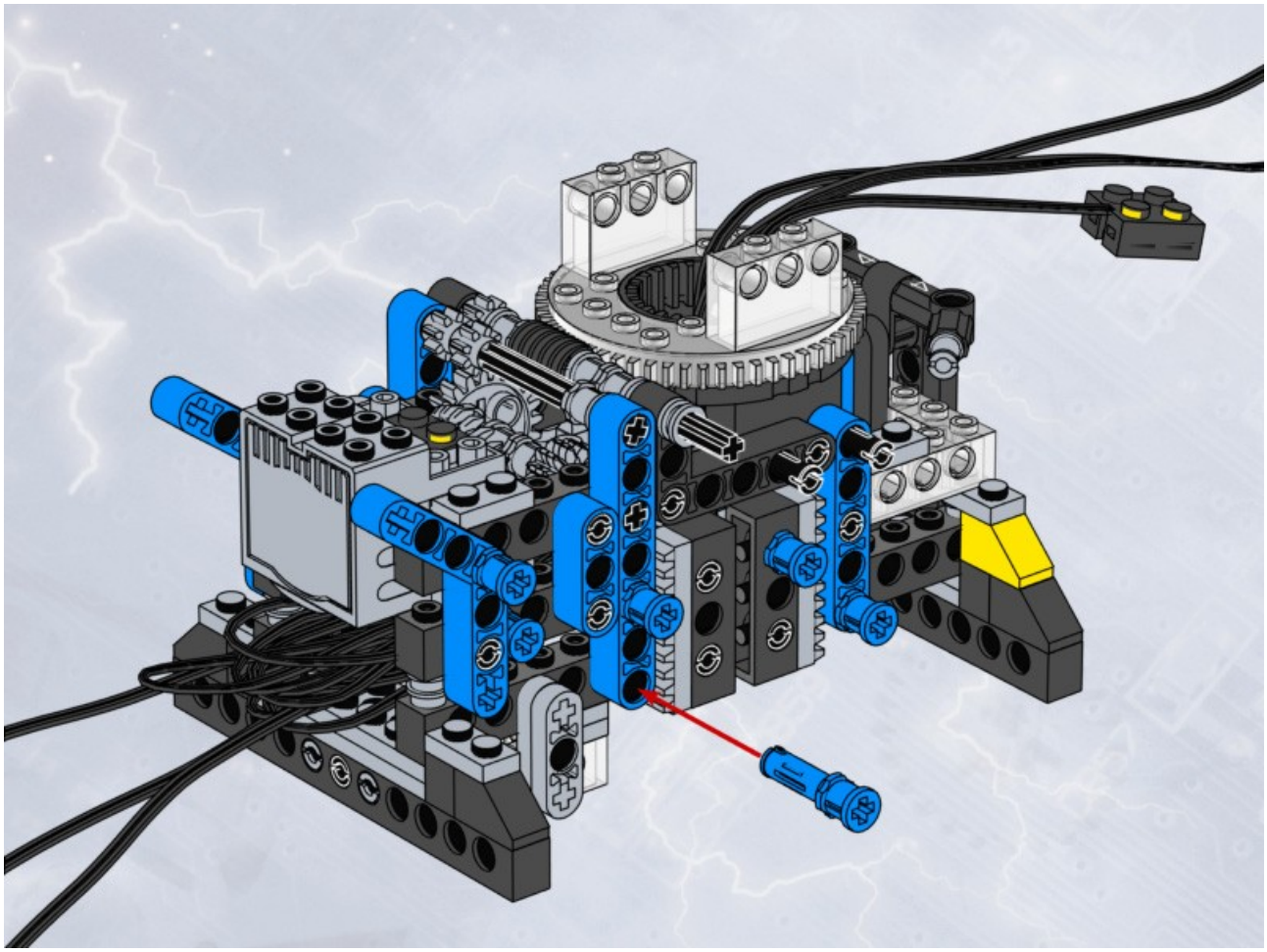

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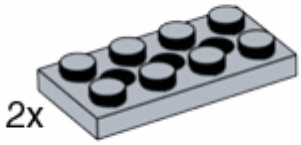

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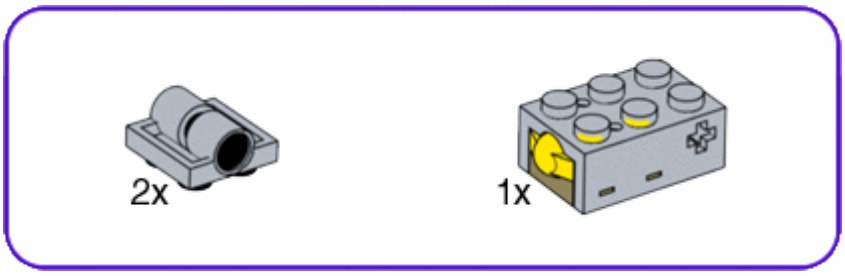

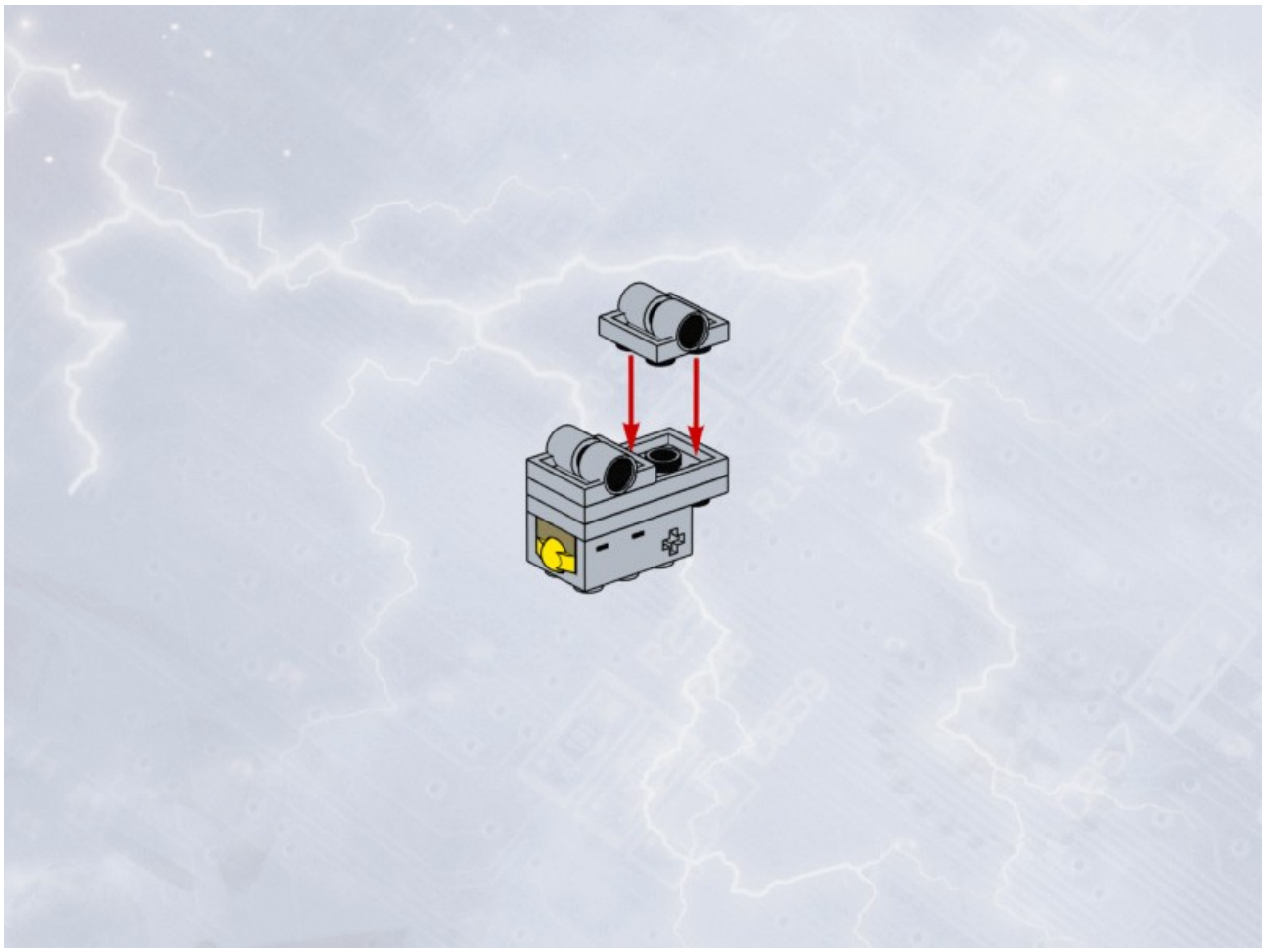

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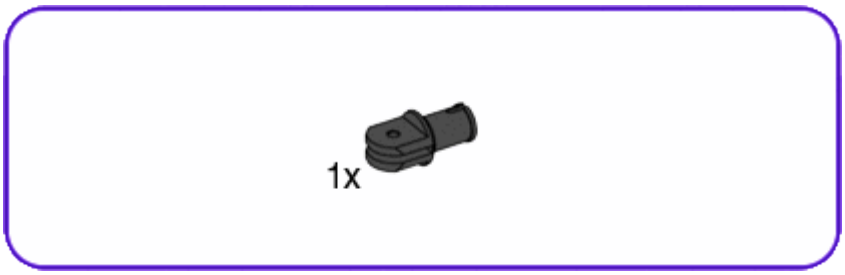

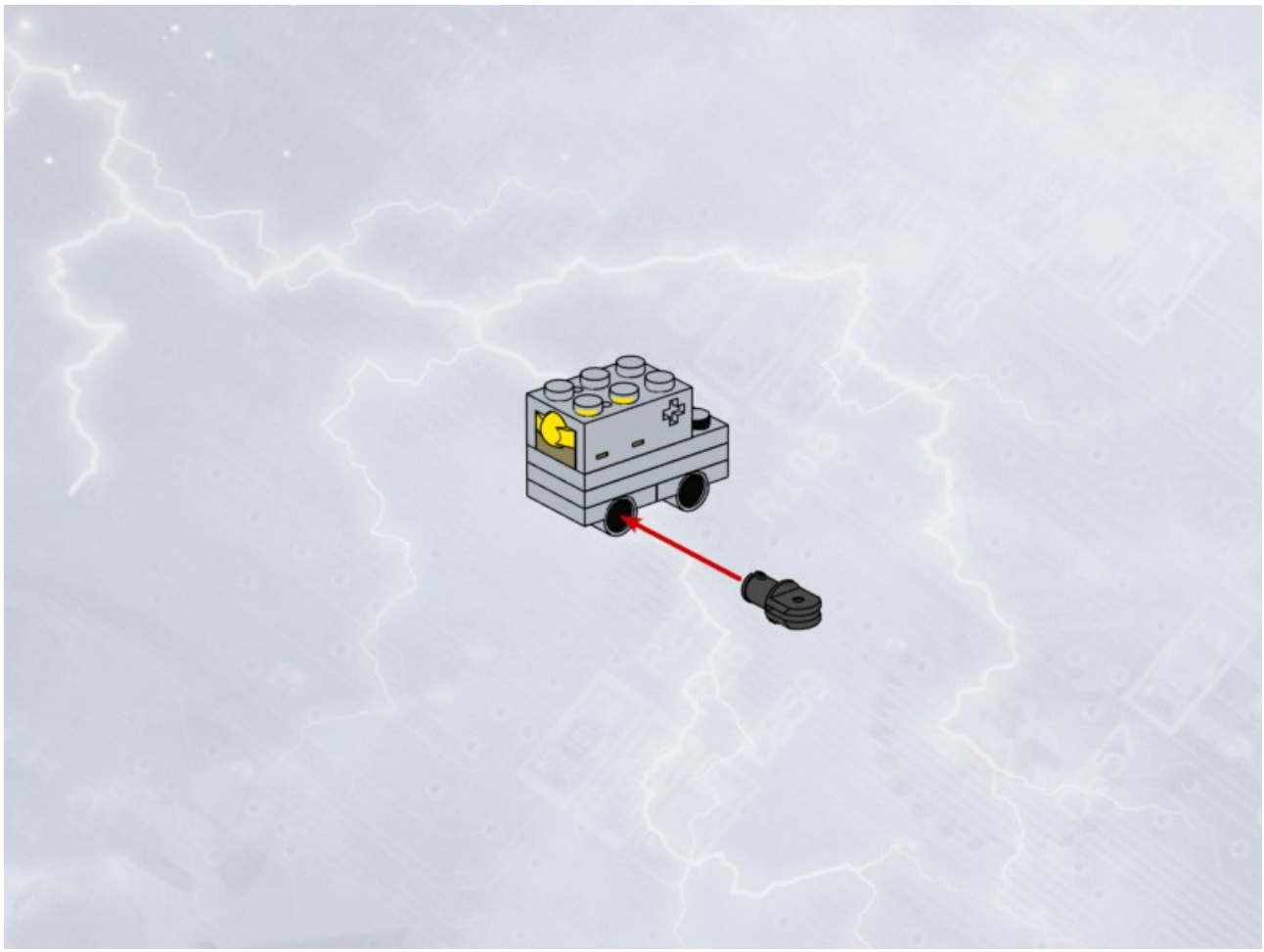

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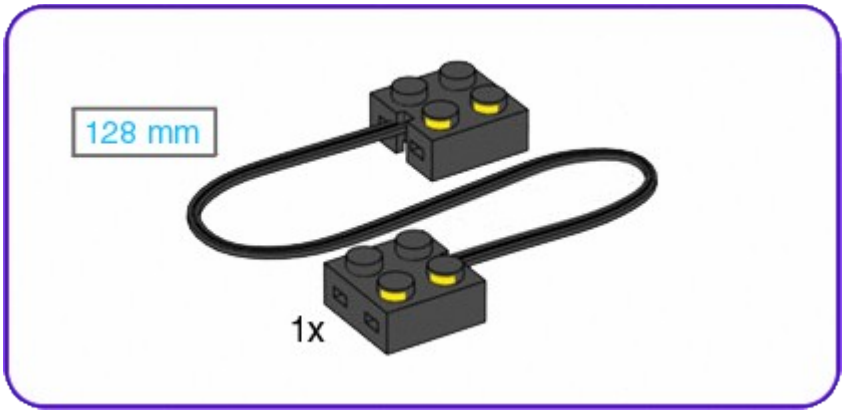

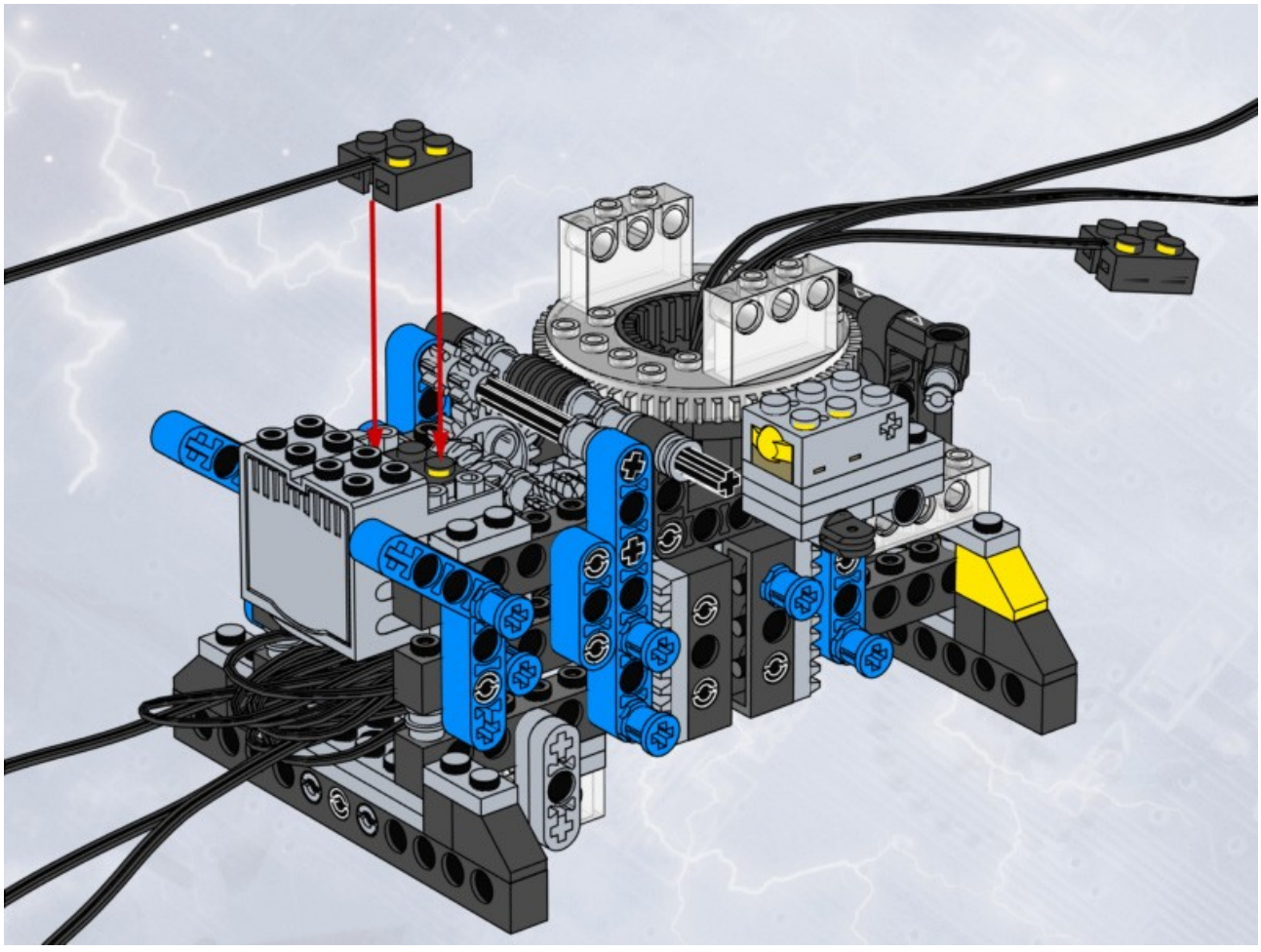

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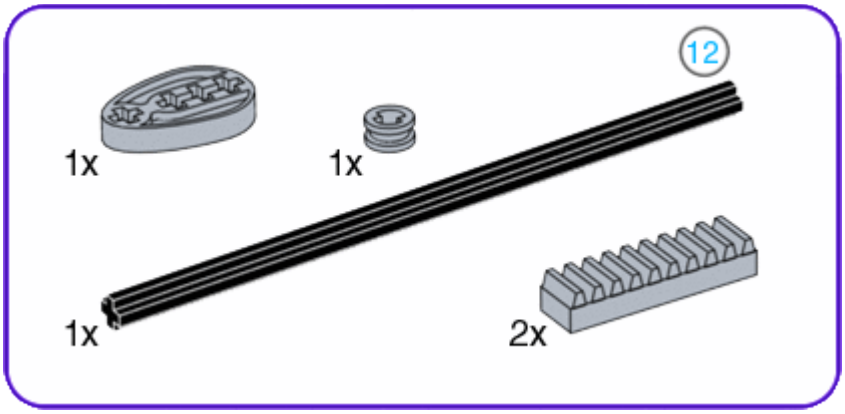

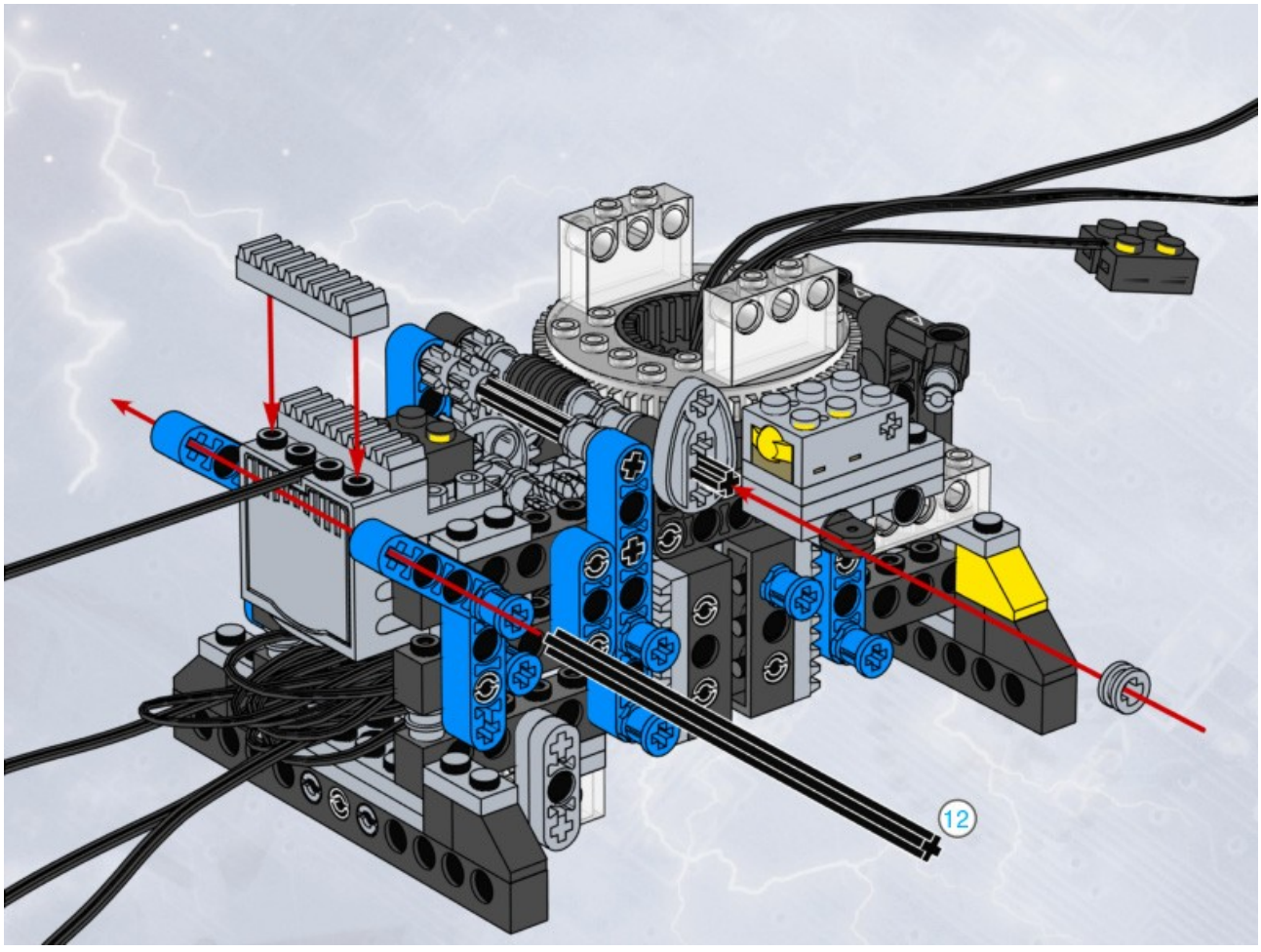

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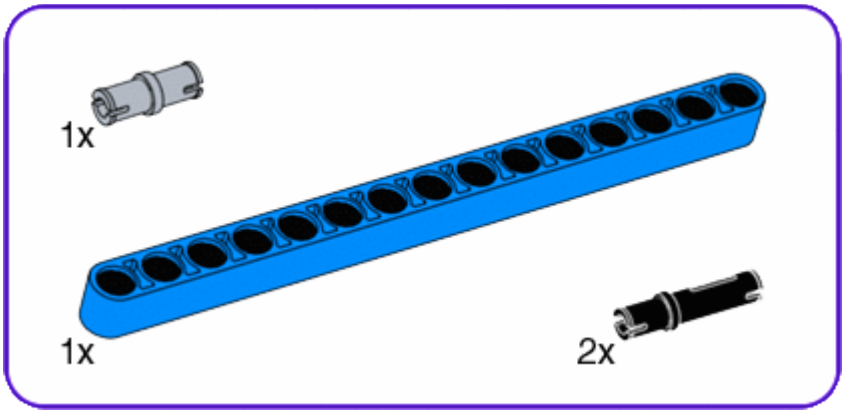

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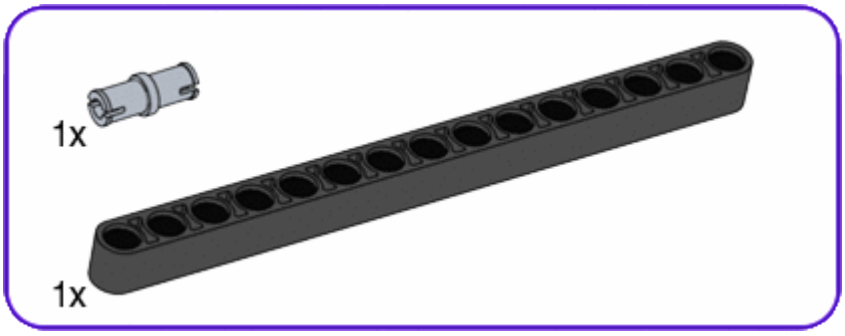

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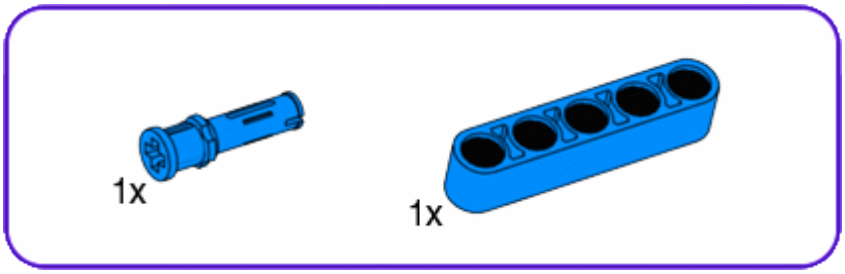

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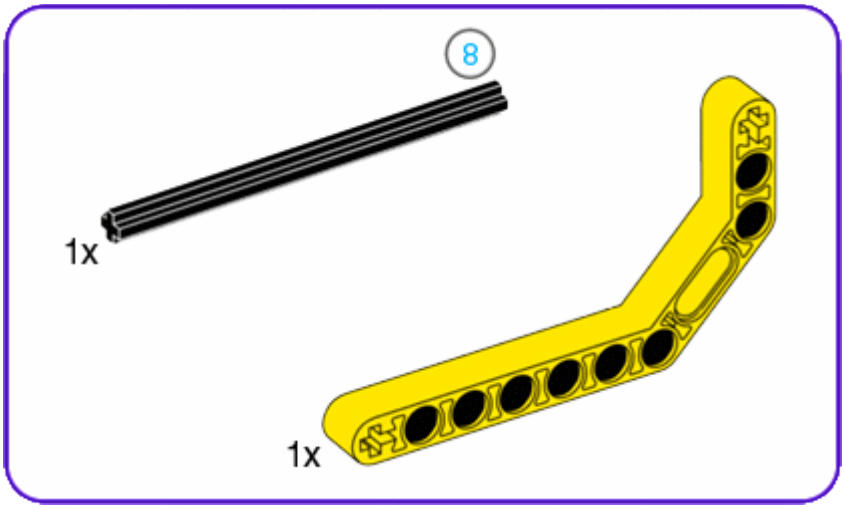

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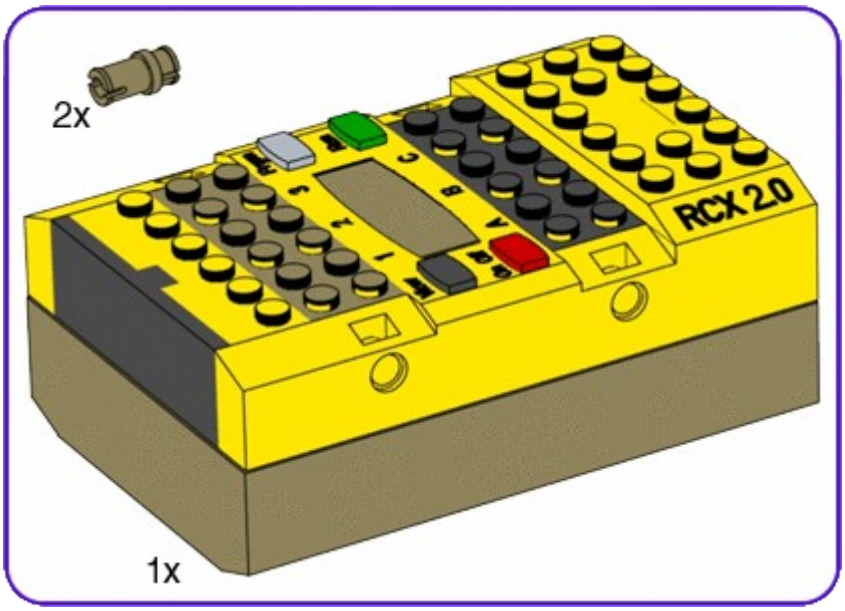

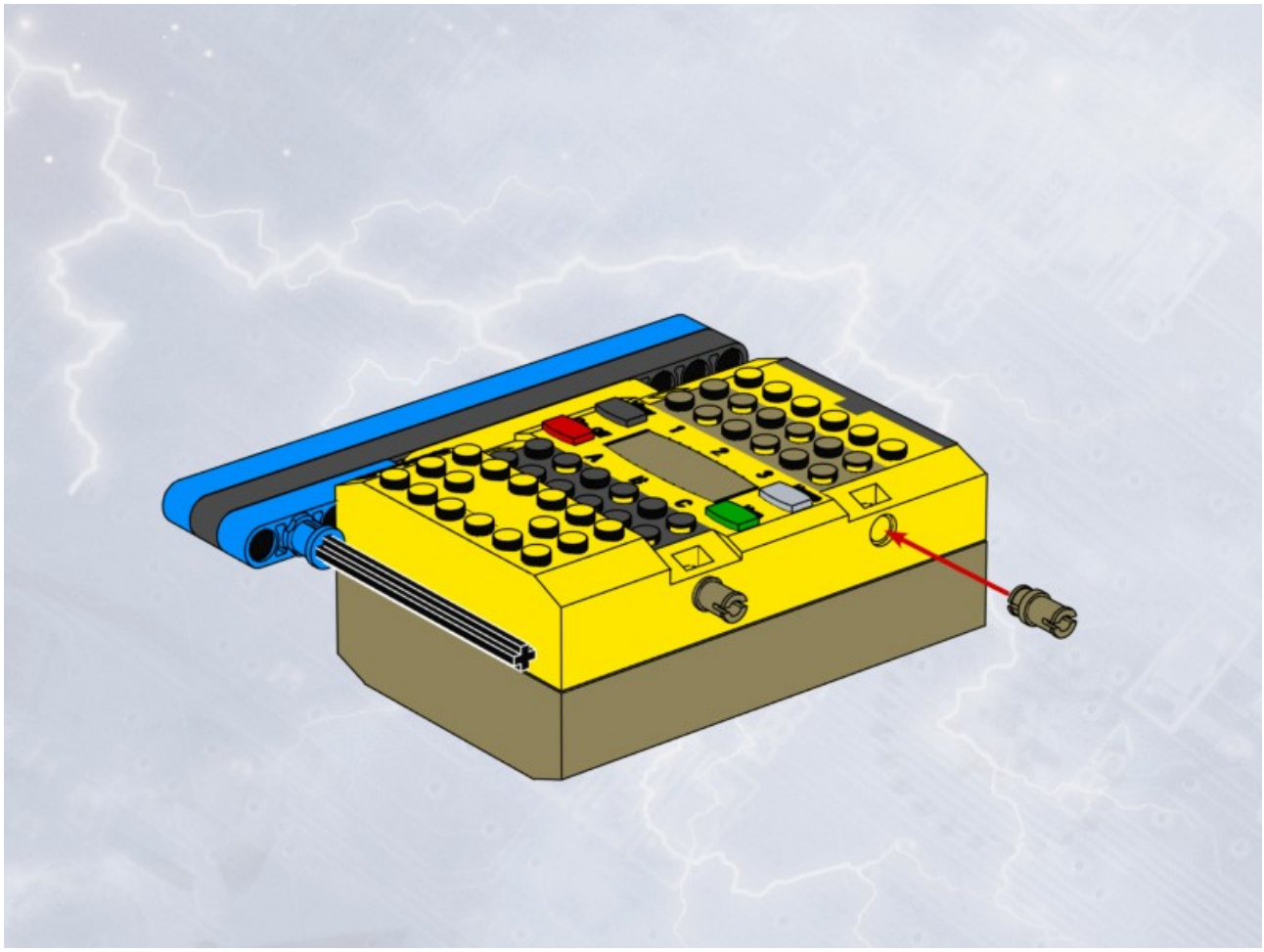

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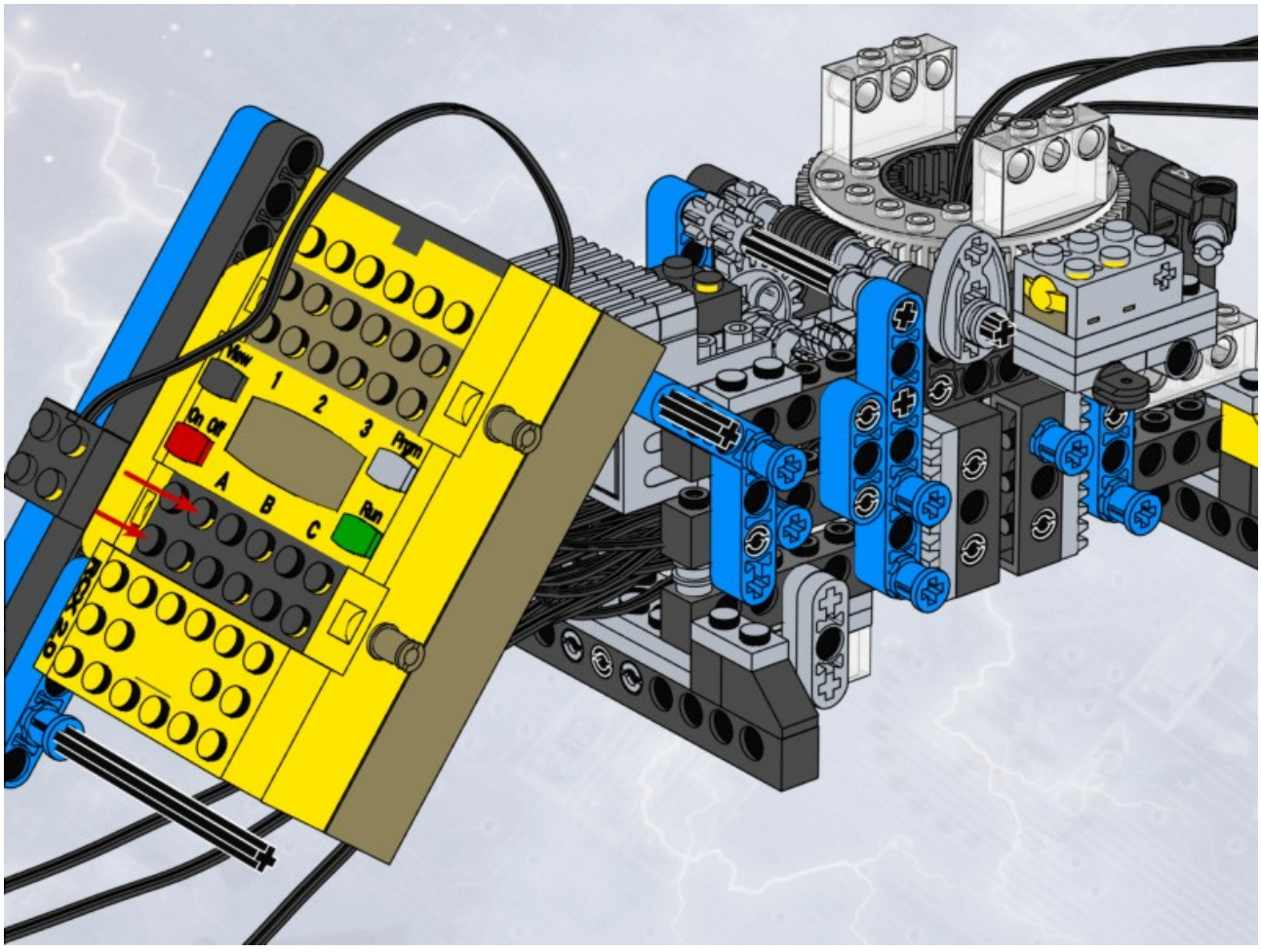

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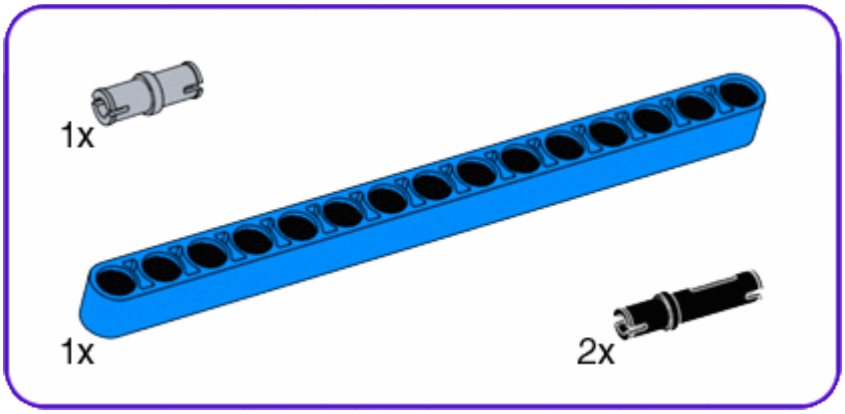

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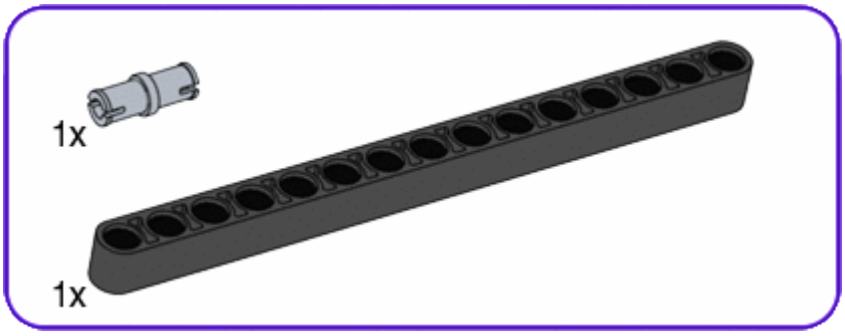

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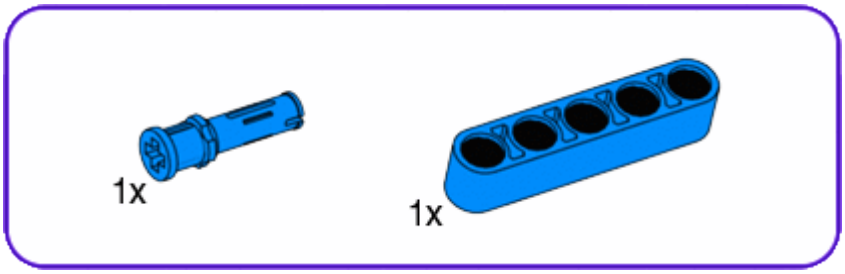

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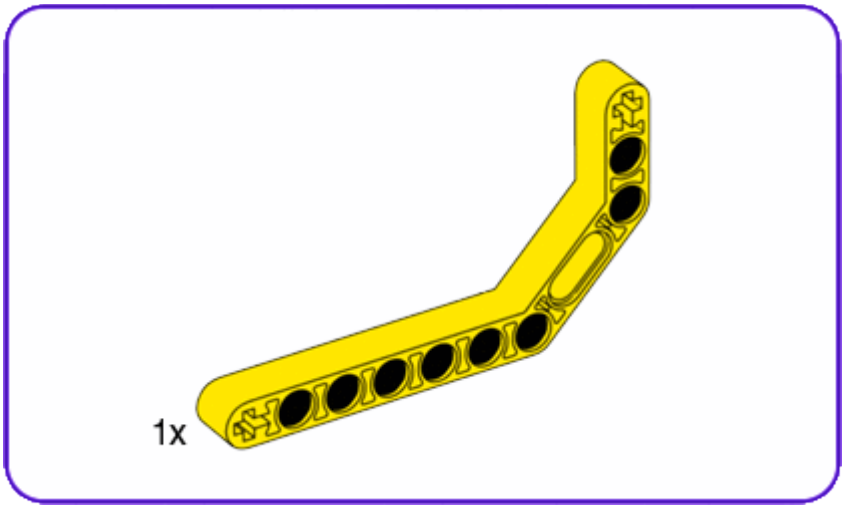

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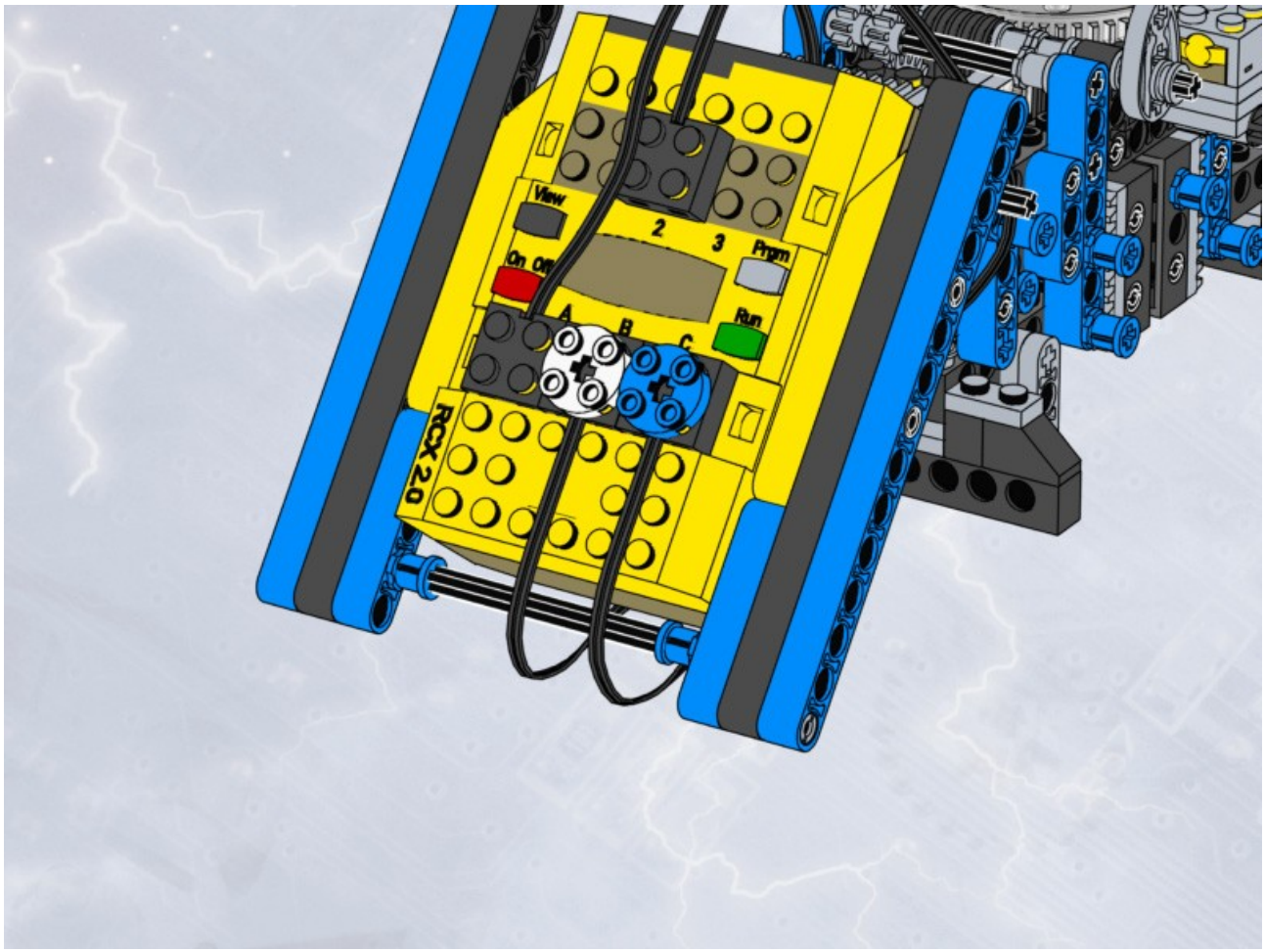

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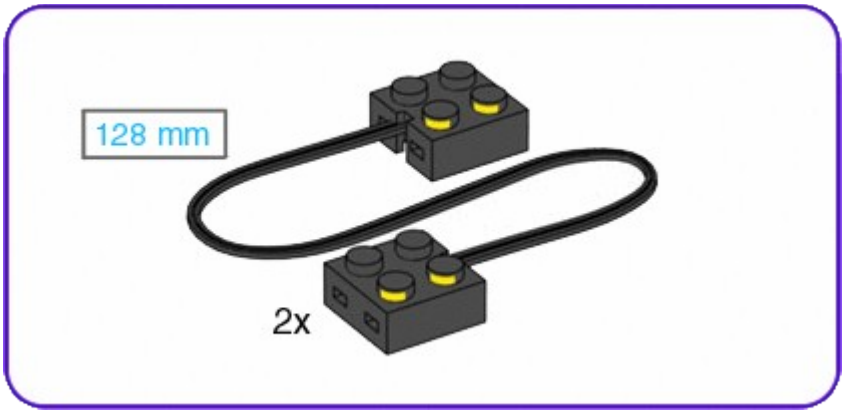

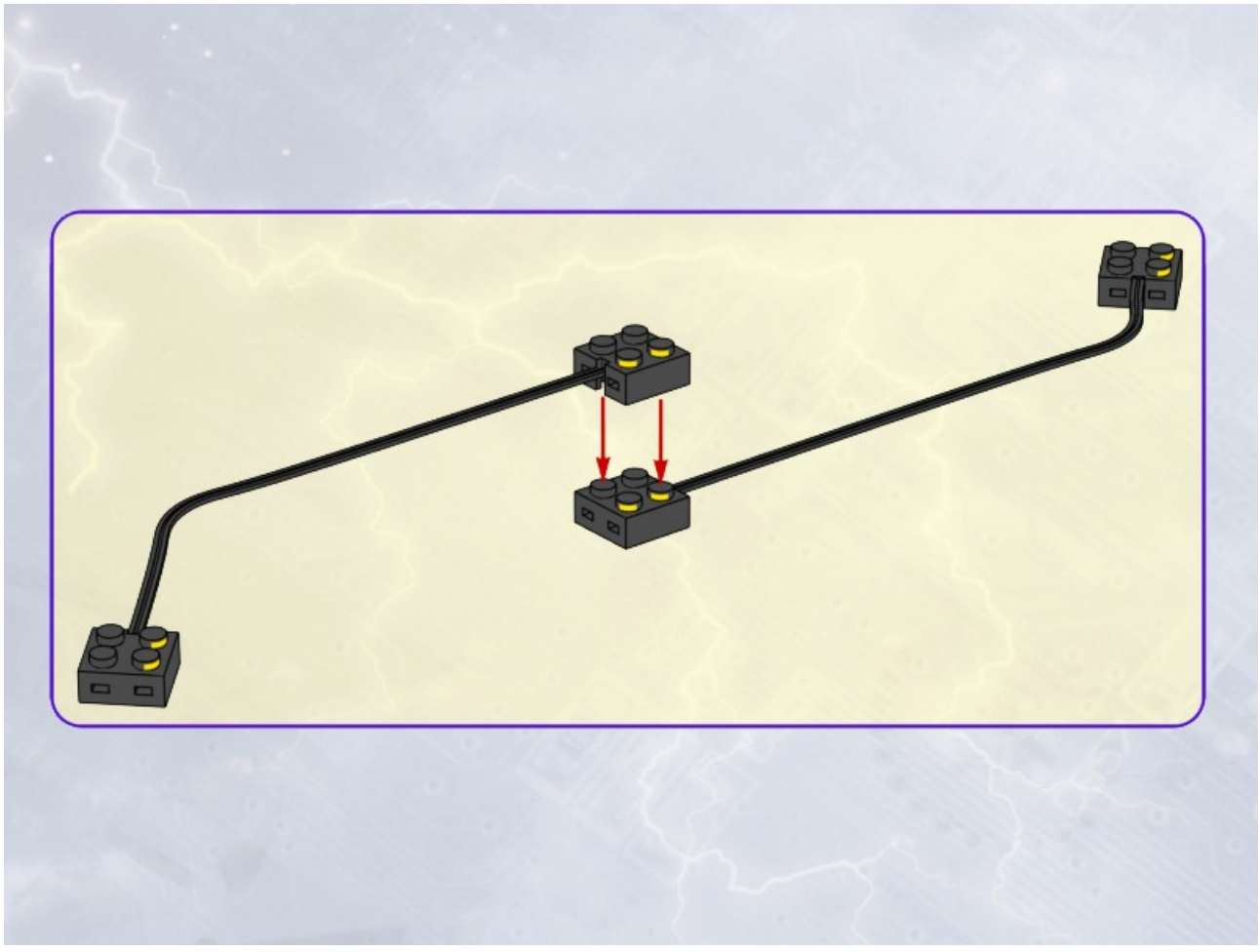

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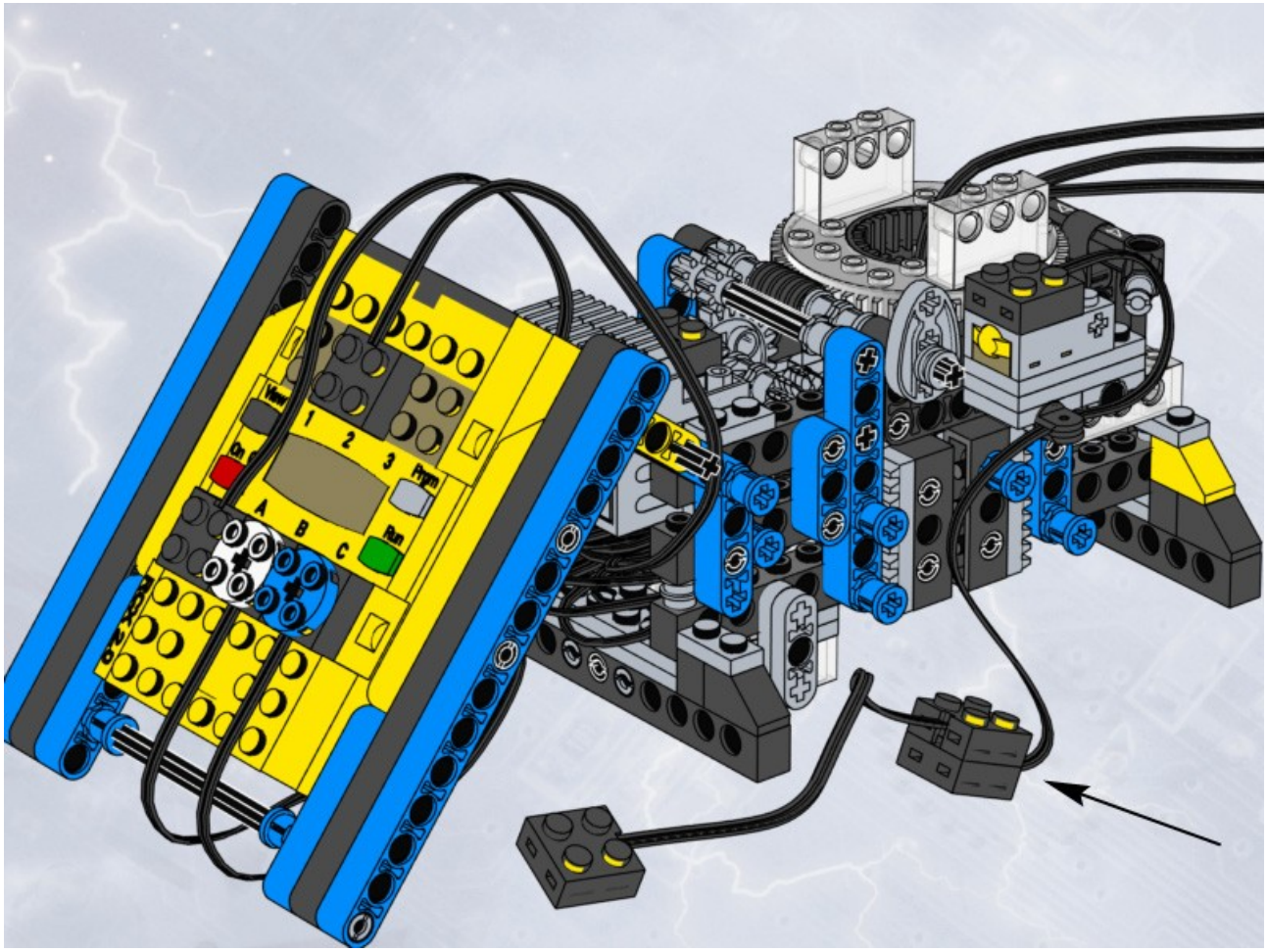

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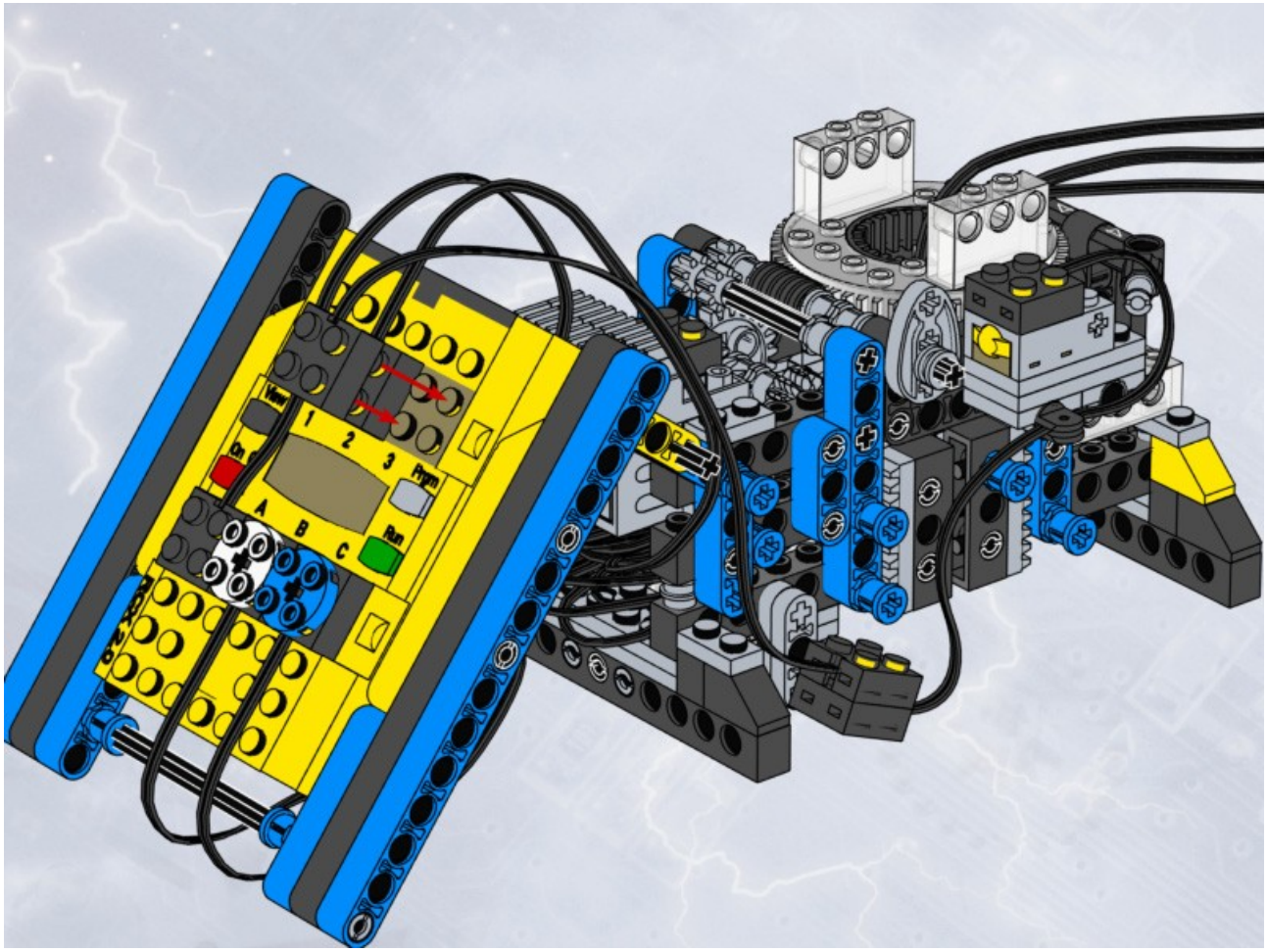

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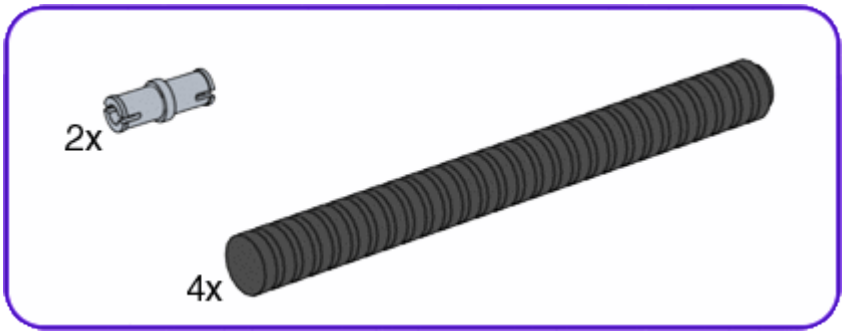

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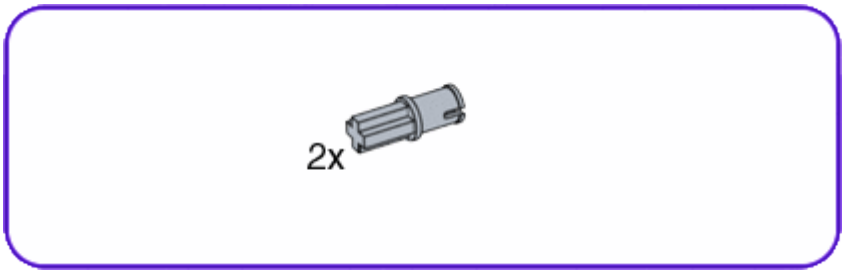

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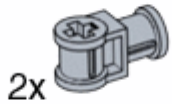

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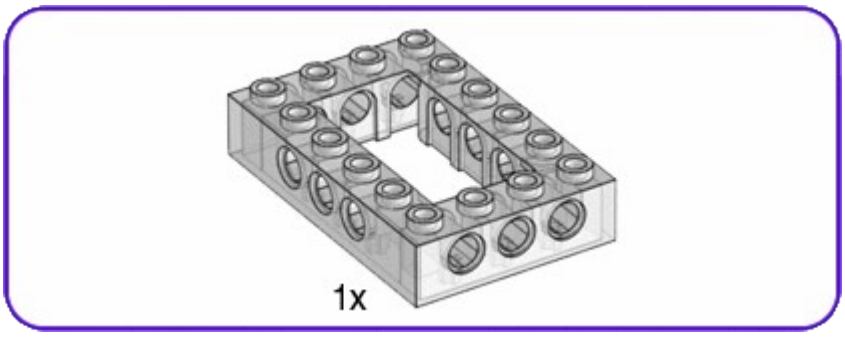

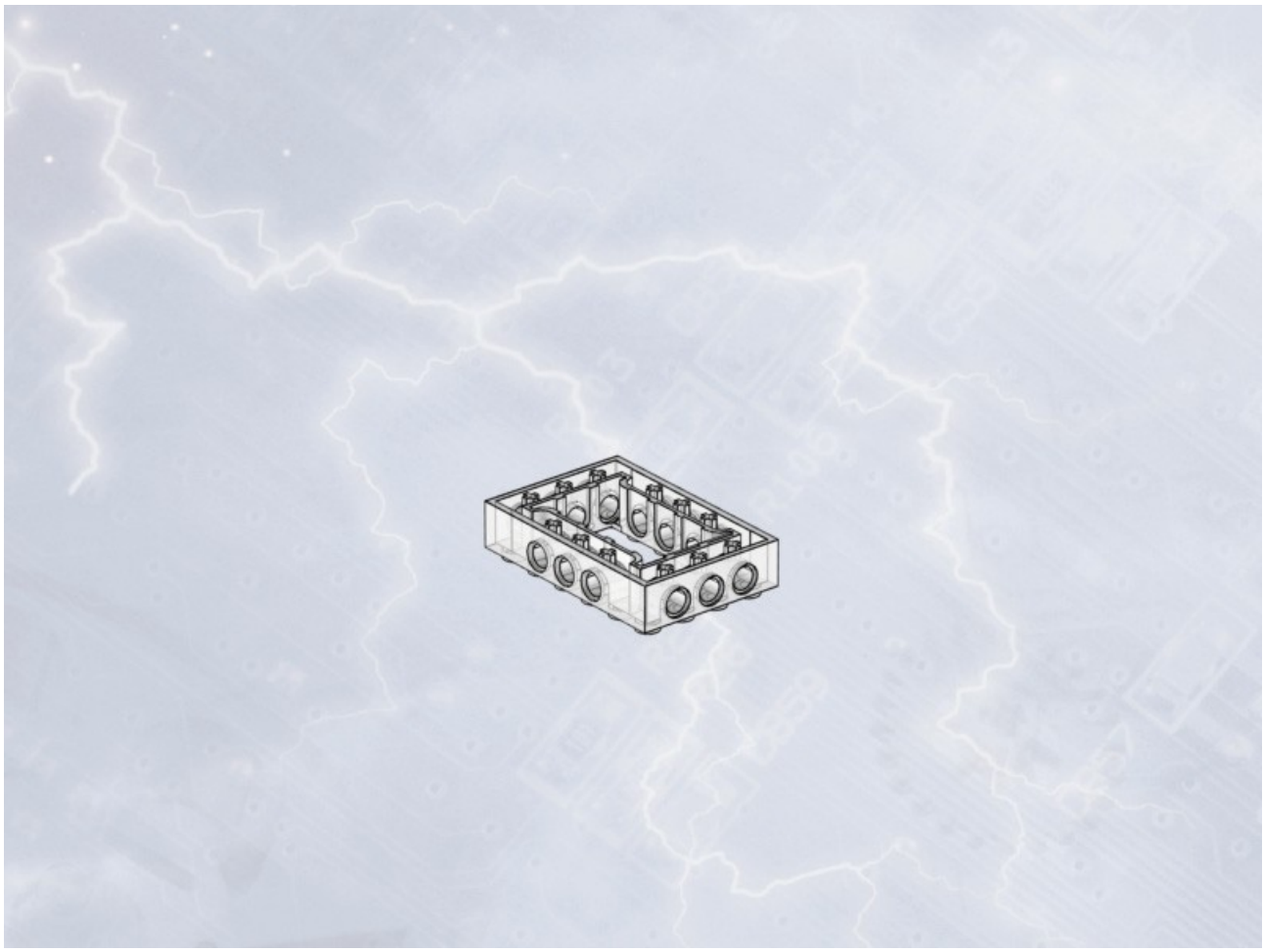

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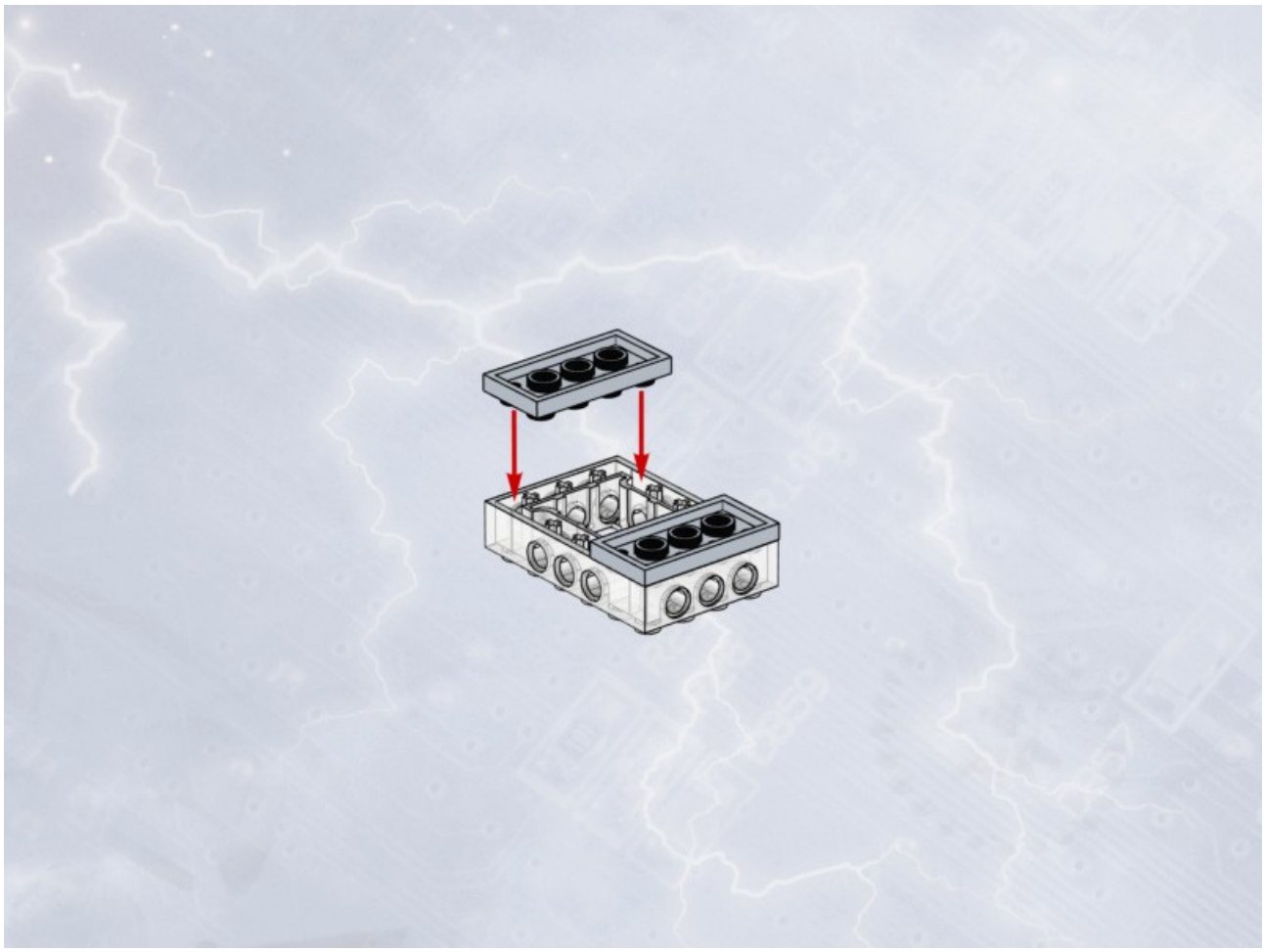

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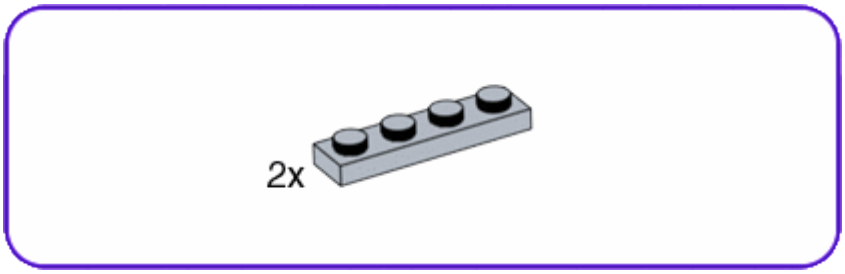

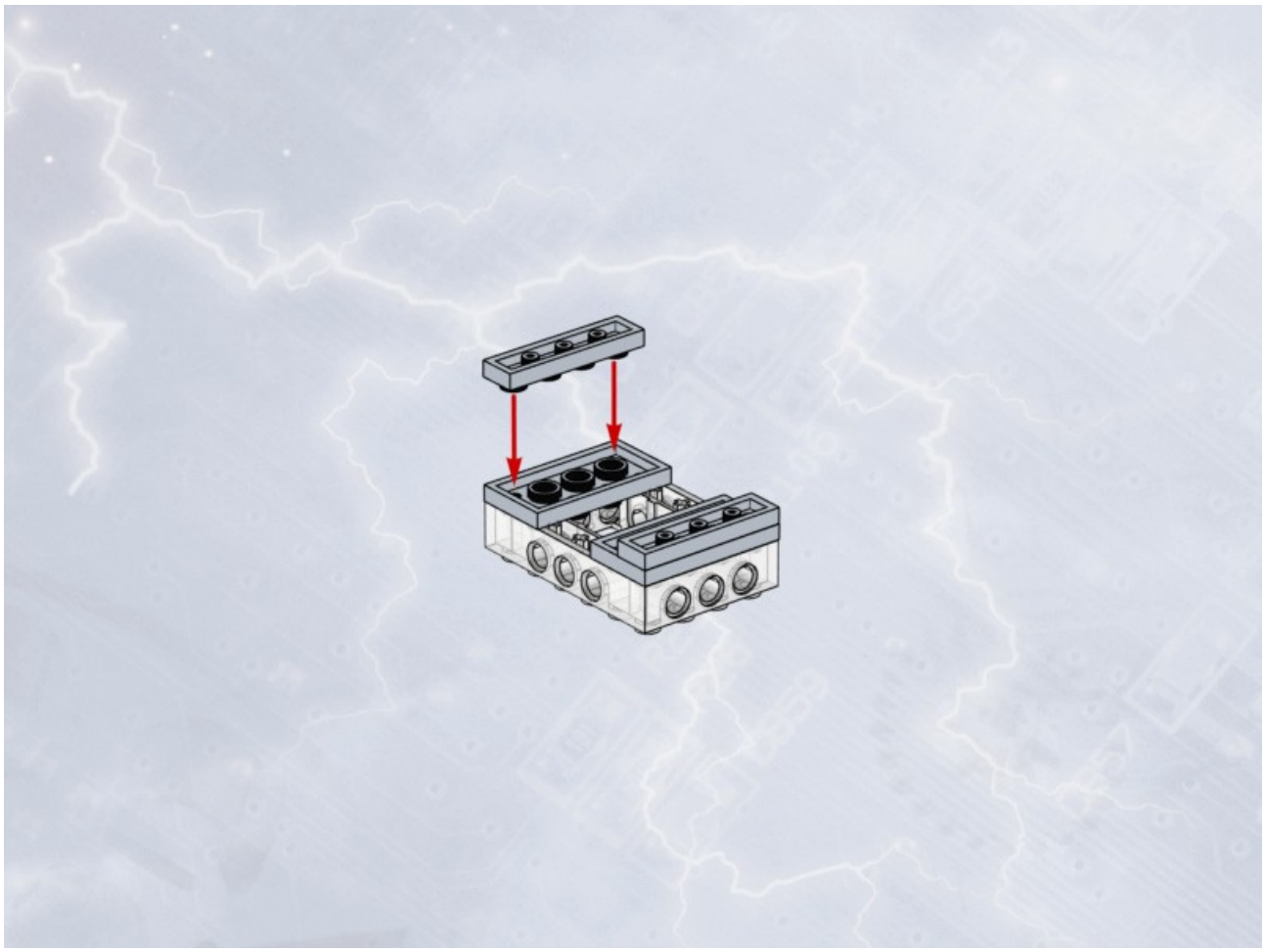

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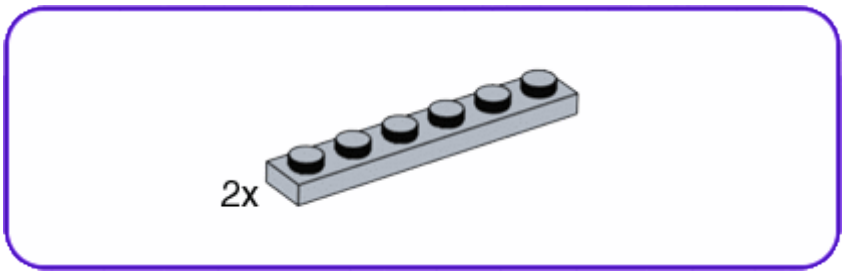

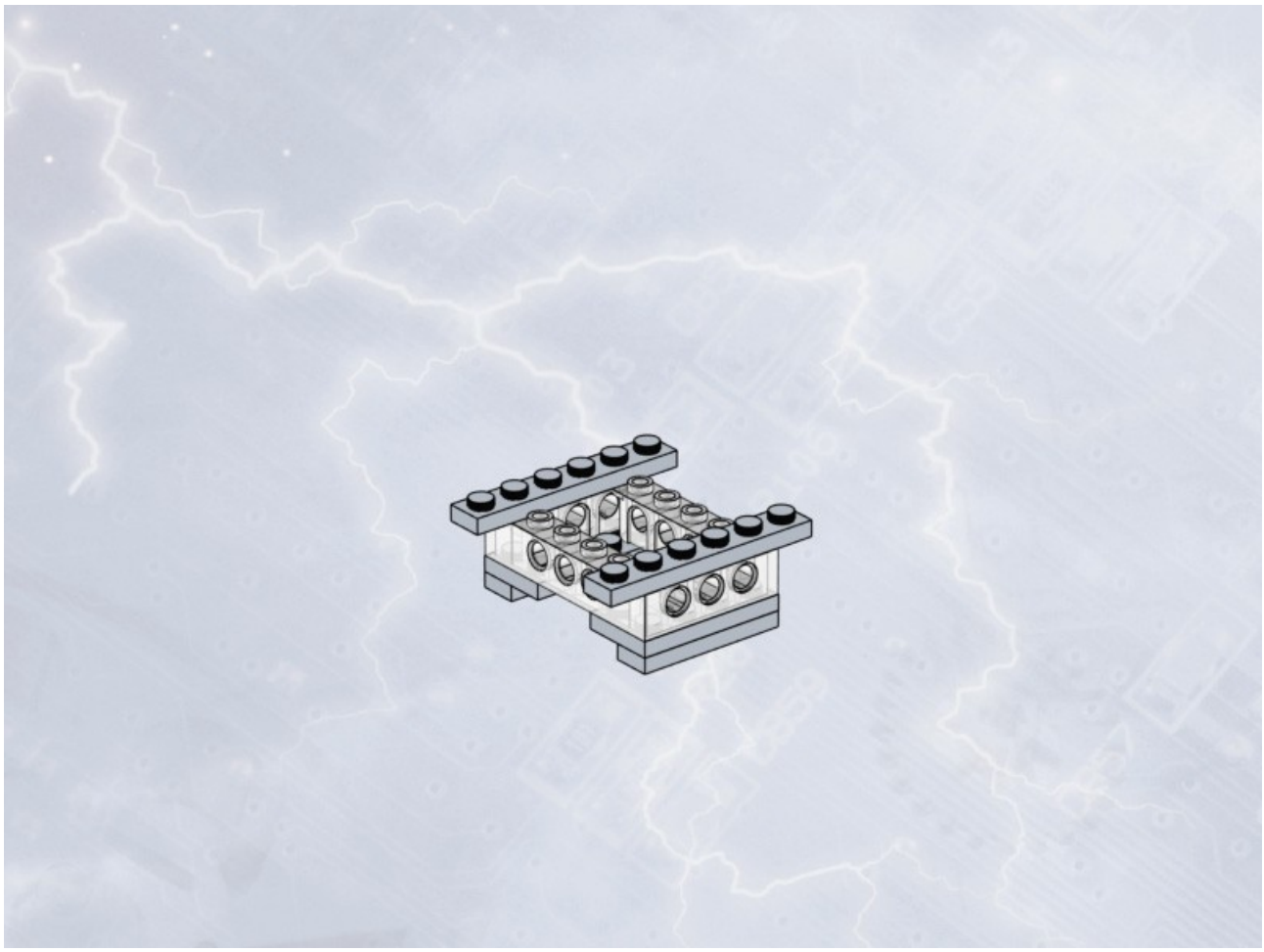

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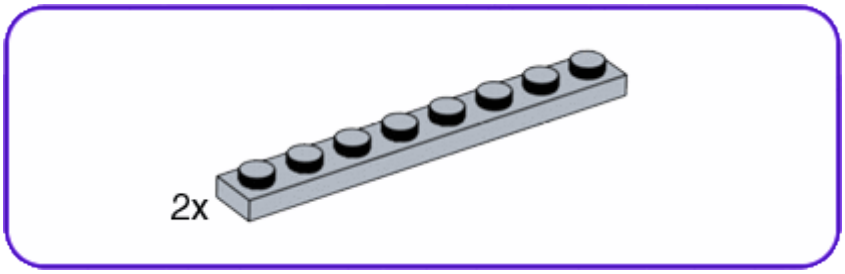

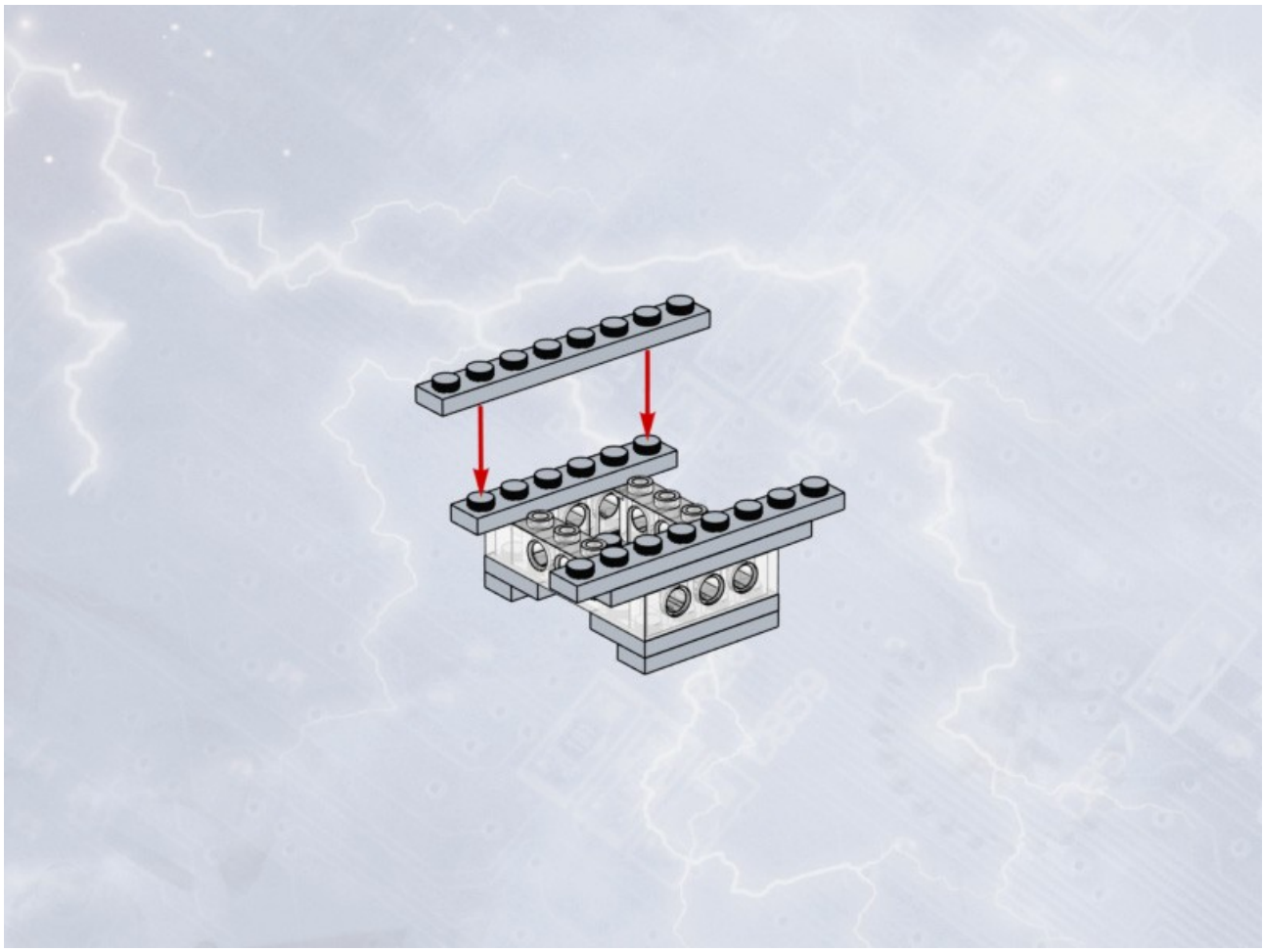

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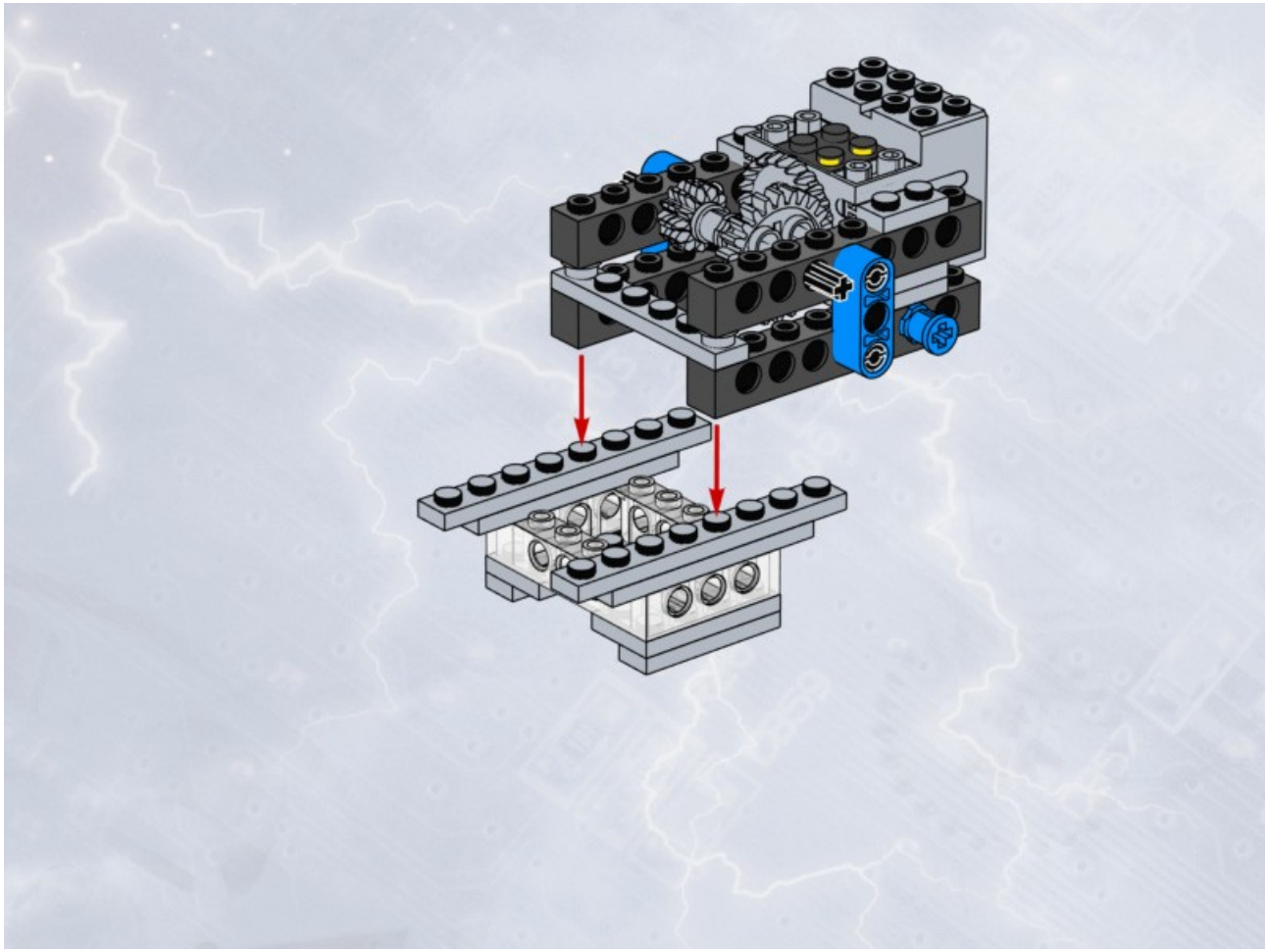

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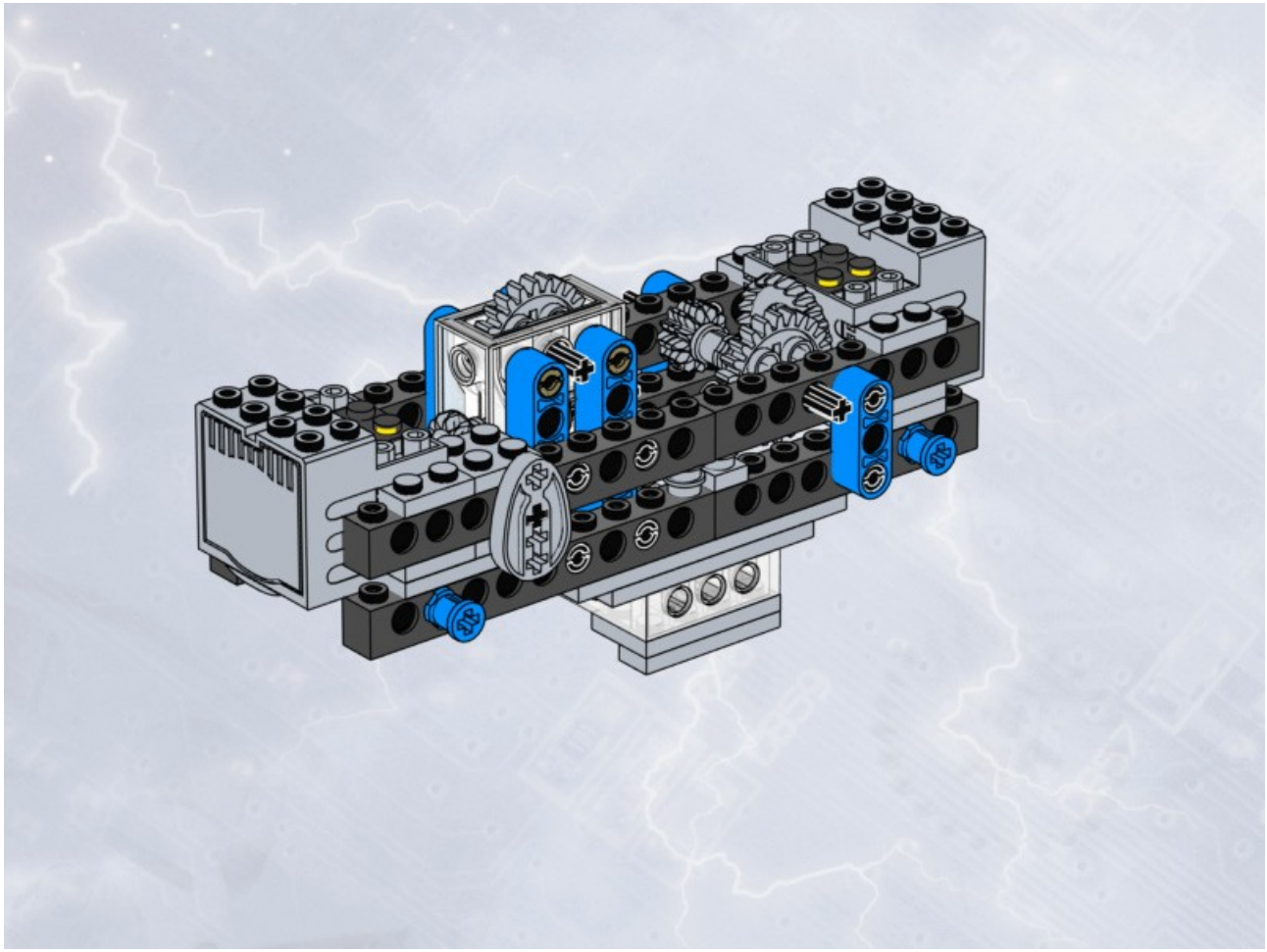

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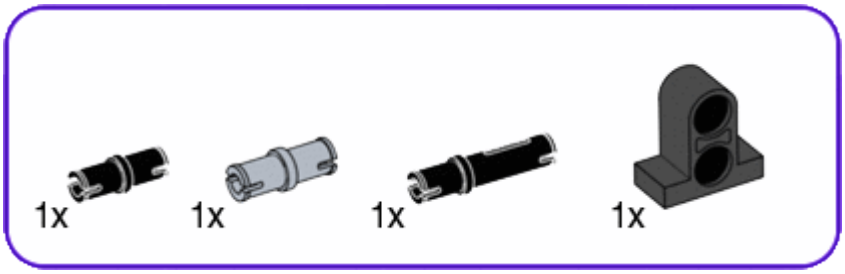

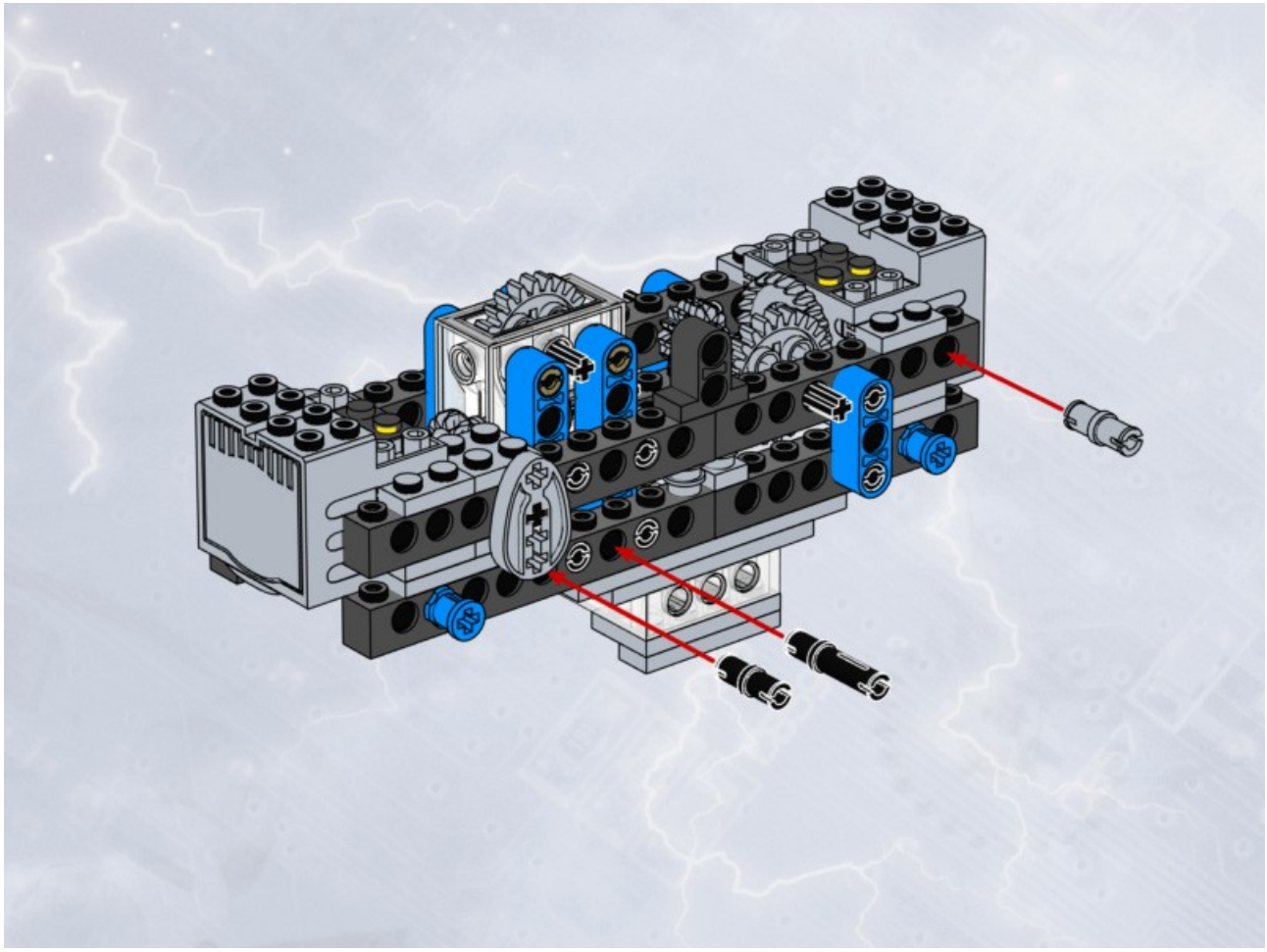

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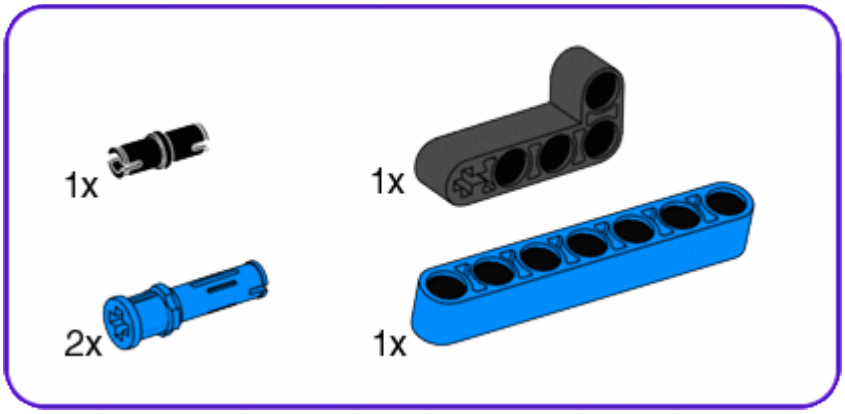

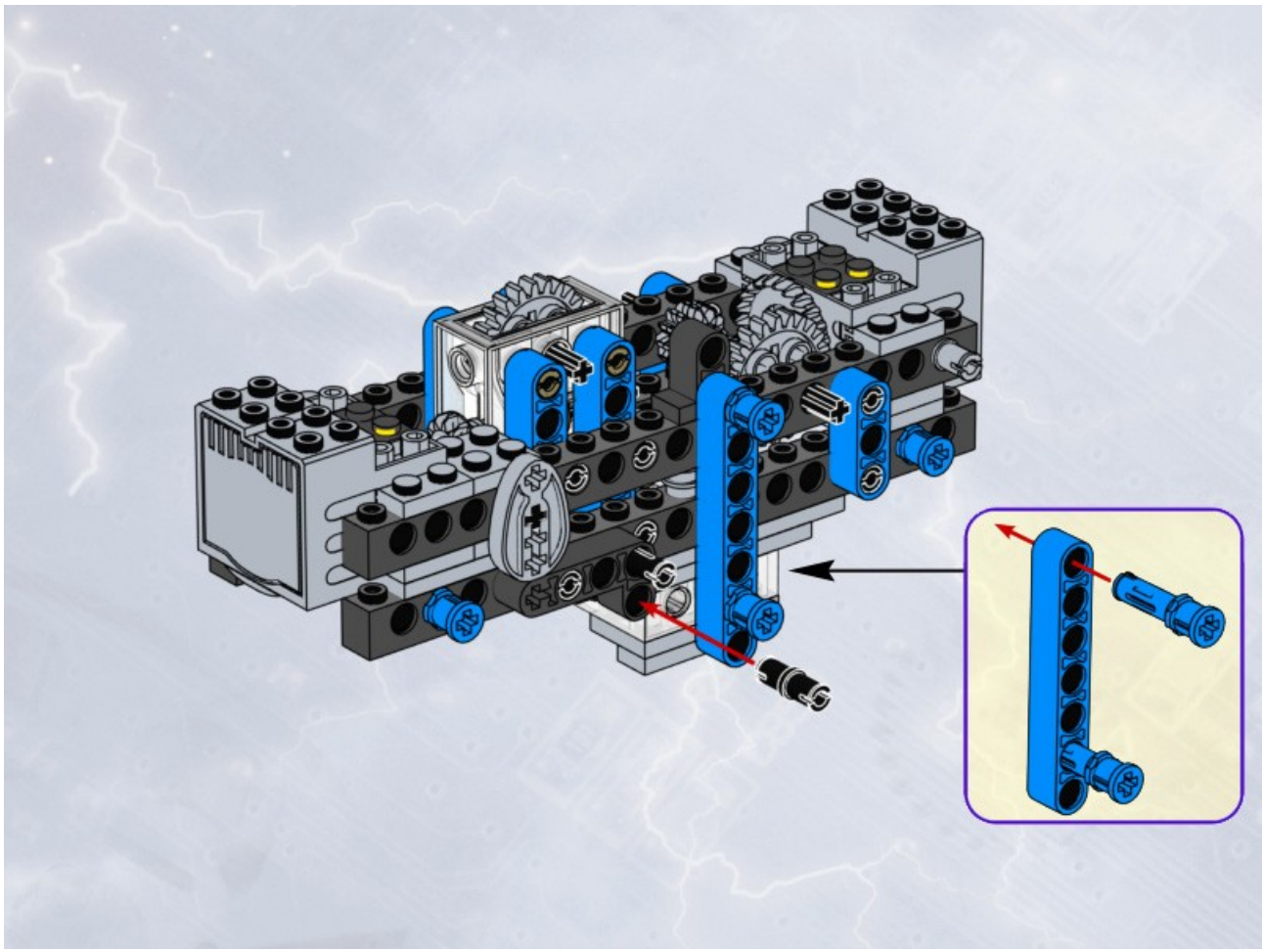

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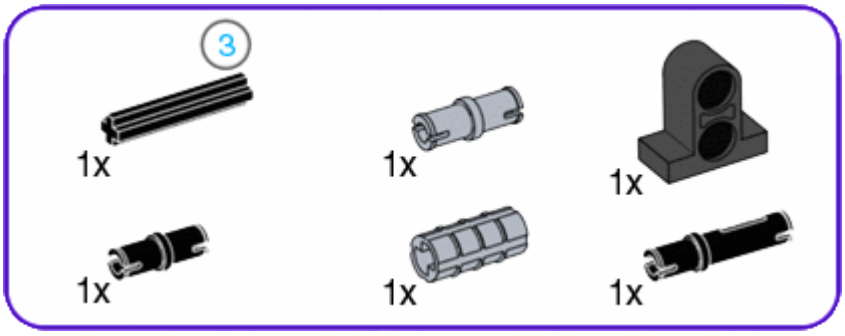

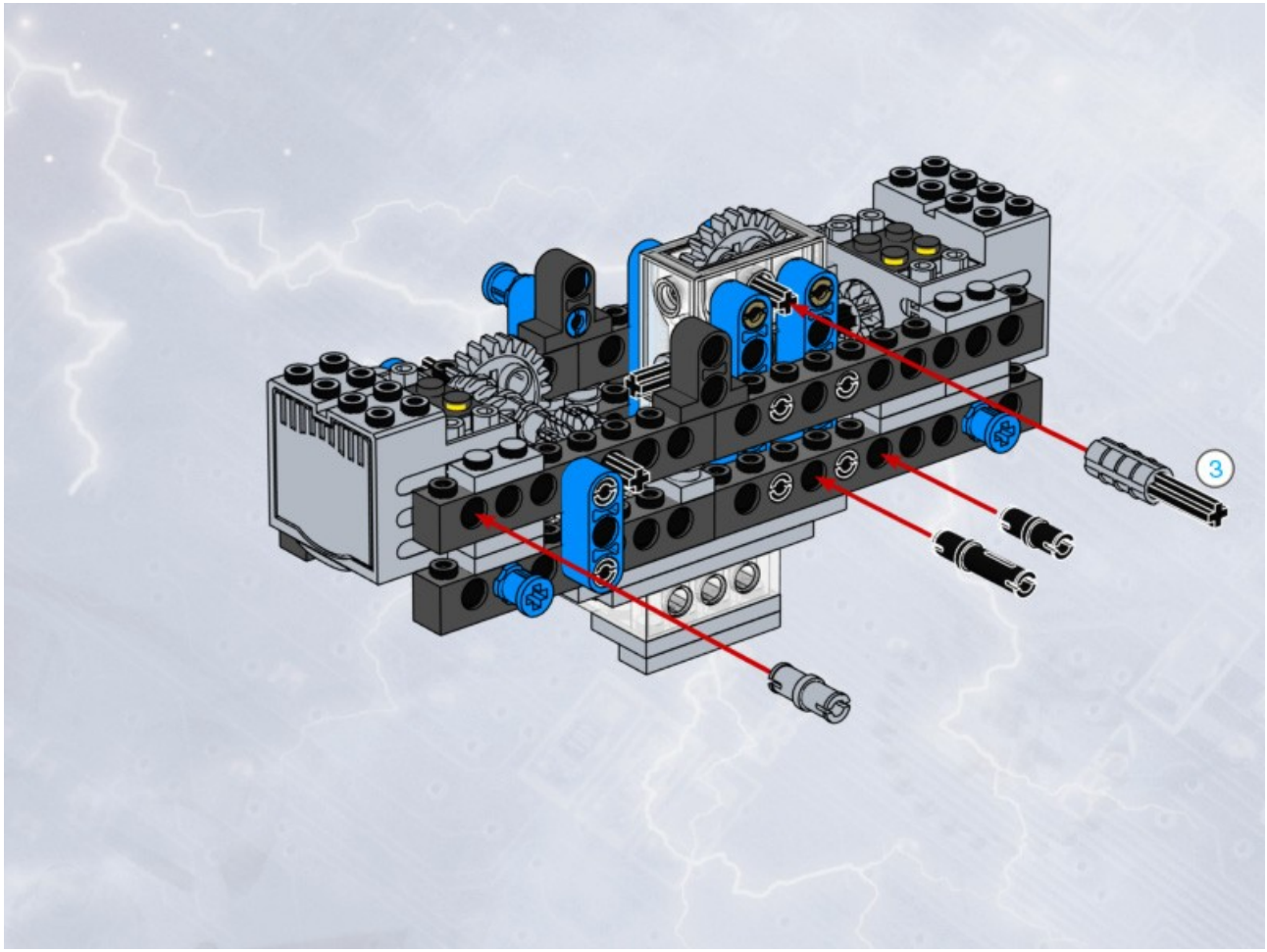

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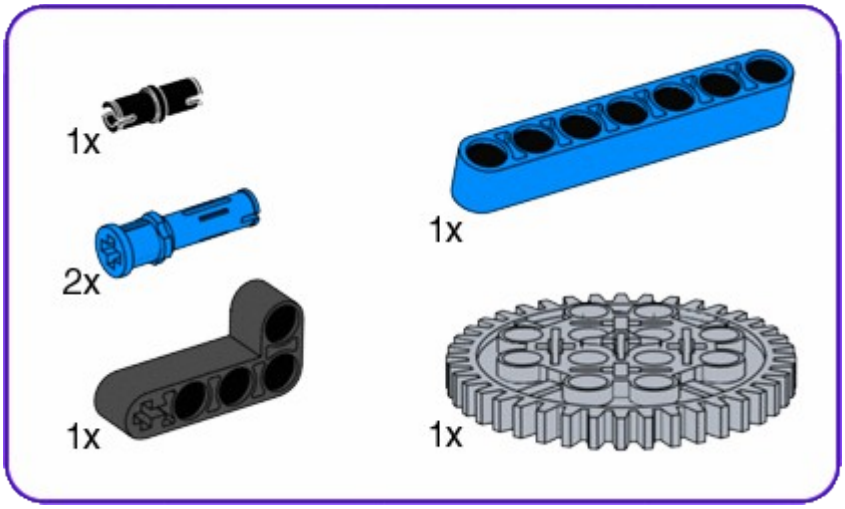

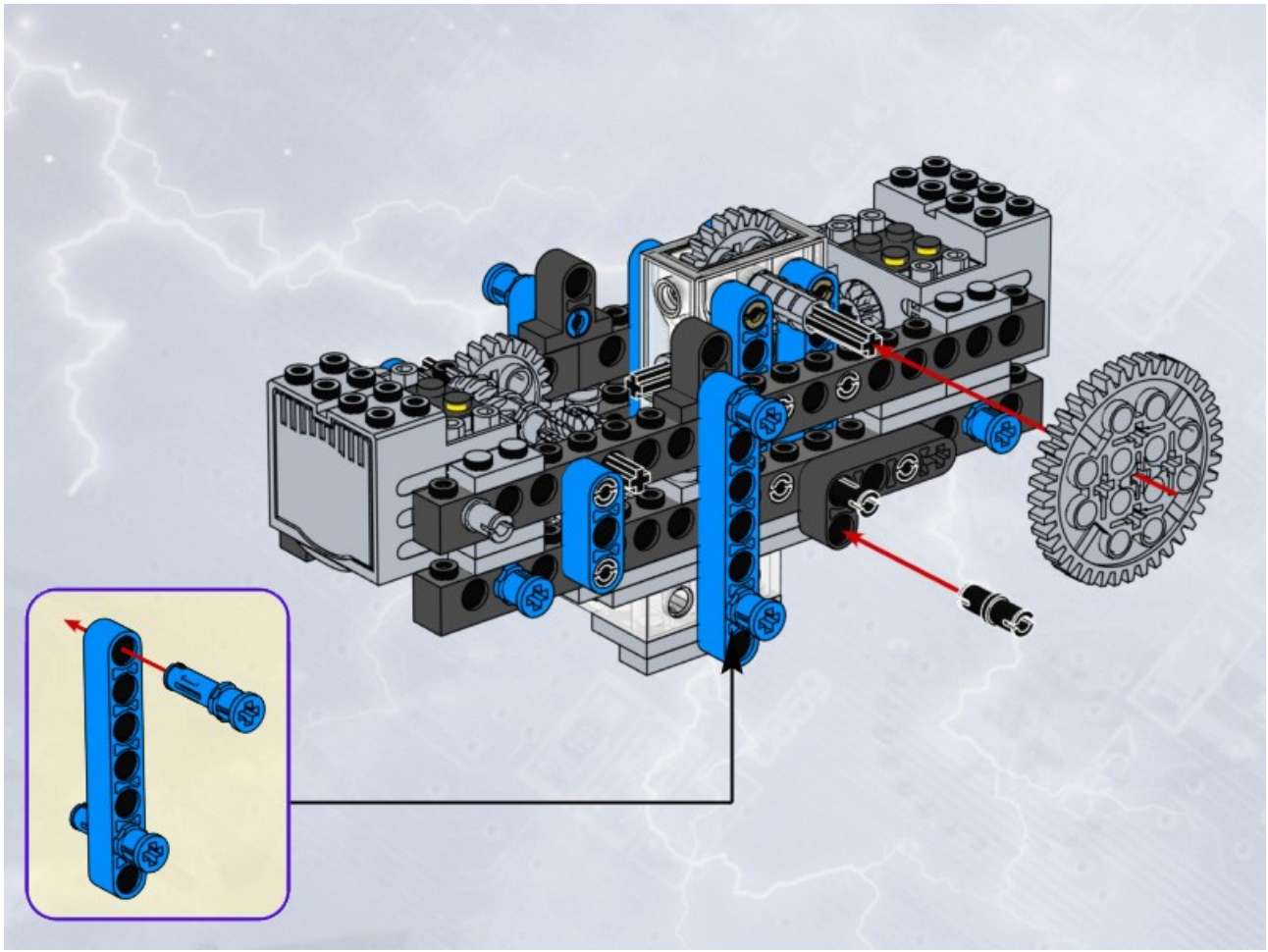

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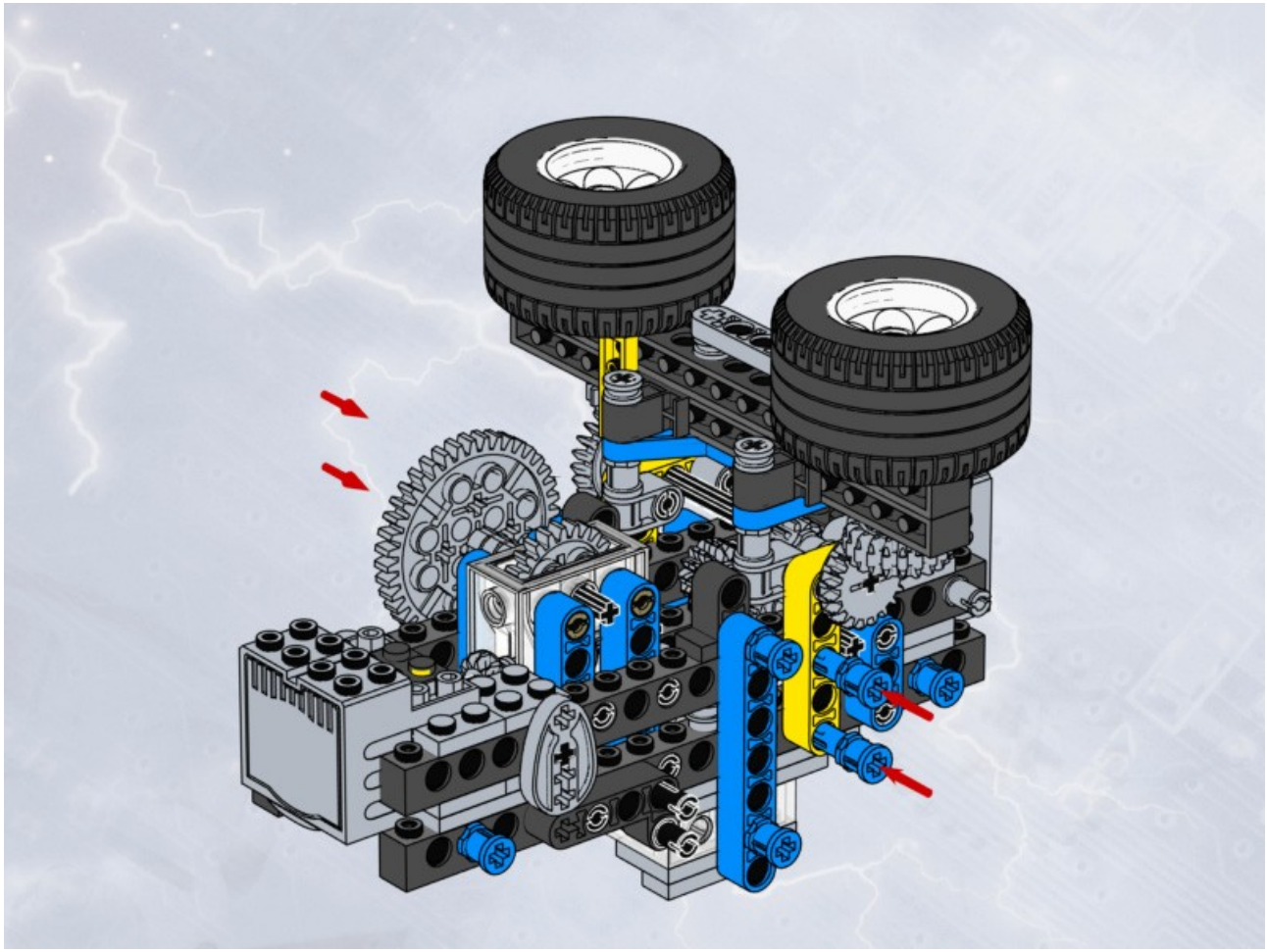

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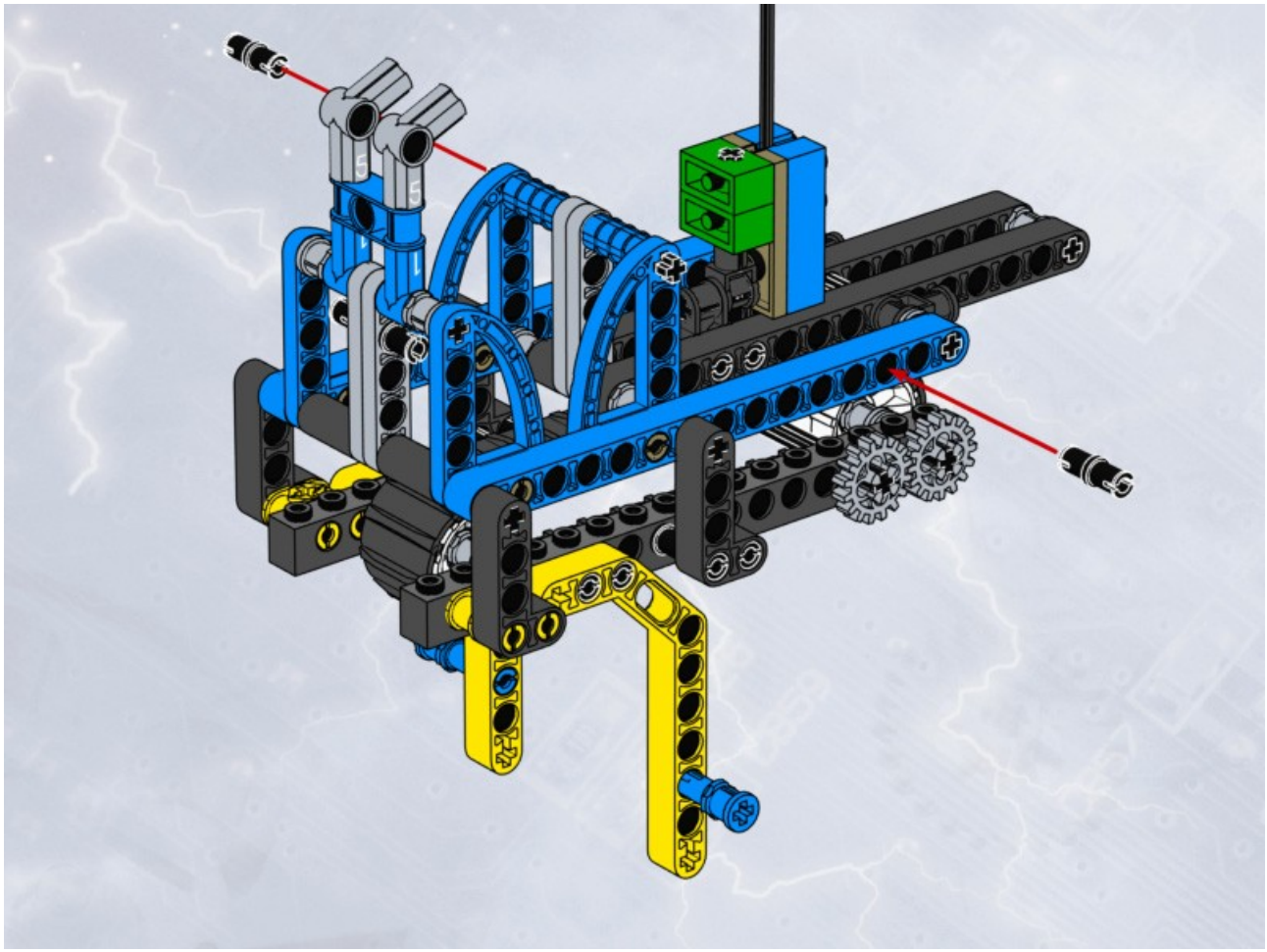

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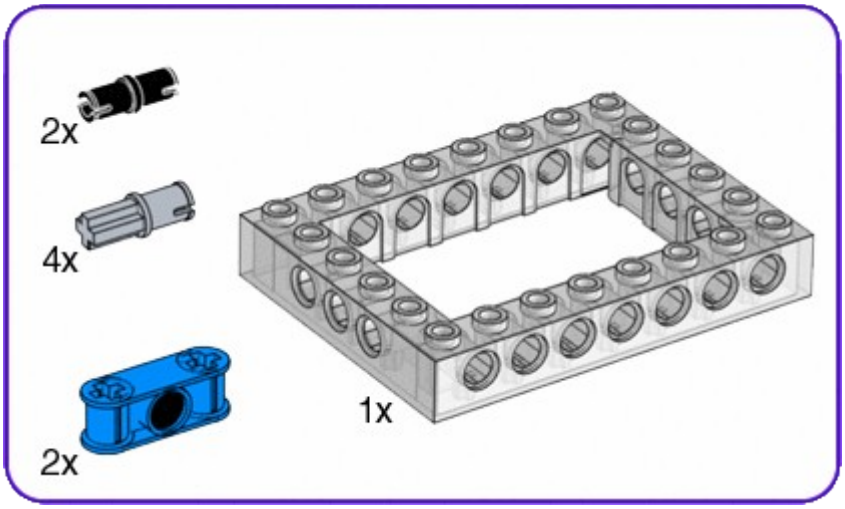

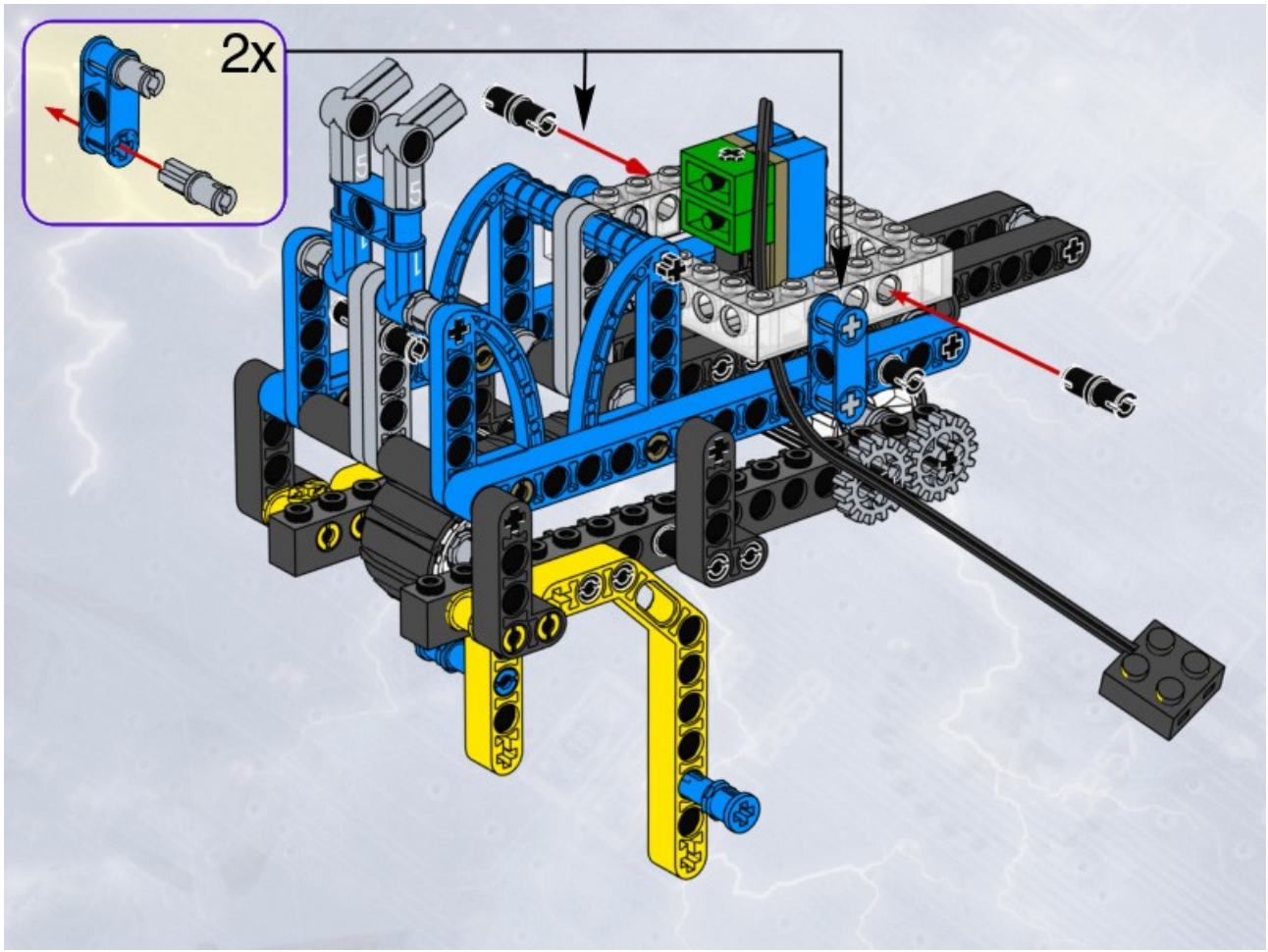

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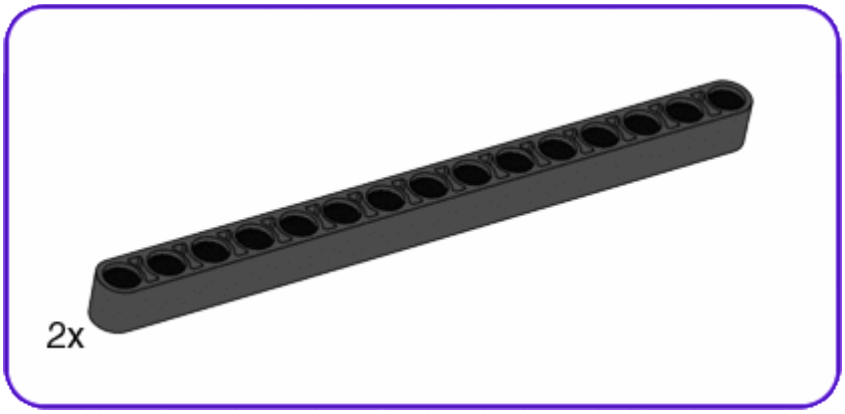

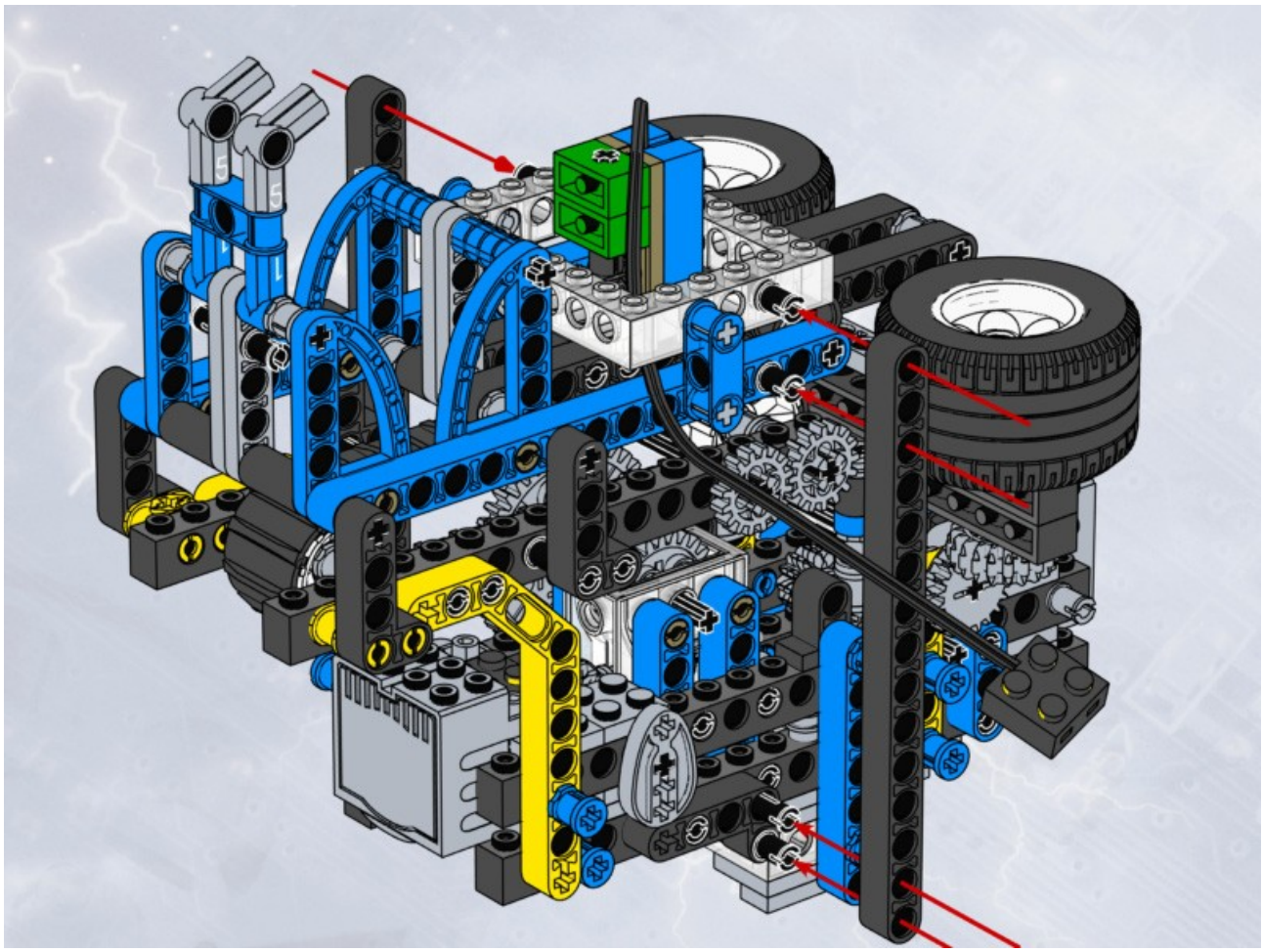

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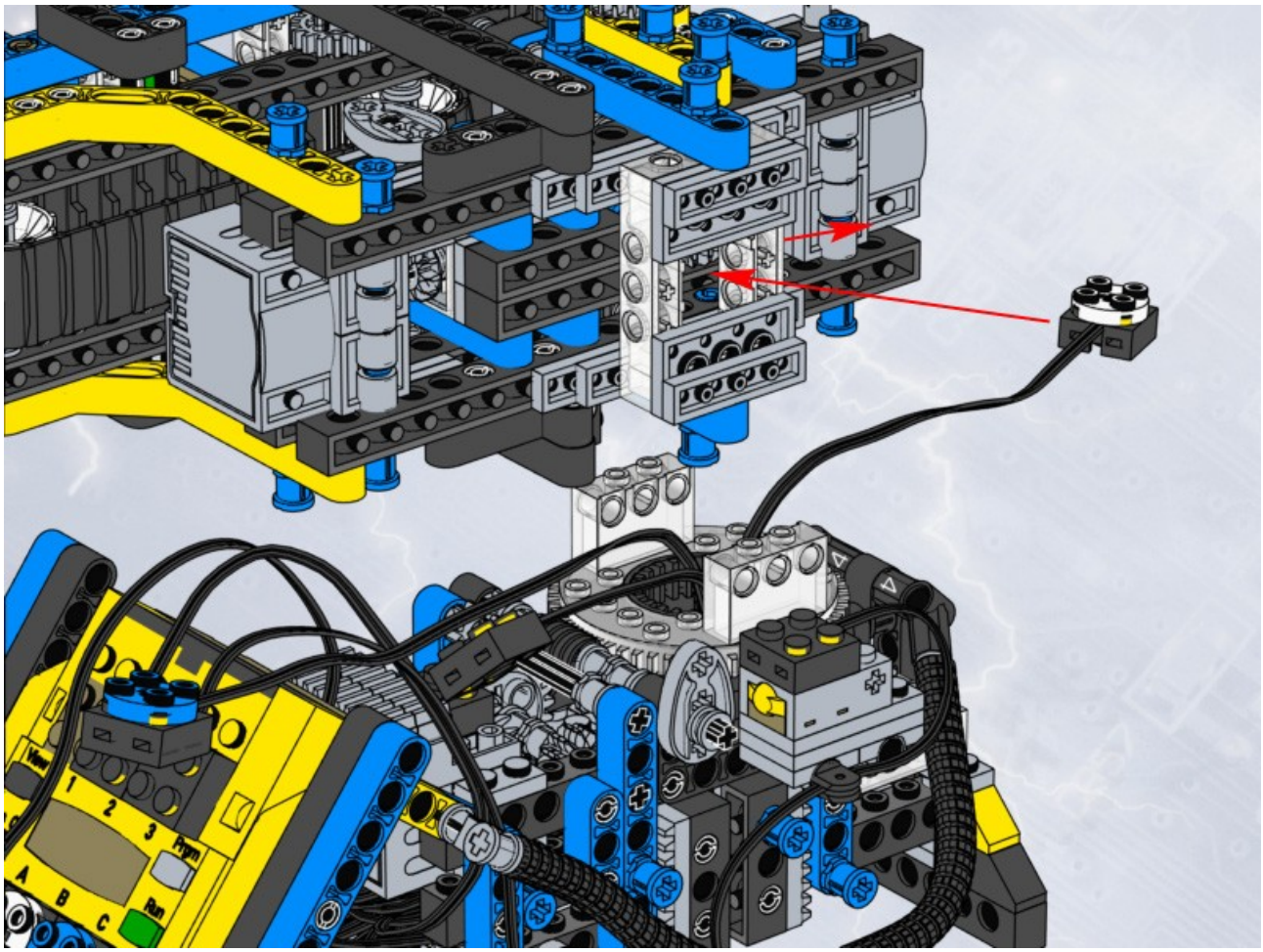

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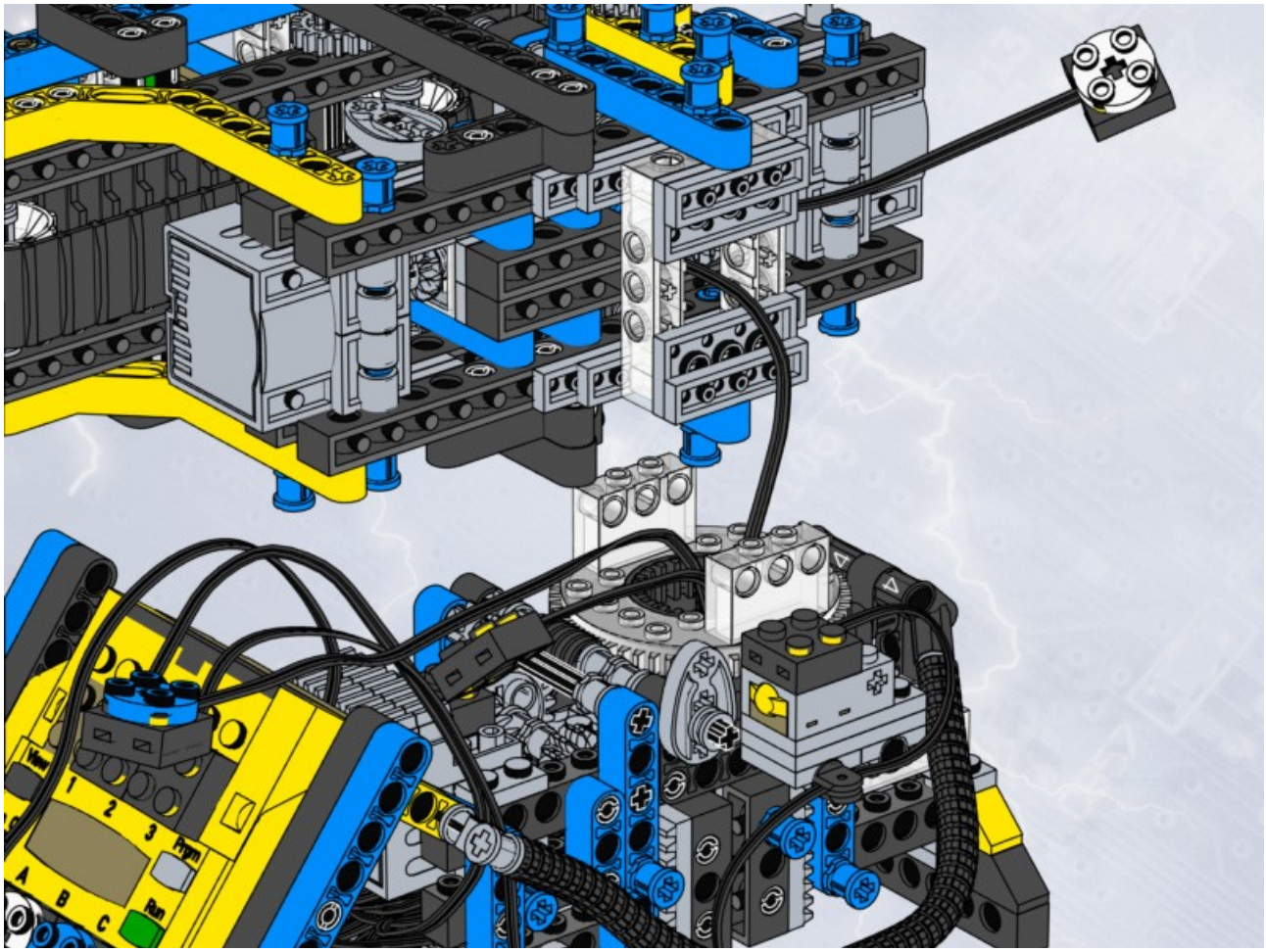

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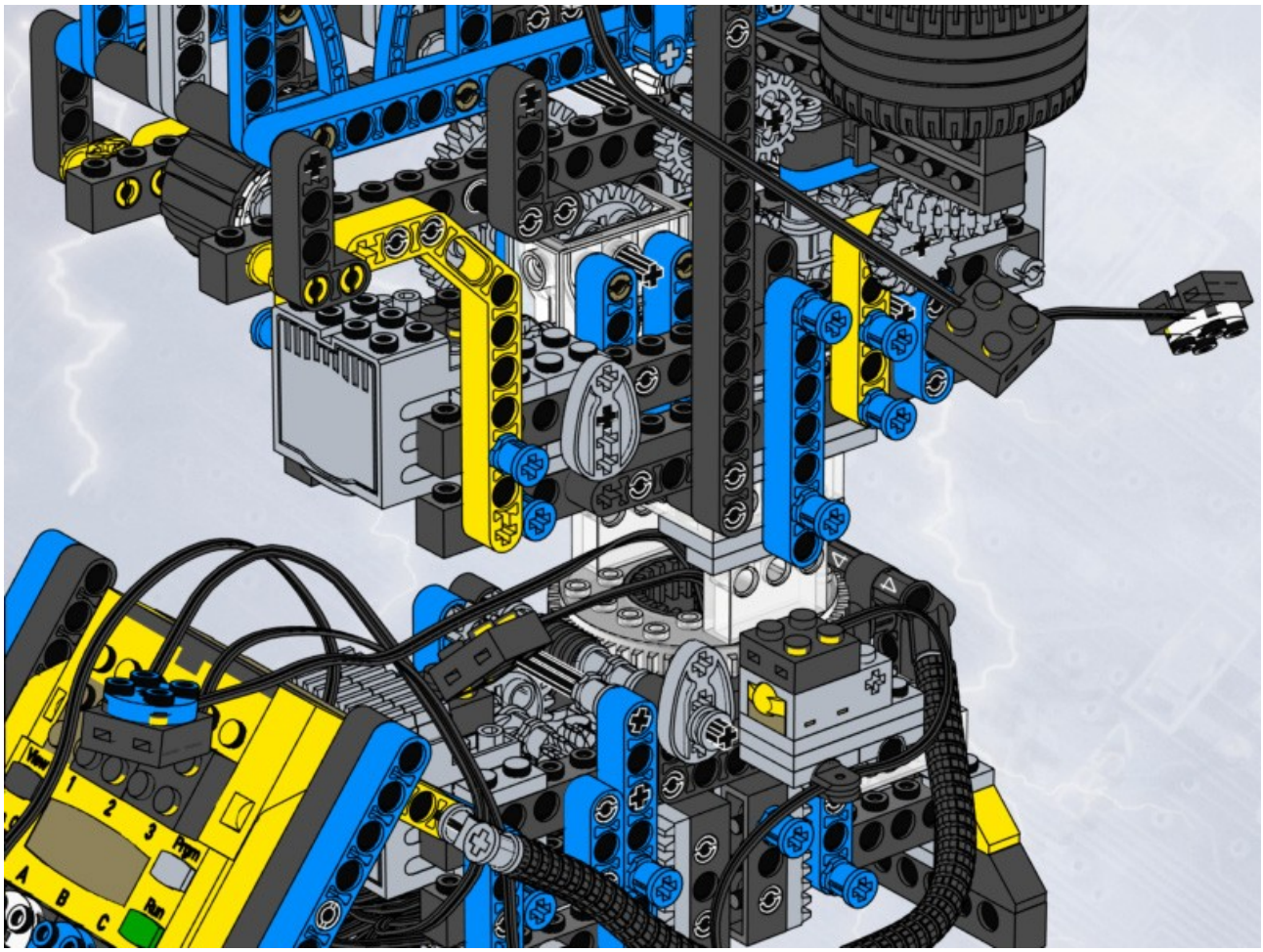

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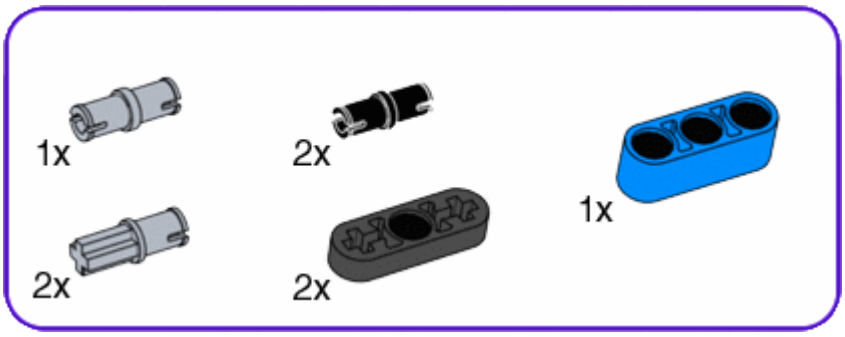

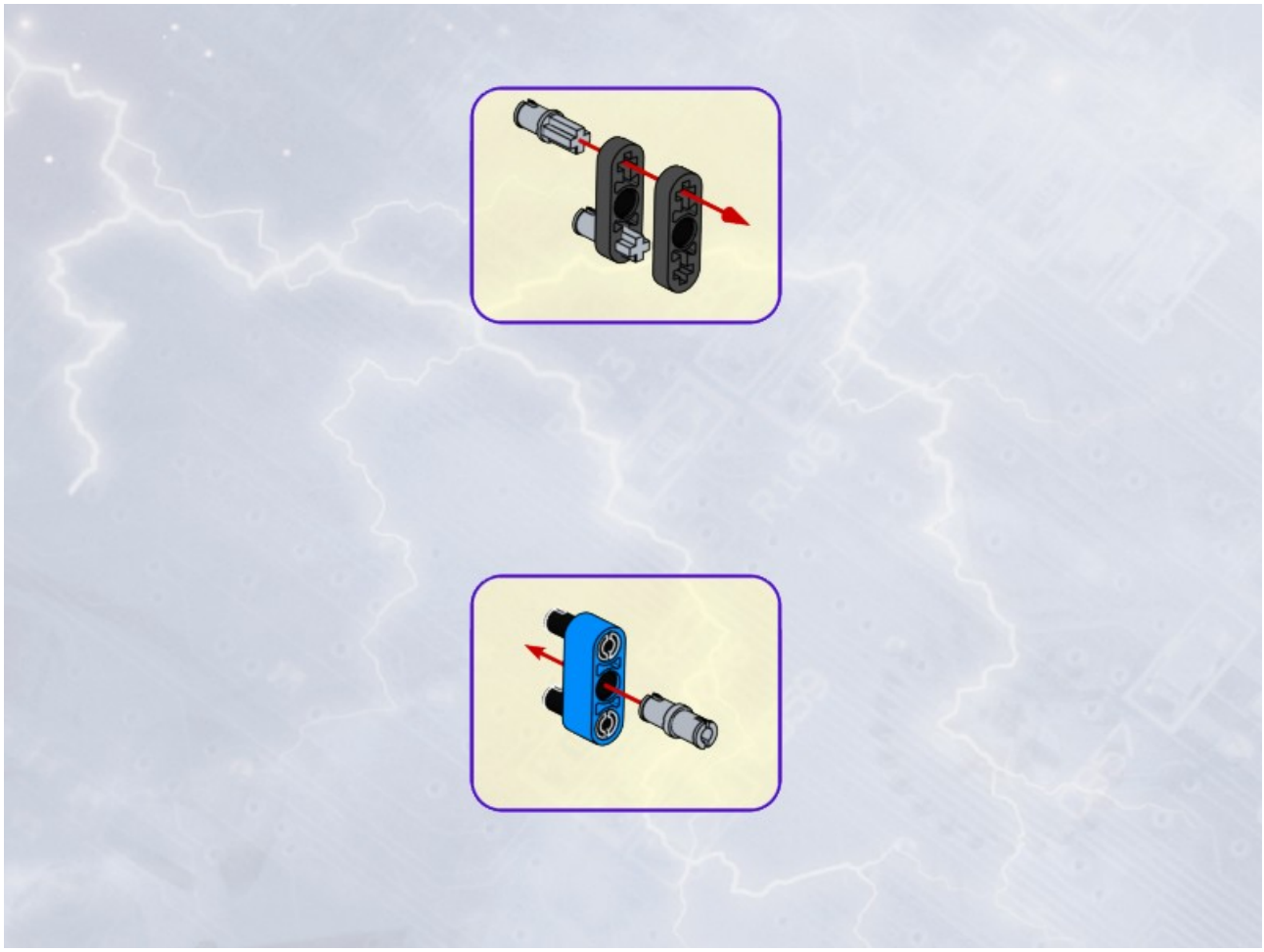

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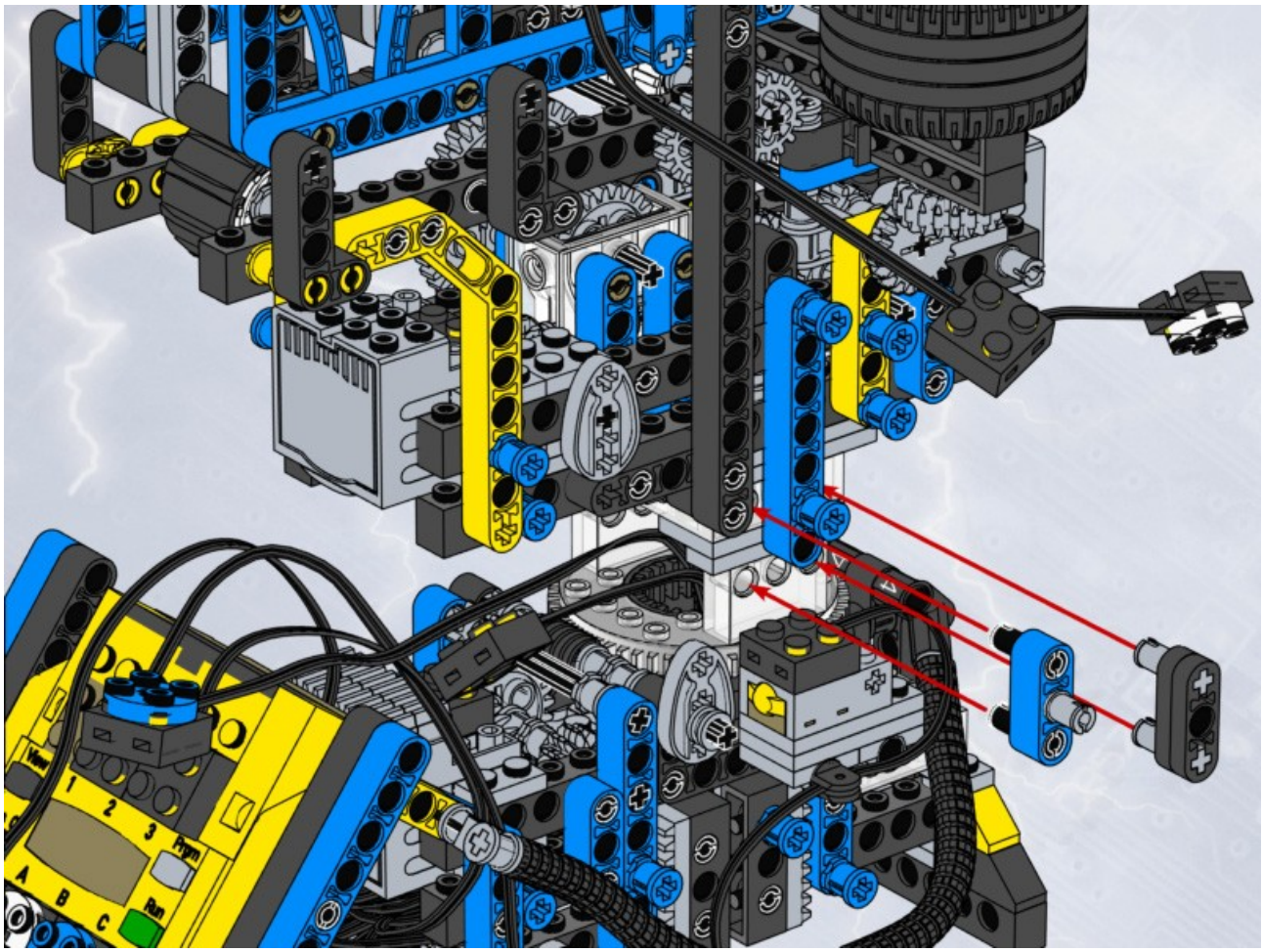

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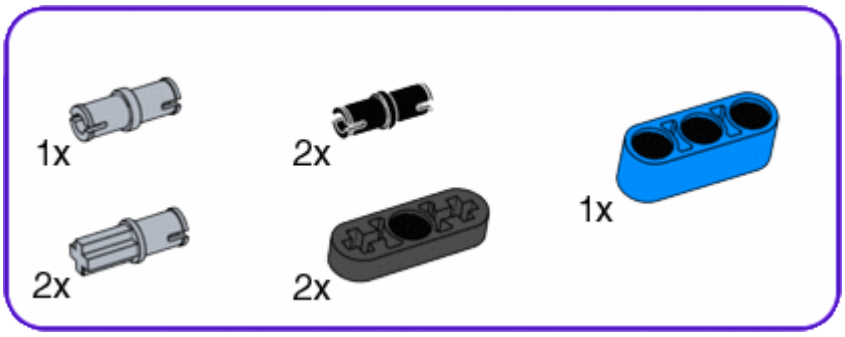

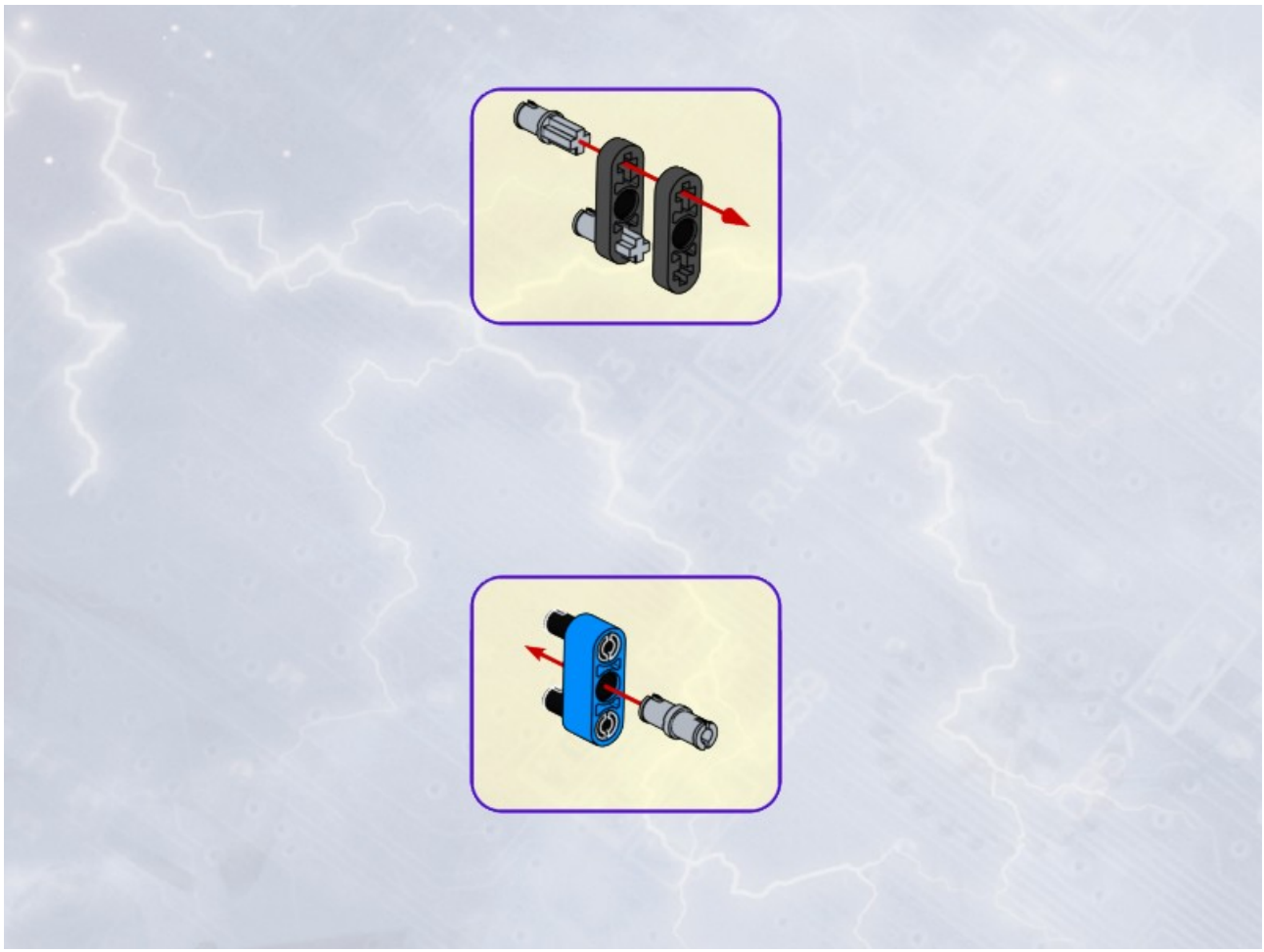

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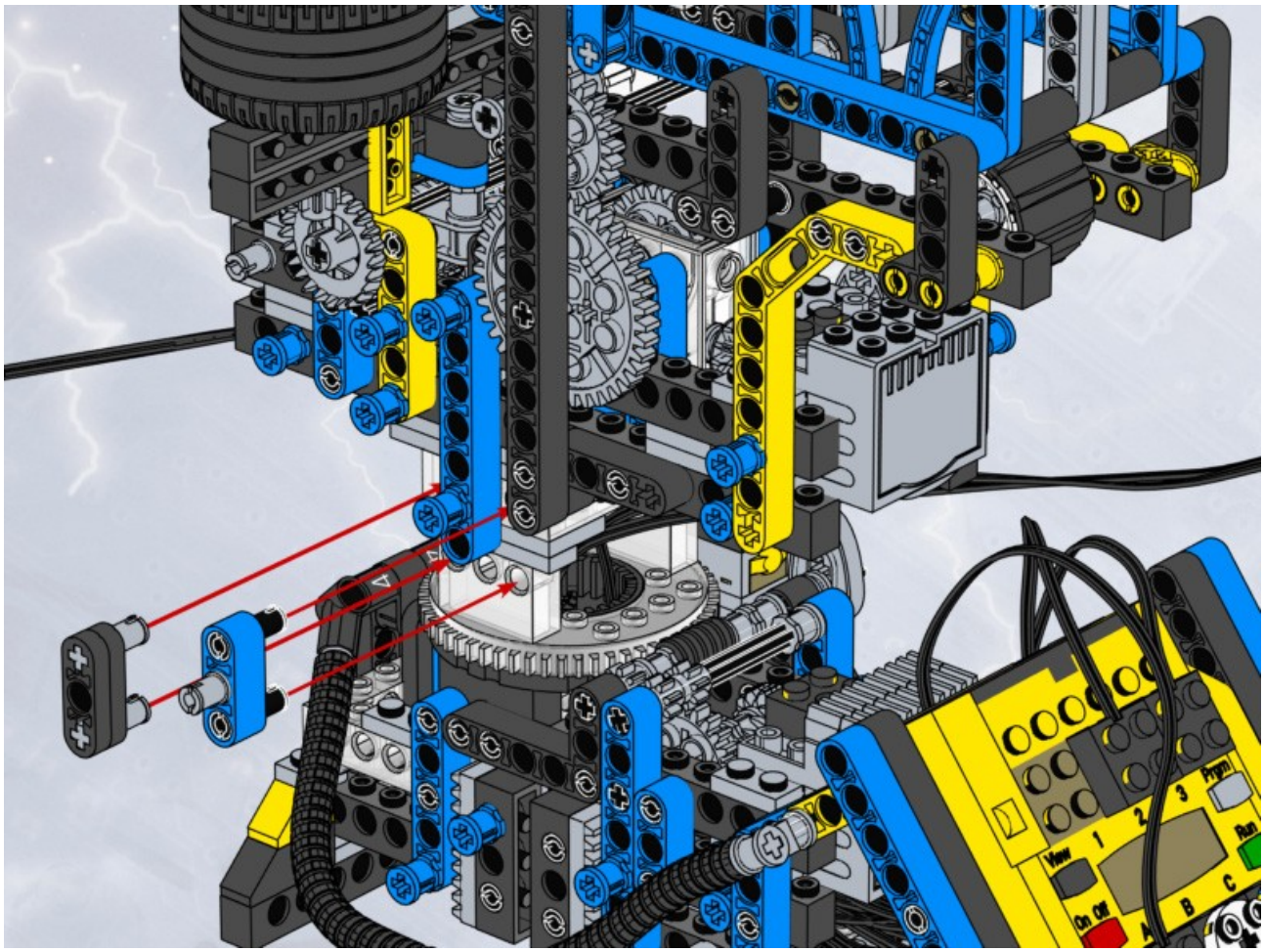

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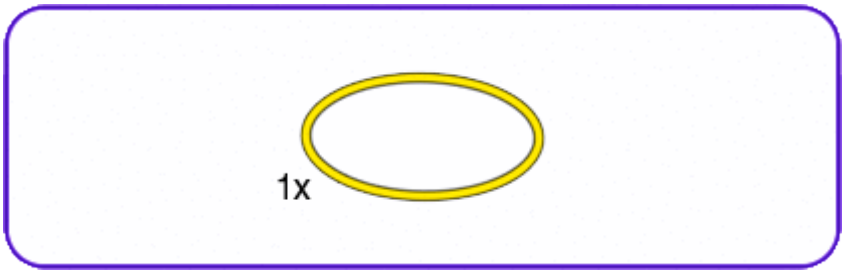

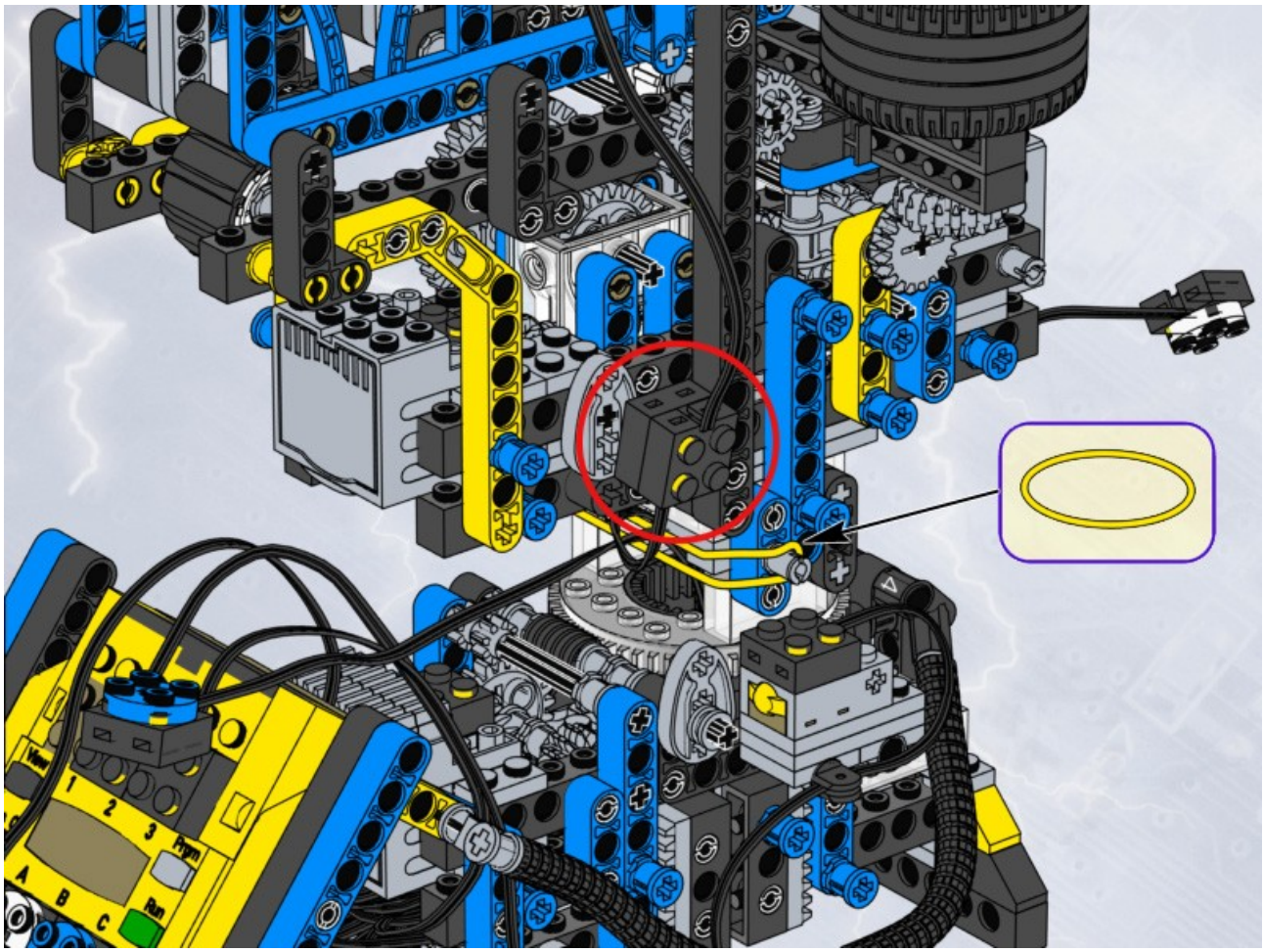

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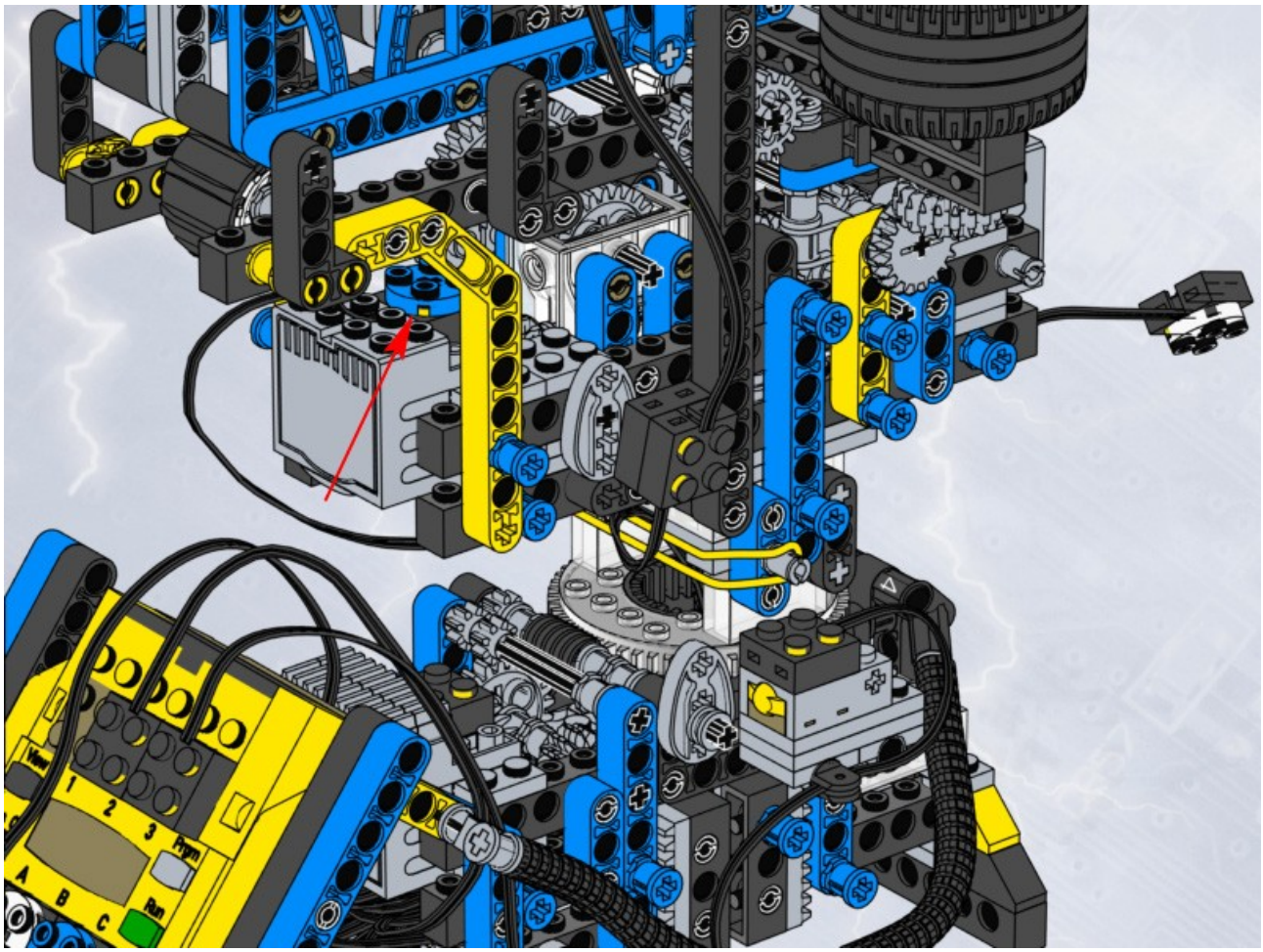

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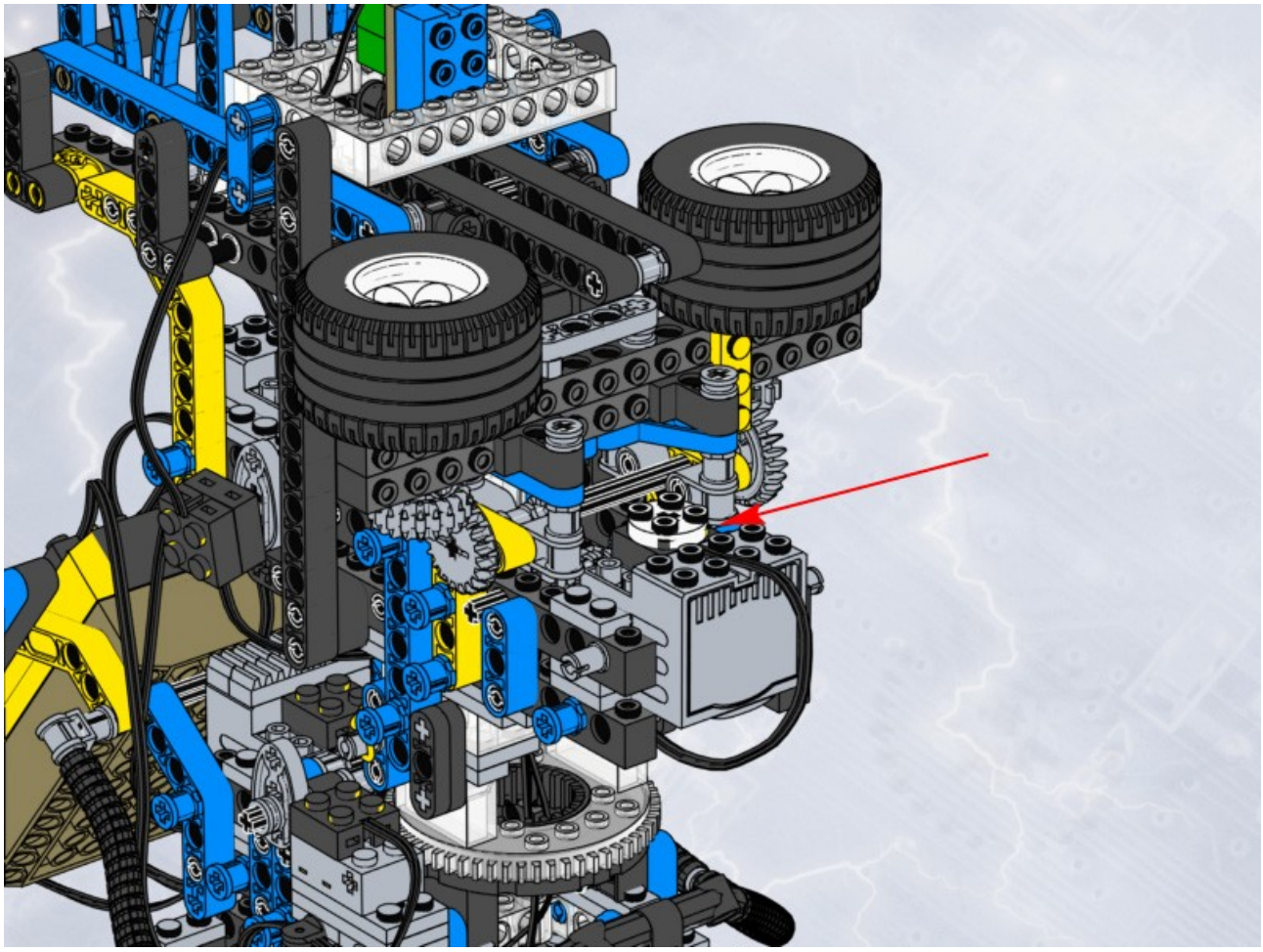

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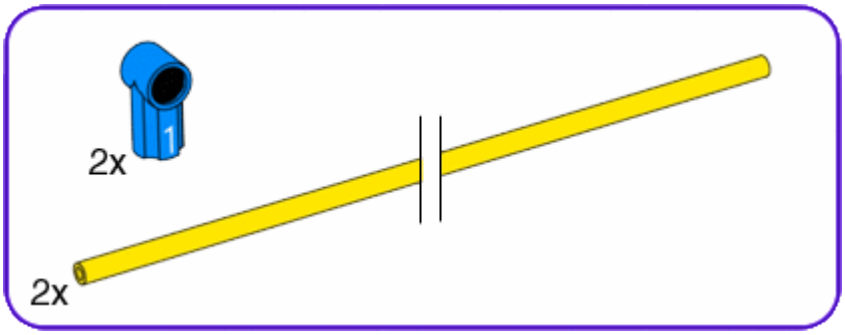

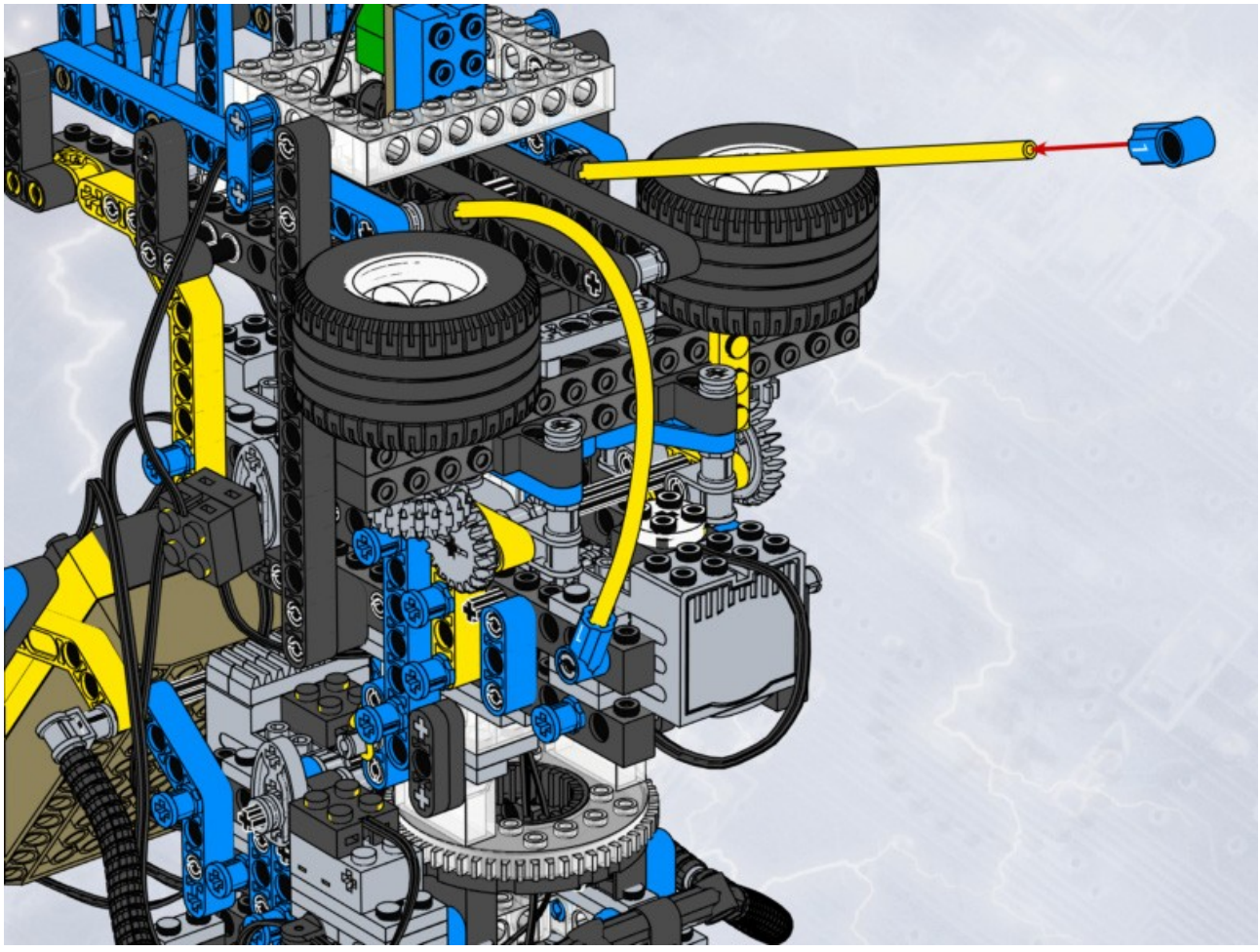

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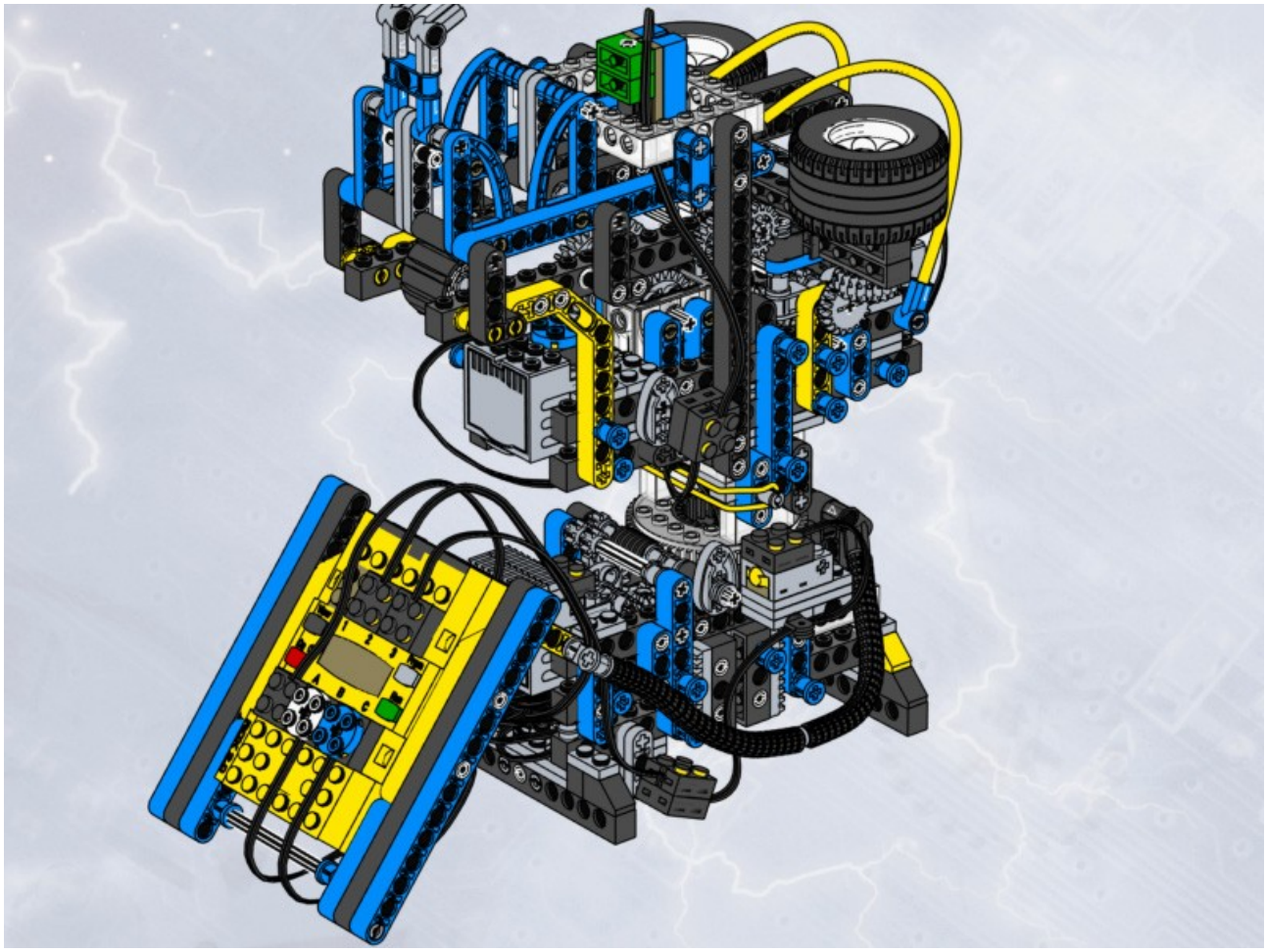
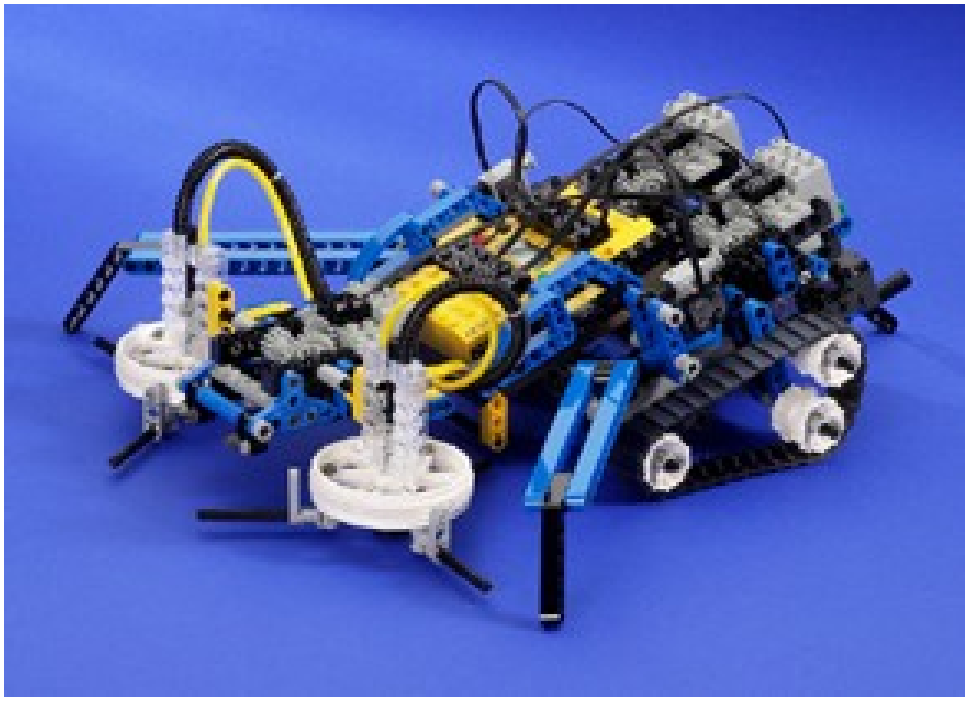


Tabletop Cleaner

Required modules: 3 x Motor Module 2, Right Table Sensor, Left Table Sensor, Rear Table Sensor, Cleaner Module



Make sure you build all the modules before starting this step.

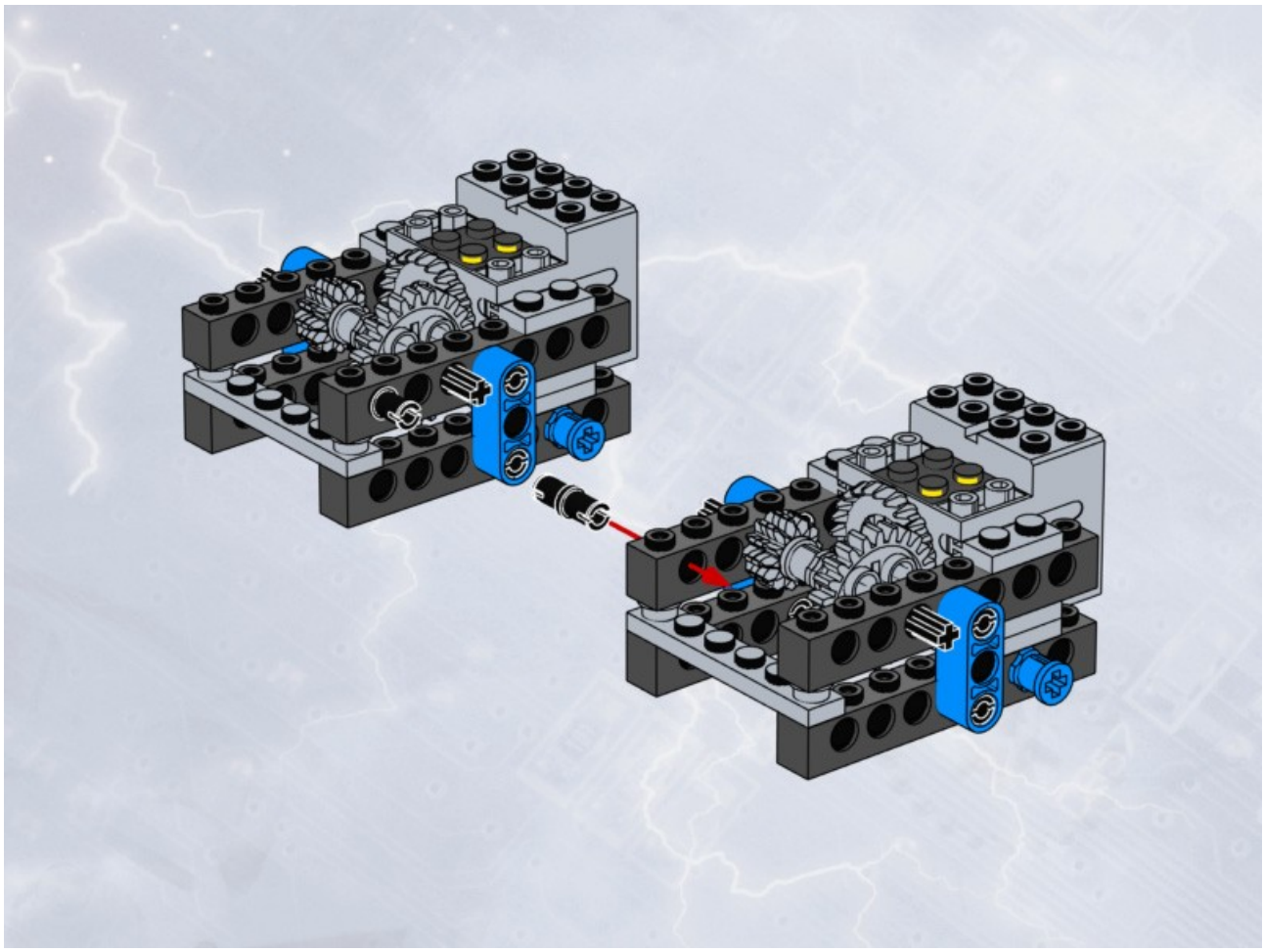
You will need 3 Motor Module 2s and at least one of these before you build the Cleaner Module.

A basic program for the cleaner is fairly simple.

Make the Cleaner drive around testing the sensors for the edge of the table then move away and turn in the relevant direction when an edge is detected.

For a greater challenge, see if you can make your cleaner move across your desk in an organized way, sweeping up and down the table working from front to back.

1



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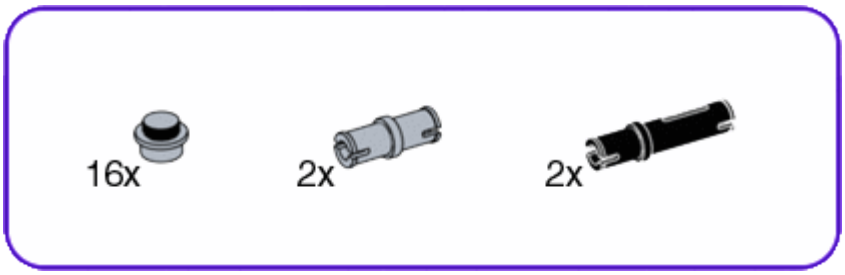

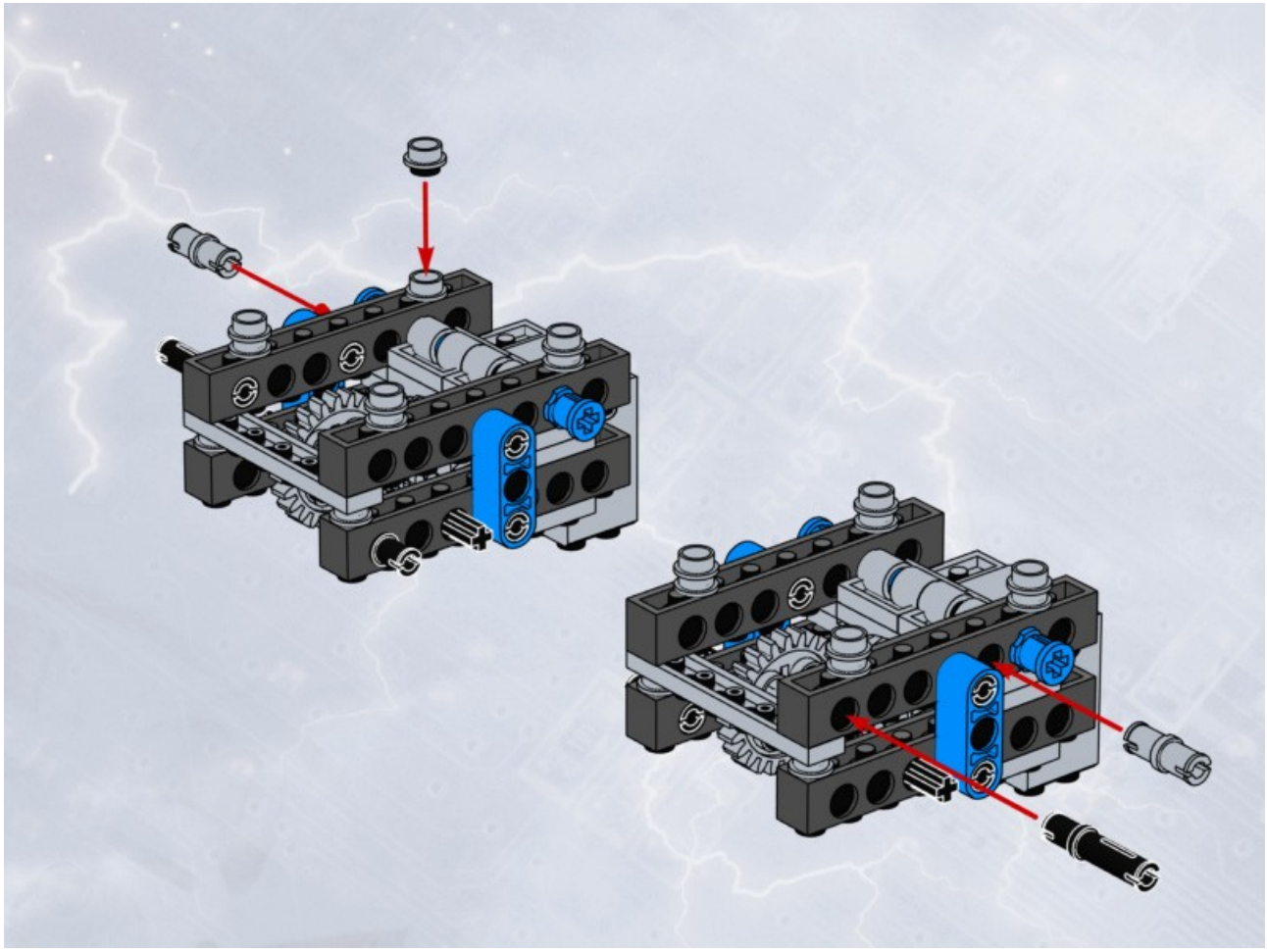

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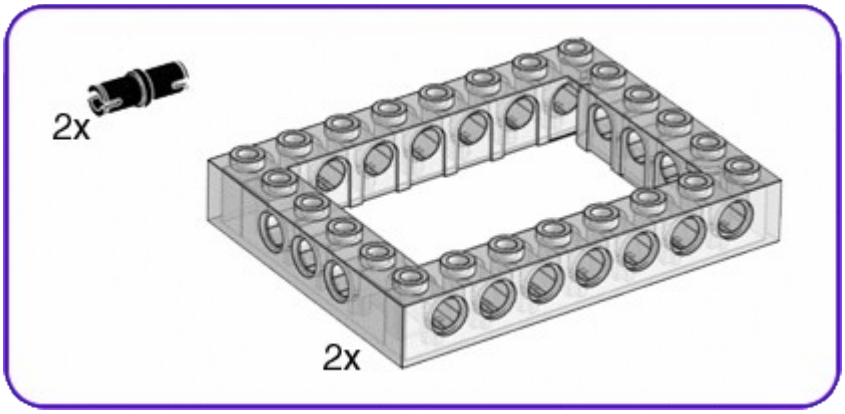

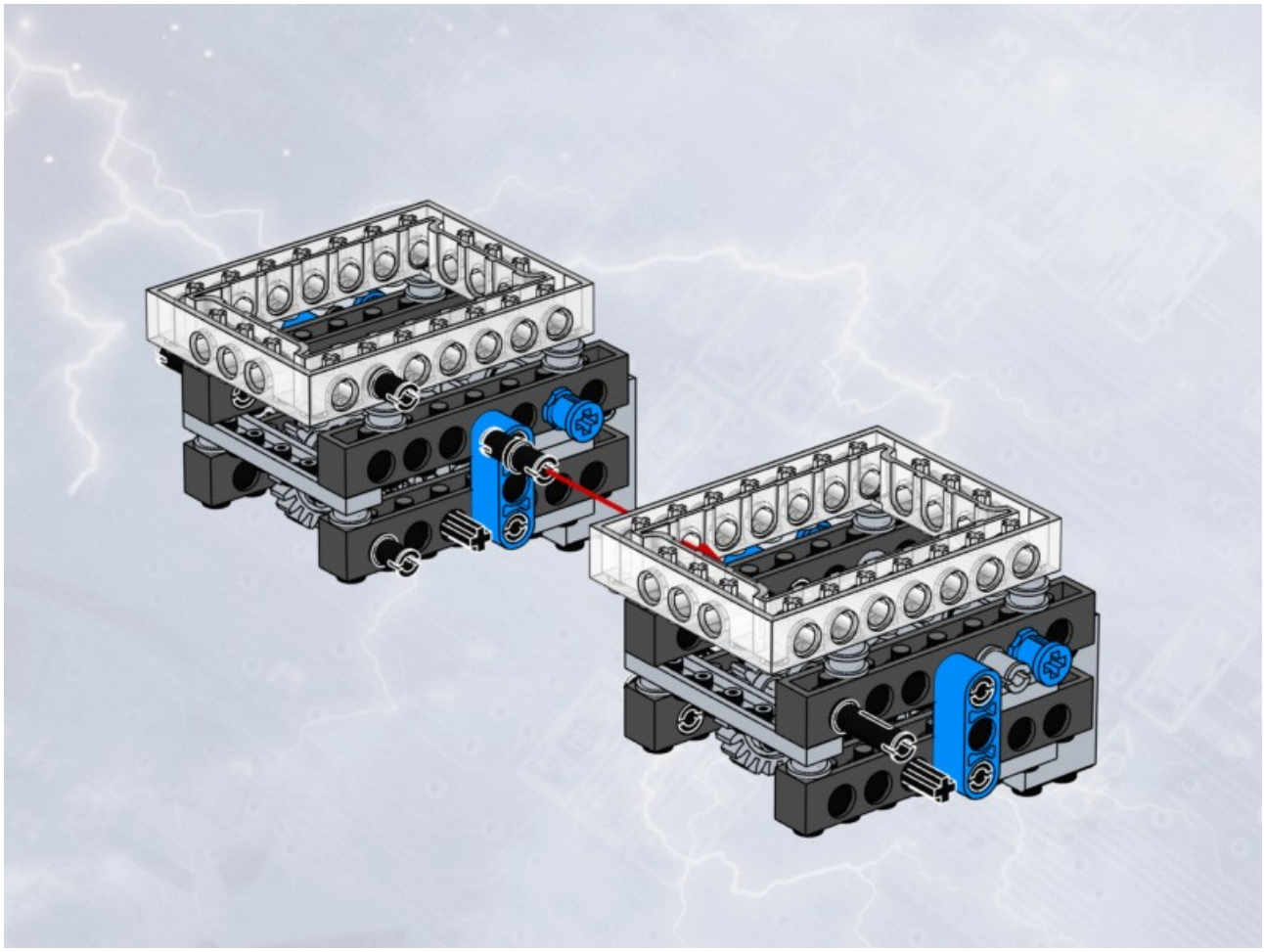

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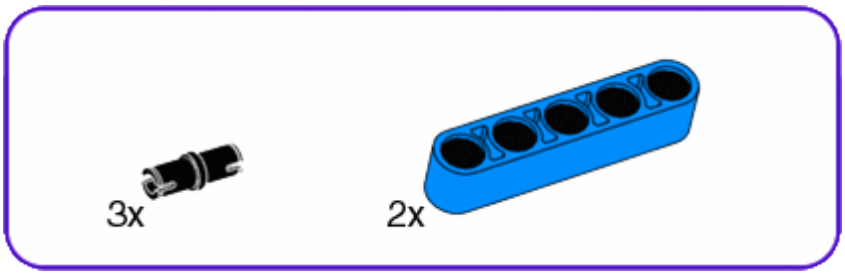

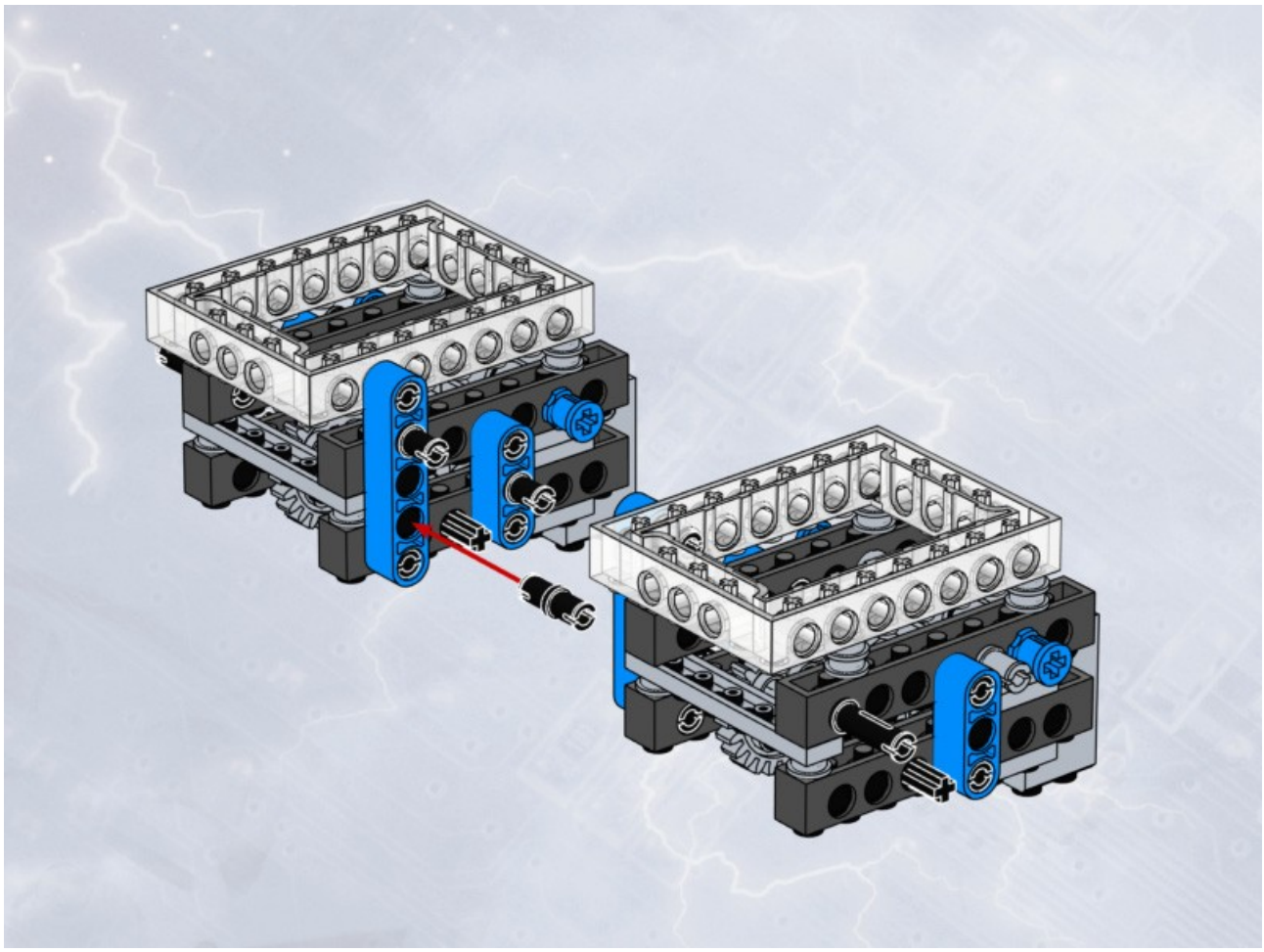

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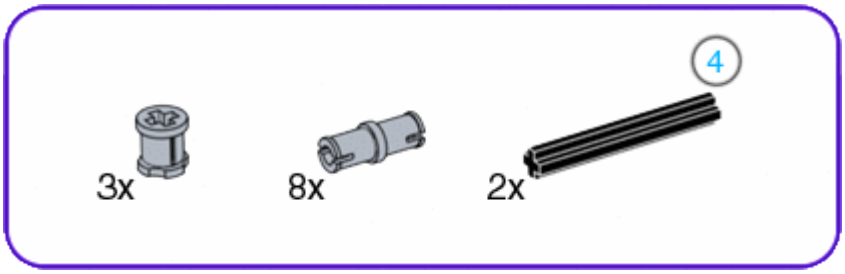

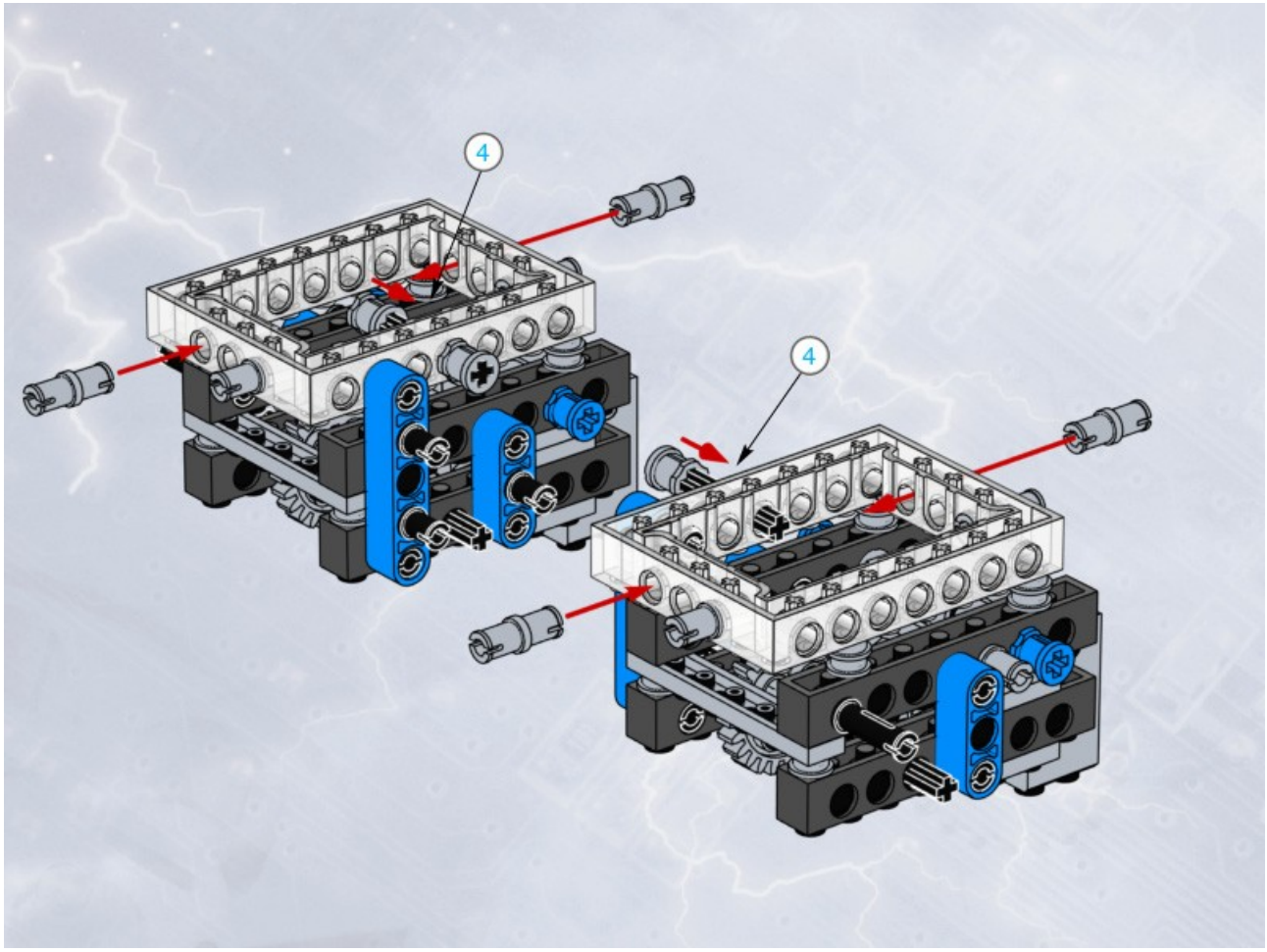

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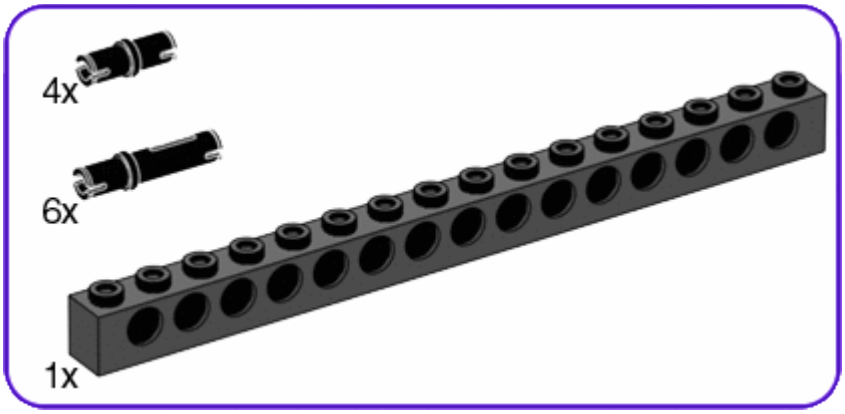

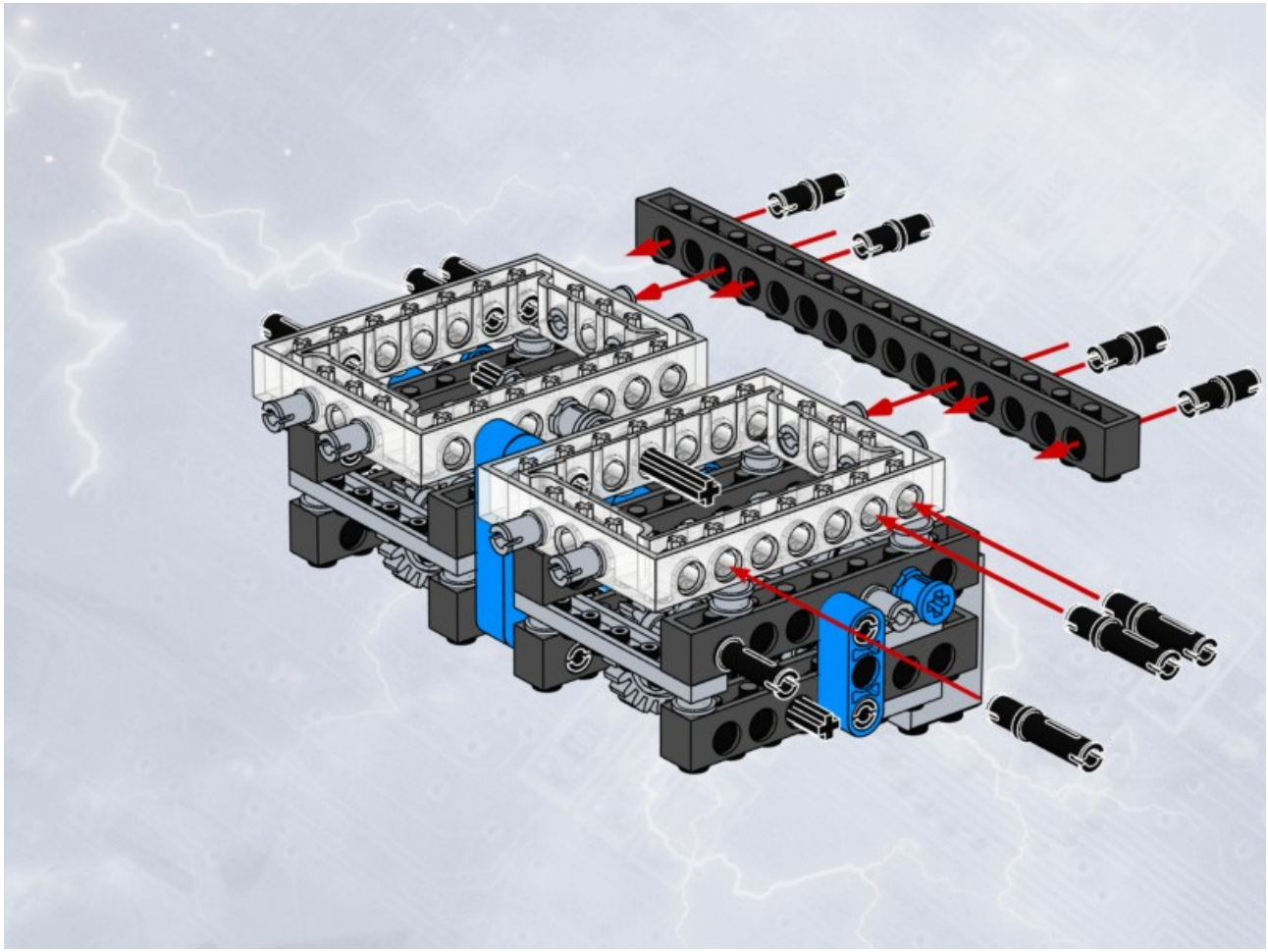

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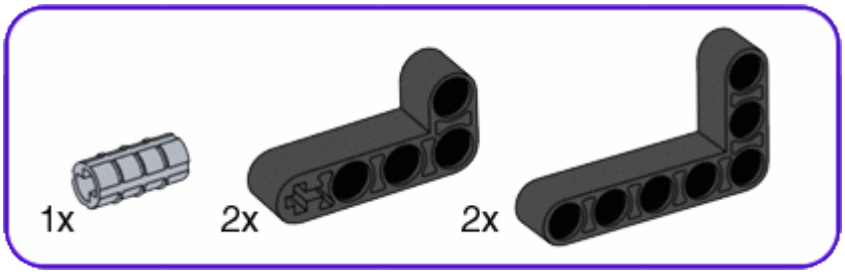

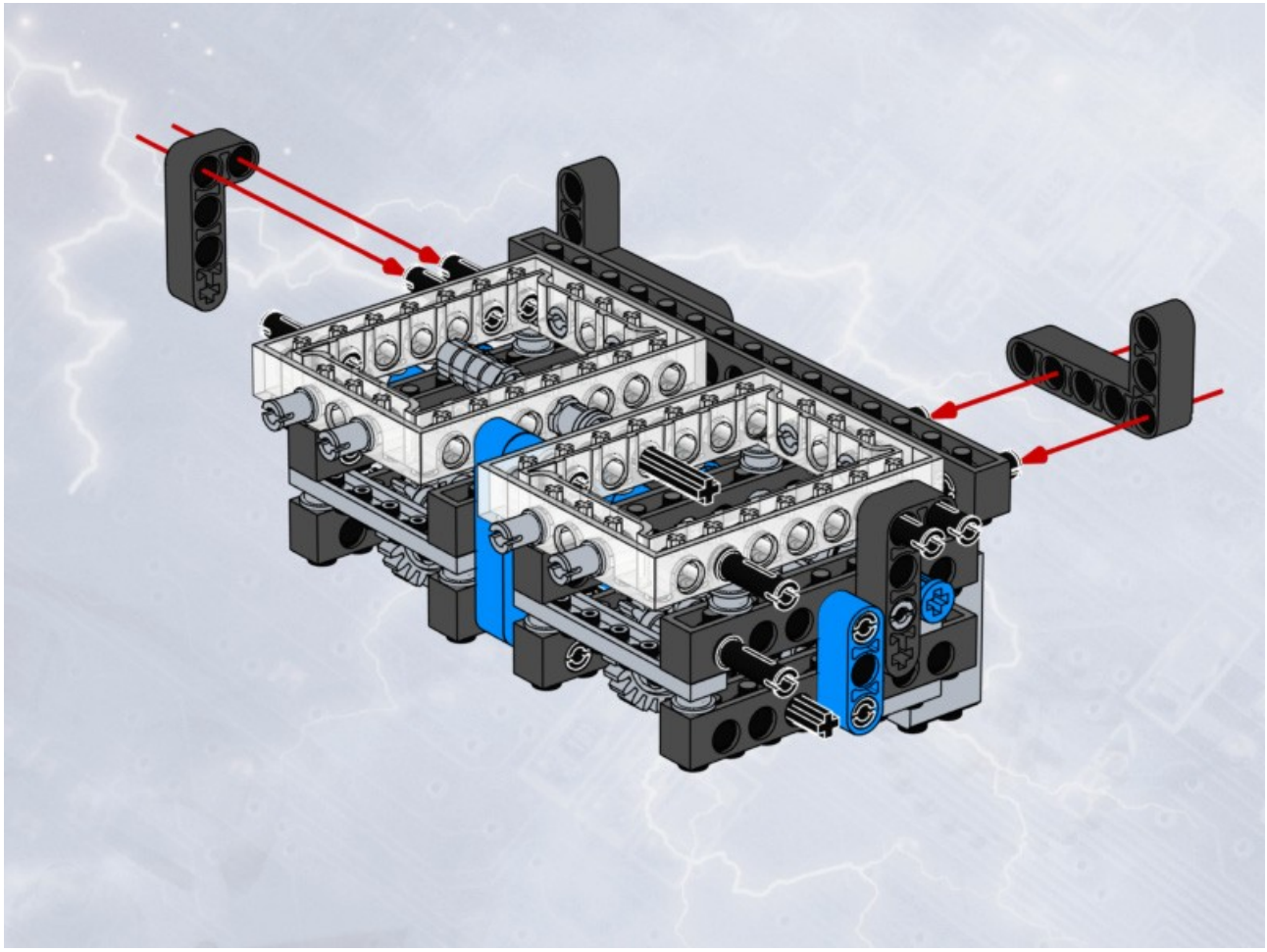

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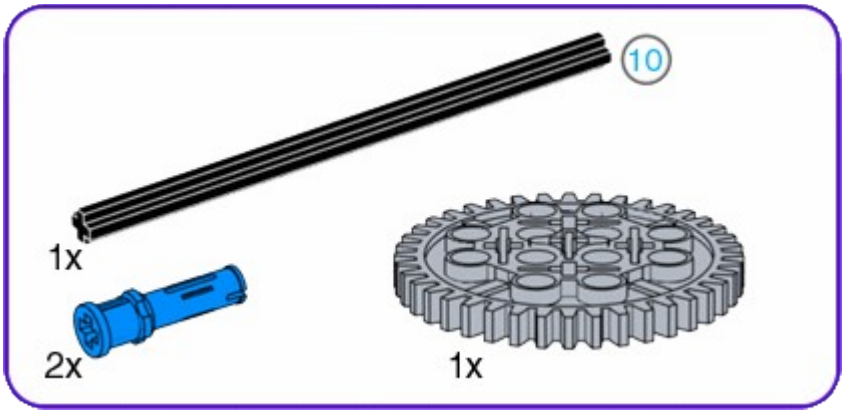

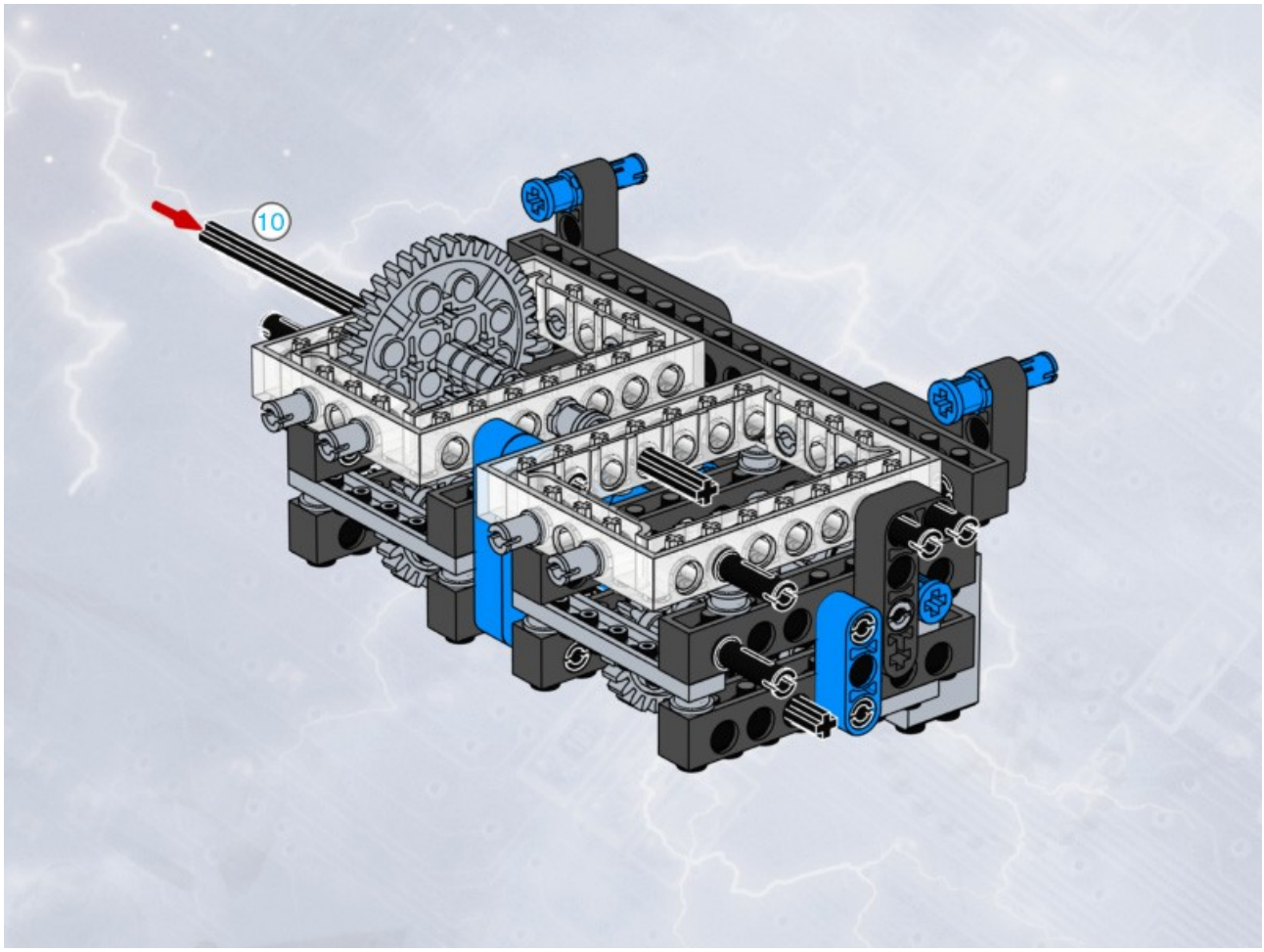

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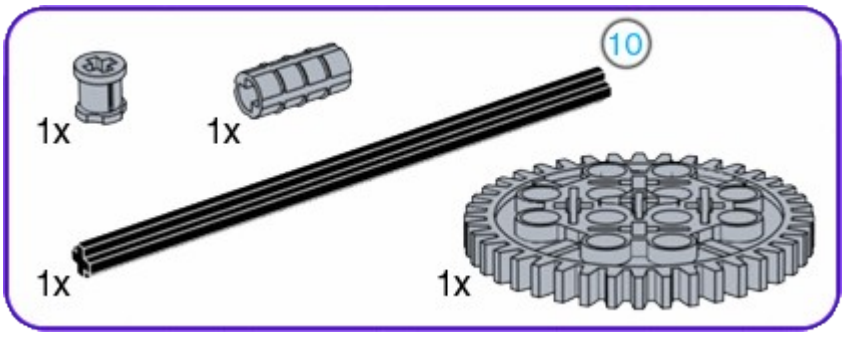

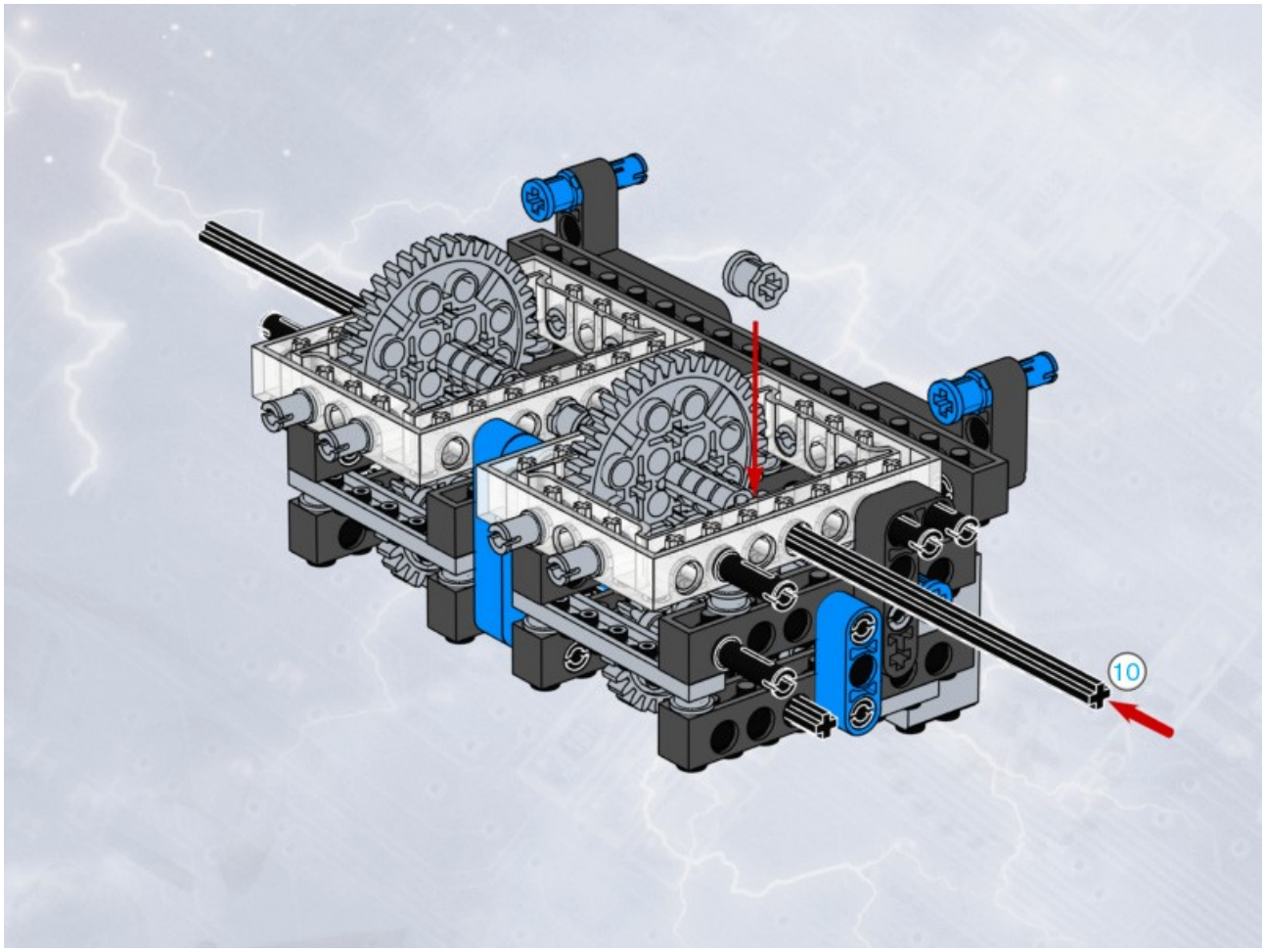

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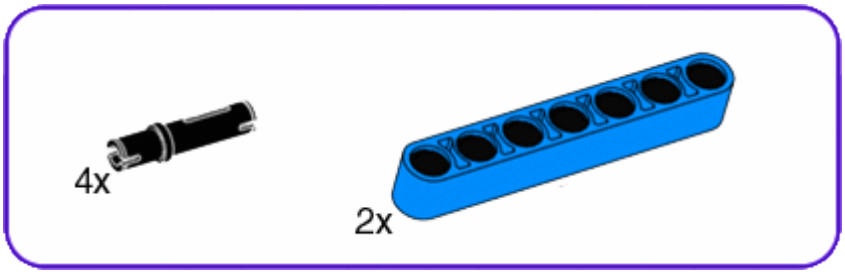

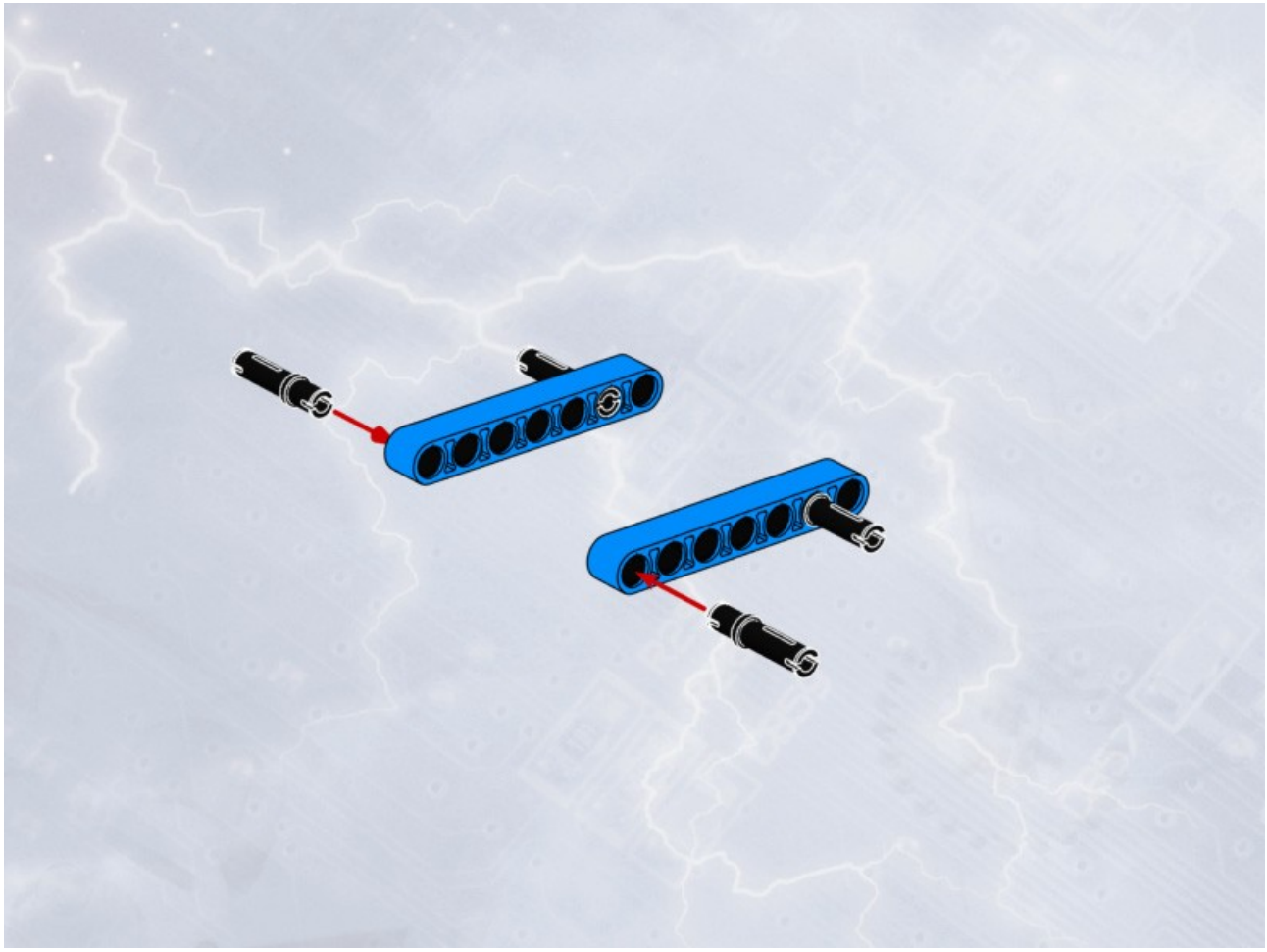

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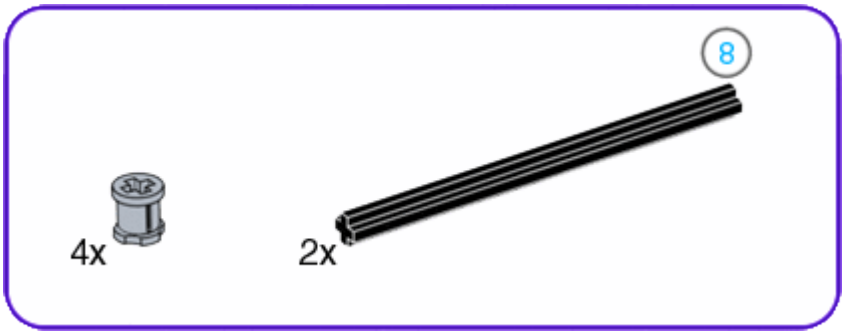

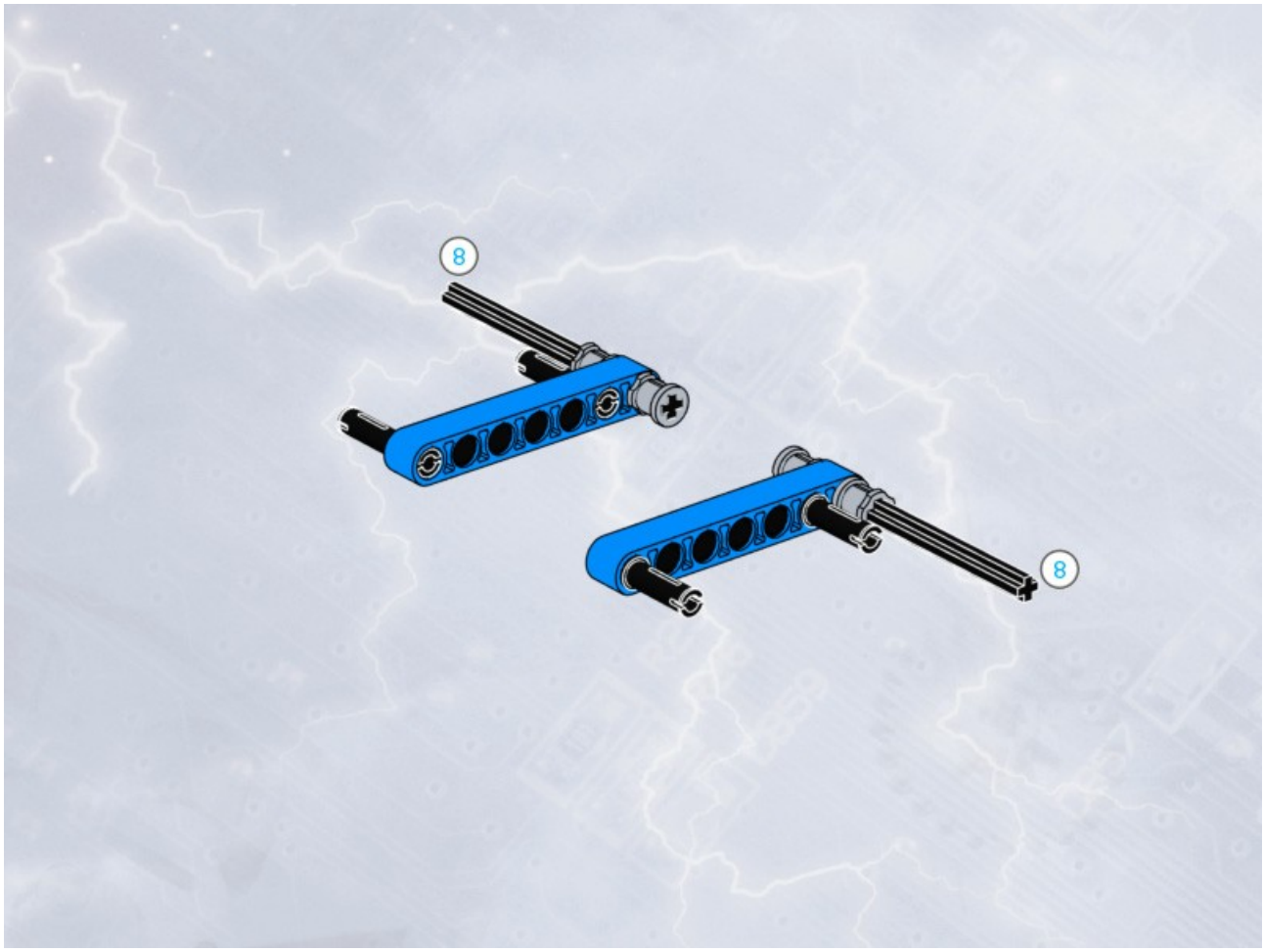

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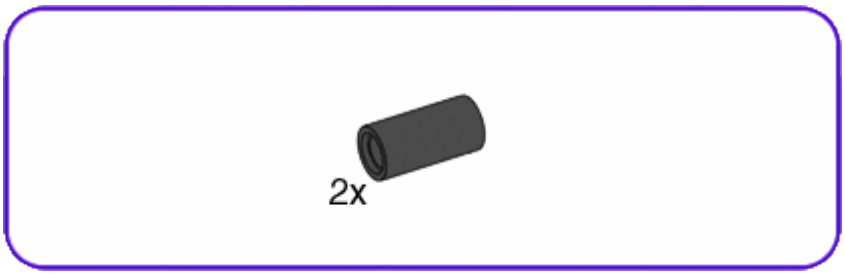

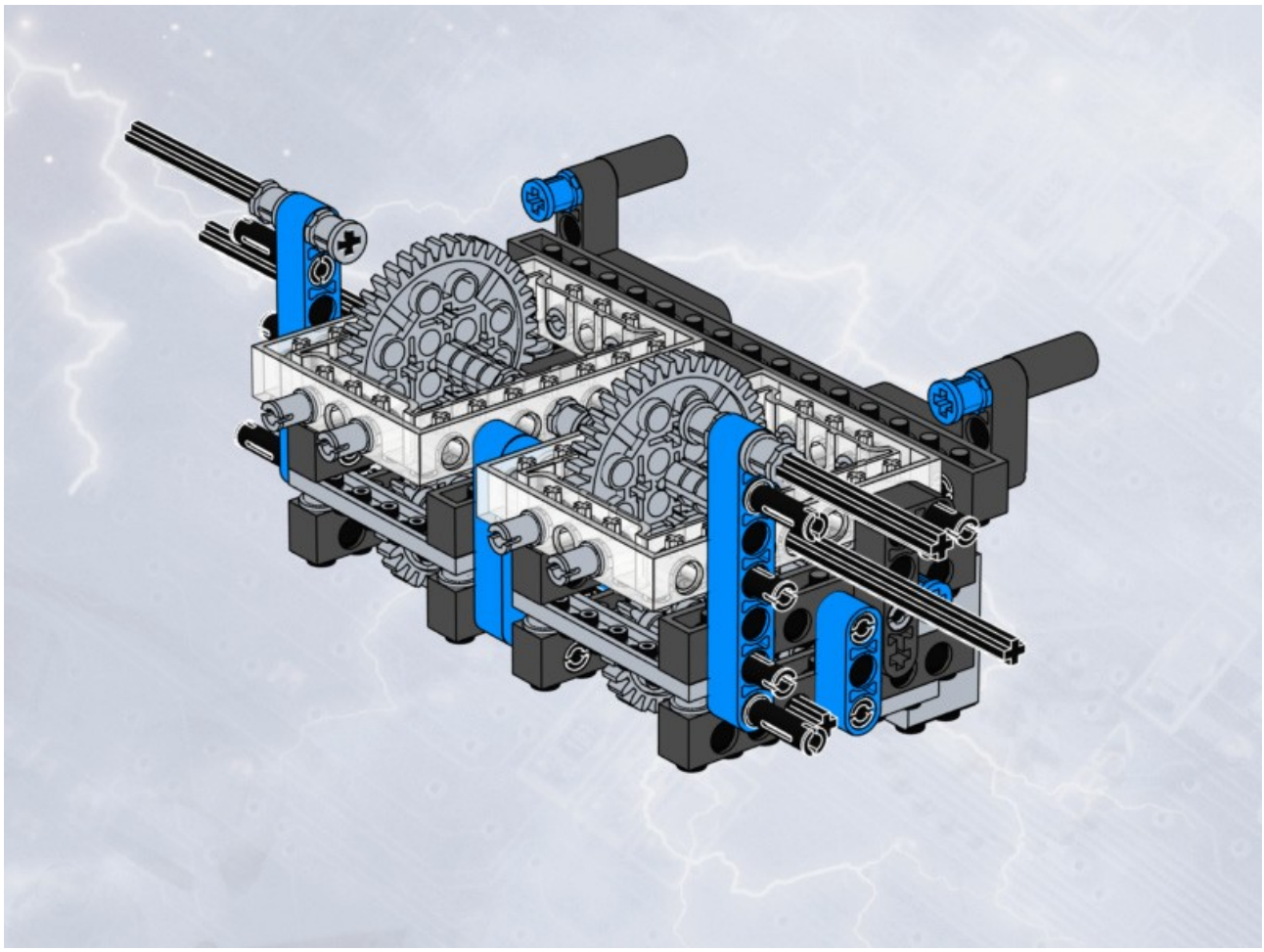

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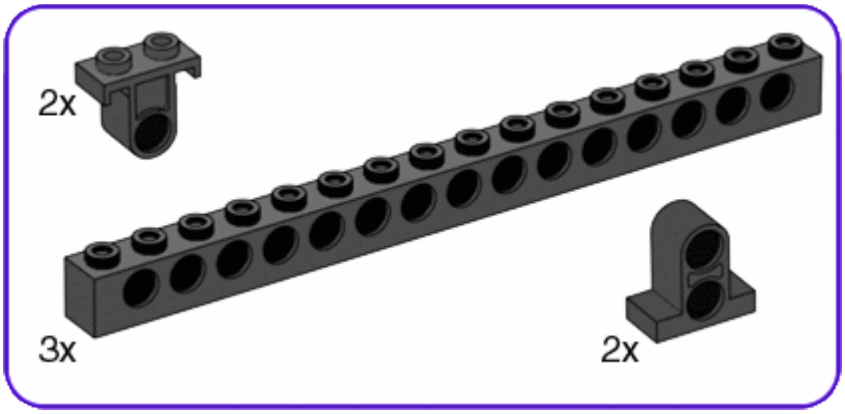

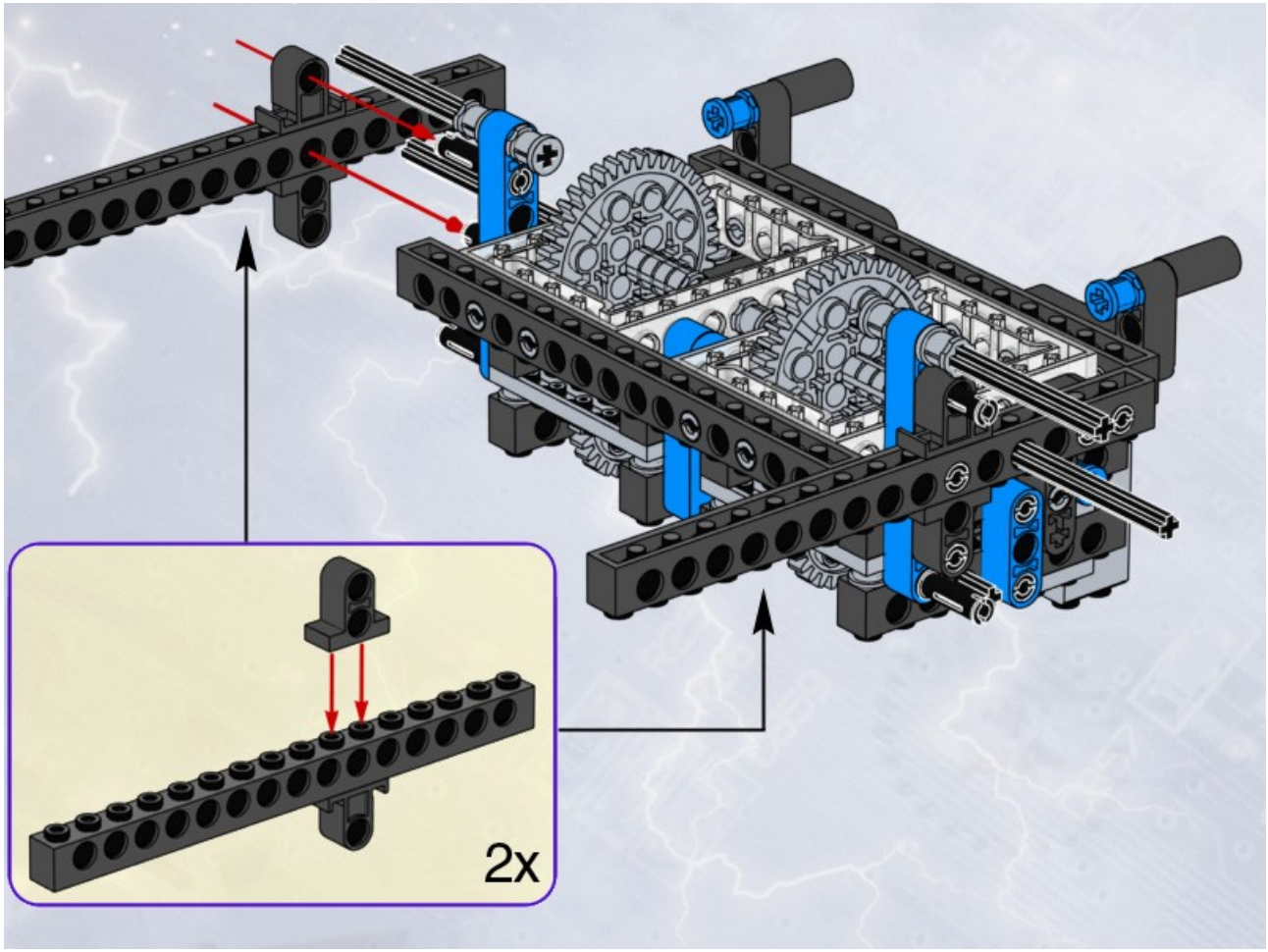

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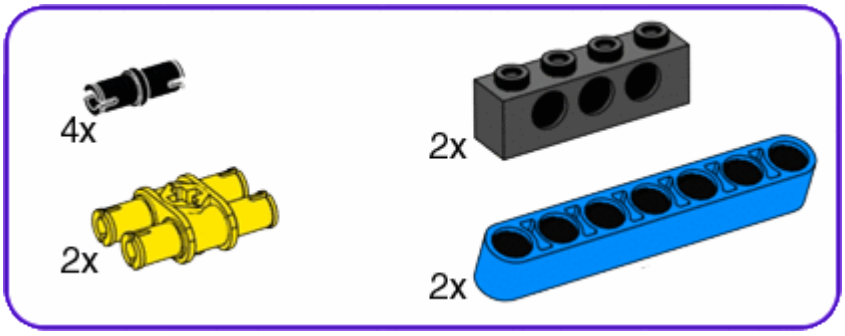

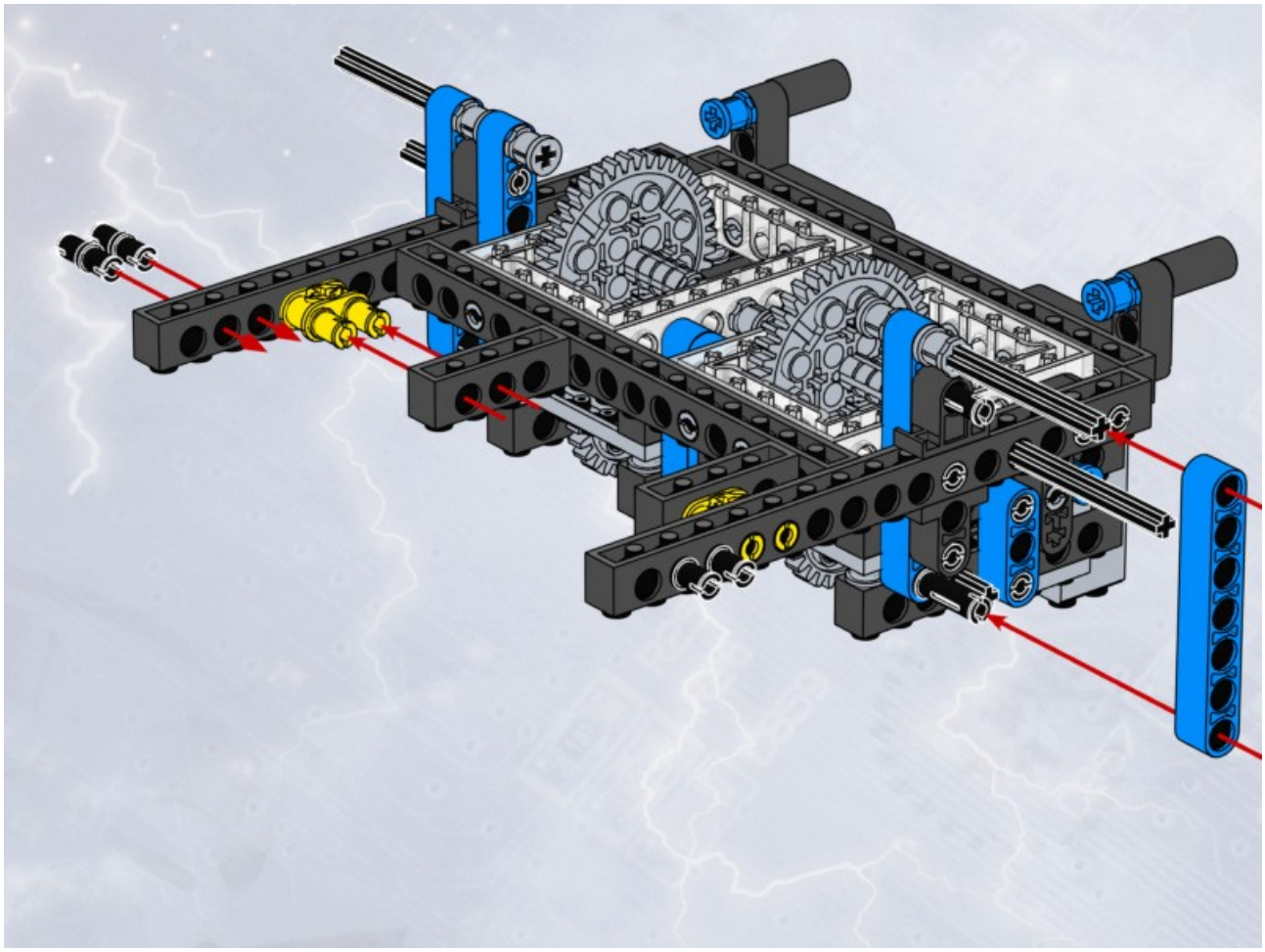

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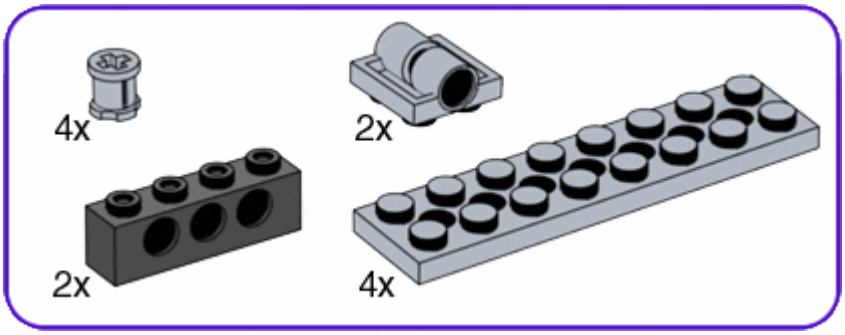

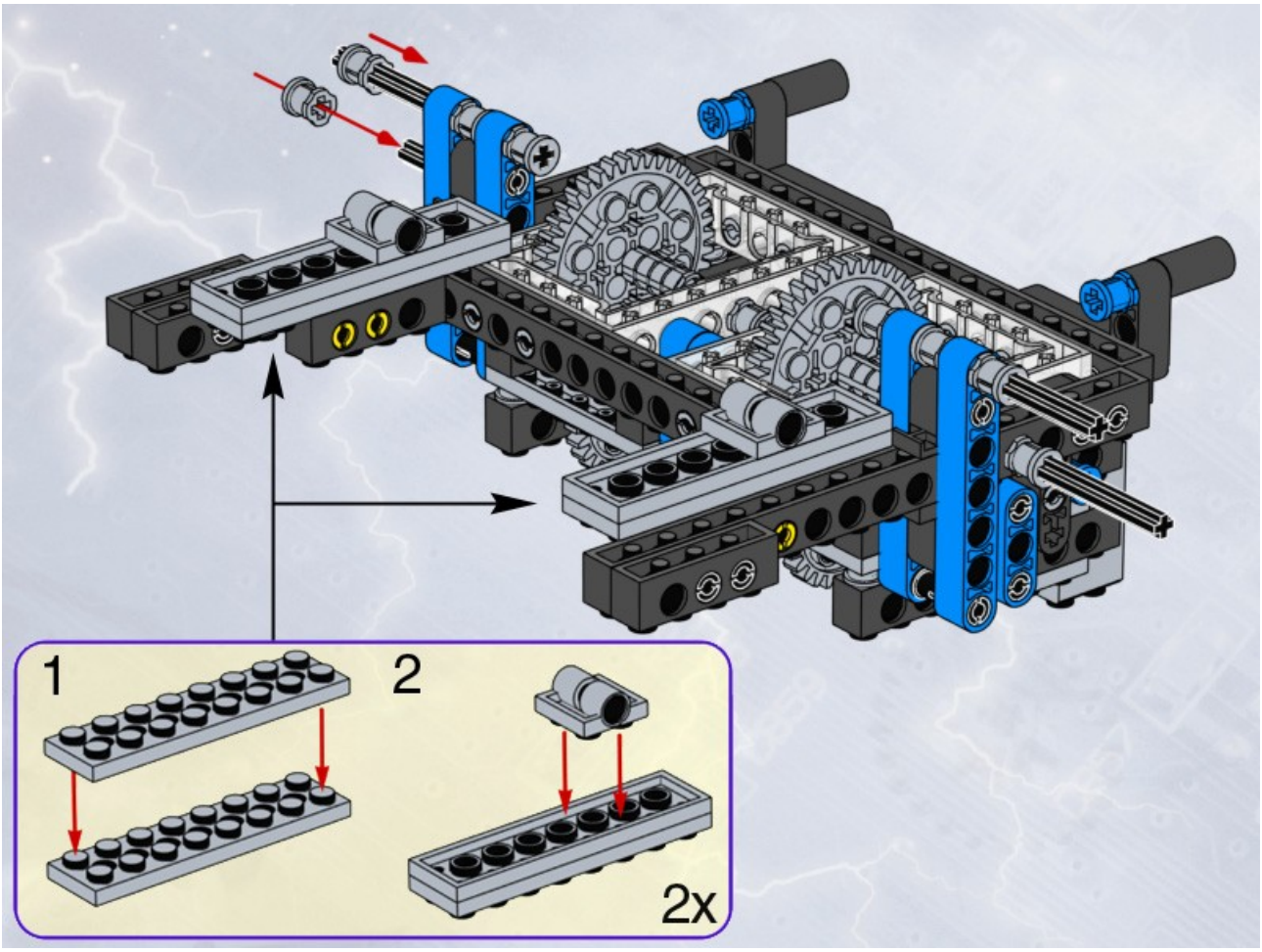

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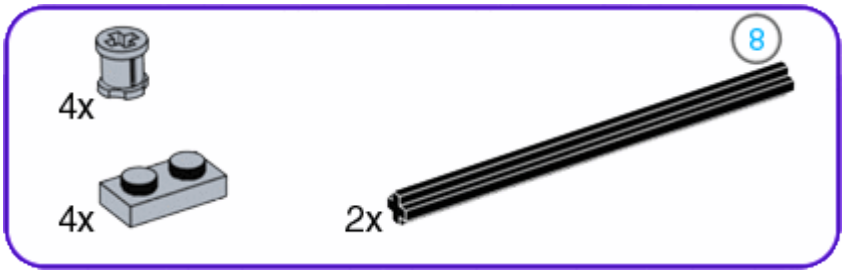

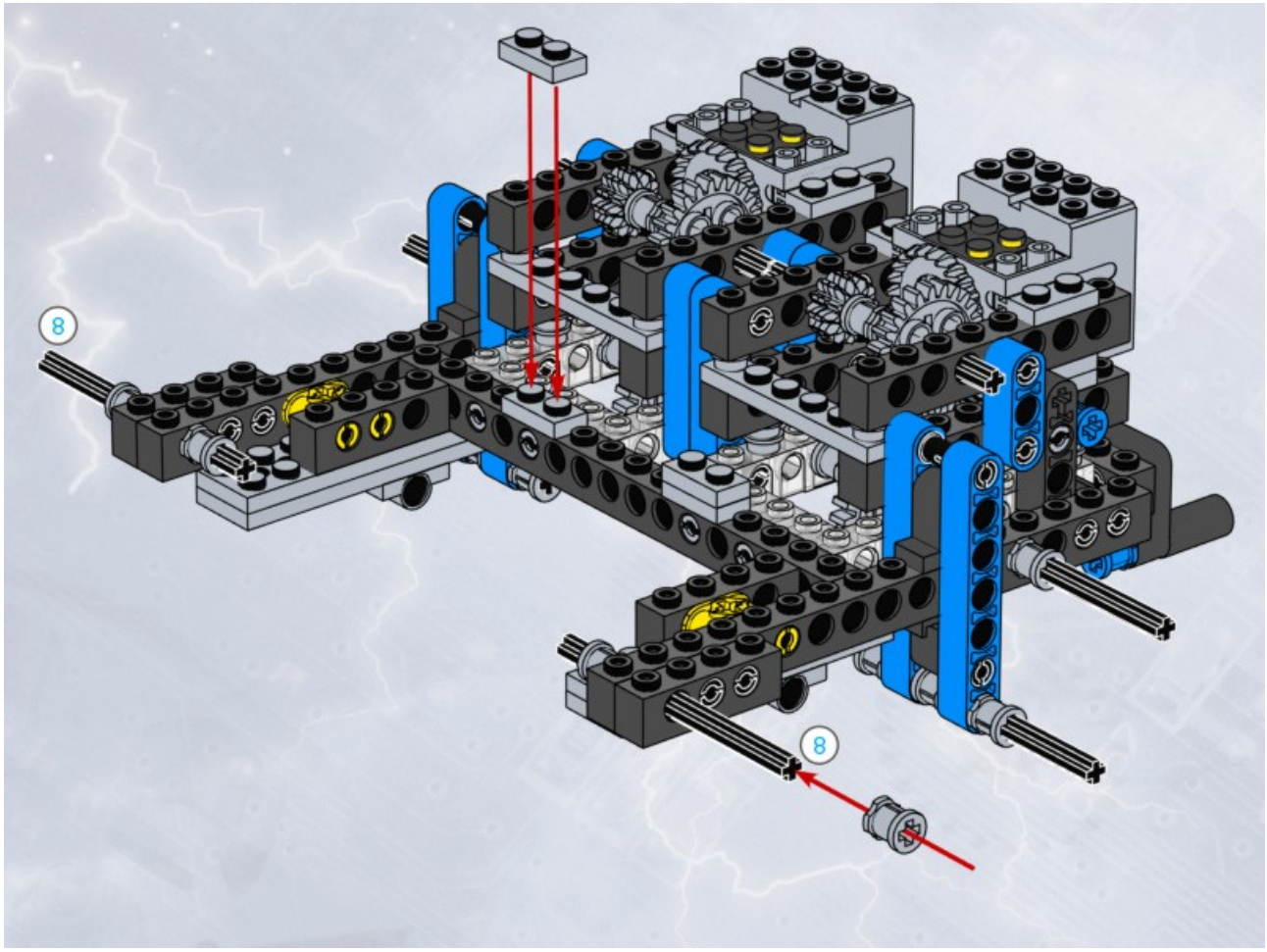

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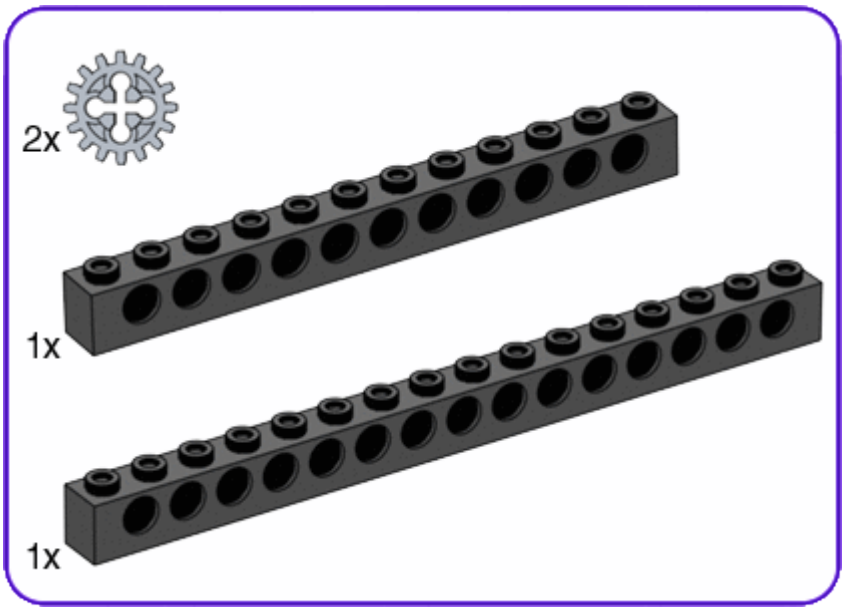

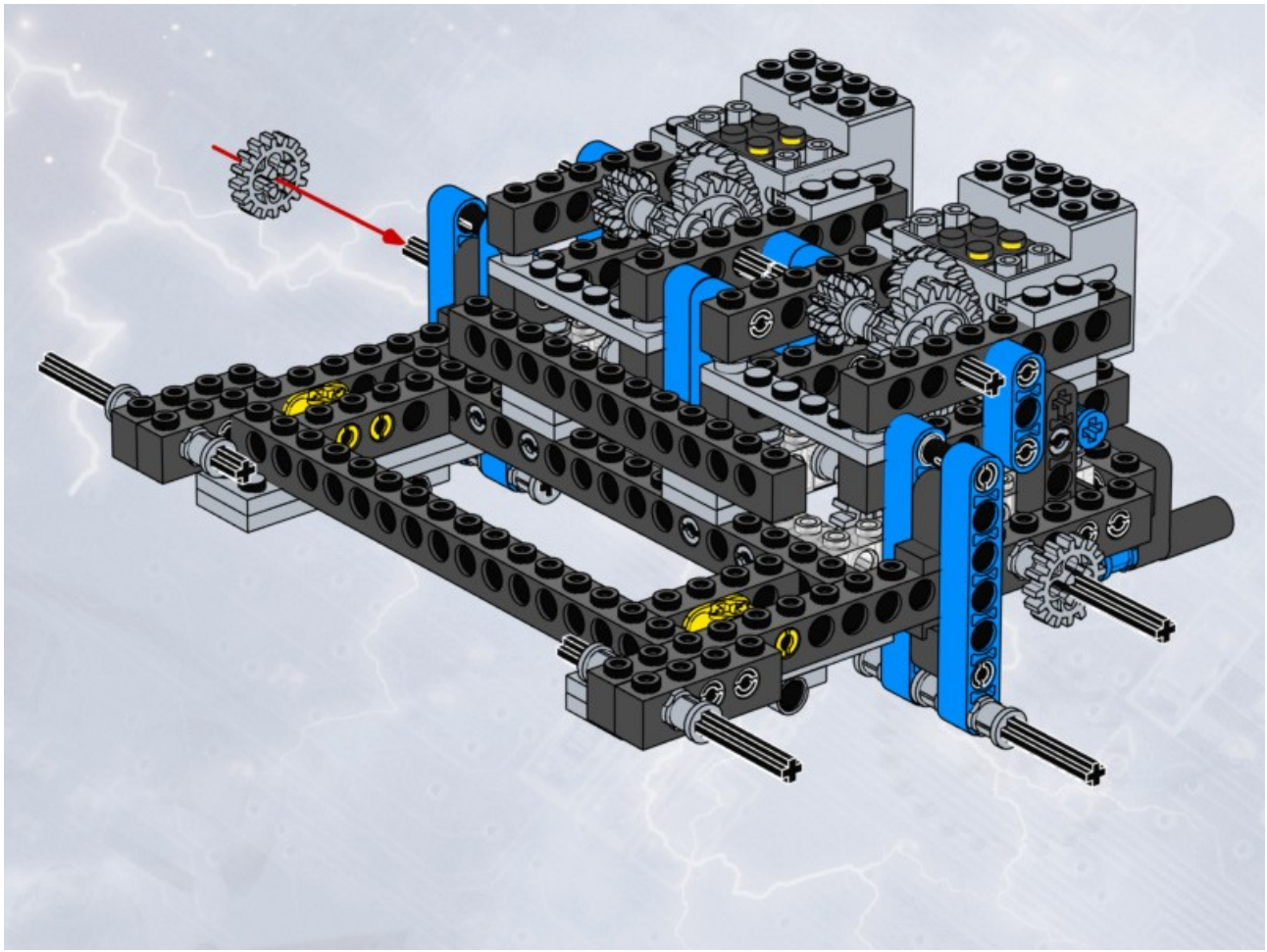

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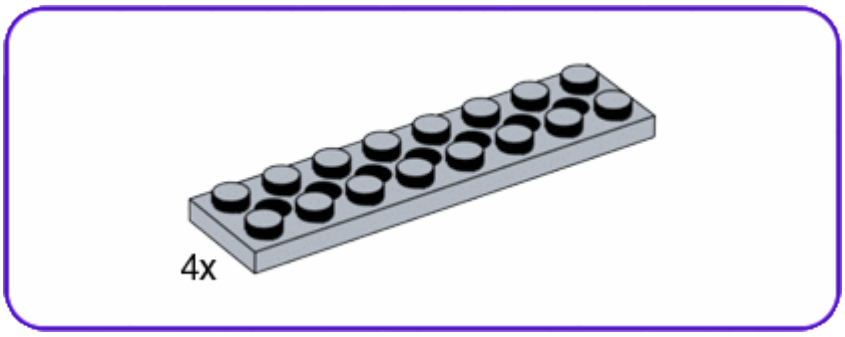

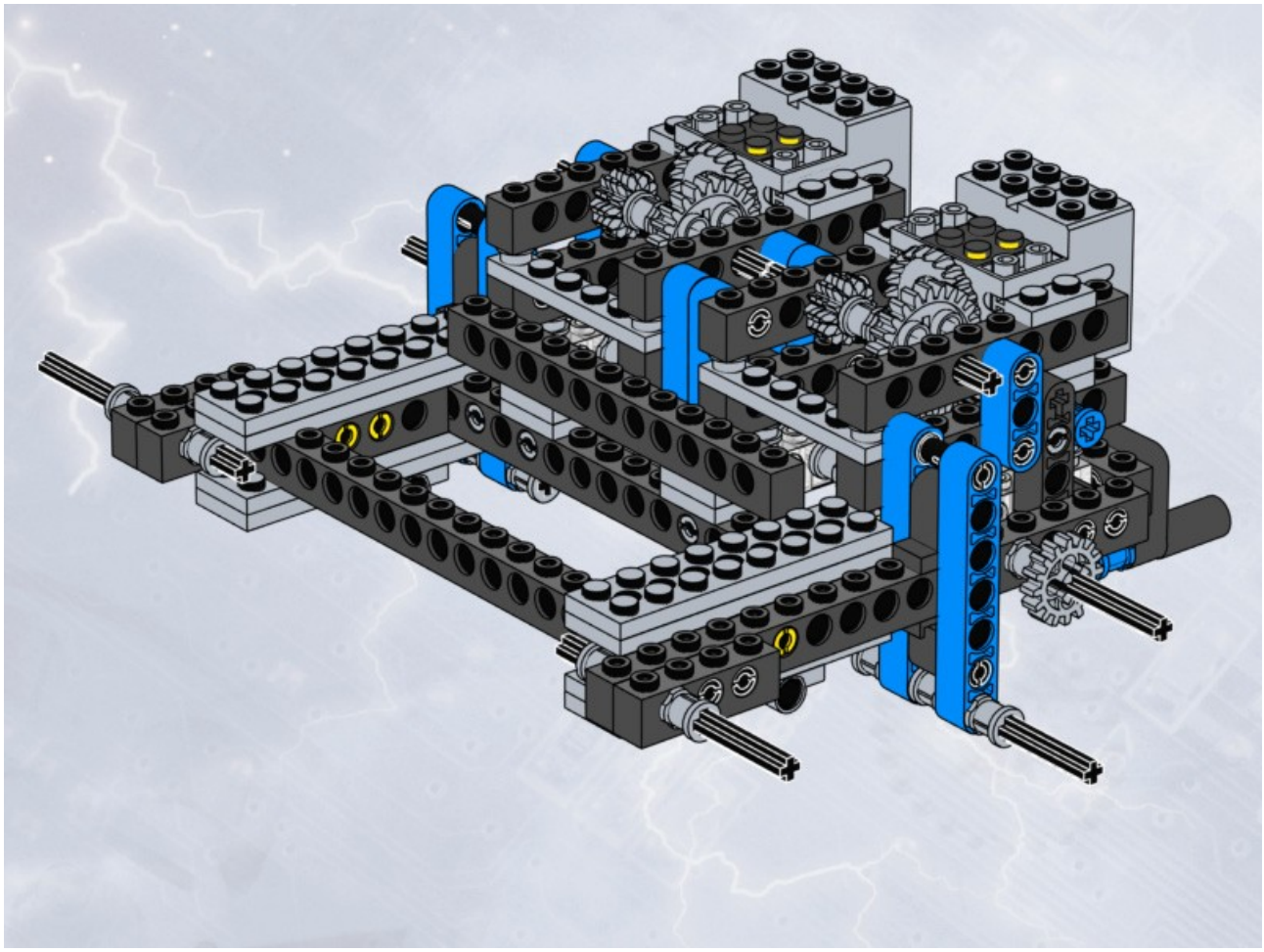

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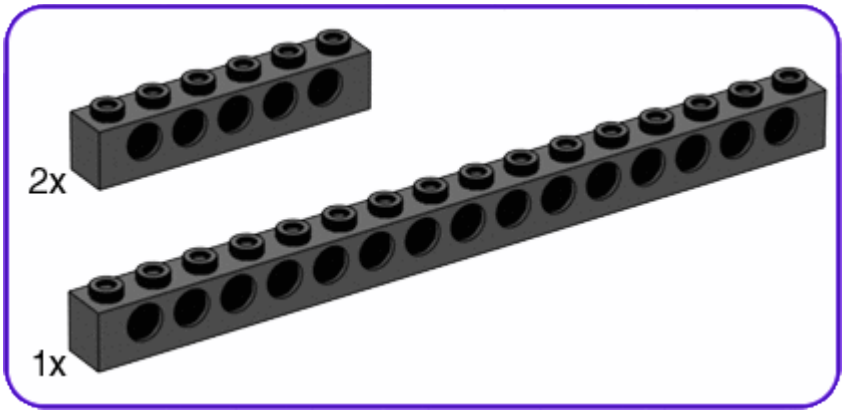

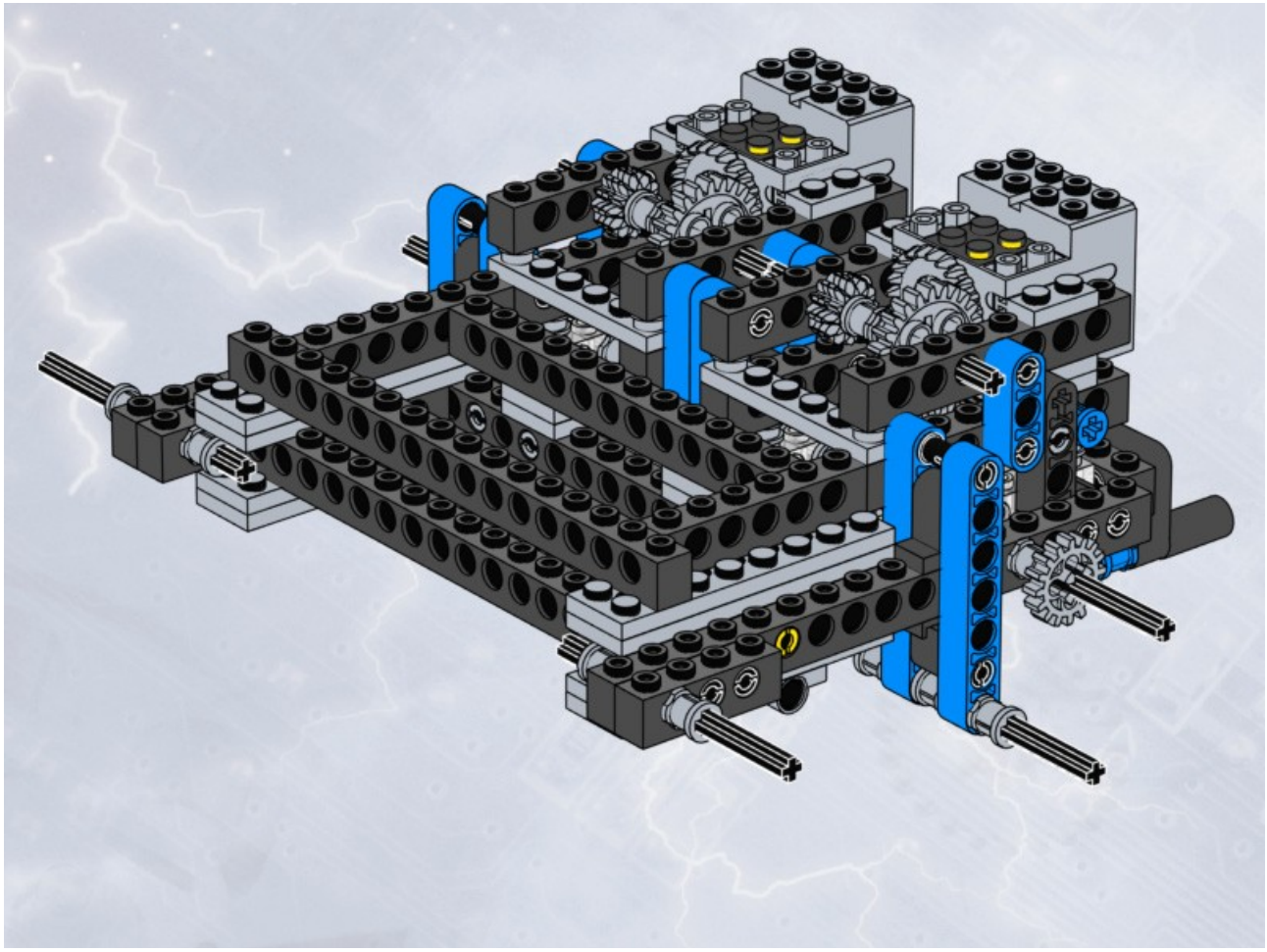

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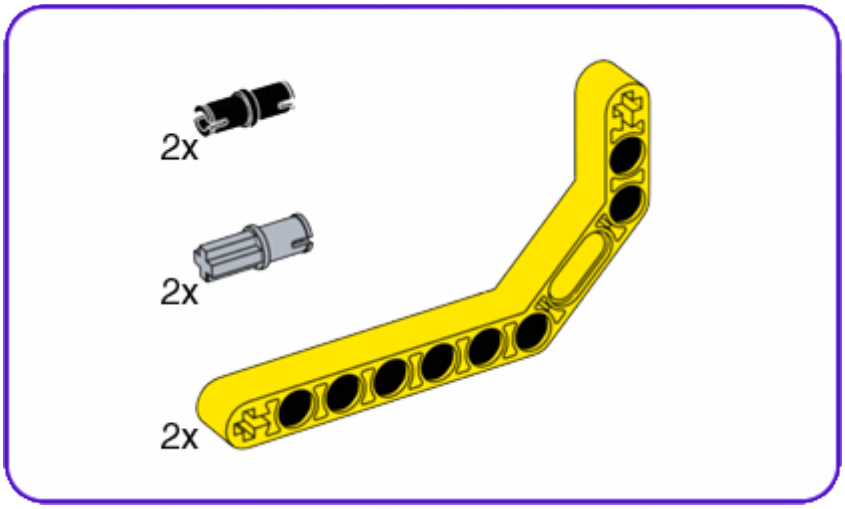

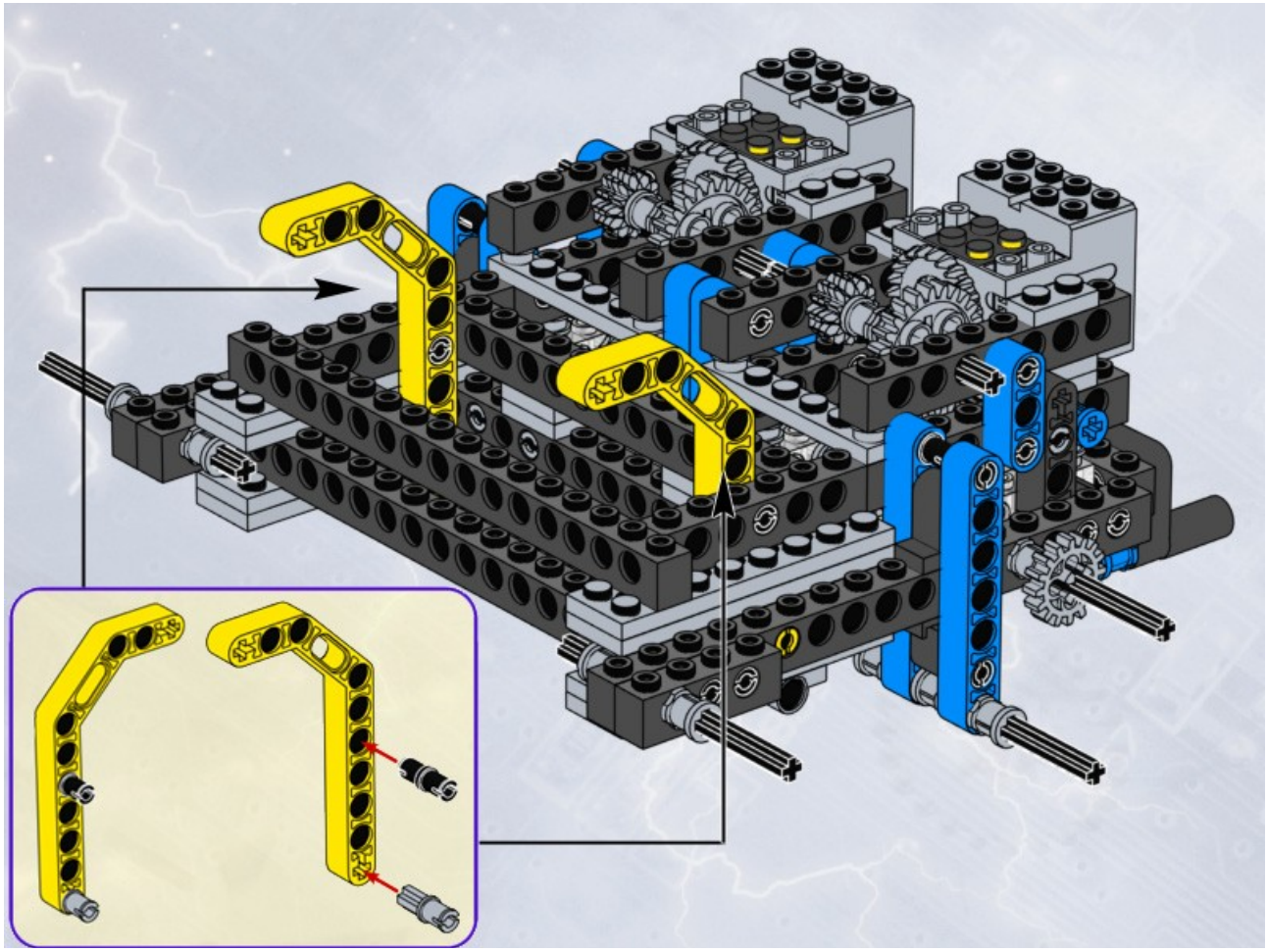

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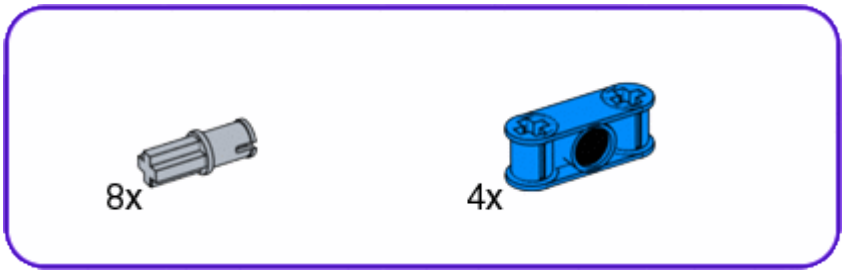

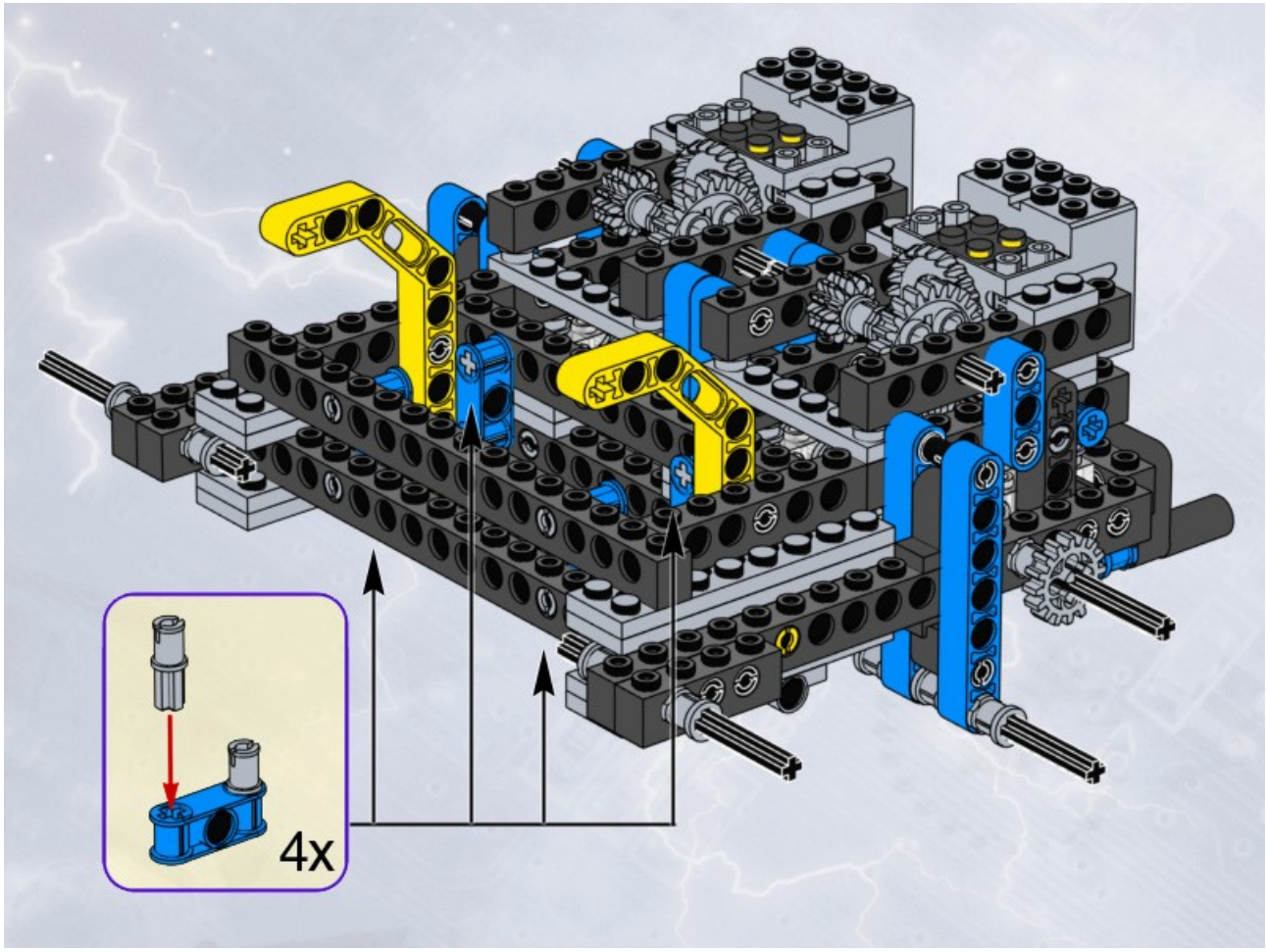

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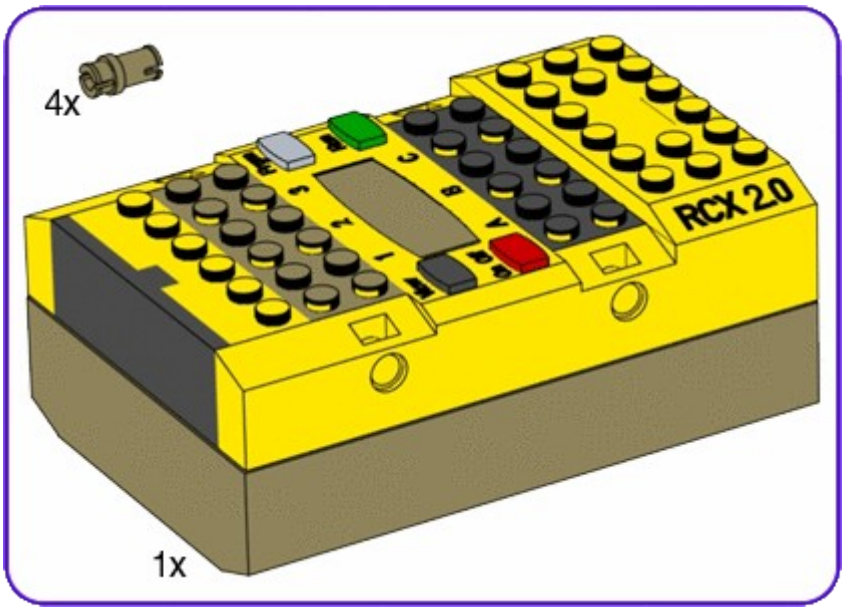

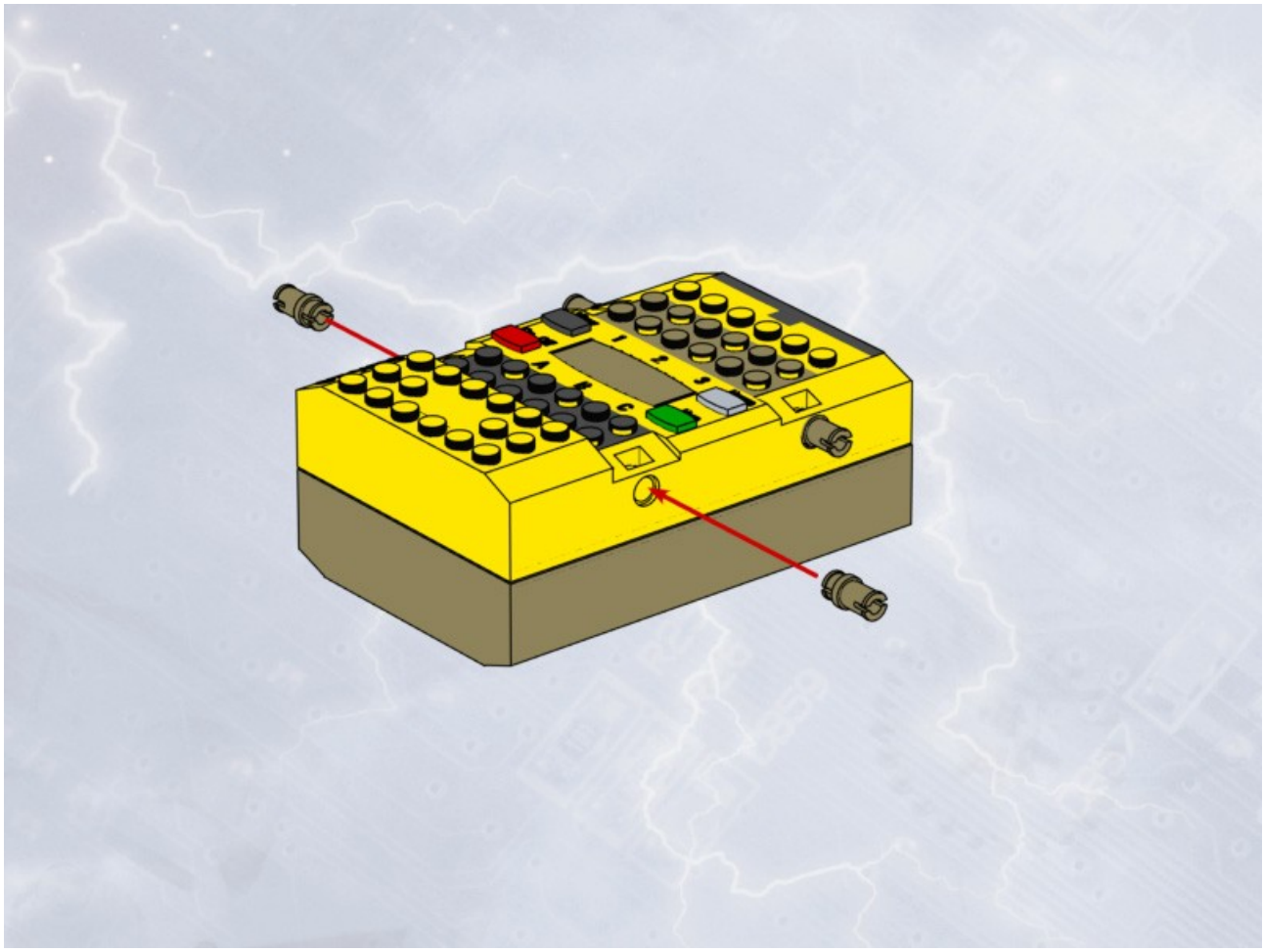

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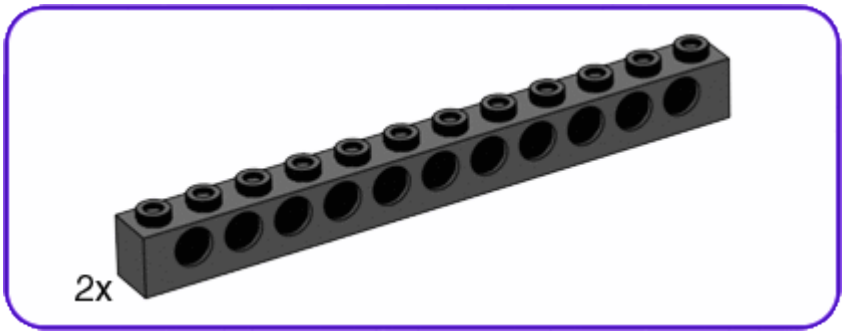

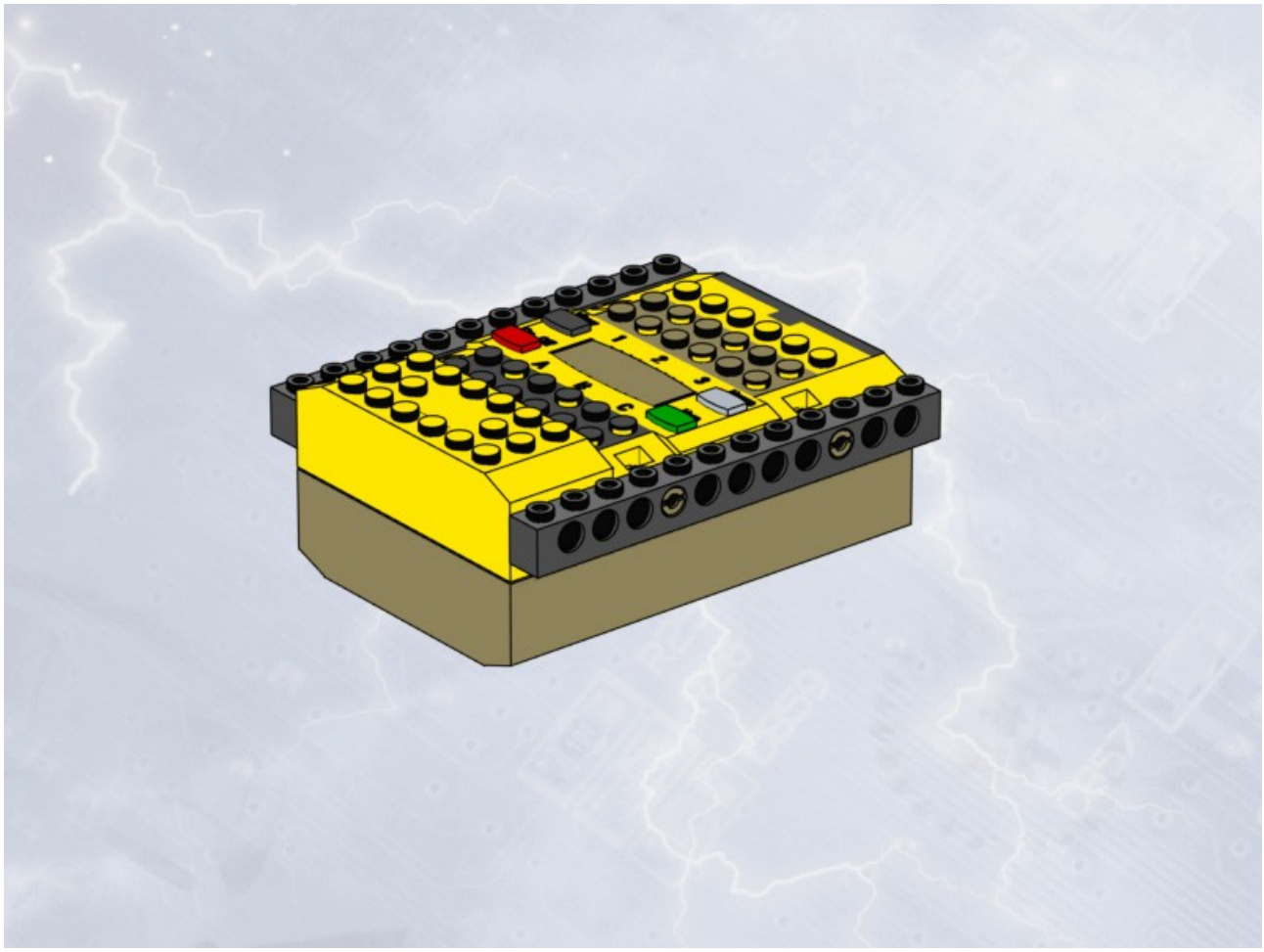

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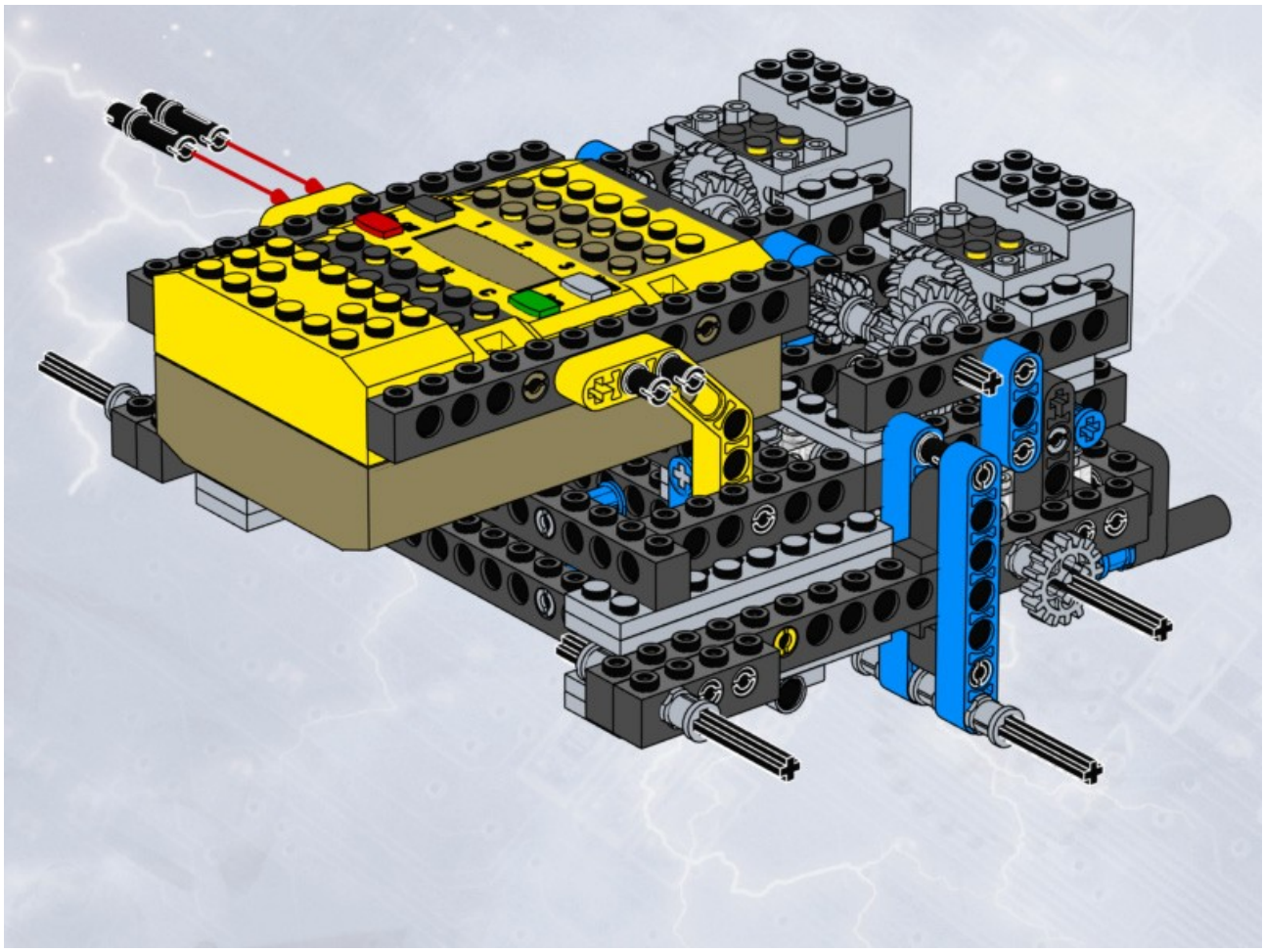

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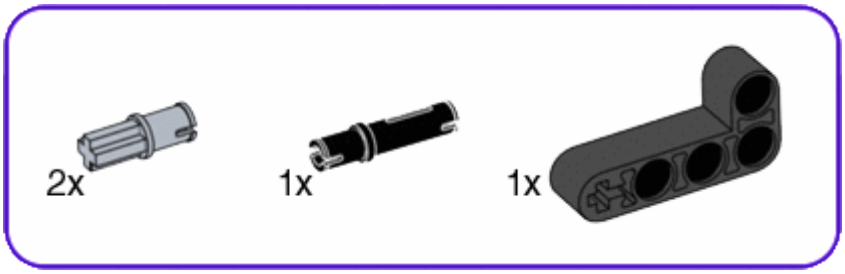

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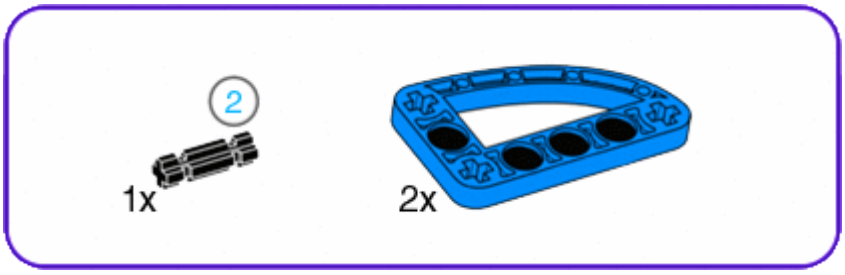

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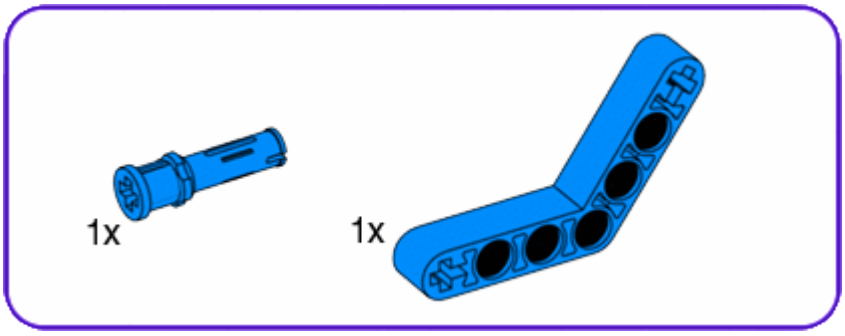

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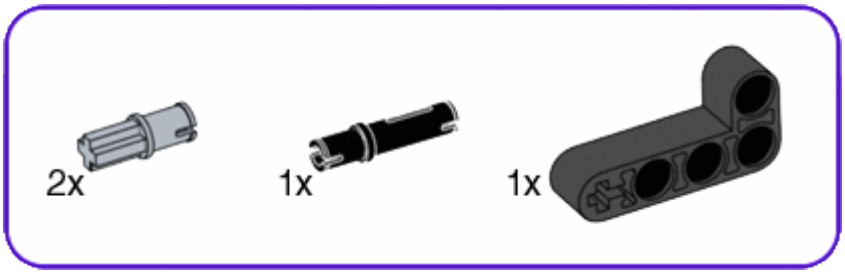

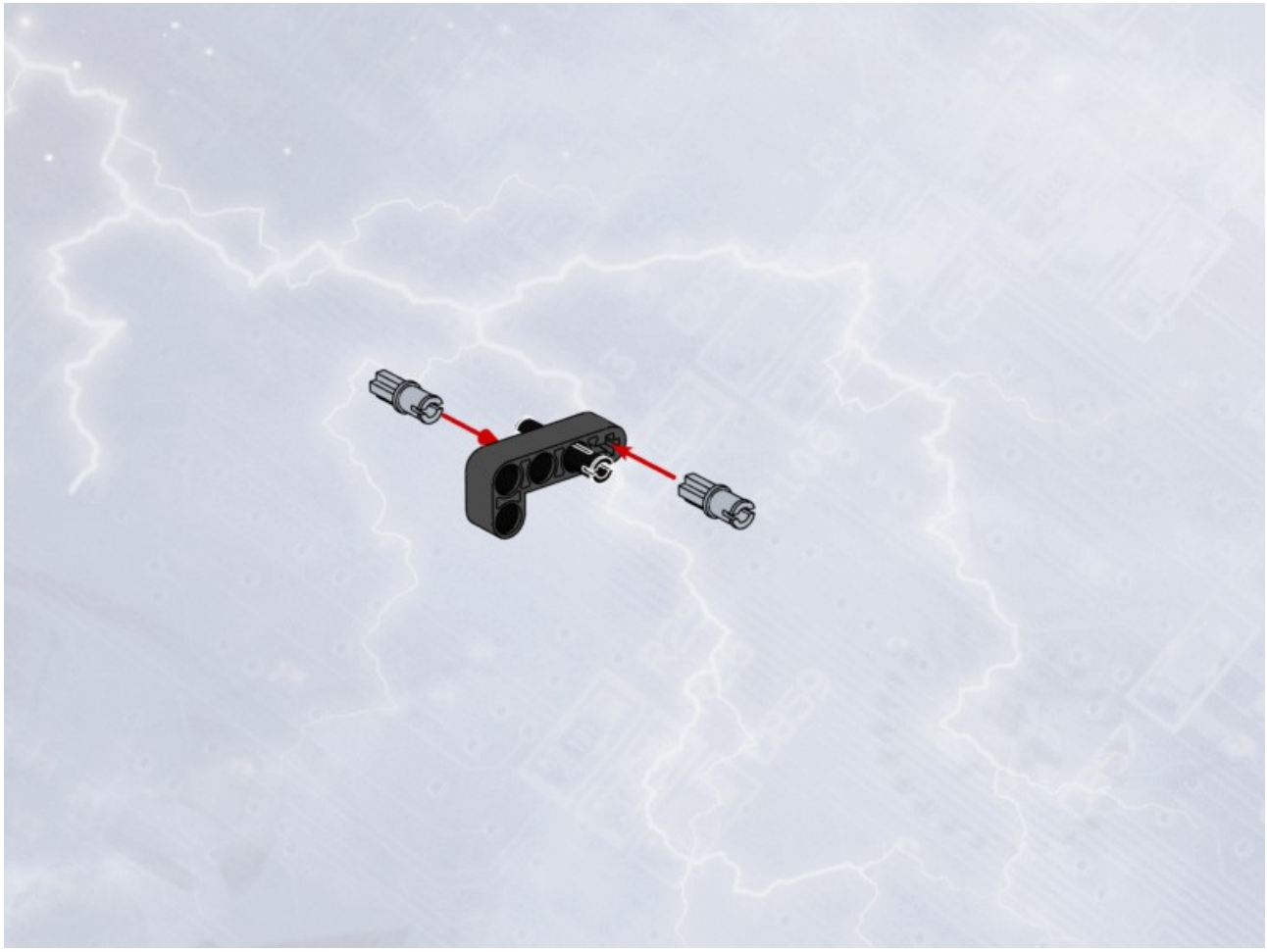

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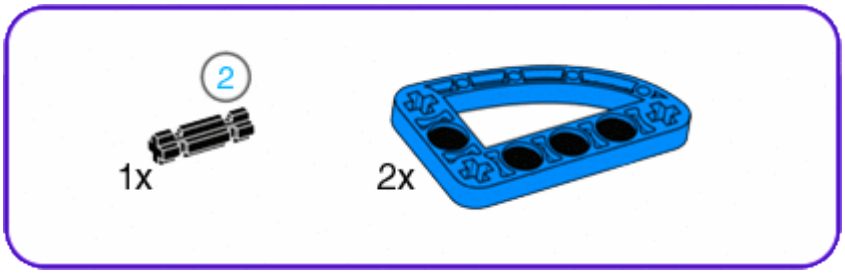

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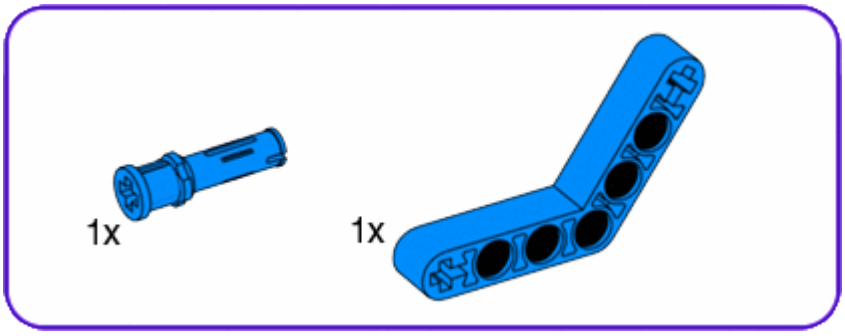

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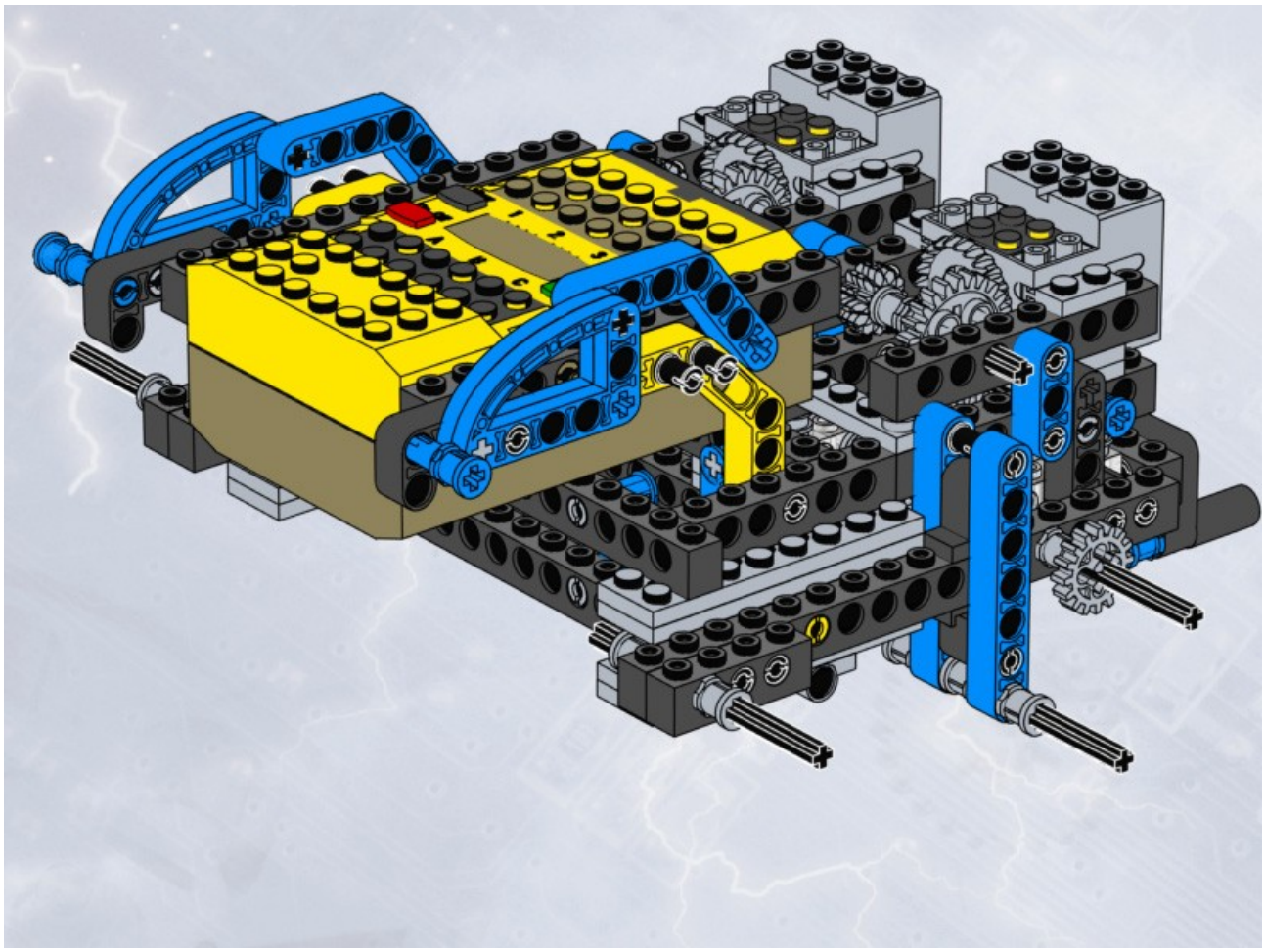

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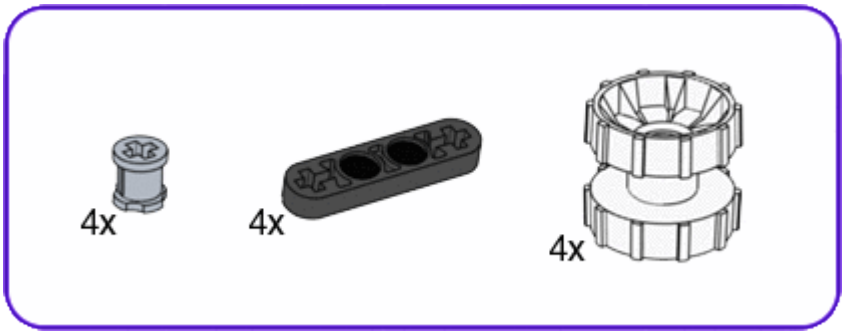

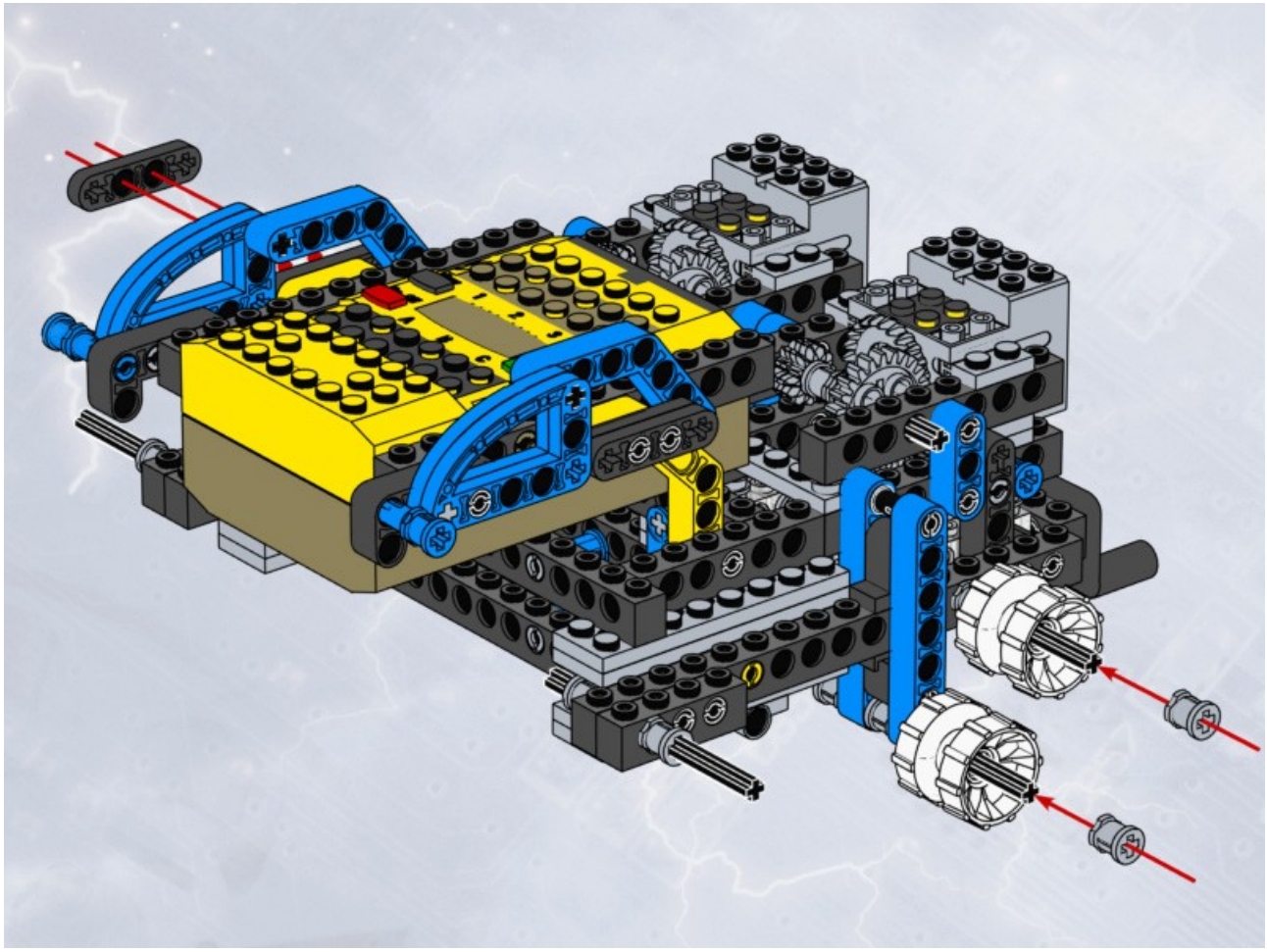

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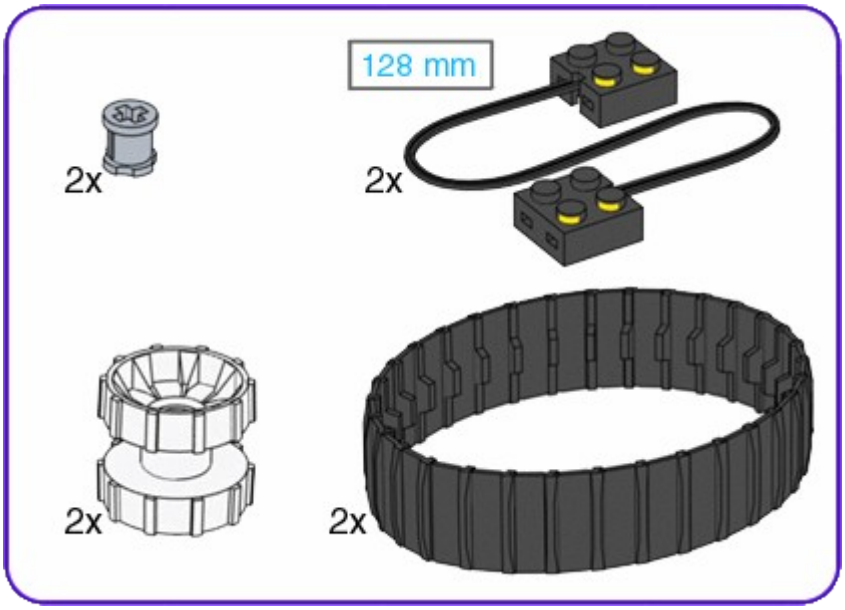

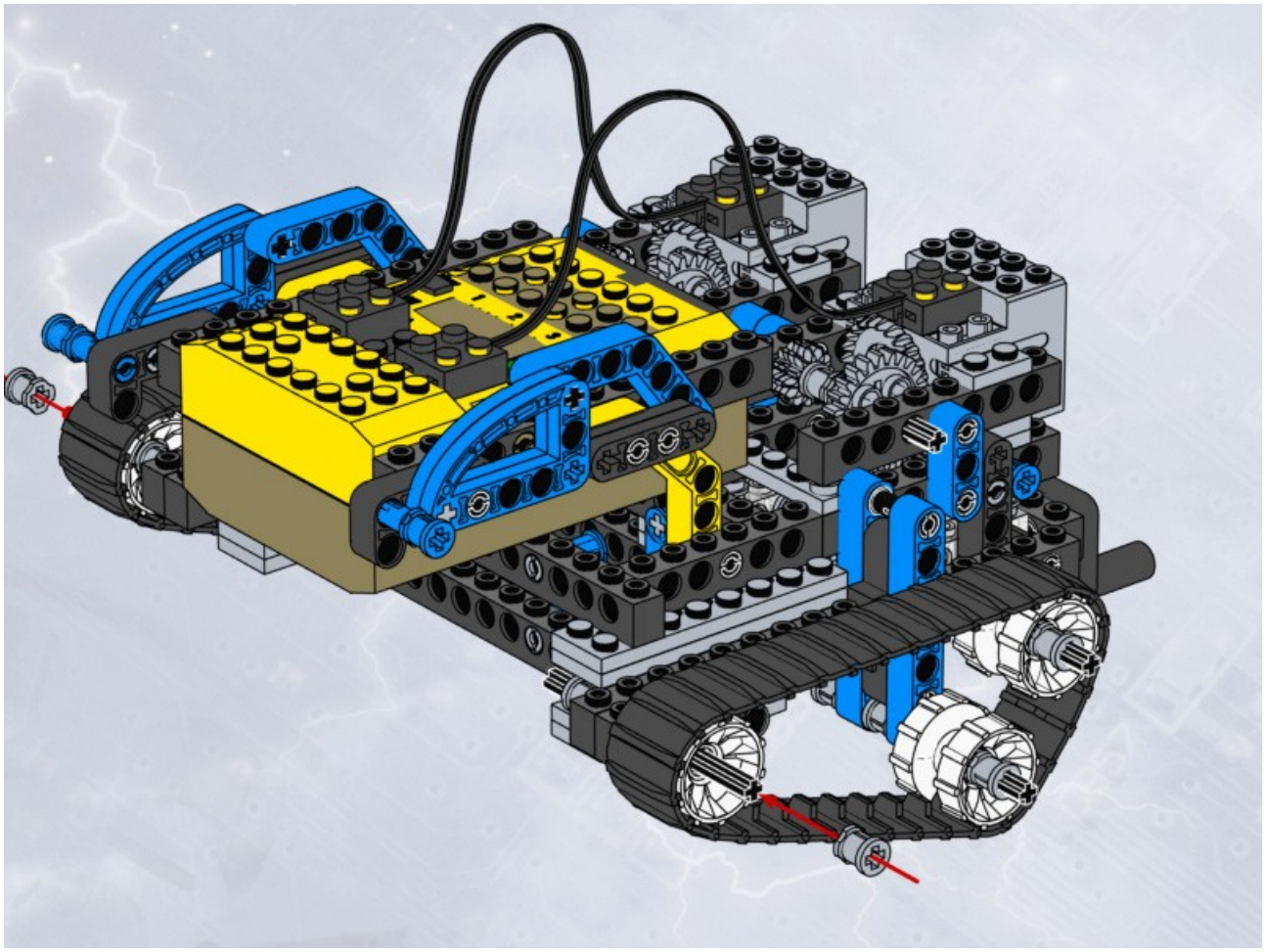

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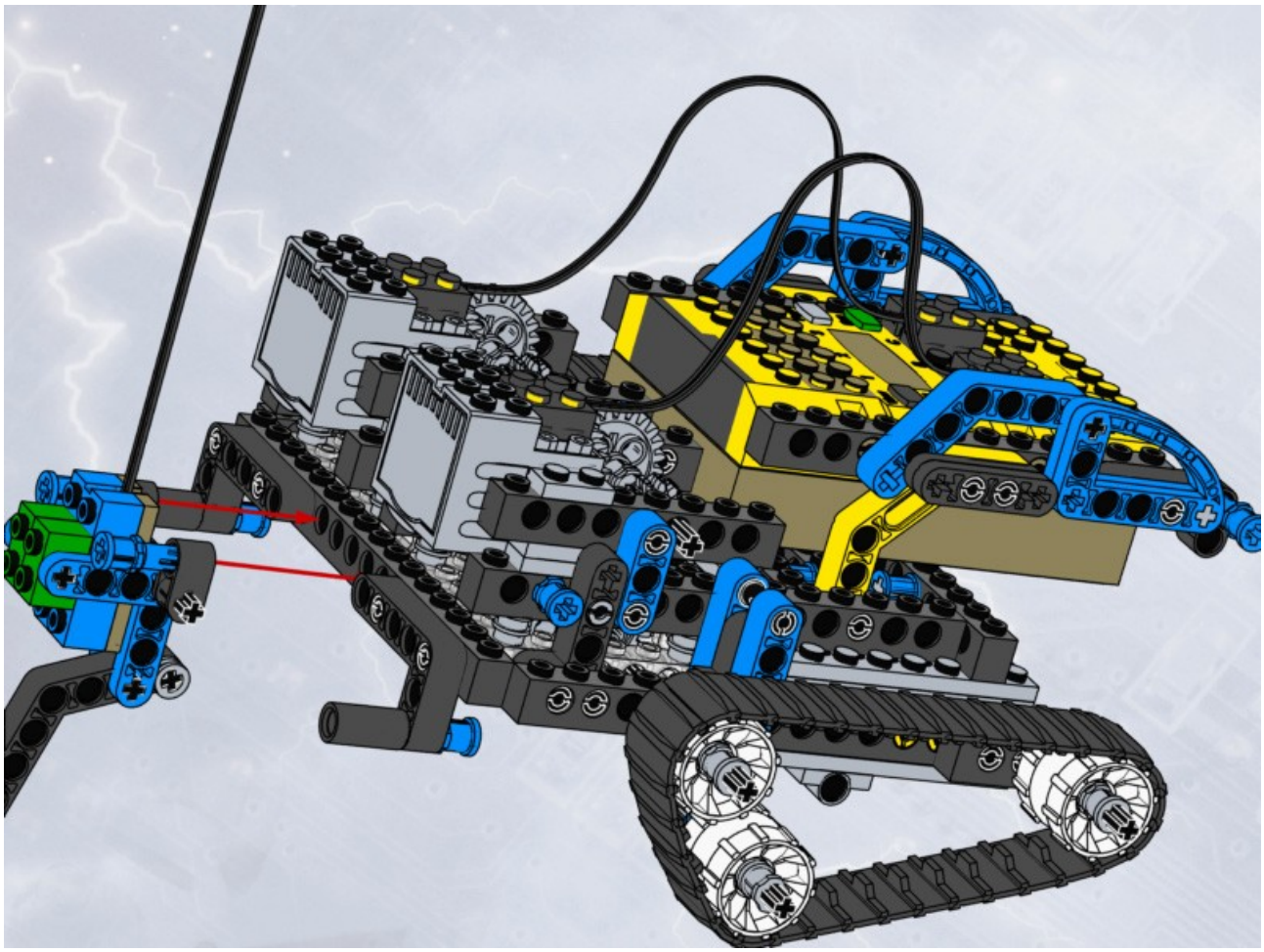

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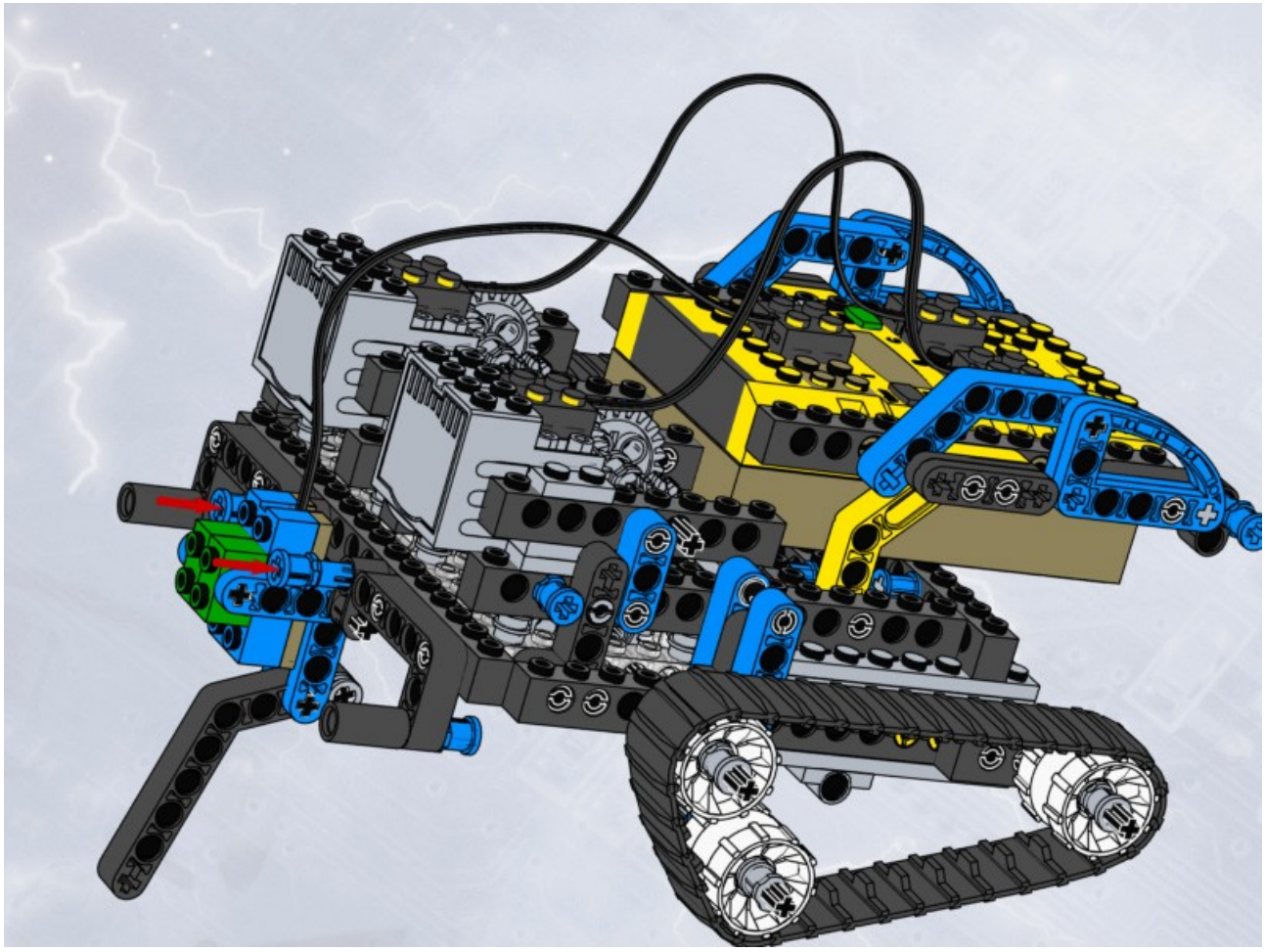

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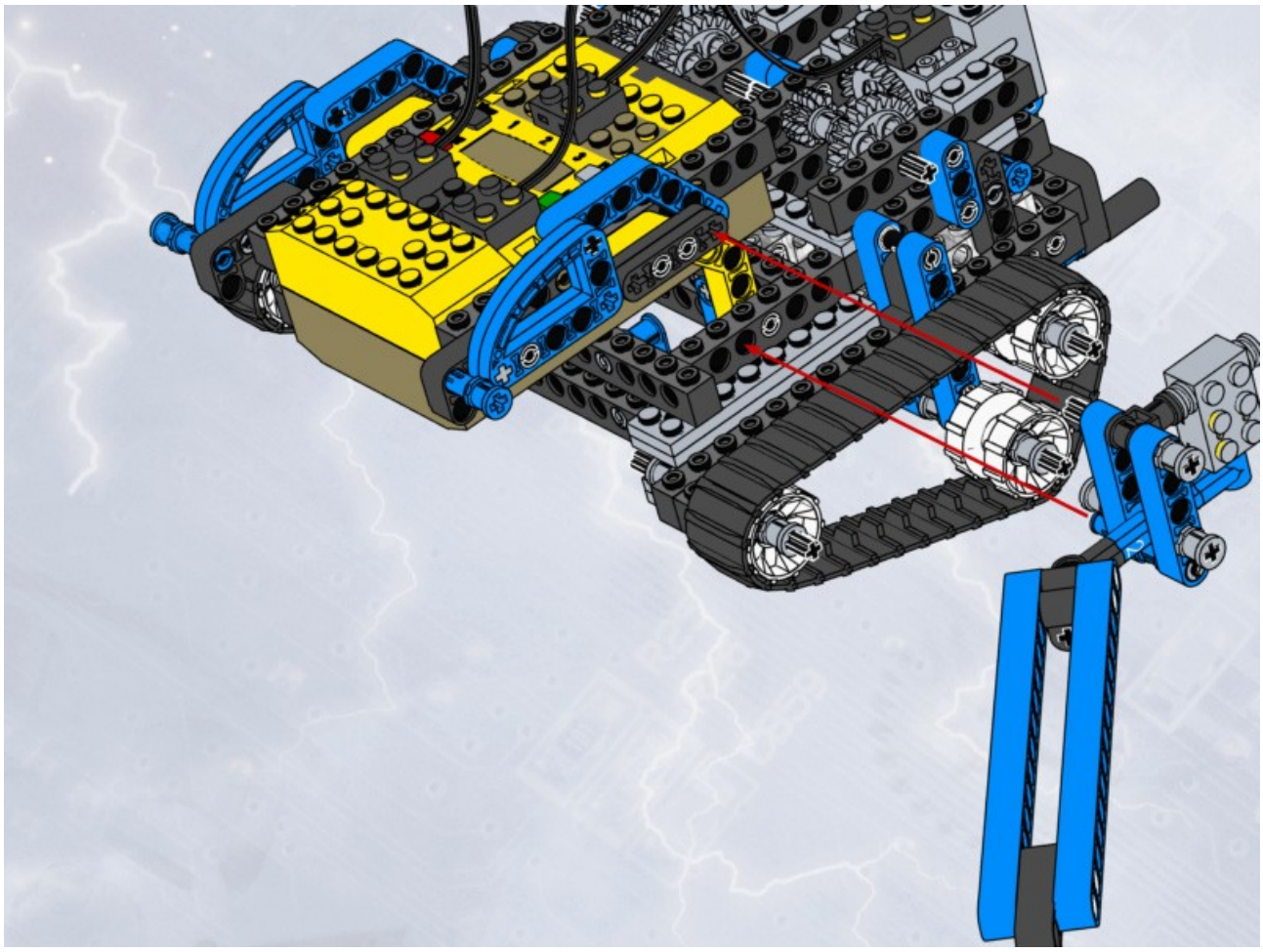

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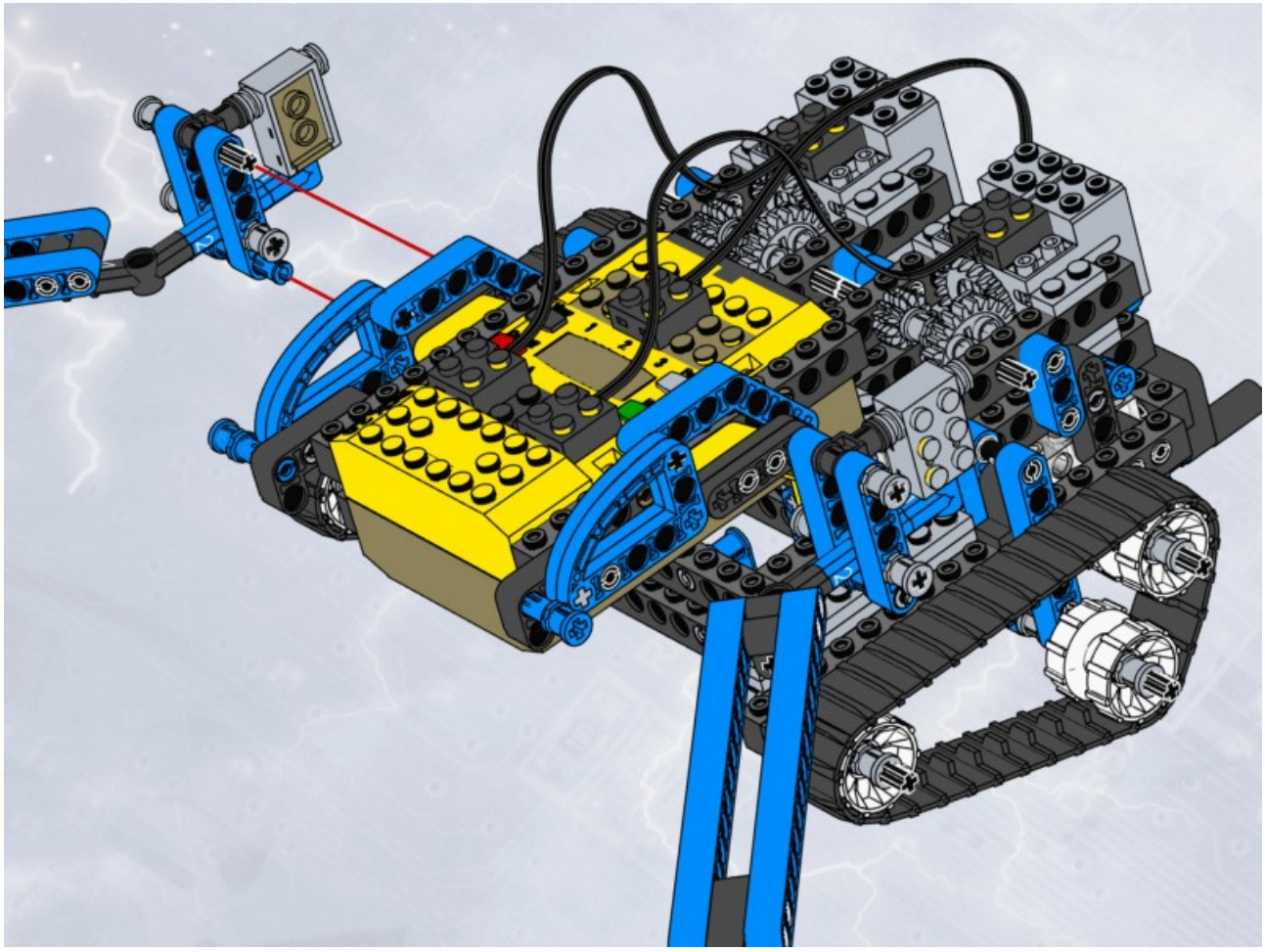

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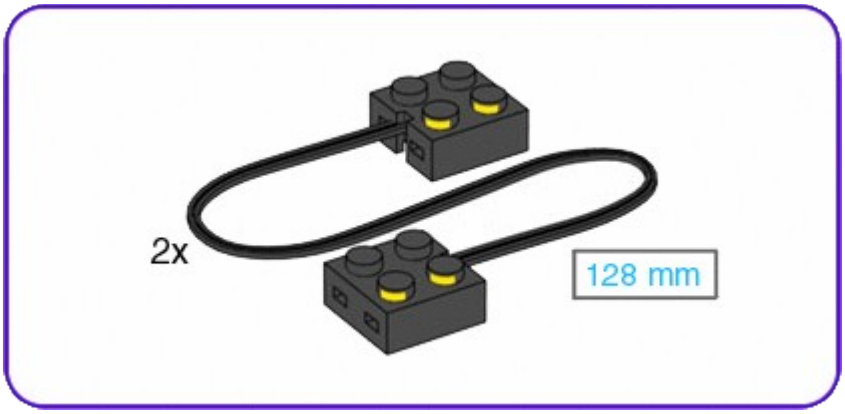

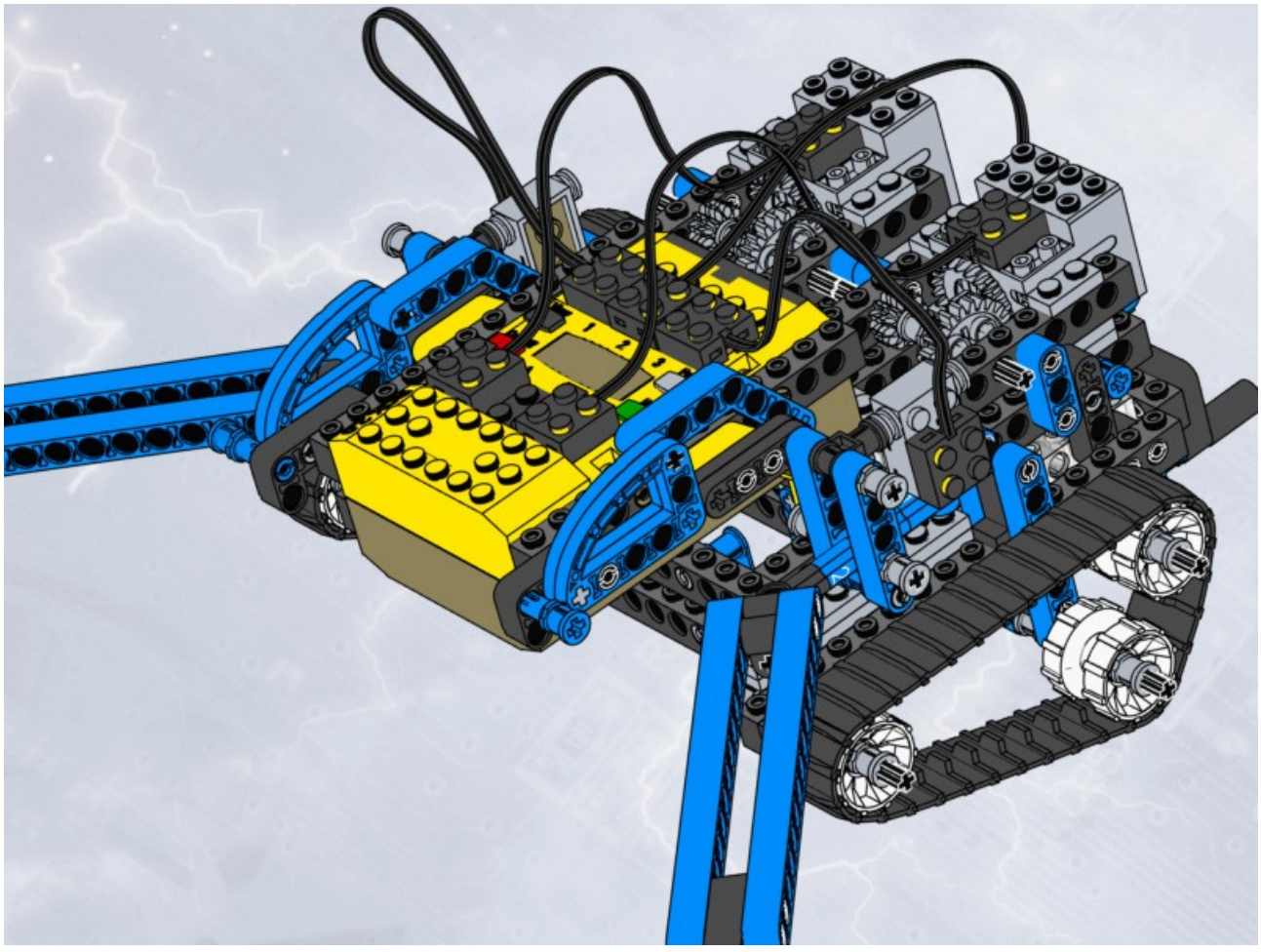

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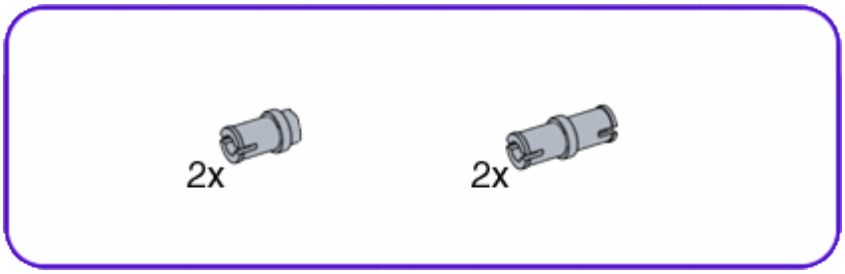

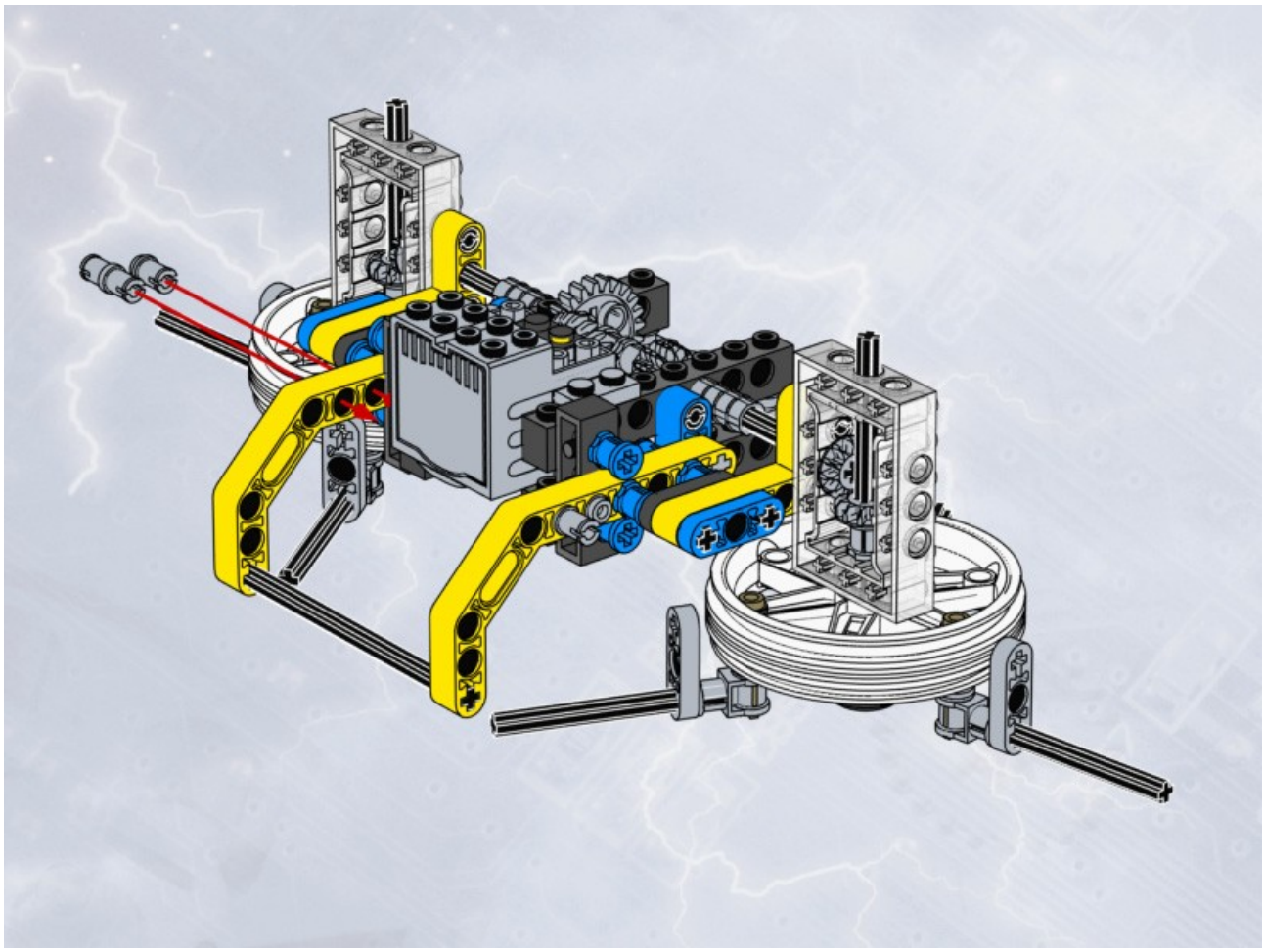

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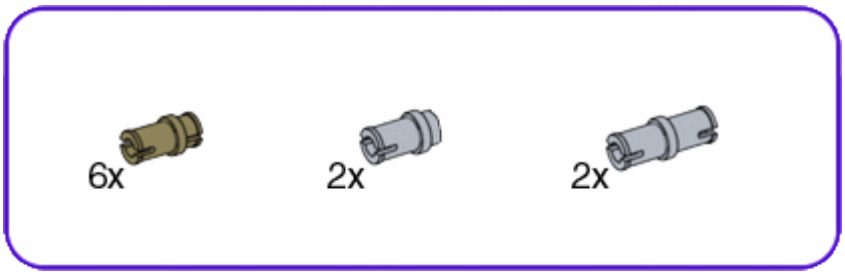

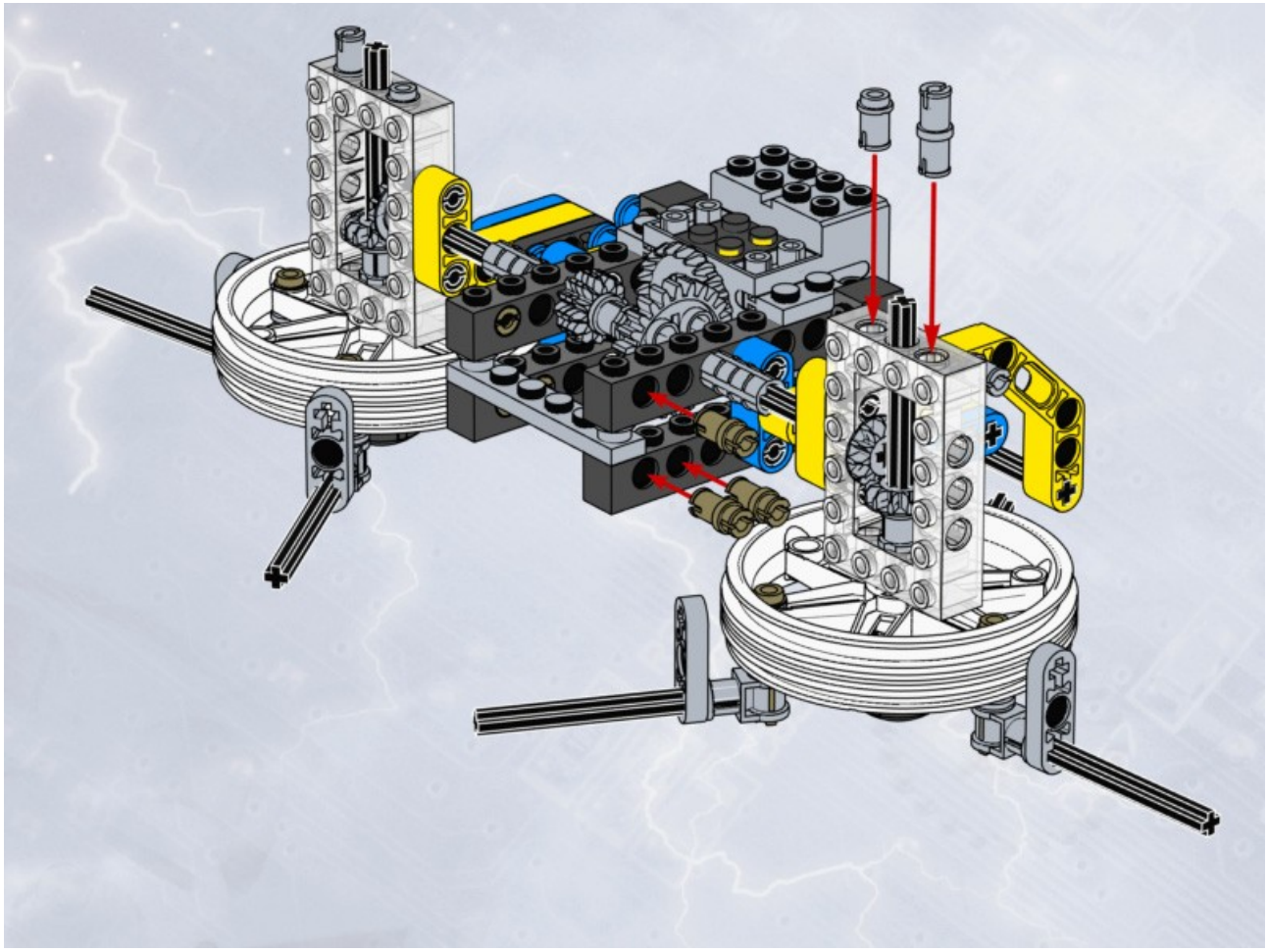

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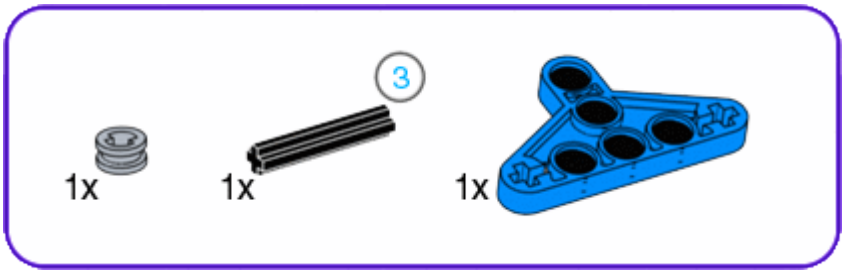

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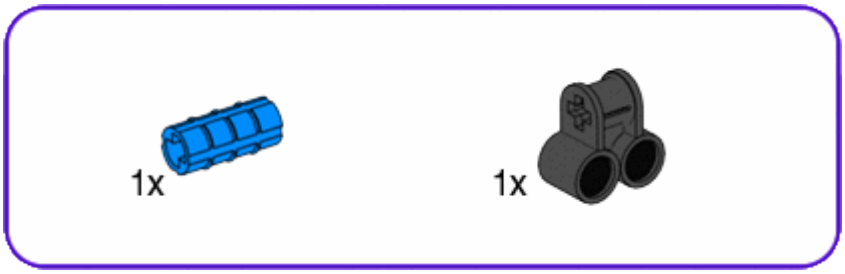

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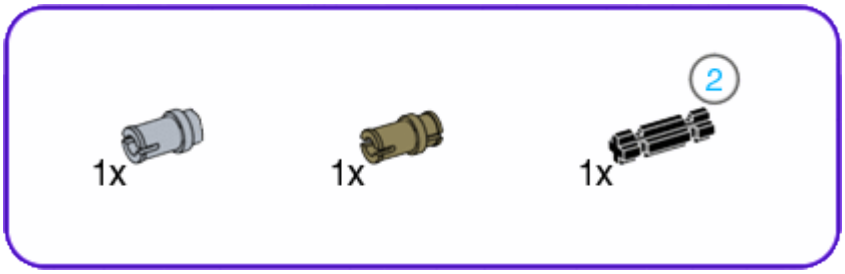

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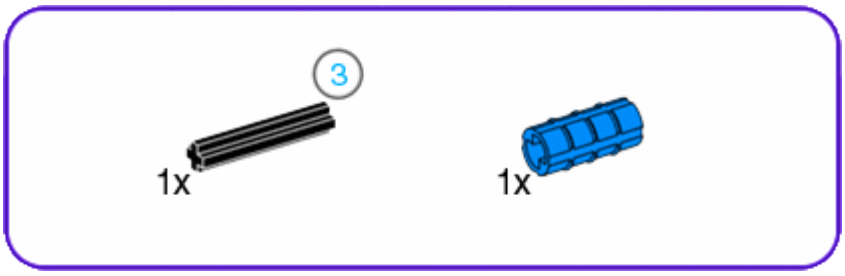

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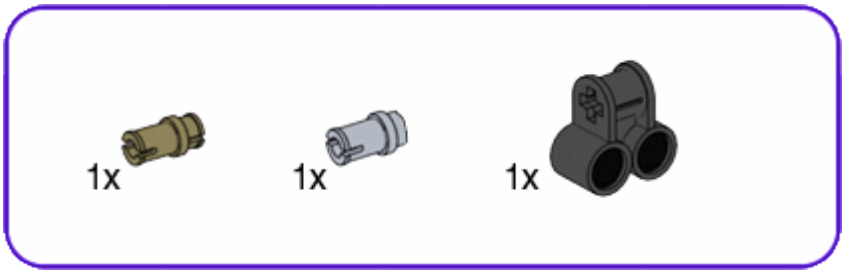

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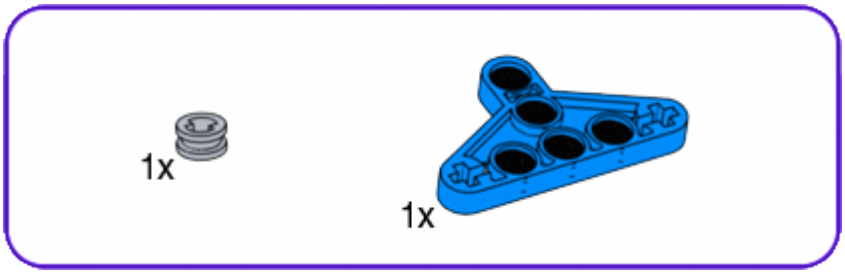

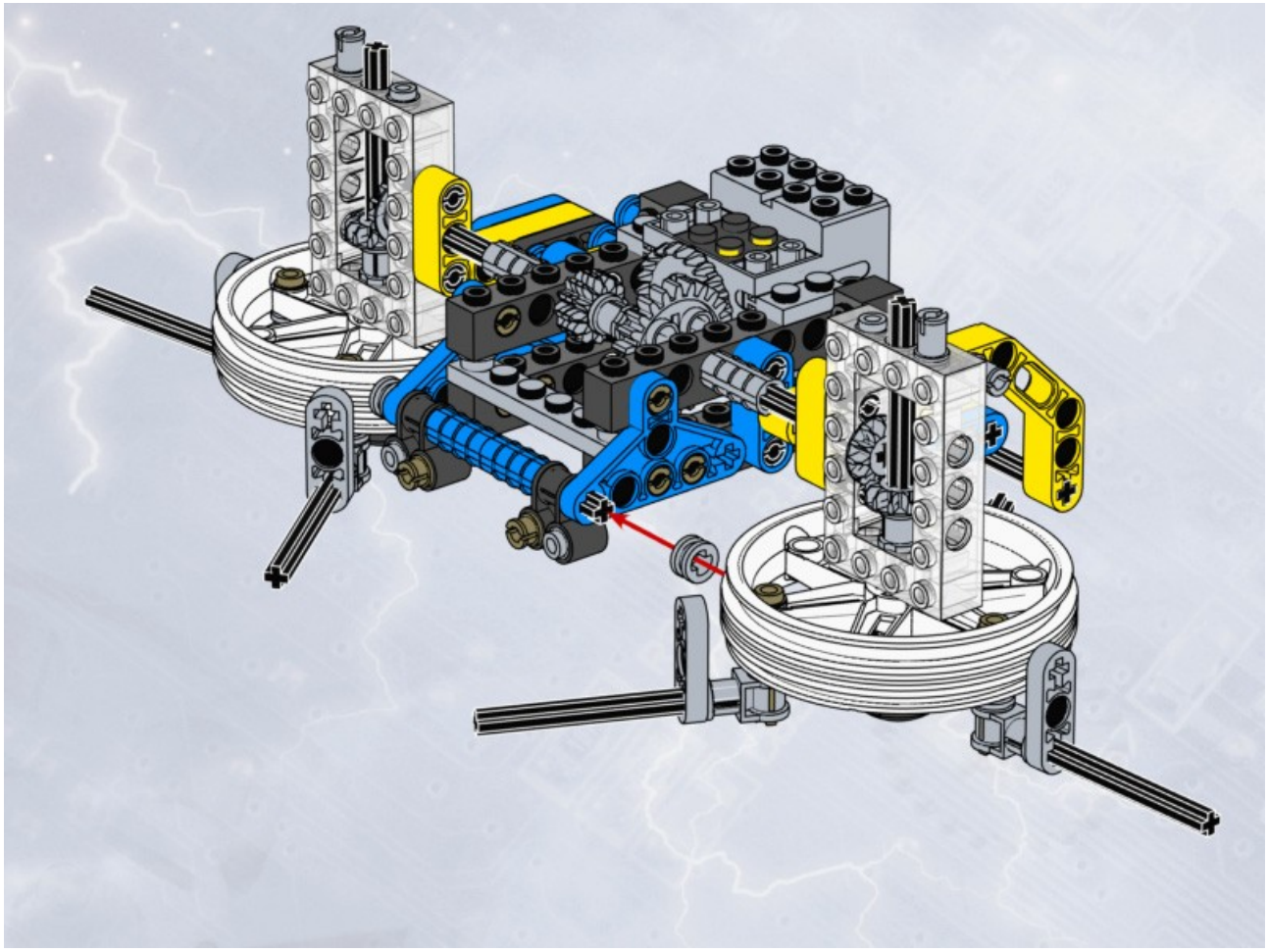

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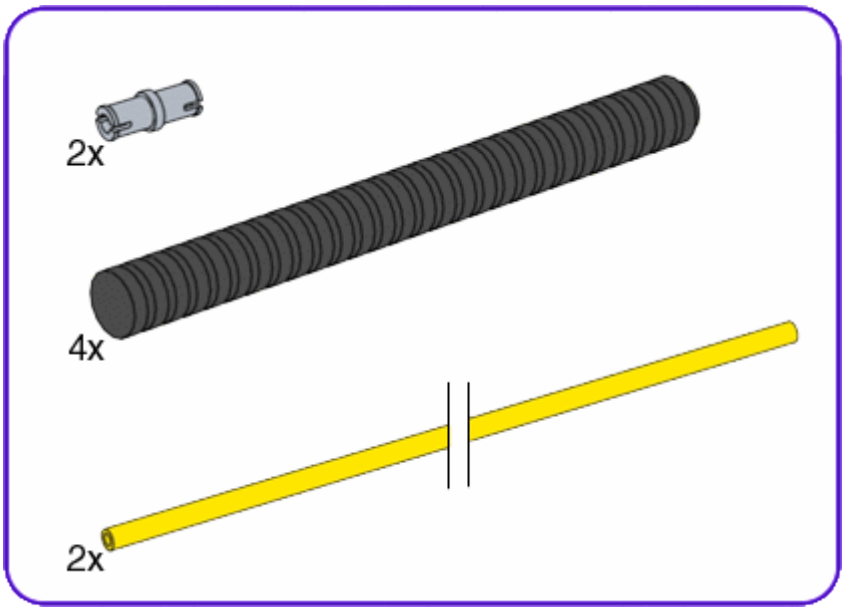

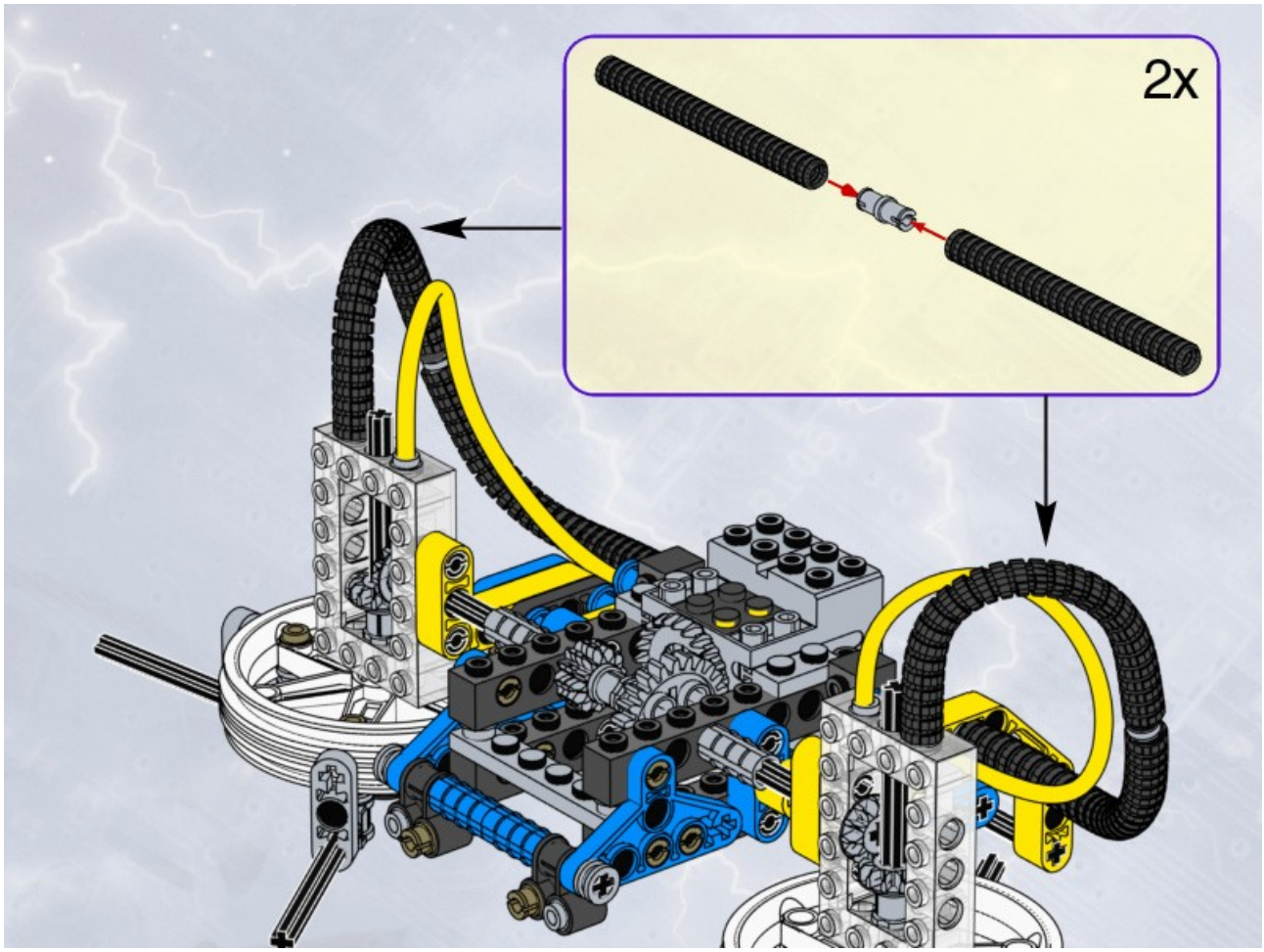

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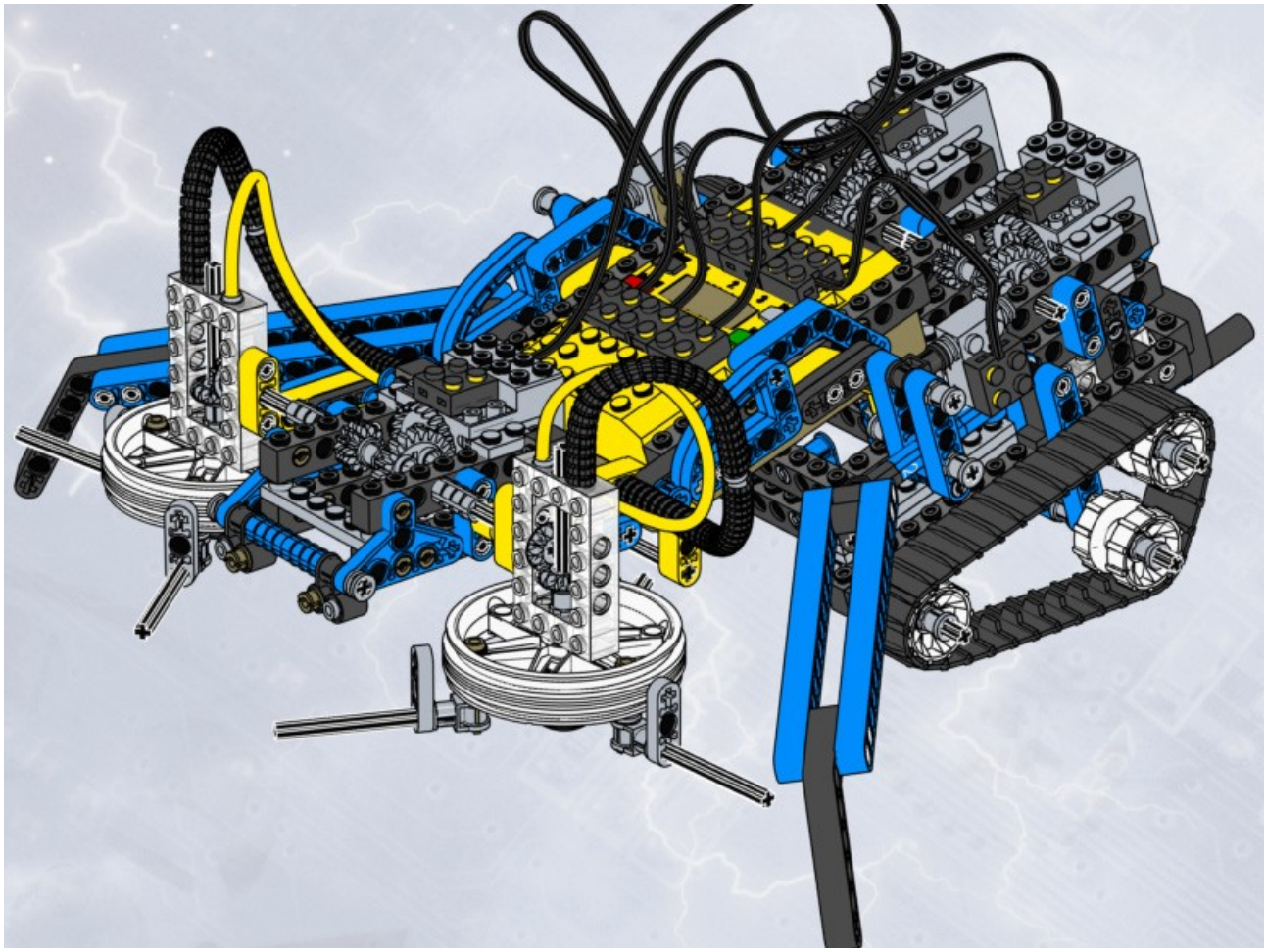
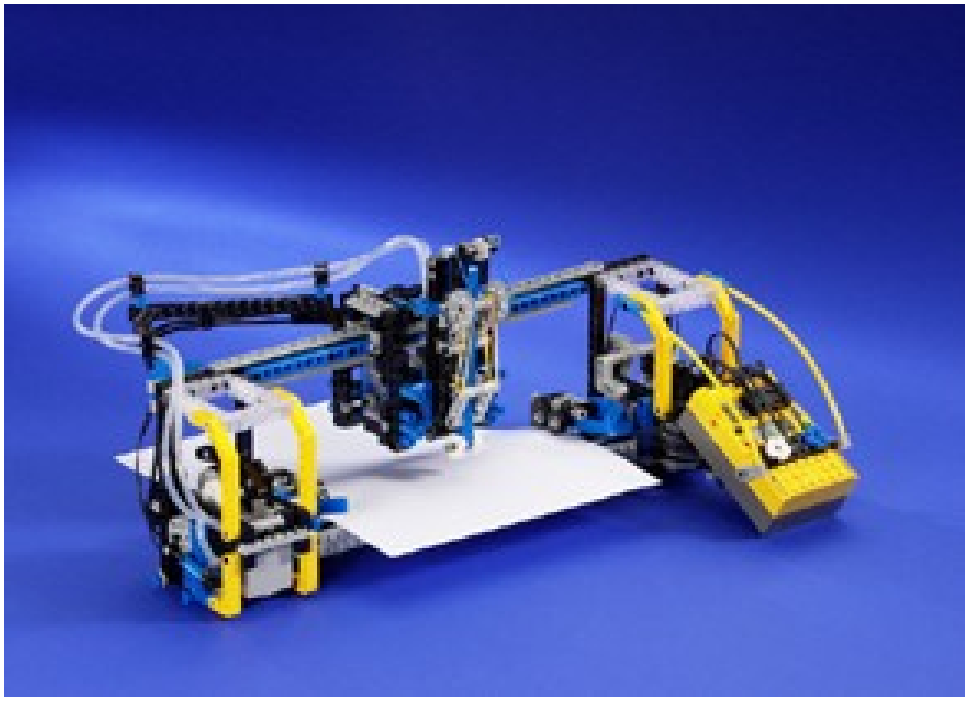


Plotter

Required modules: Motor Module 2, Motor Module 3, Motor Module 4, Pneumatics Module, Gear Rack Module, Pen Module, Plotter Table Module



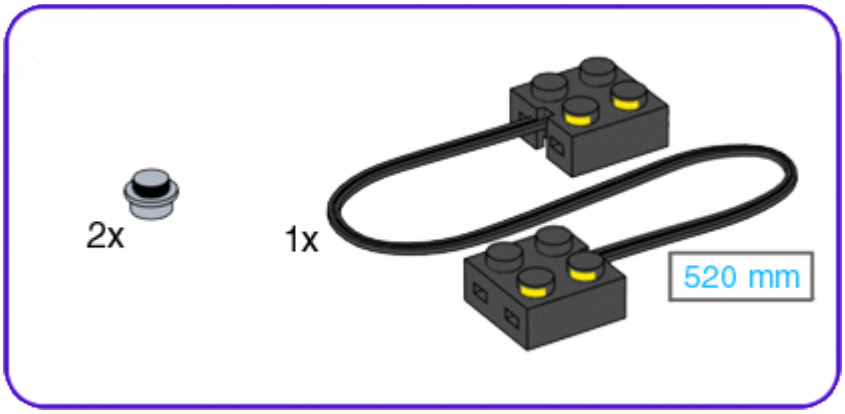
The plotter has a lot of Modules, make sure you build all of these before starting on this step. The final assembly is really quite simple once all the modules are done.

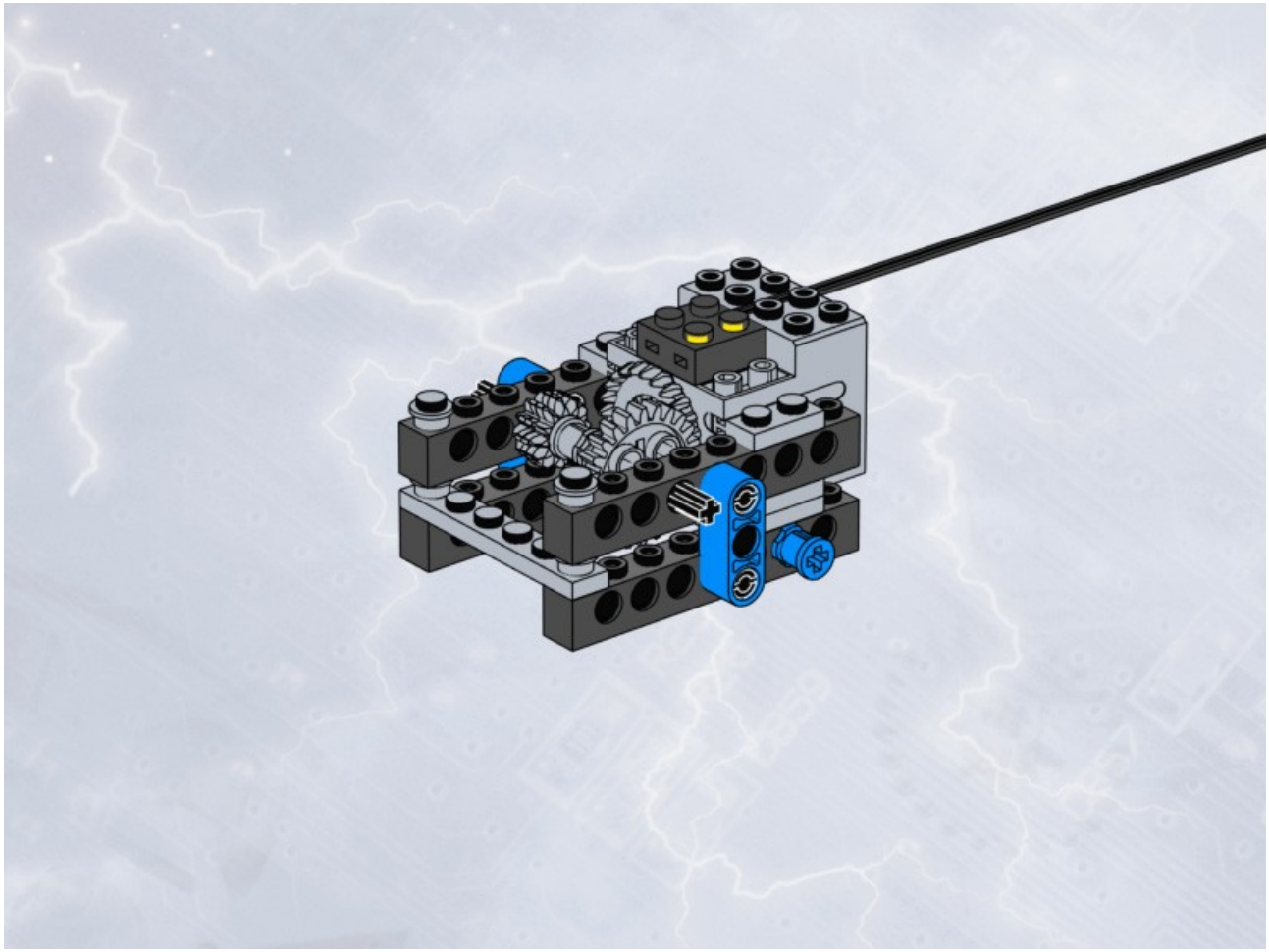
There is no single right way to program the plotter. Once you are used to the basic functions for moving the pen up, down and from side to side and the paper back and forth it is all up to you.

As you practice with it you will find you are able to draw more and more complicated shapes.

Start simple and work up. Try making it write out your name.

1





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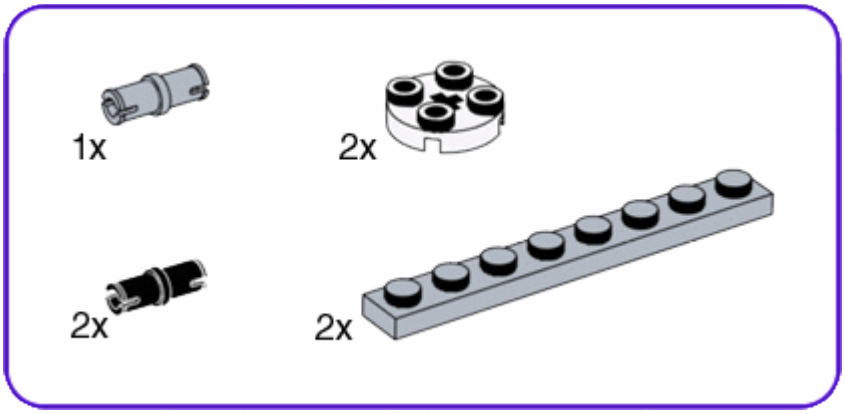

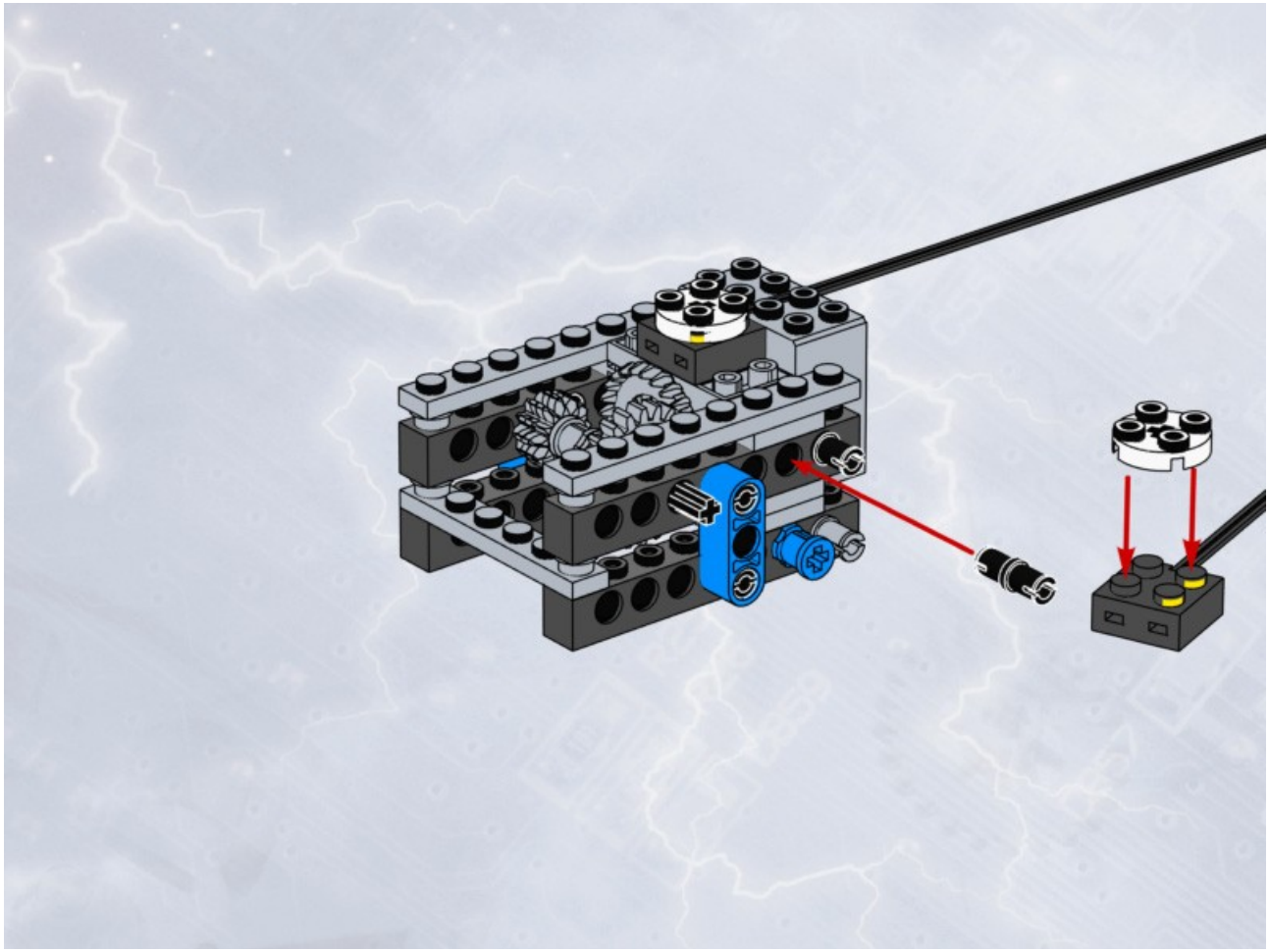

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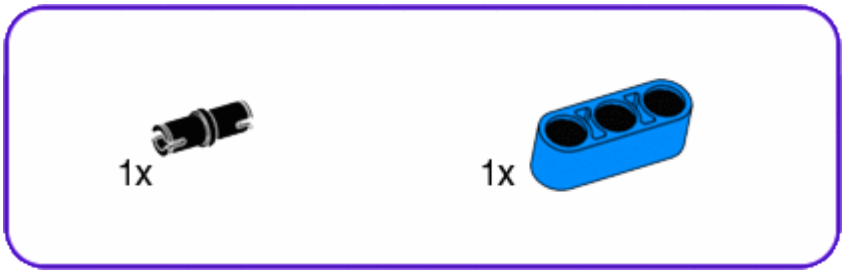

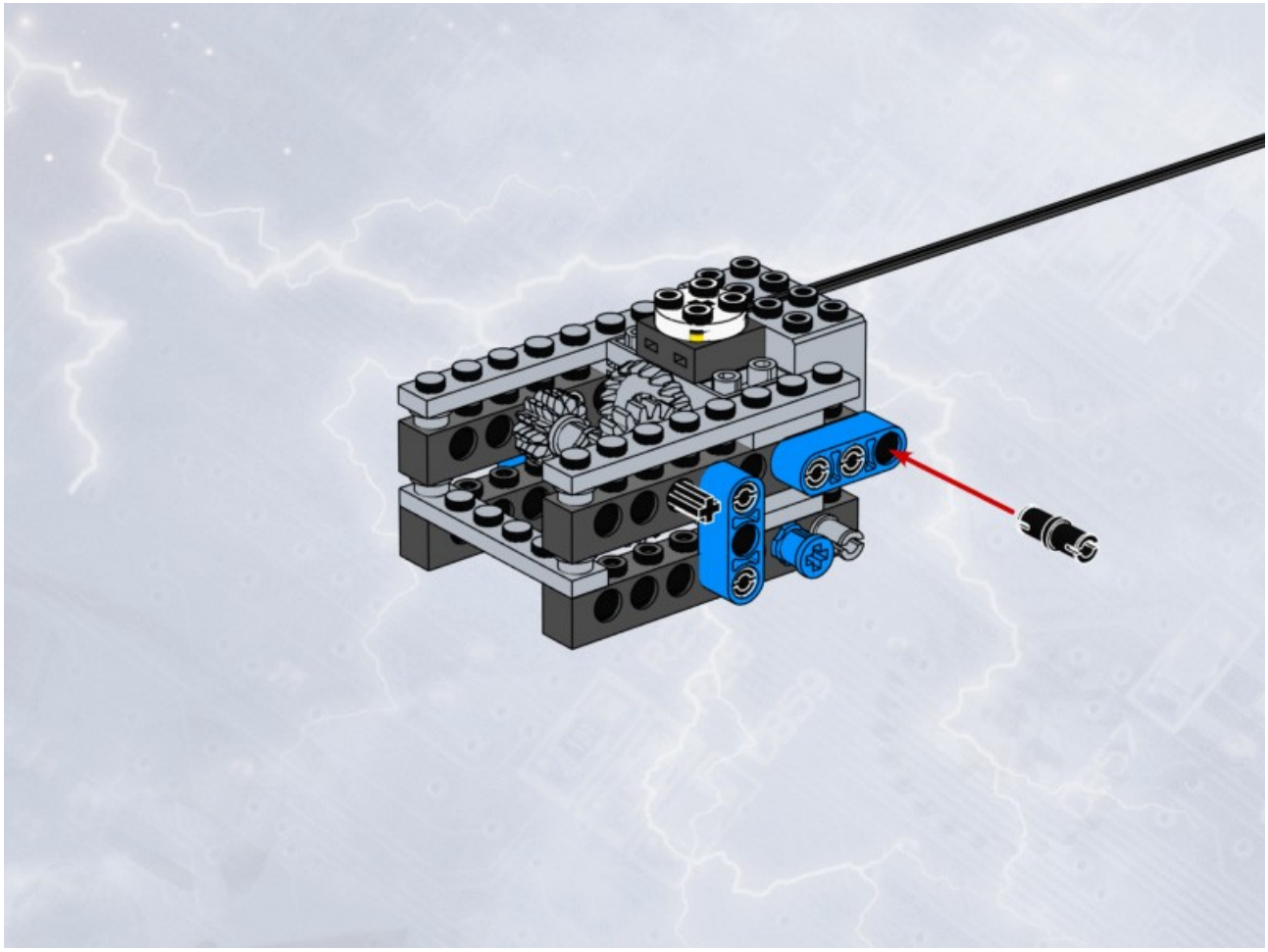

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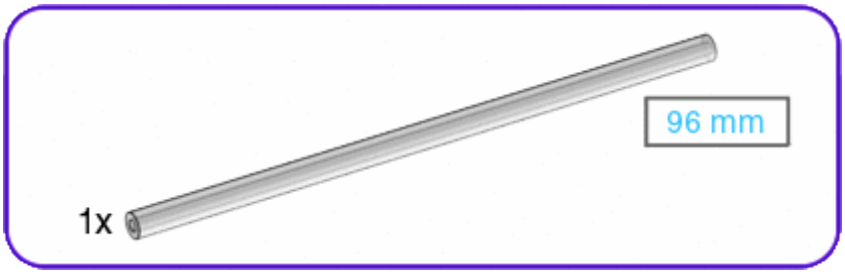

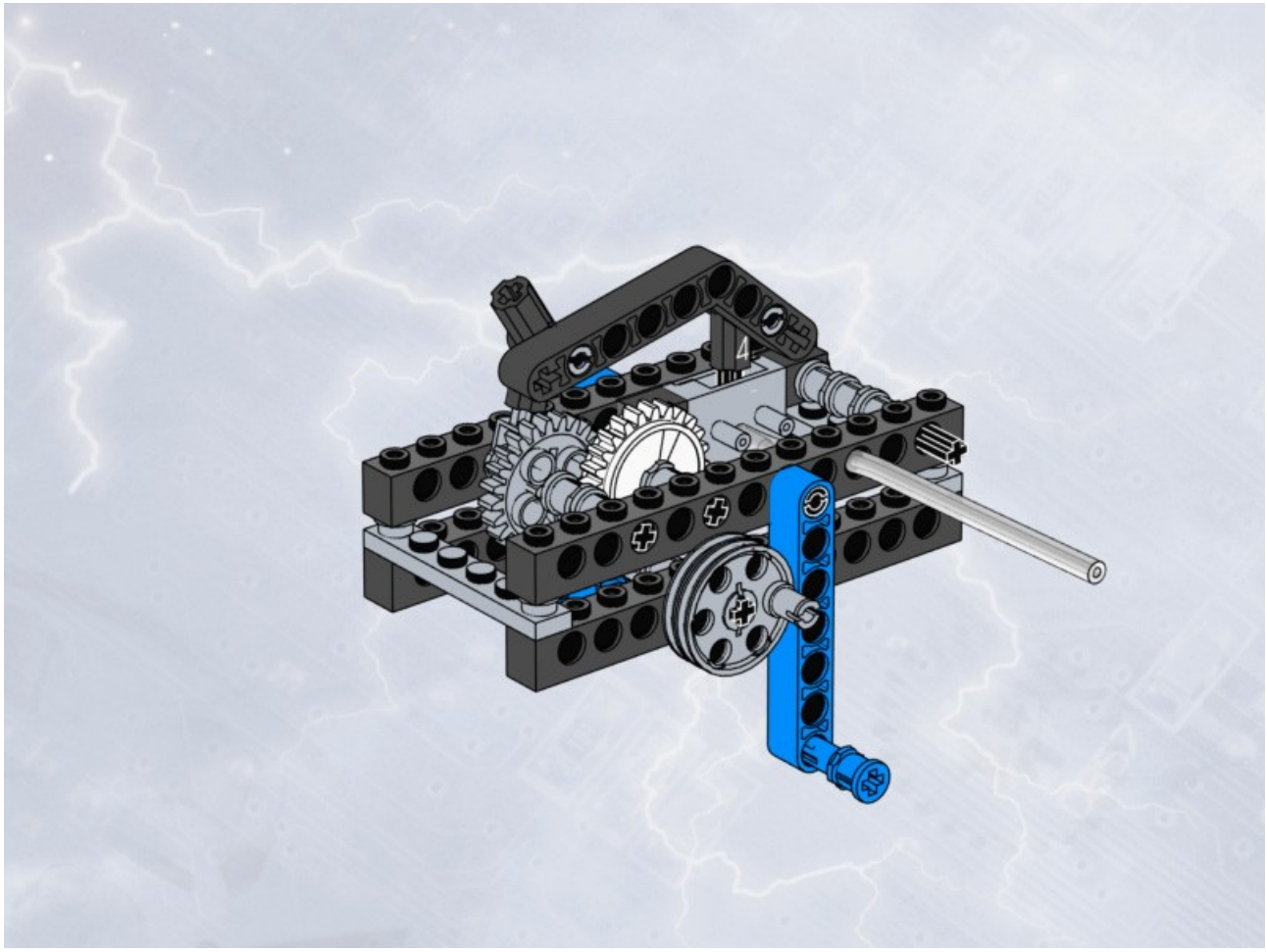

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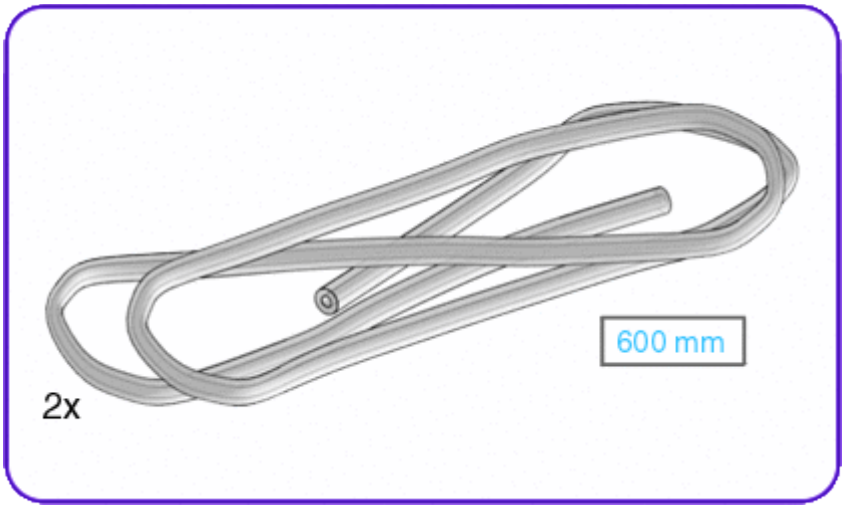

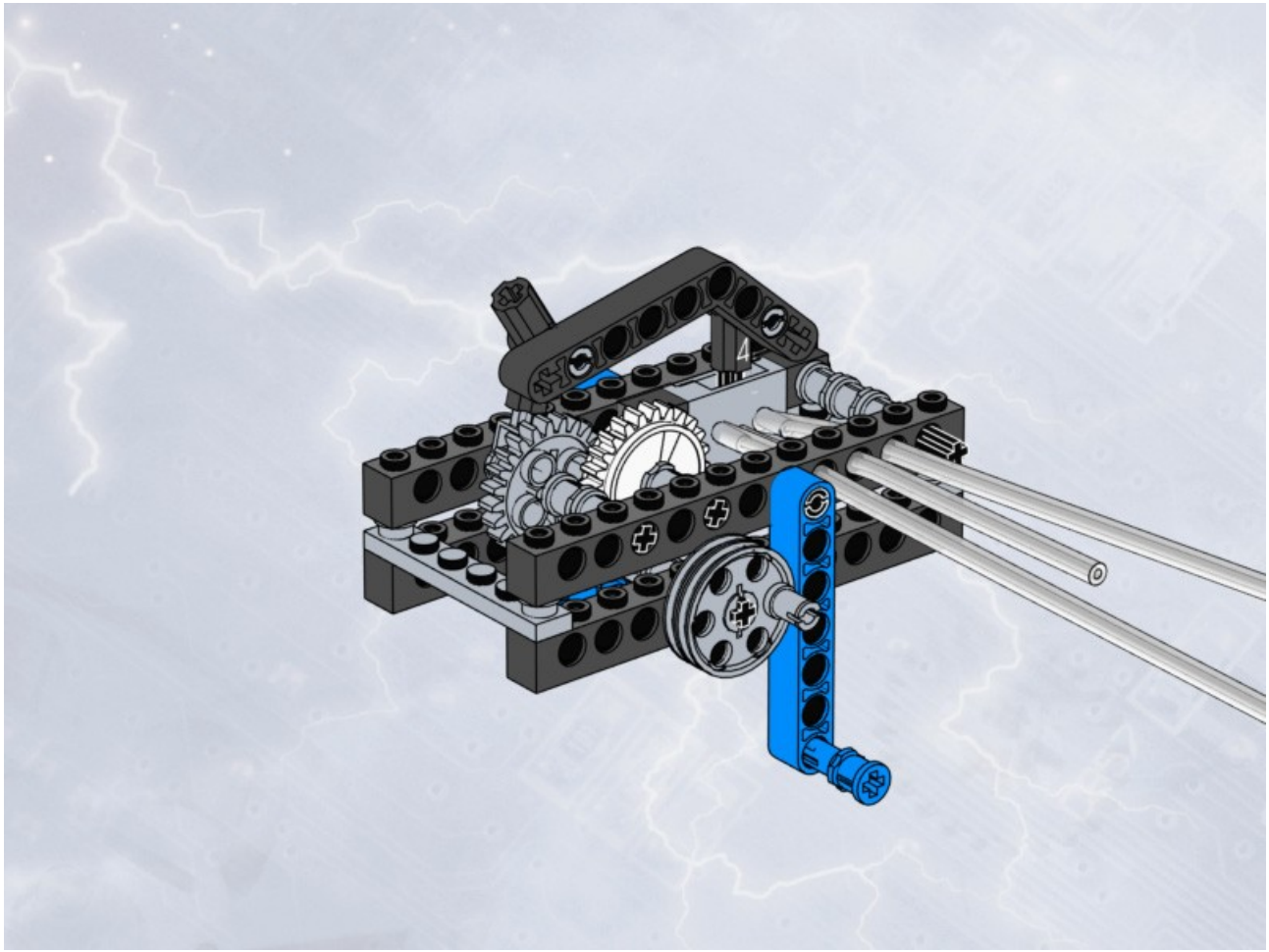

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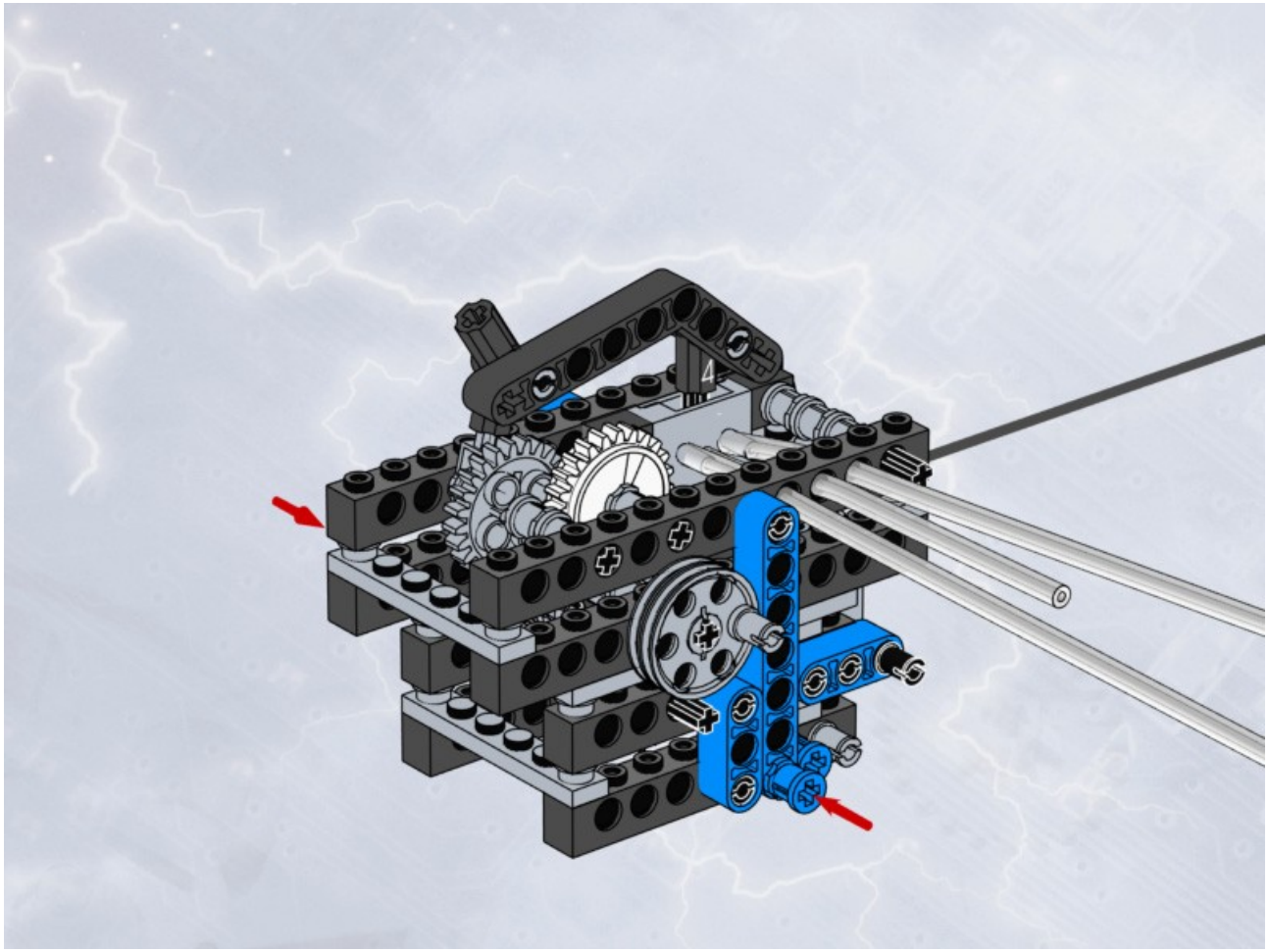

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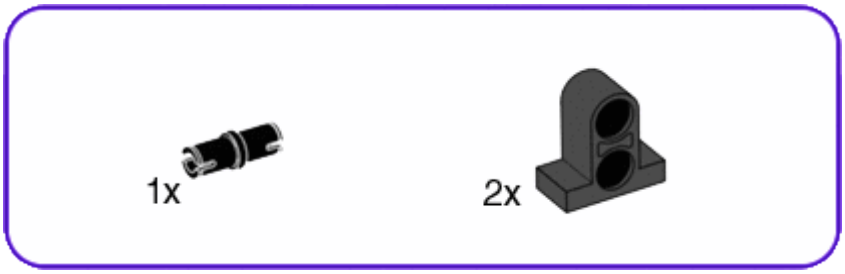

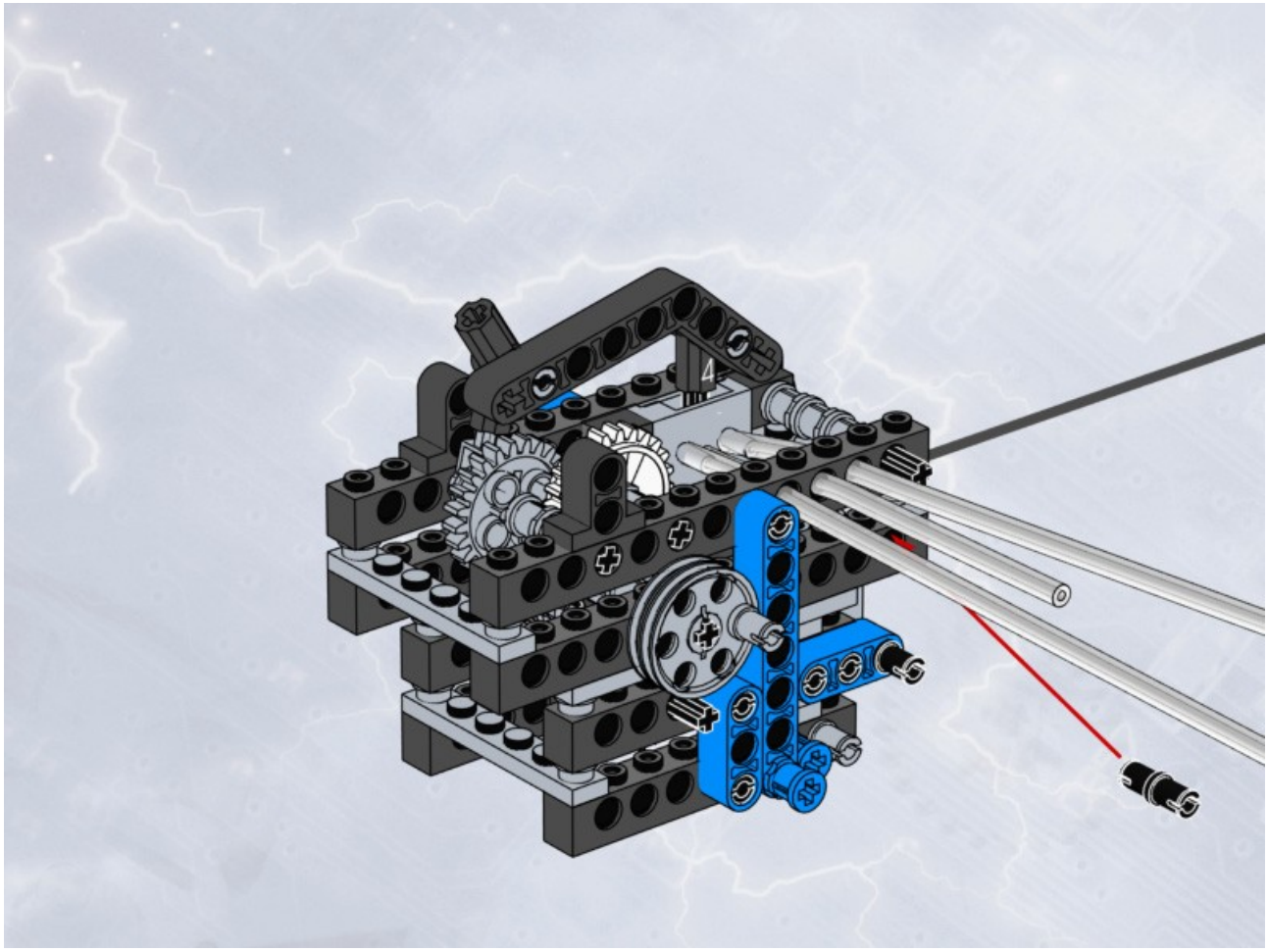

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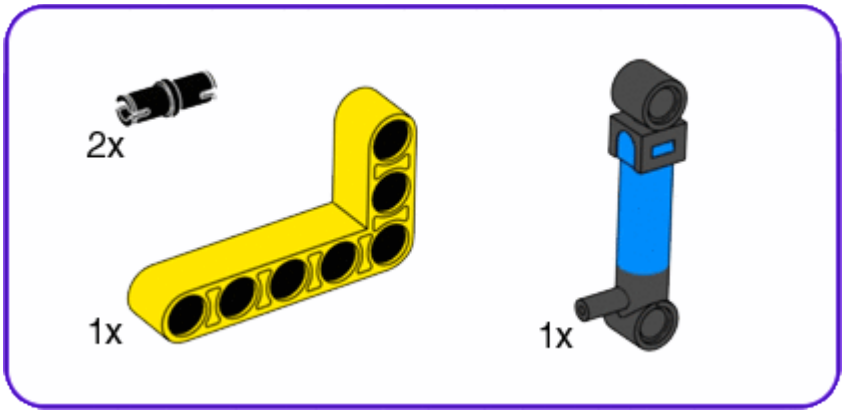

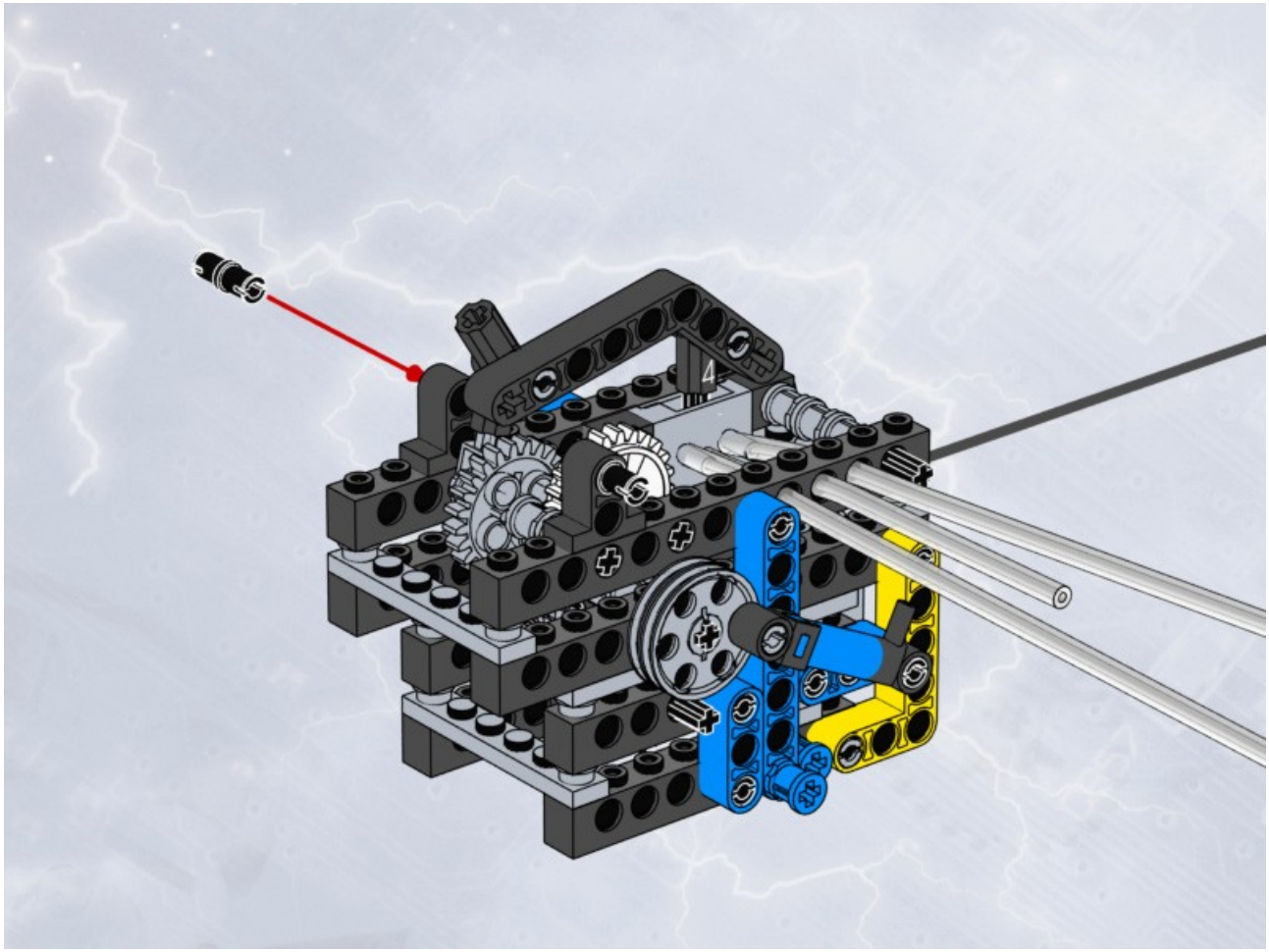

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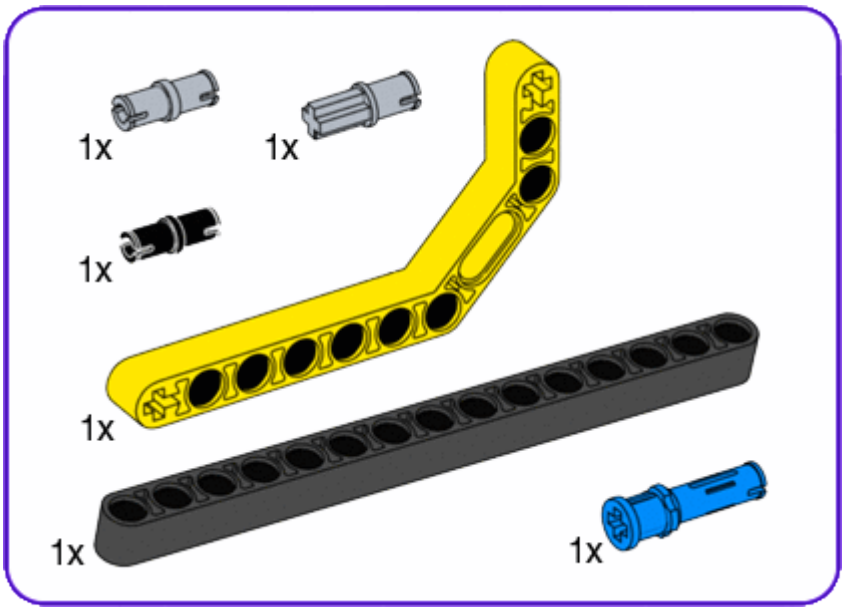

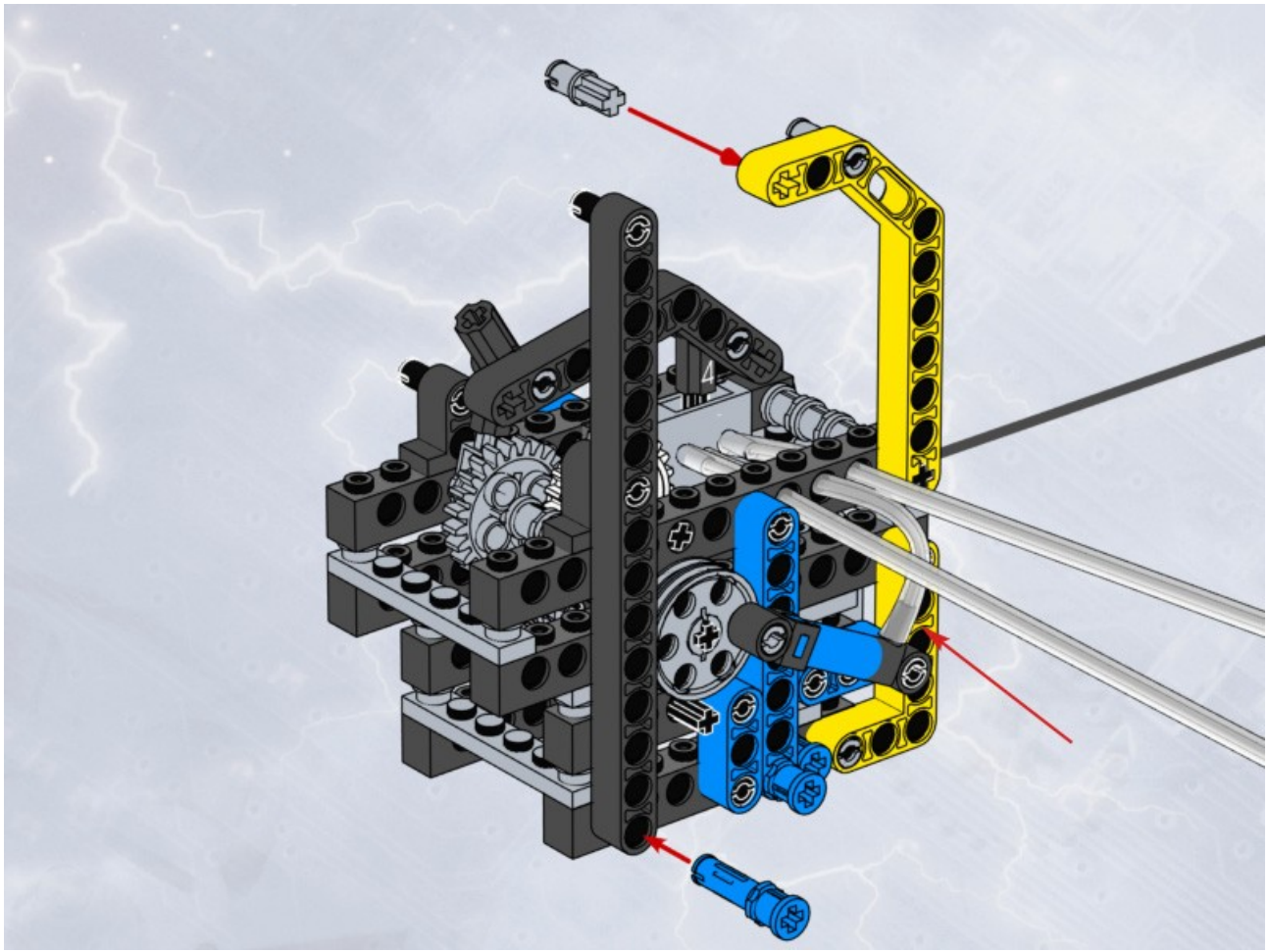

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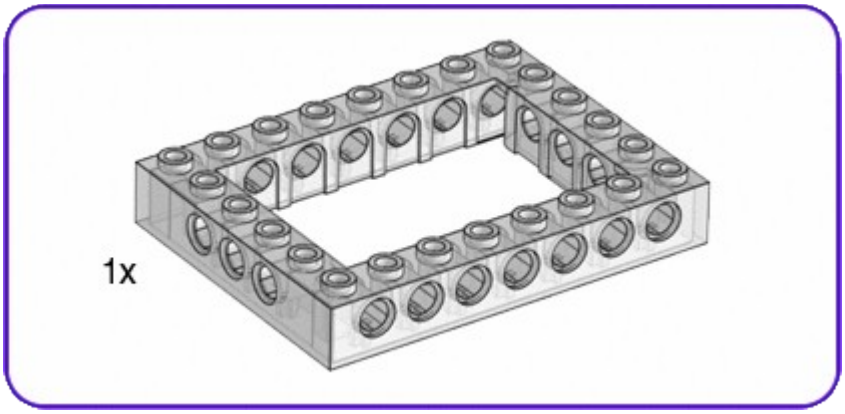

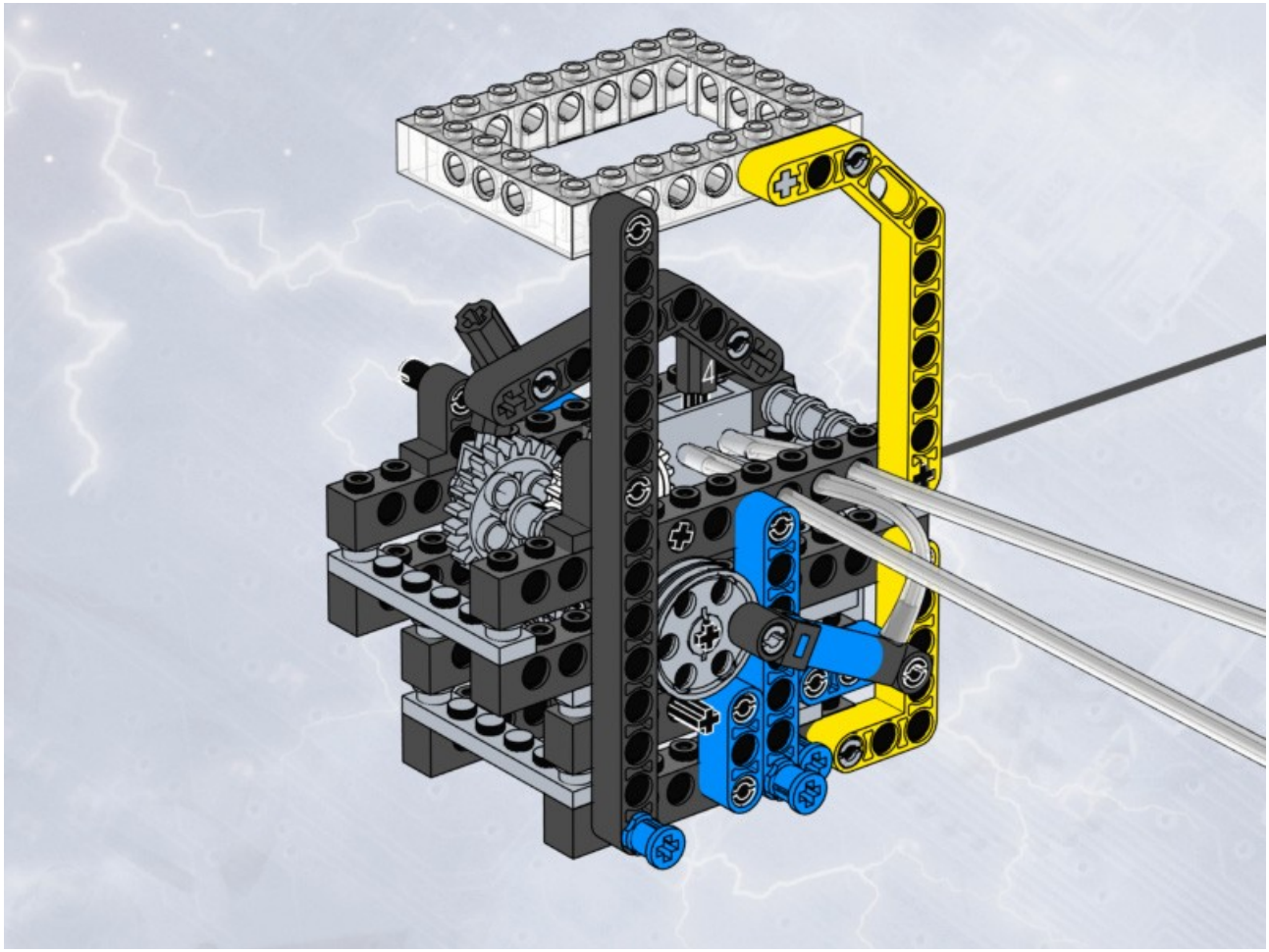

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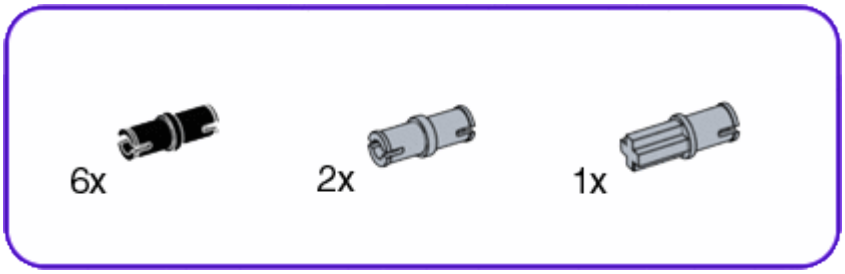

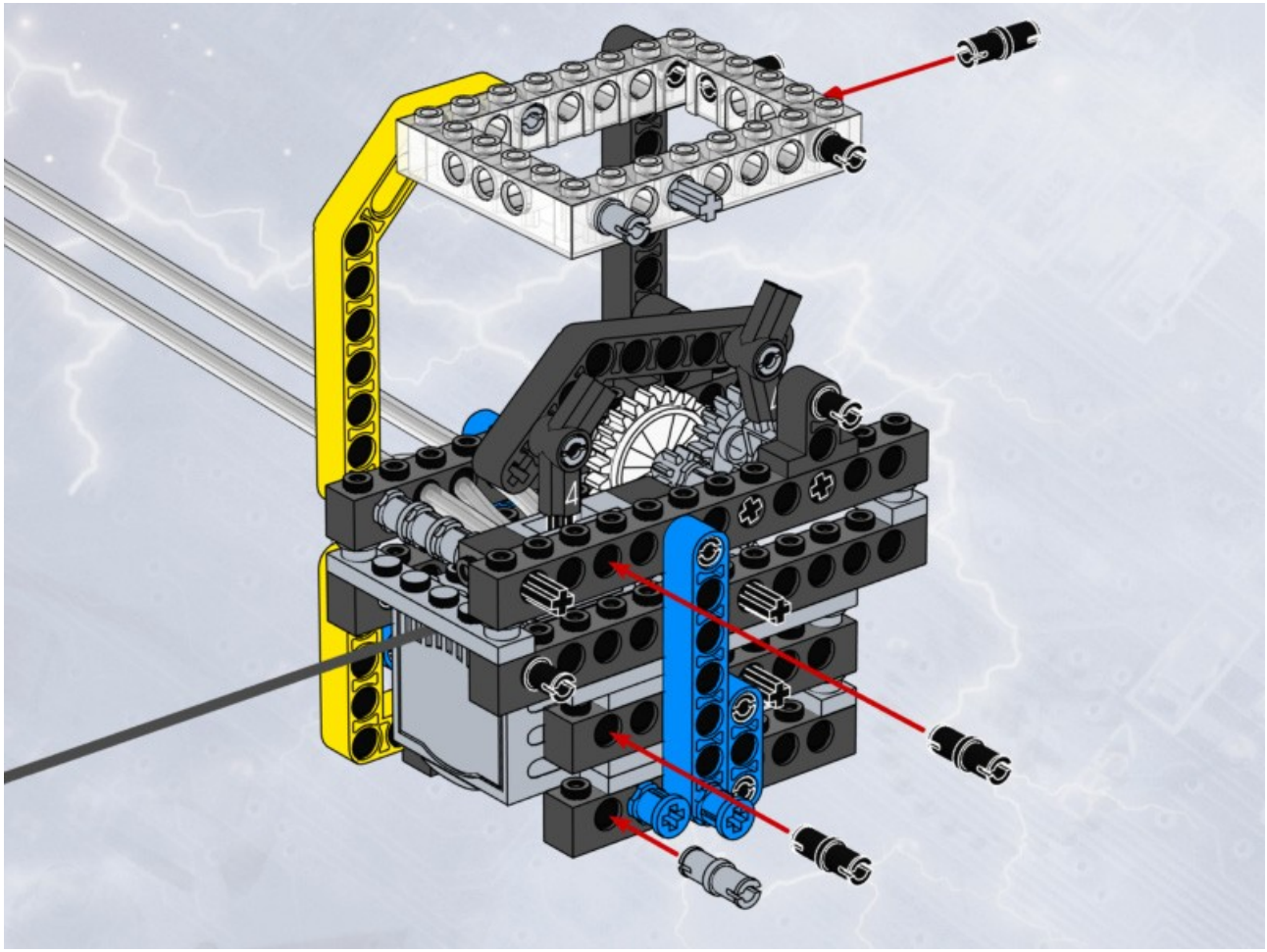

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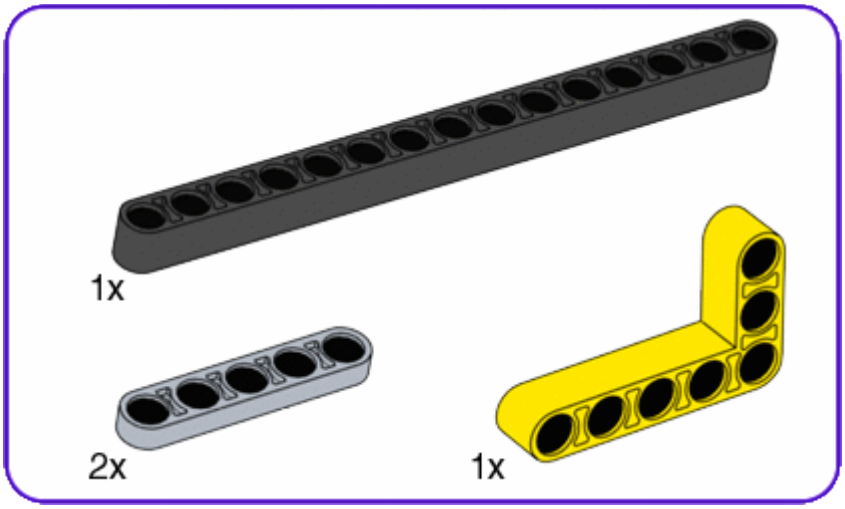

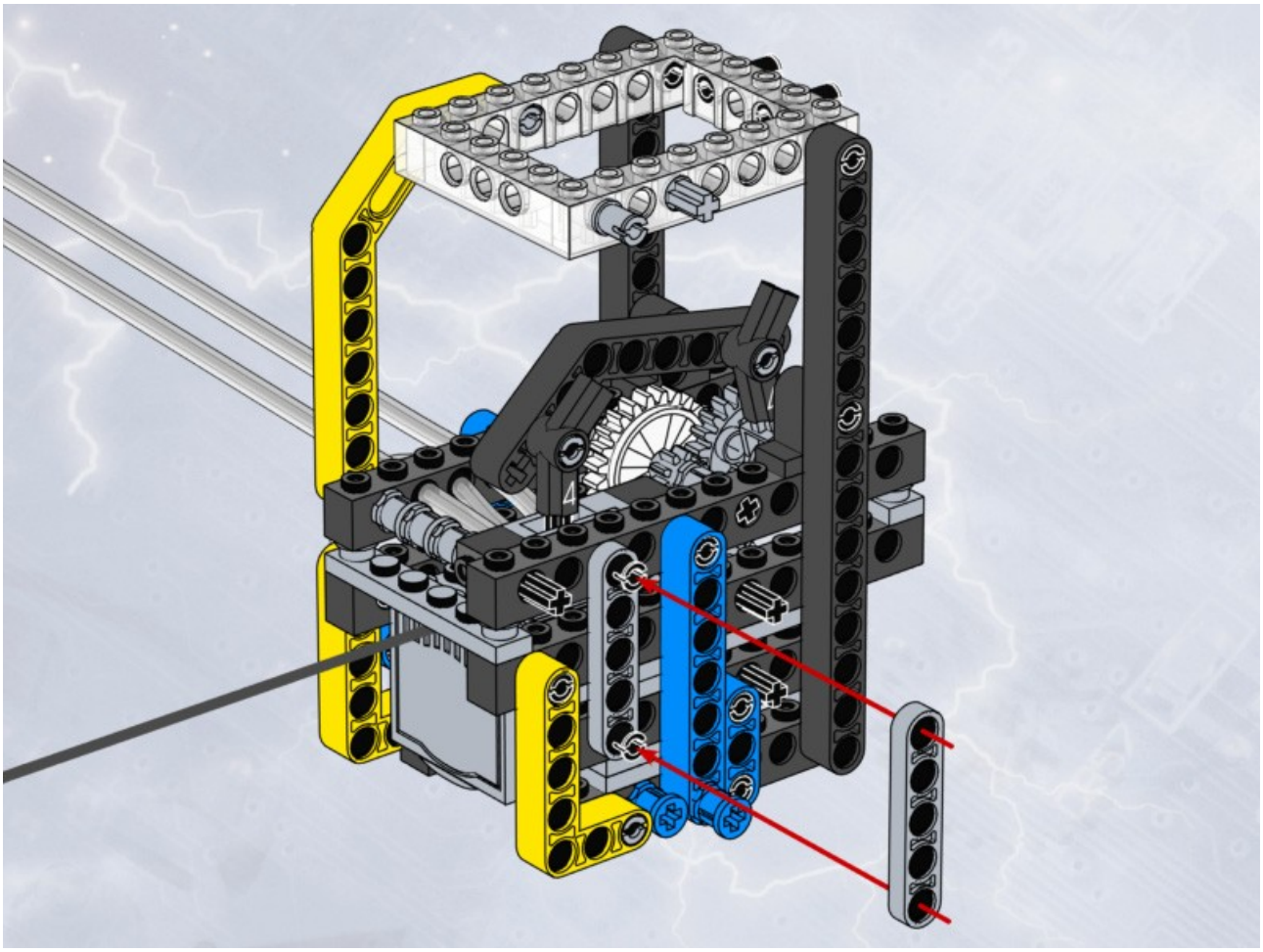

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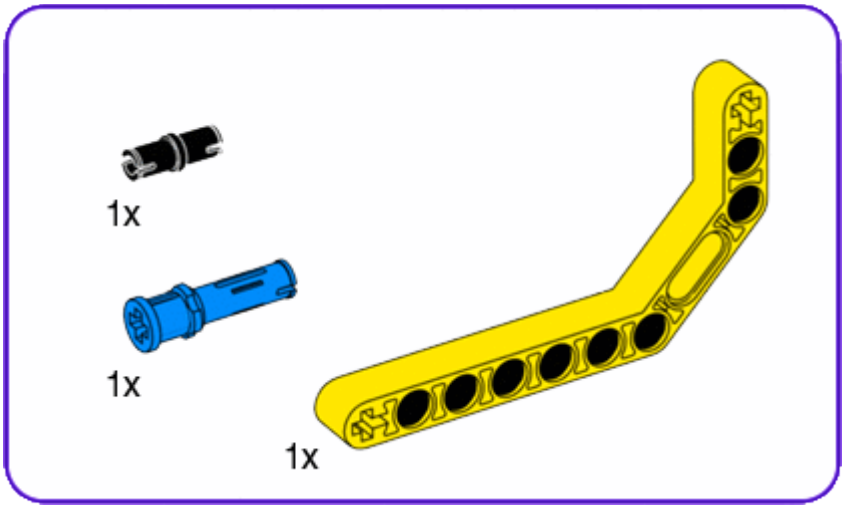

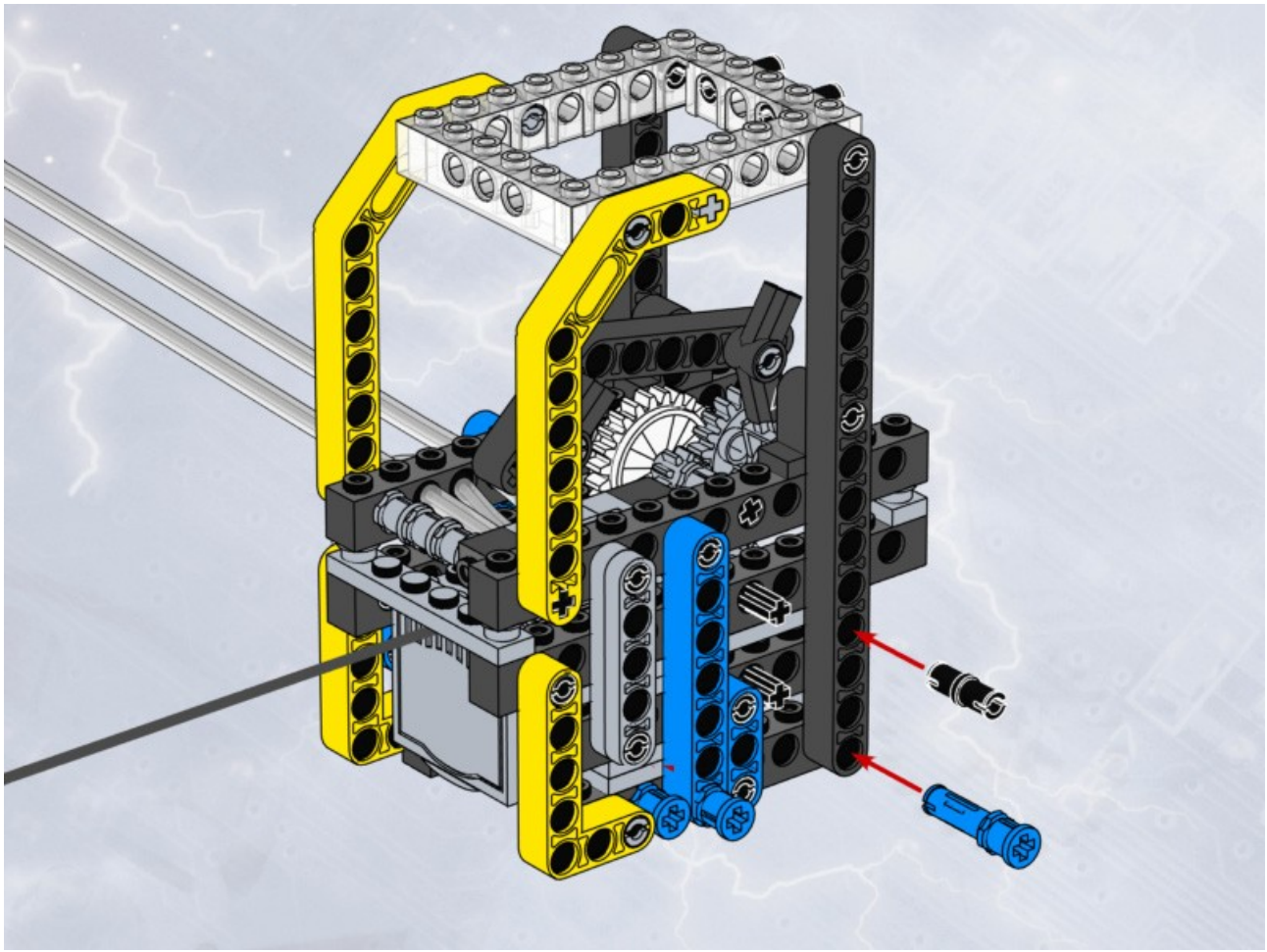

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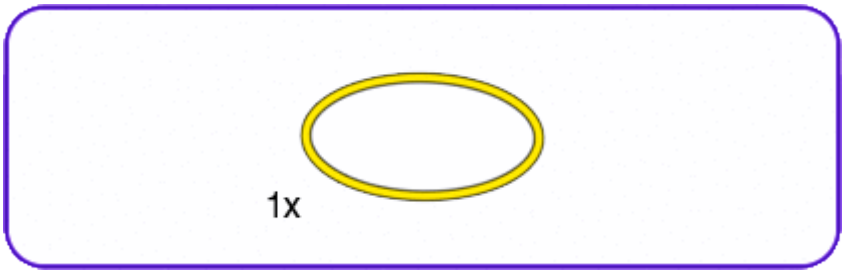

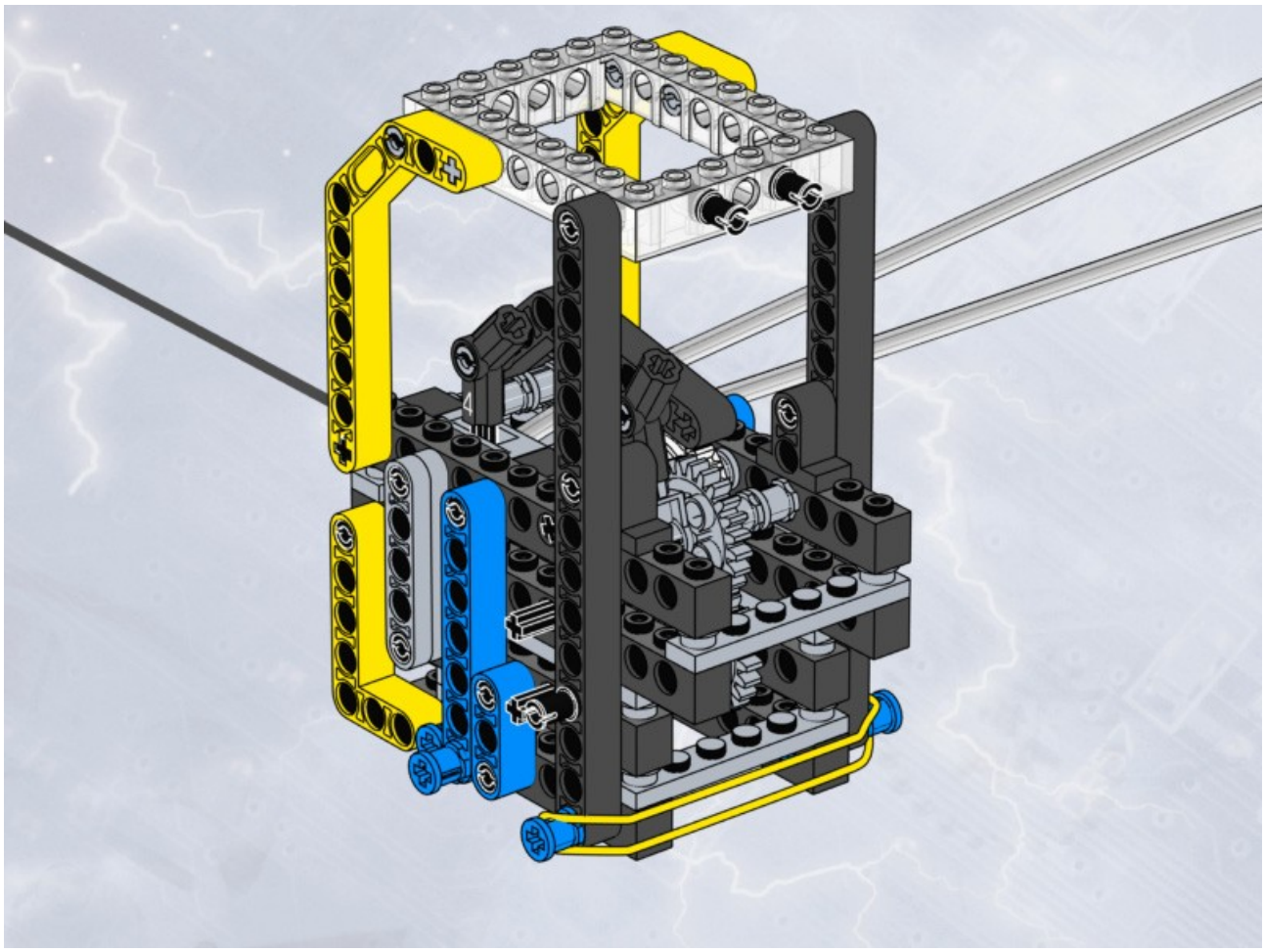

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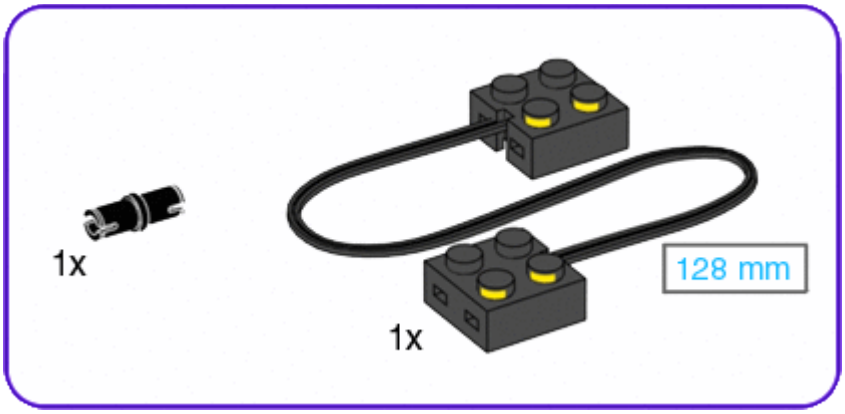

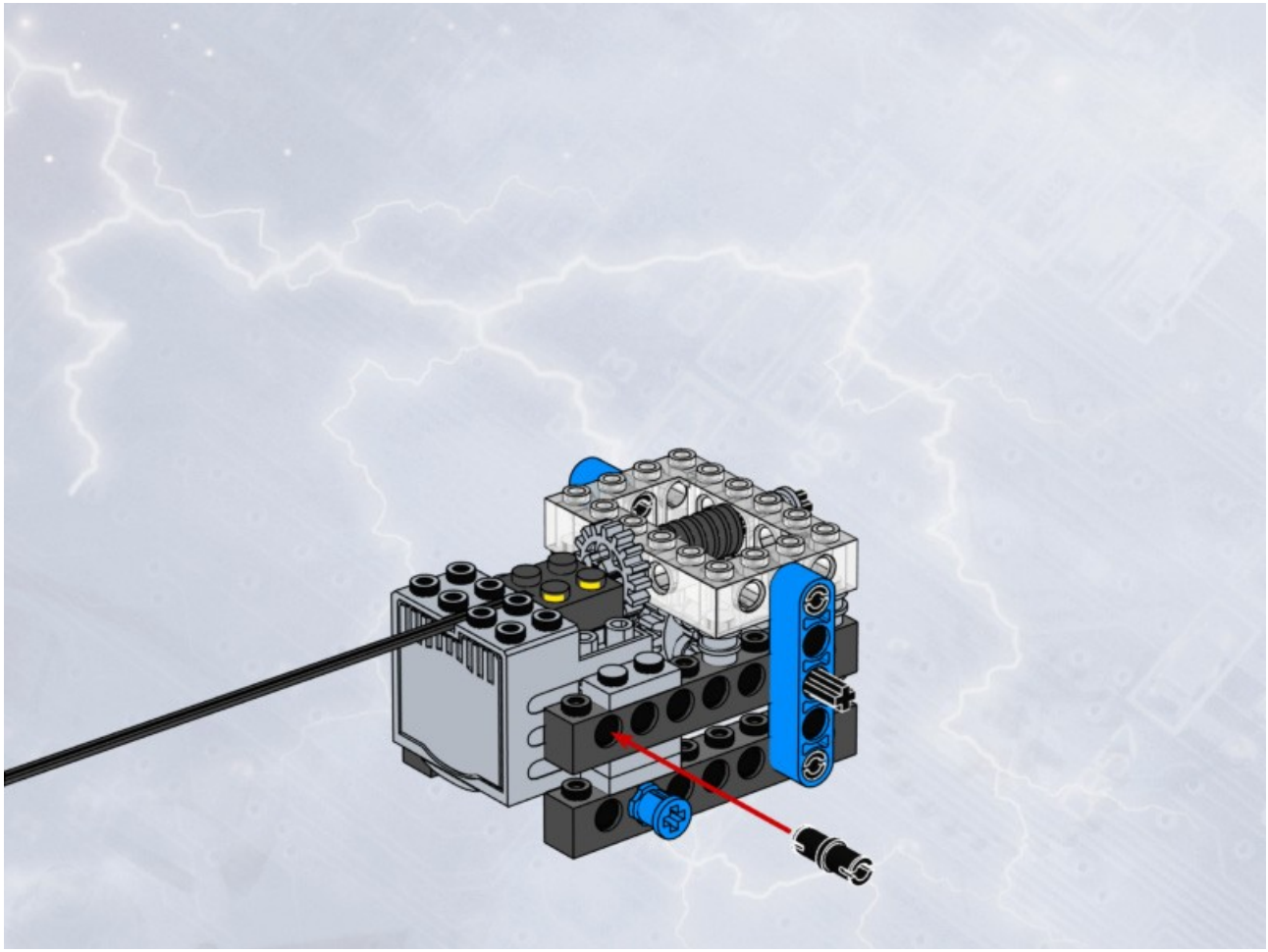

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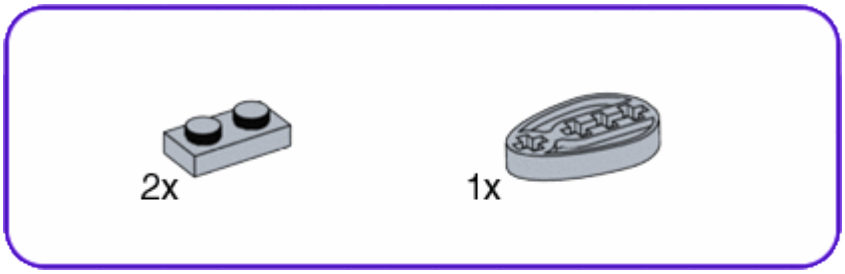

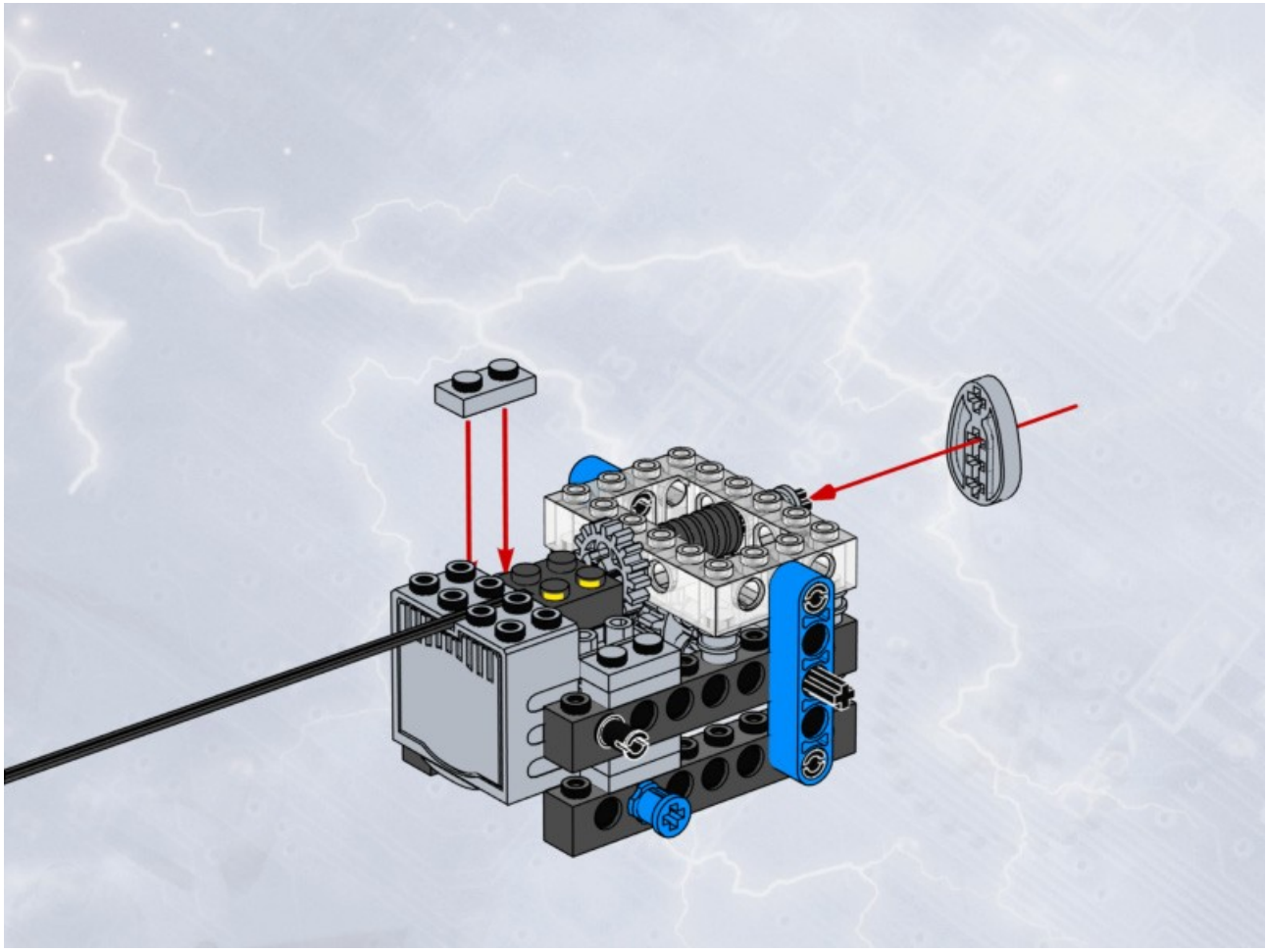

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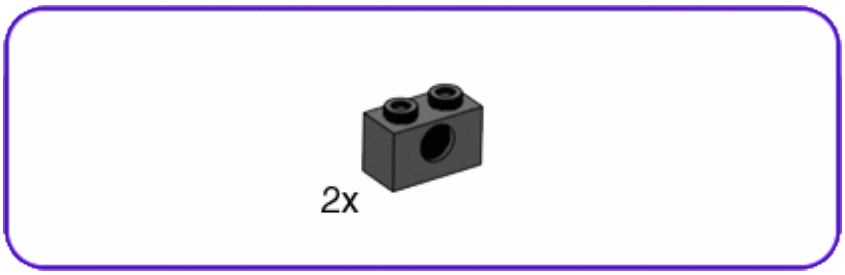

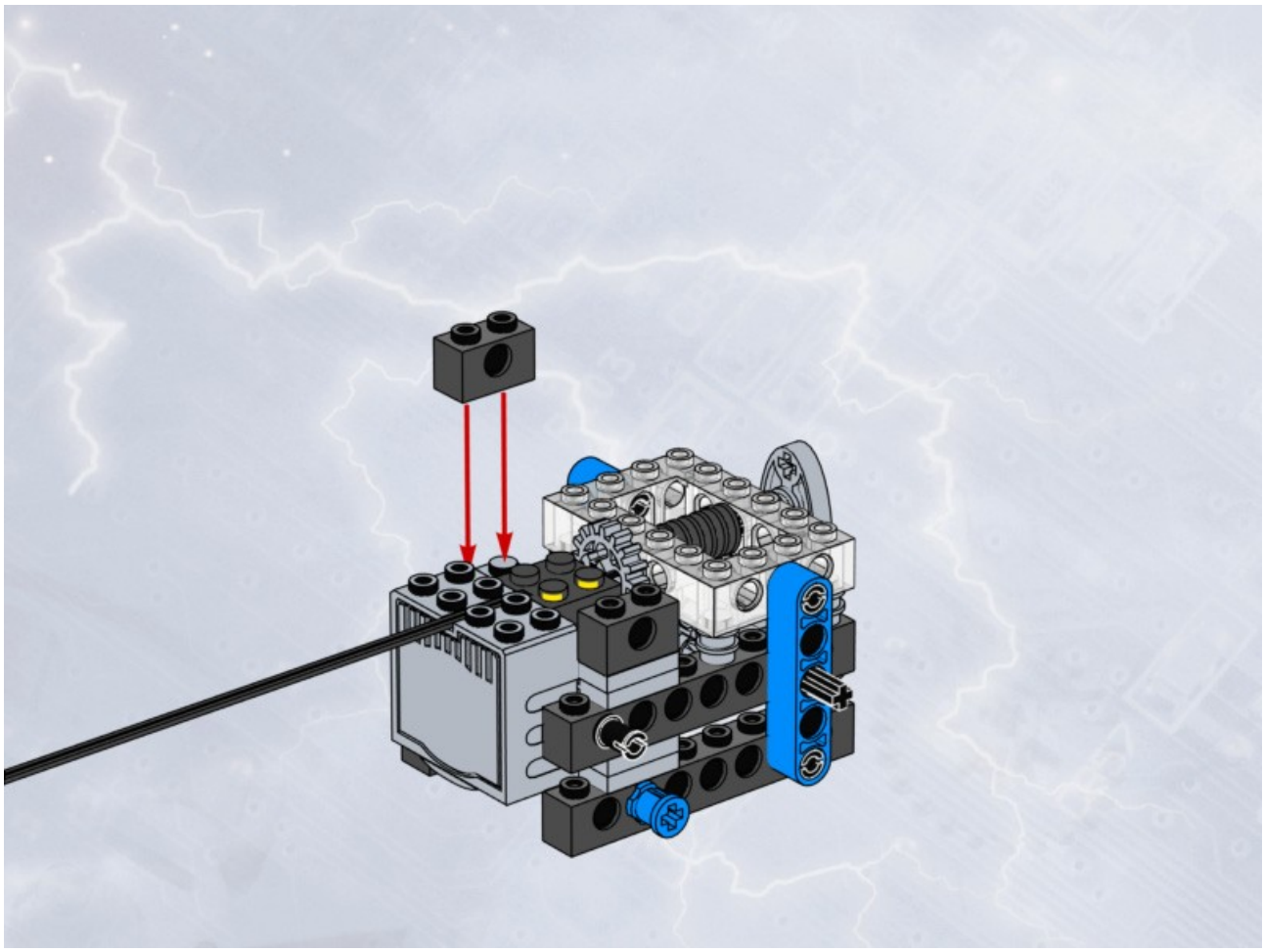

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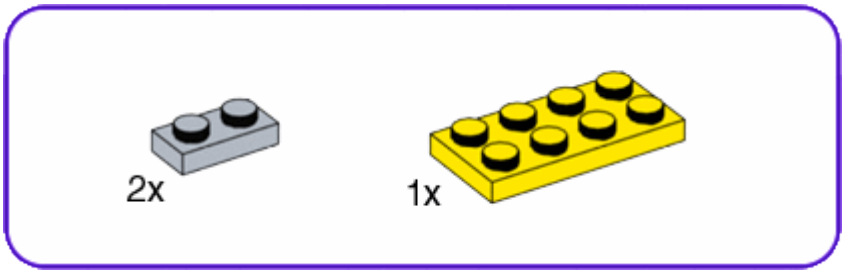

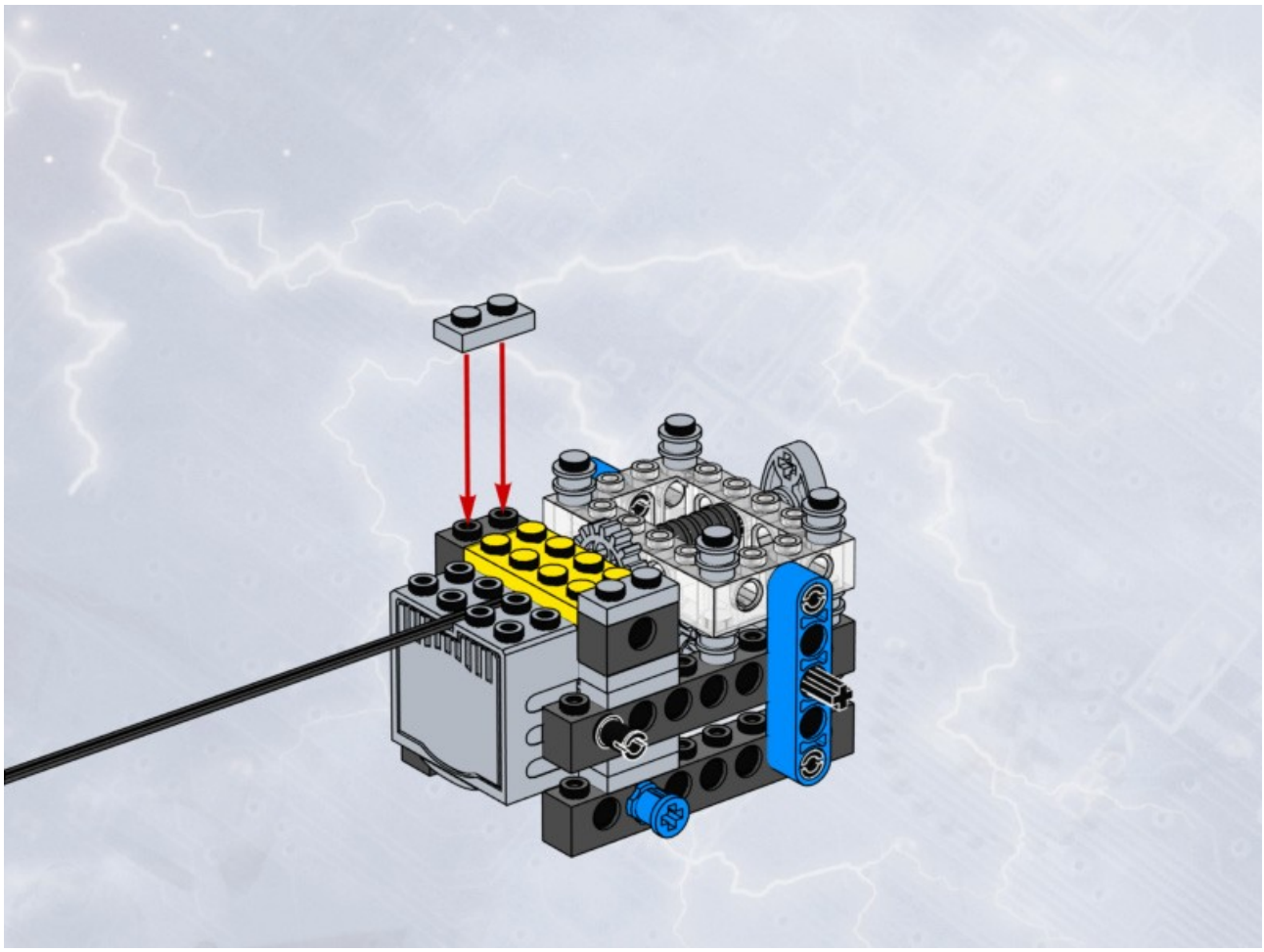

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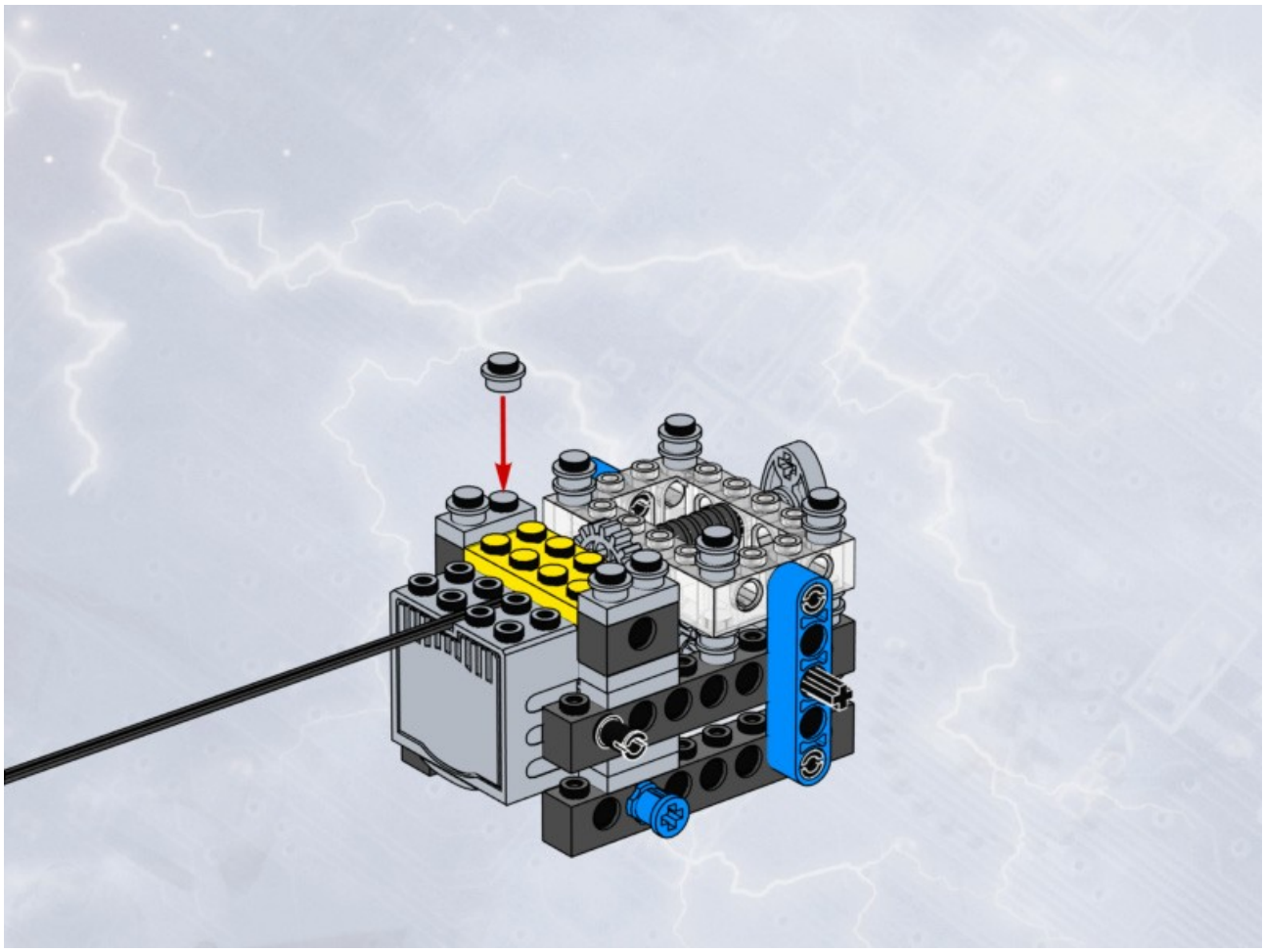

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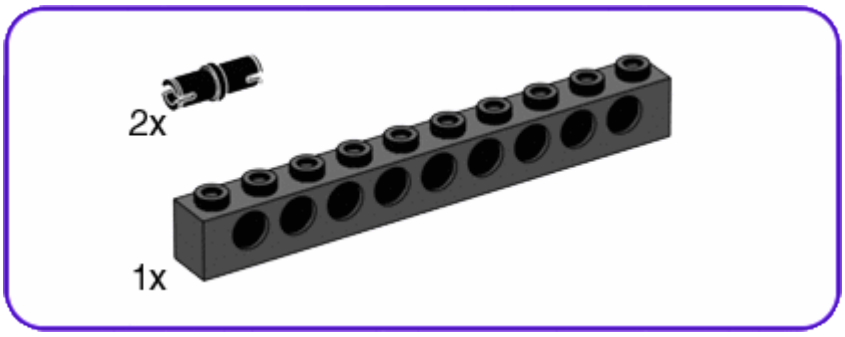

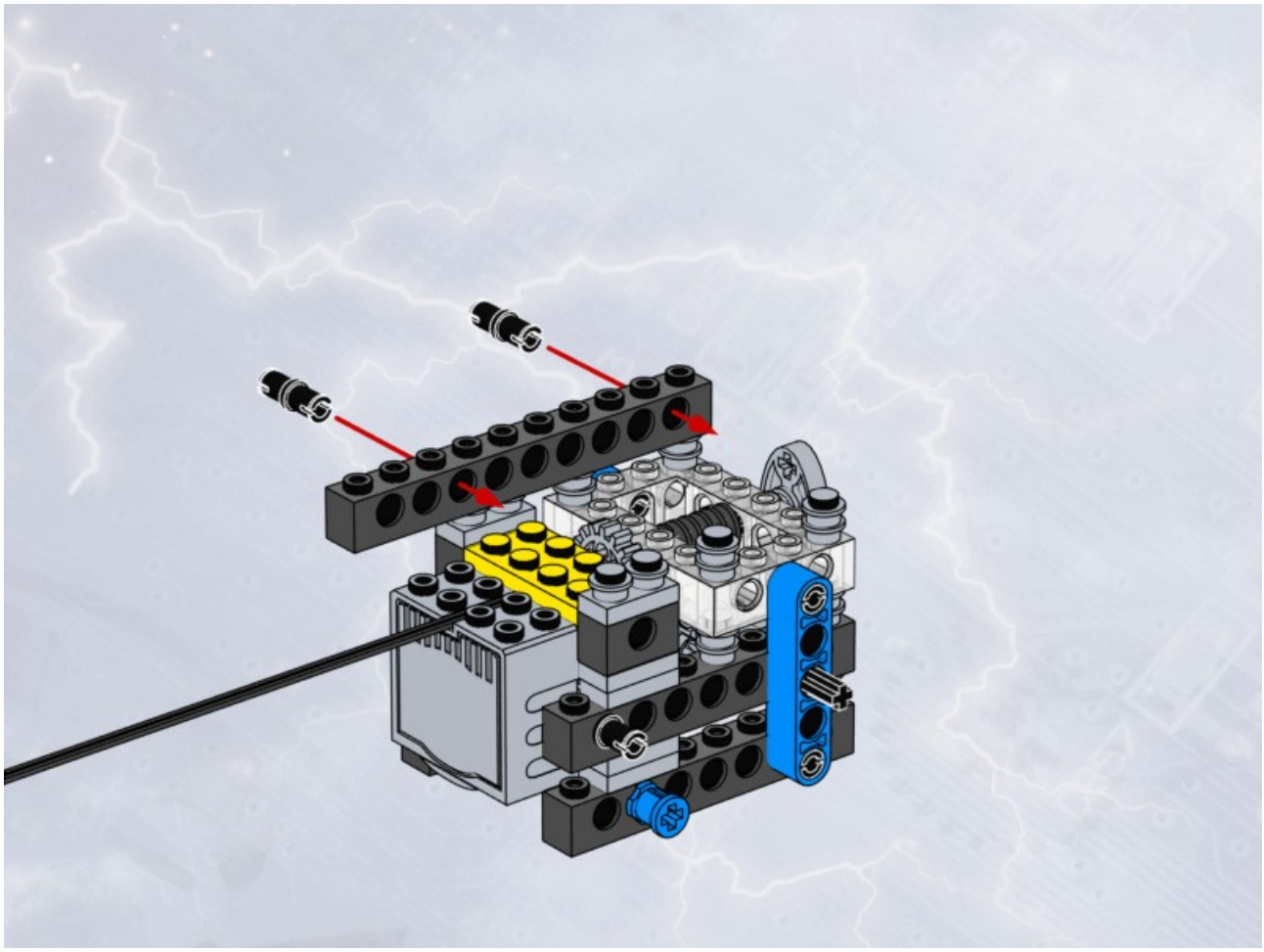

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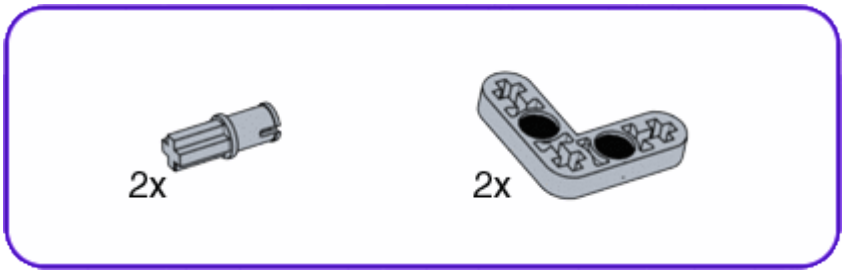

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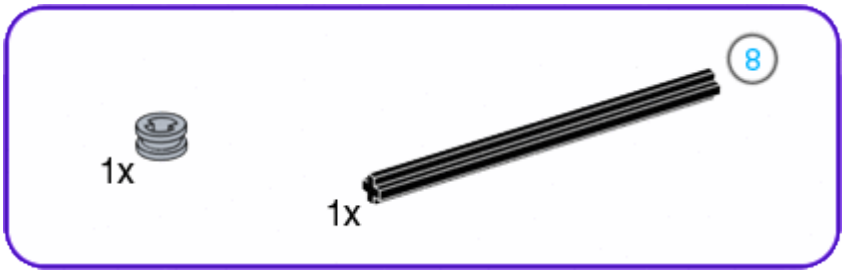

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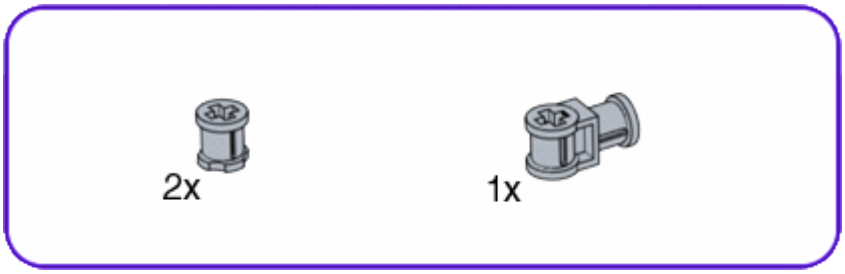

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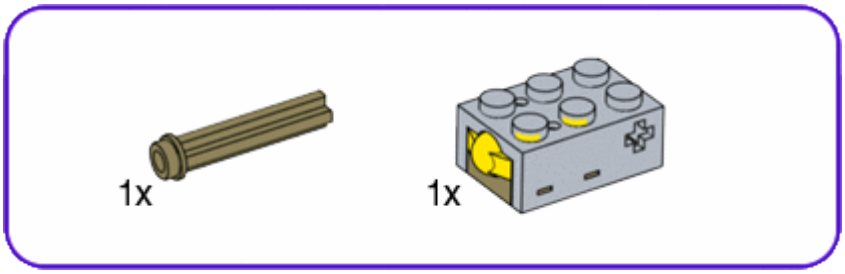

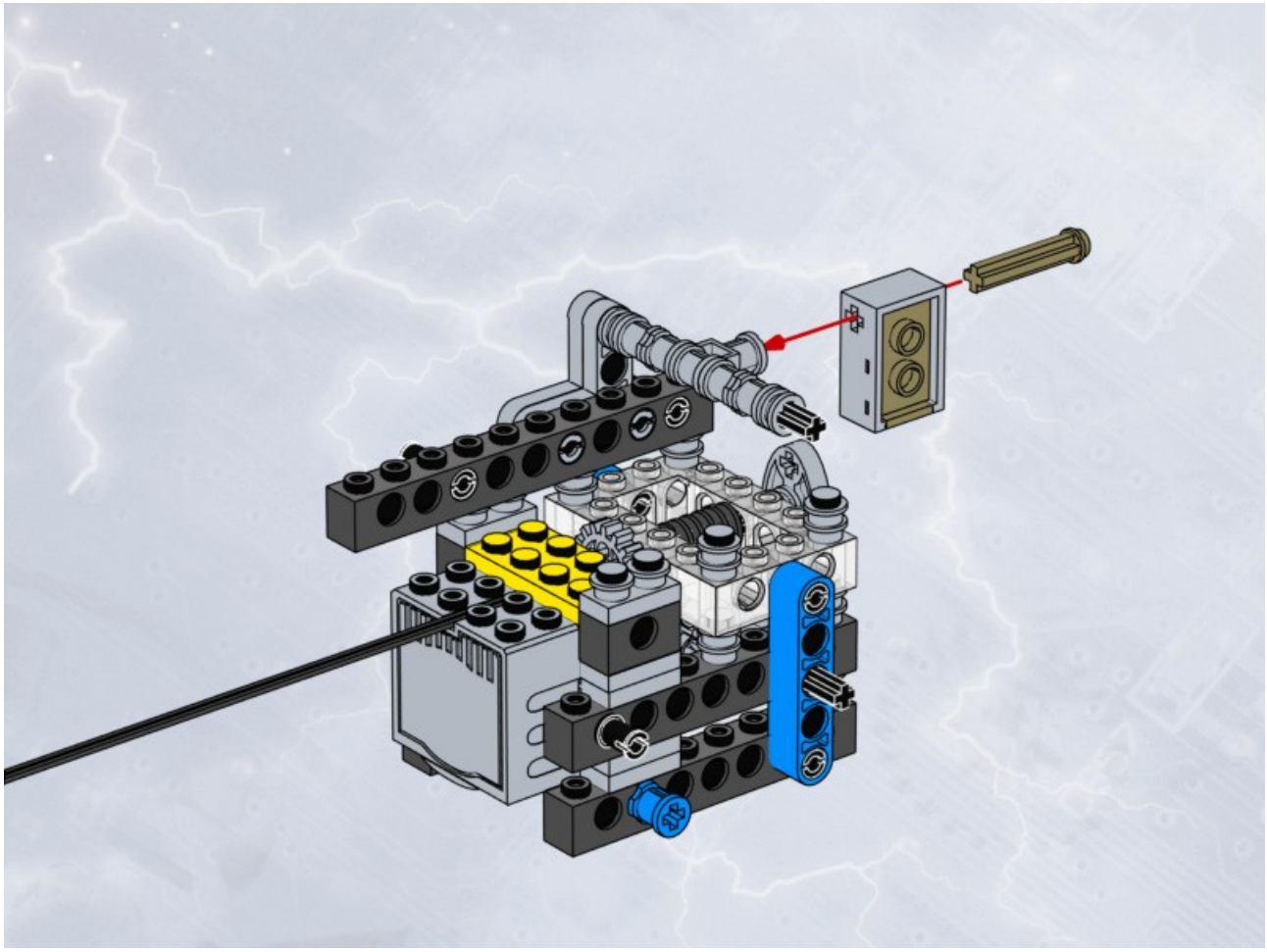

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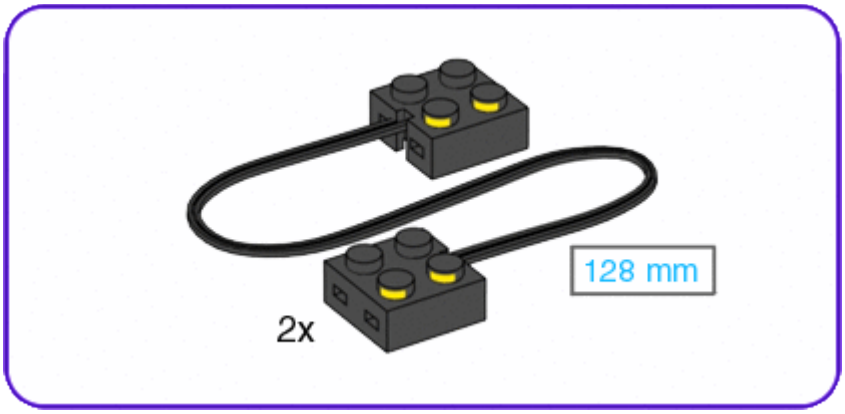

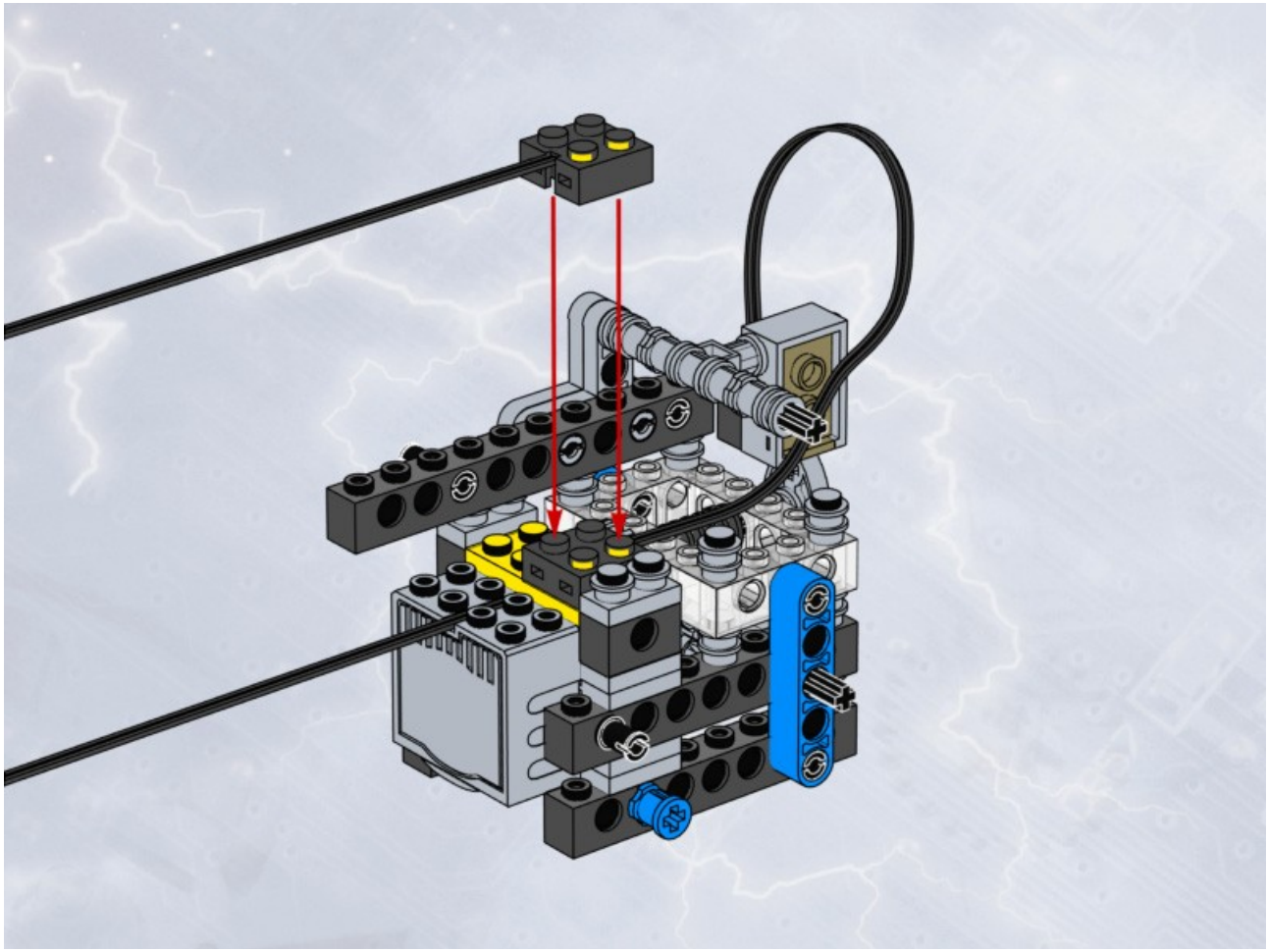

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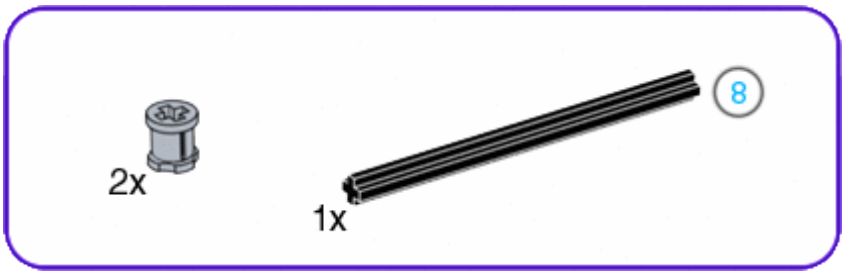

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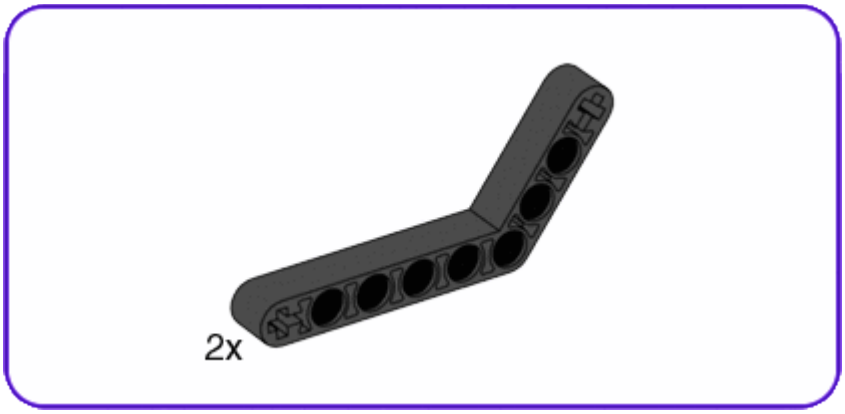

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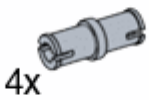

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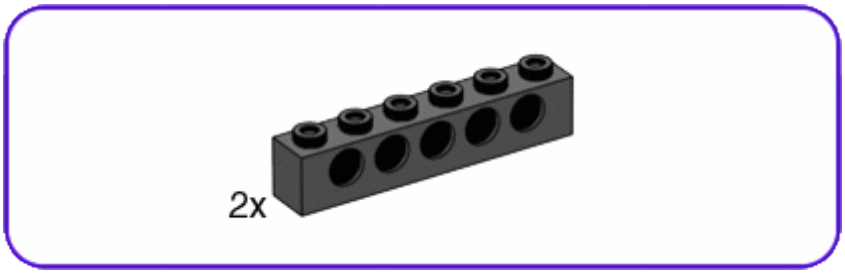

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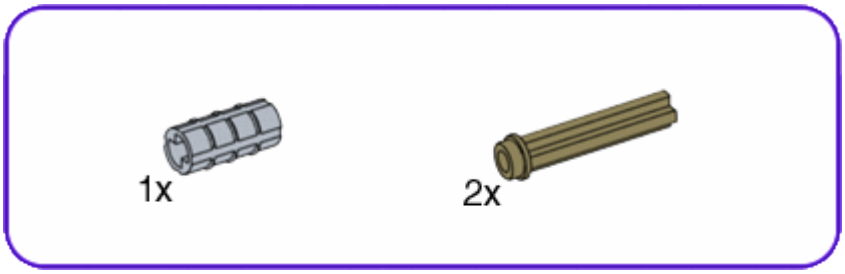

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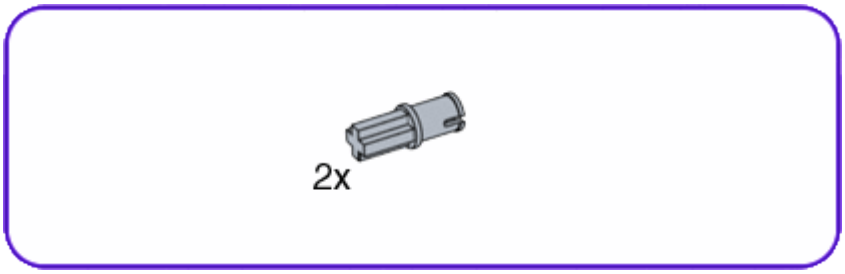

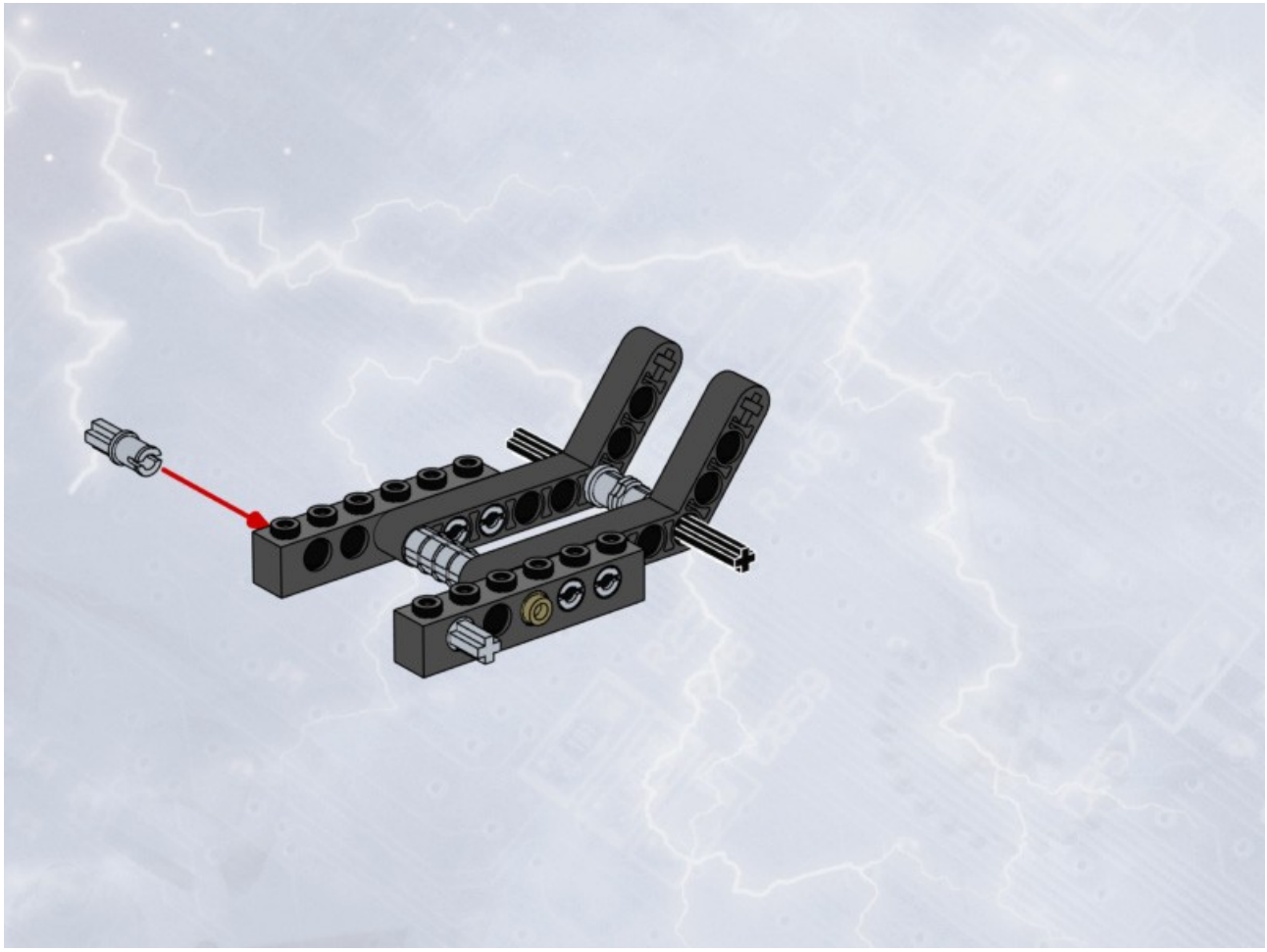

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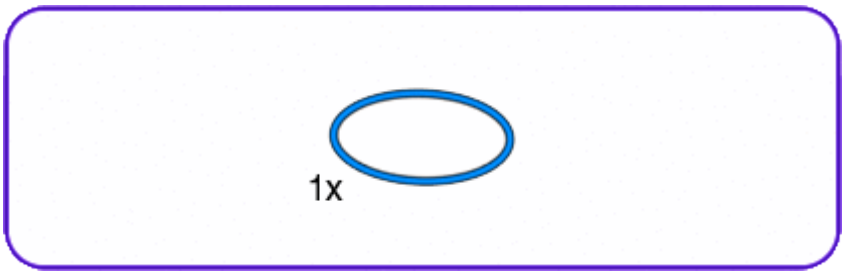

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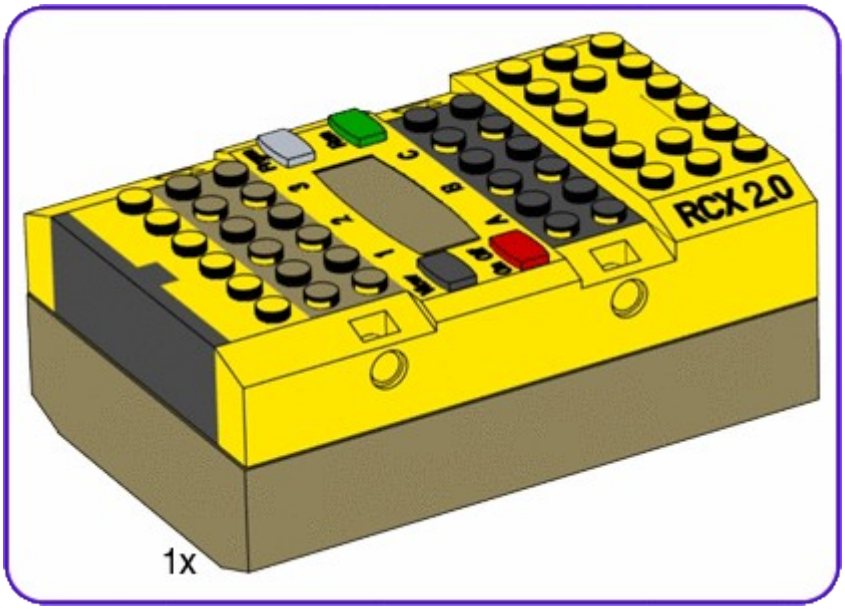

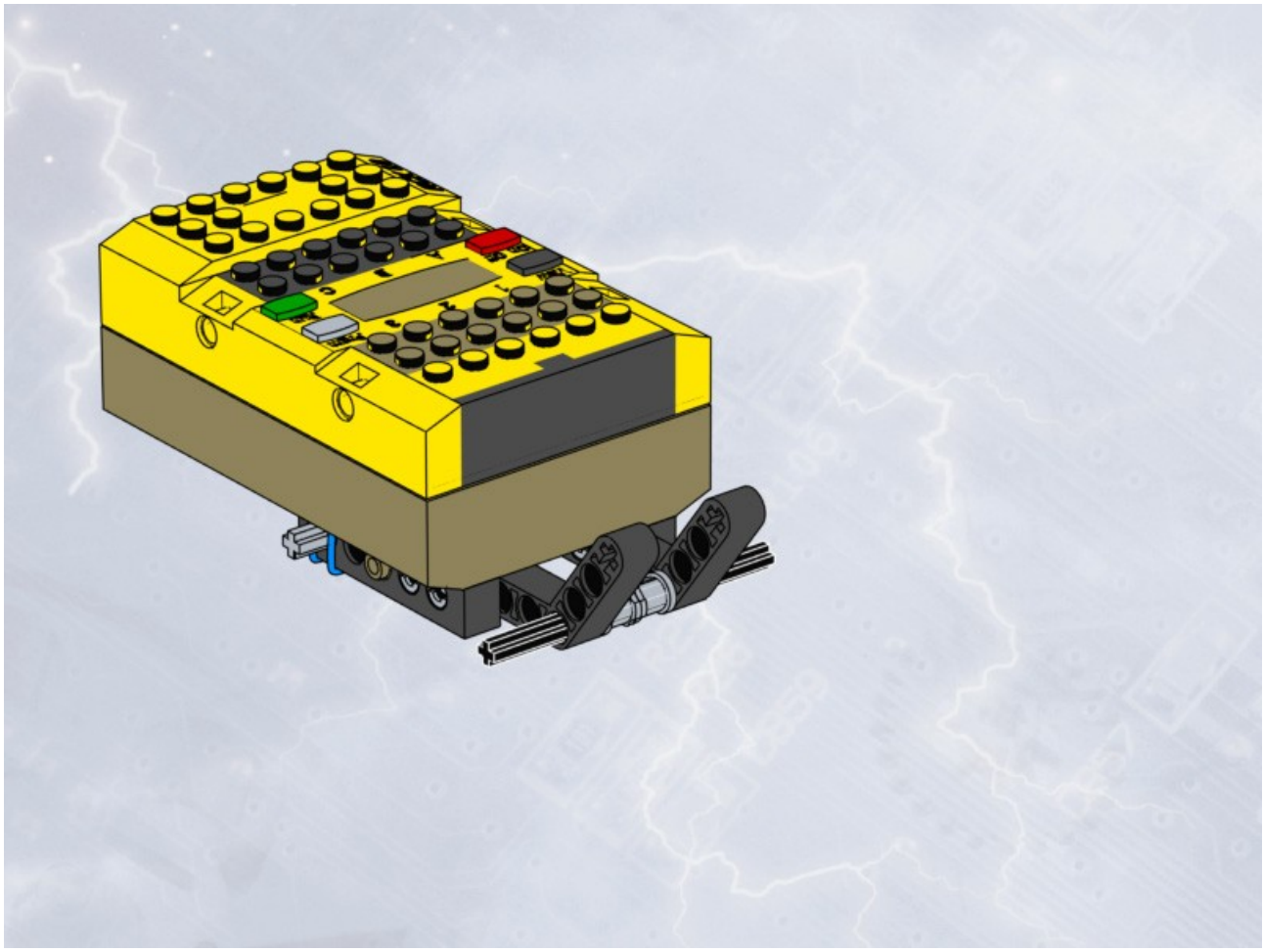

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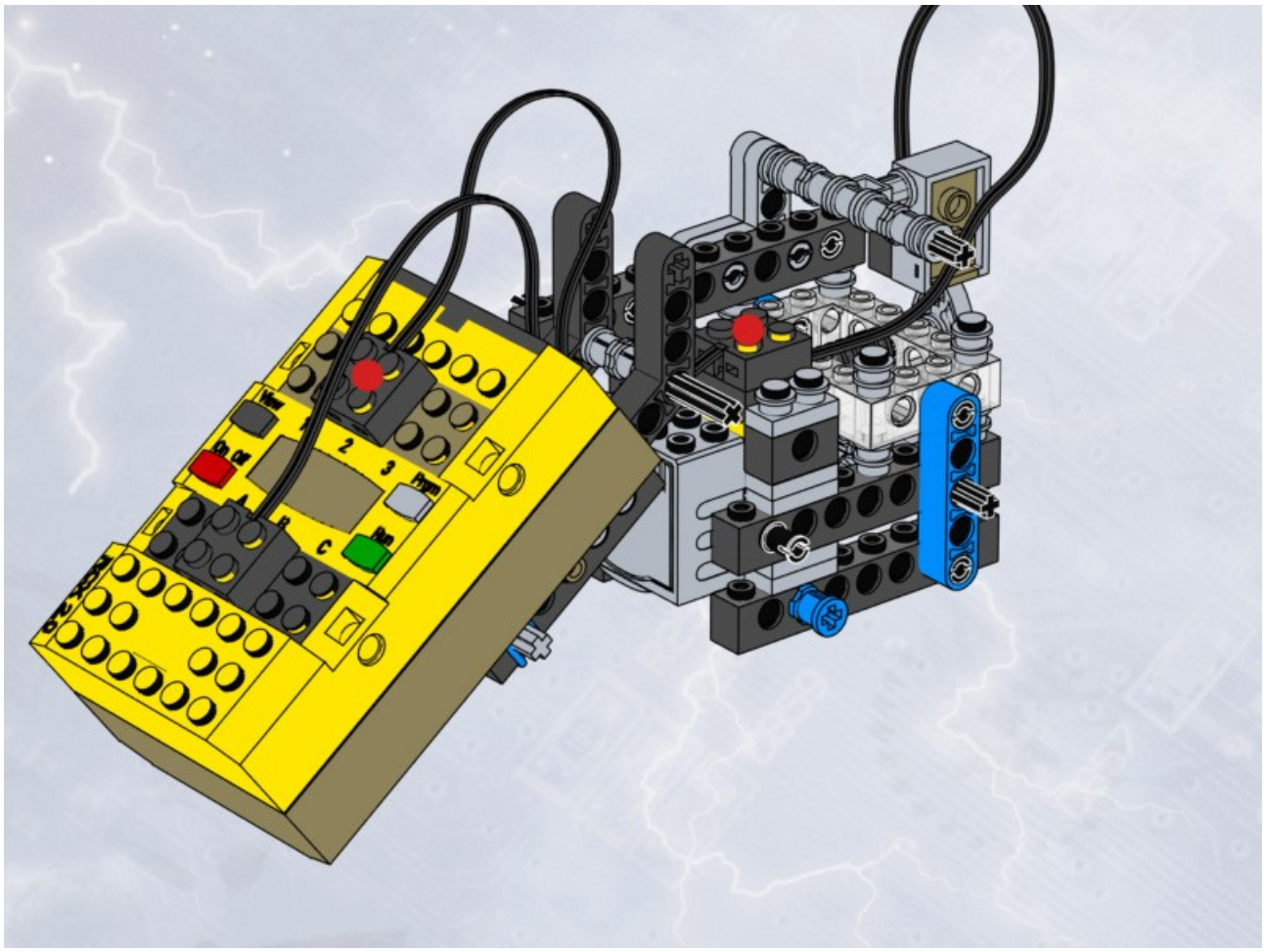

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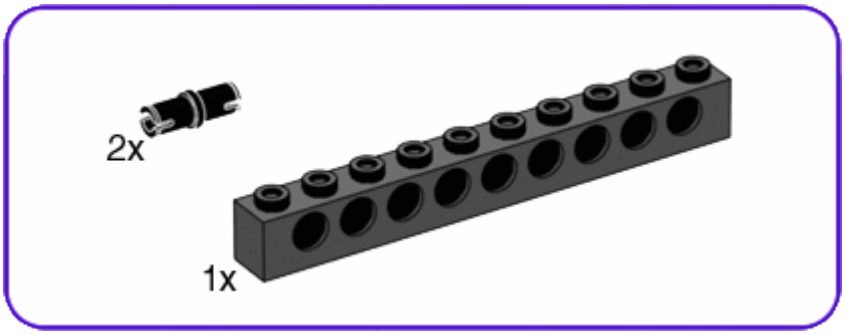

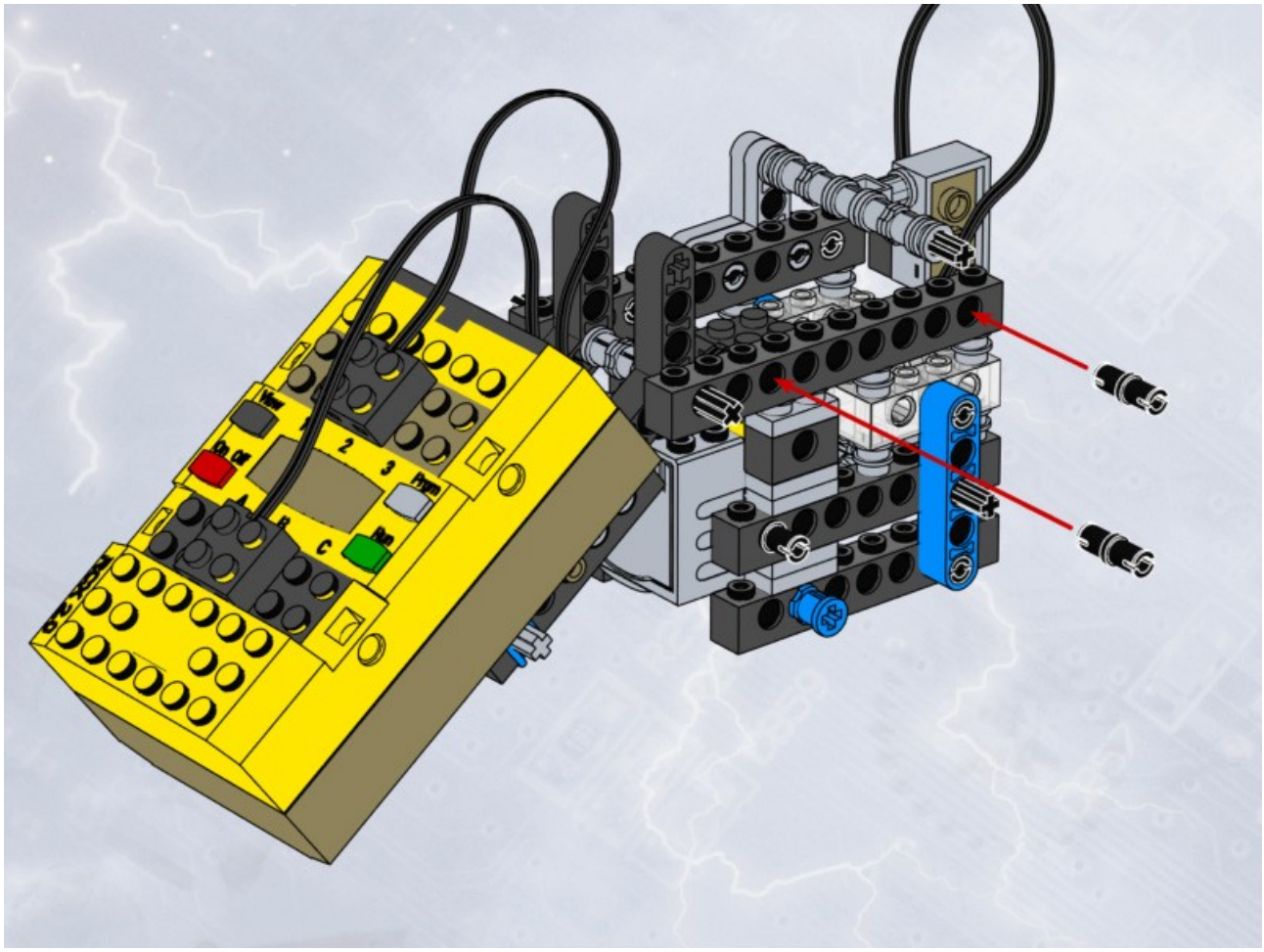

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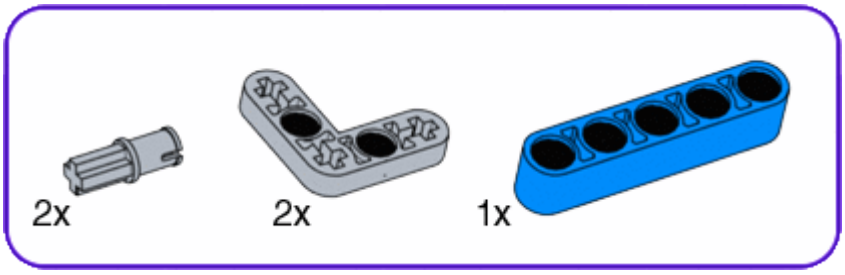

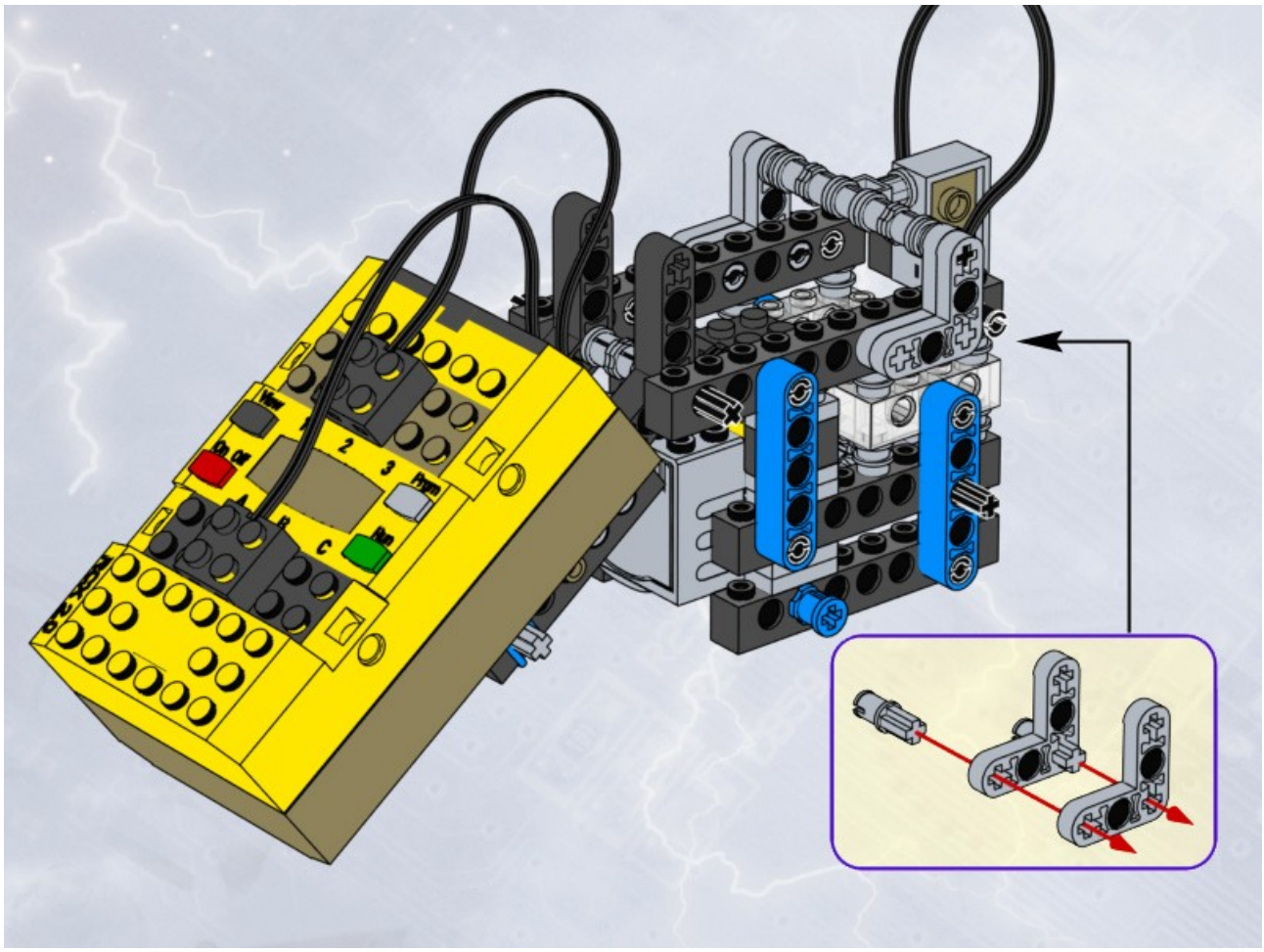

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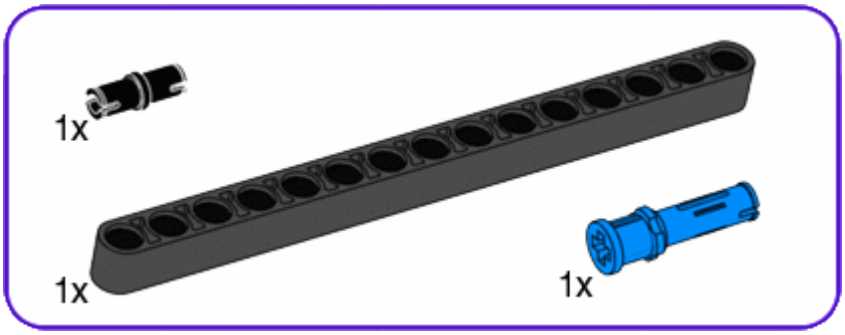

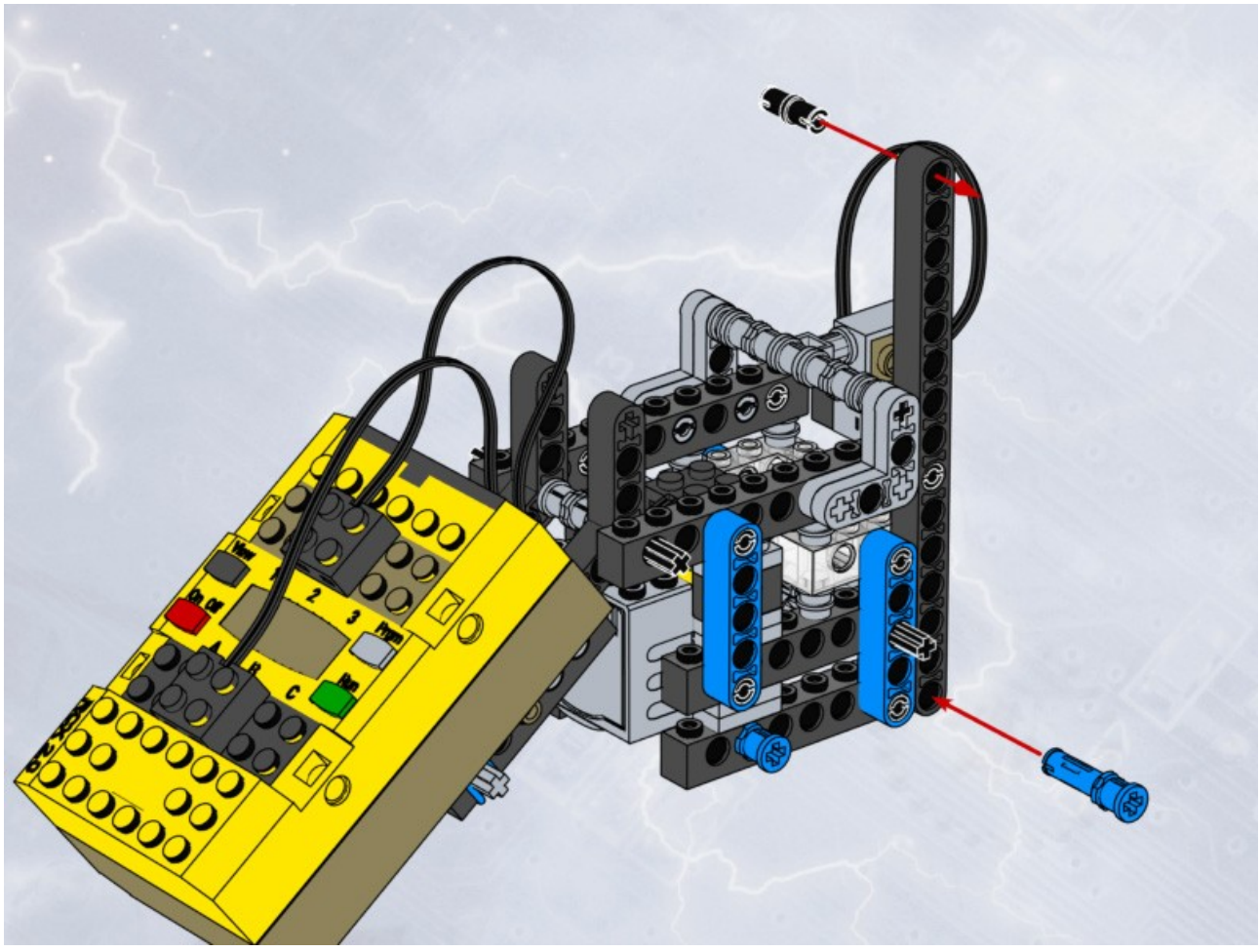

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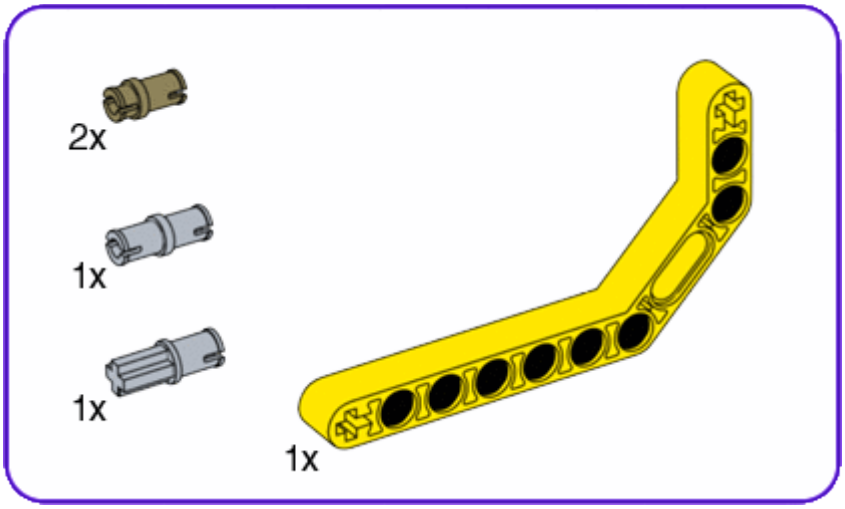

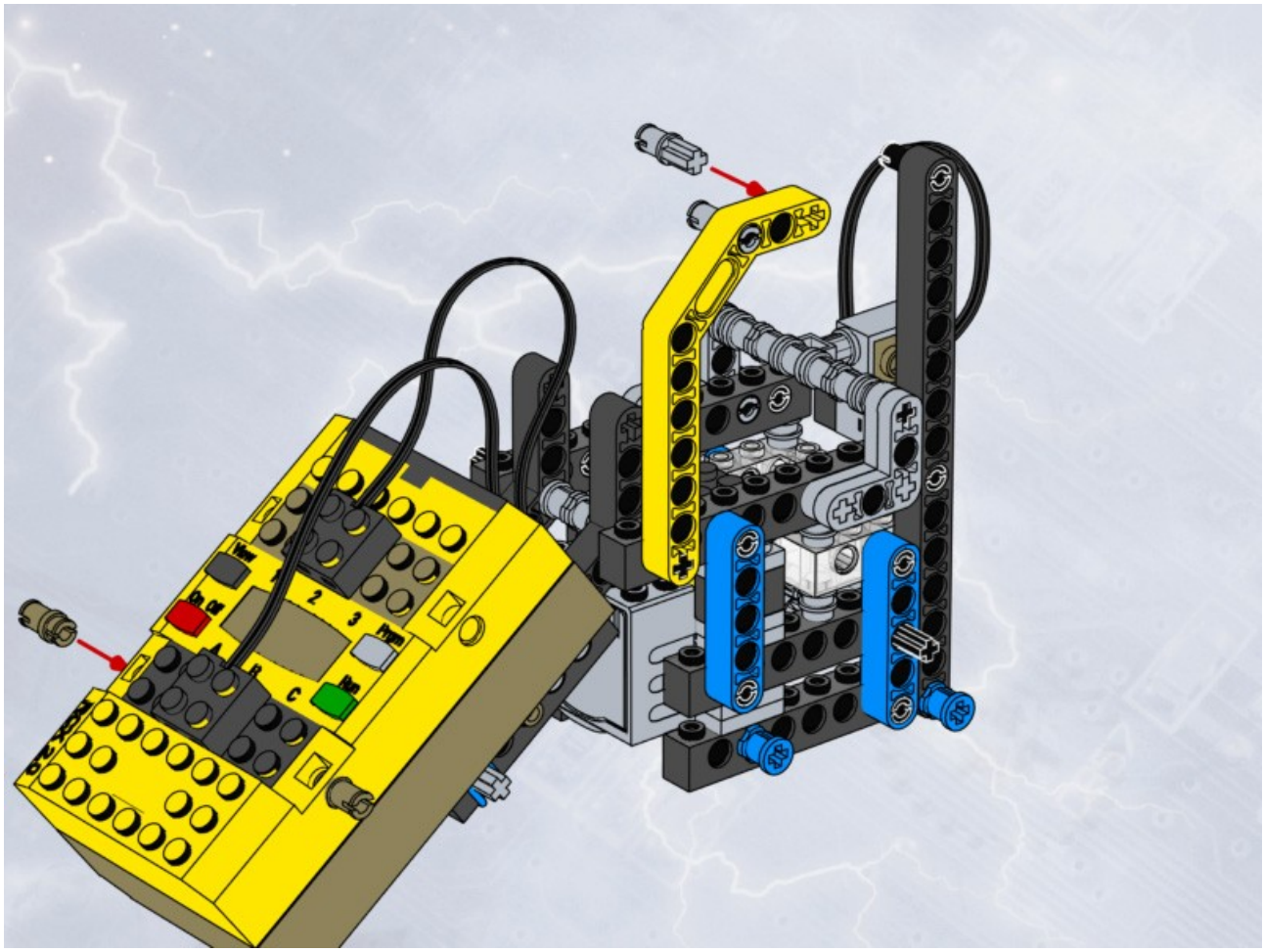

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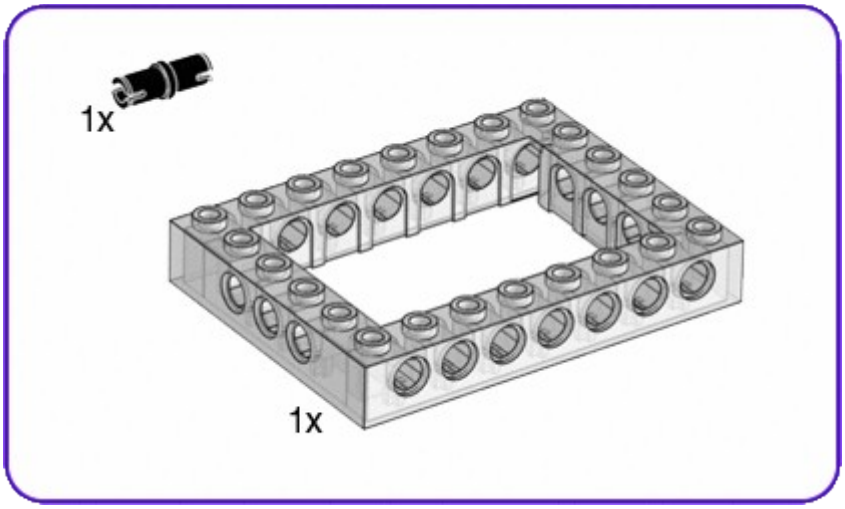

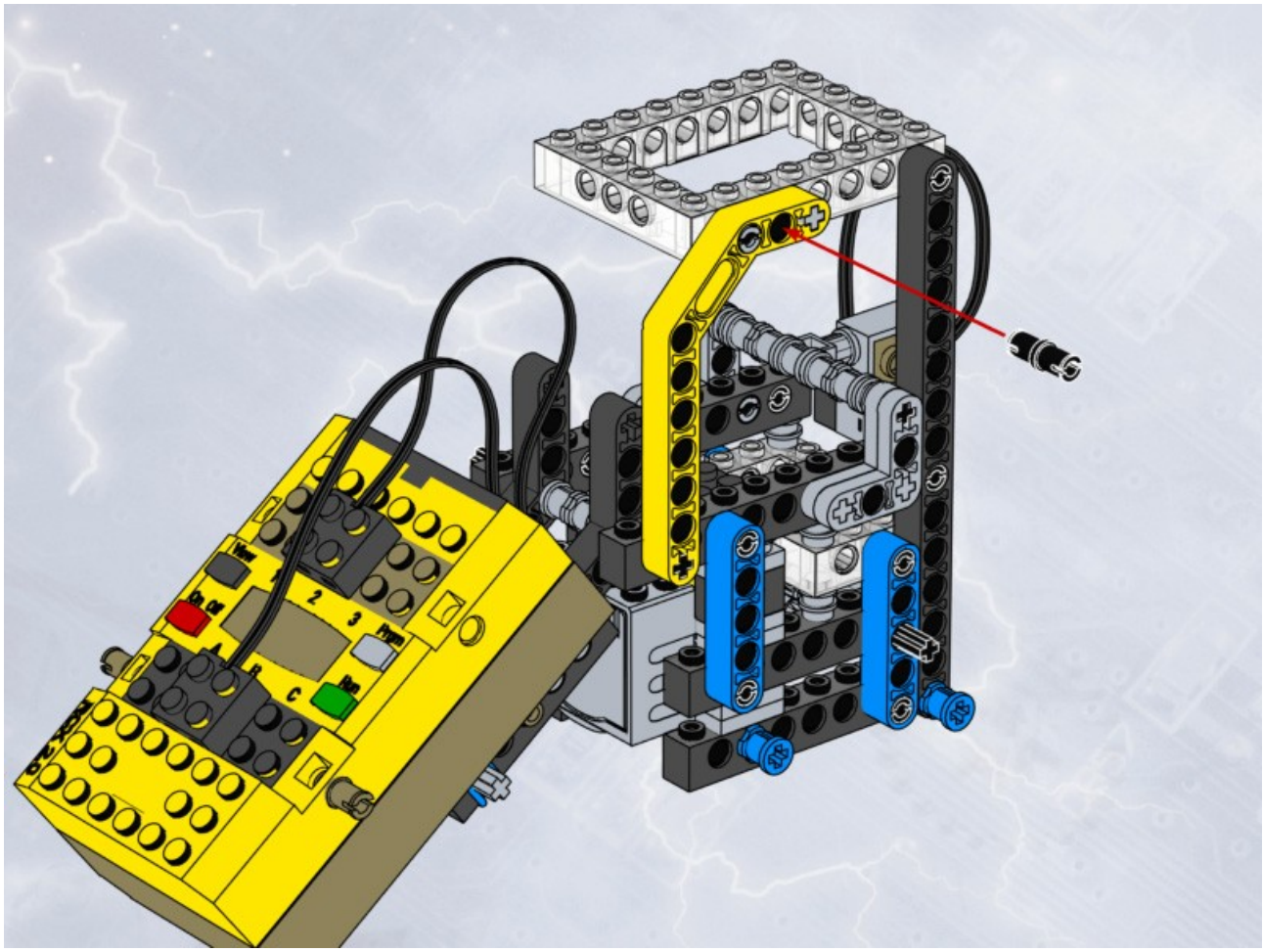

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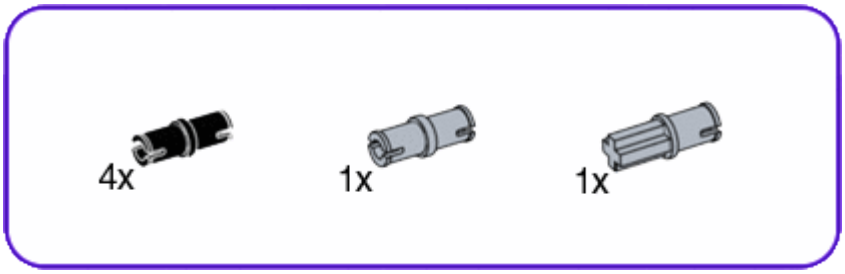

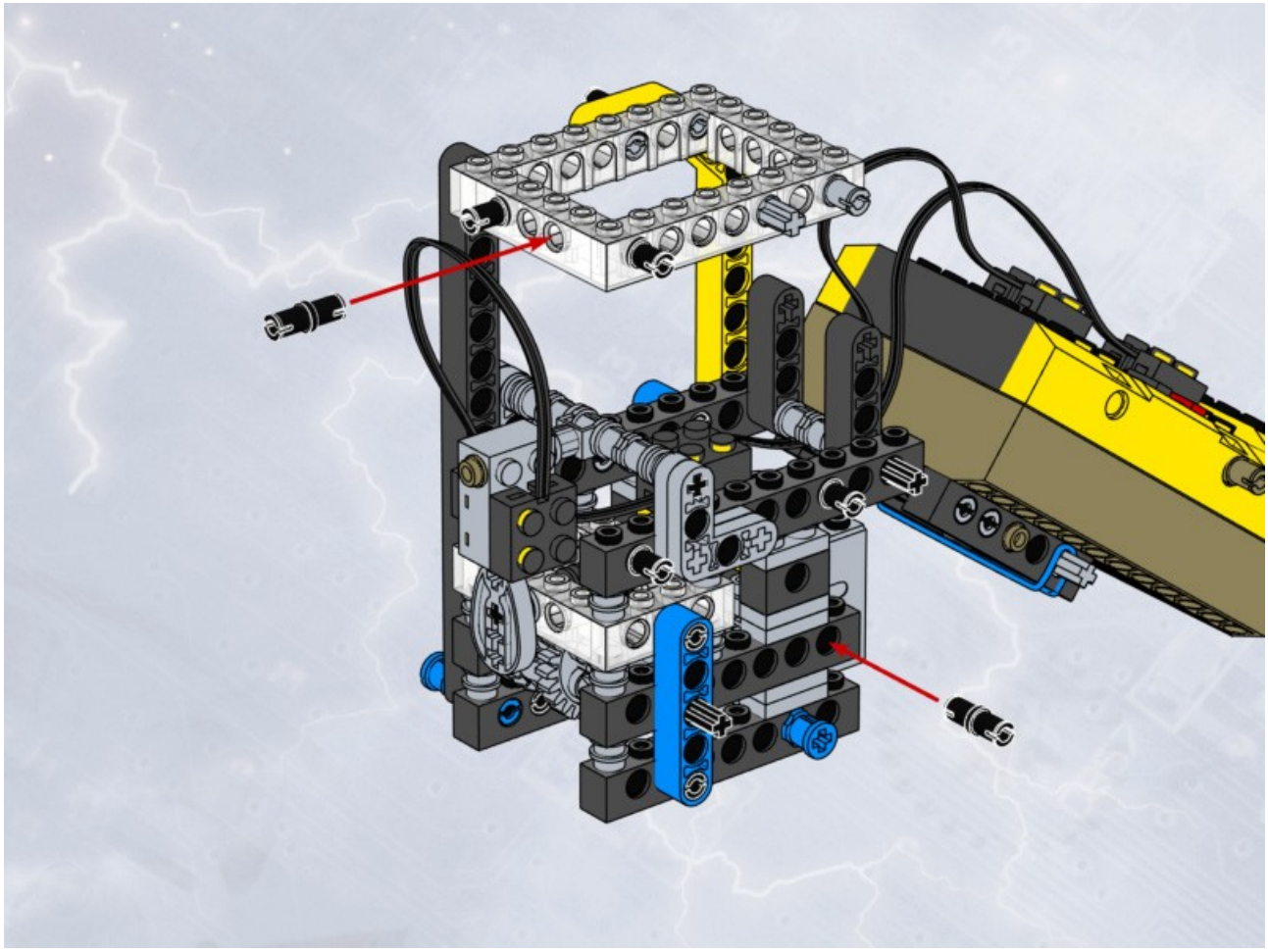

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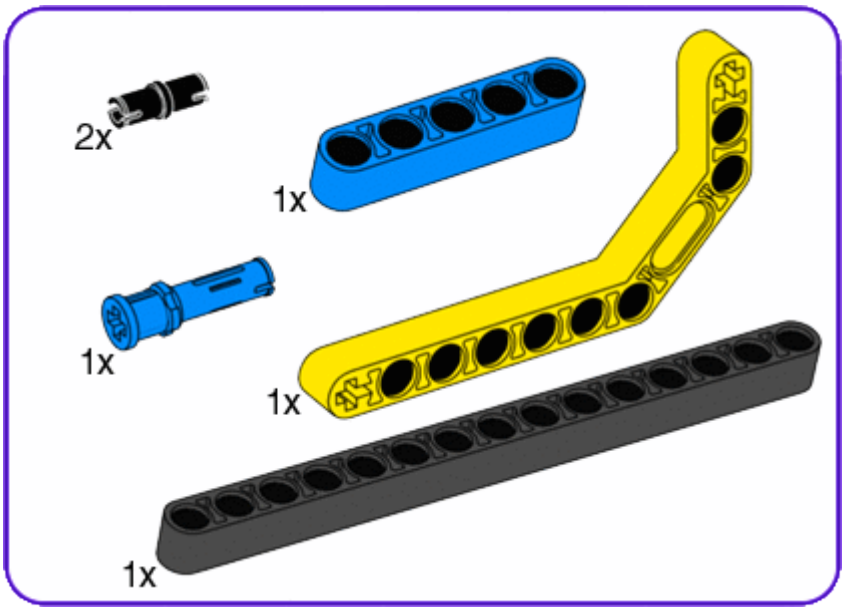

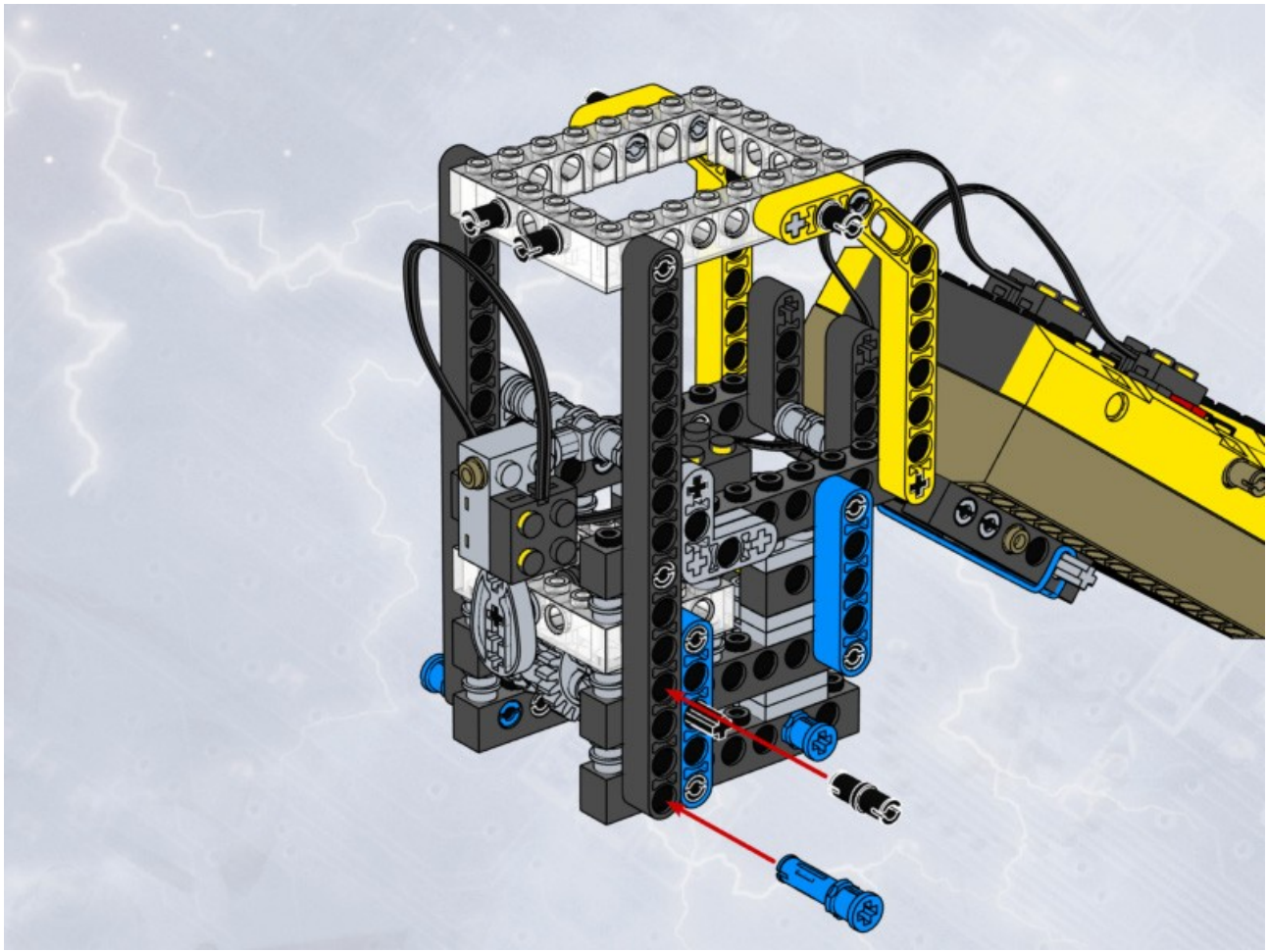

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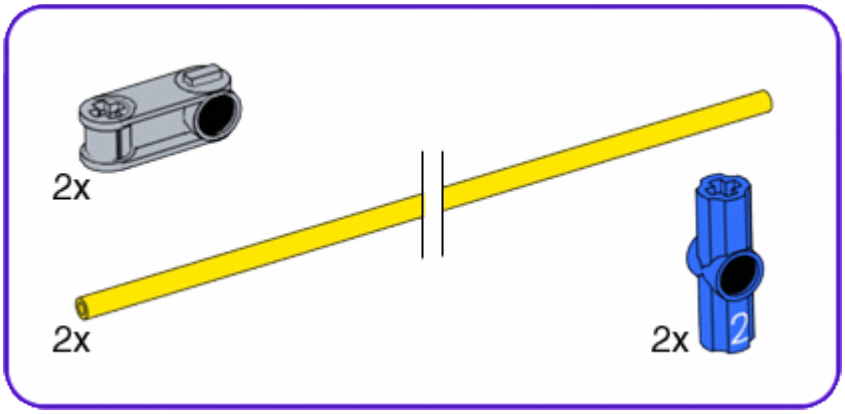

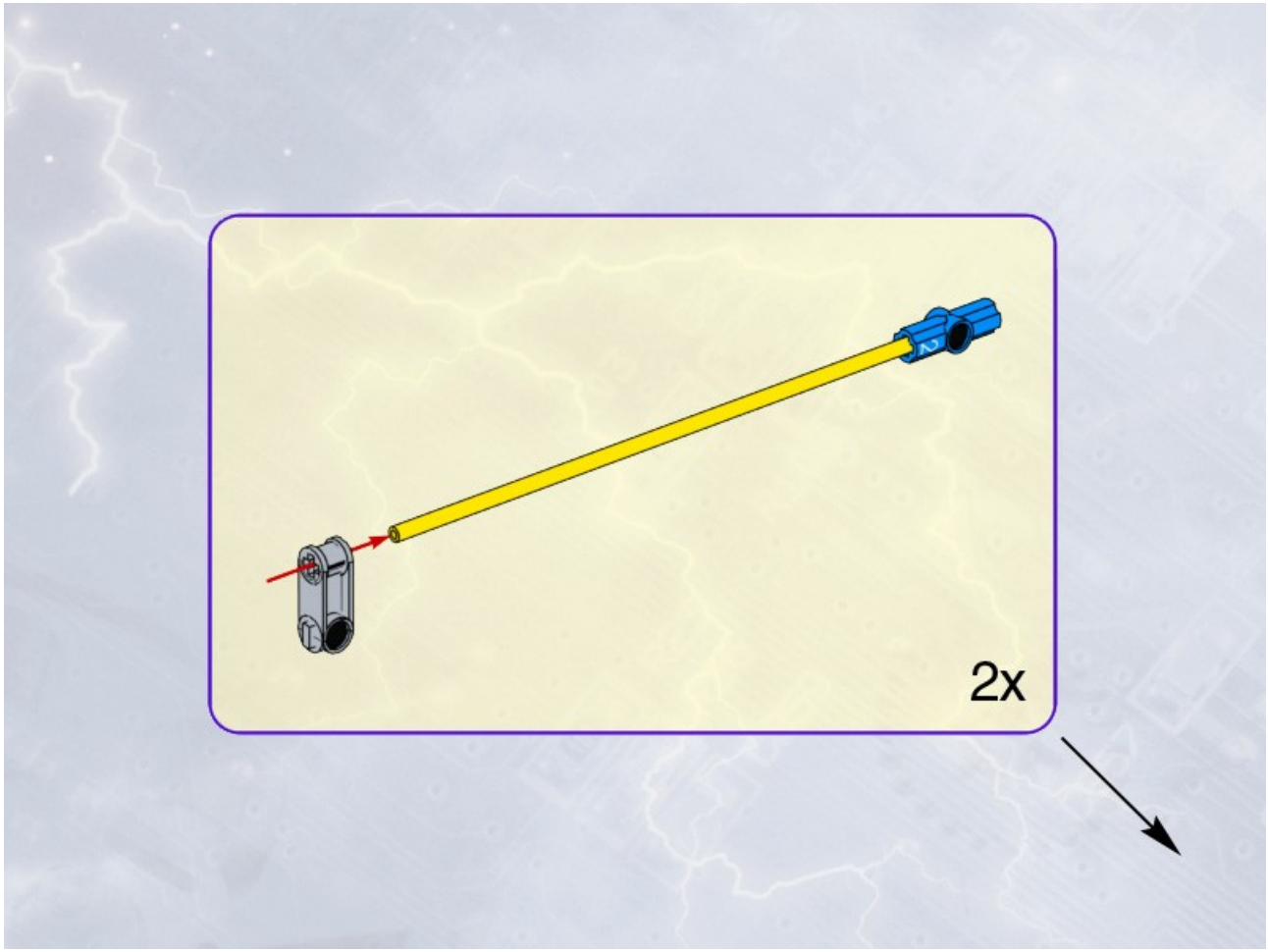

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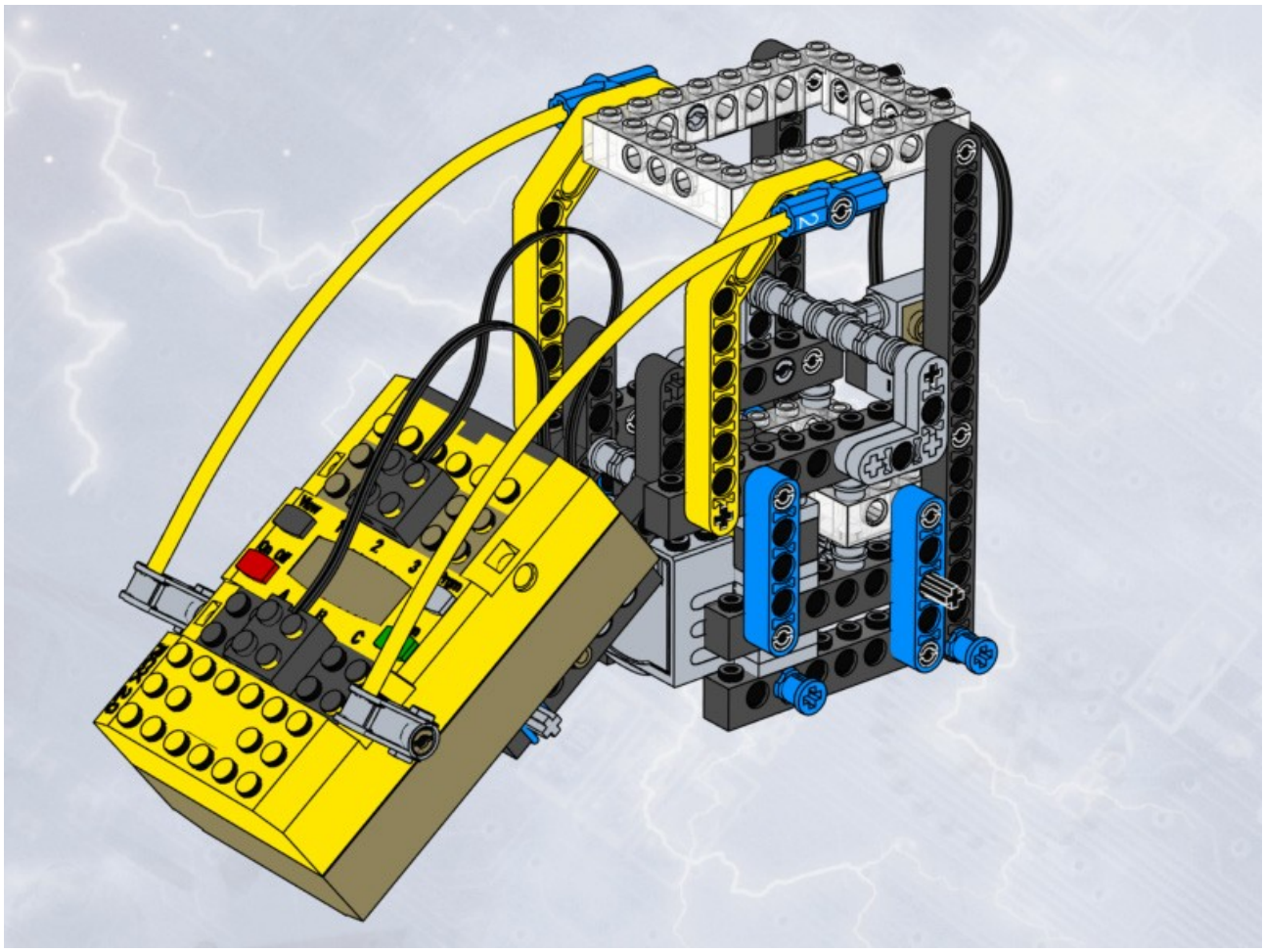

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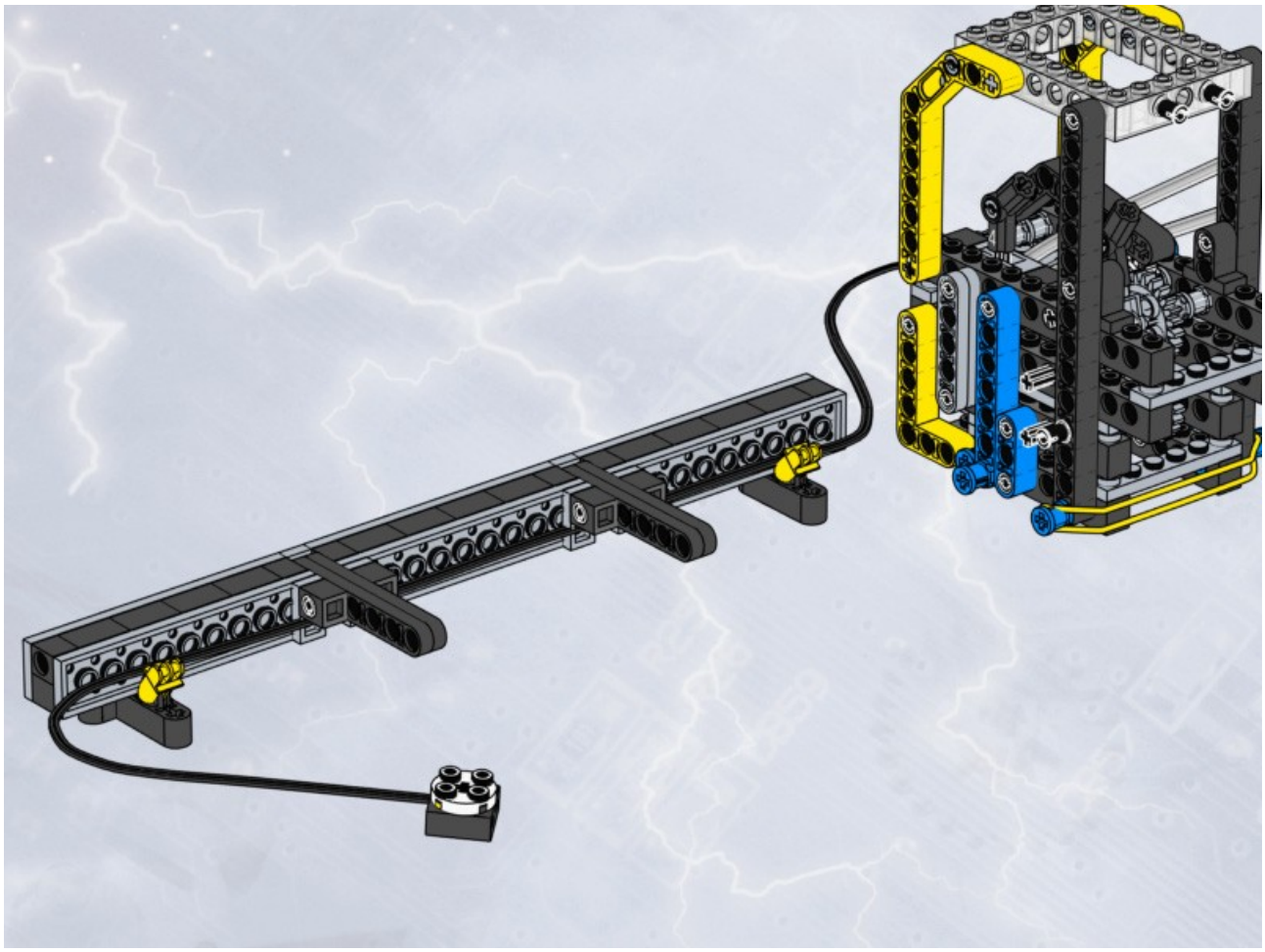

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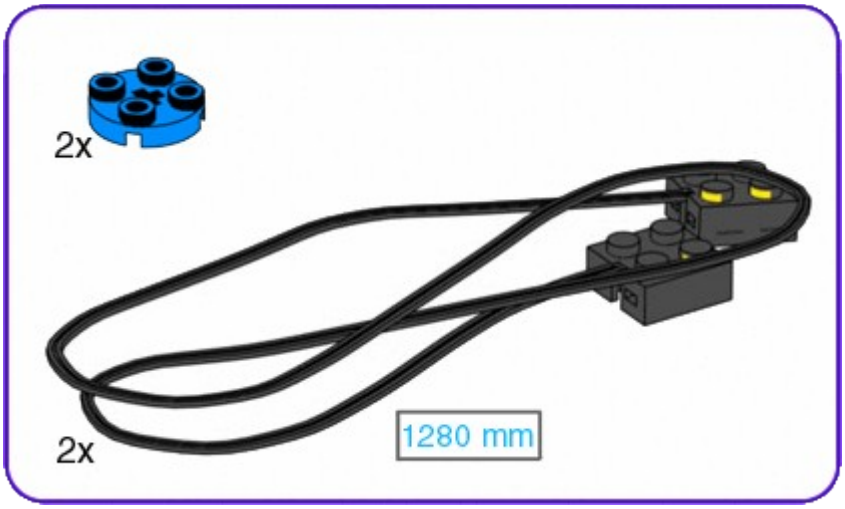

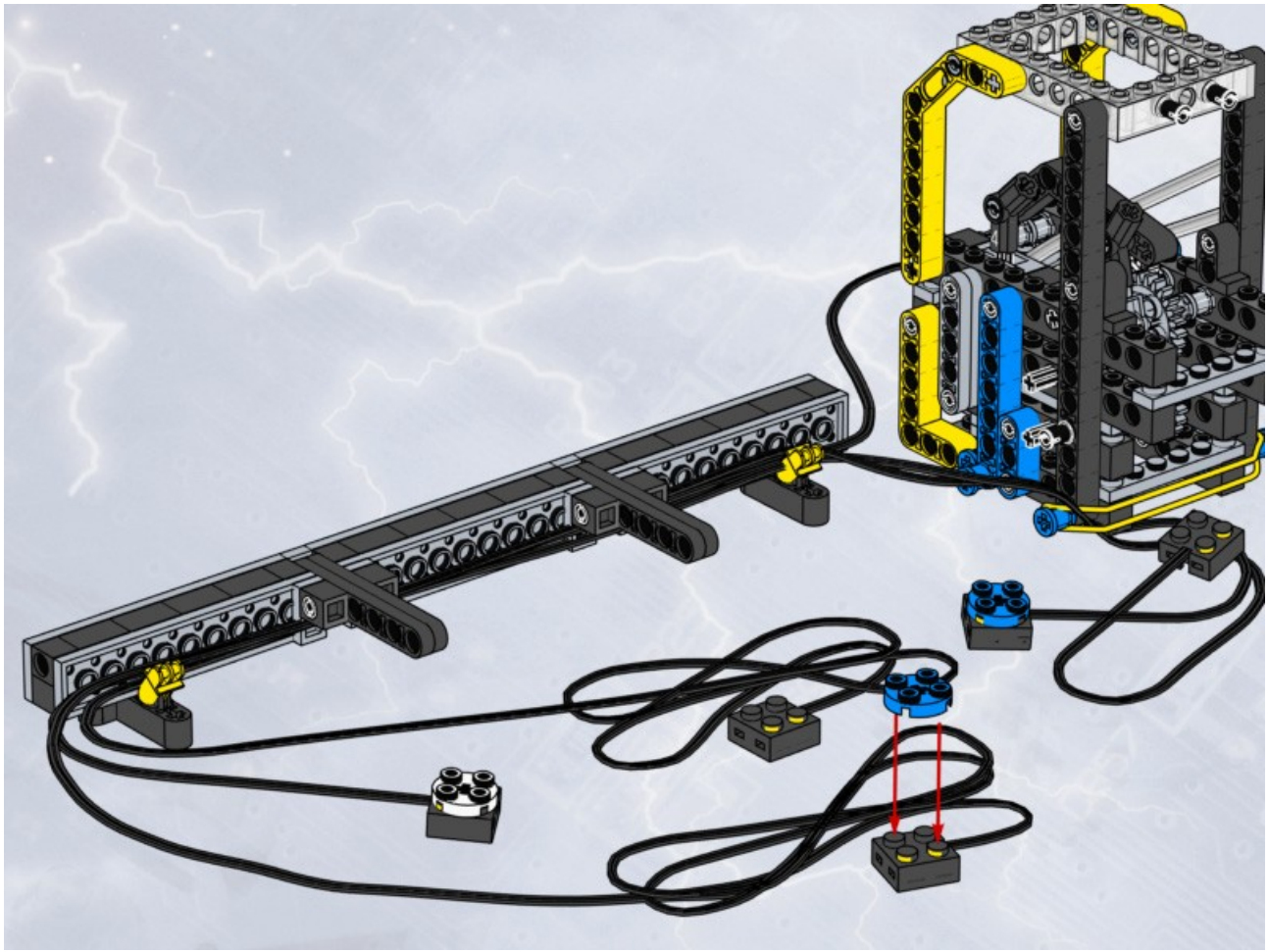

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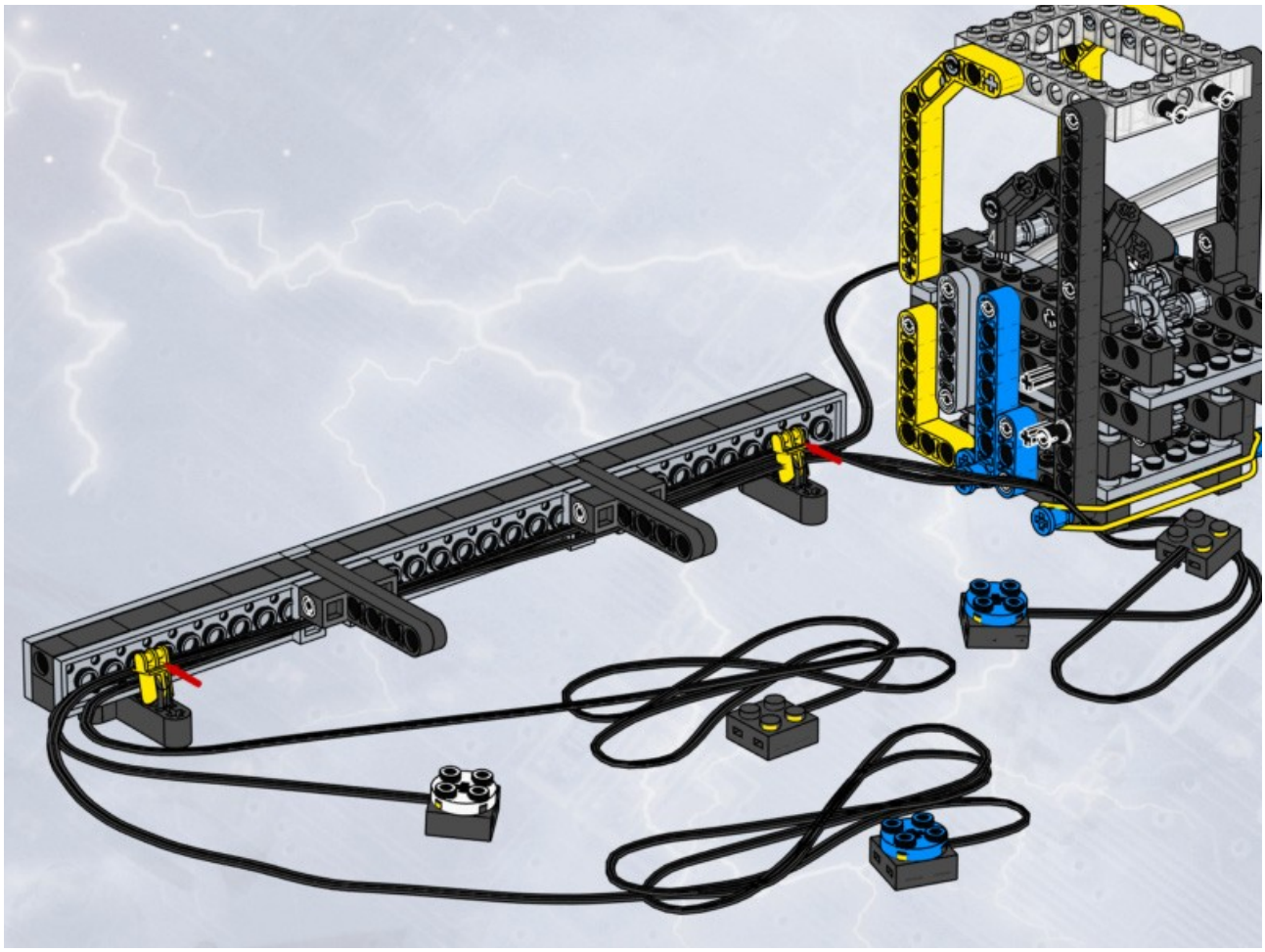

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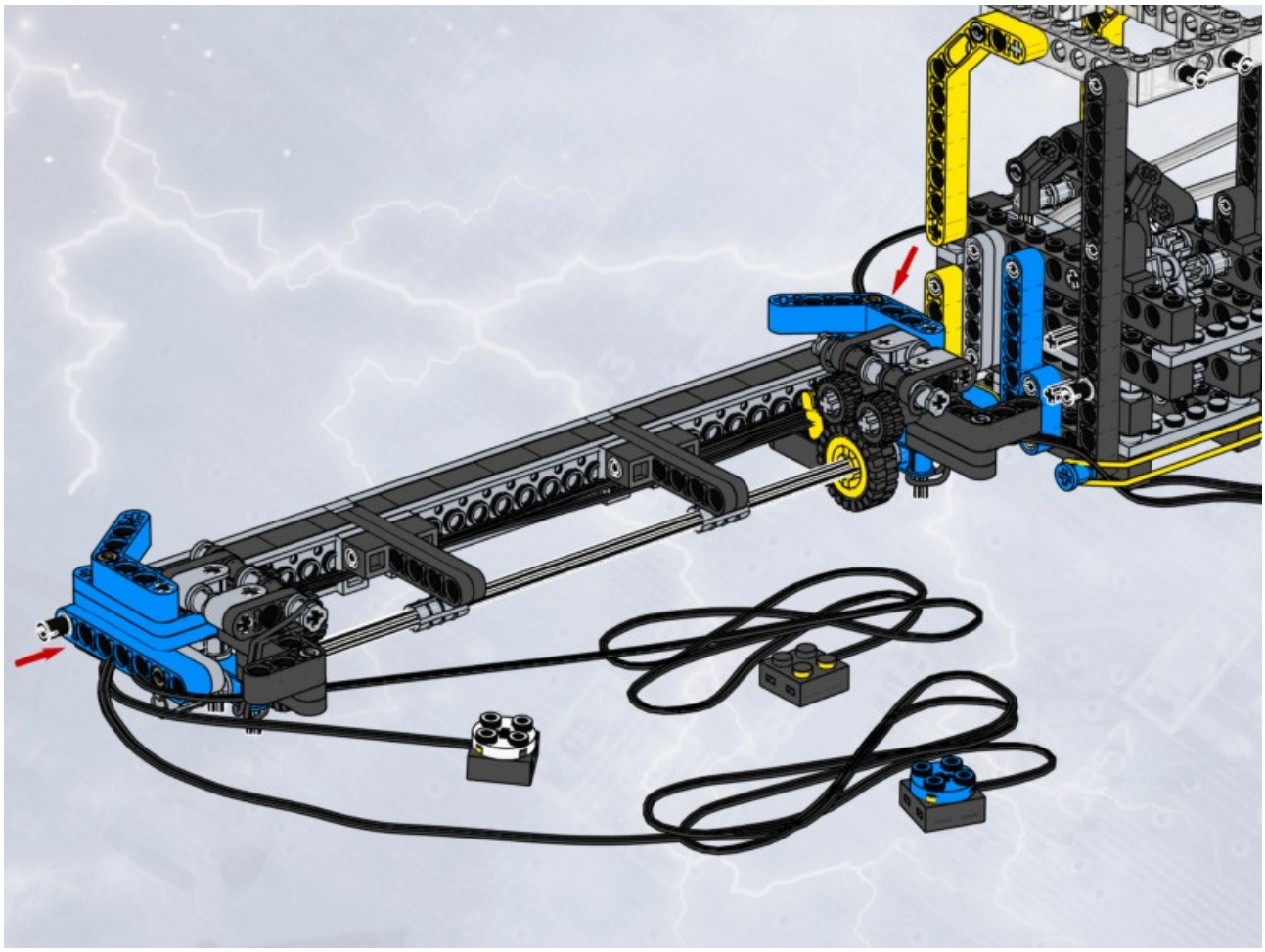

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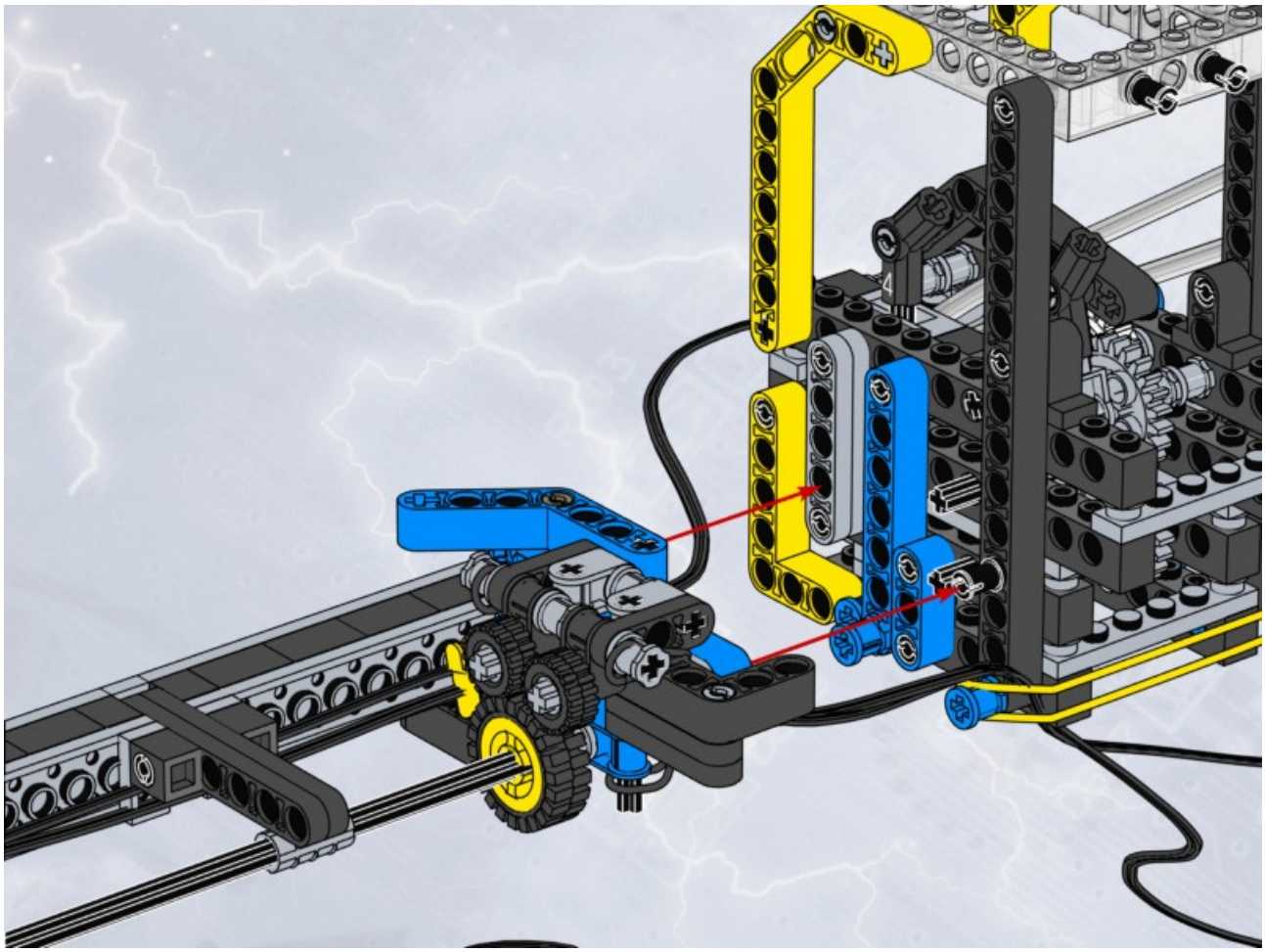

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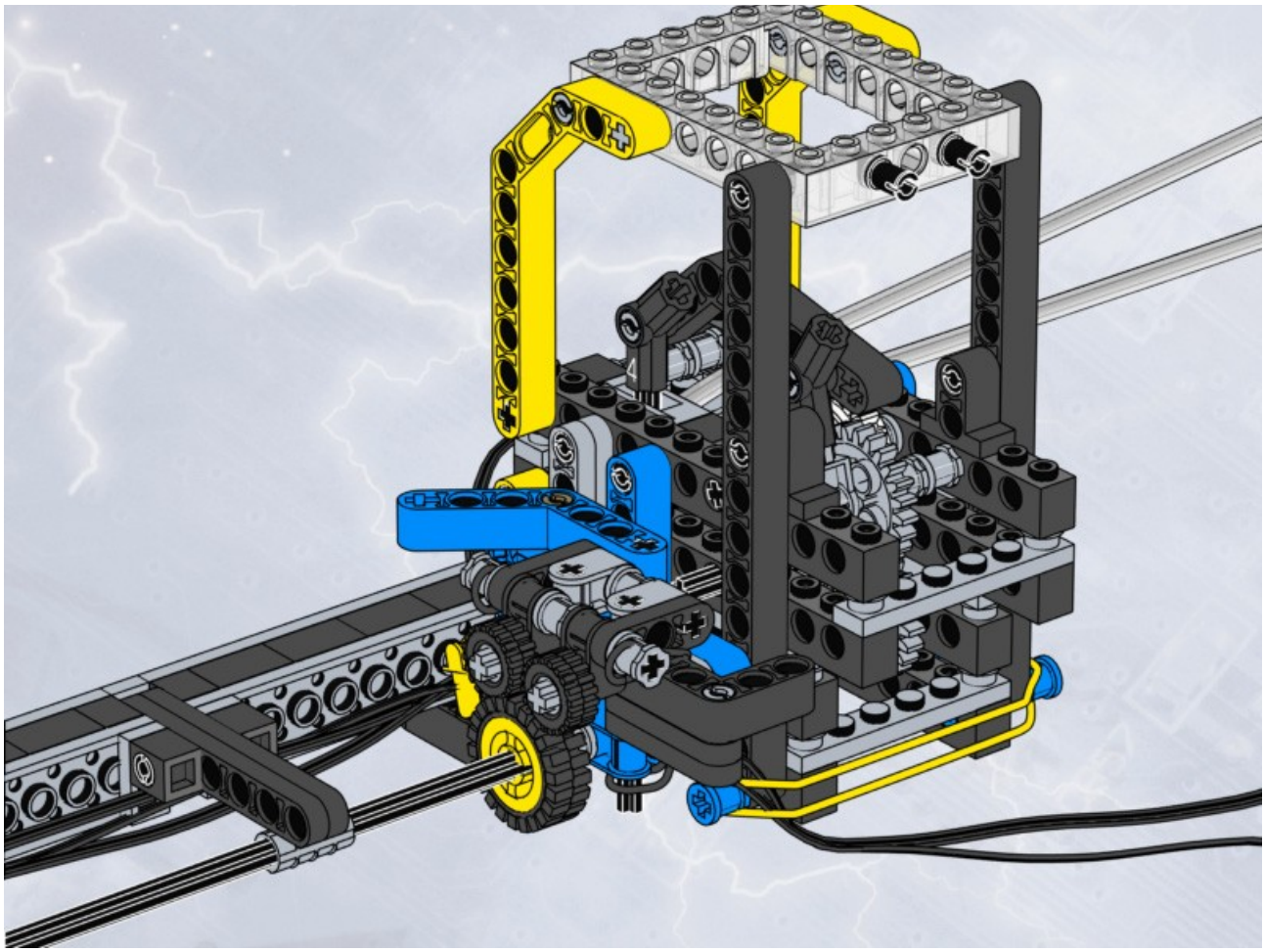

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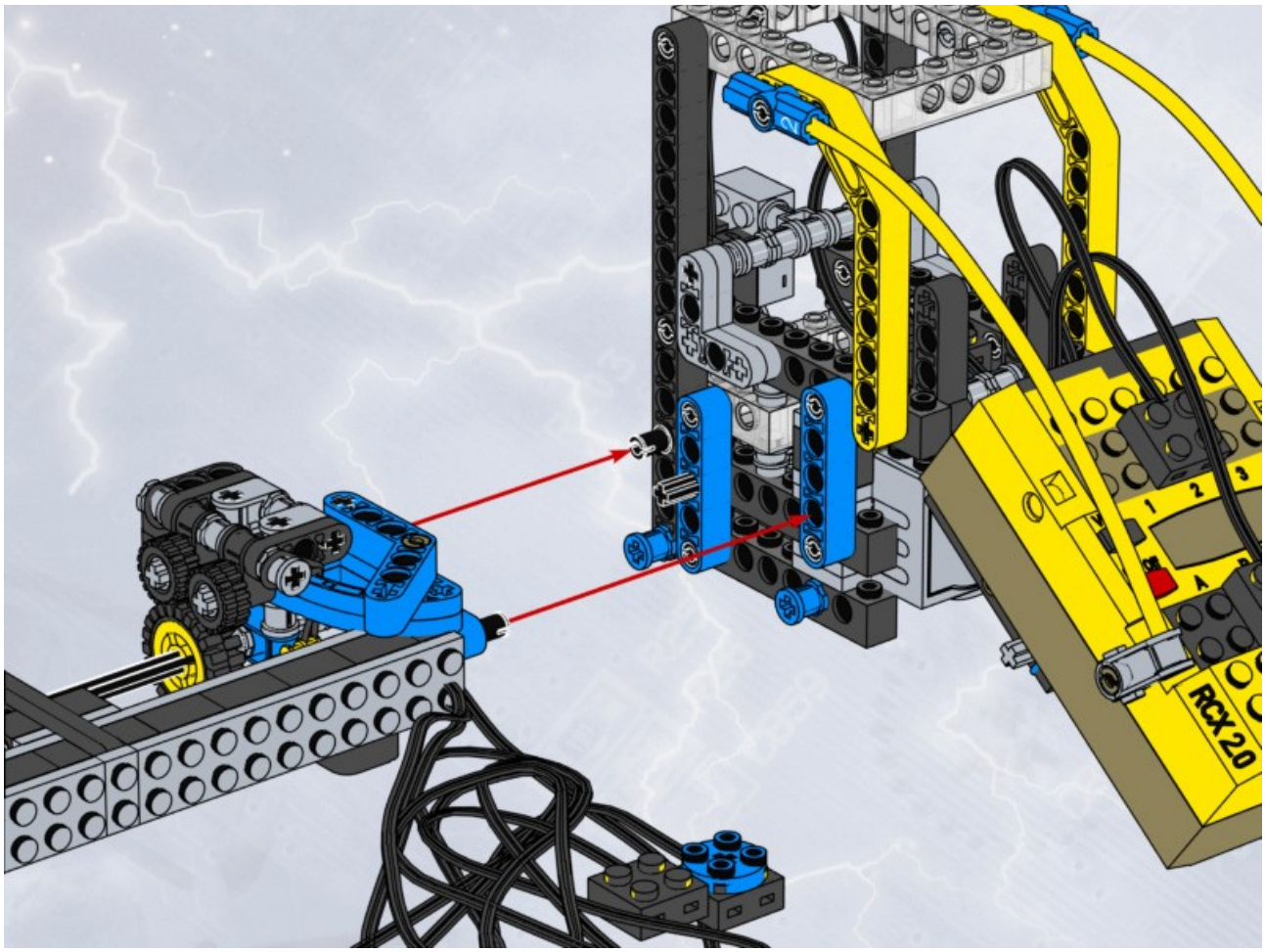

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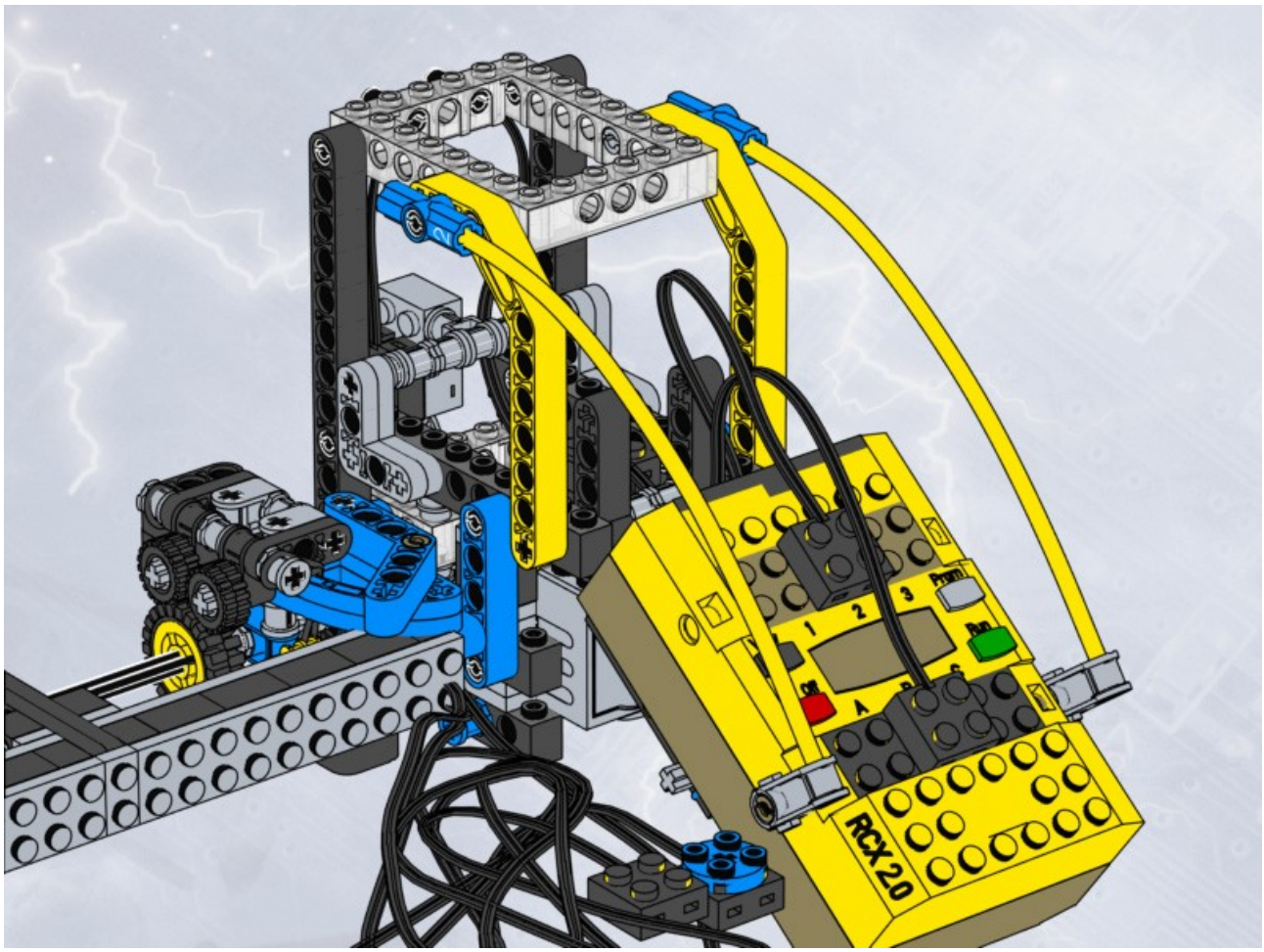

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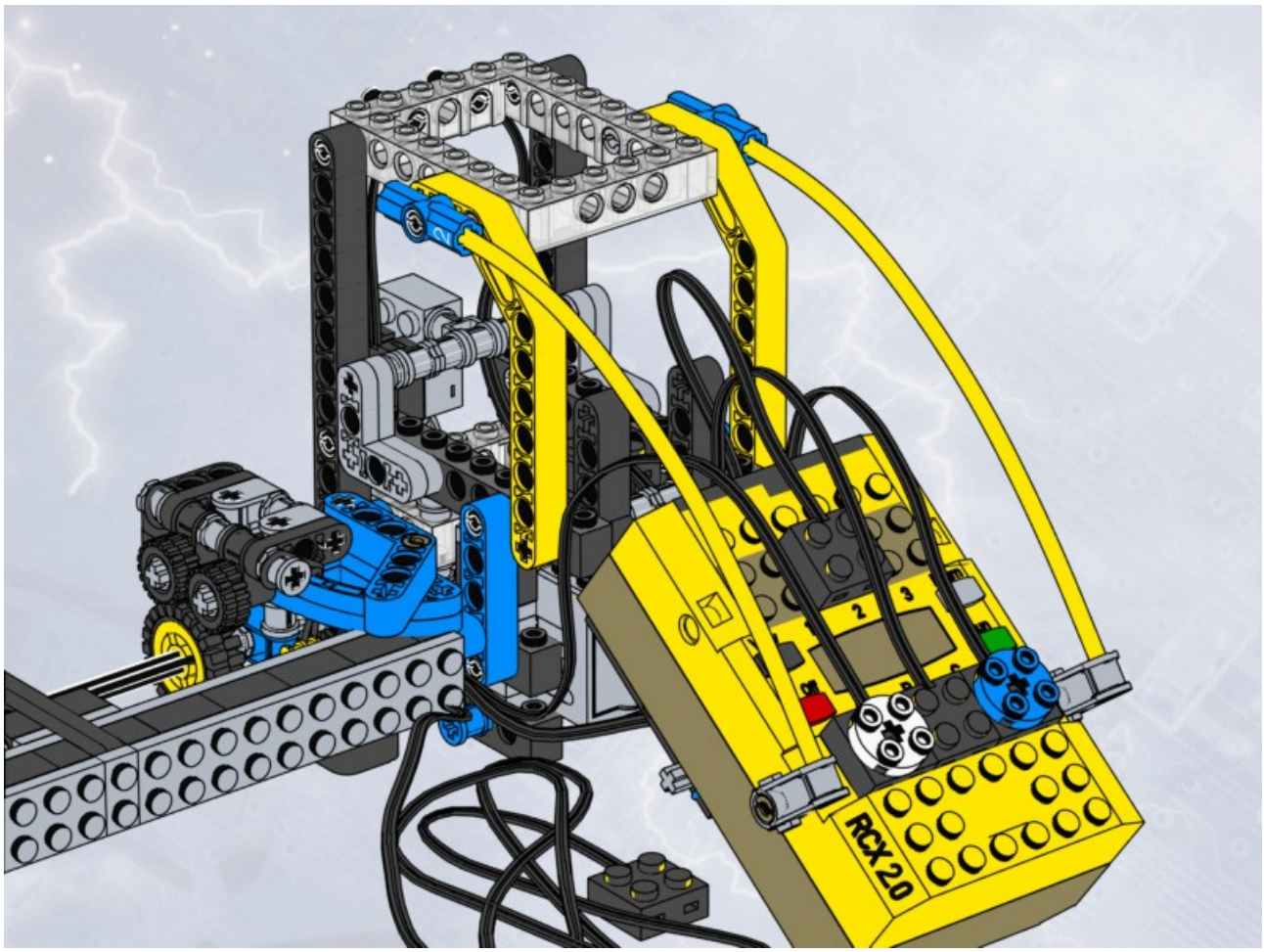

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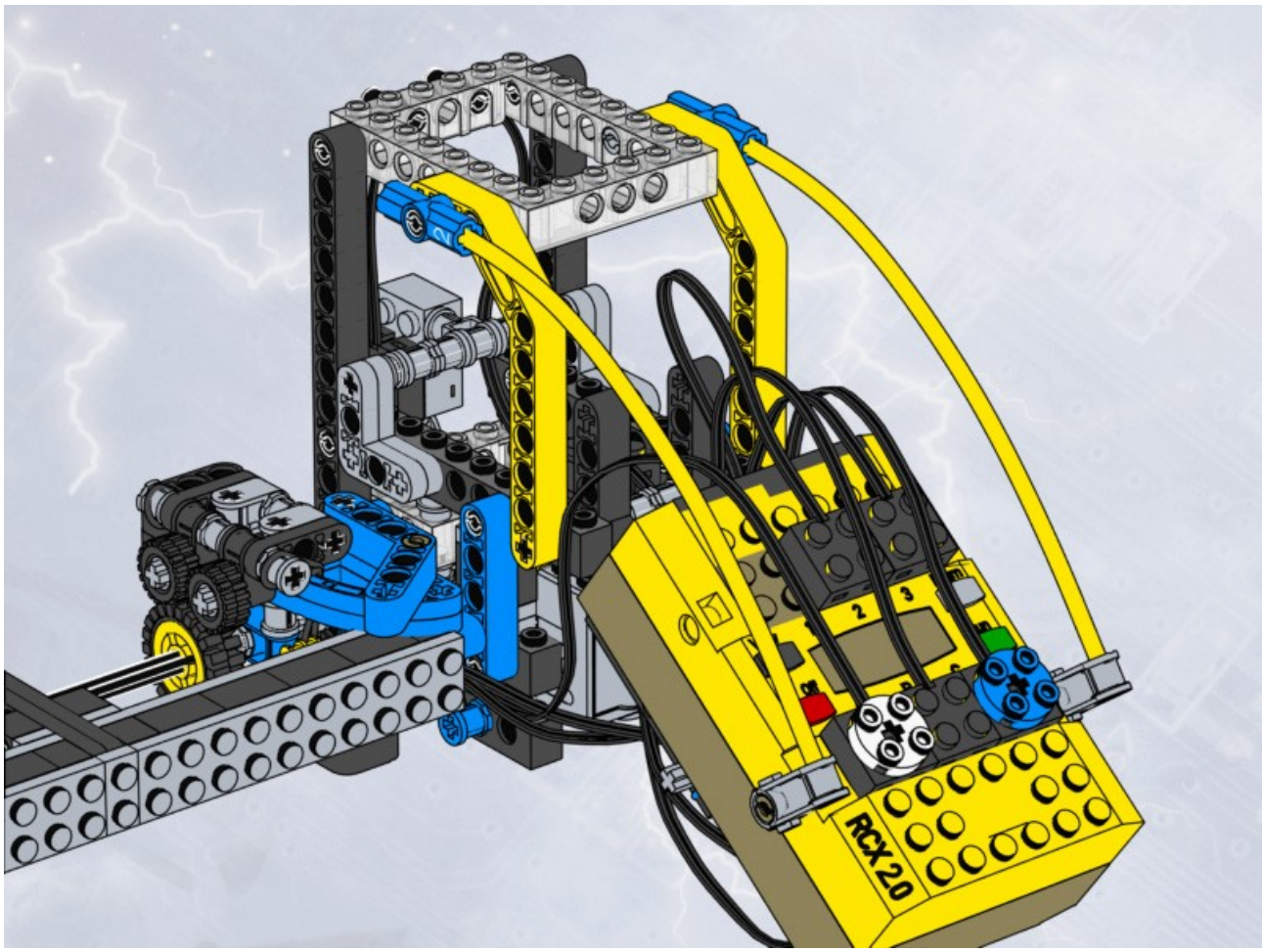

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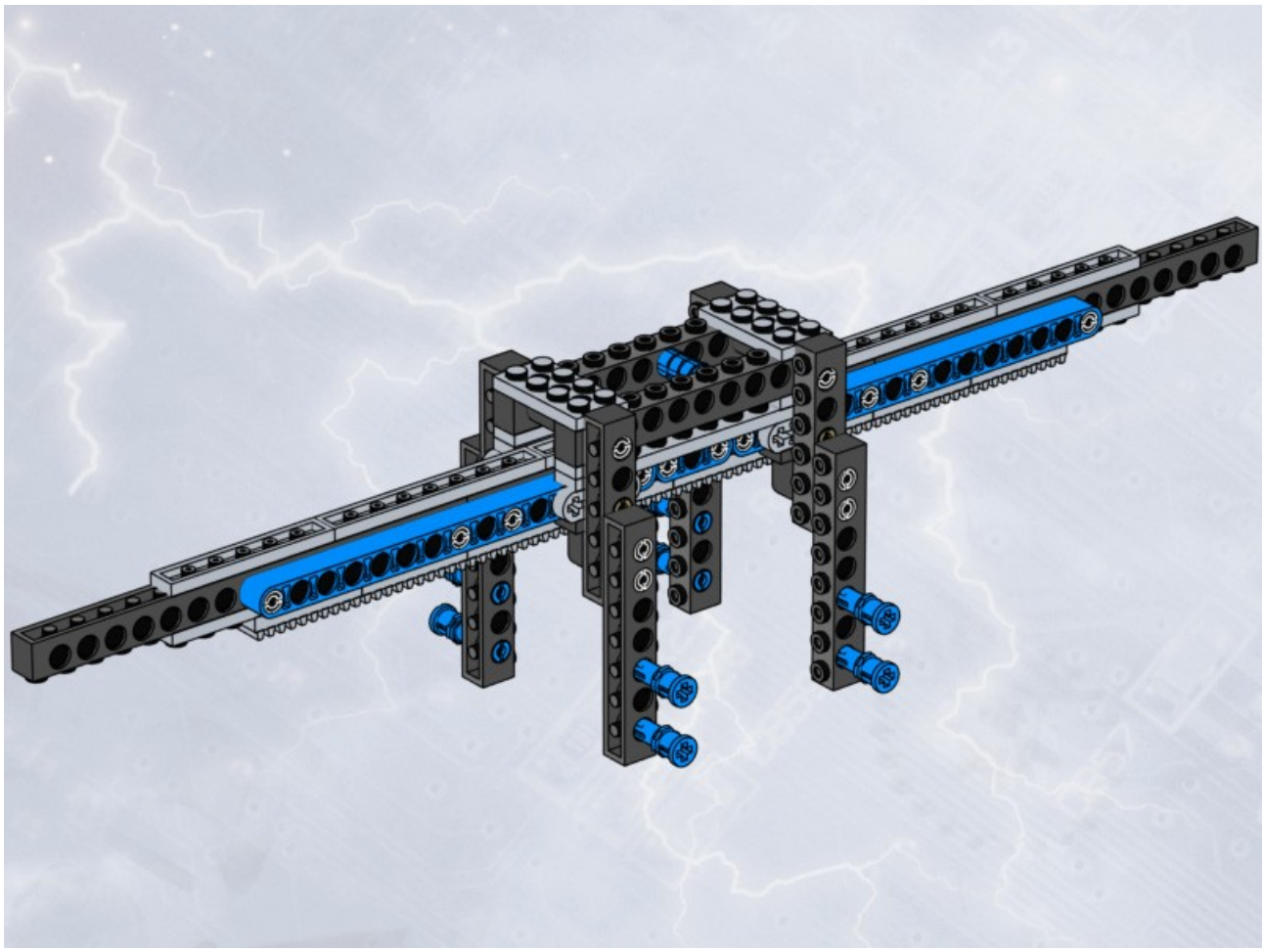

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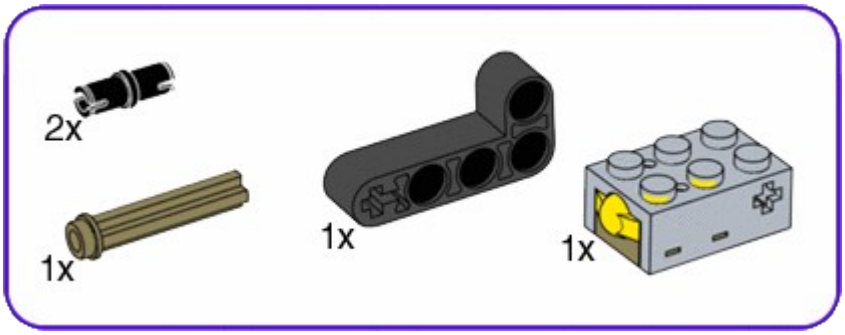

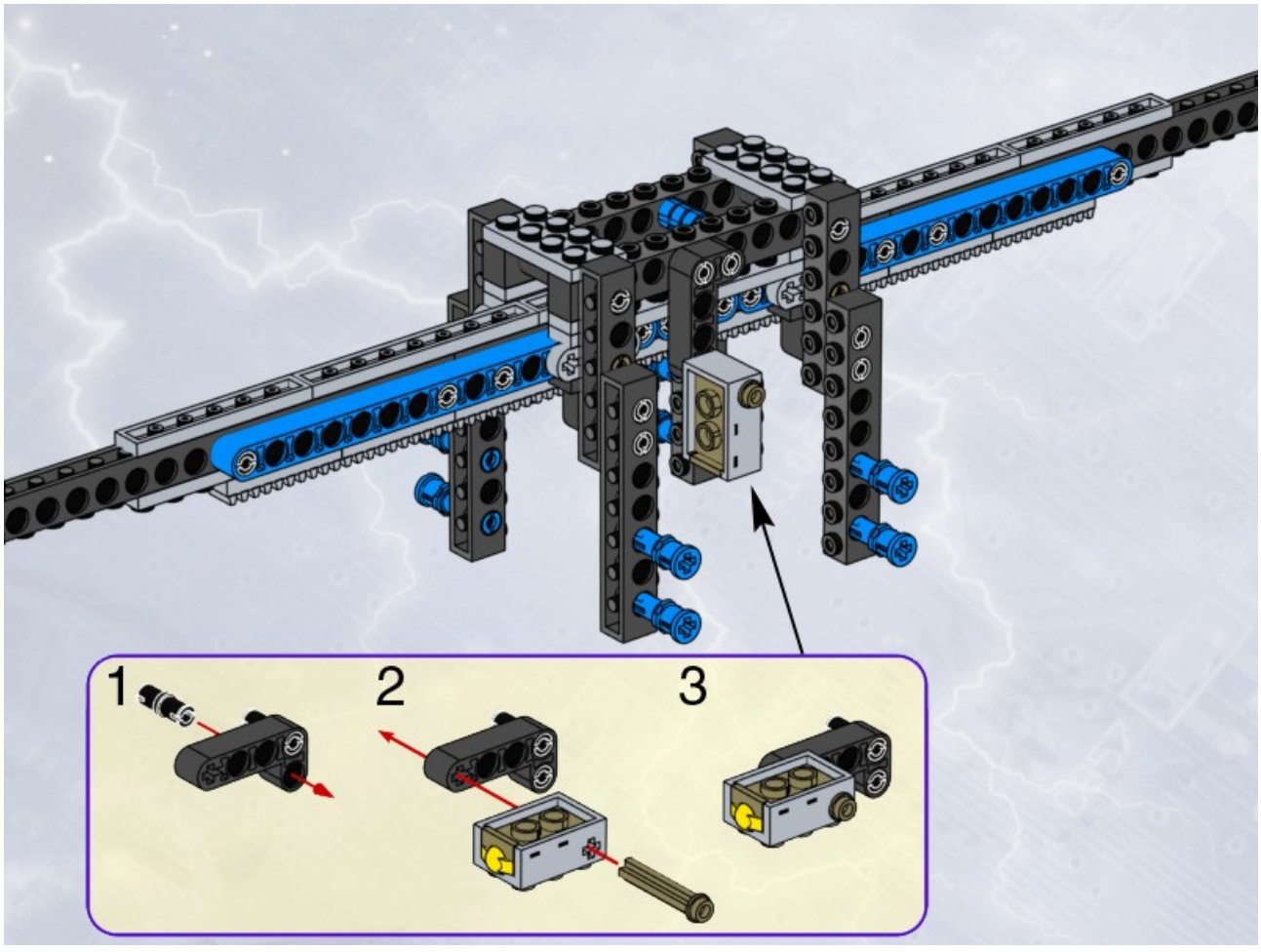

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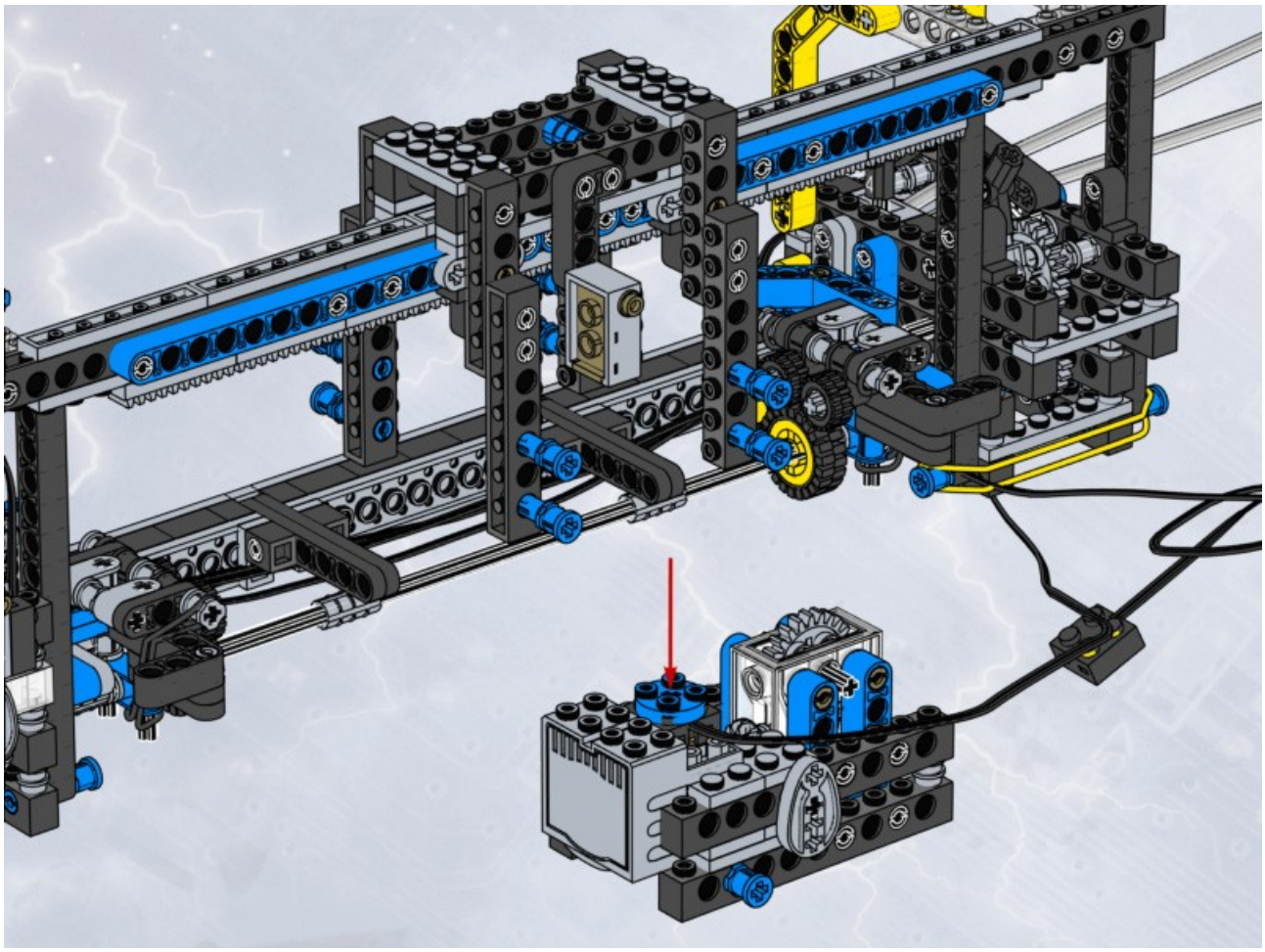

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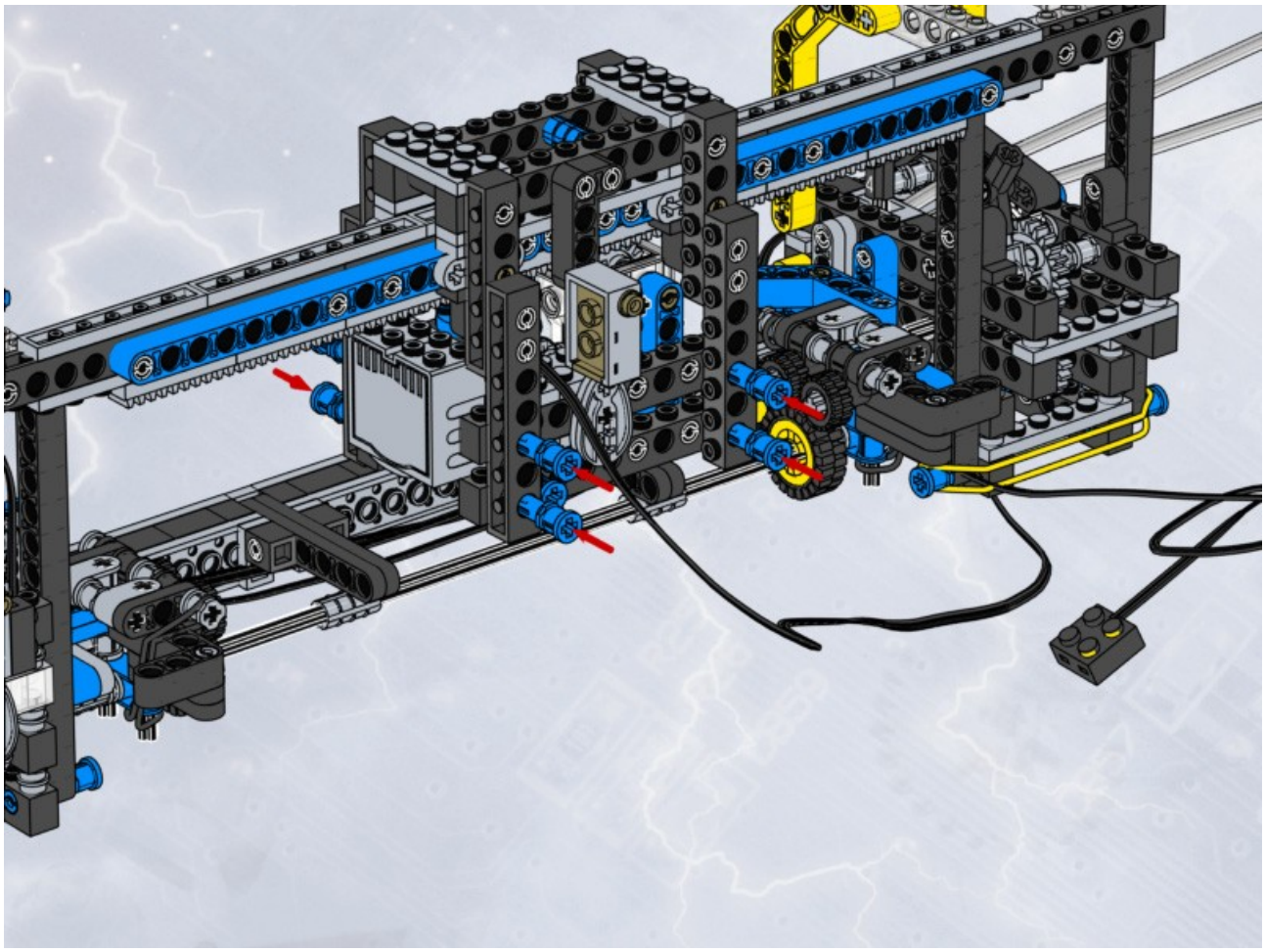

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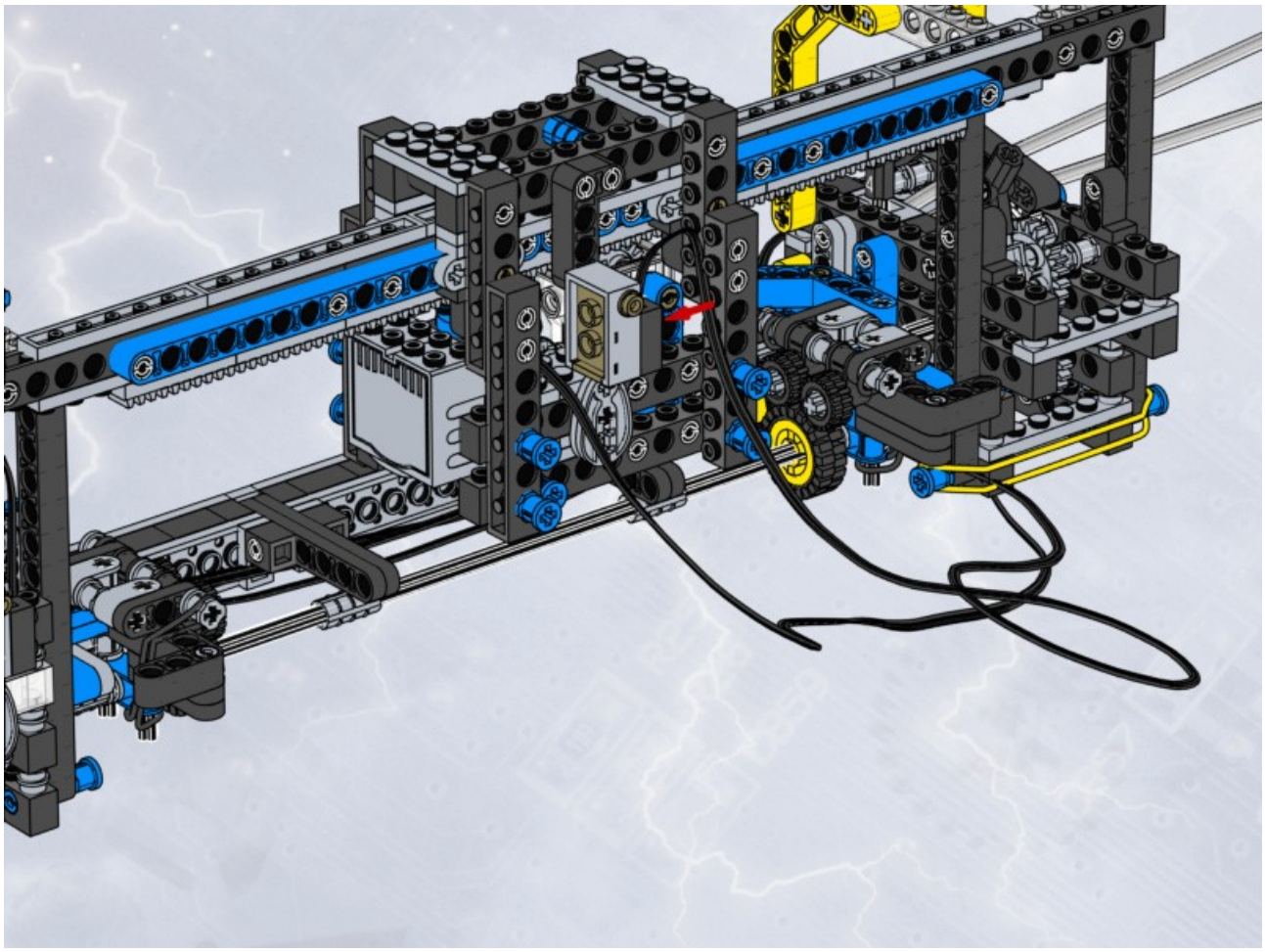

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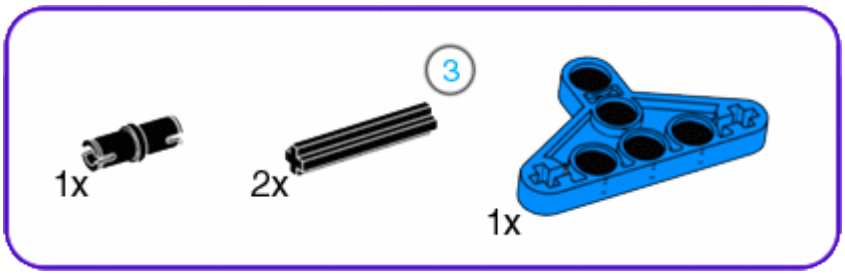

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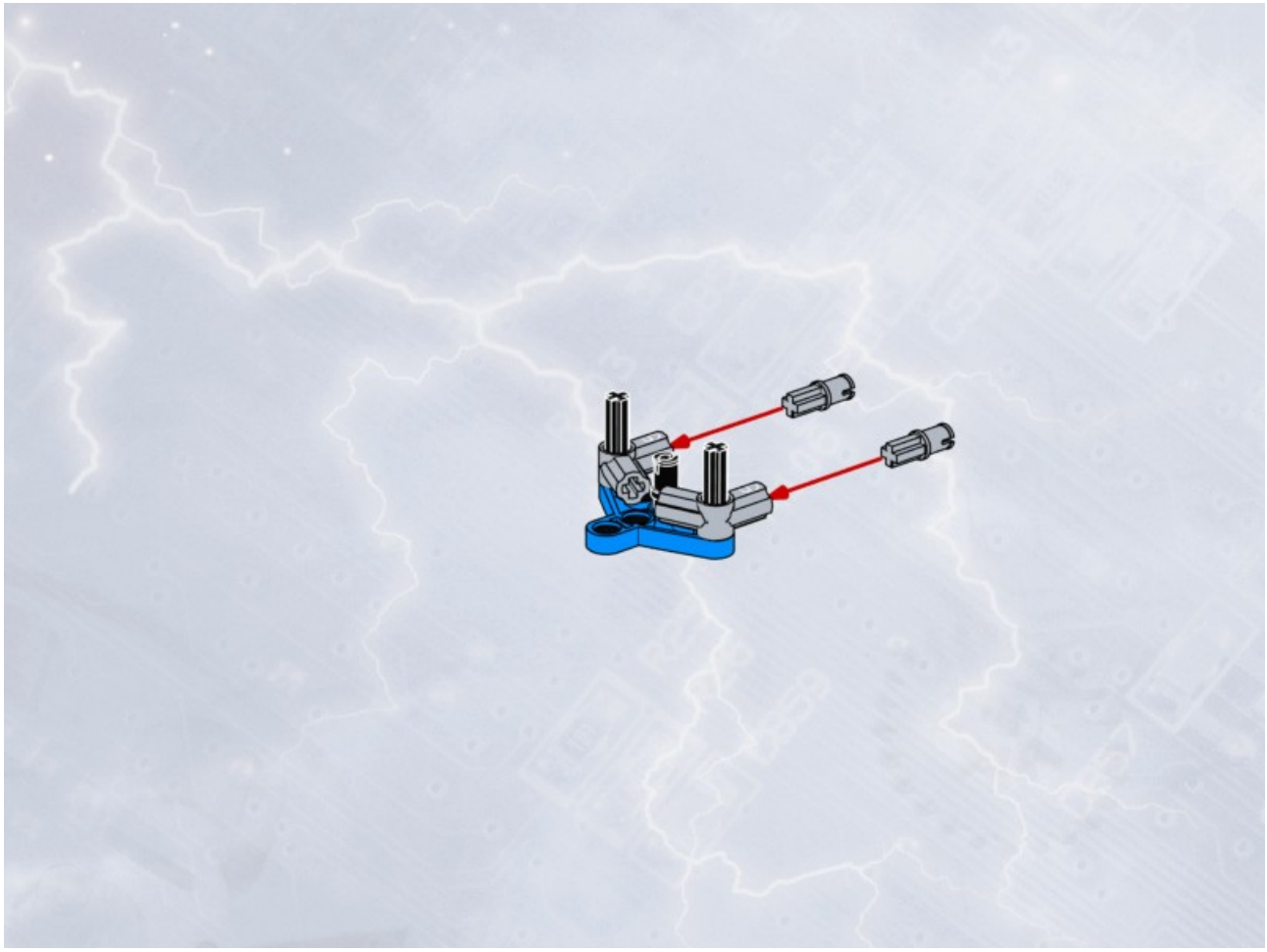

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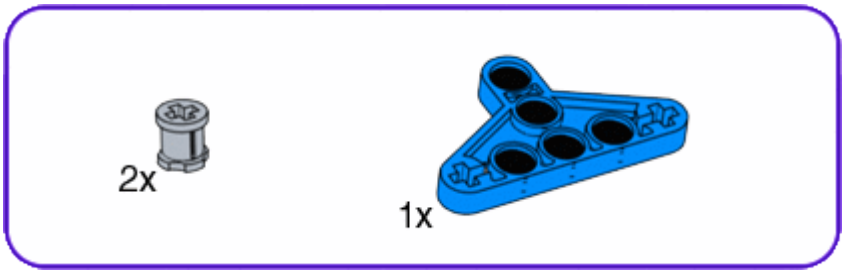

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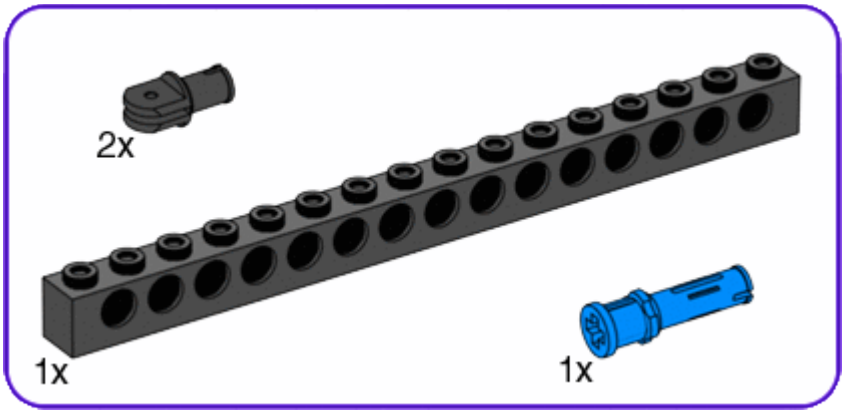

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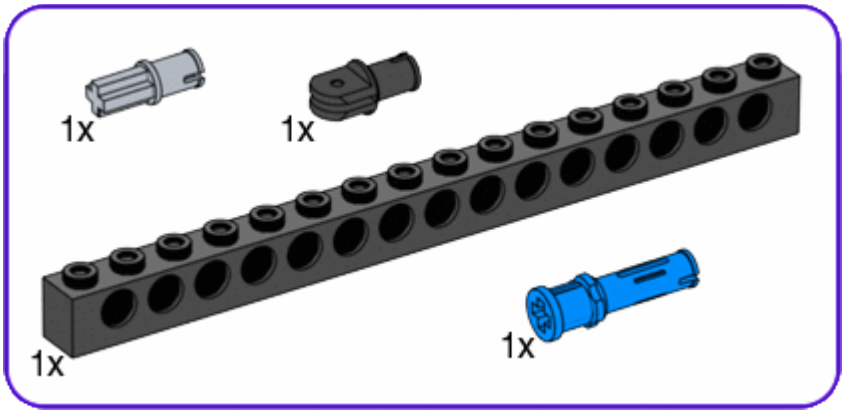

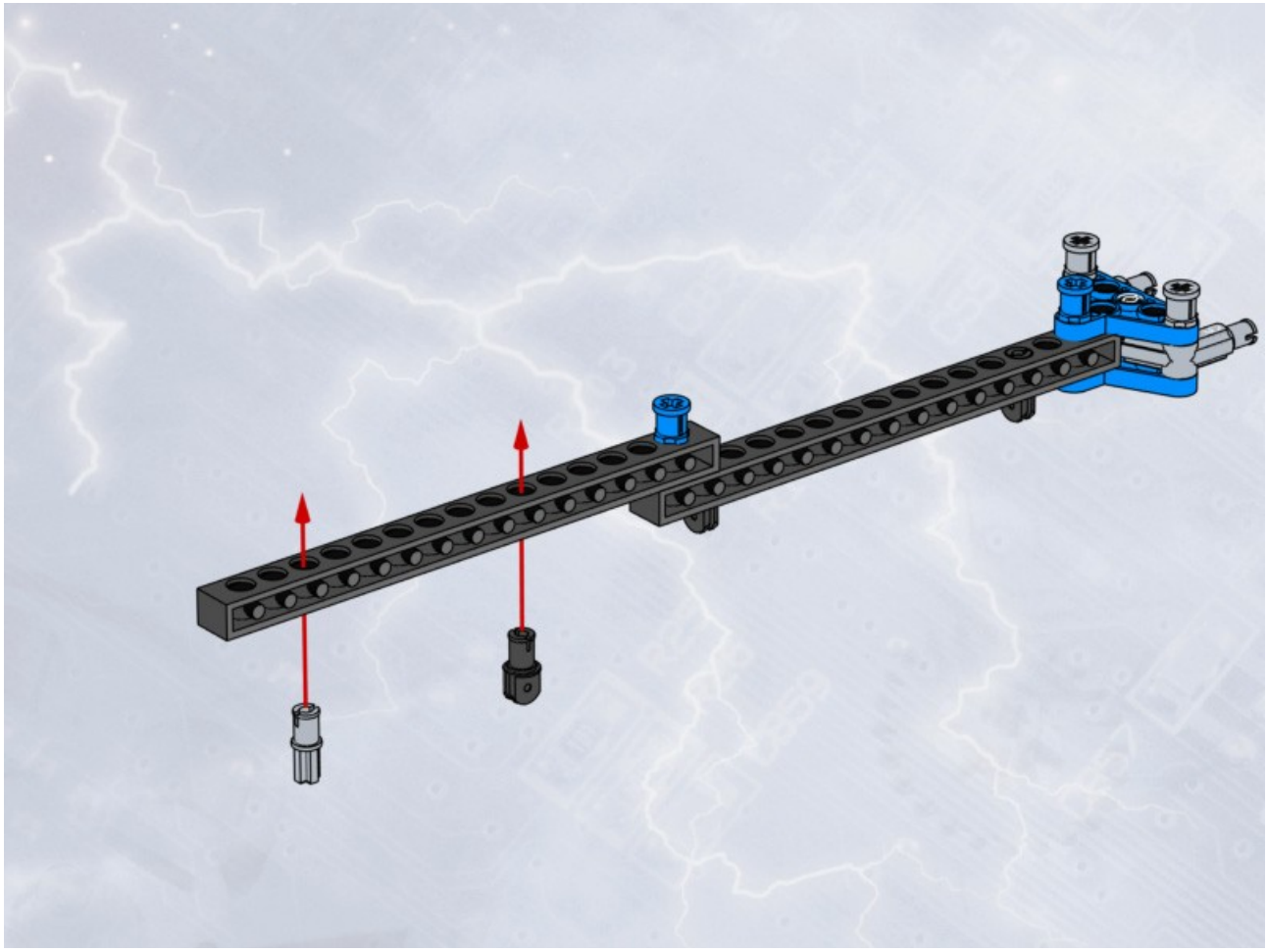

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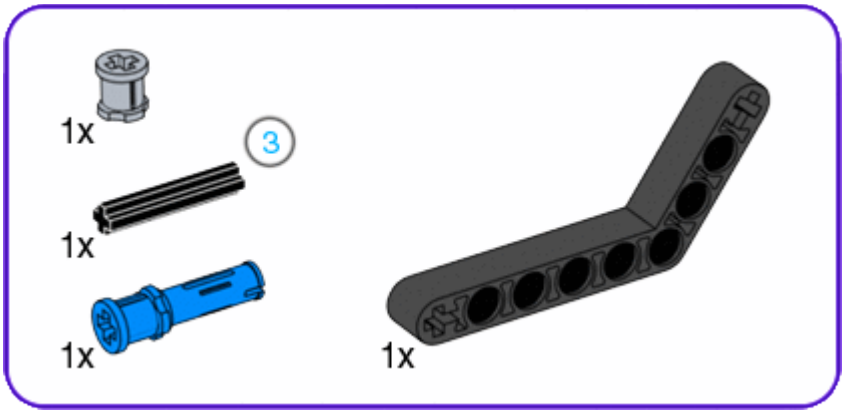

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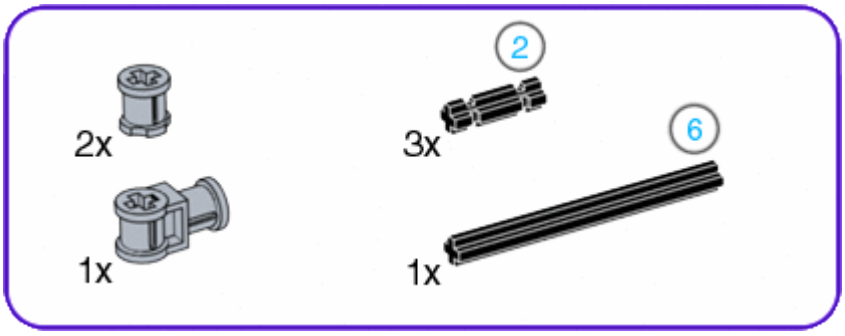

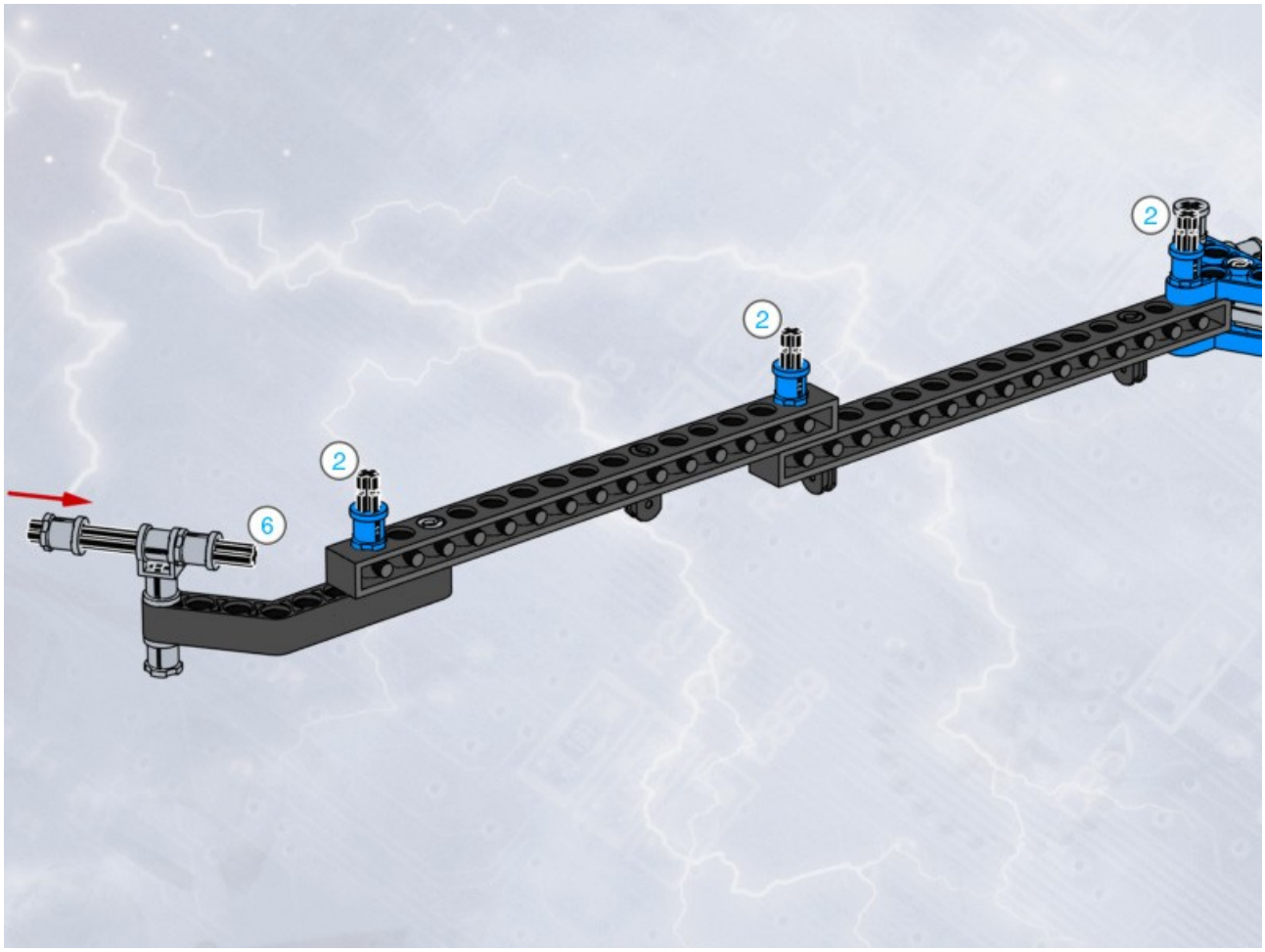

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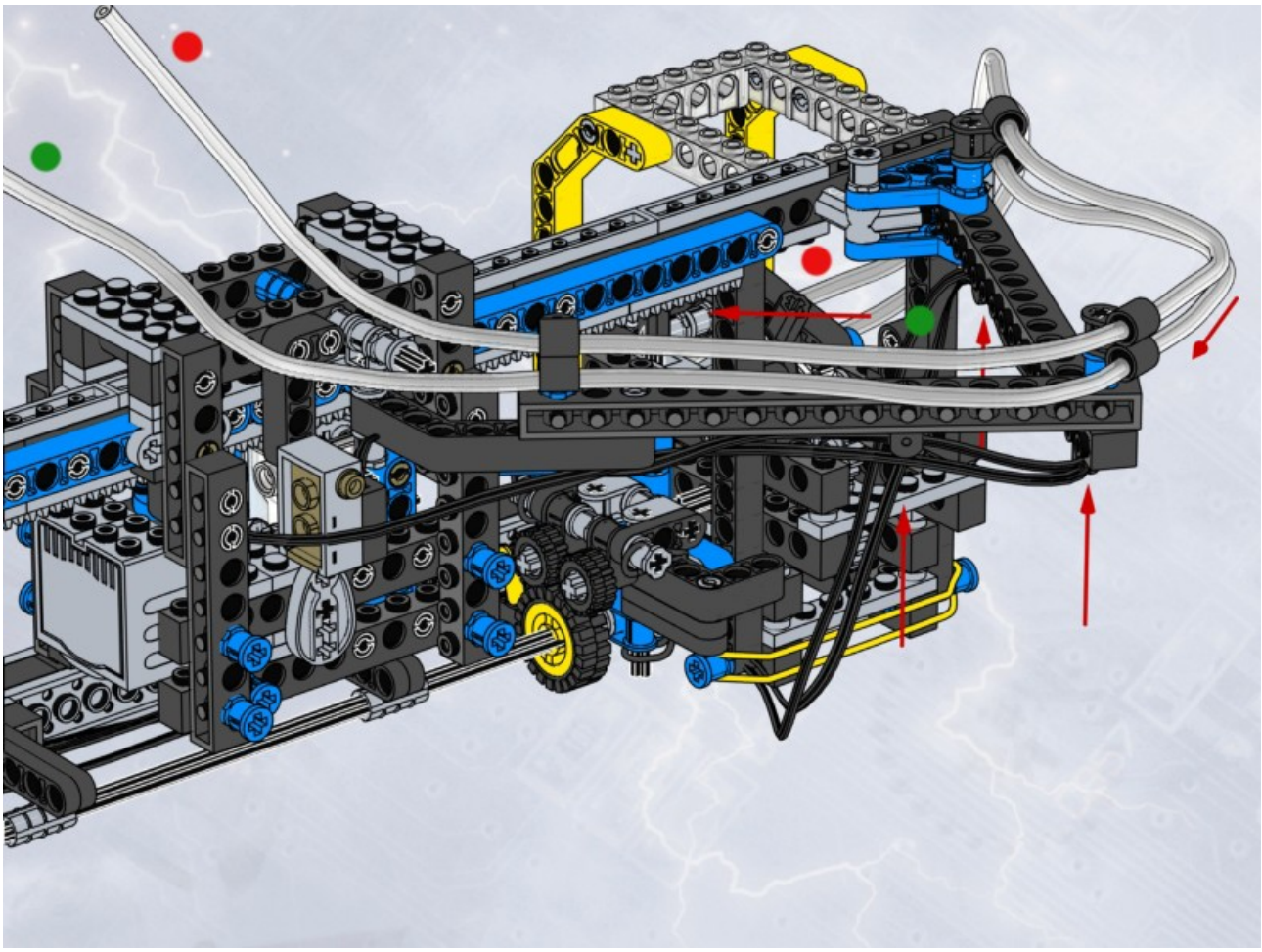

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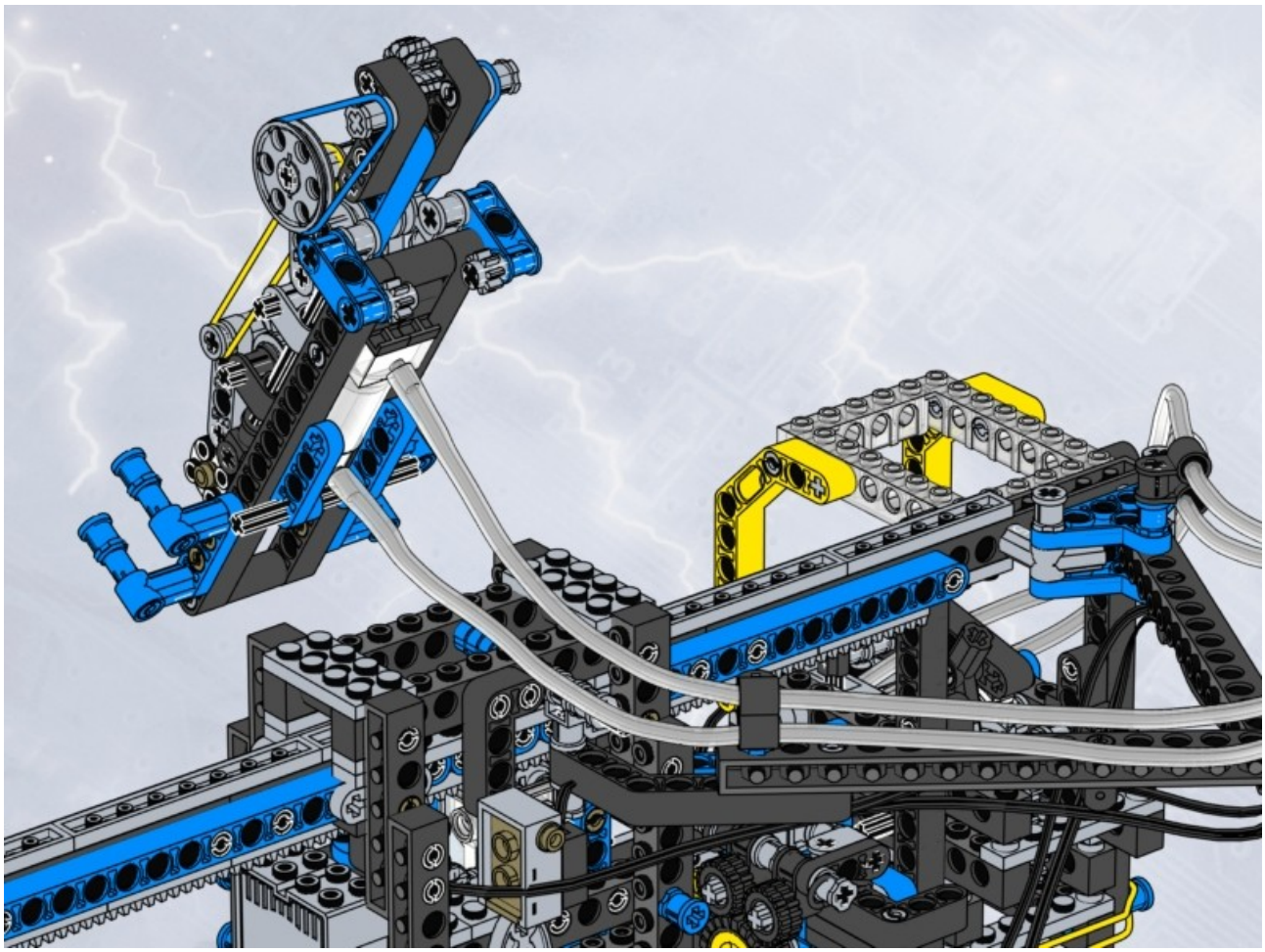

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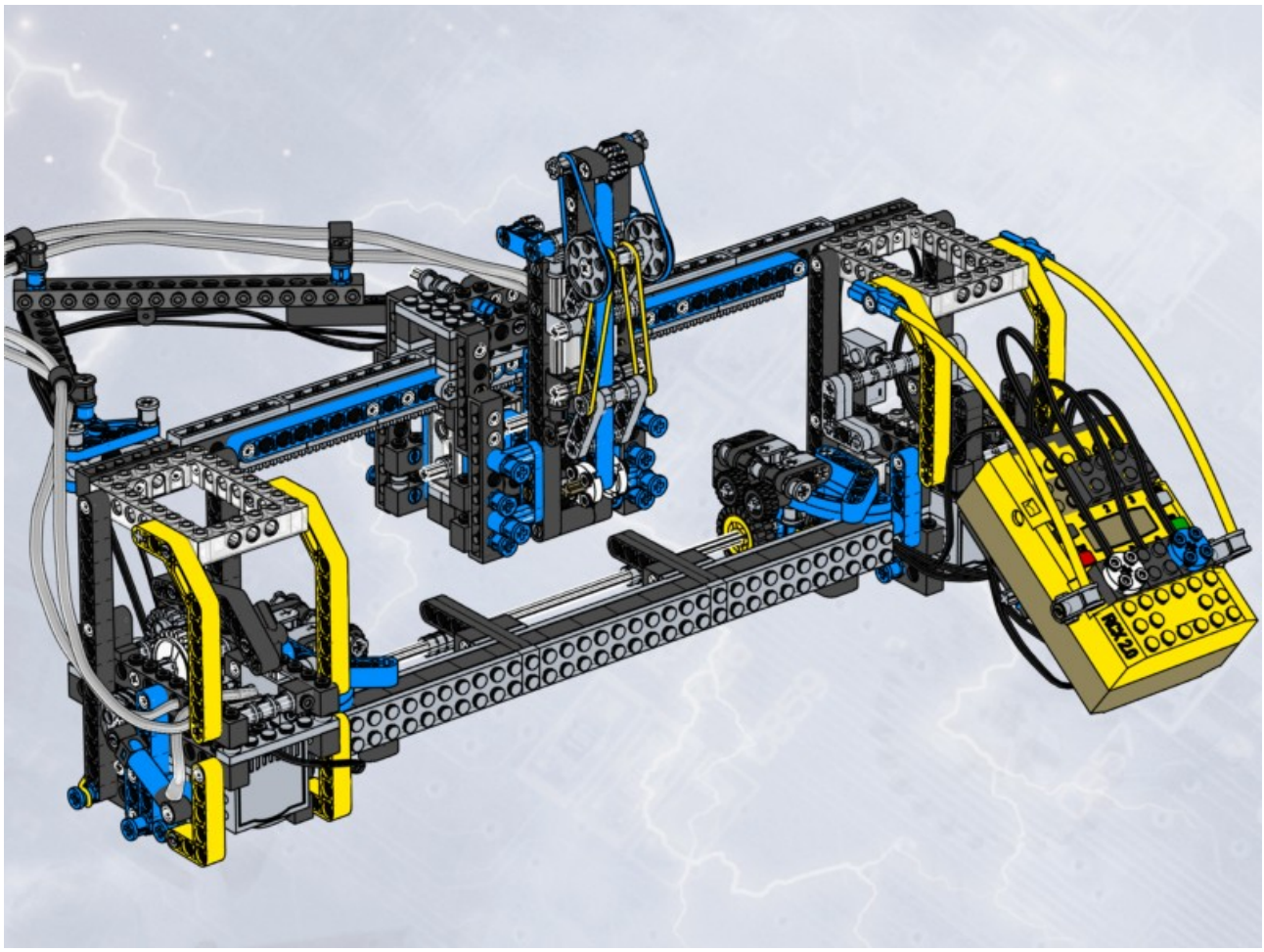
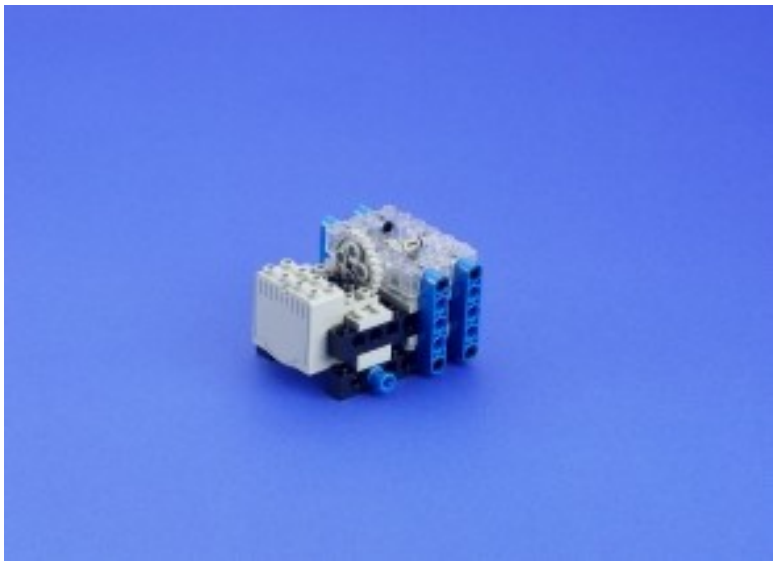


Motor Module 1



Motor Module 1 reduces the rotation speed but increases the torque of the Motor.

The torque expresses the power with which the motor turns.

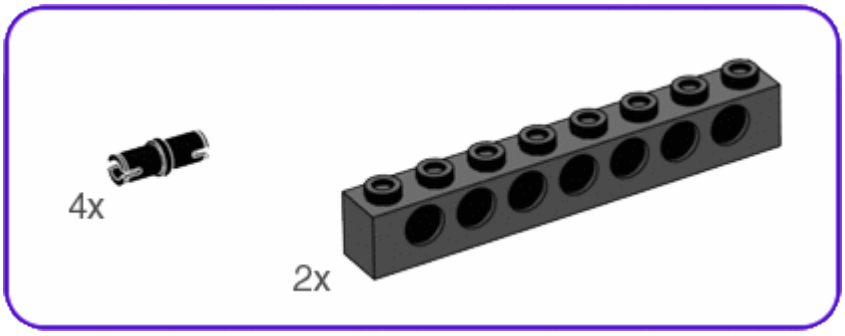
Notice that the direction of Rotation is kept the same but is slower than the motor on it's own, however the strength of rotation is much stronger.

This means this module can be used to move or lift heavier objects than could be done without the gearing but it will be at a slower speed.

Motor Module 1 has two steps of gearing.

Each of them reduces the speed three times which gives a total of 9 to 1 gearing, meaning that when the driving gear on the motor rotates 9 times the output axle only rotates once.

1



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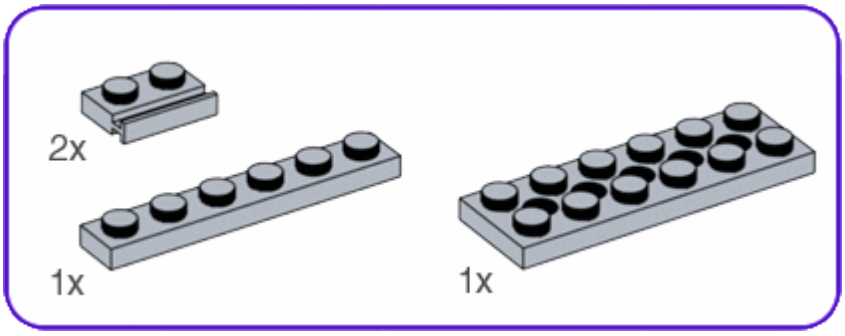

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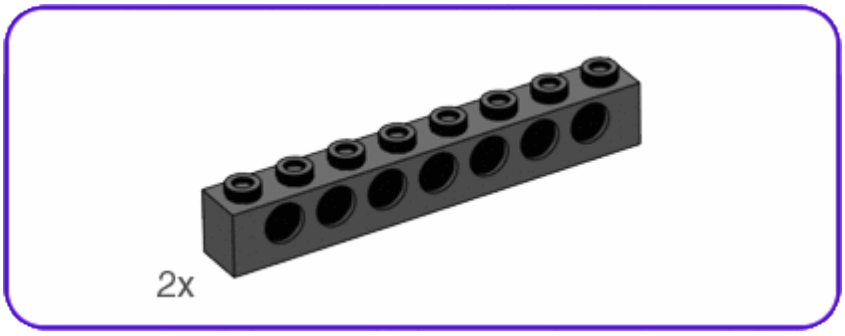

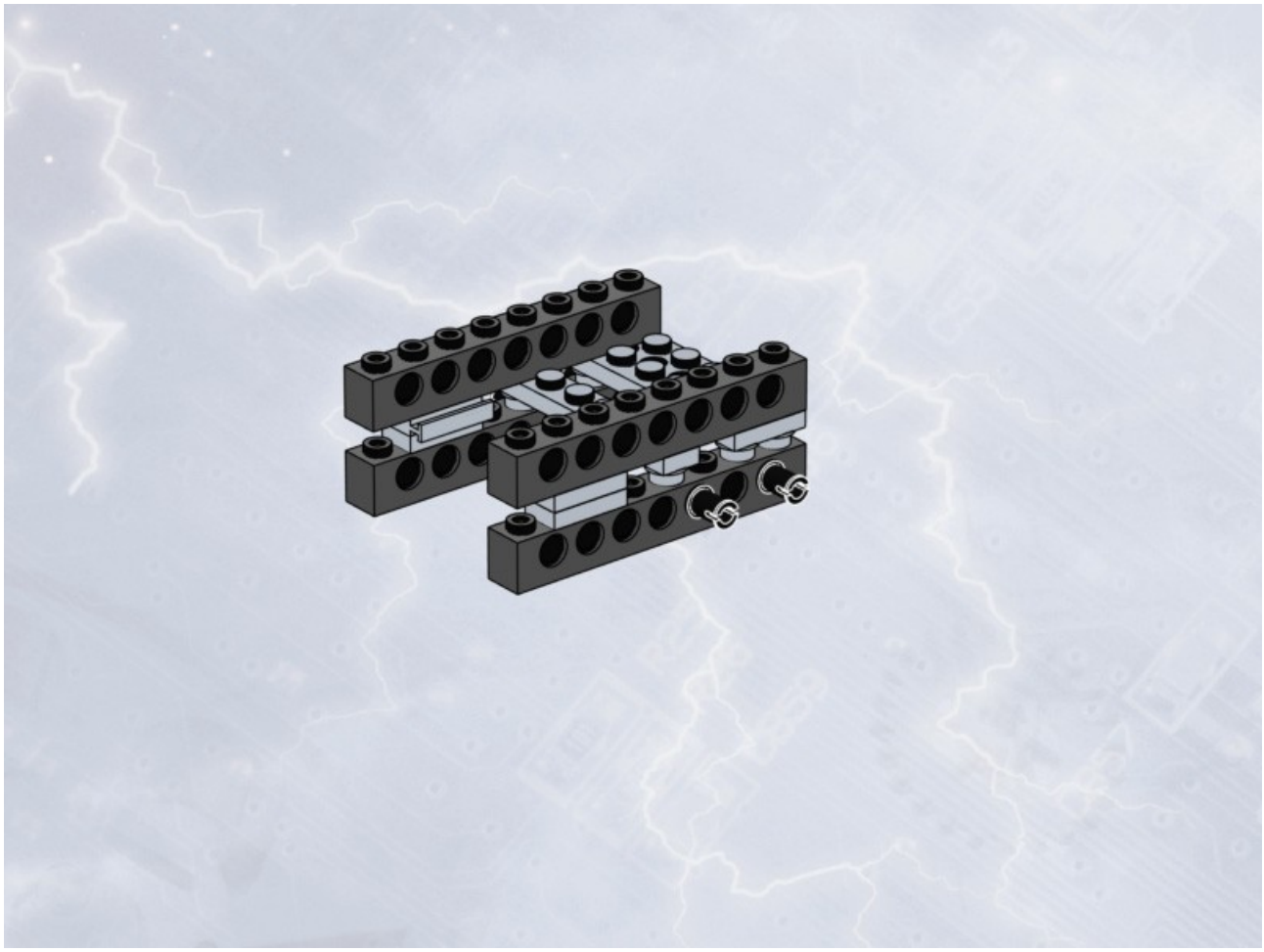

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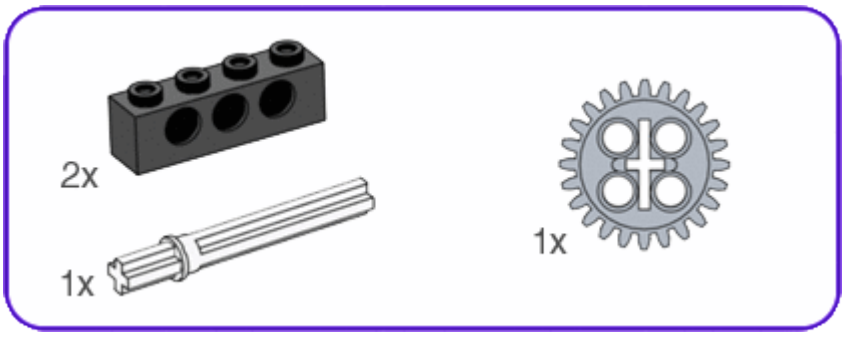

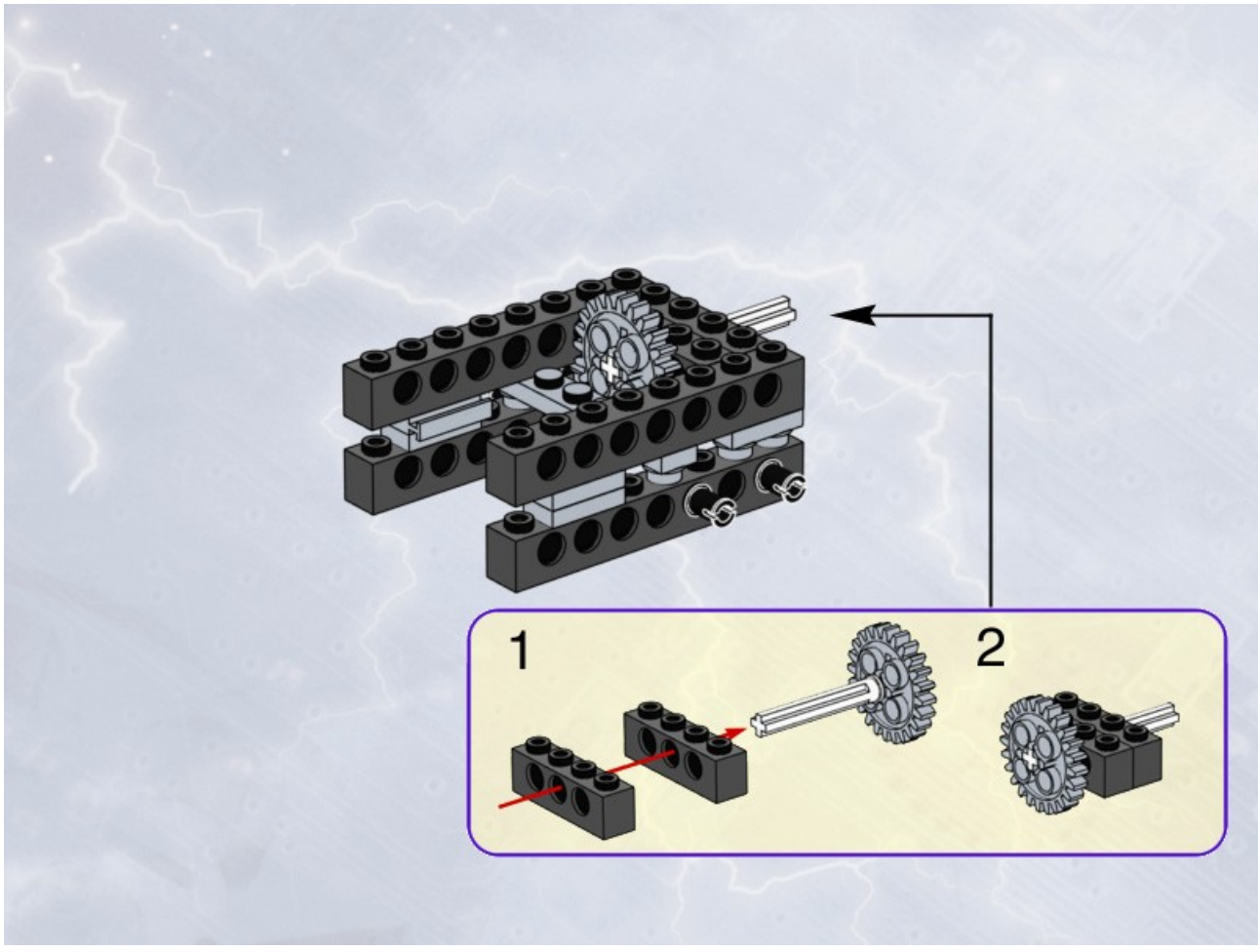

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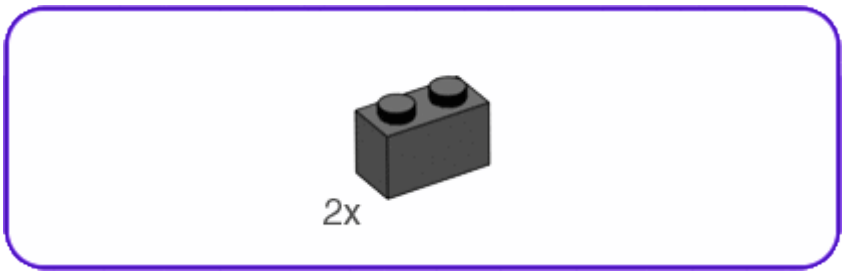

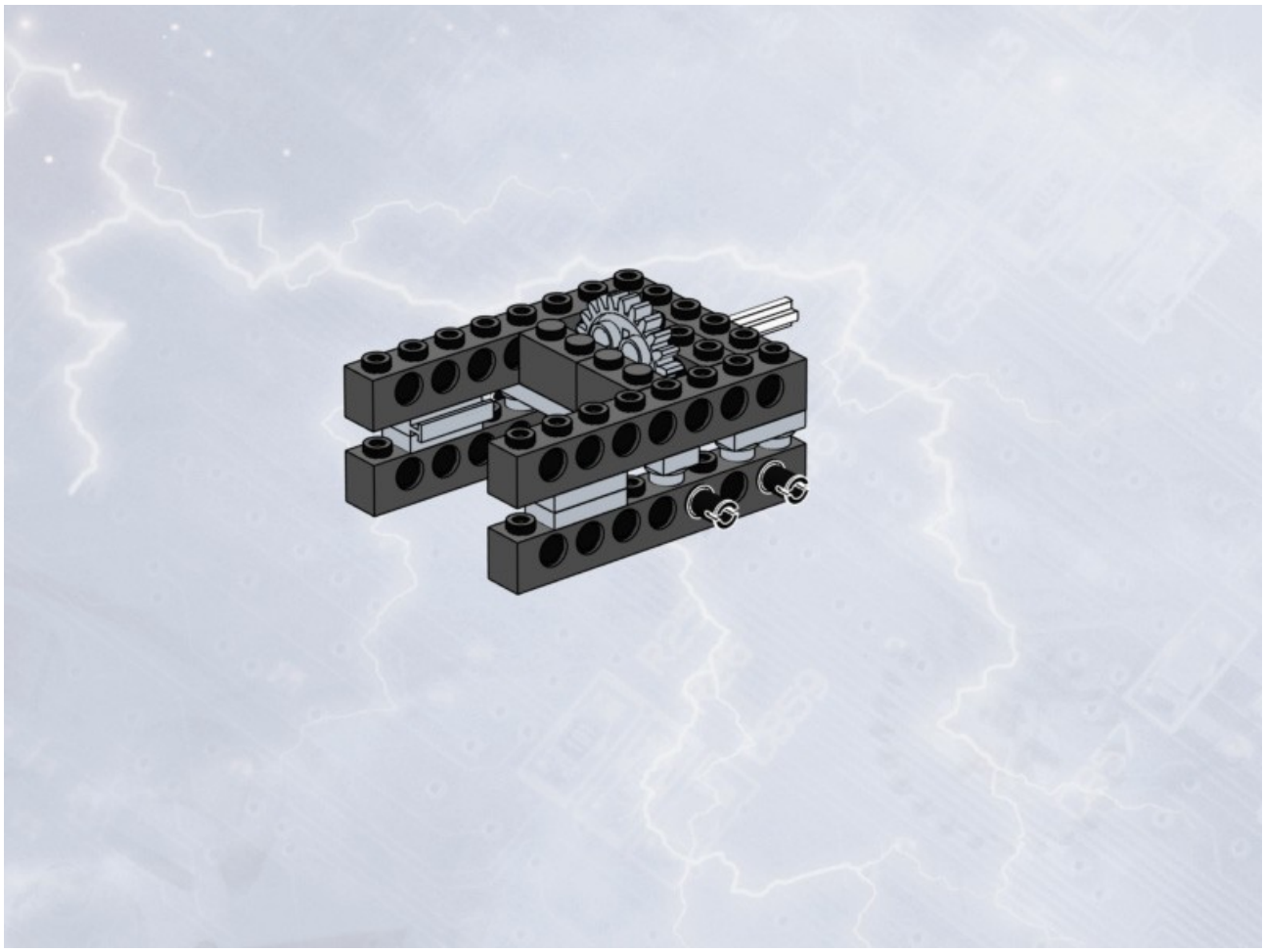

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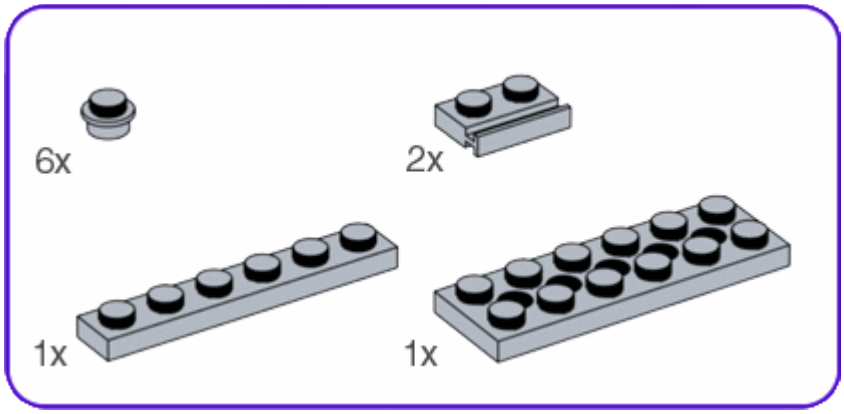

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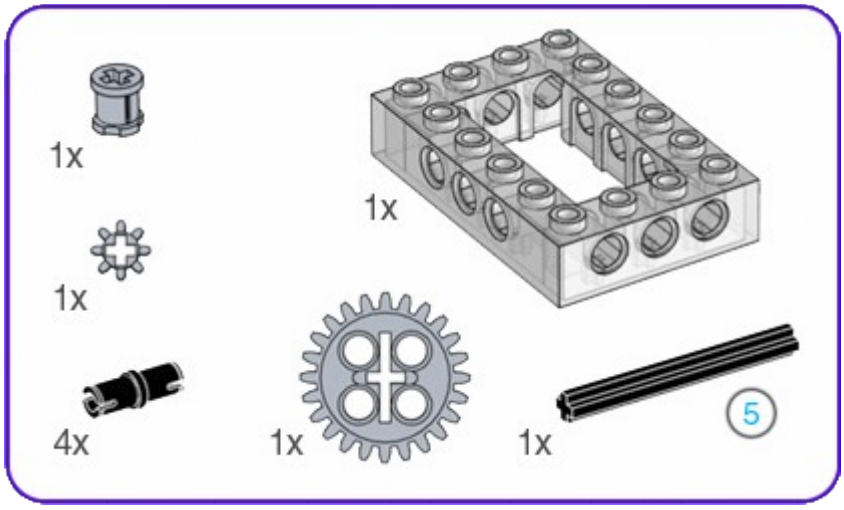

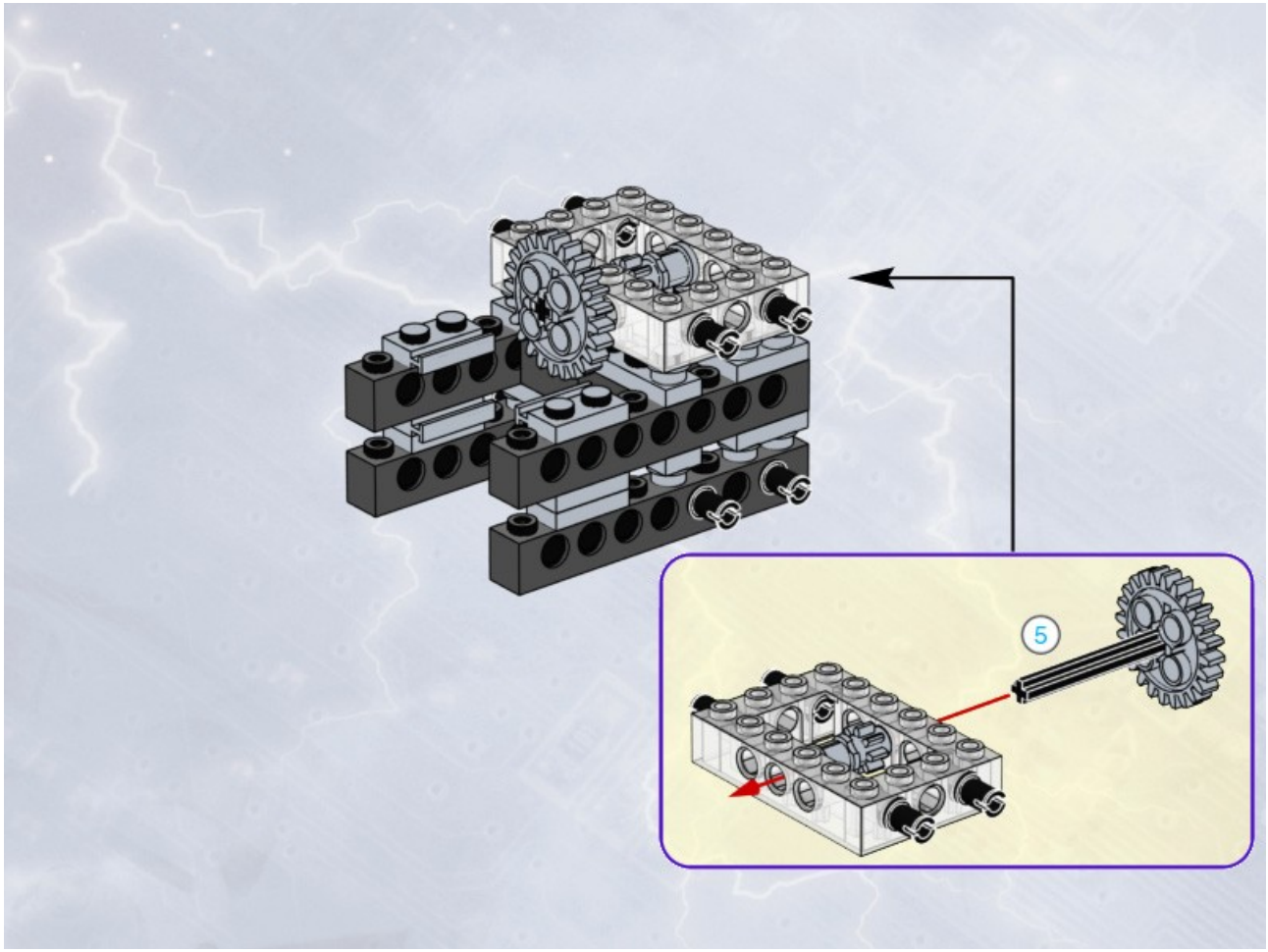

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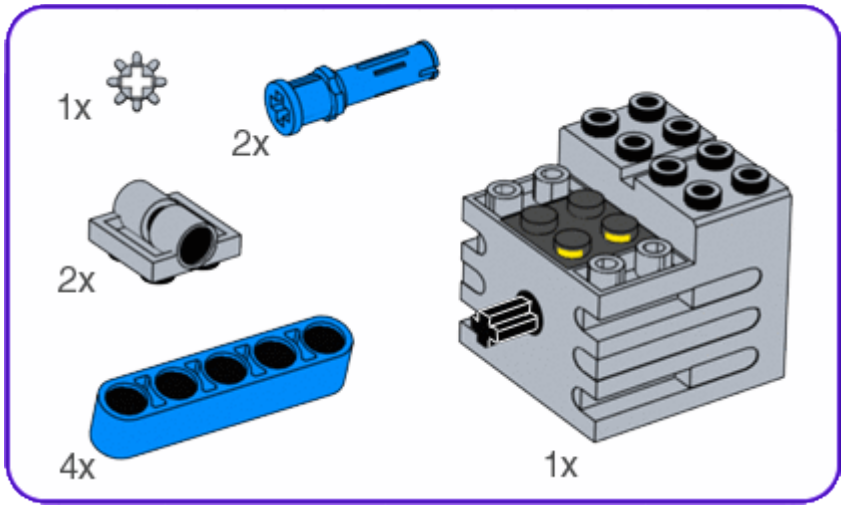

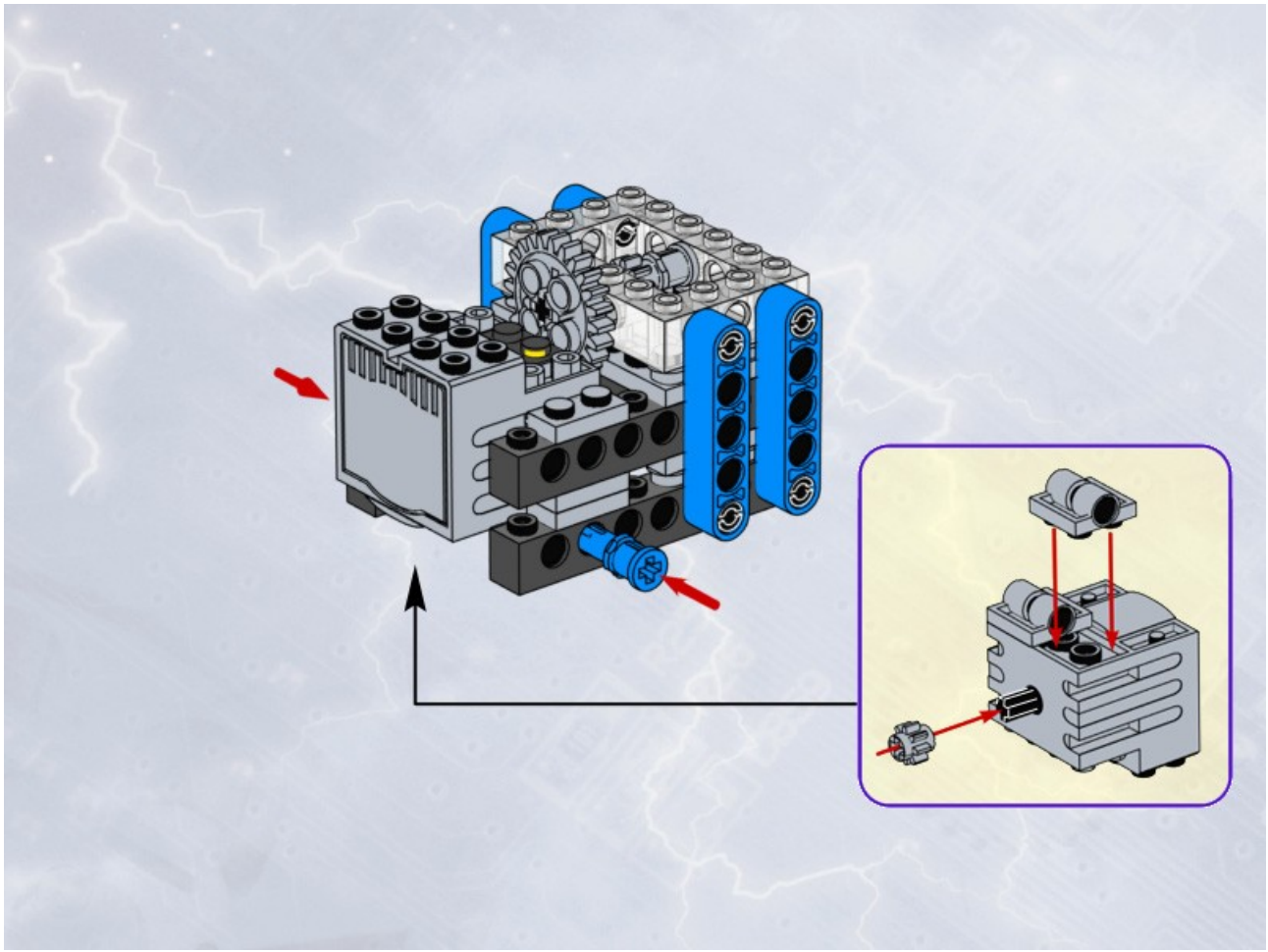

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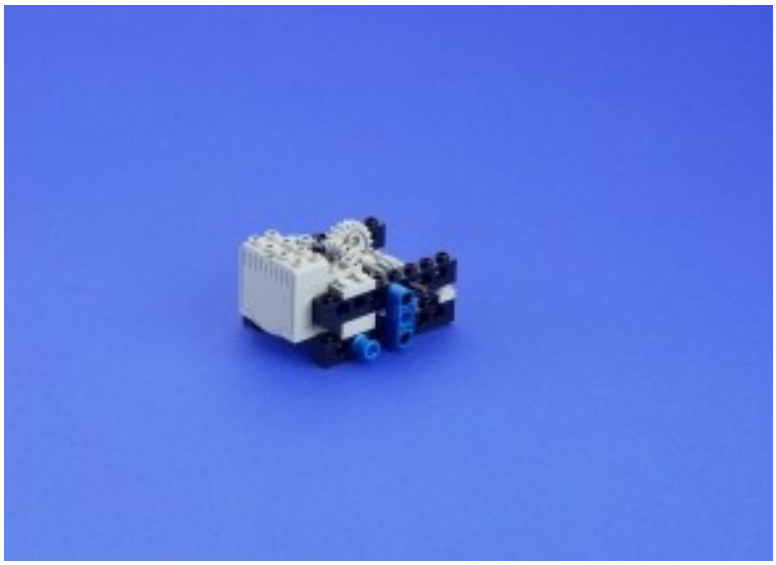
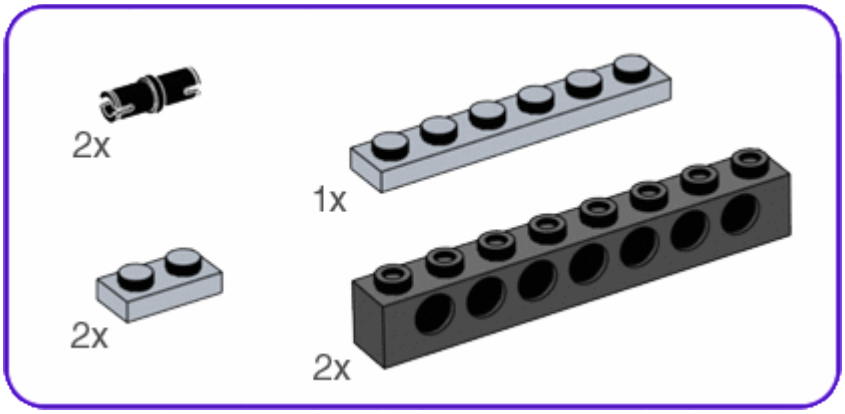
Motor Module 2



The main purpose of Motor Module 2 is to turn the angle of rotation.

Notice that the driving gear drives another gear placed at a 90-degree angle. This Motor Module then gives the possibility of three outputs; one output on each of the gears on the cross-axle and on the cross-axle itself. This Motor Module offers a 1 to 1 gear ratio.

1



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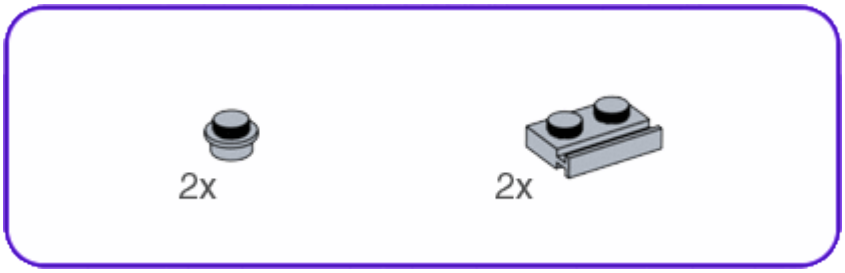

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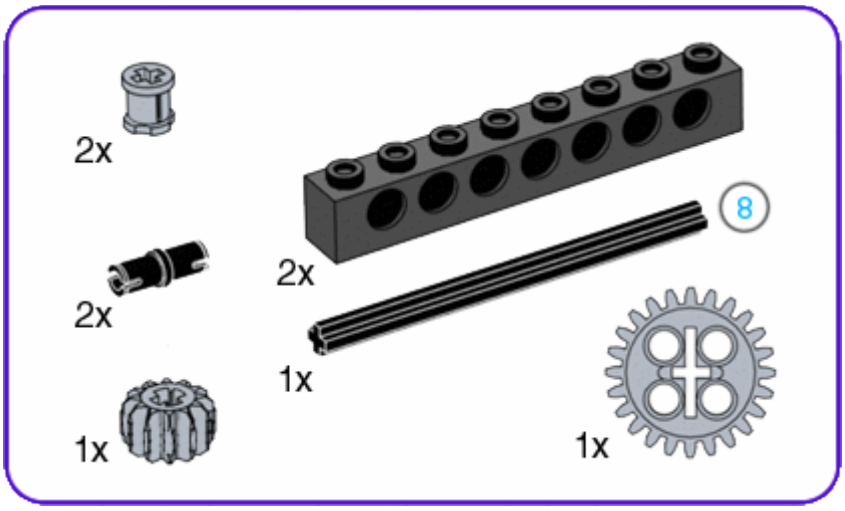

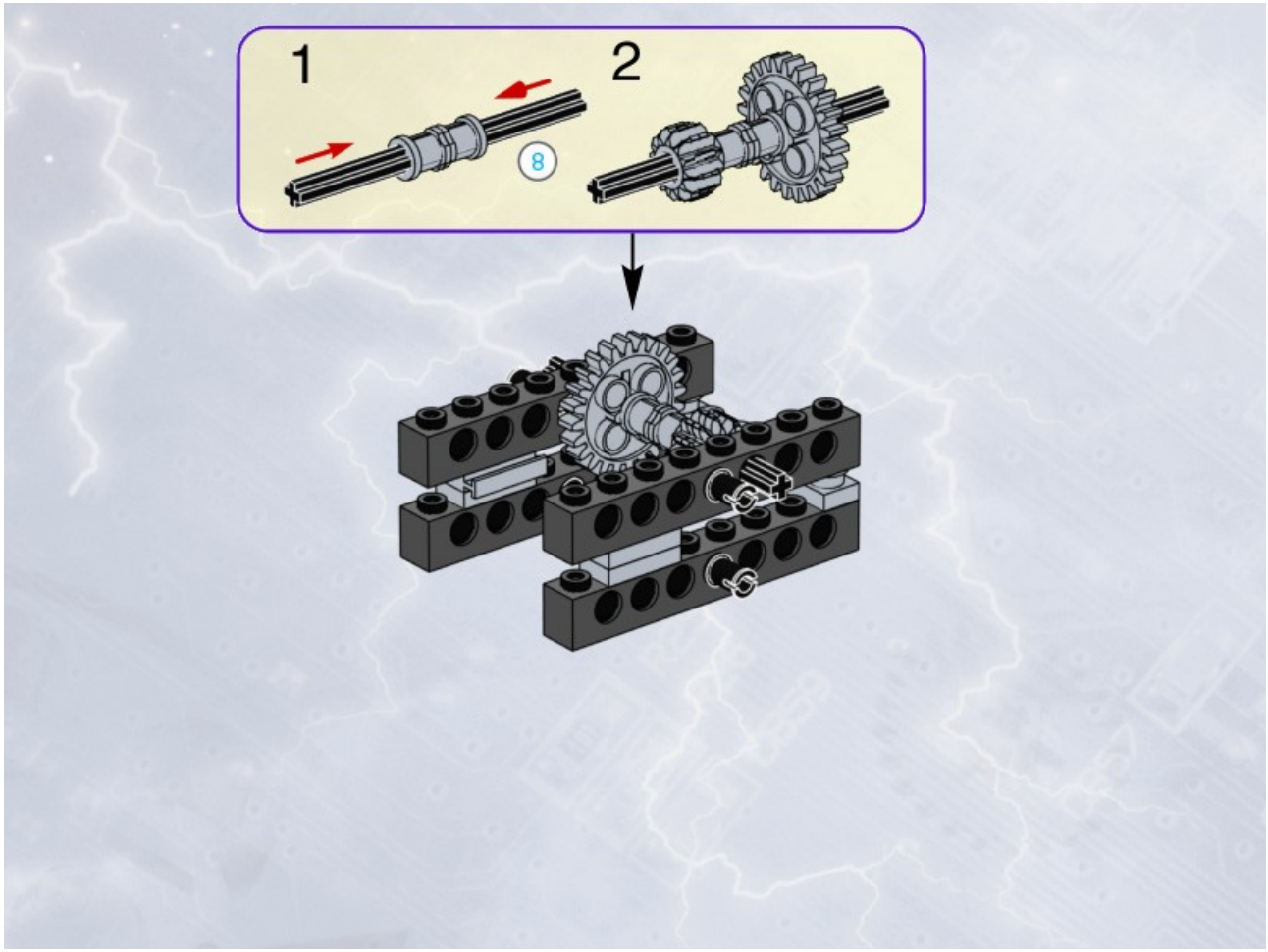

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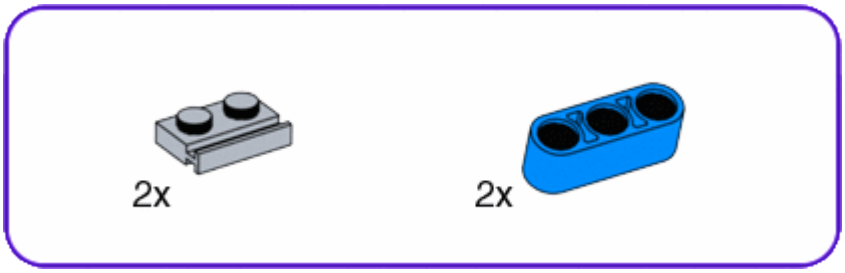

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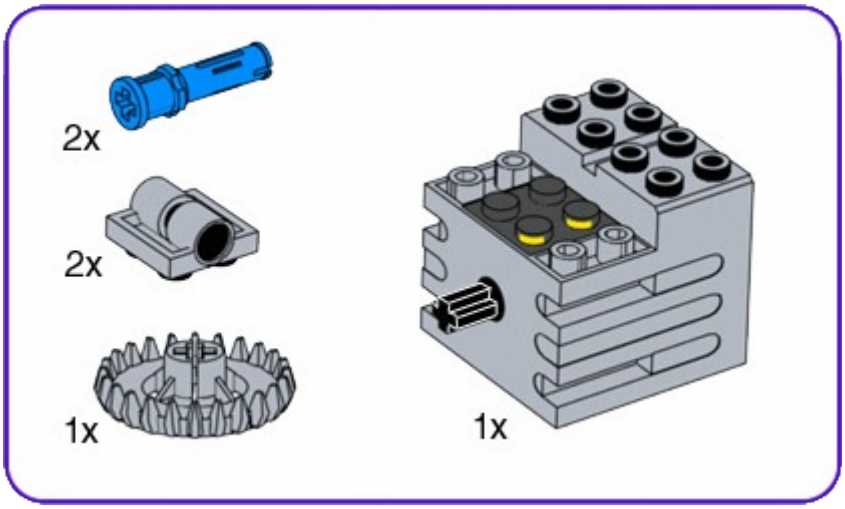

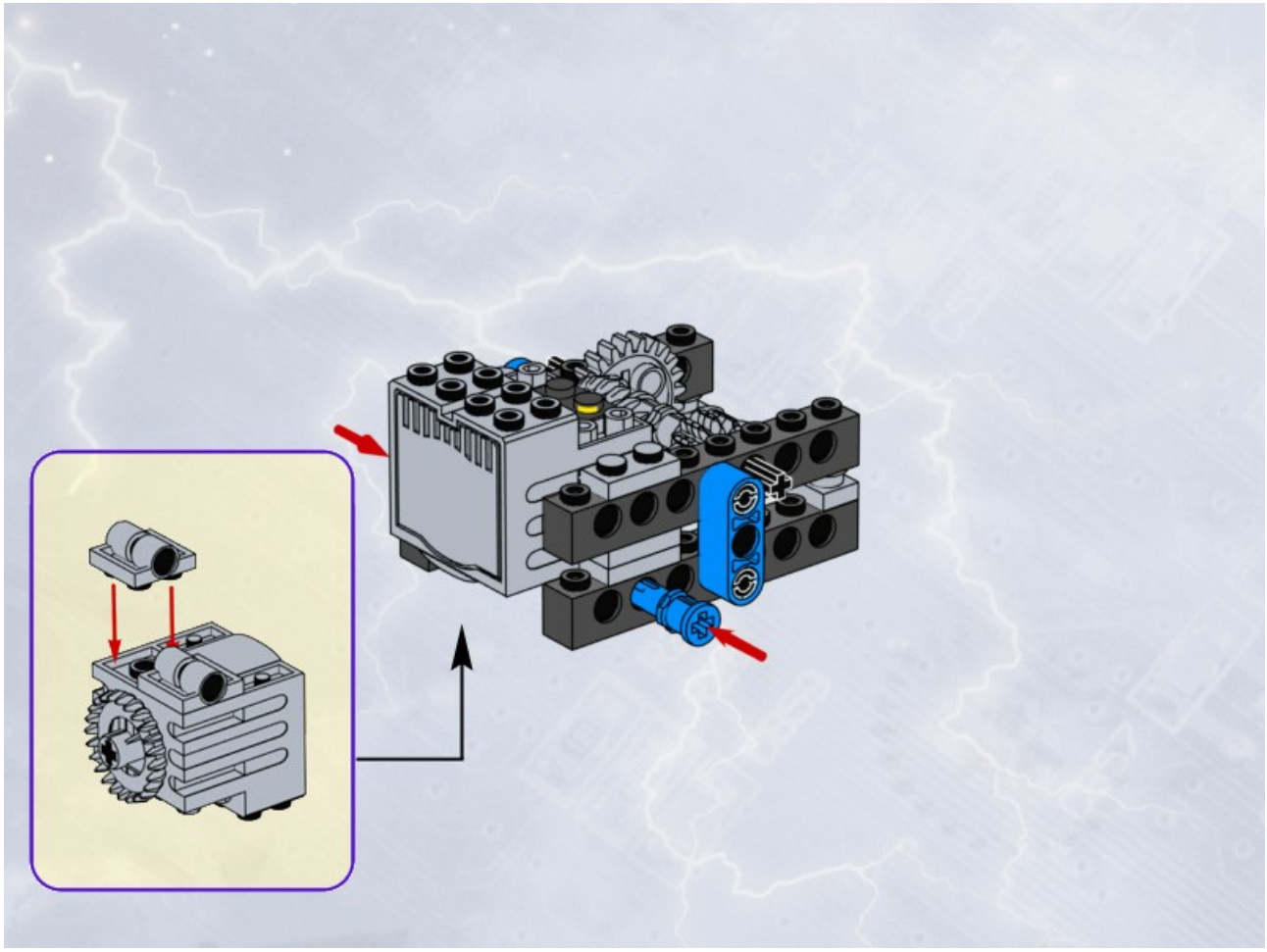

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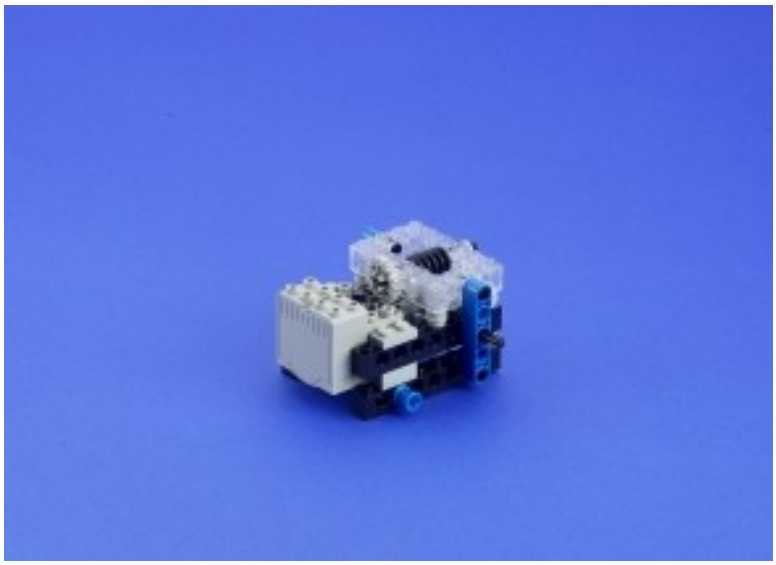
Motor Module 3



This Motor Module achieves a 24 to 1 gear ratio by transferring power from the driving axle to the output axle via a worm gear.

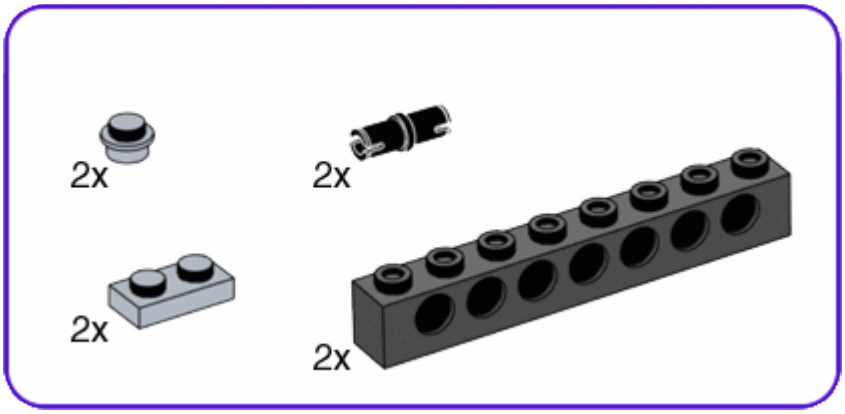
For each revolution of the worm gear the 24-tooth crown gear rotates only one tooth, so the worm gear must turn 24 times to turn the 24 tooth gear one revolution.

This gives a very slow turning of the output axle, but high rotation strength, or torque.

On this Motor Module there are three possible outputs; two directly on the crown gears and one on the output axle itself.

Another strong feature of this Module is that the worm gear can be used to lock the position of the output axle as the worm gear can turn the crown gear but the crown gear cannot move the worm gear.

1



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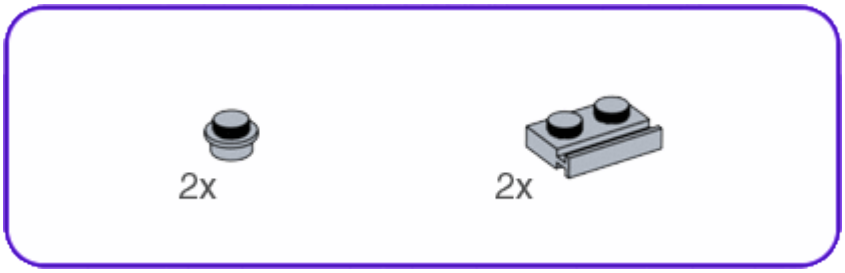

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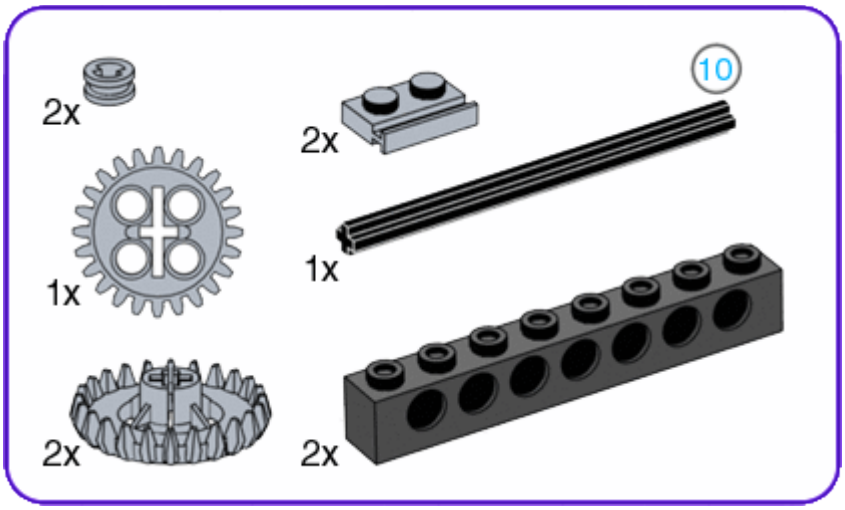

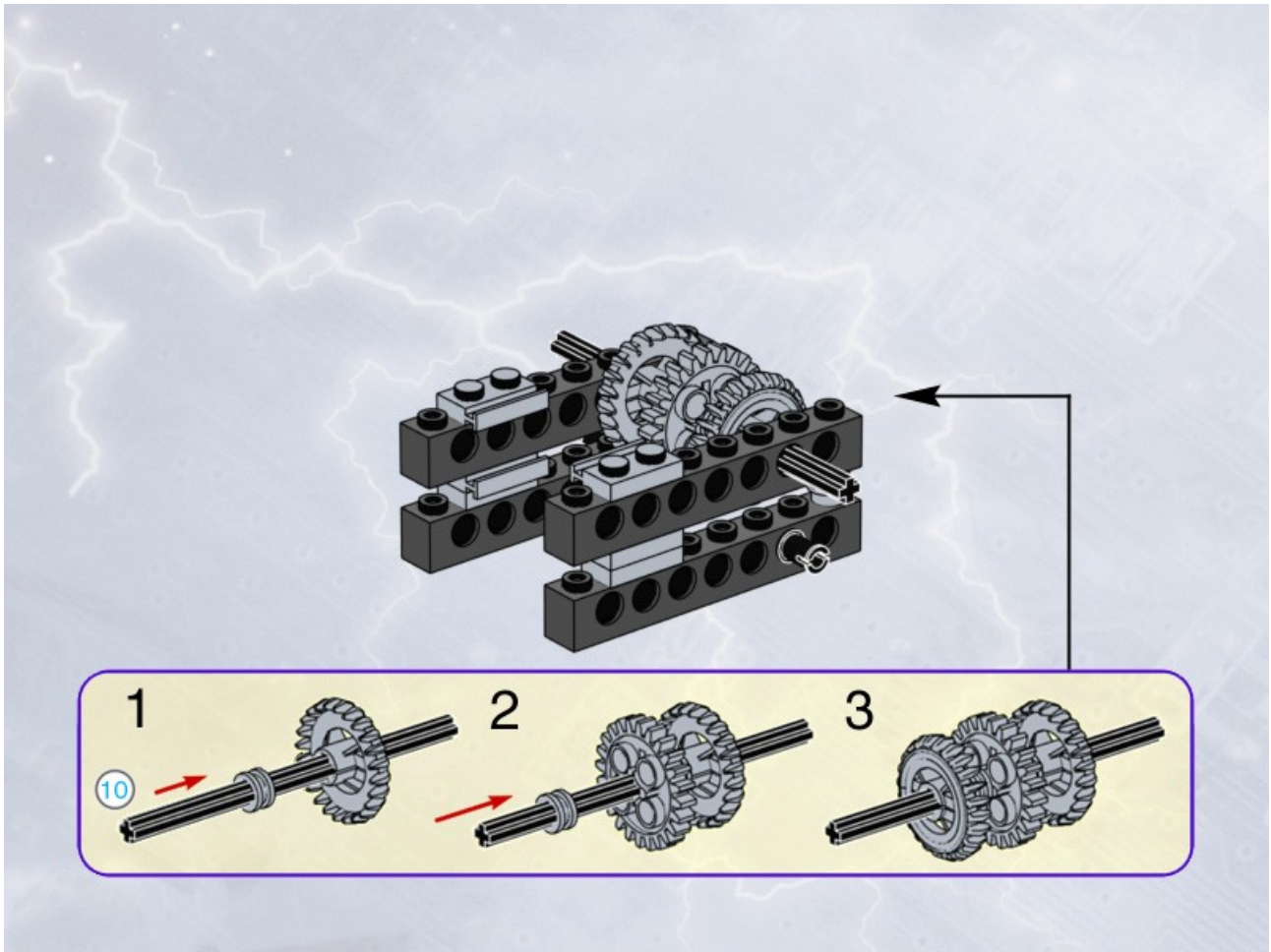

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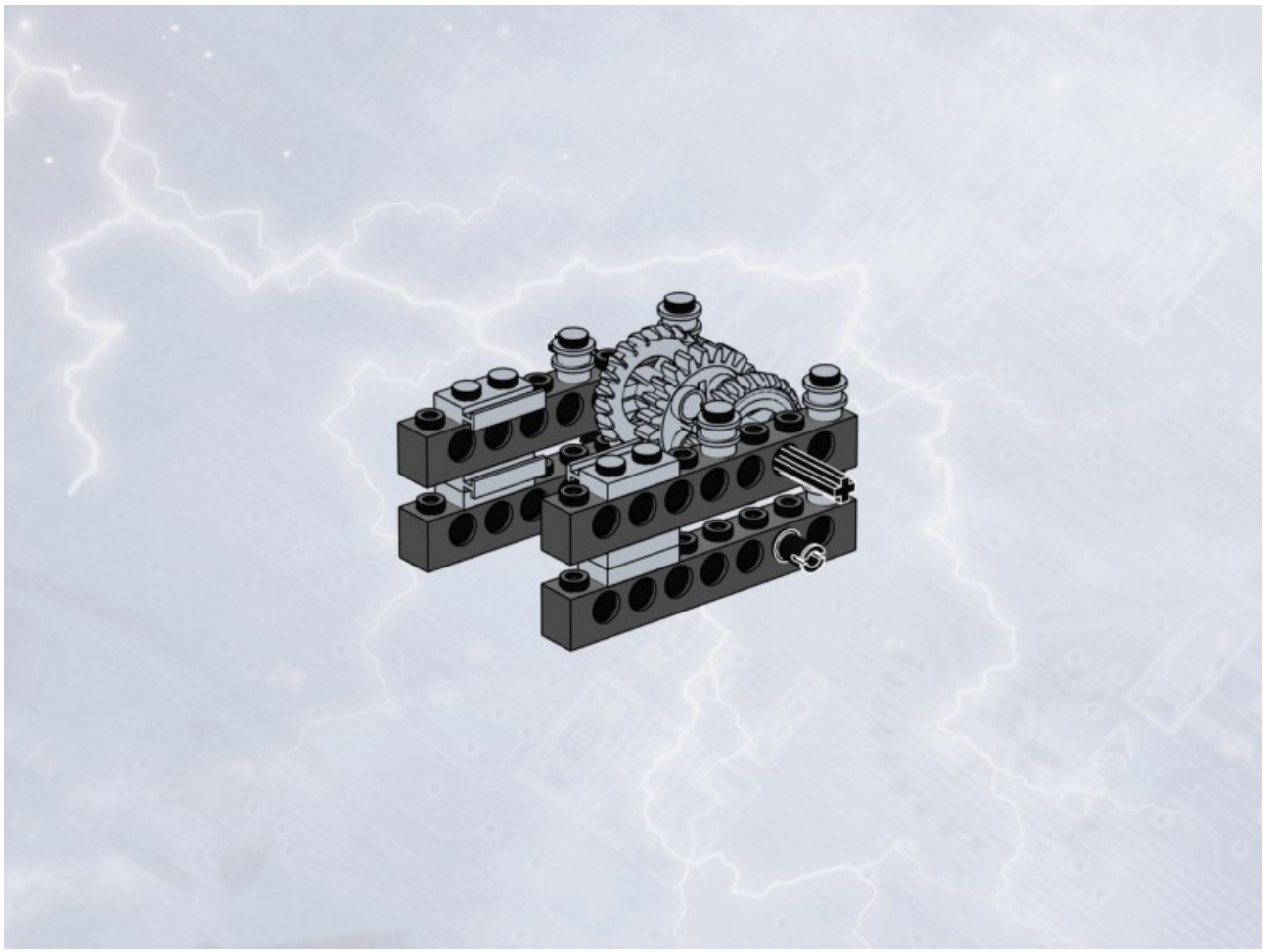

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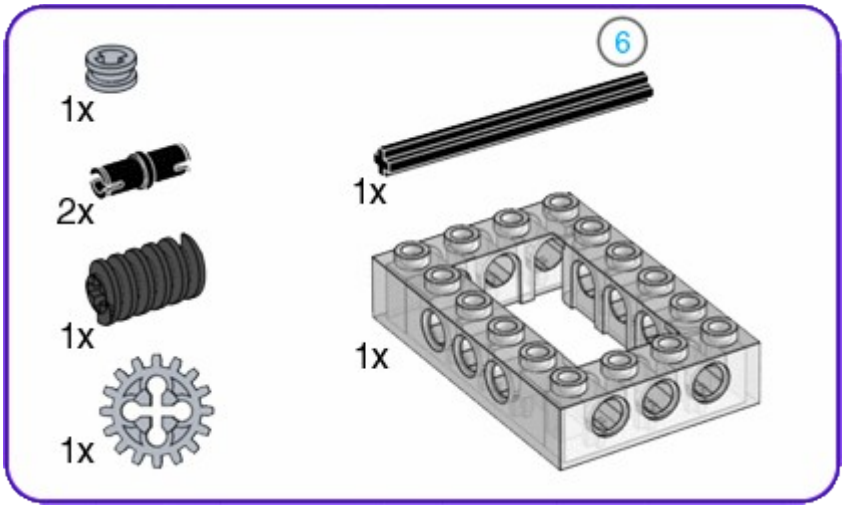

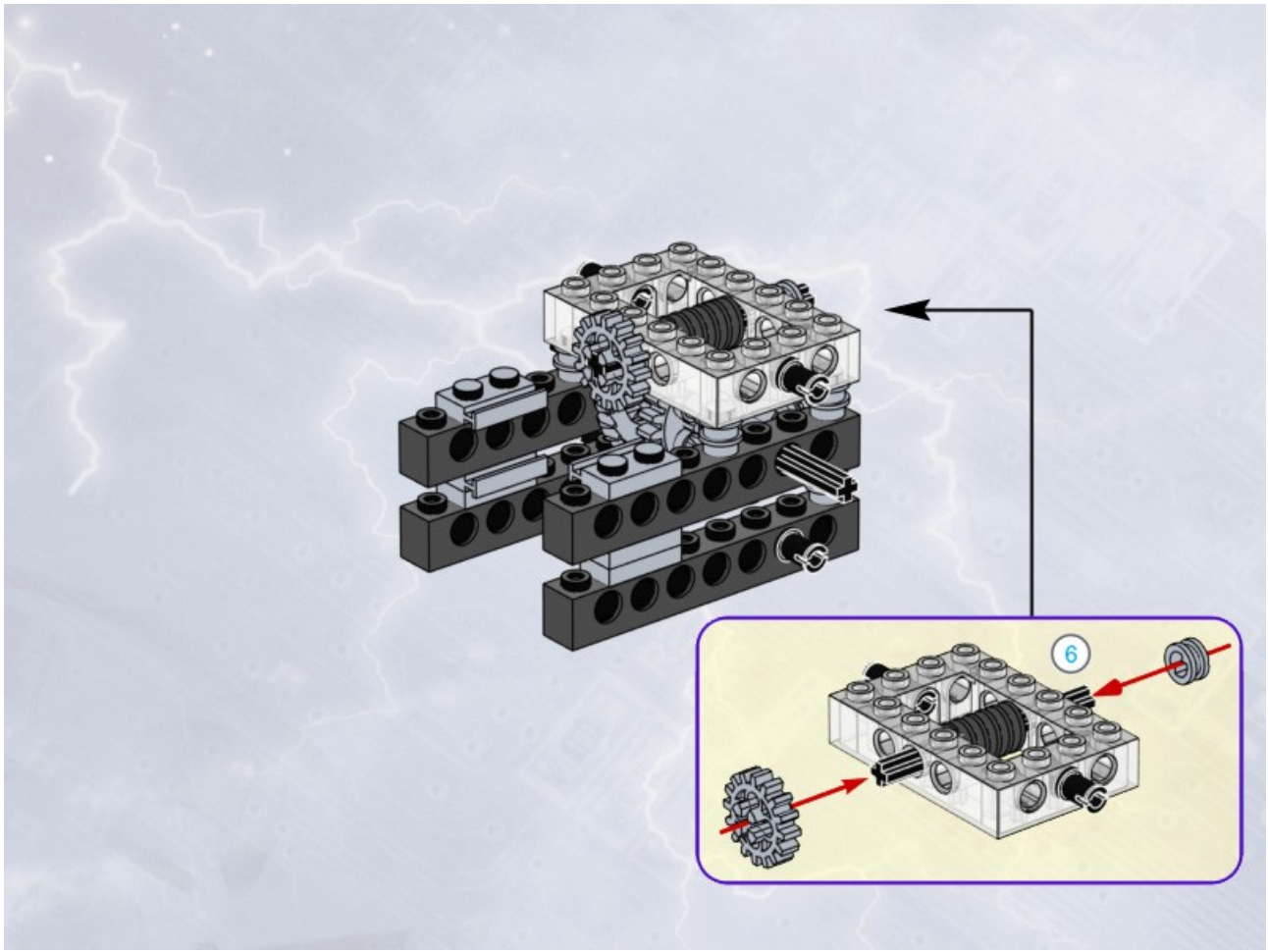

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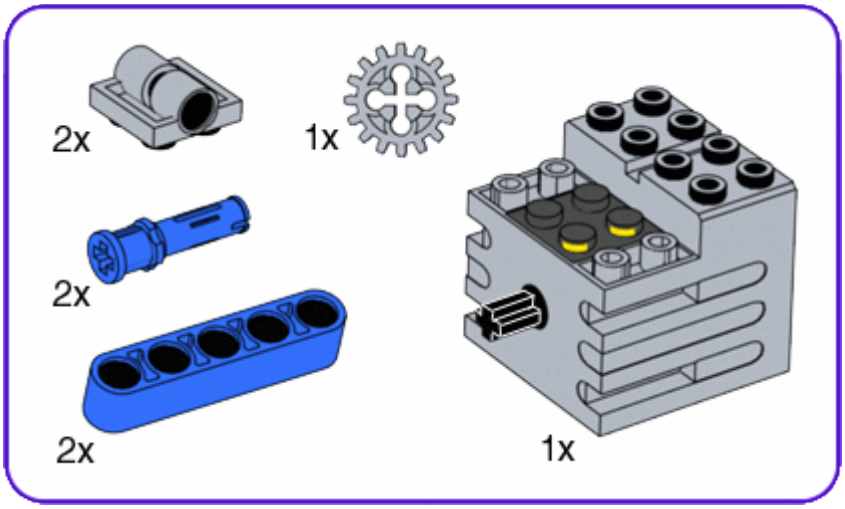
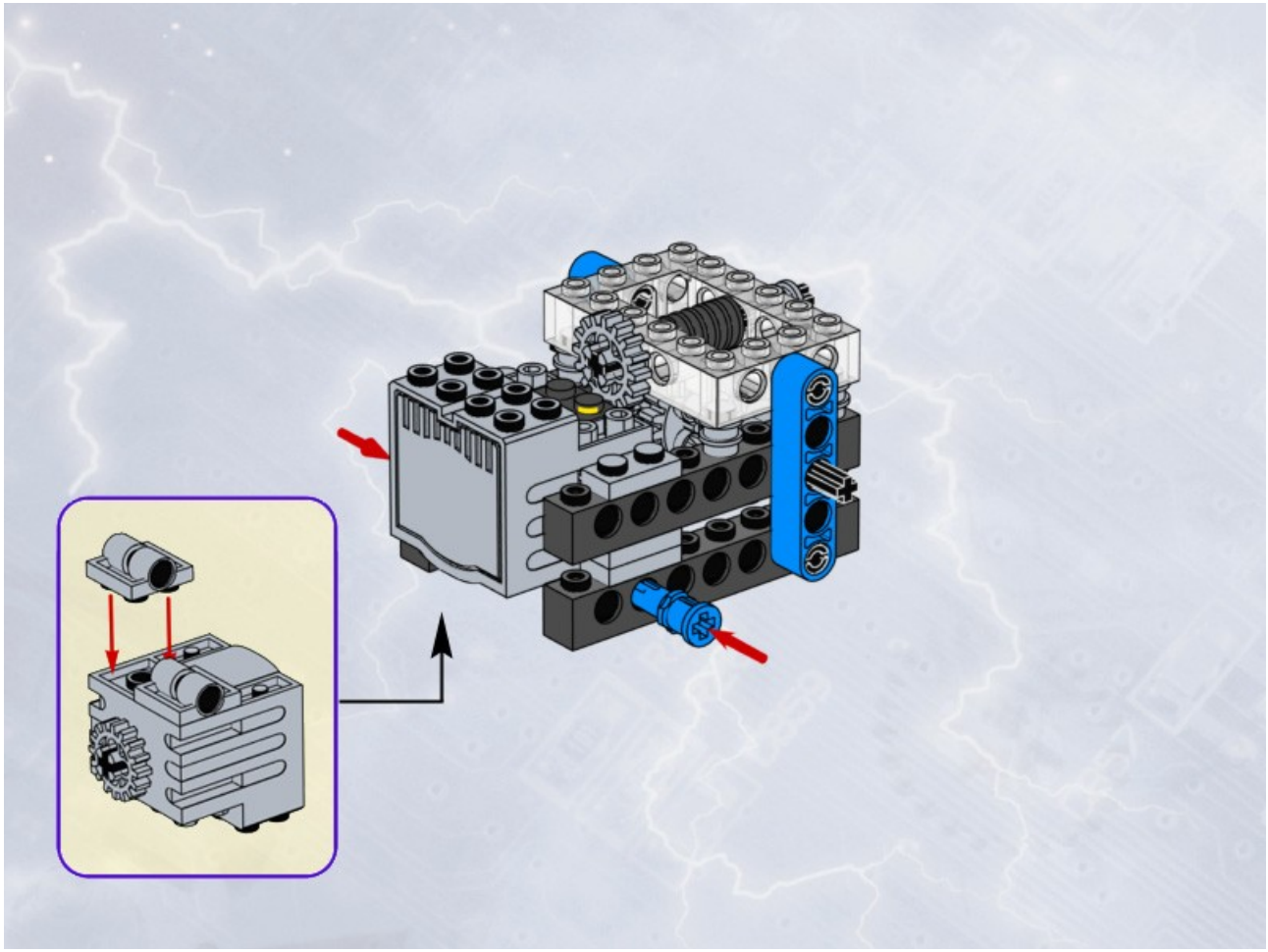
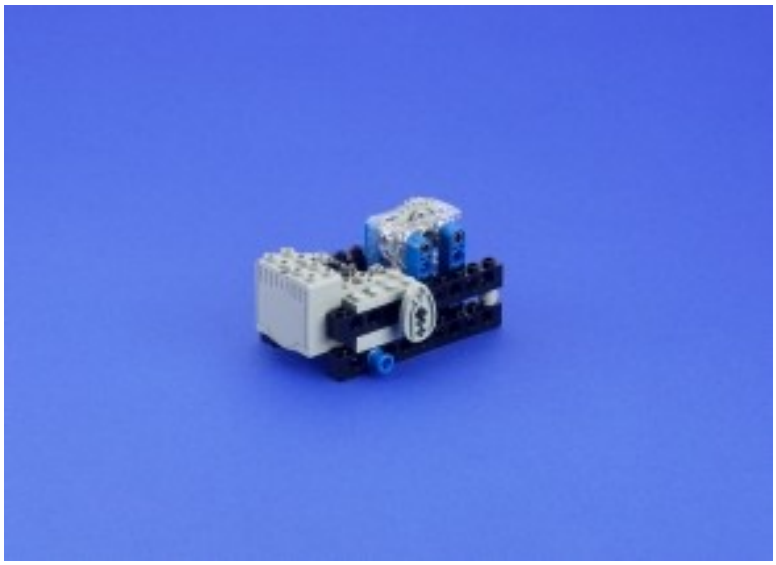




7

Motor Module 4



This Motor Module also uses the worm gear.

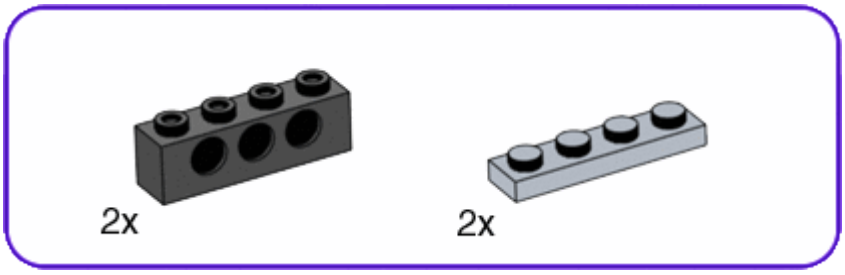
It is placed in a so called worm gear block and gives a 24 to 1 gear ratio, transferring power to the 24-tooth gear placed in the top of the block.

There are three outputs on this Motor Module; one is placed right after the driving gear, giving a 1 to 1 gear ratio.

The attached cam wheel can be used to activate a Touch Sensor.

The other outputs comes from the 24-tooth gear or the axle that goes through it.

1



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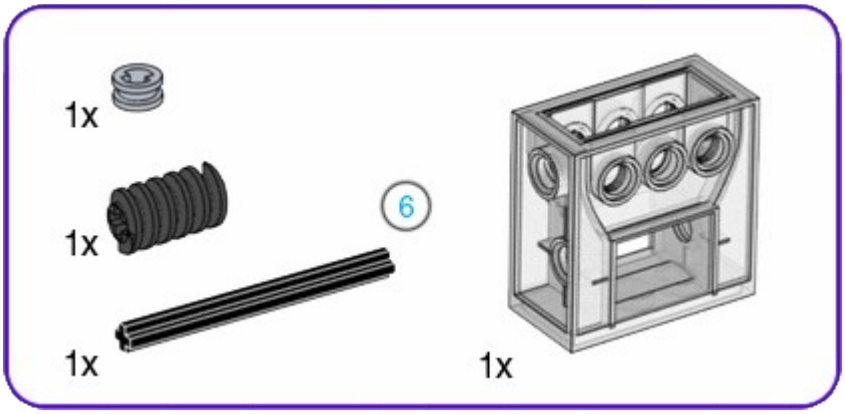

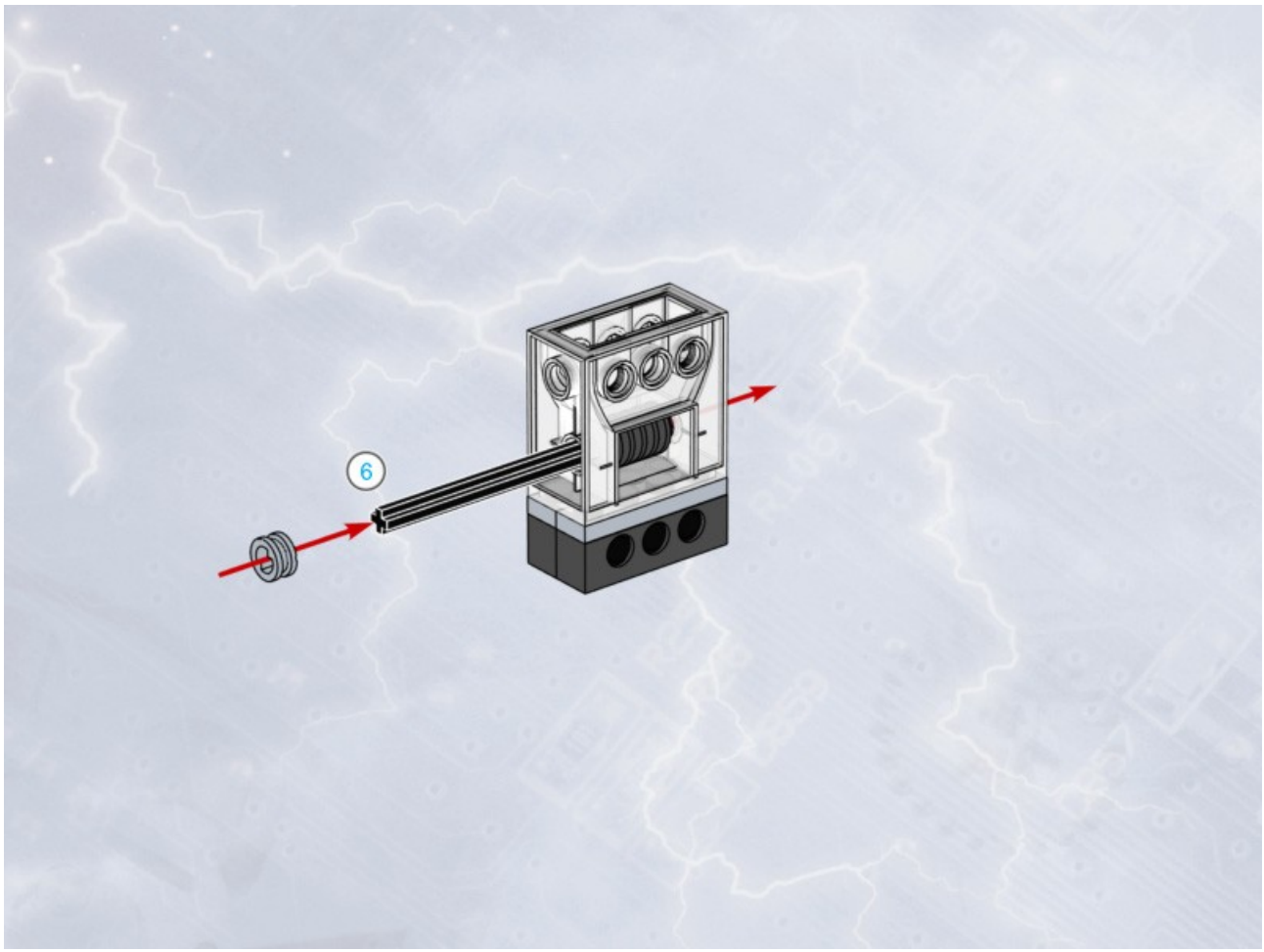

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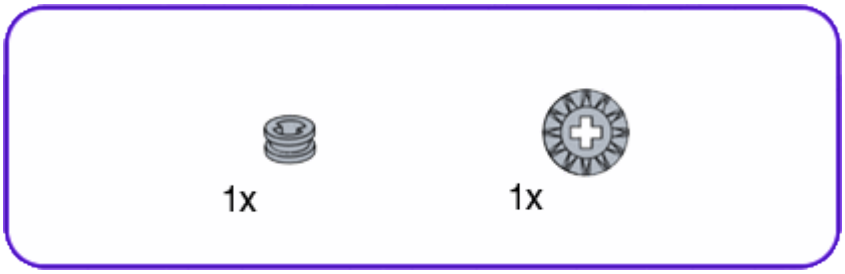

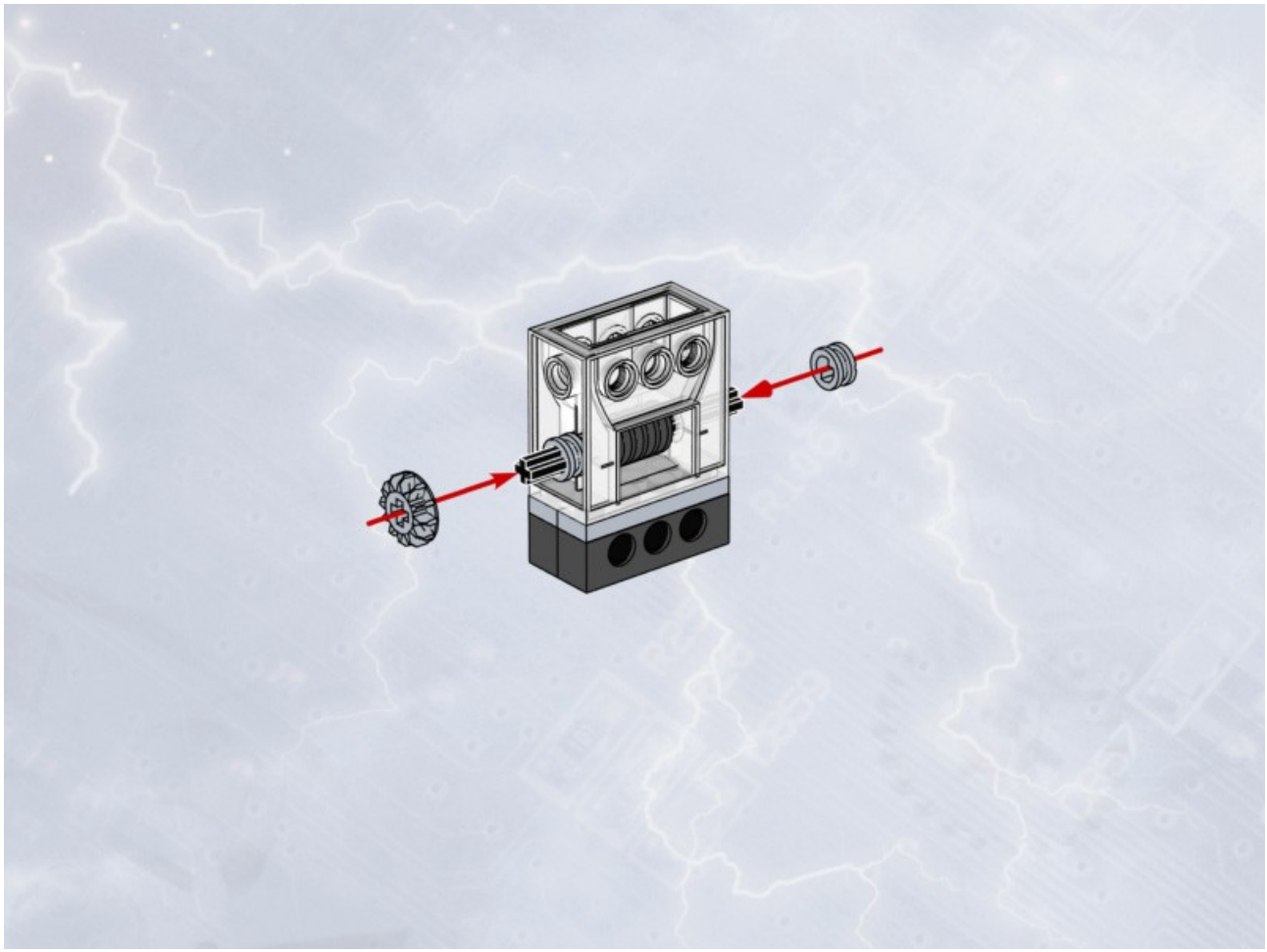

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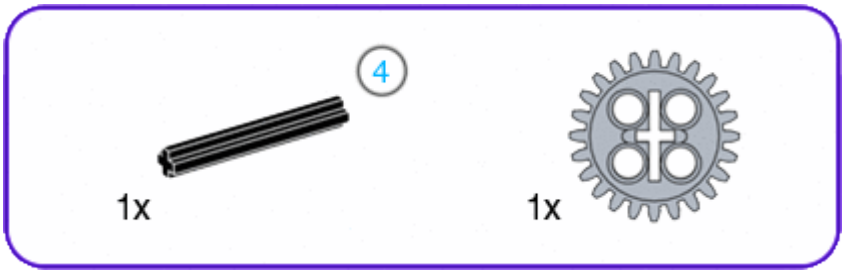

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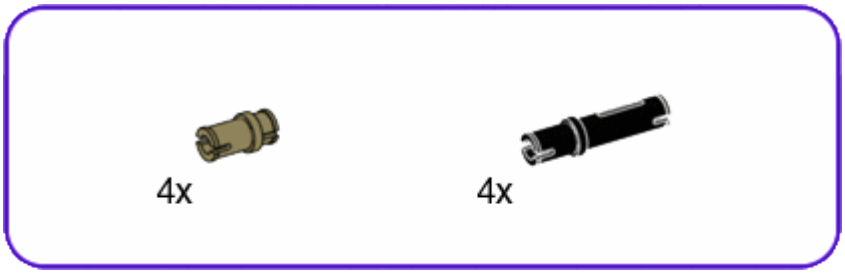

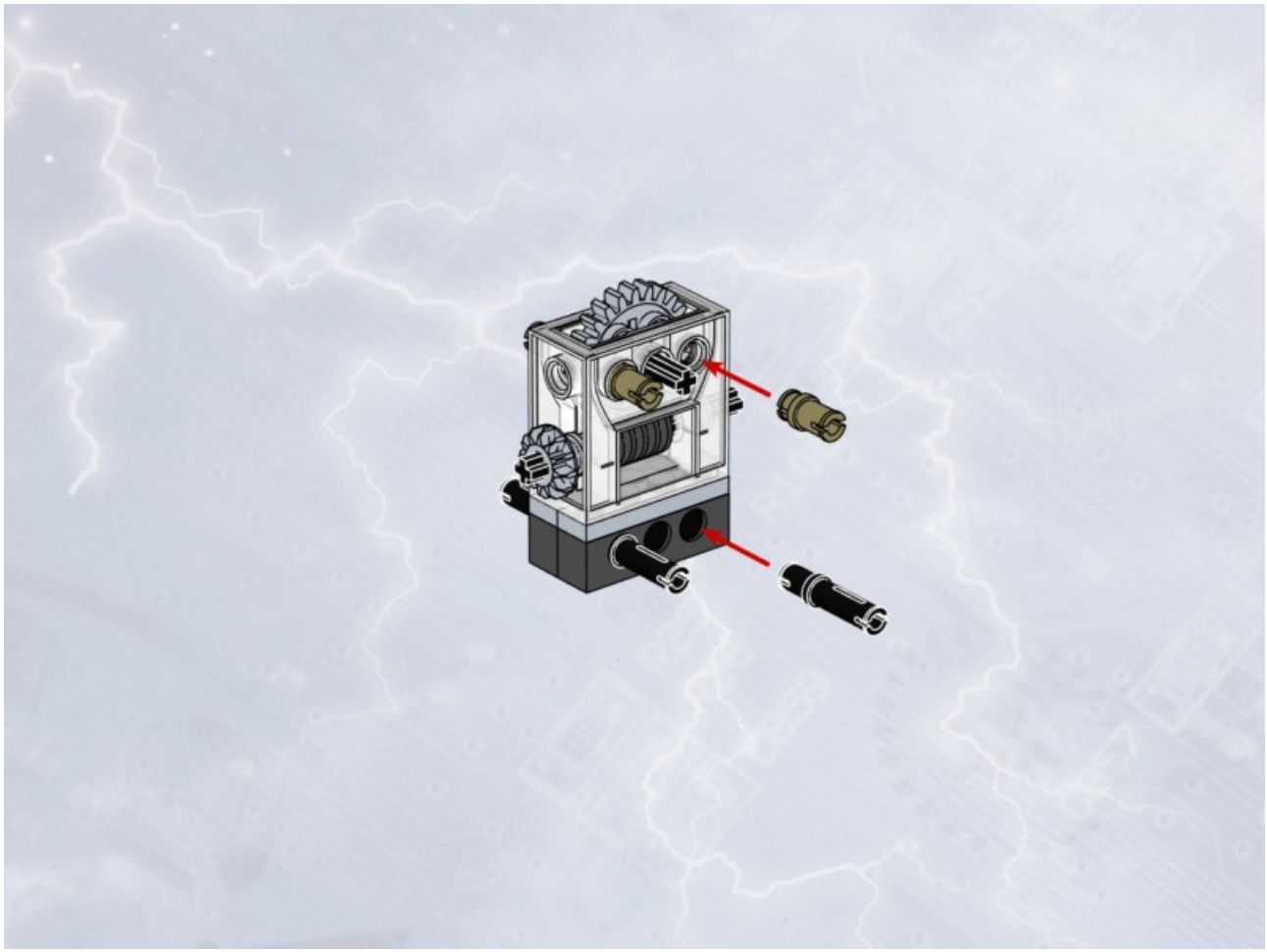

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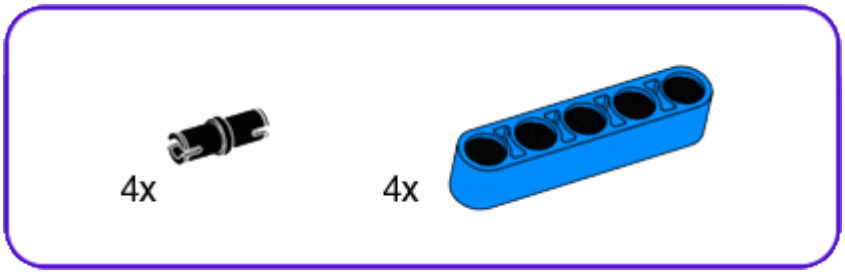

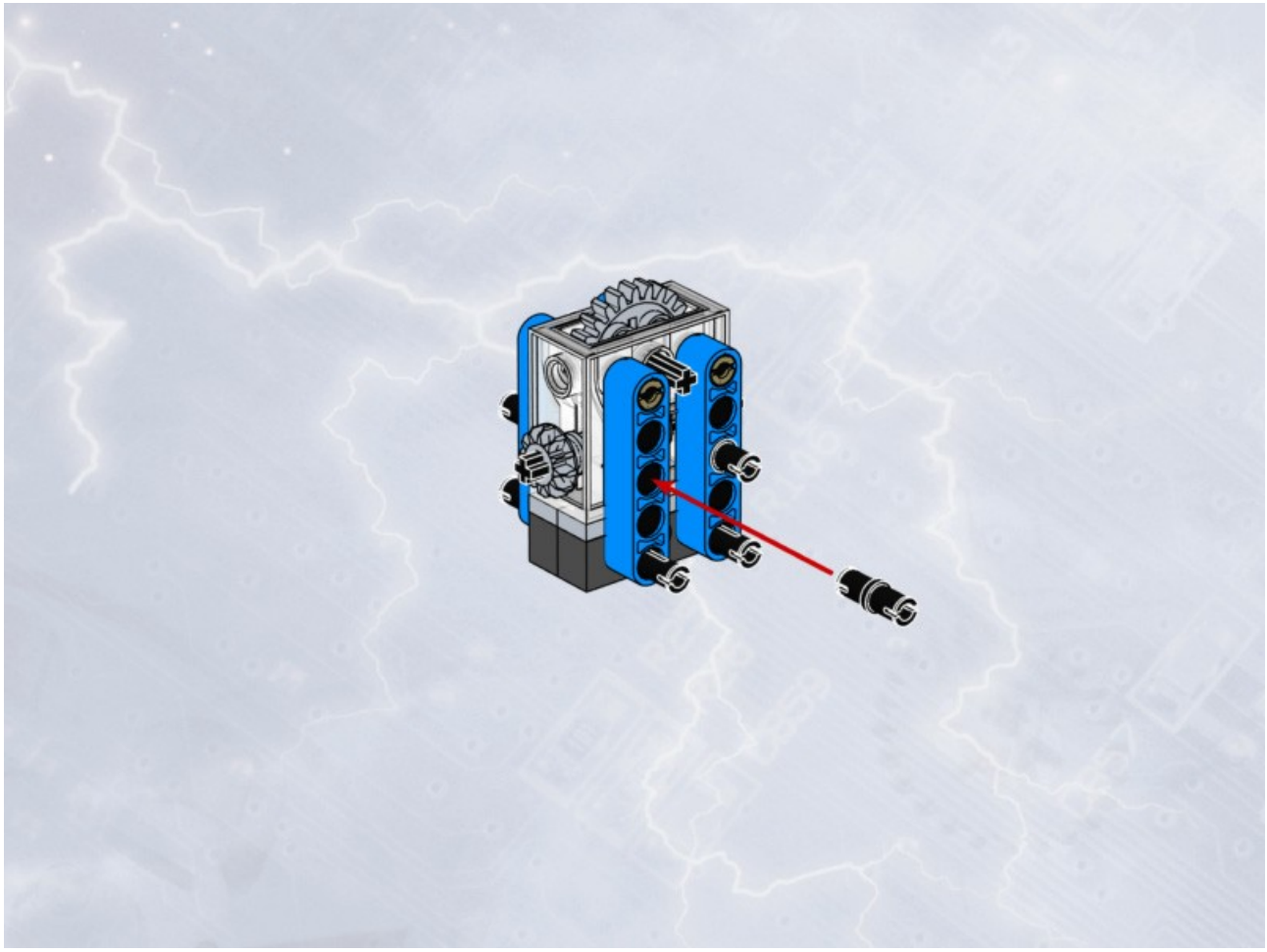

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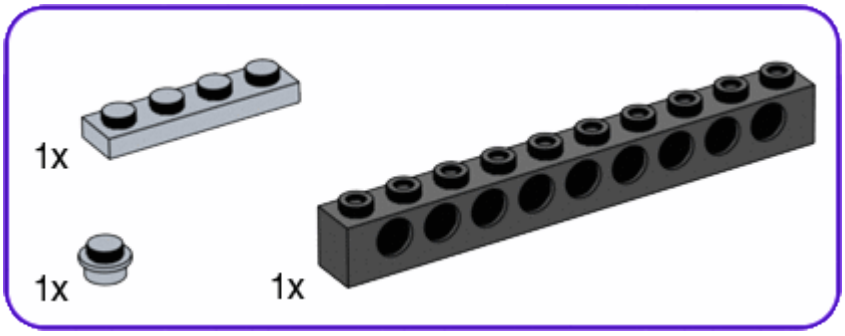

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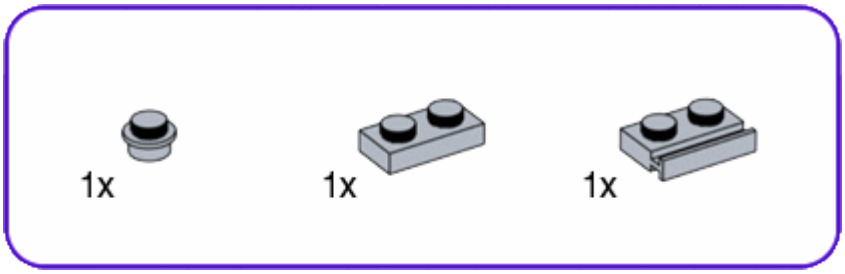

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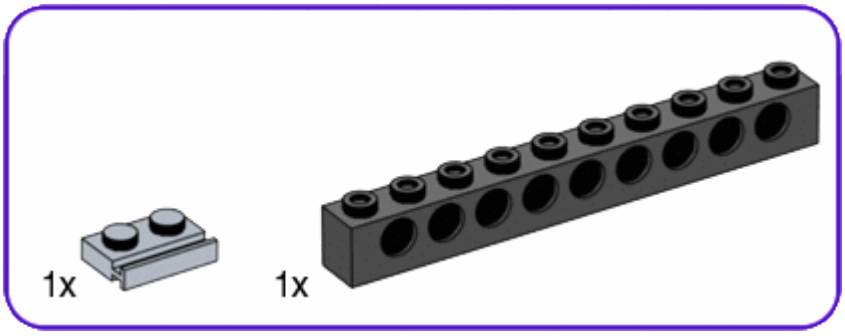

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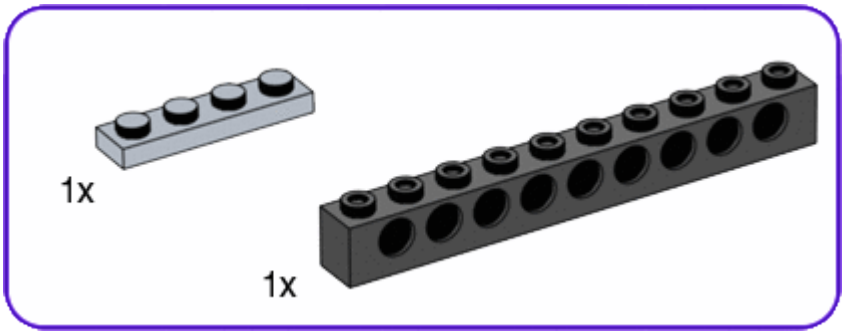

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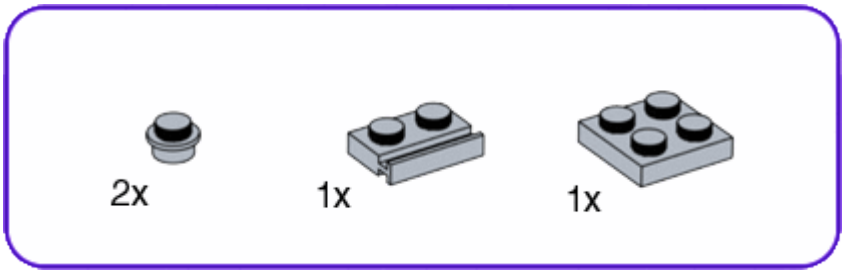

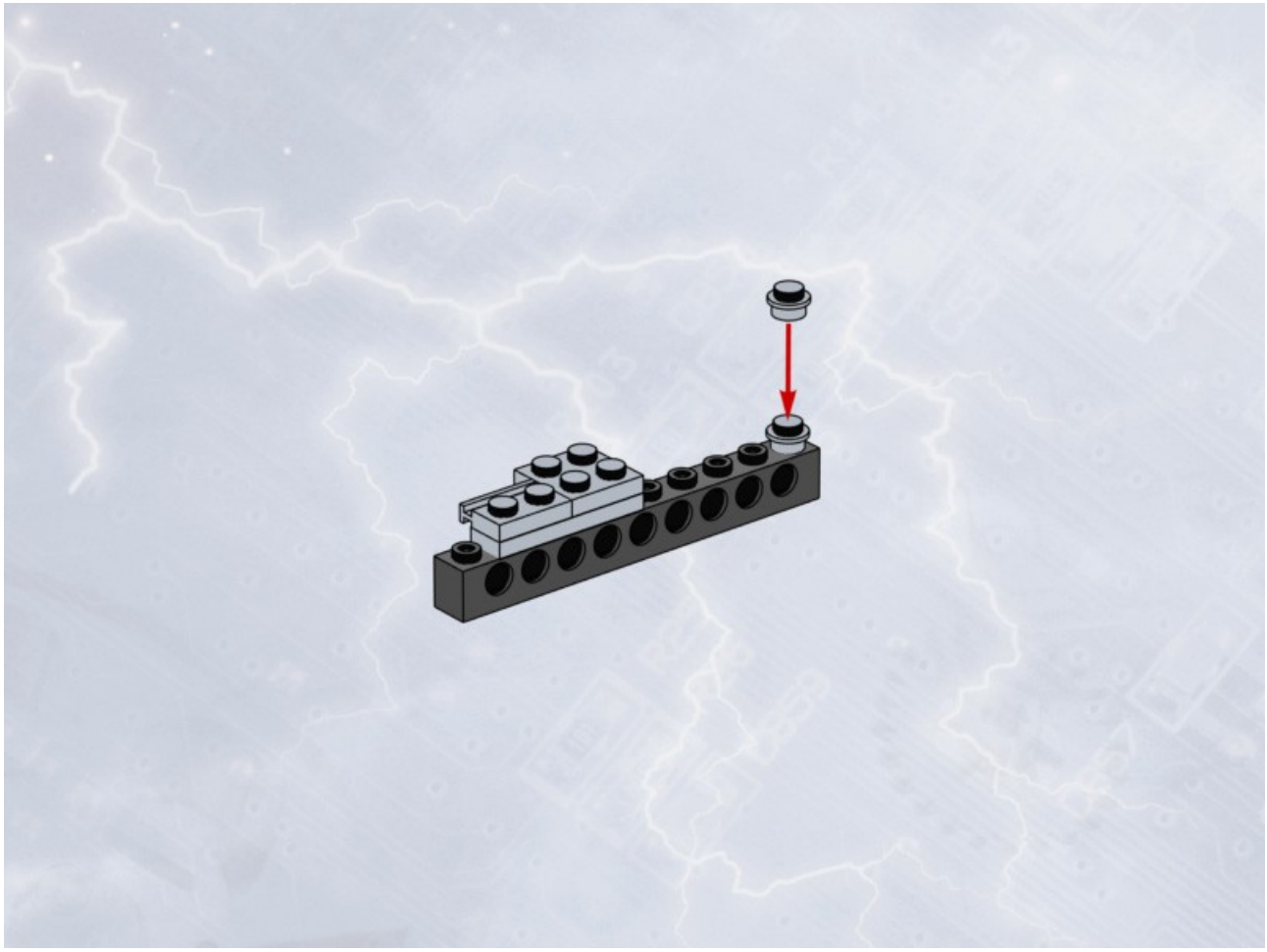

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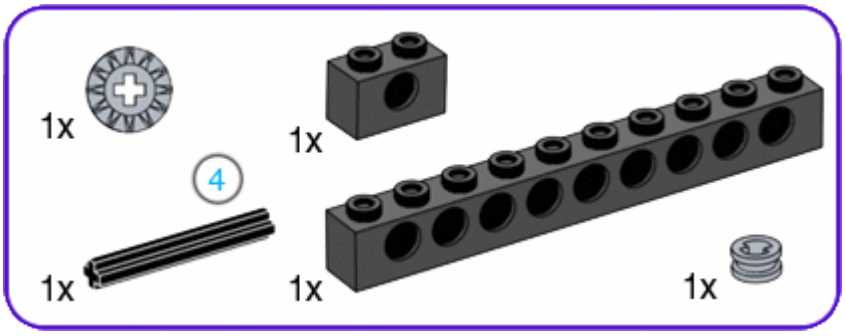

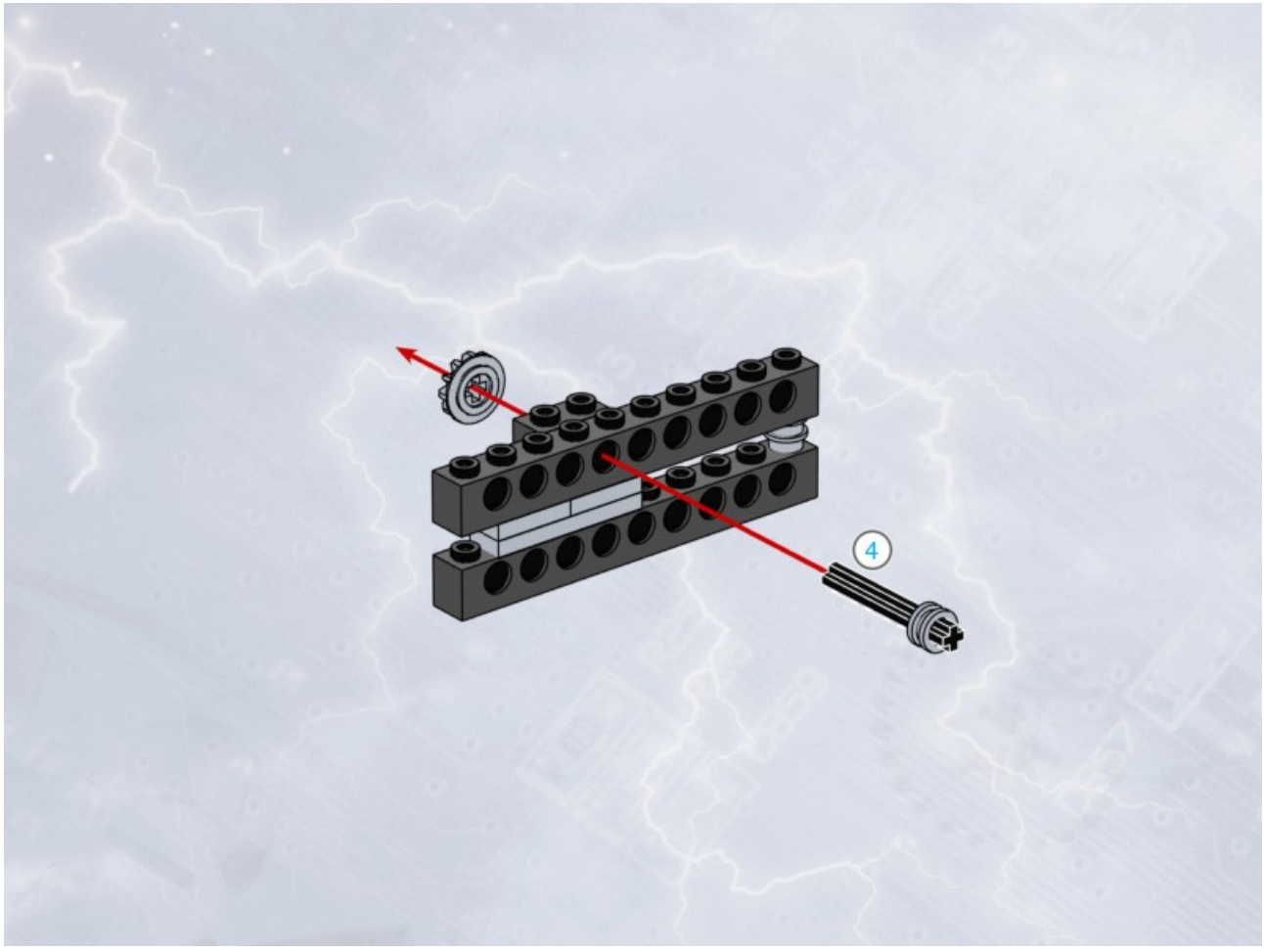

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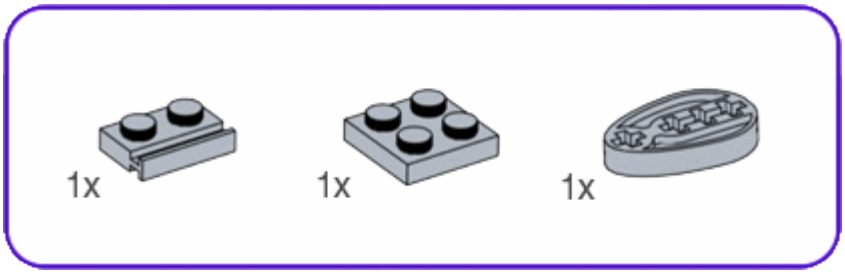

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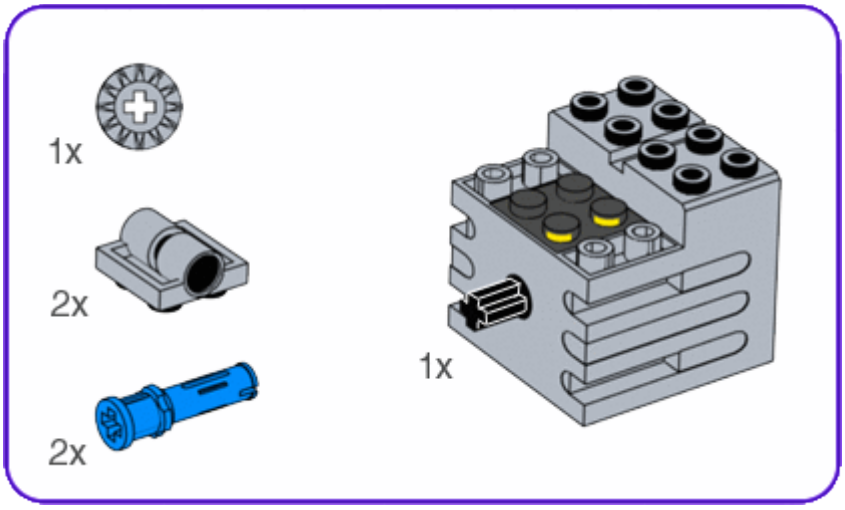
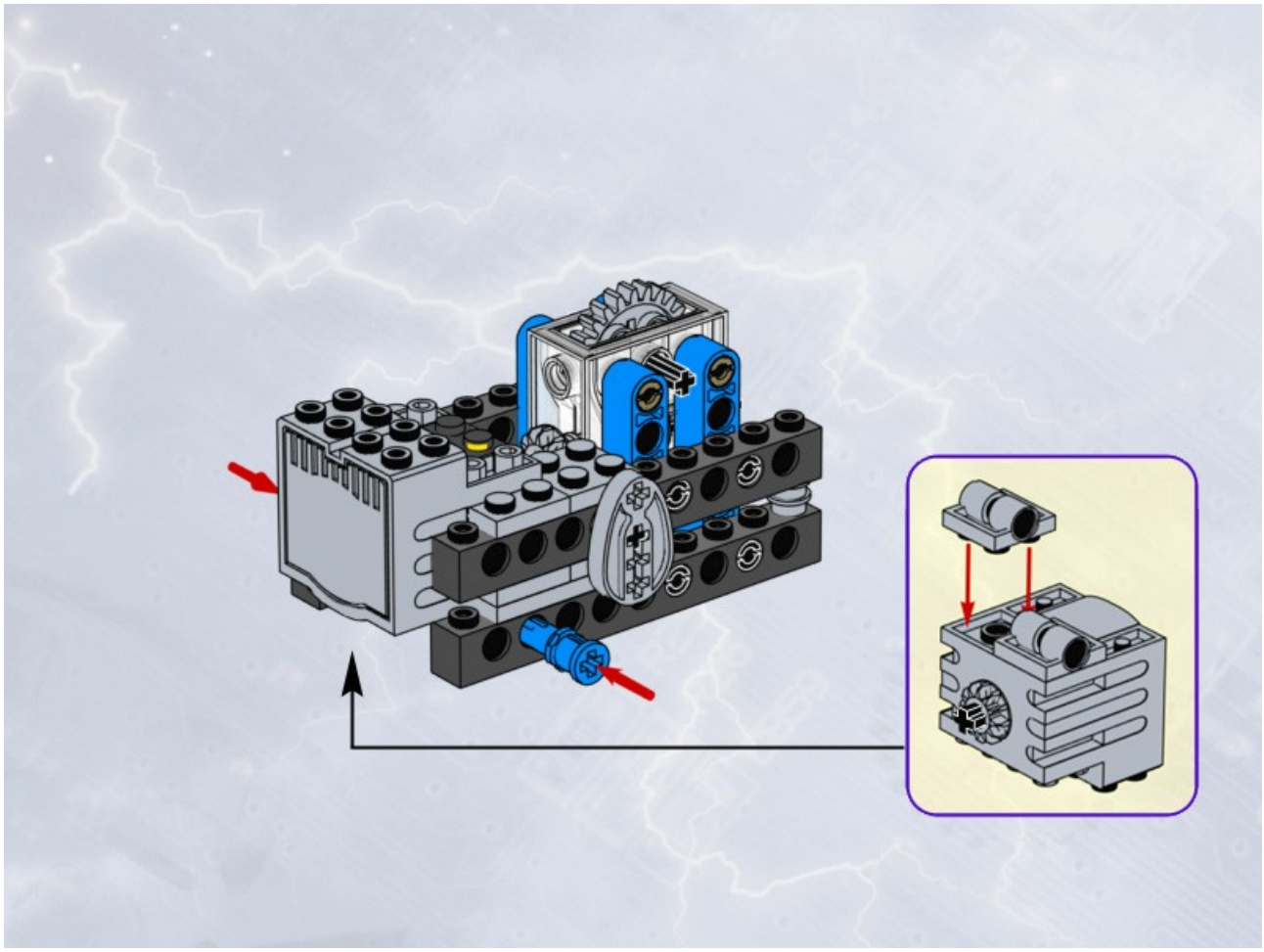
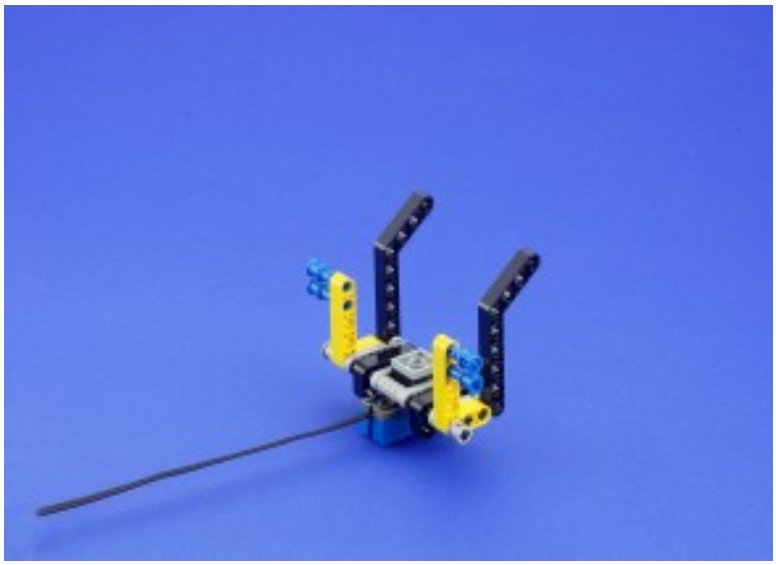




17

Tram Sensor Module

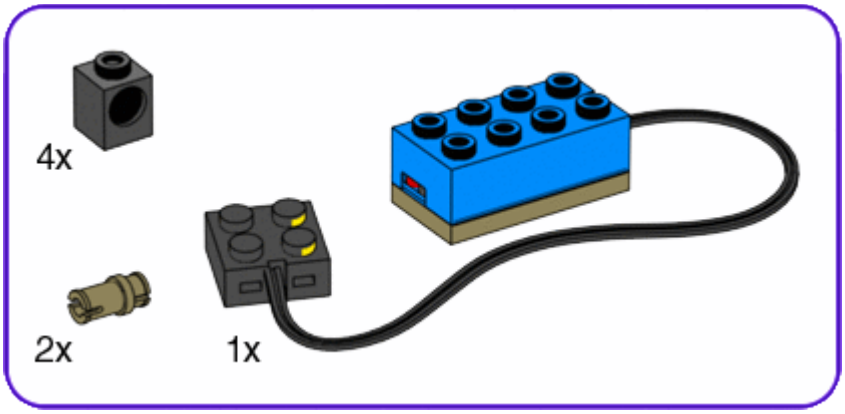


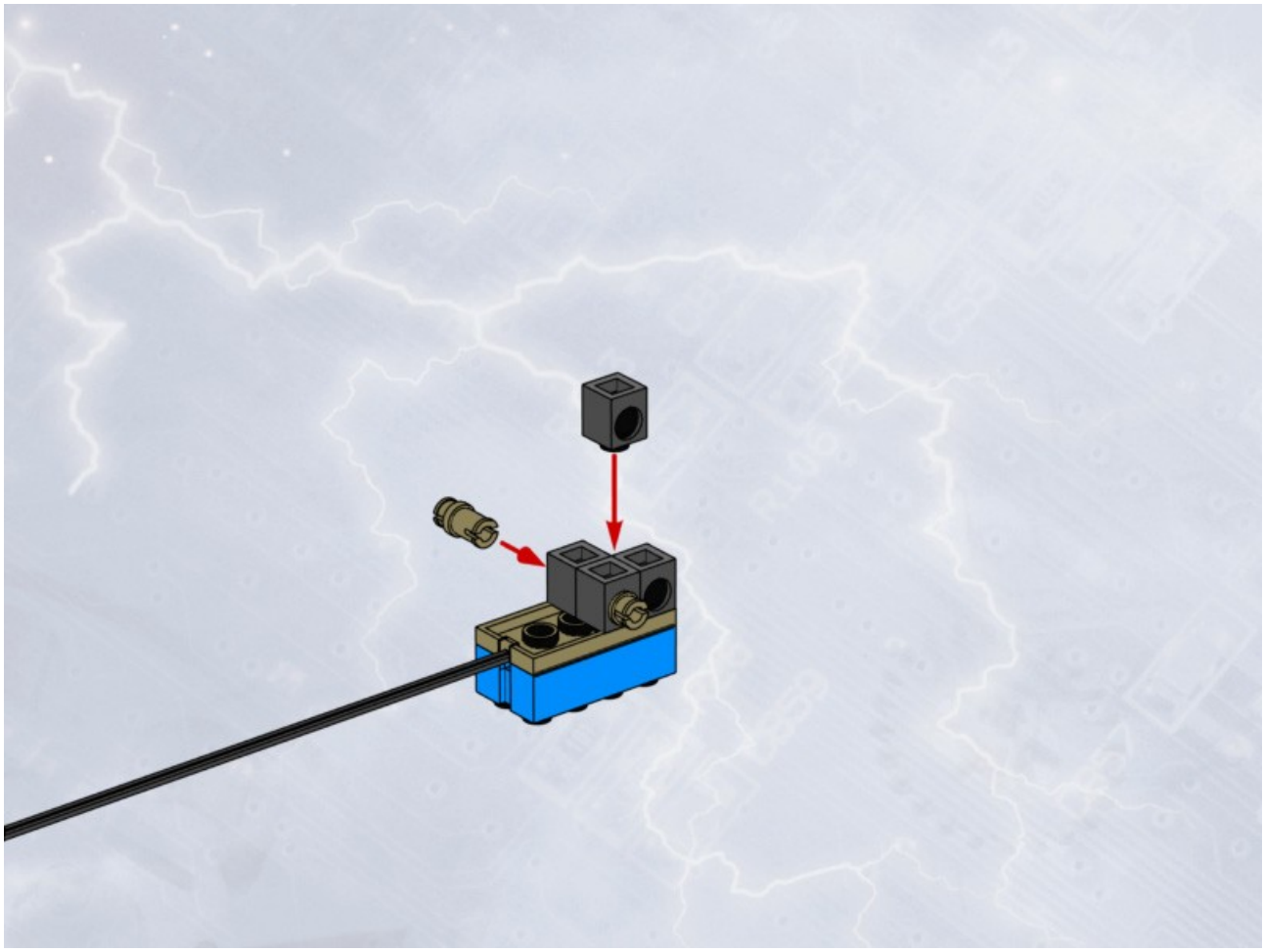
Used in both versions of the Aerial Tram this Module uses a single Light Sensor to detect either end of the Tram's overhead cable.

There are two angle beams that slide in front of the sensor when the Tram reaches the ends of the cable, one Light Grey and the other Black.

This way the RCX can tell which end of the cable the Tram has reached and be programmed to respond appropriately.

1





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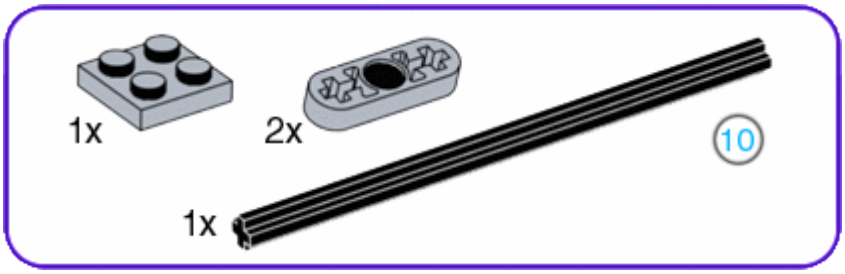

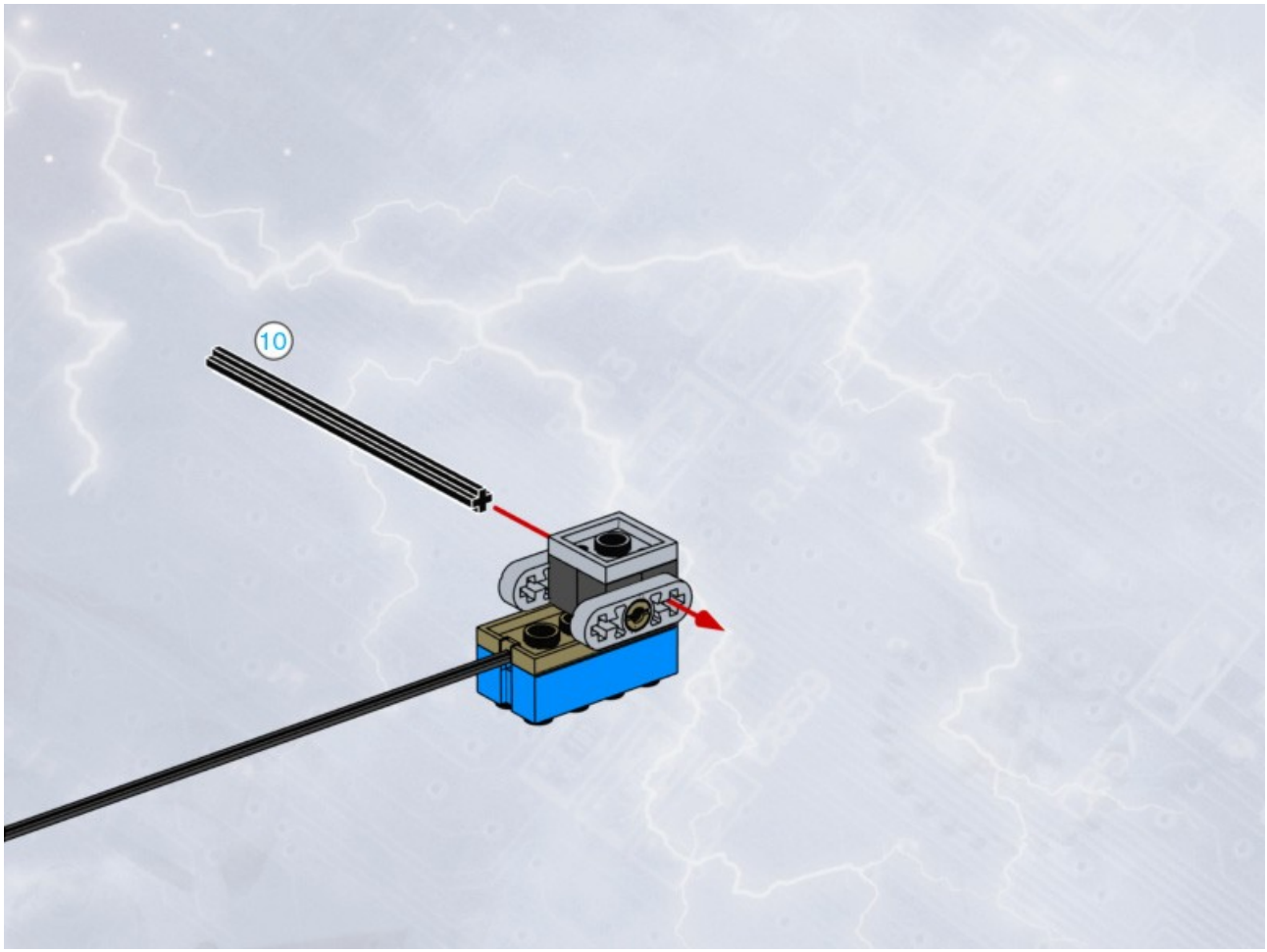

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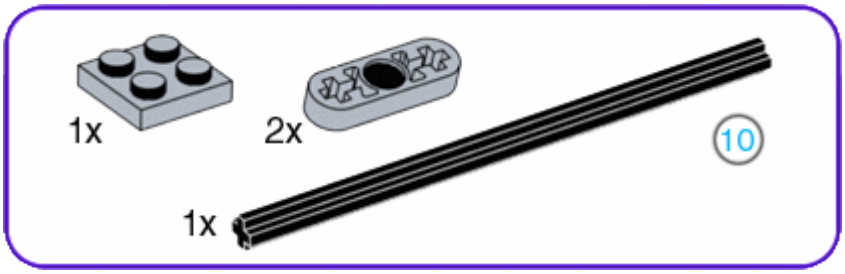

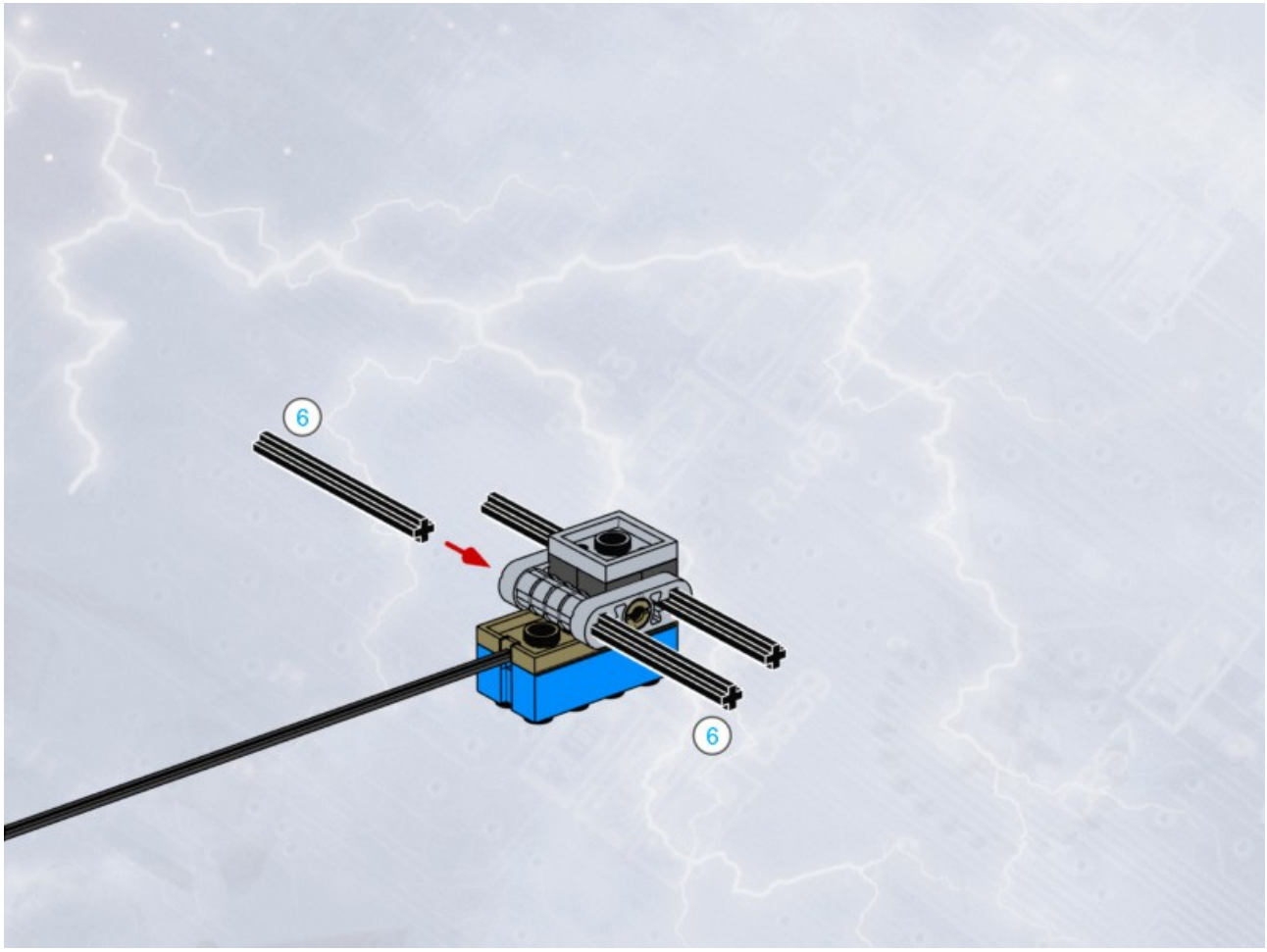

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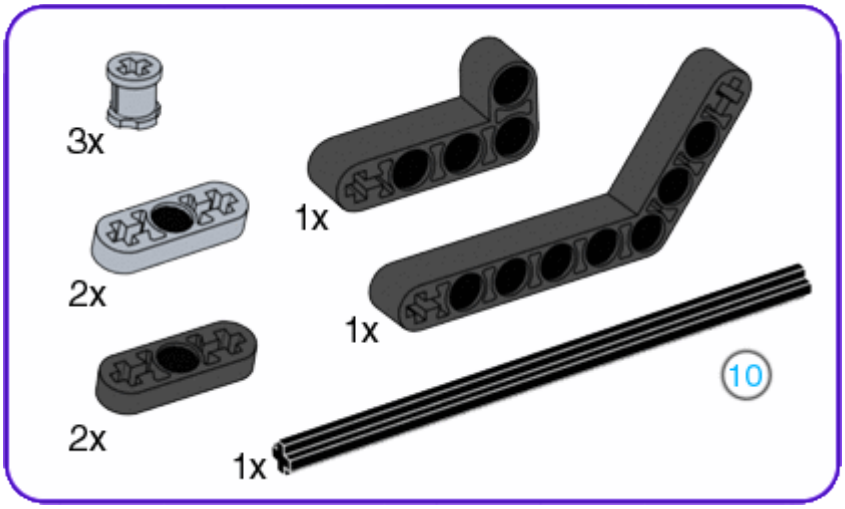

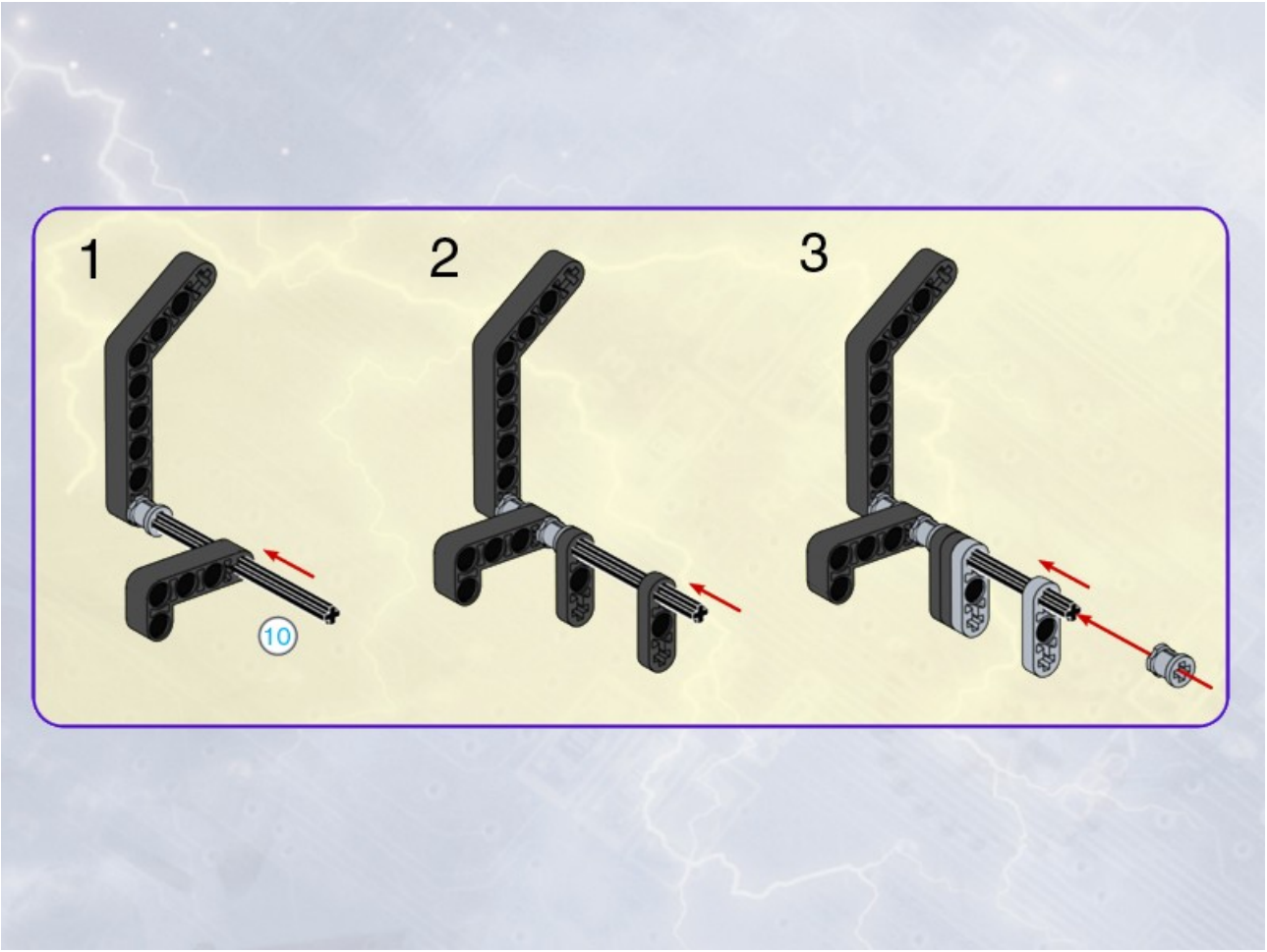

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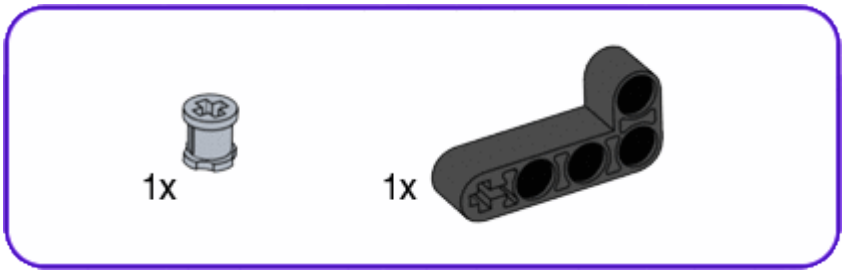

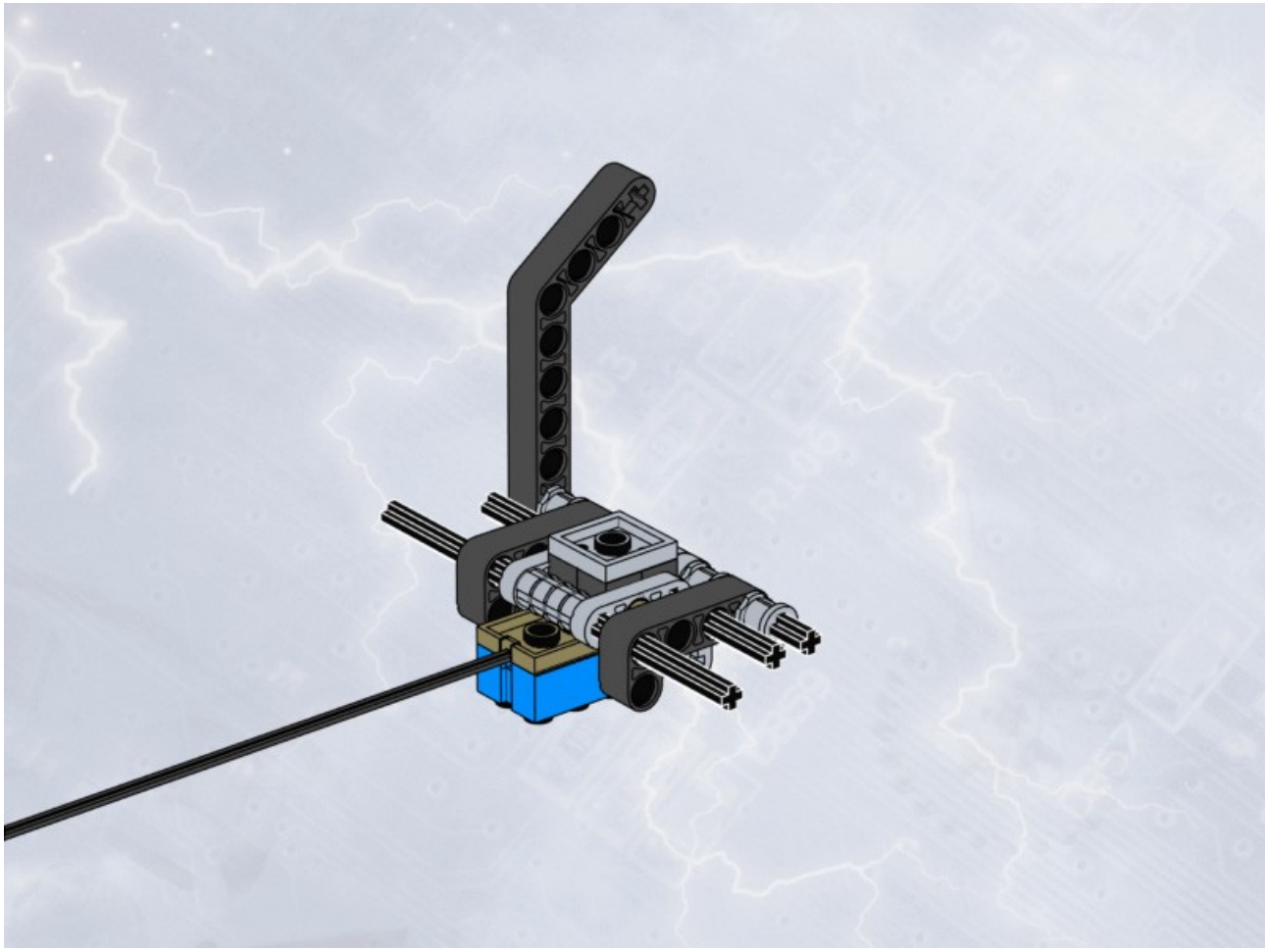

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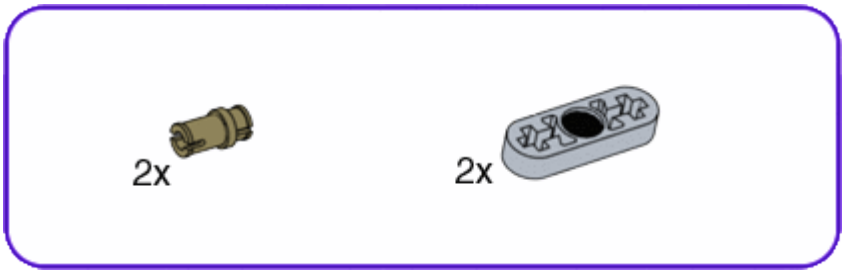

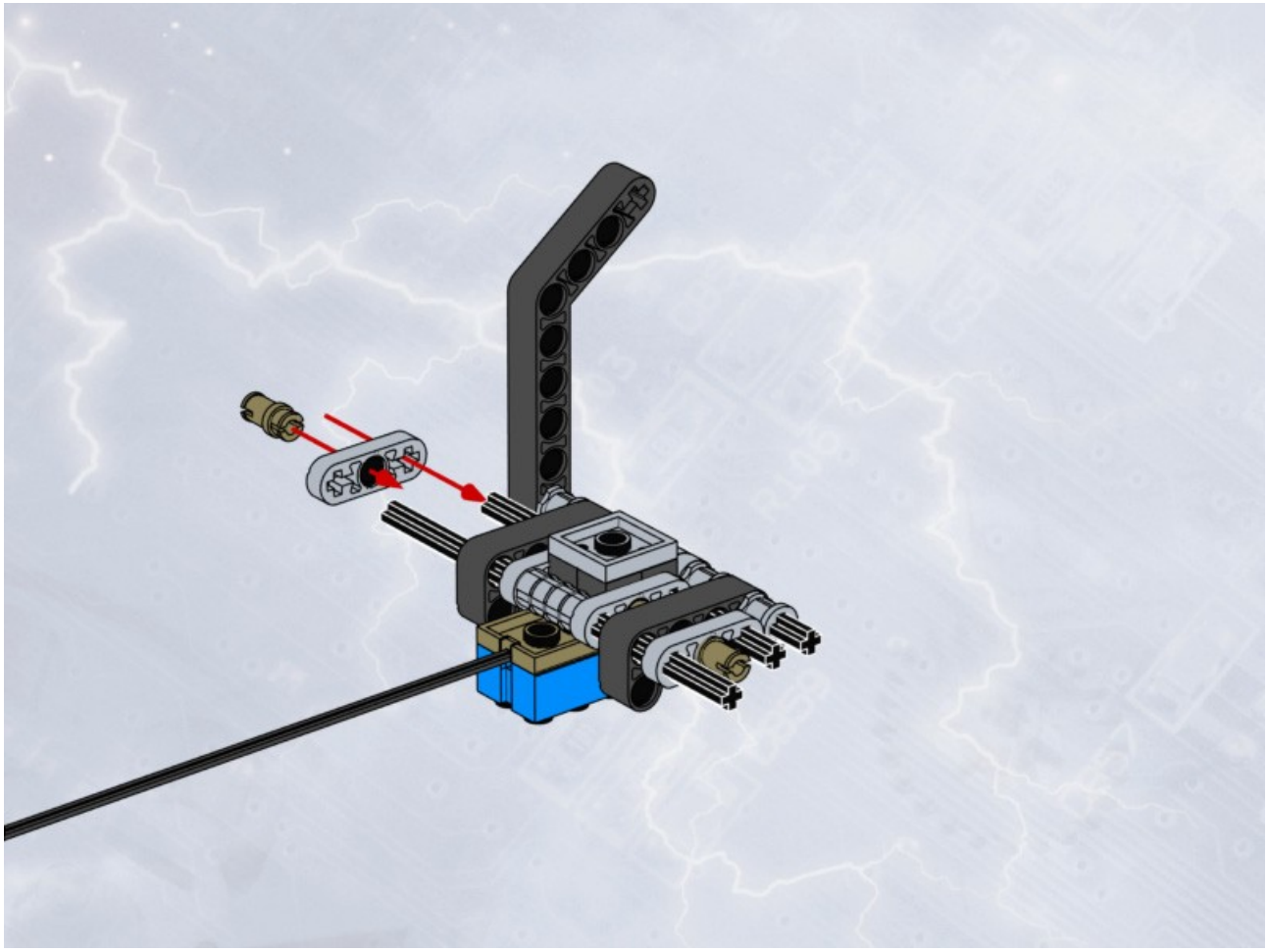

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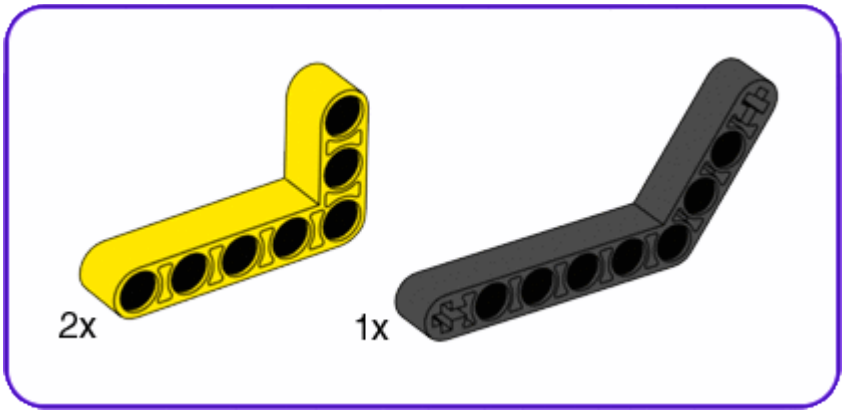

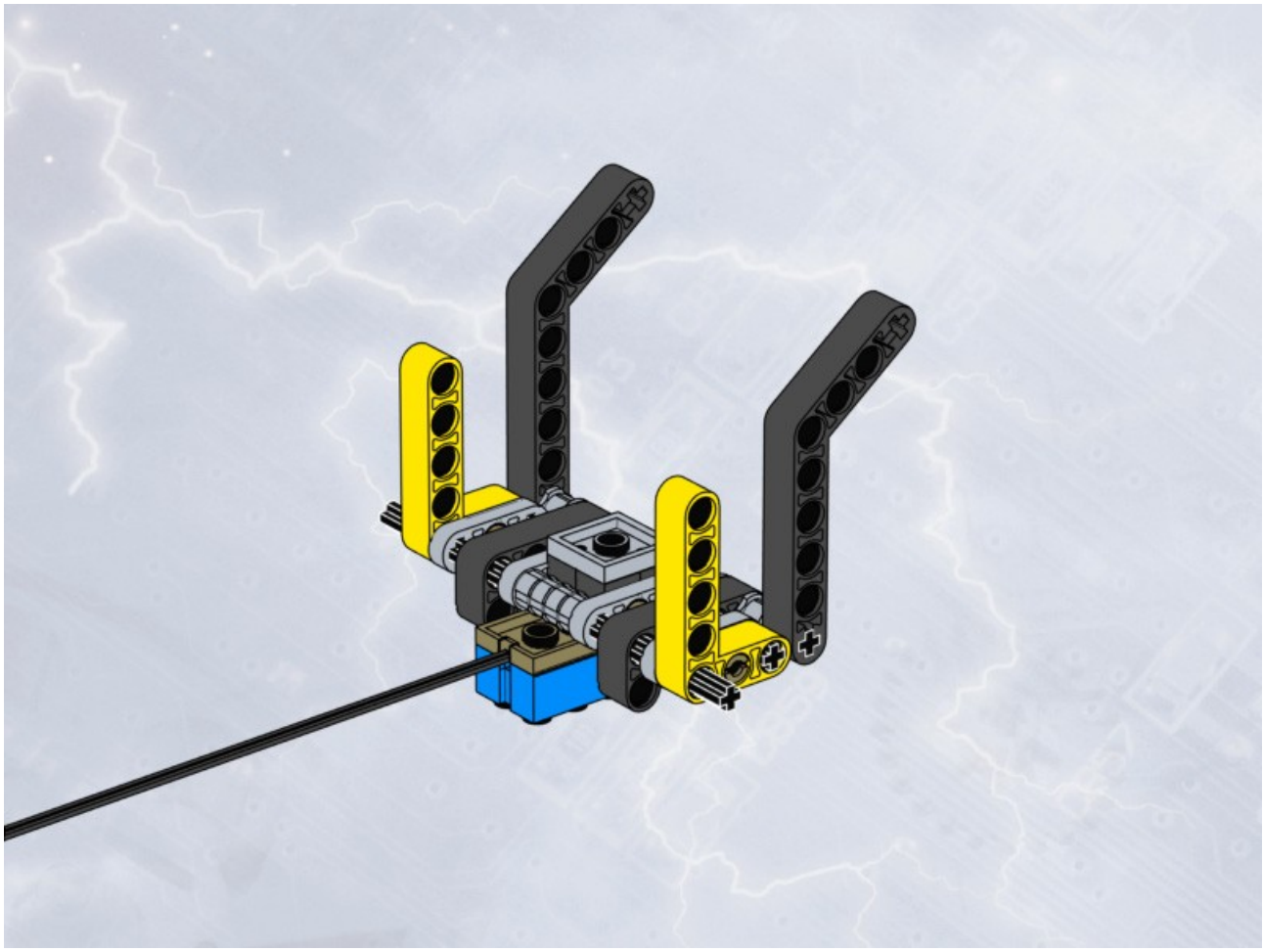

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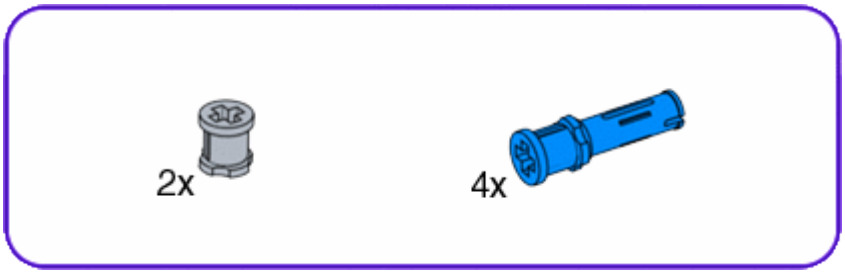

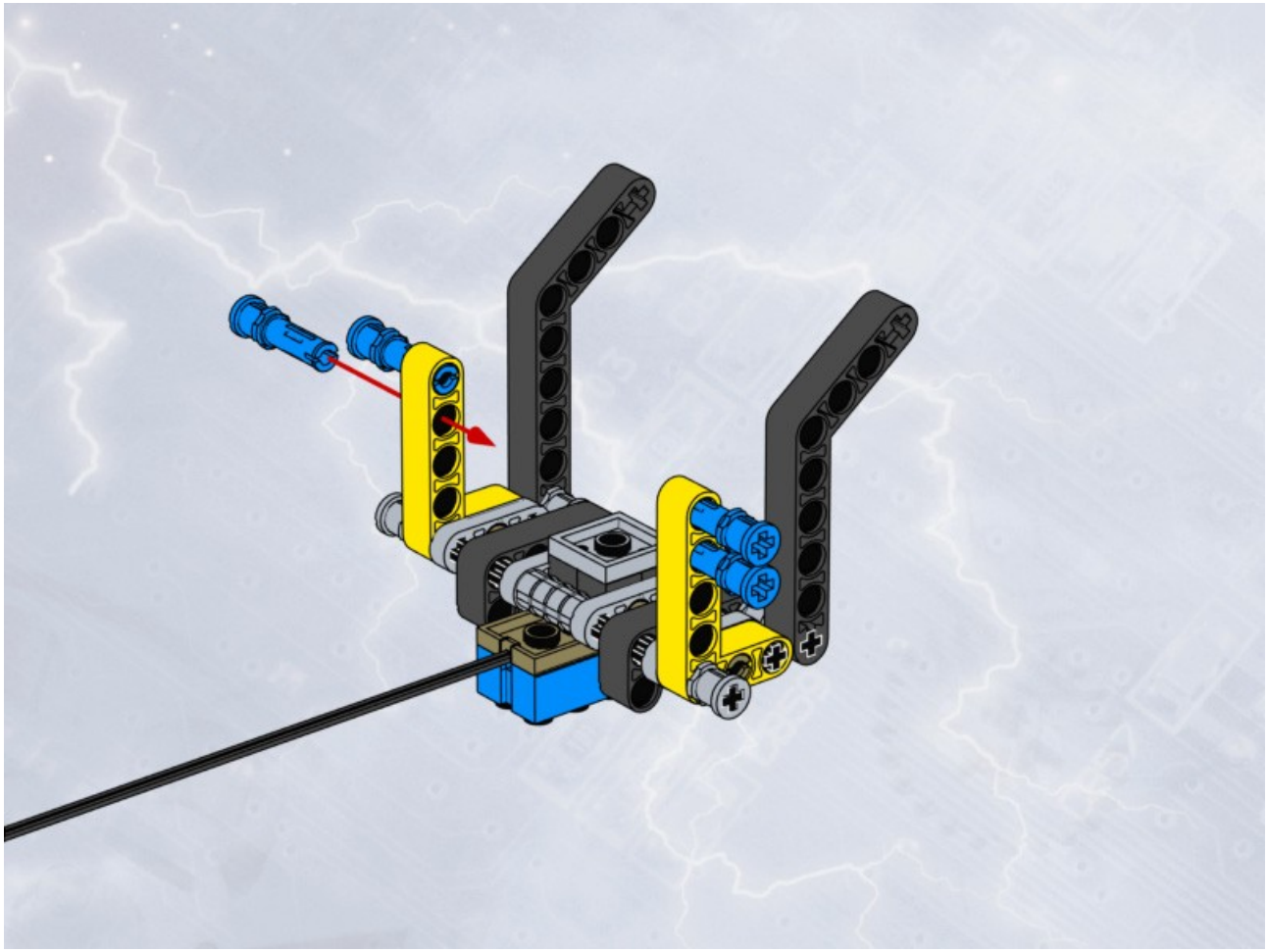

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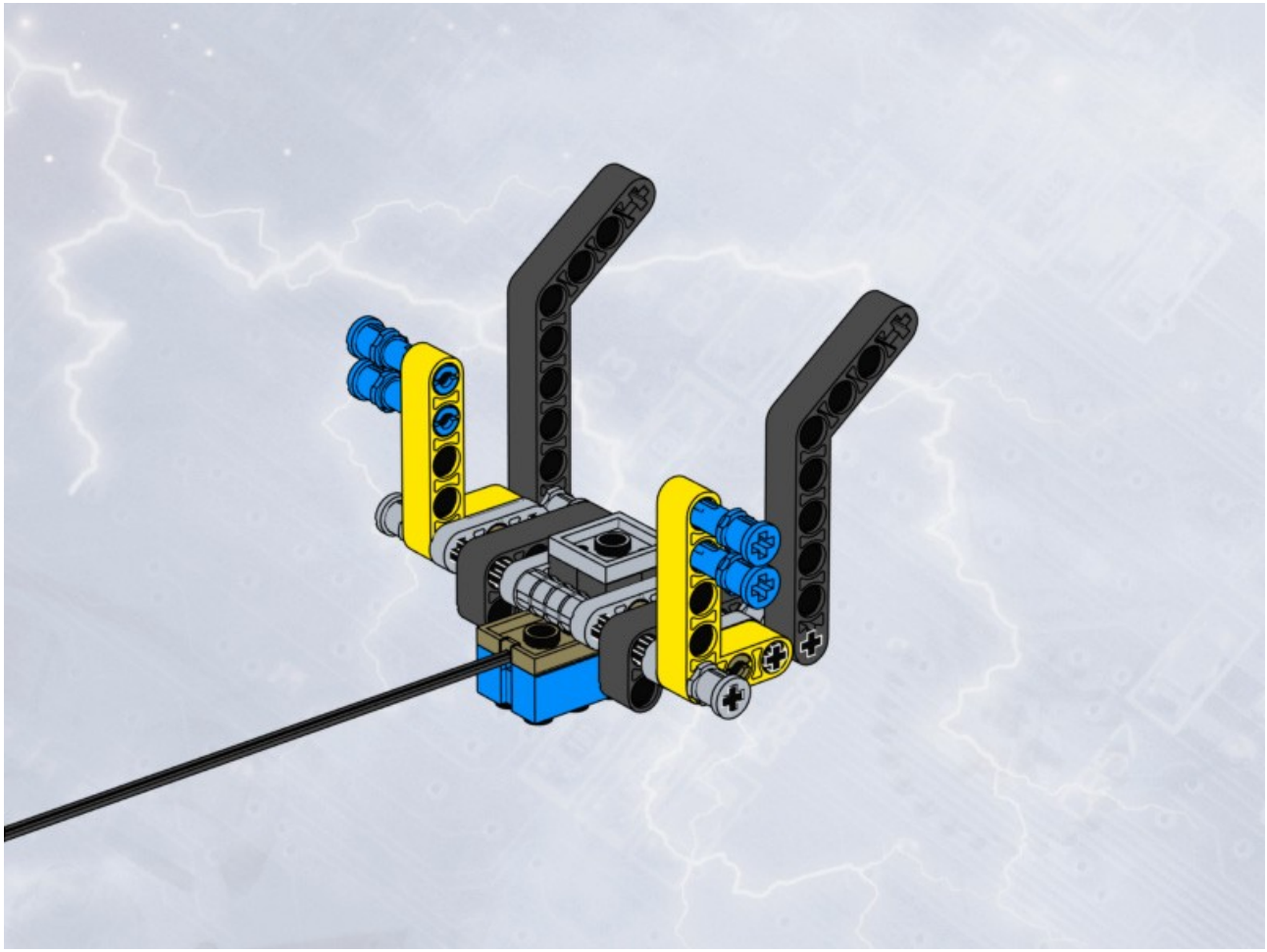


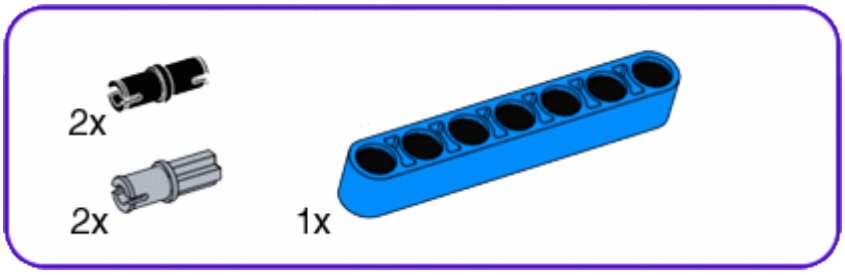
Winch Module

The Winch Module is designed to lower and raise a hook using a spool with a length of cable.

With a total gear ratio of 8 to 1 from the motor to the winch spool, the winch moves quite smoothly.

Build the Winch and see if you can program your Aerial Tram to stop over a certain spot and lower the hook and pick something up.

1



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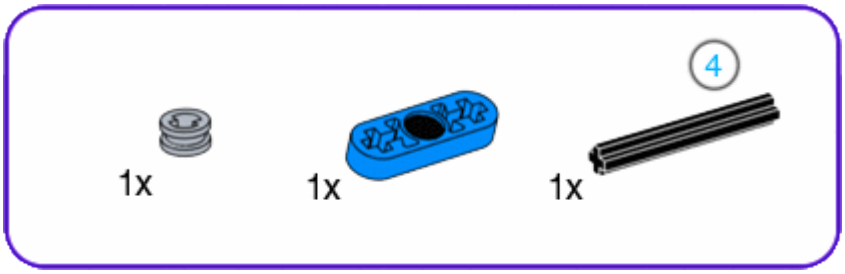

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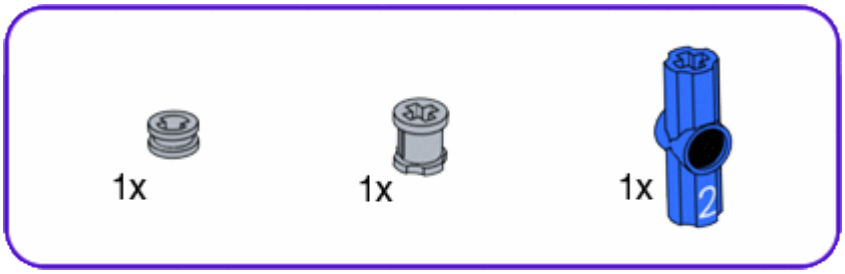

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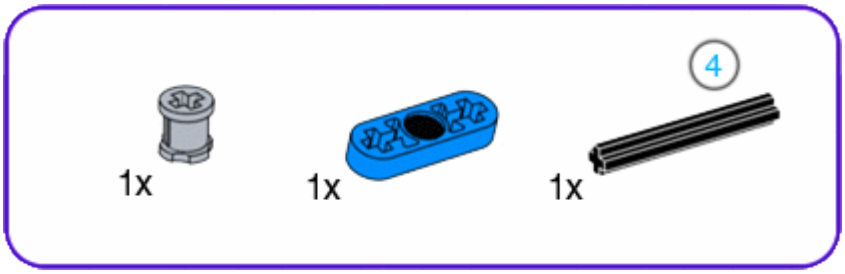

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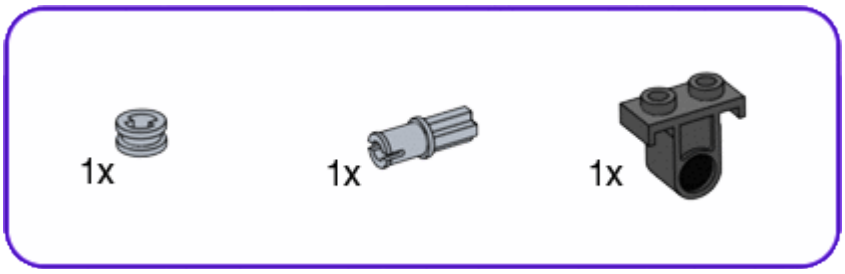

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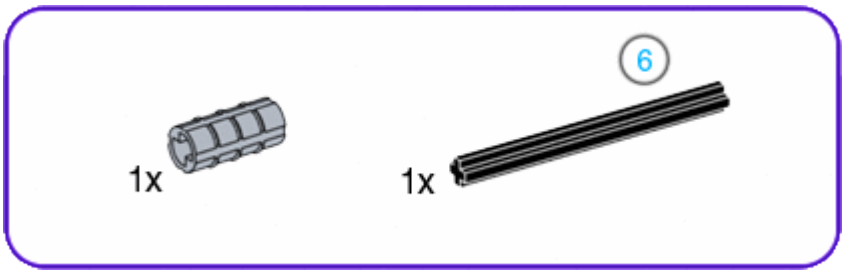

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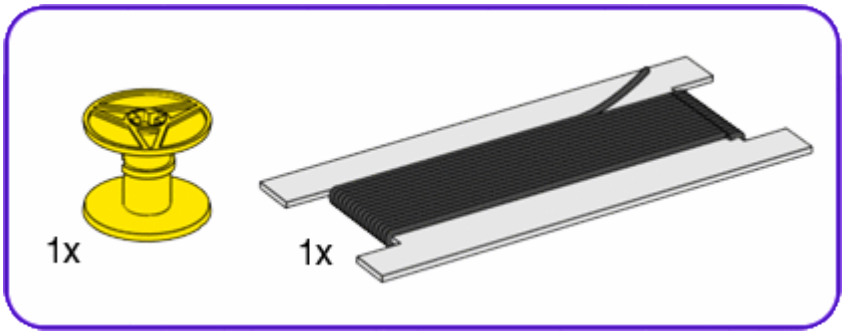

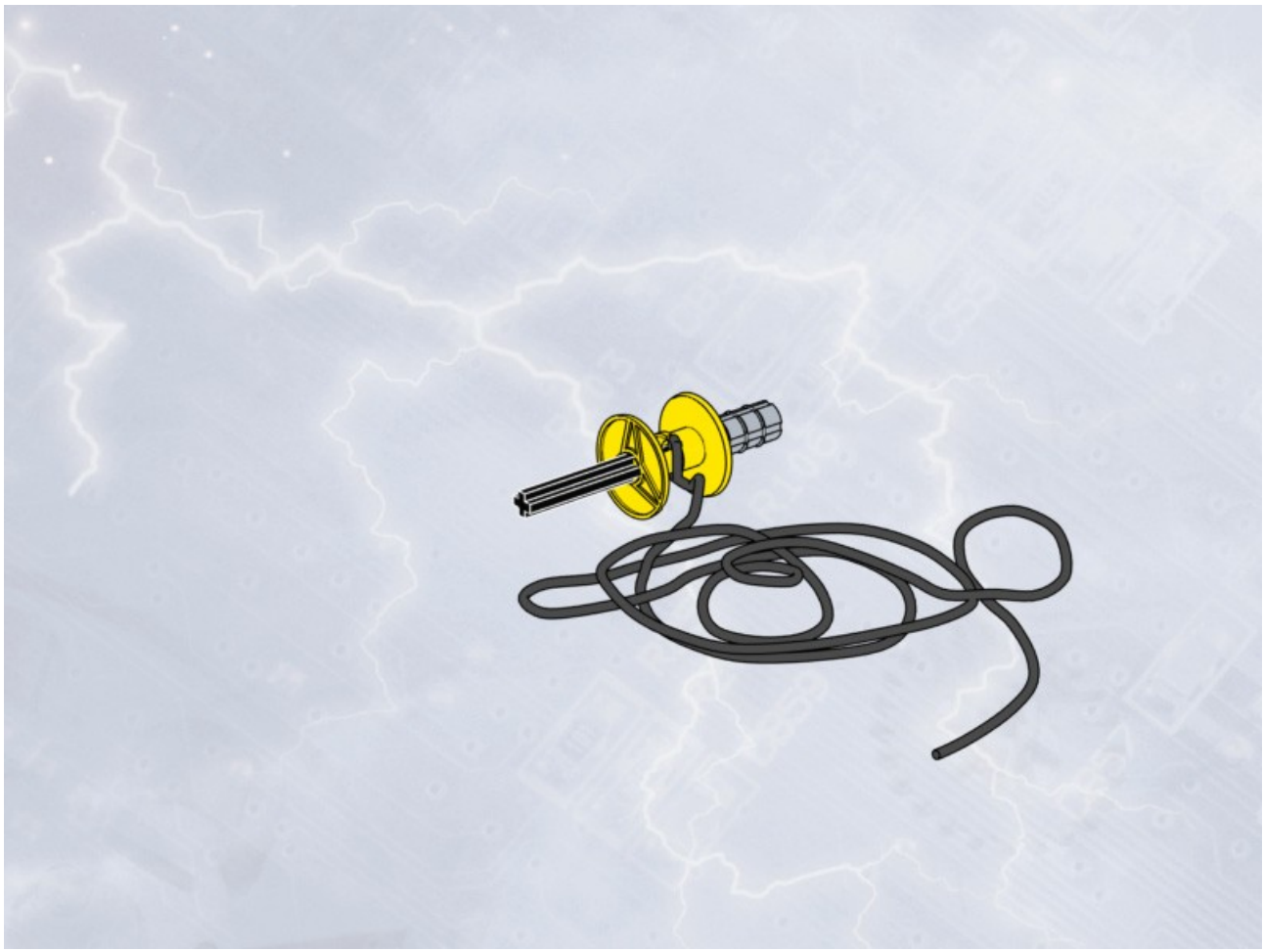

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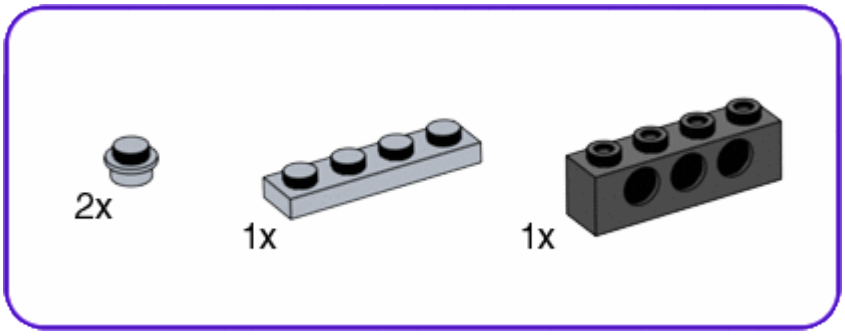

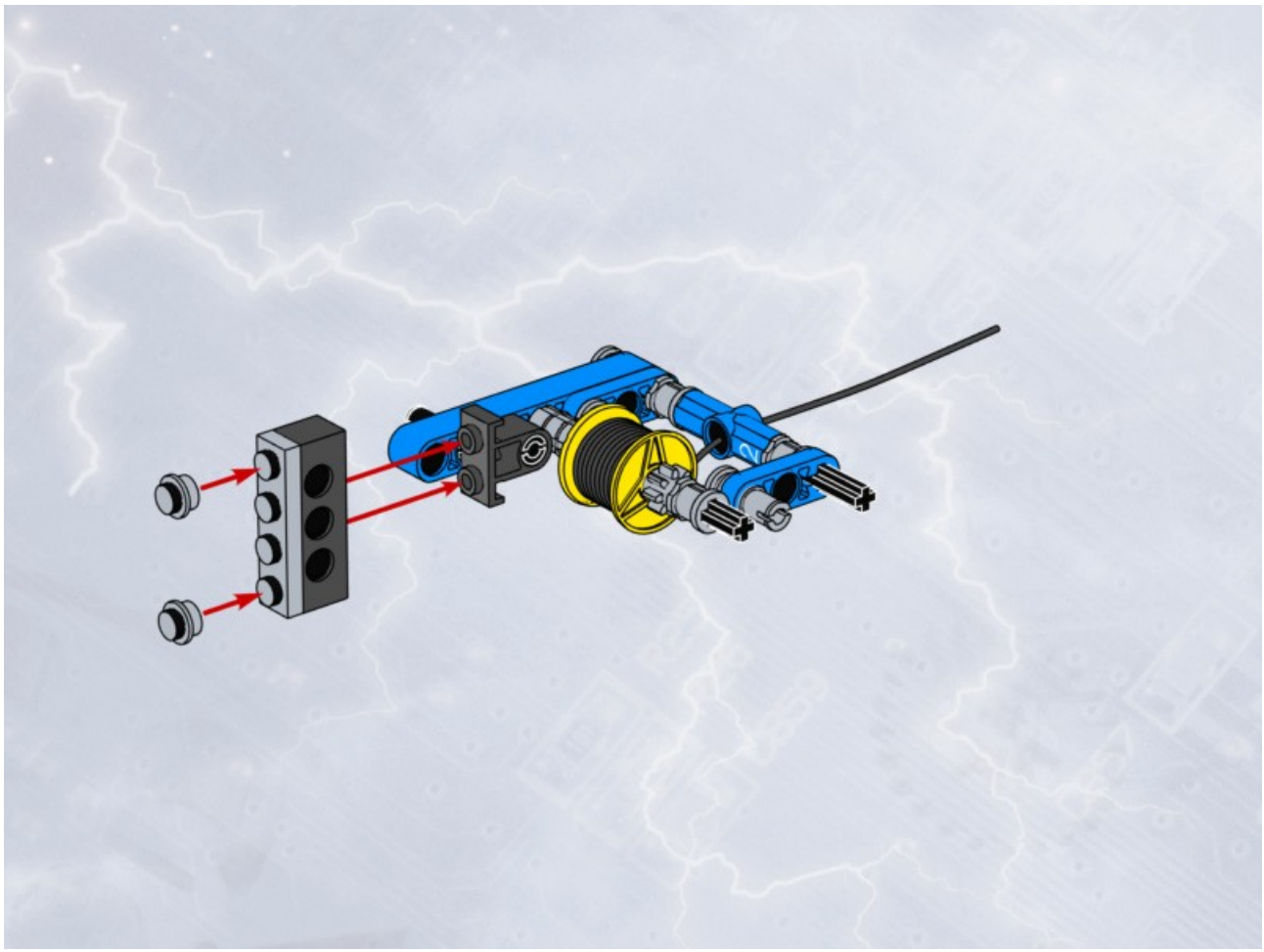

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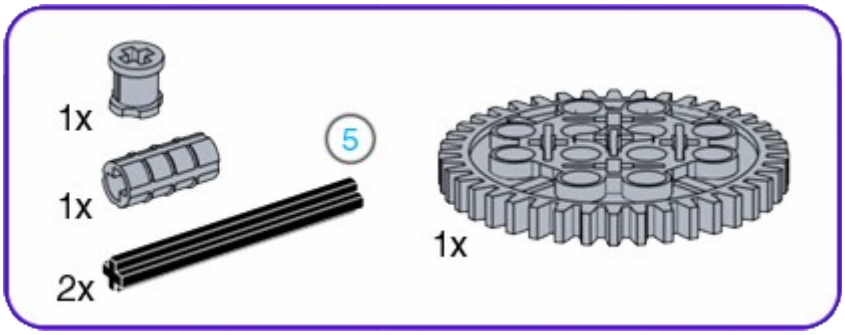

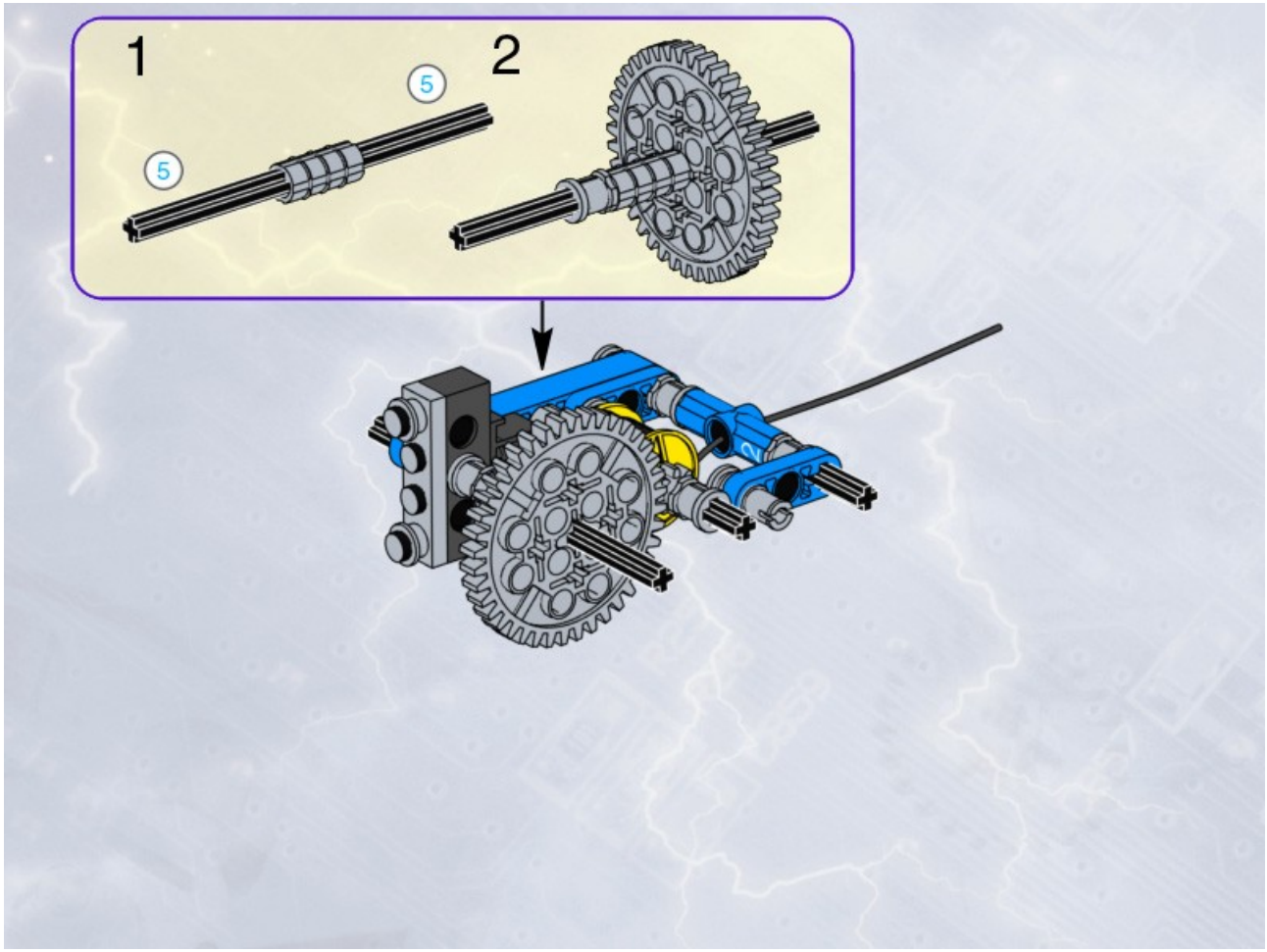

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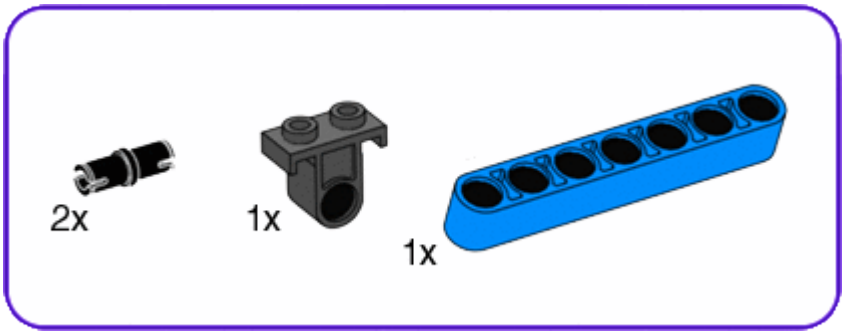

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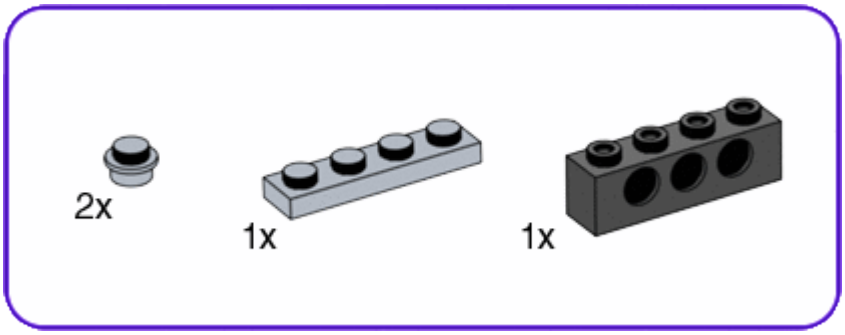

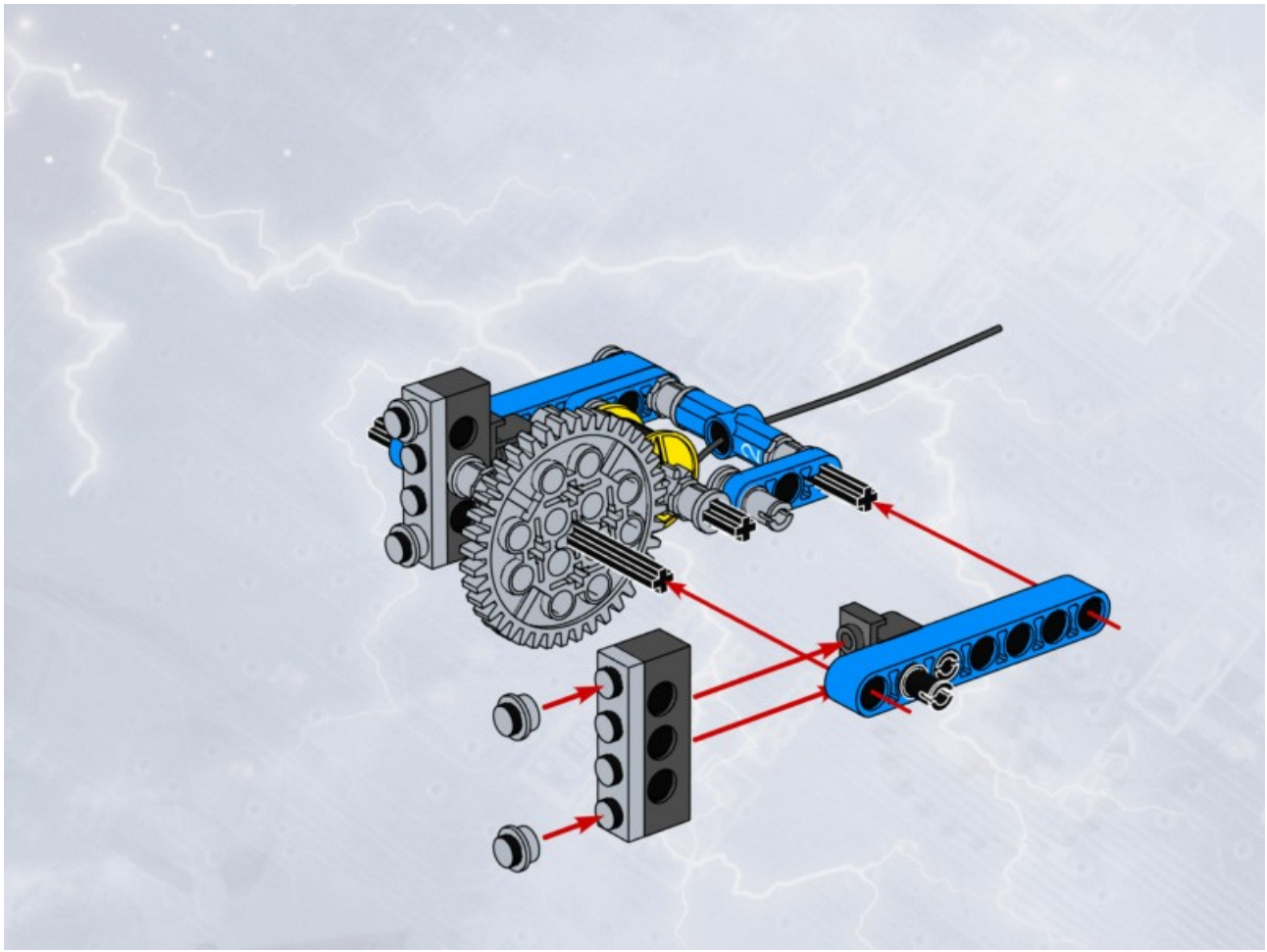

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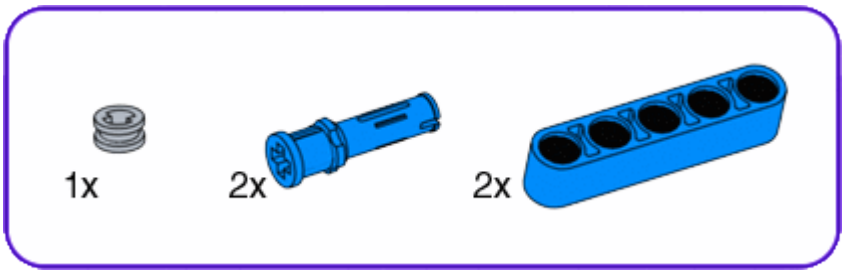

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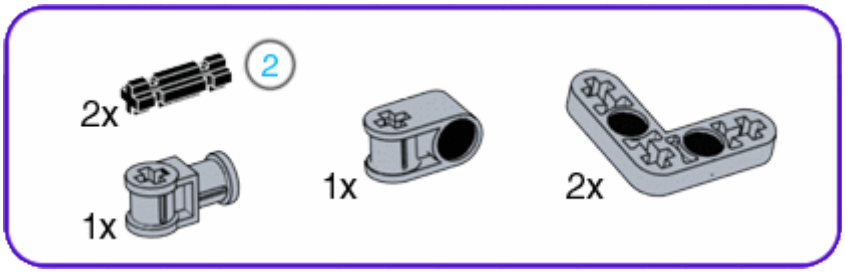
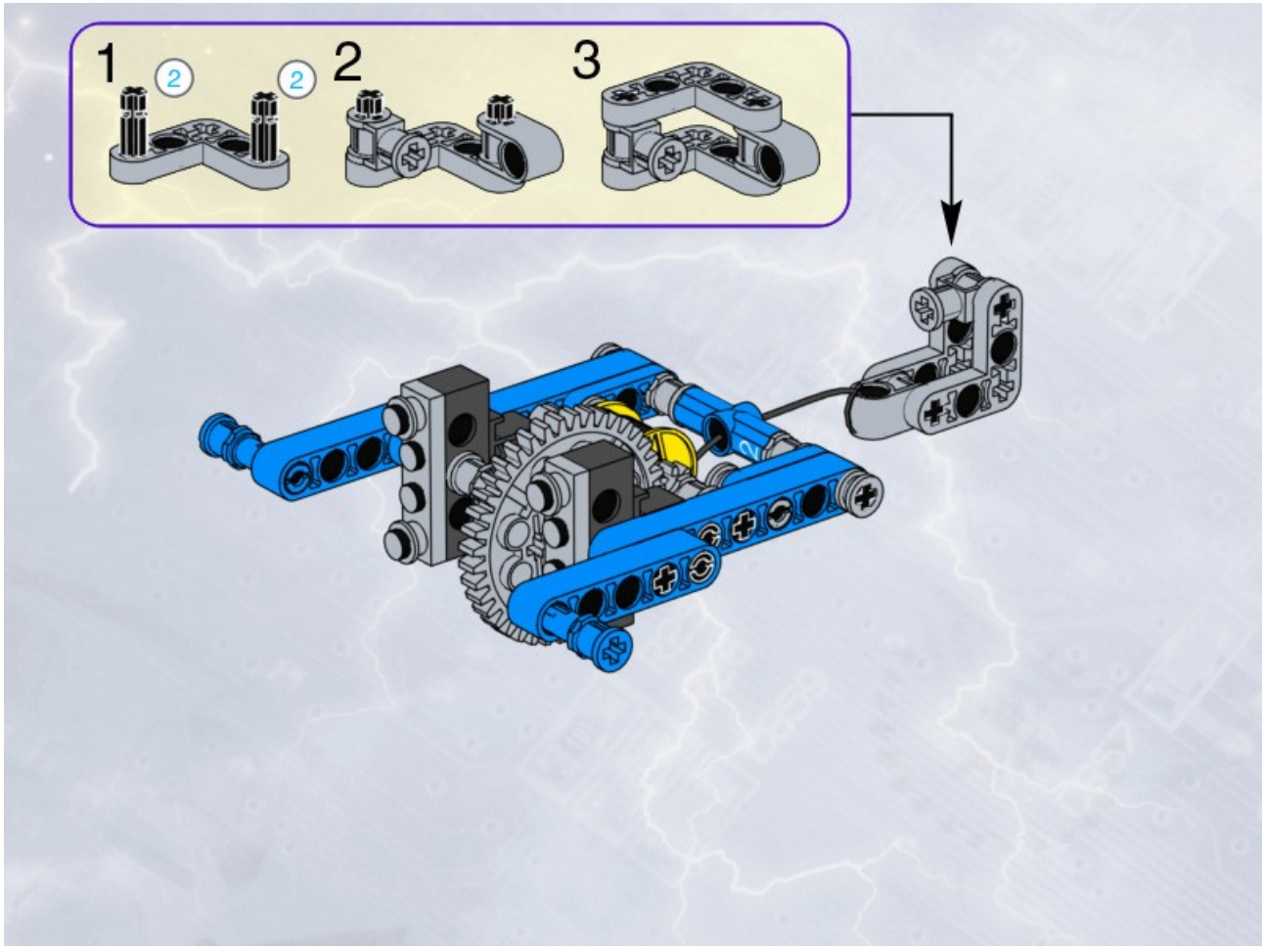




16

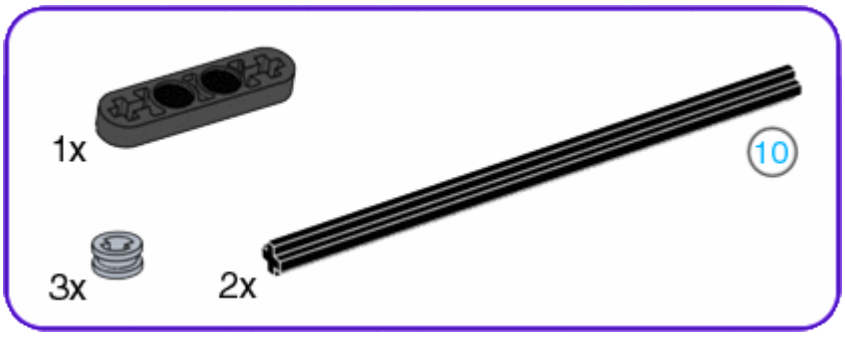
Grabber Module

The Grabber is a simple mechanism that can pick up and release objects.

It is attached to the relatively slow moving but powerful Motor Module 1 via a white clutch gear.

The clutch allows the motor to continue to turn even when the grabber reaches its limits, keeping the pressure on the jaws of the grabber without straining the motor.

1



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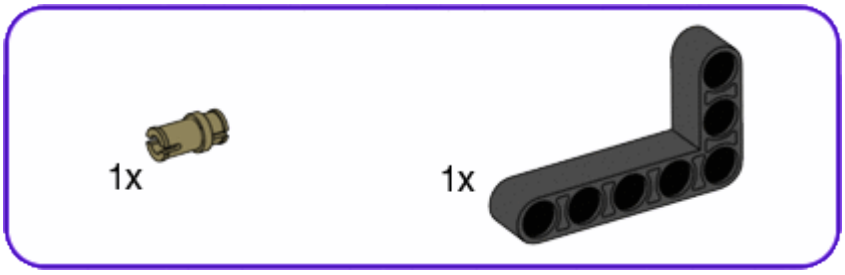

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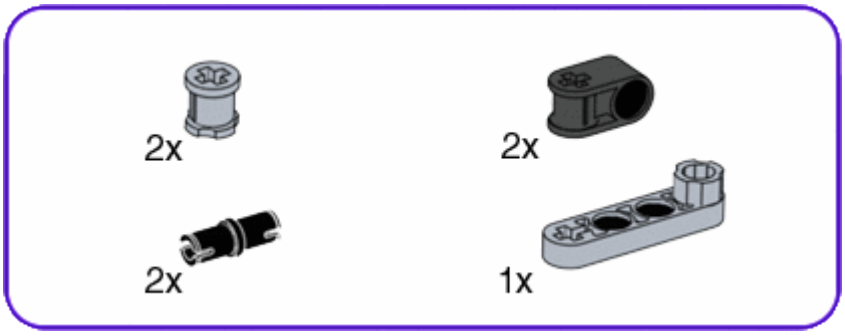

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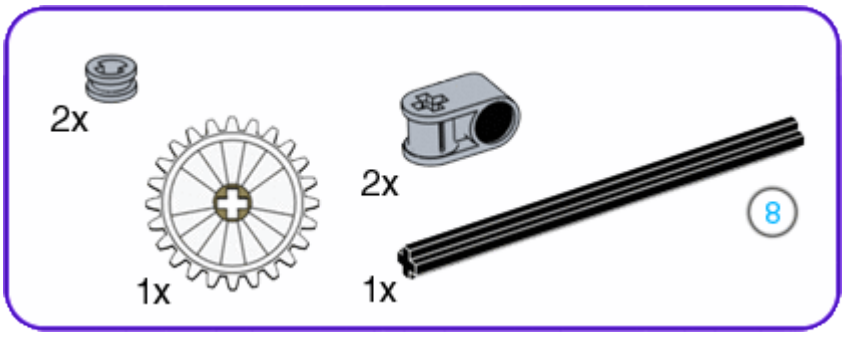

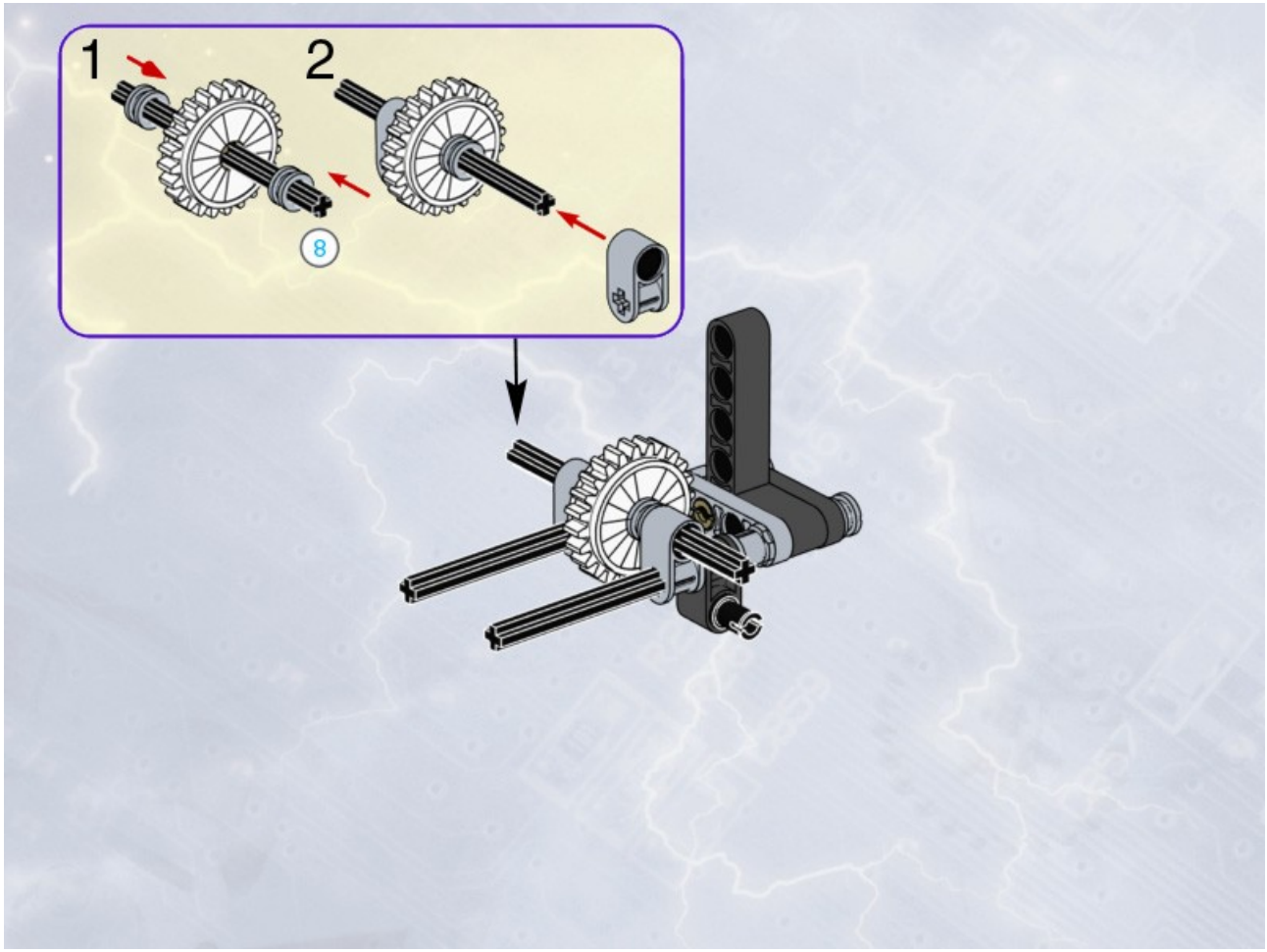

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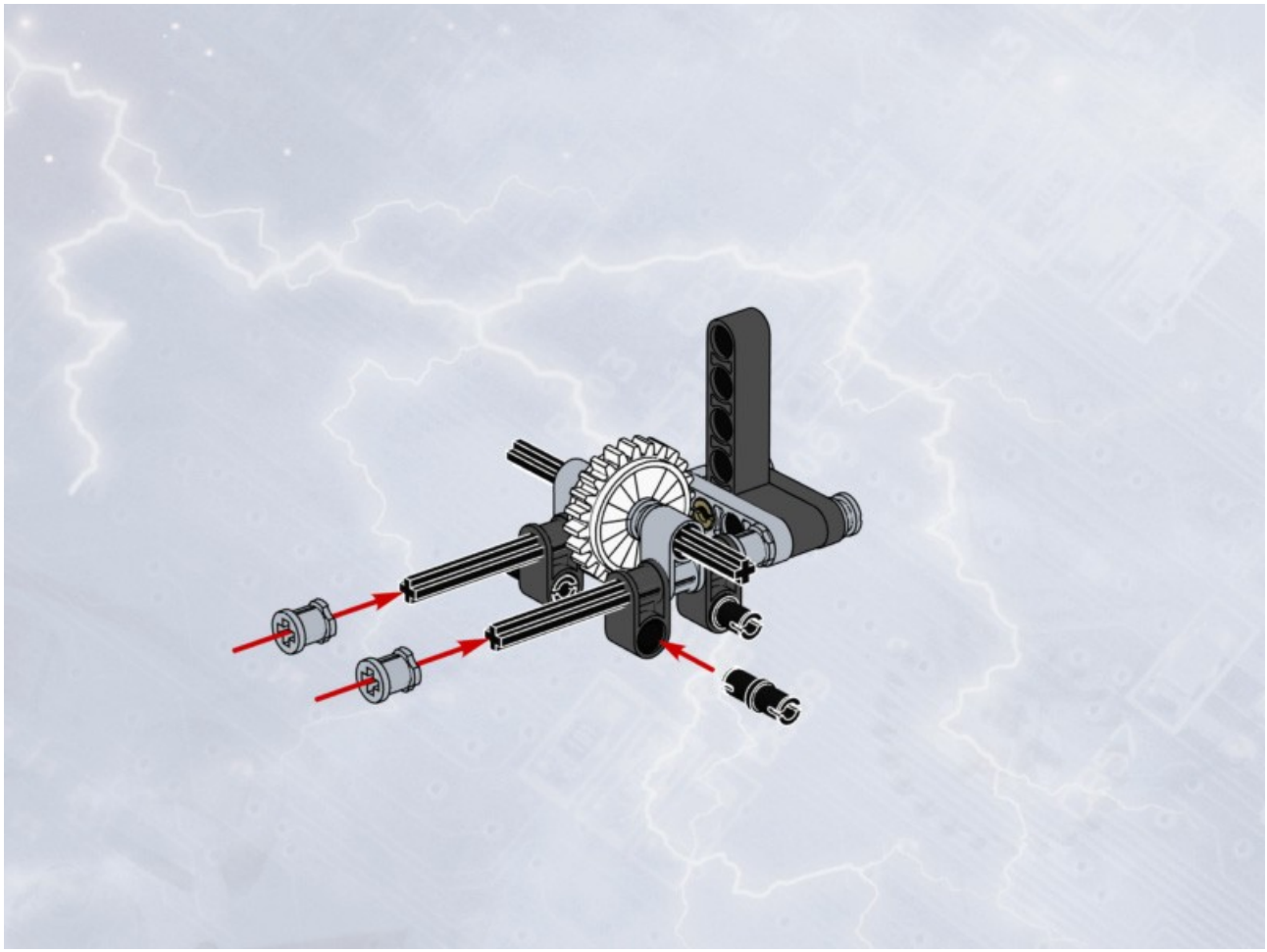

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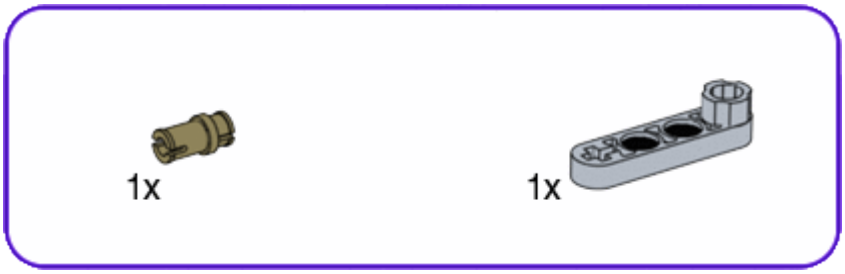

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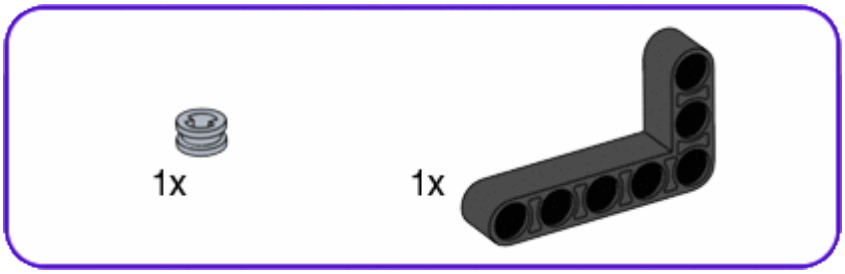

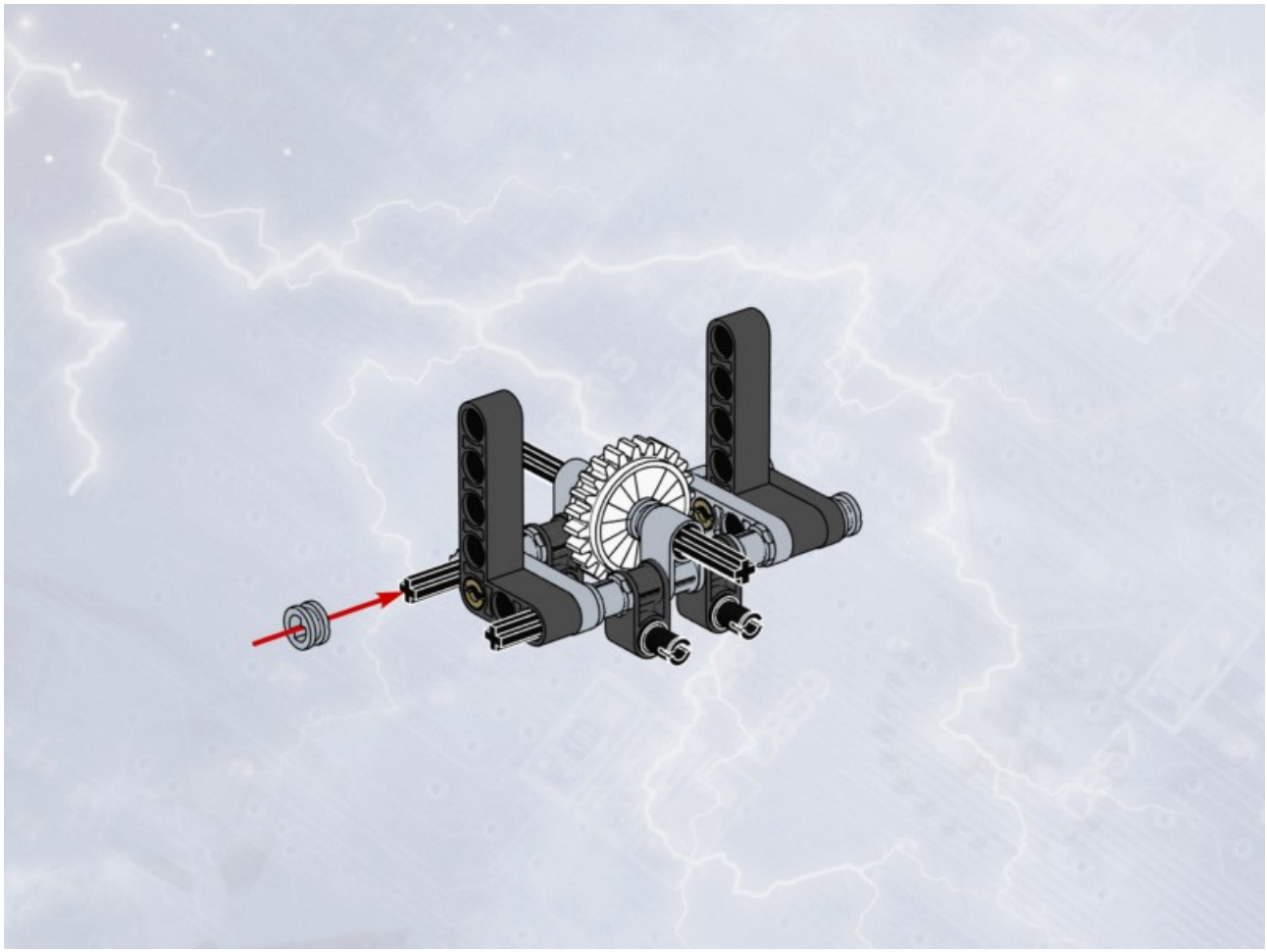

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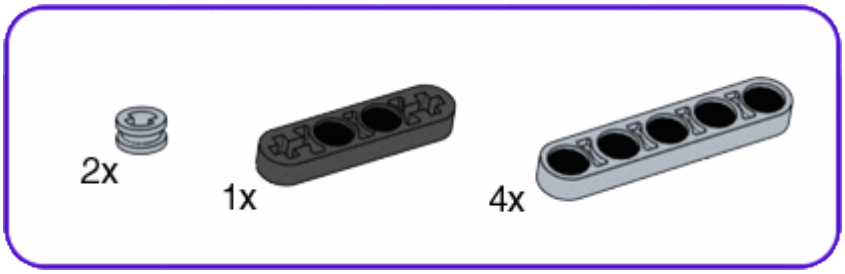

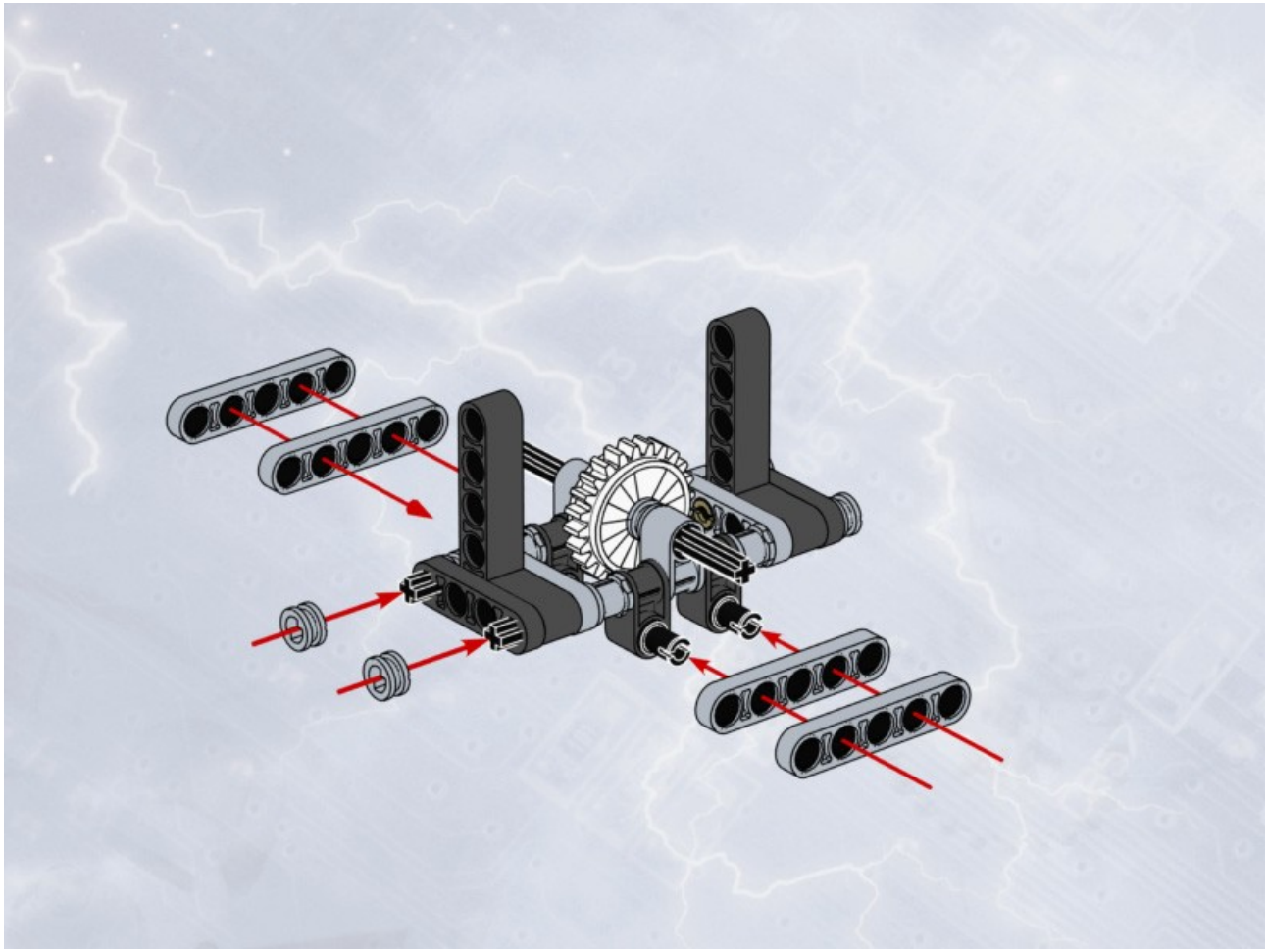

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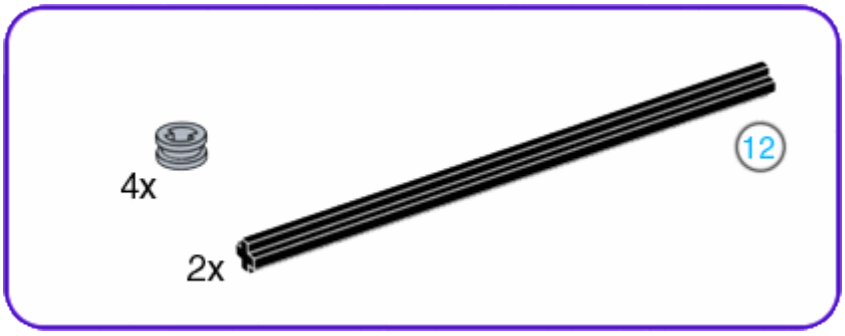

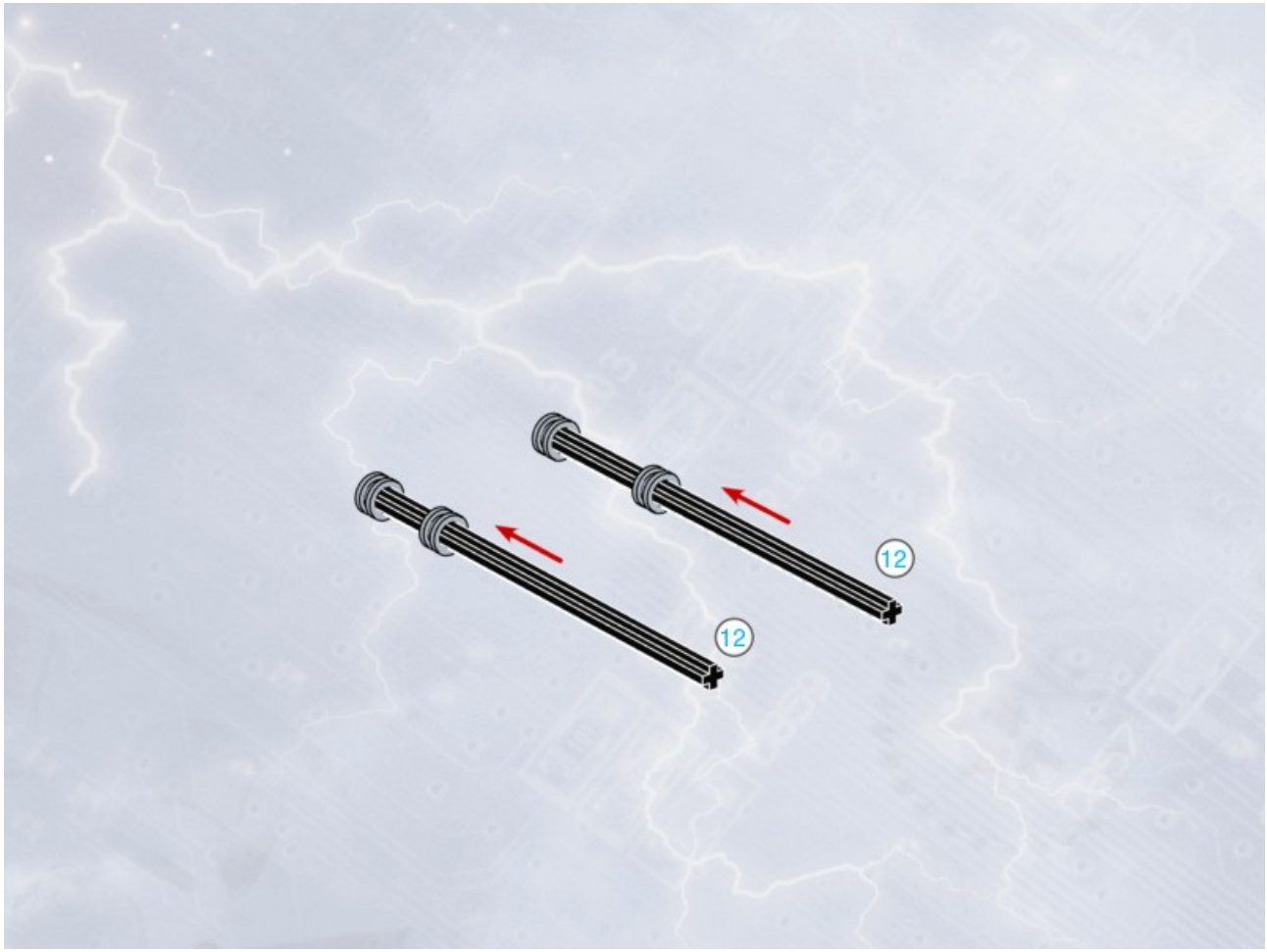

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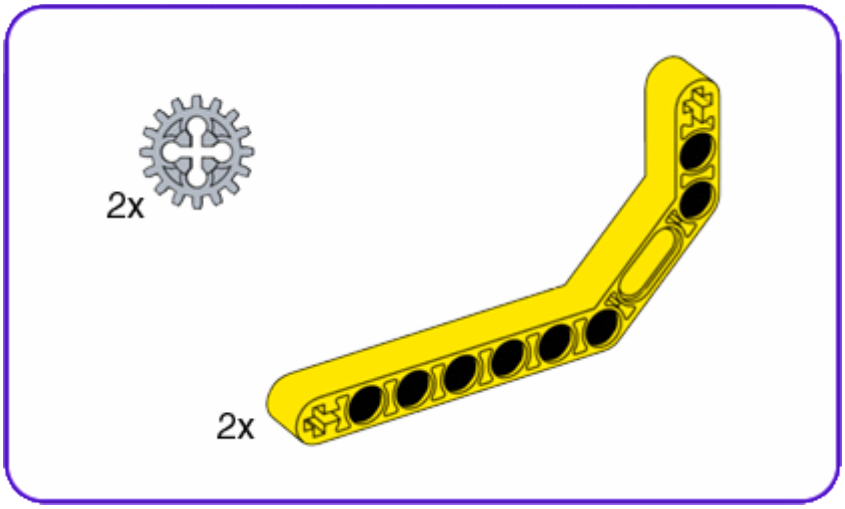

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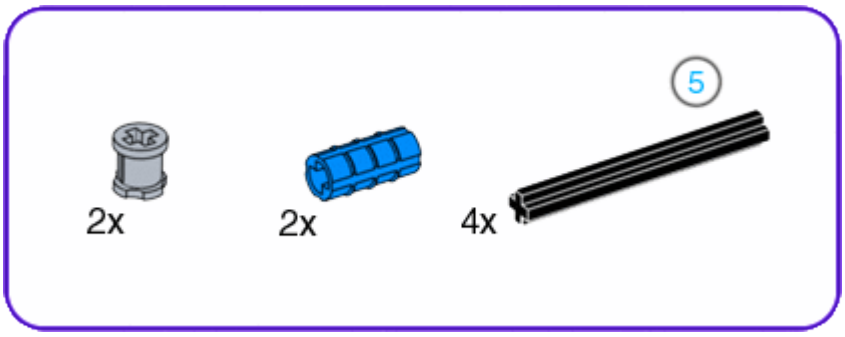

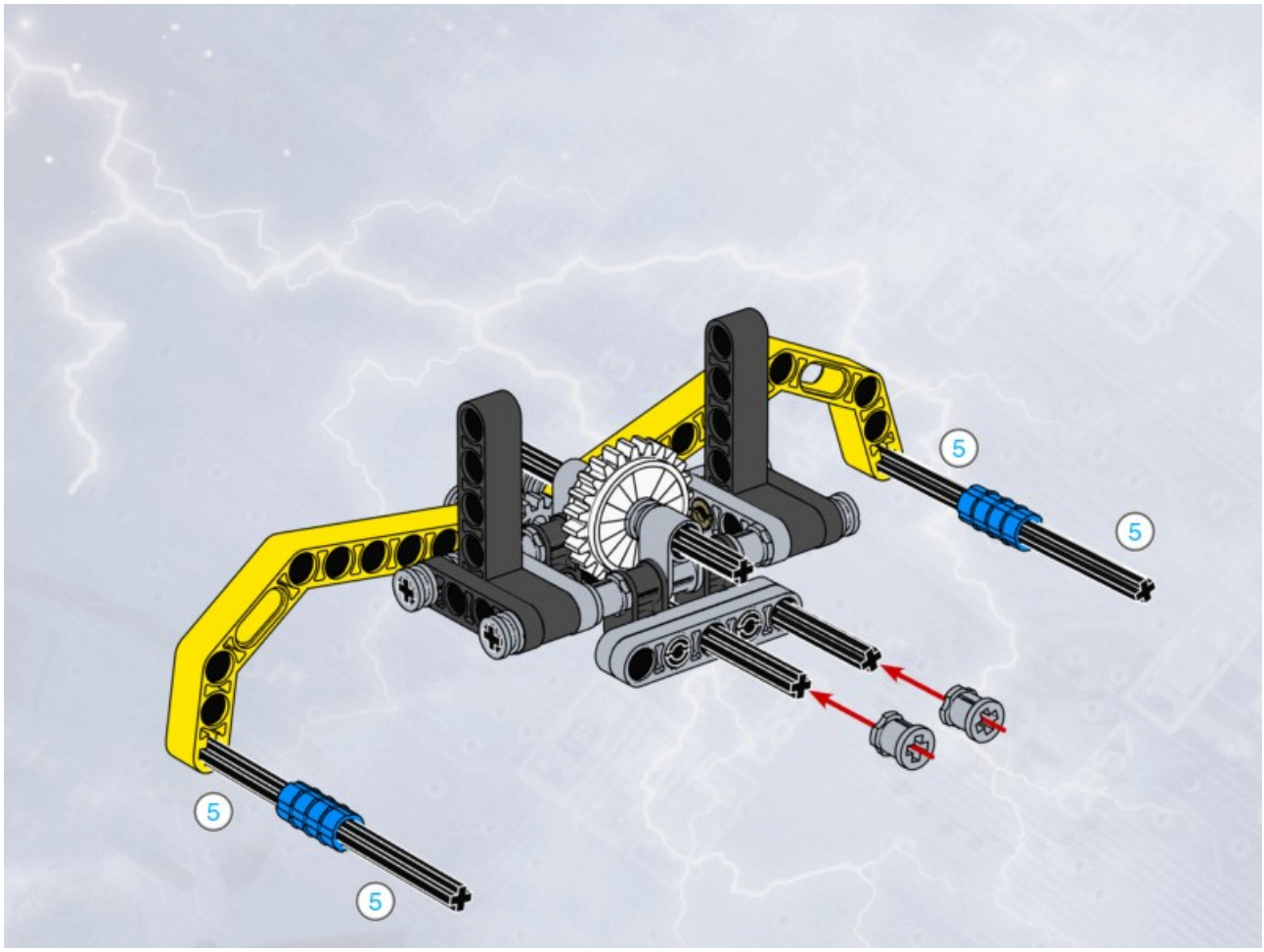

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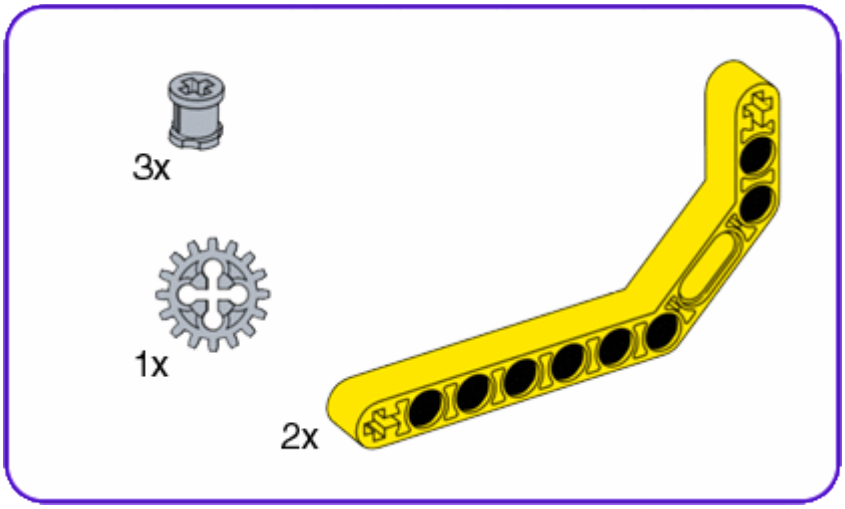

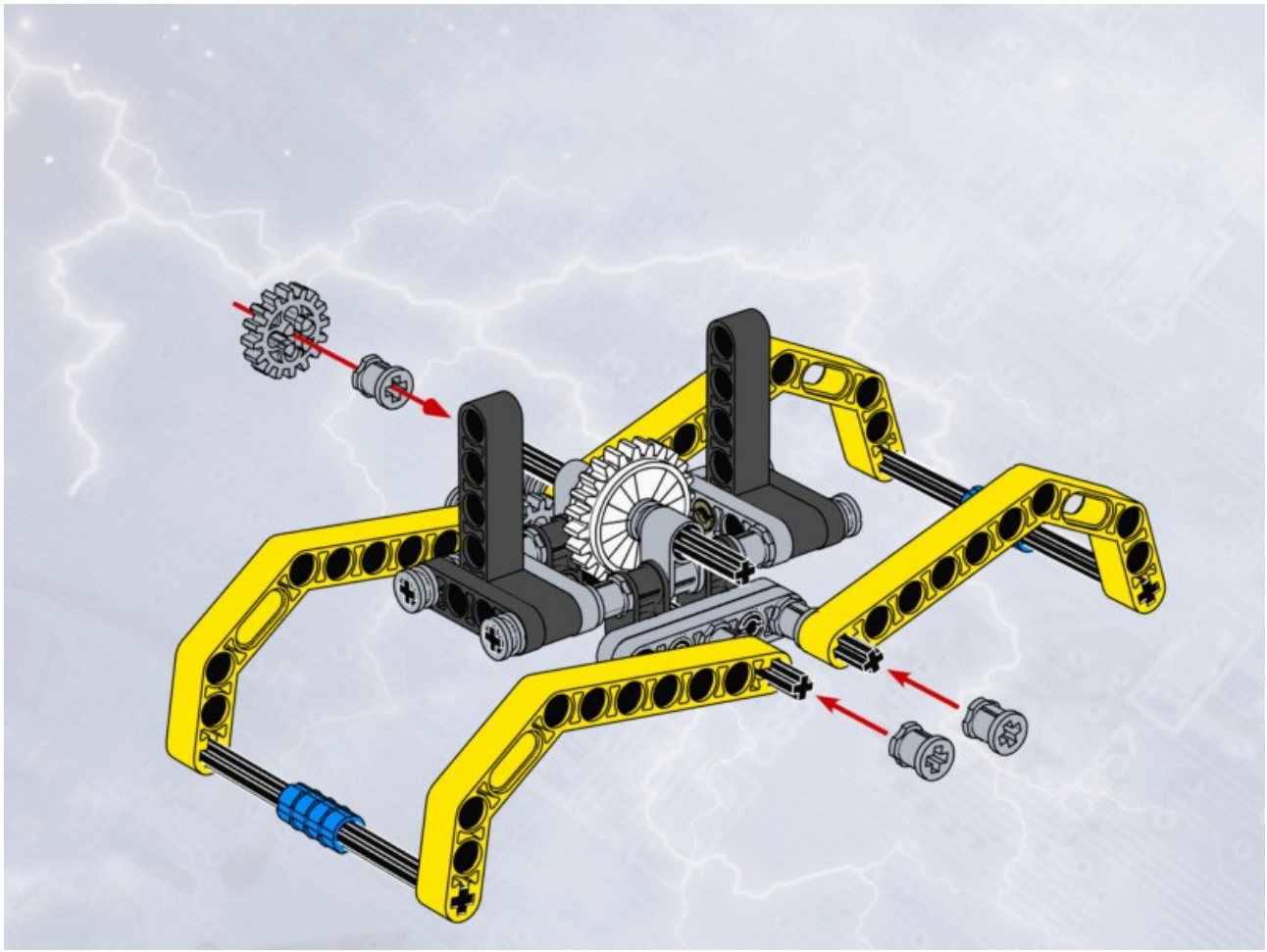

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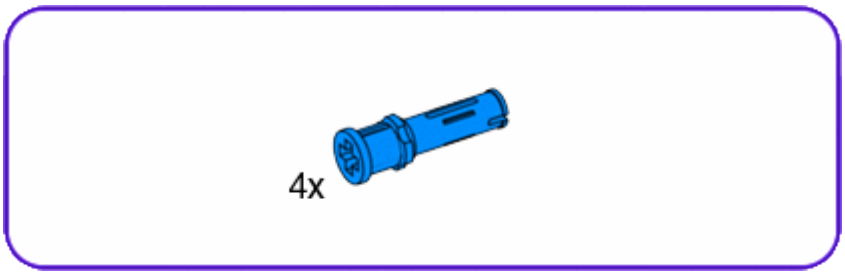

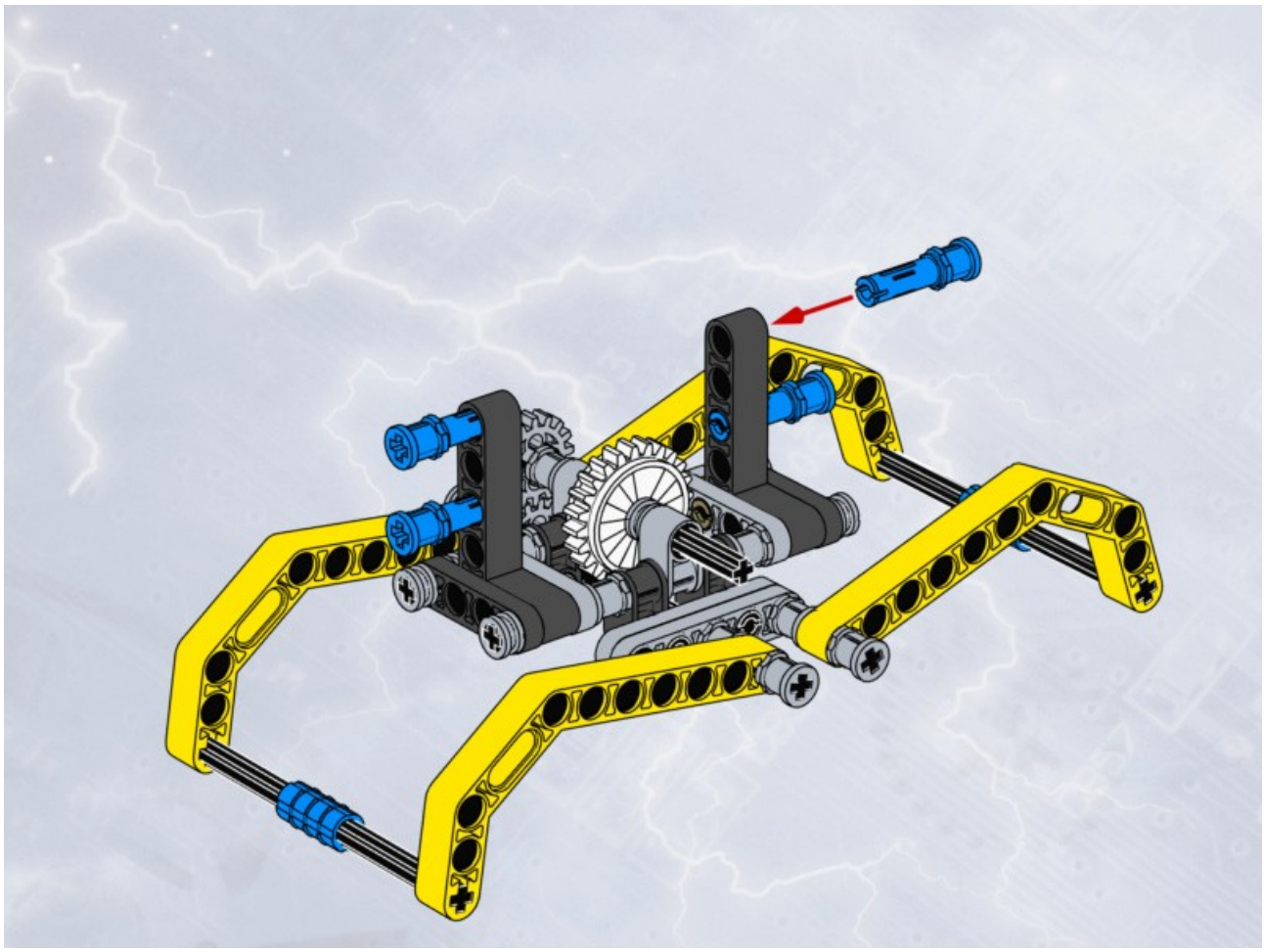

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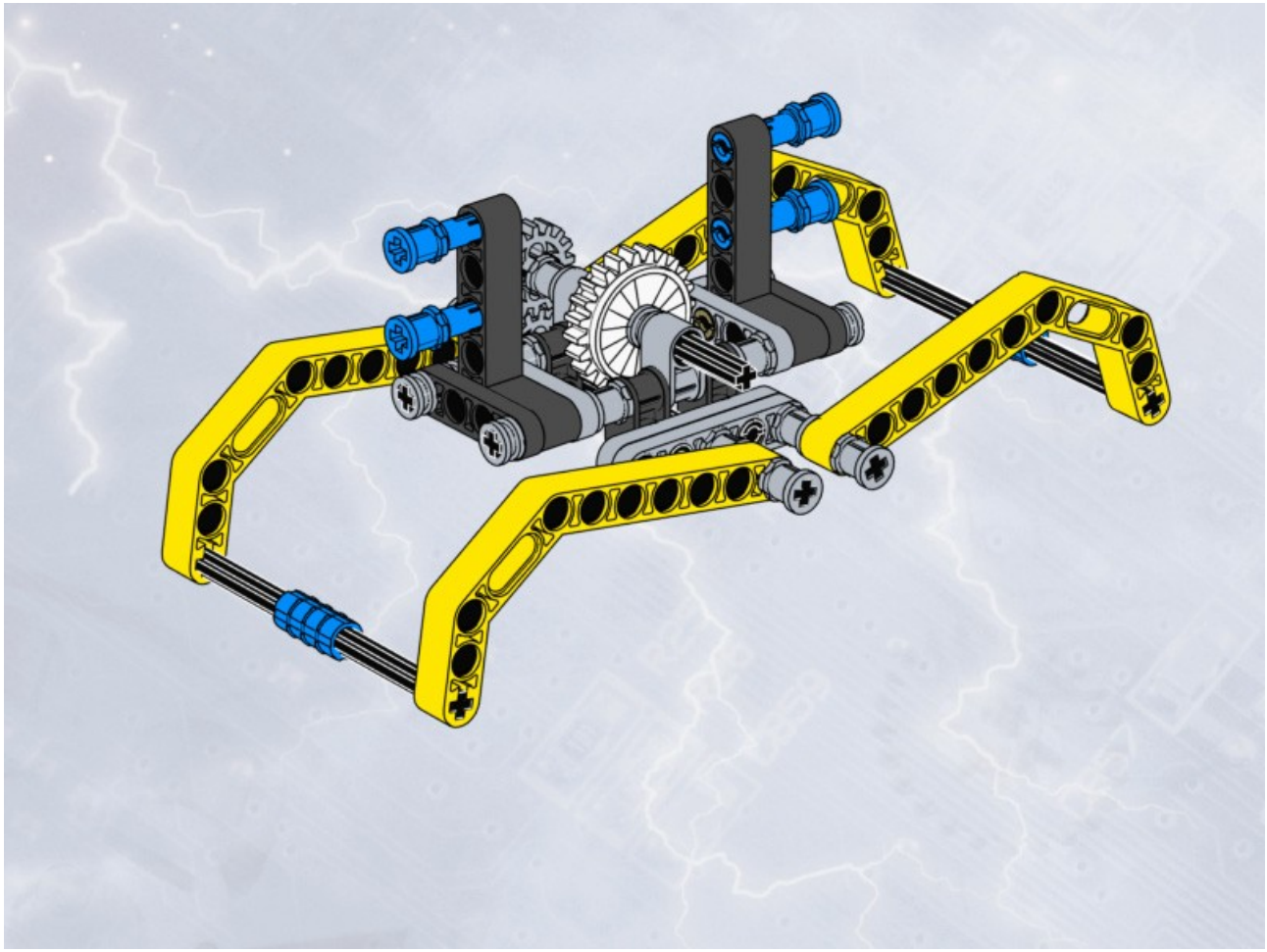
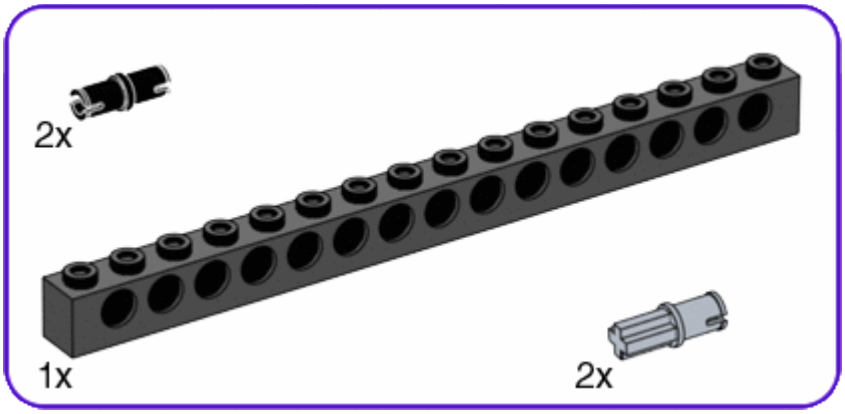
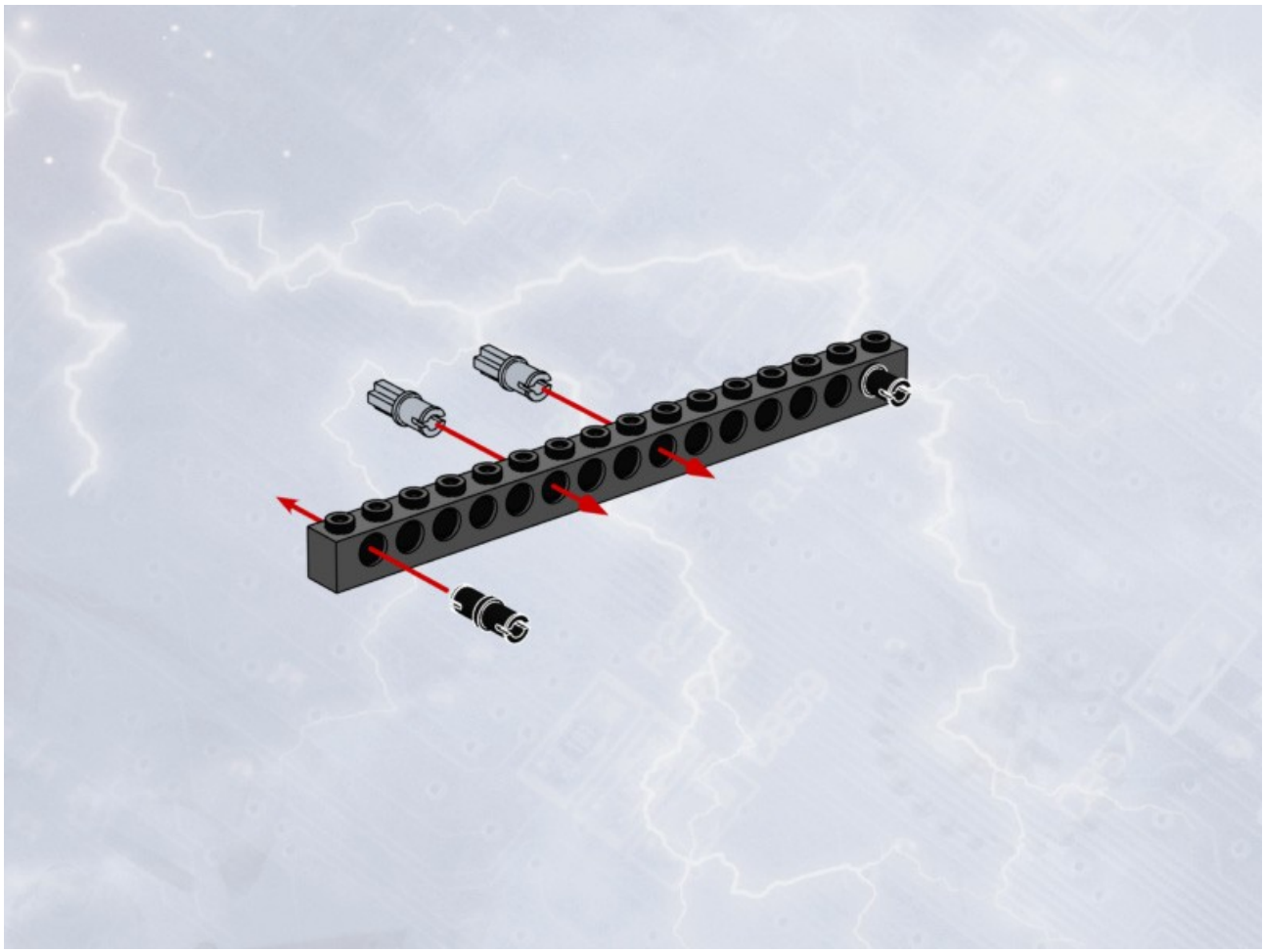


Shooter Module

This module actually makes the discs fly from the Disc Shooter.
The two wheels rotate at different speeds, which makes the discs spin and fly further.
Once you have built this module you can experiment with different gear ratios to see how it affects the flight of the discs.

1





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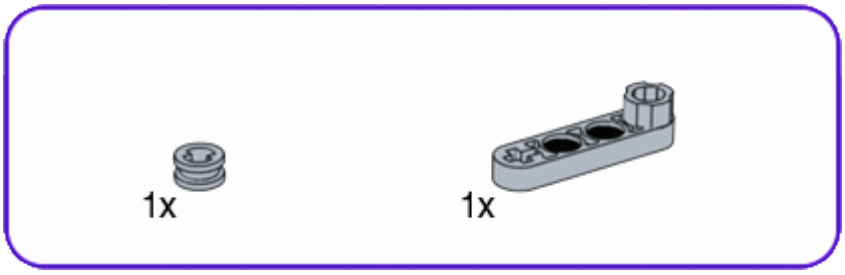

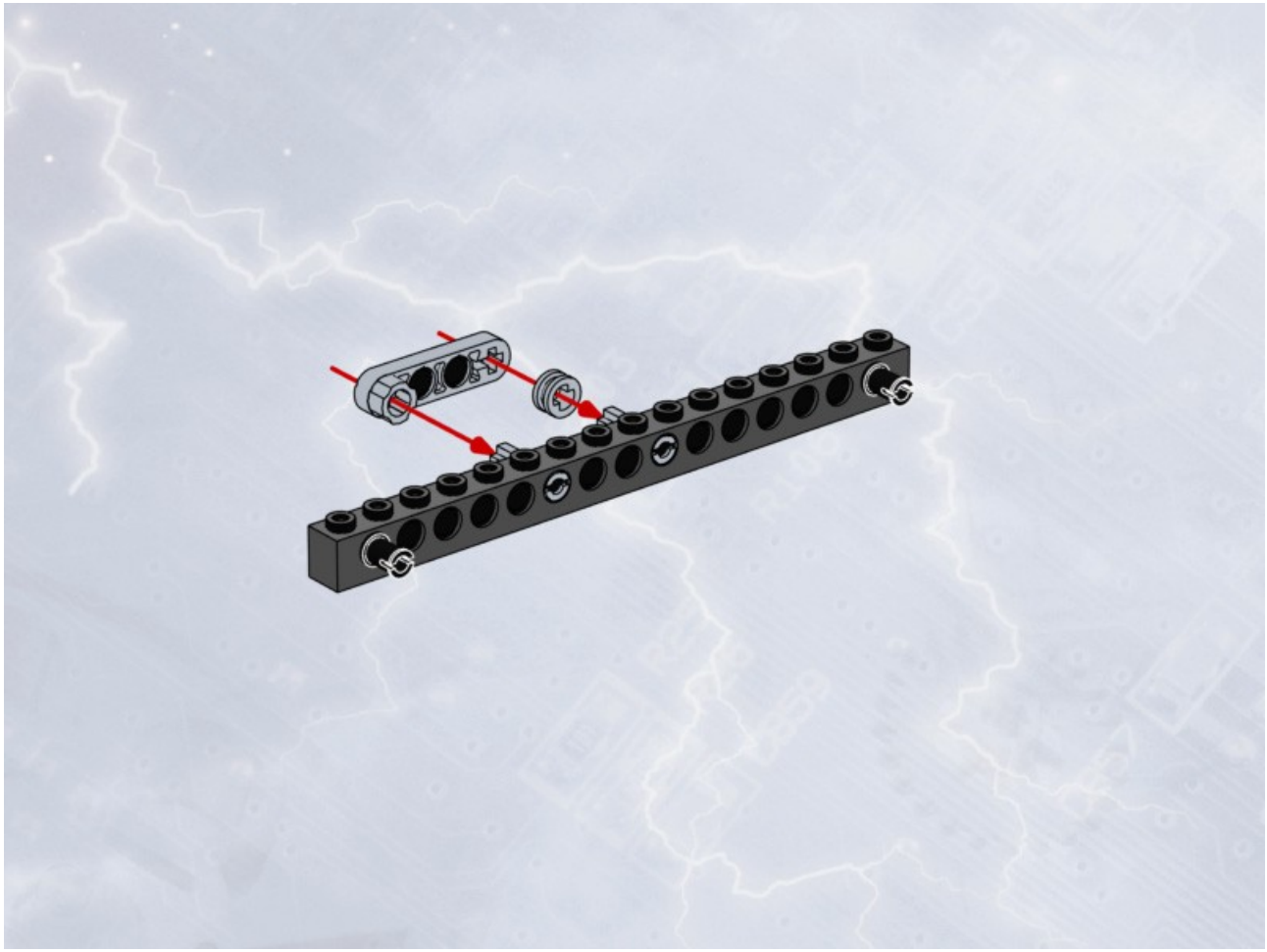

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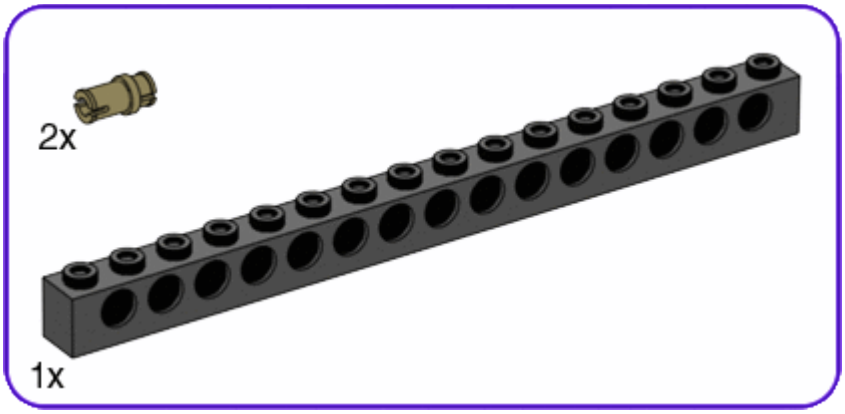

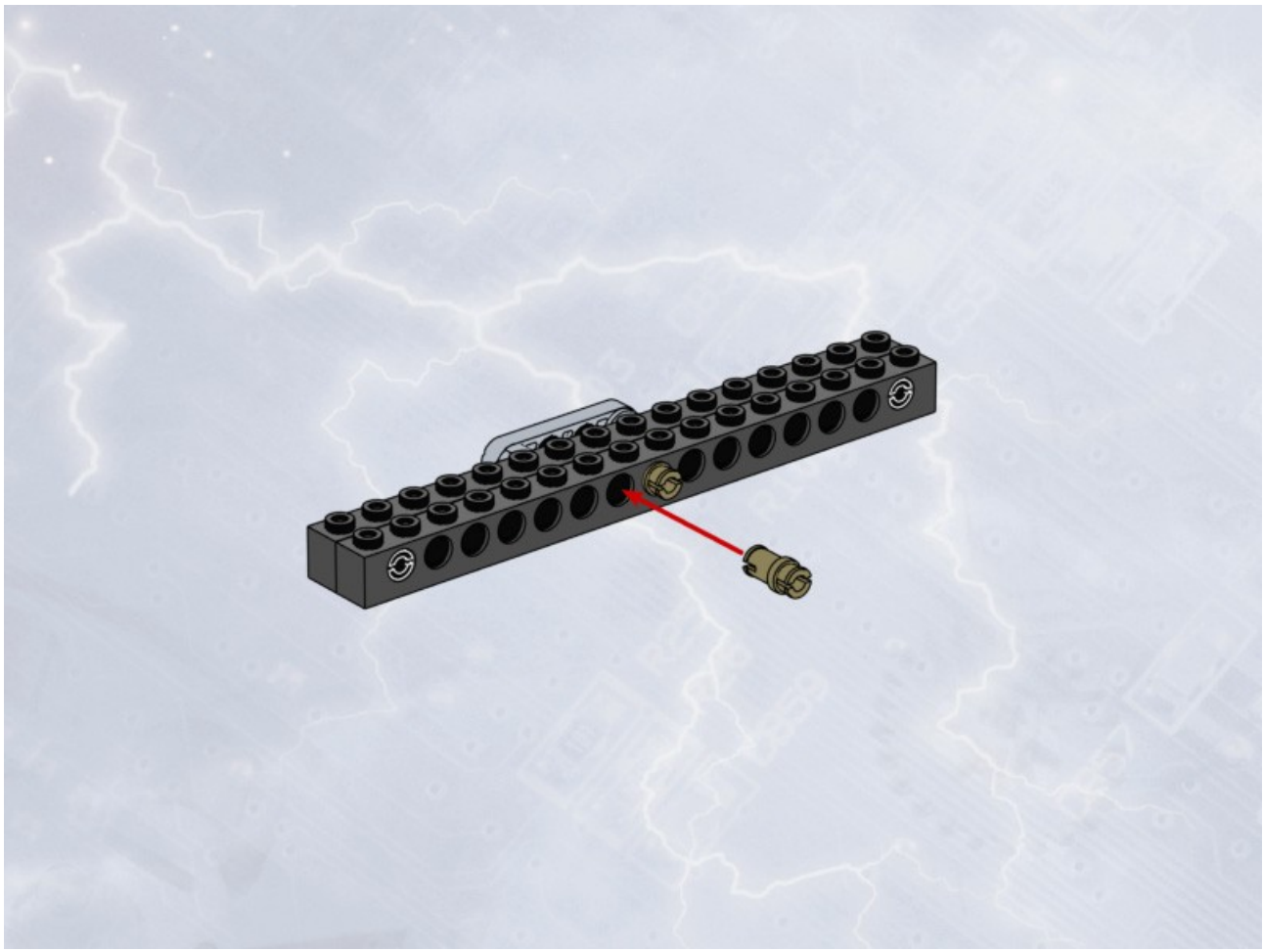

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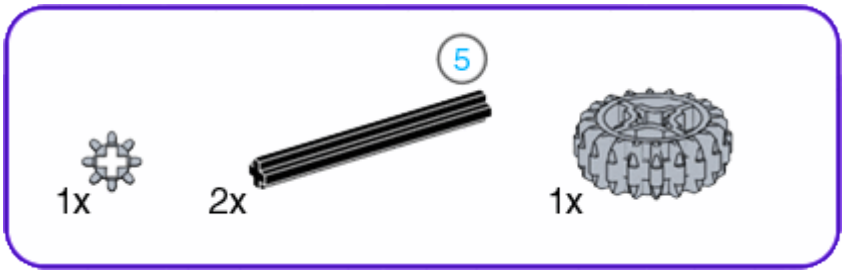

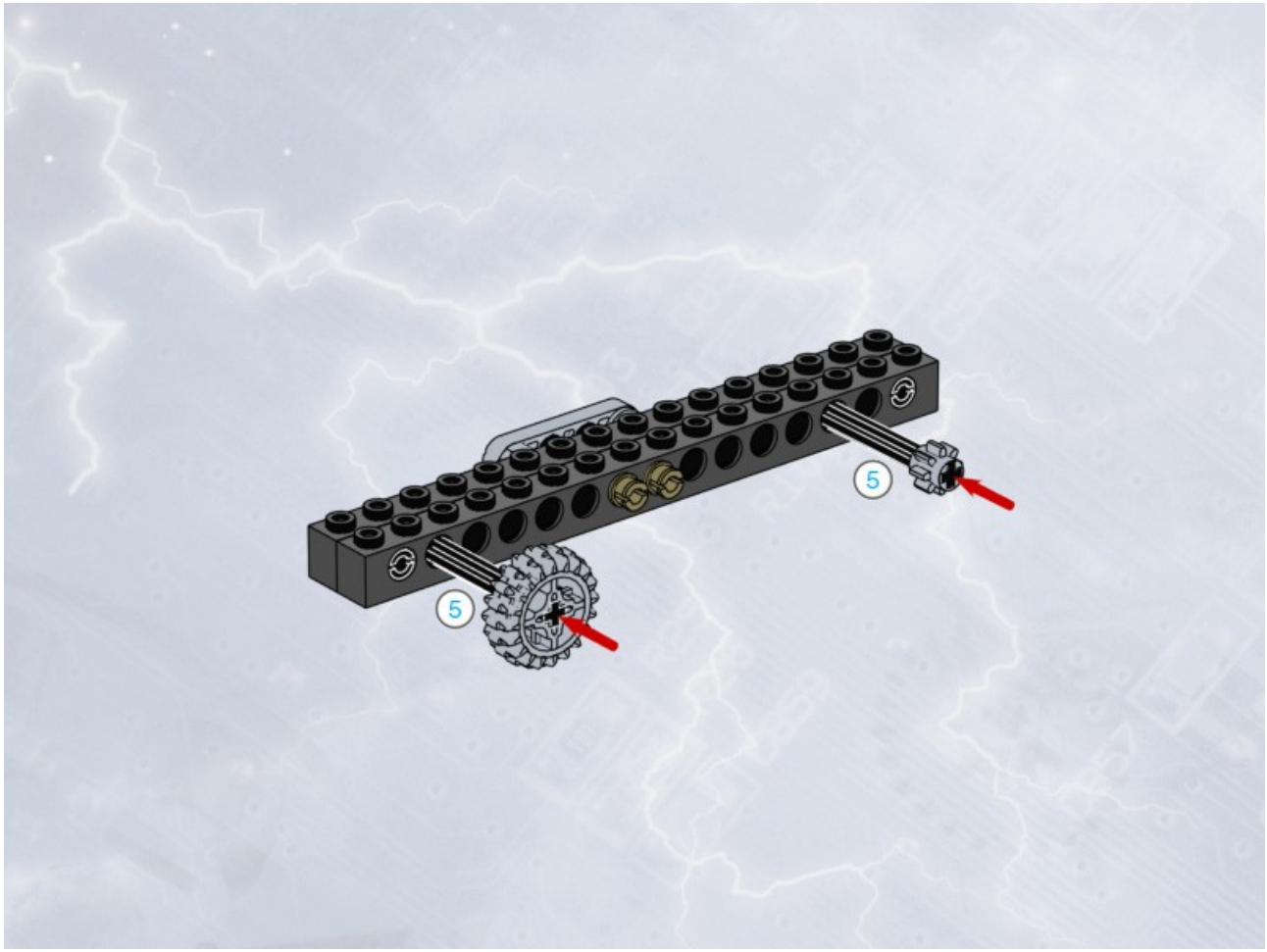

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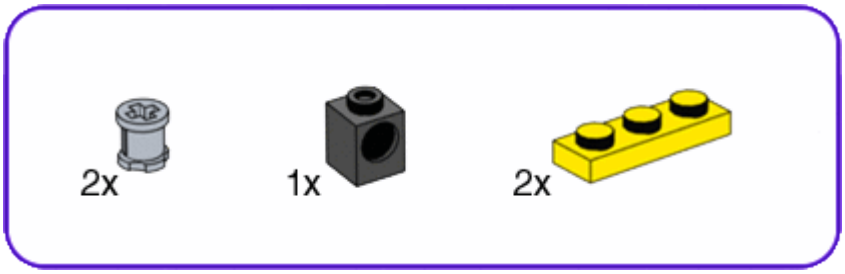

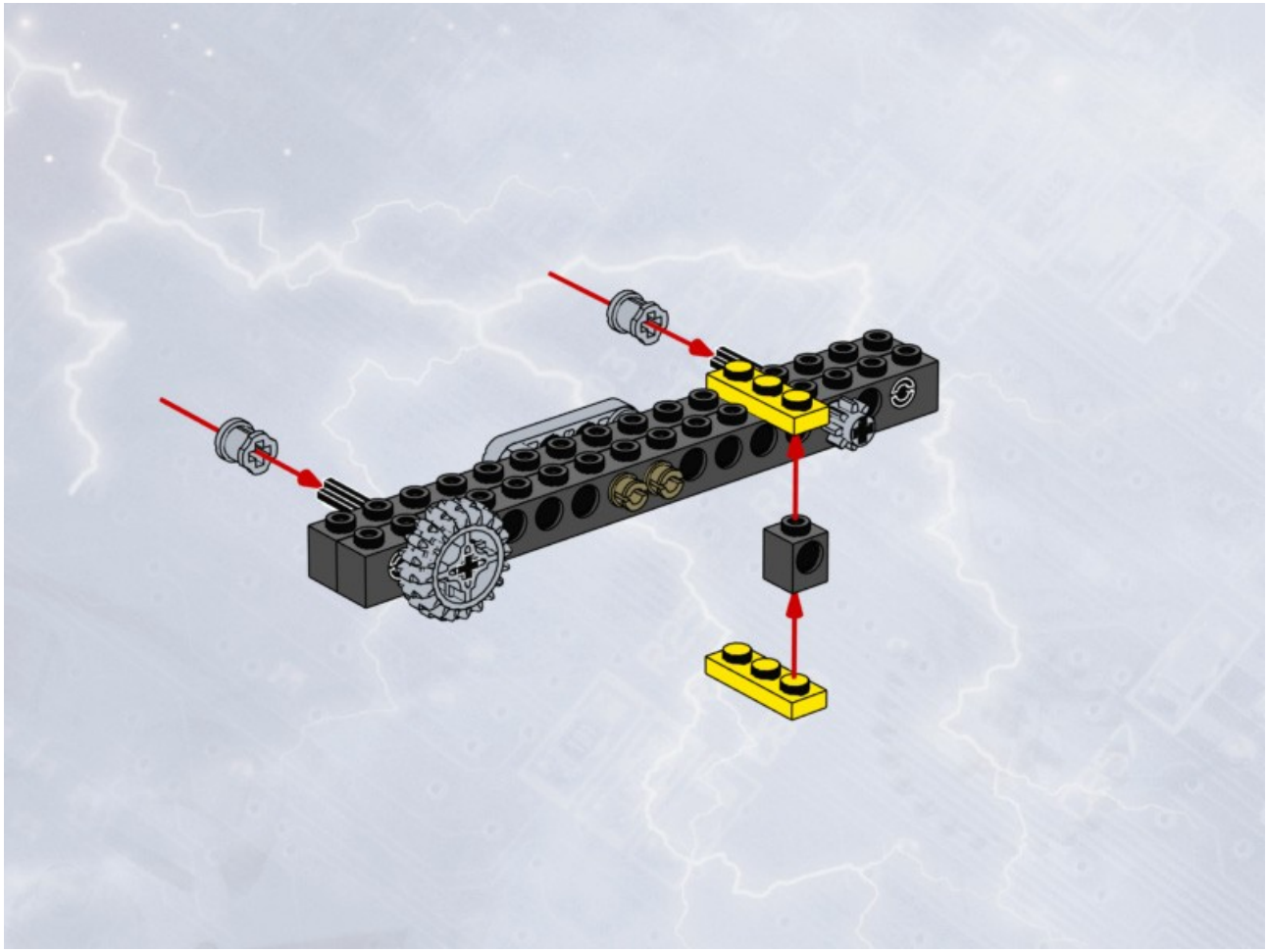

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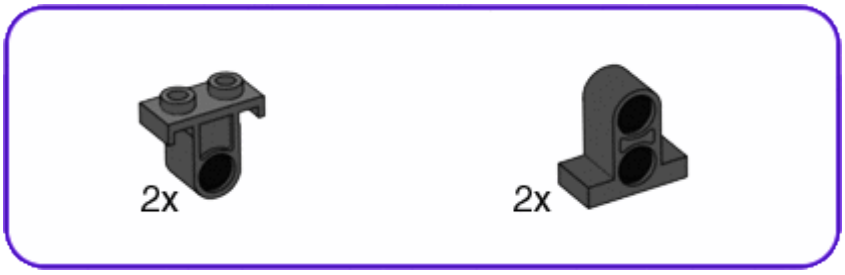

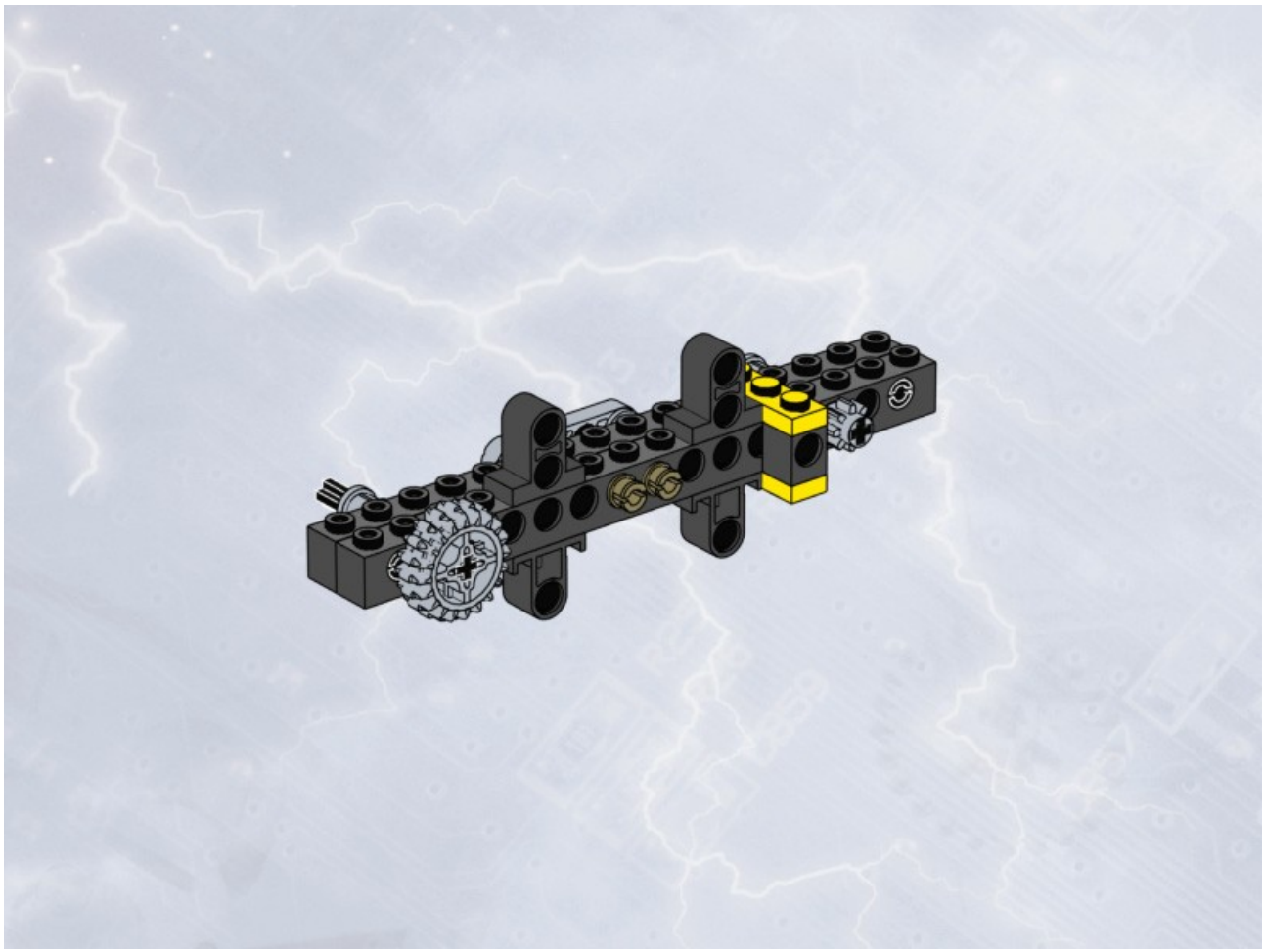

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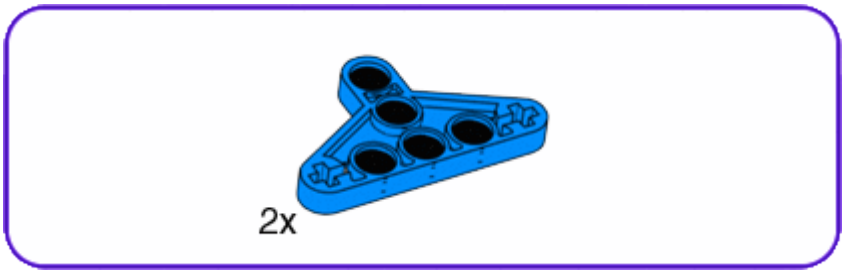

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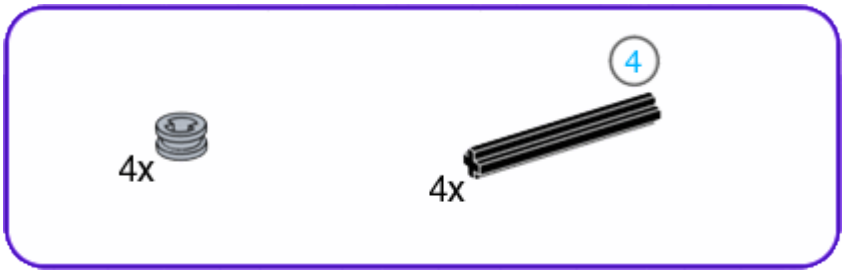

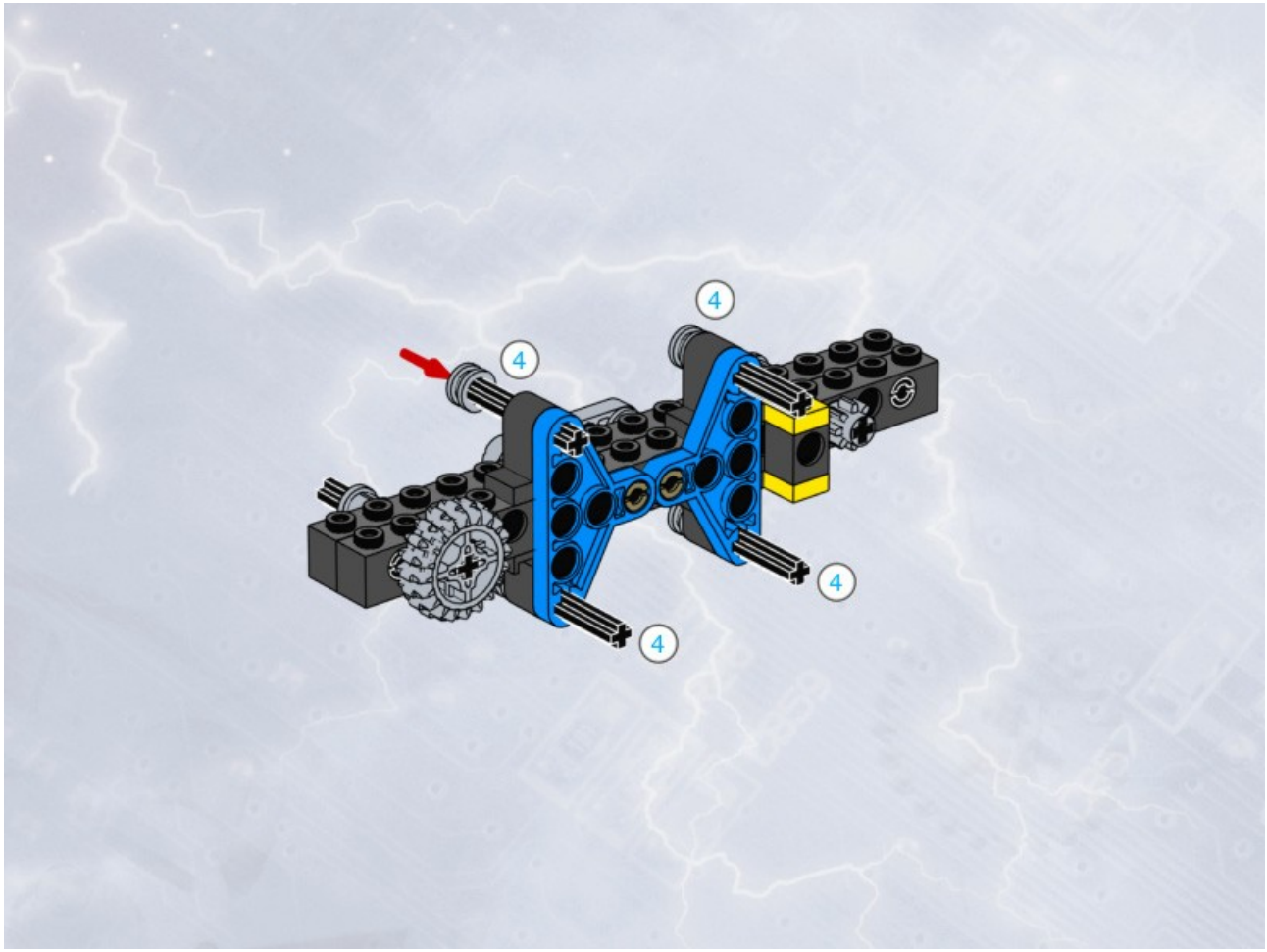

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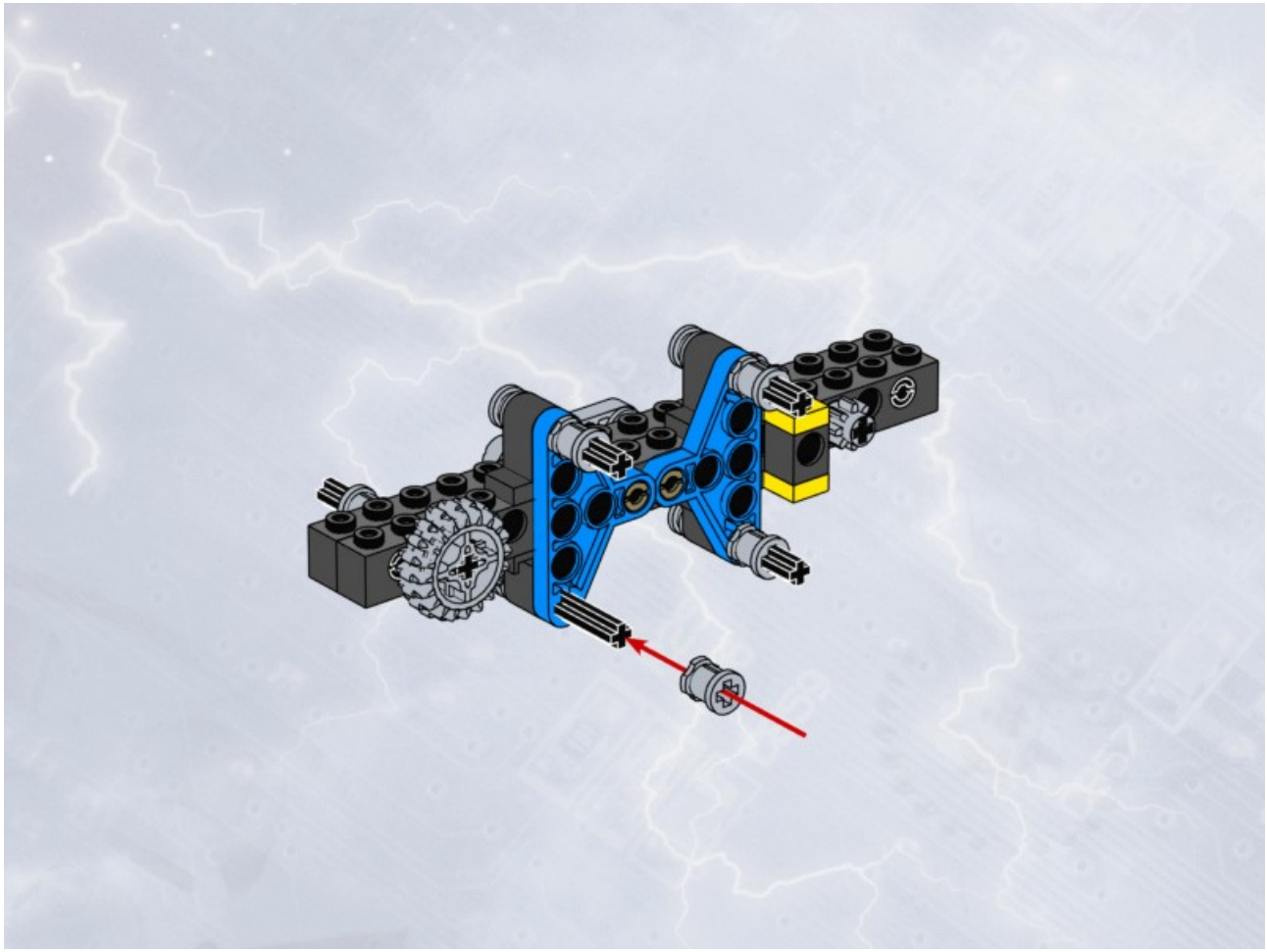

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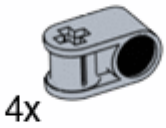

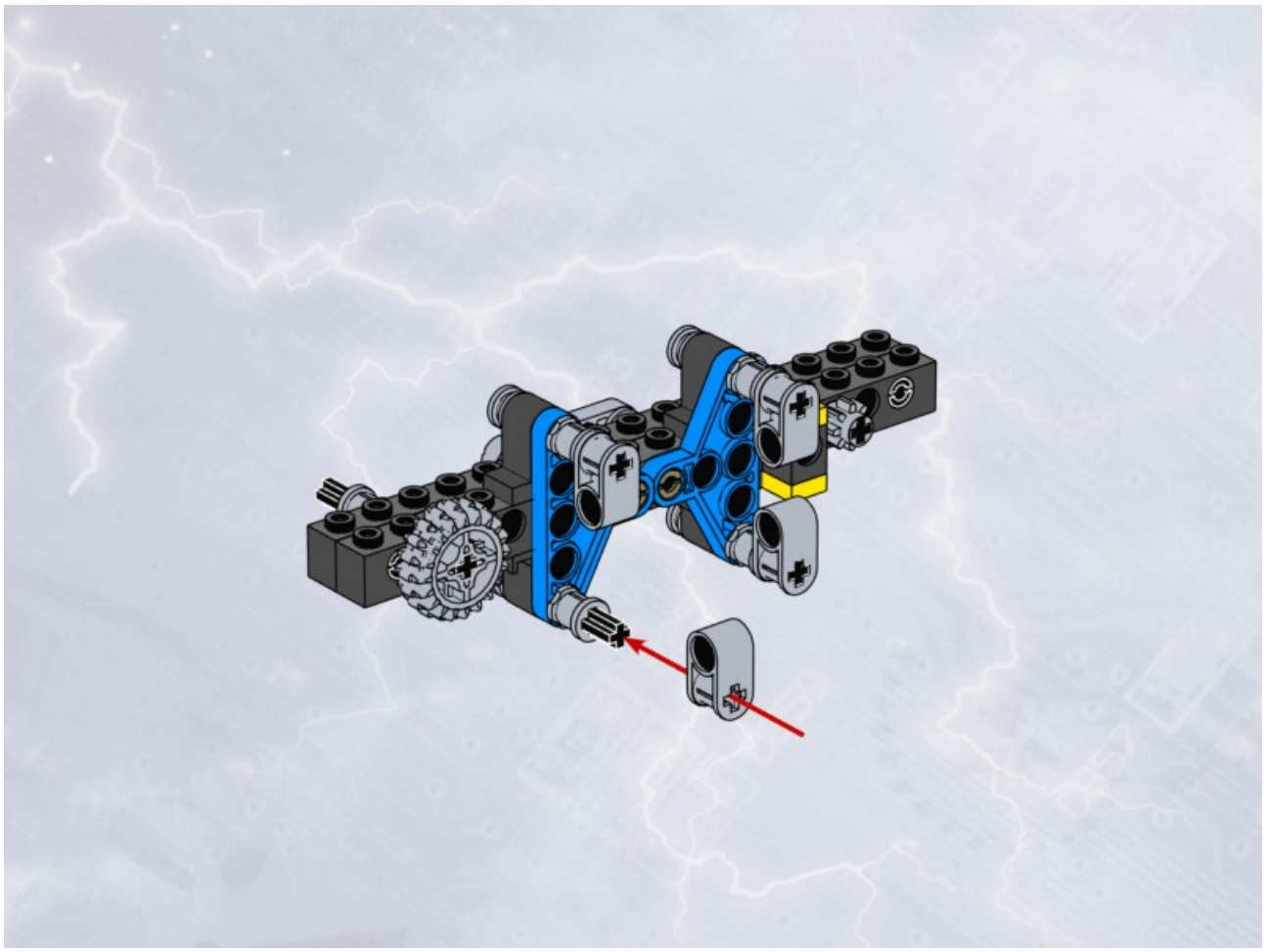

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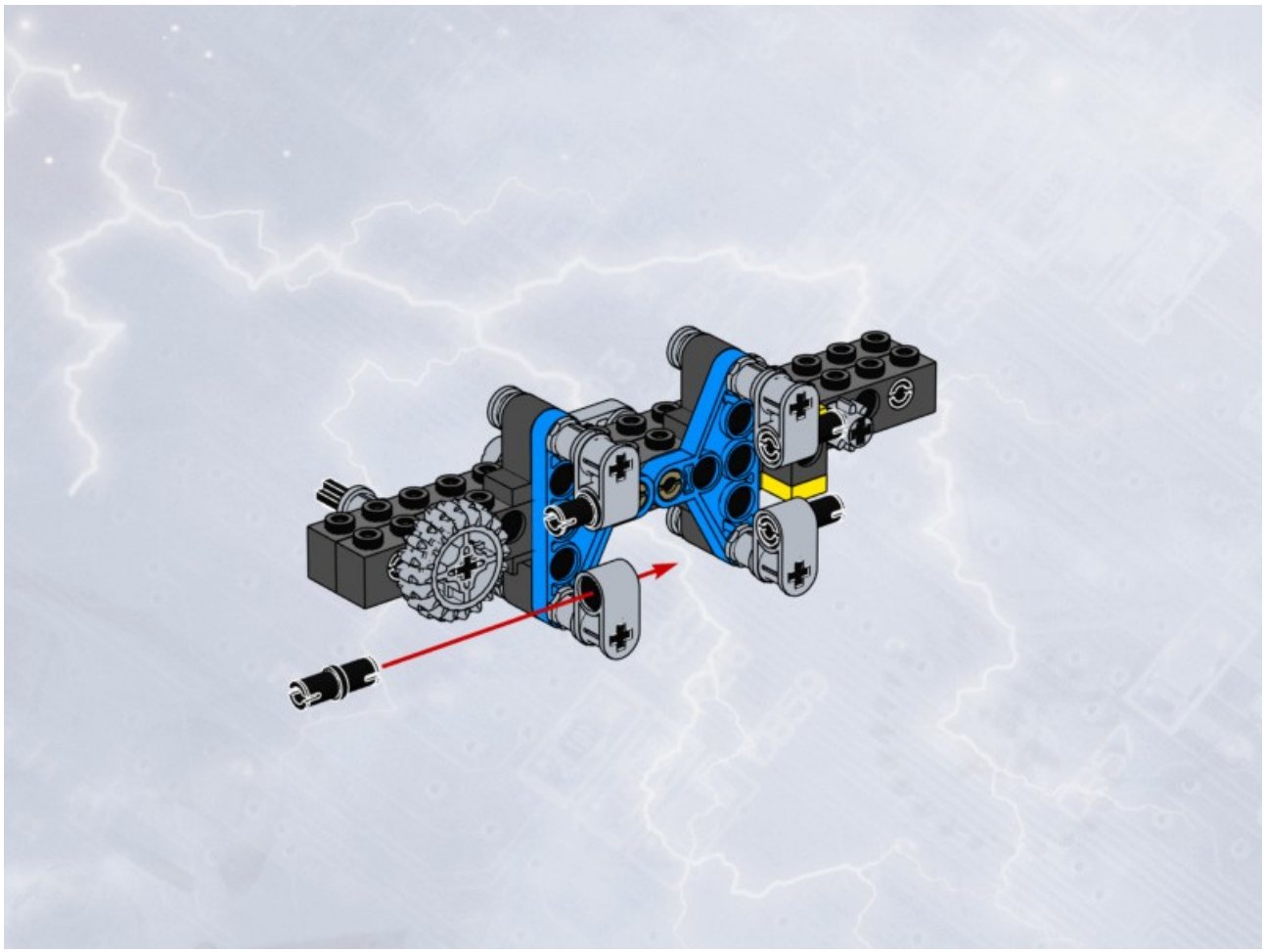

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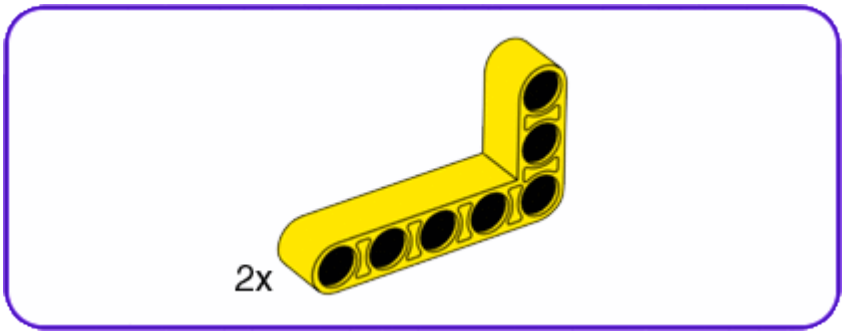

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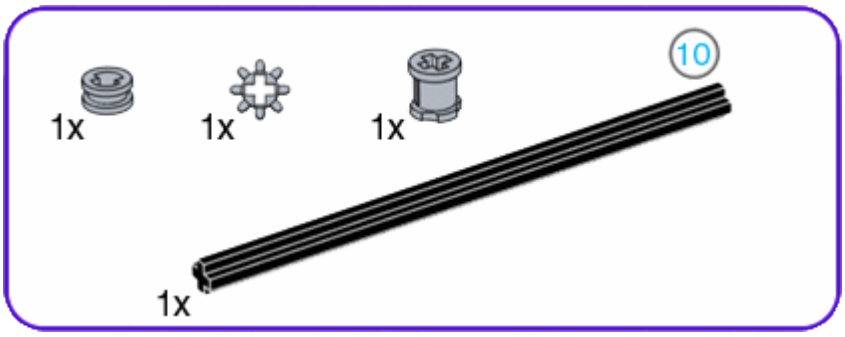

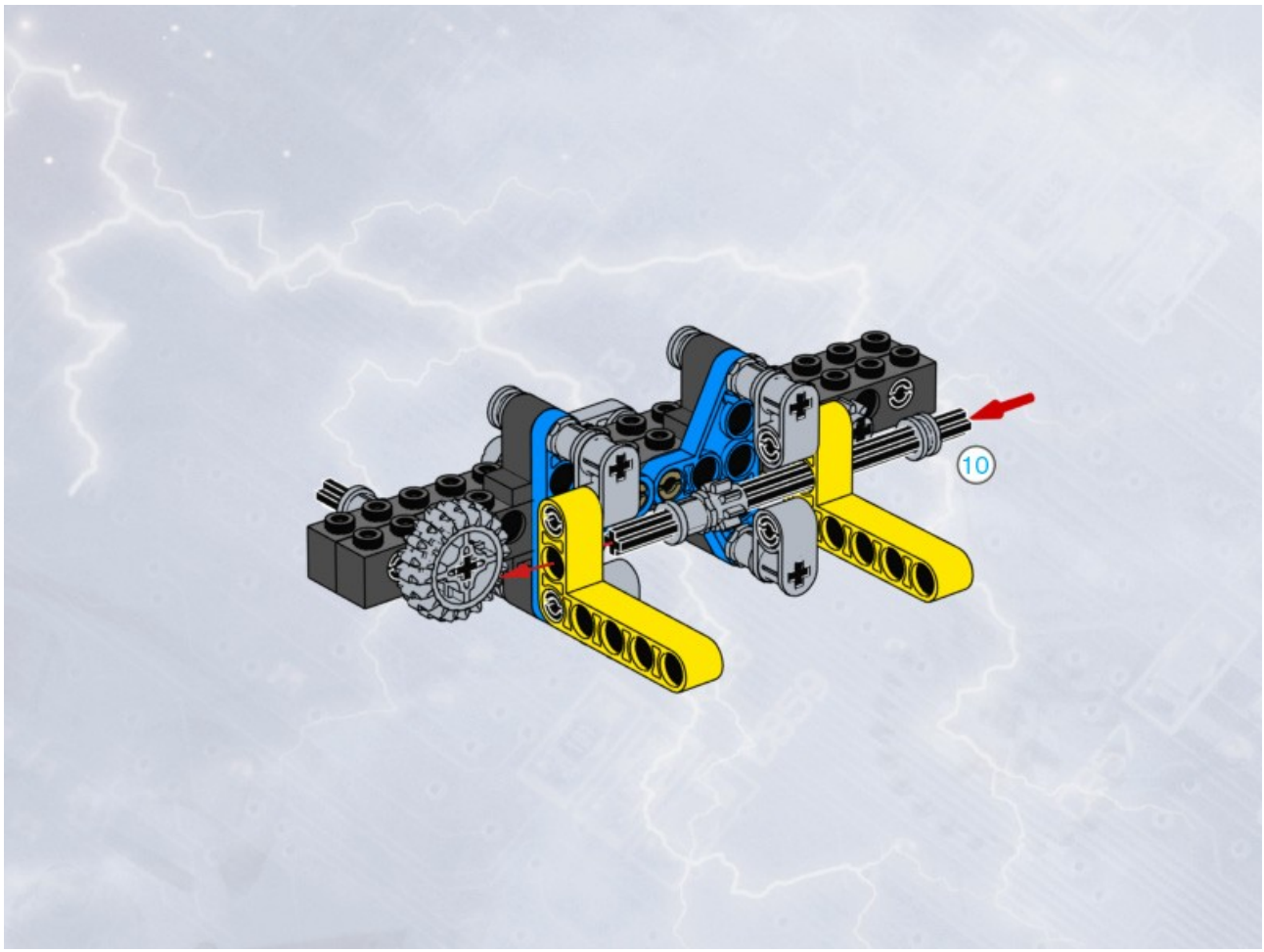

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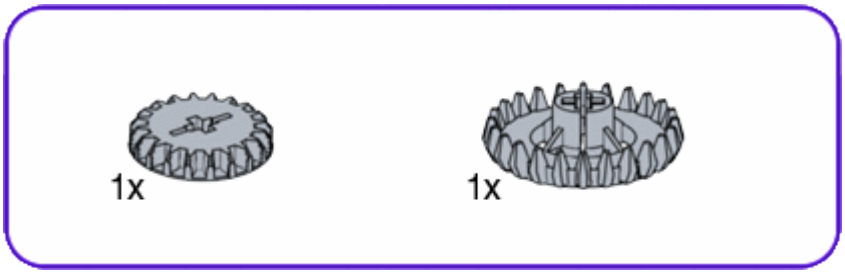

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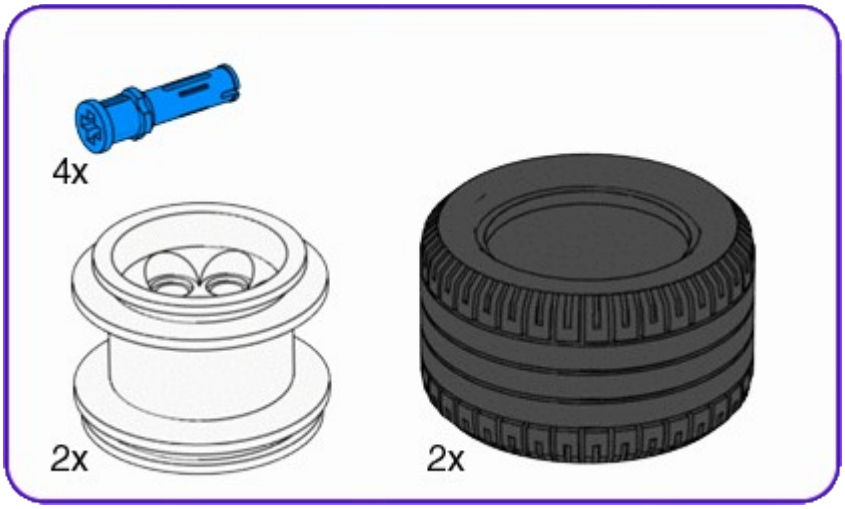
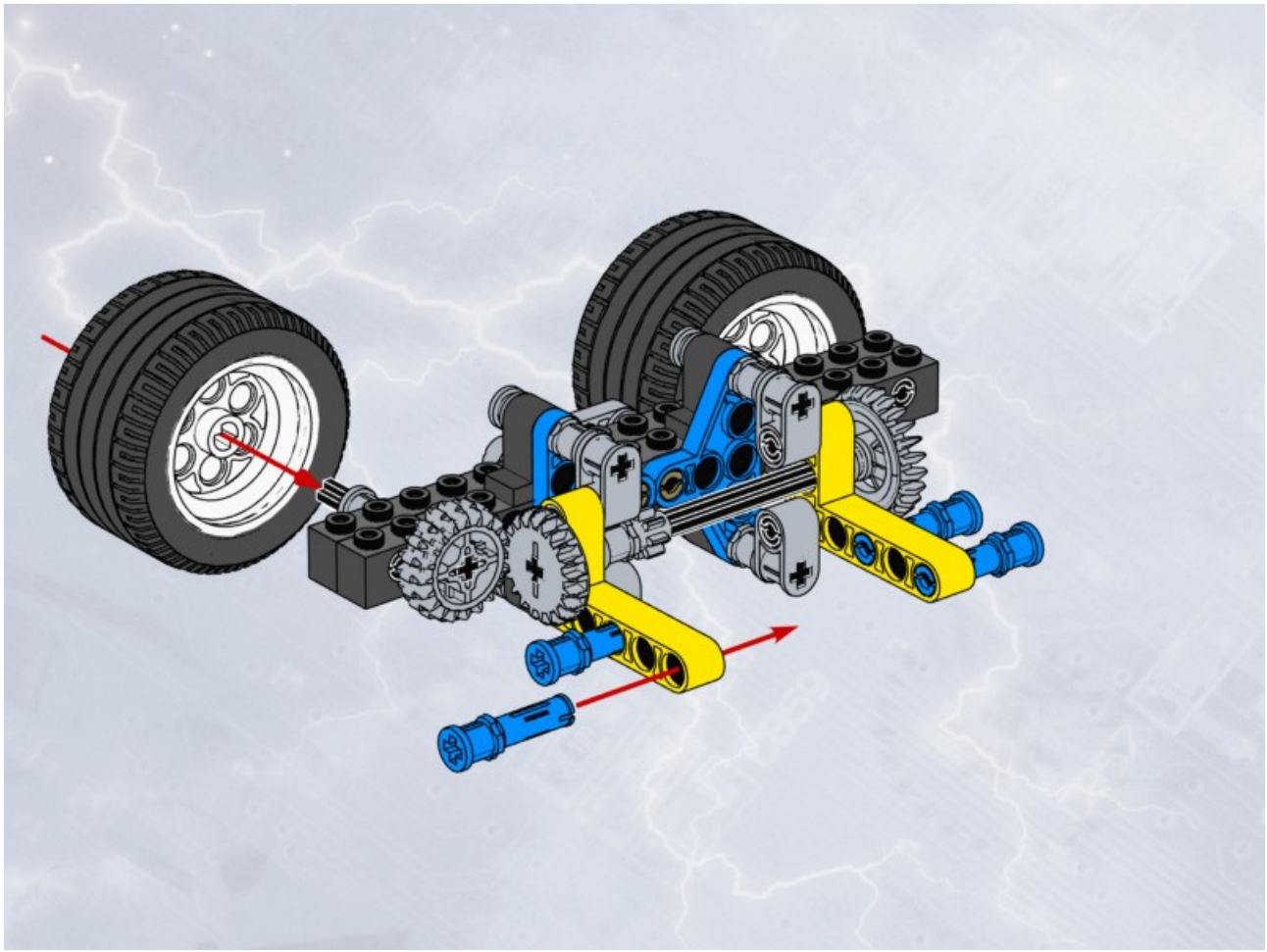




16

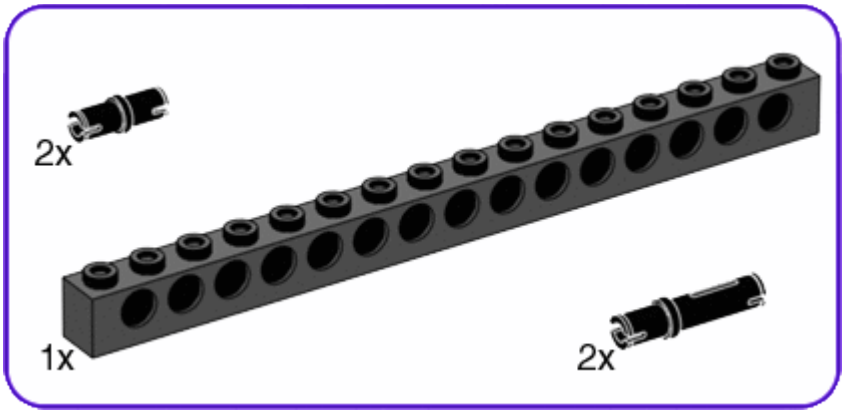
Shooter Track Module

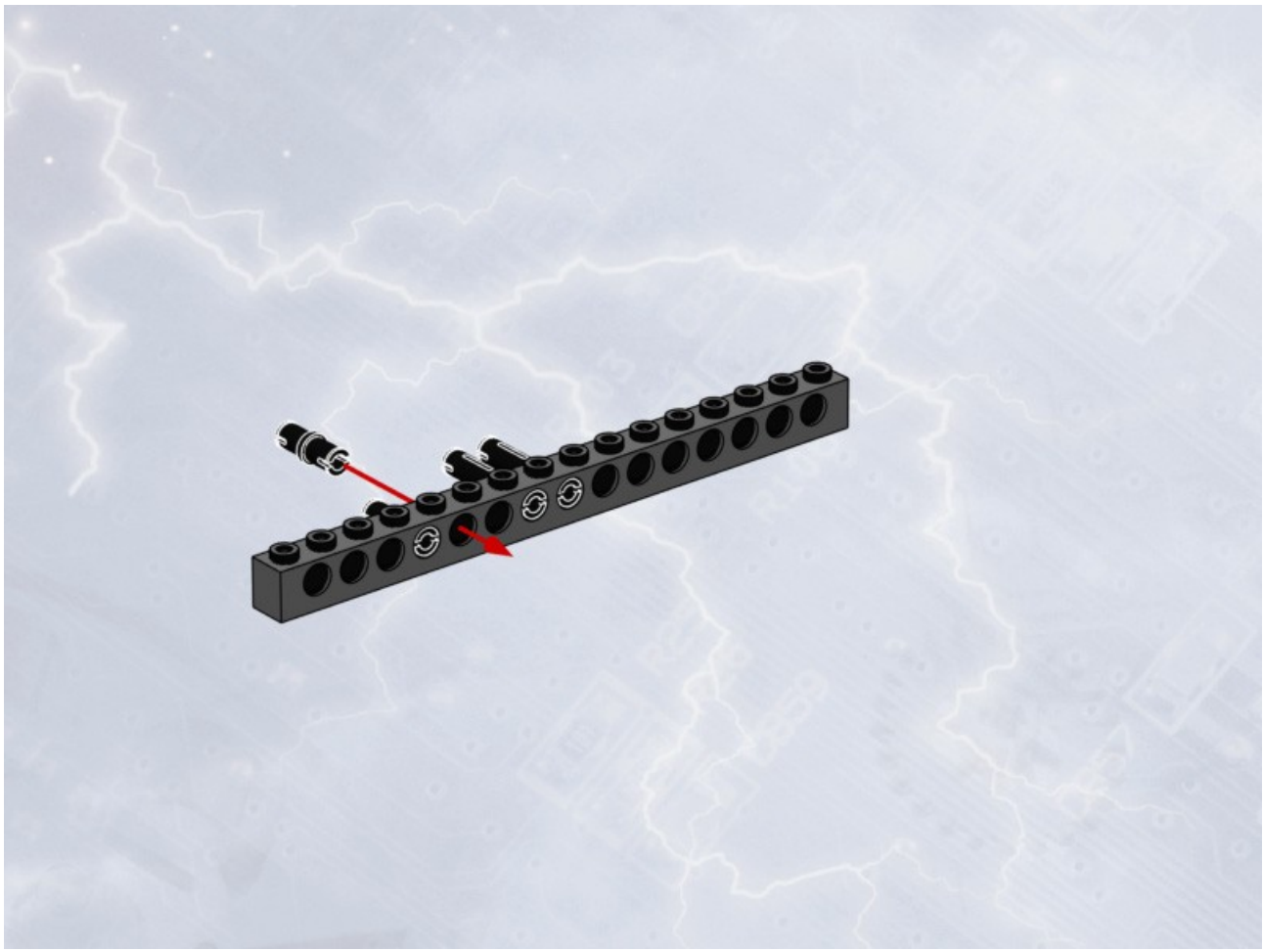
The Shooter Track Module is the part of the Disc Shooter that holds the discs and delivers them to the Shooter Module that spits them out in the air.

With a total gear ratio of 15 to 1 from the Motor to the Track, the discs are delivered smoothly and do not pile up.

A Light Sensor is installed to check for discs passing underneath. It can start the shooter module, and also count the discs stopping the shooter when the last disc has been shot.

1





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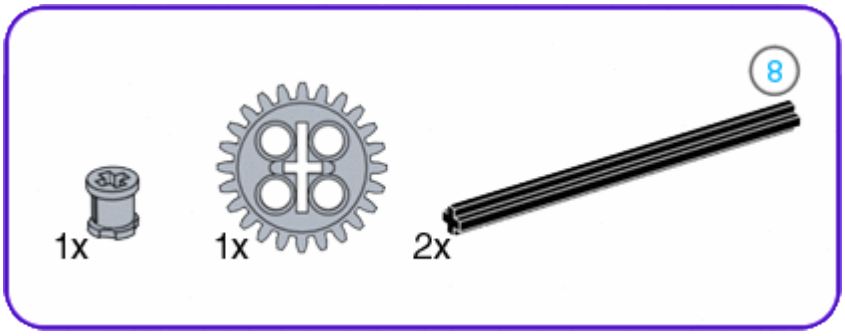

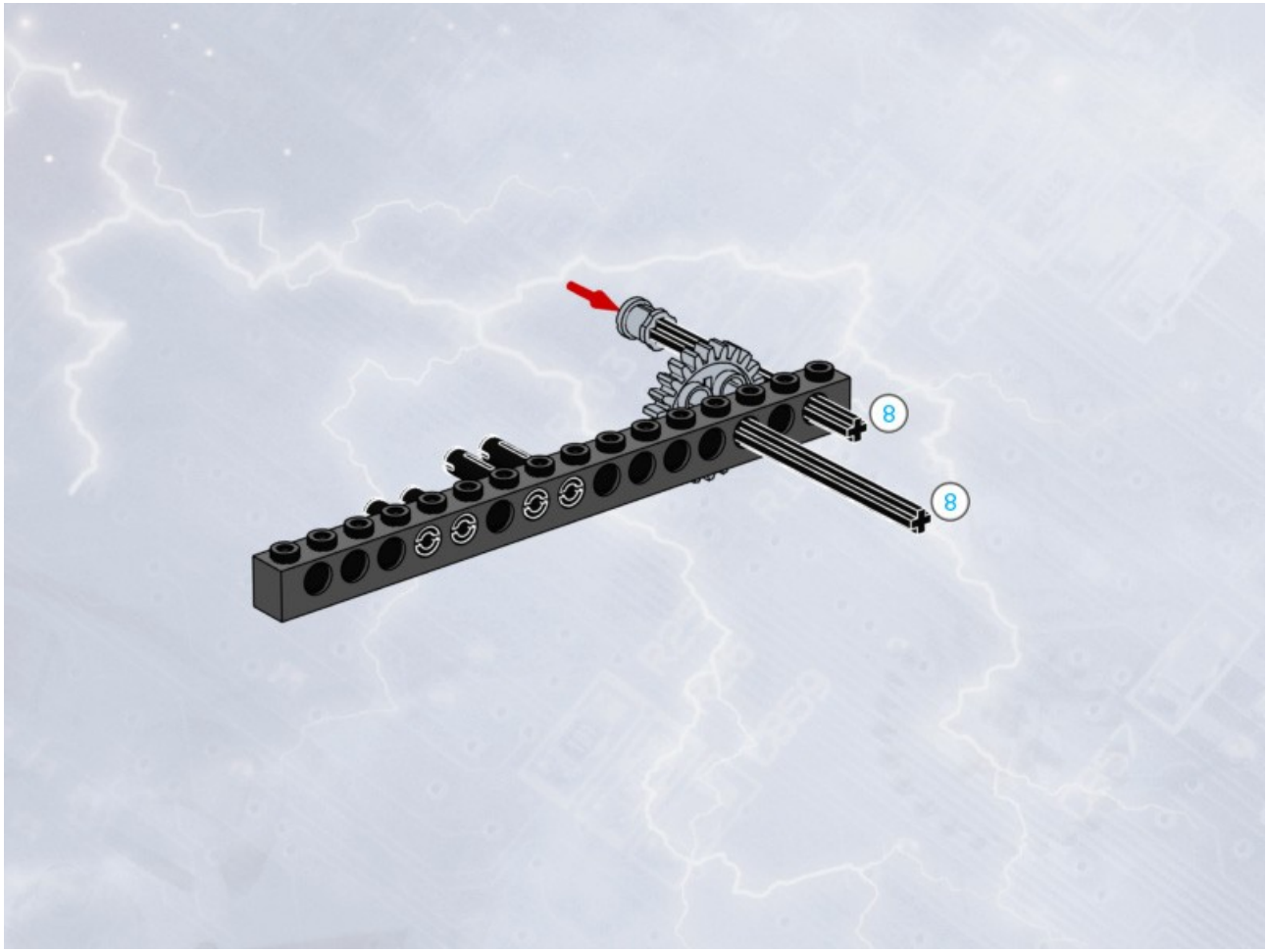

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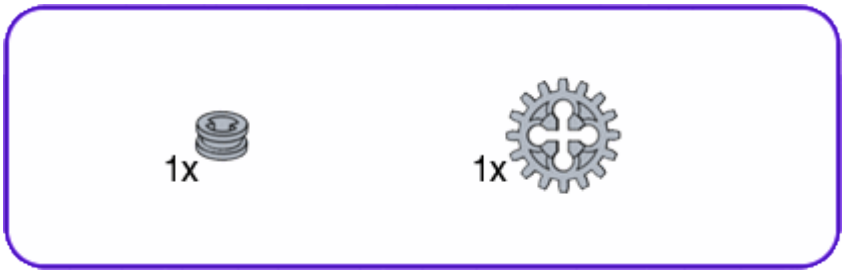

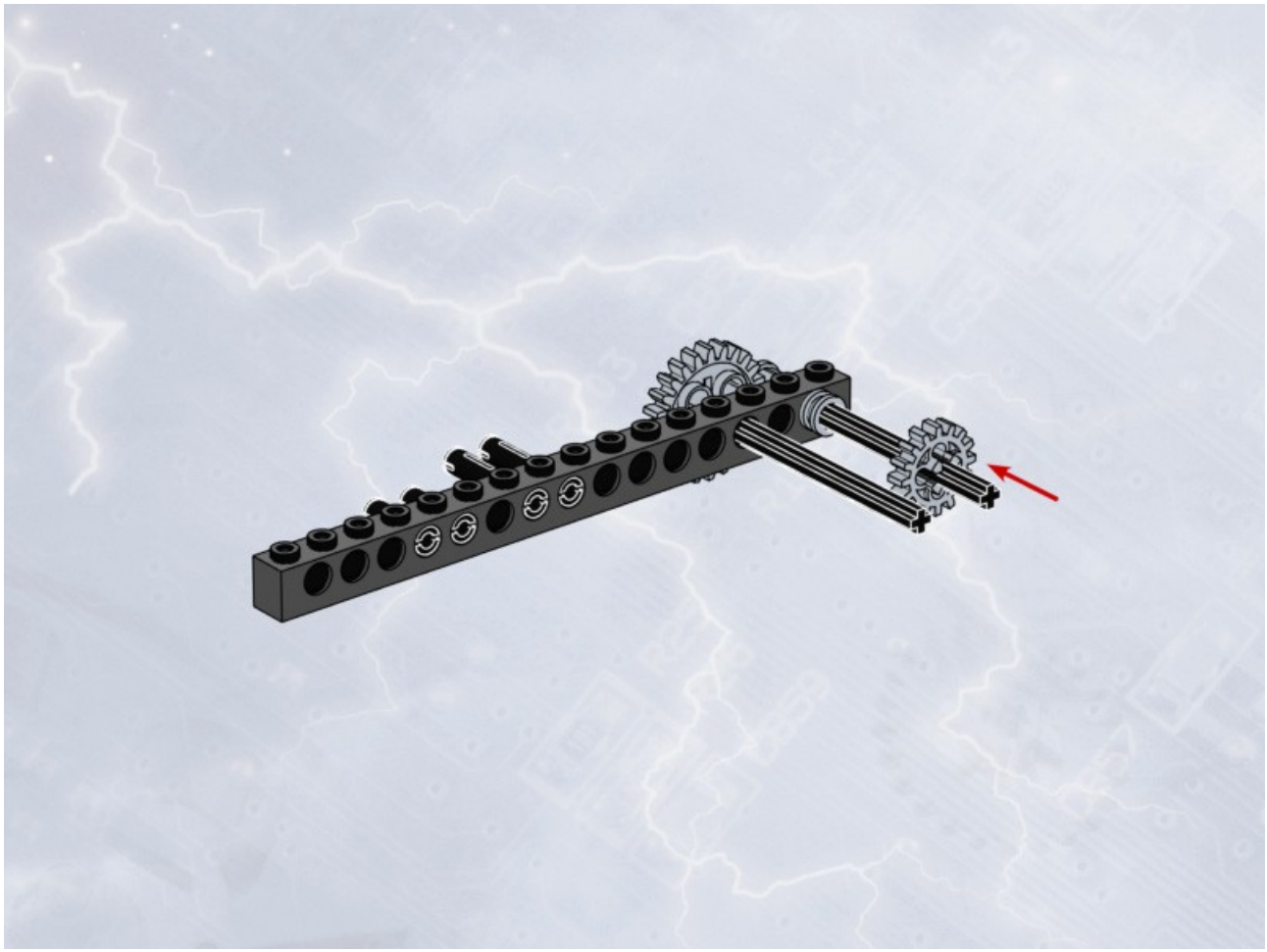

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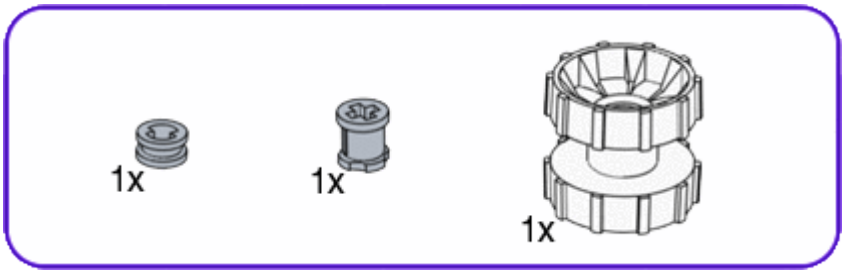

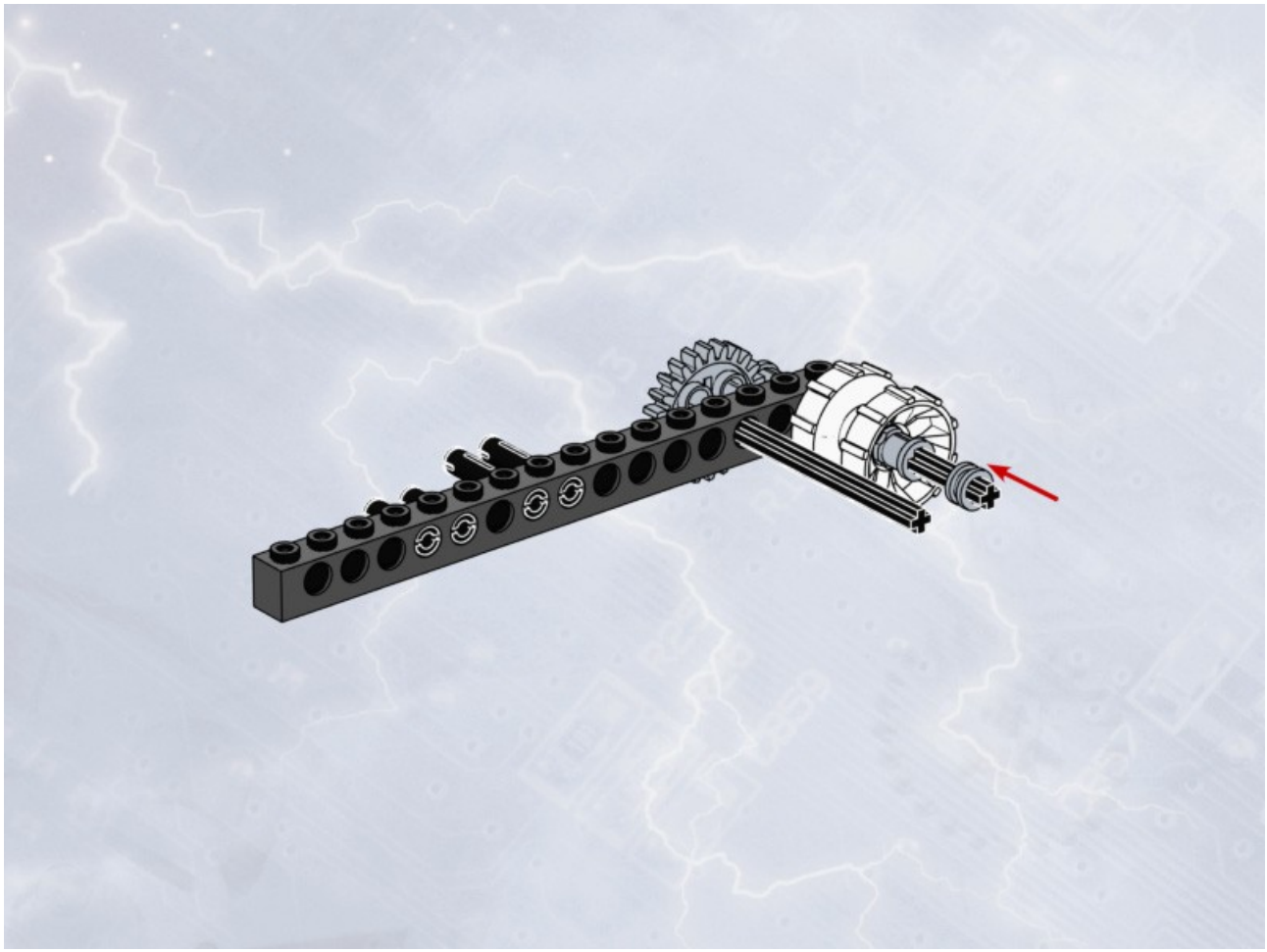

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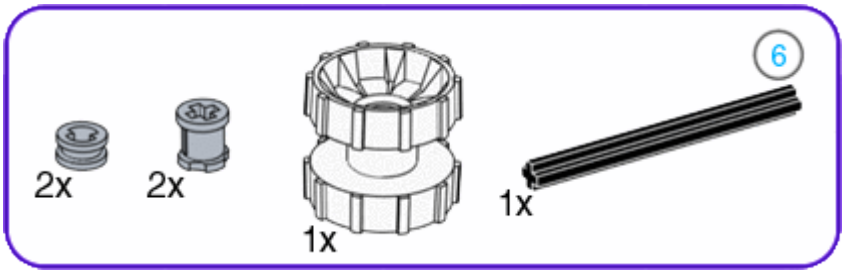

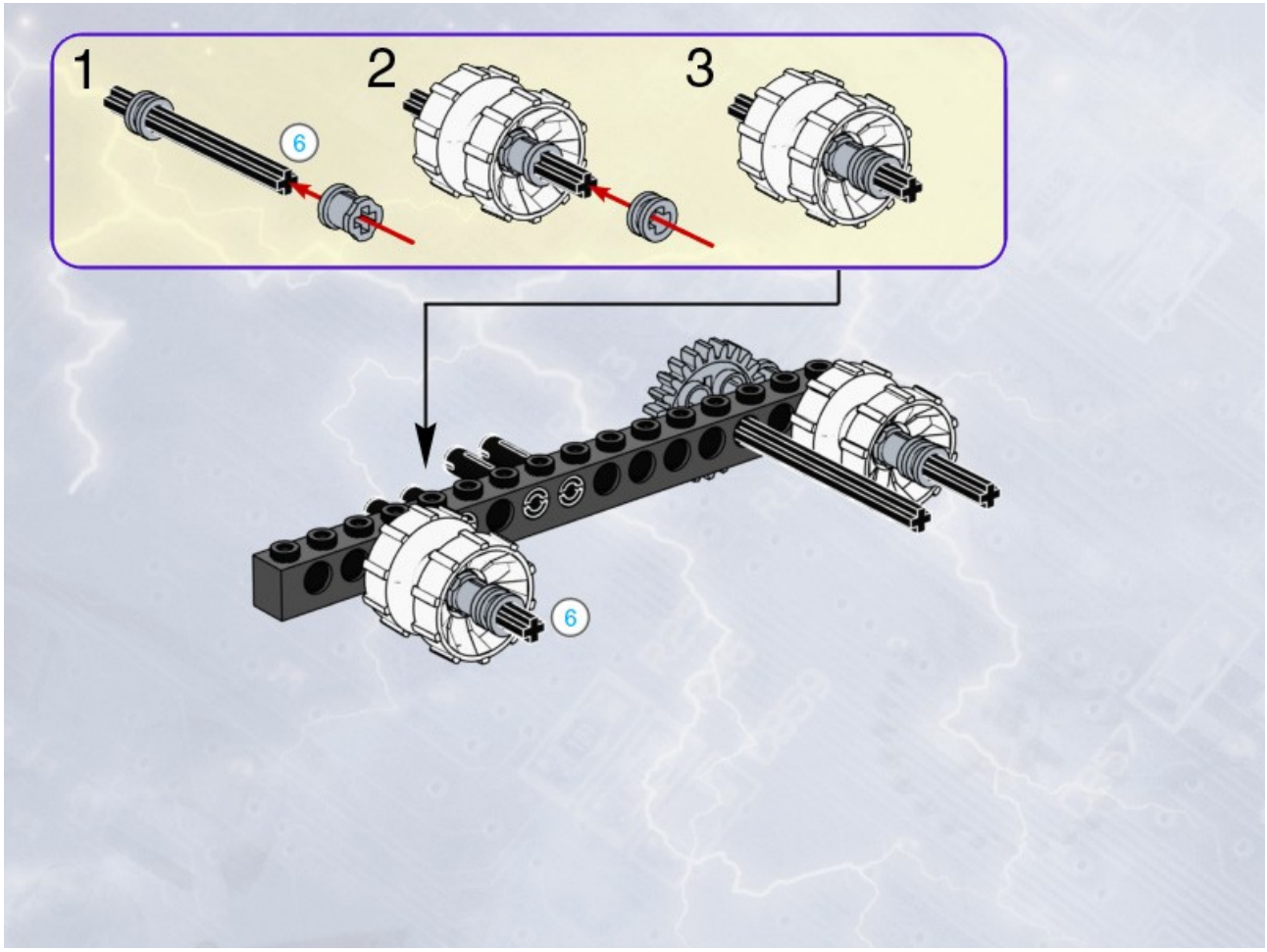

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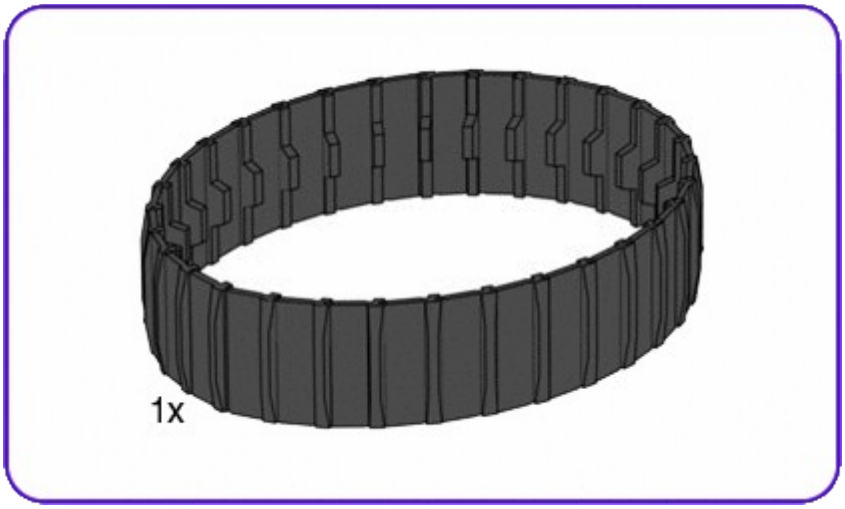

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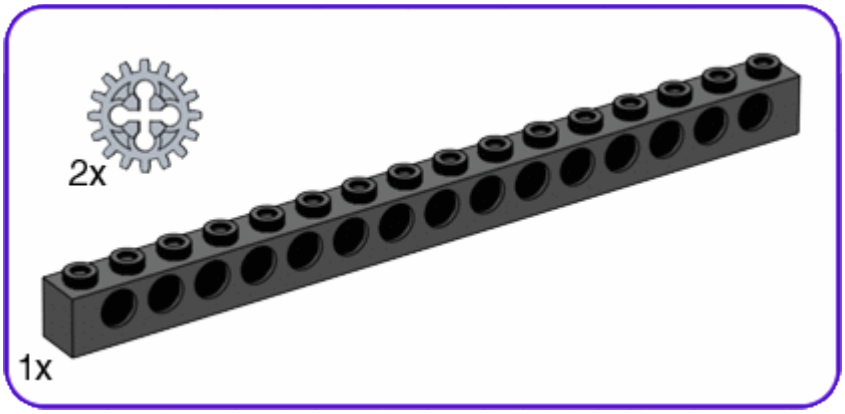

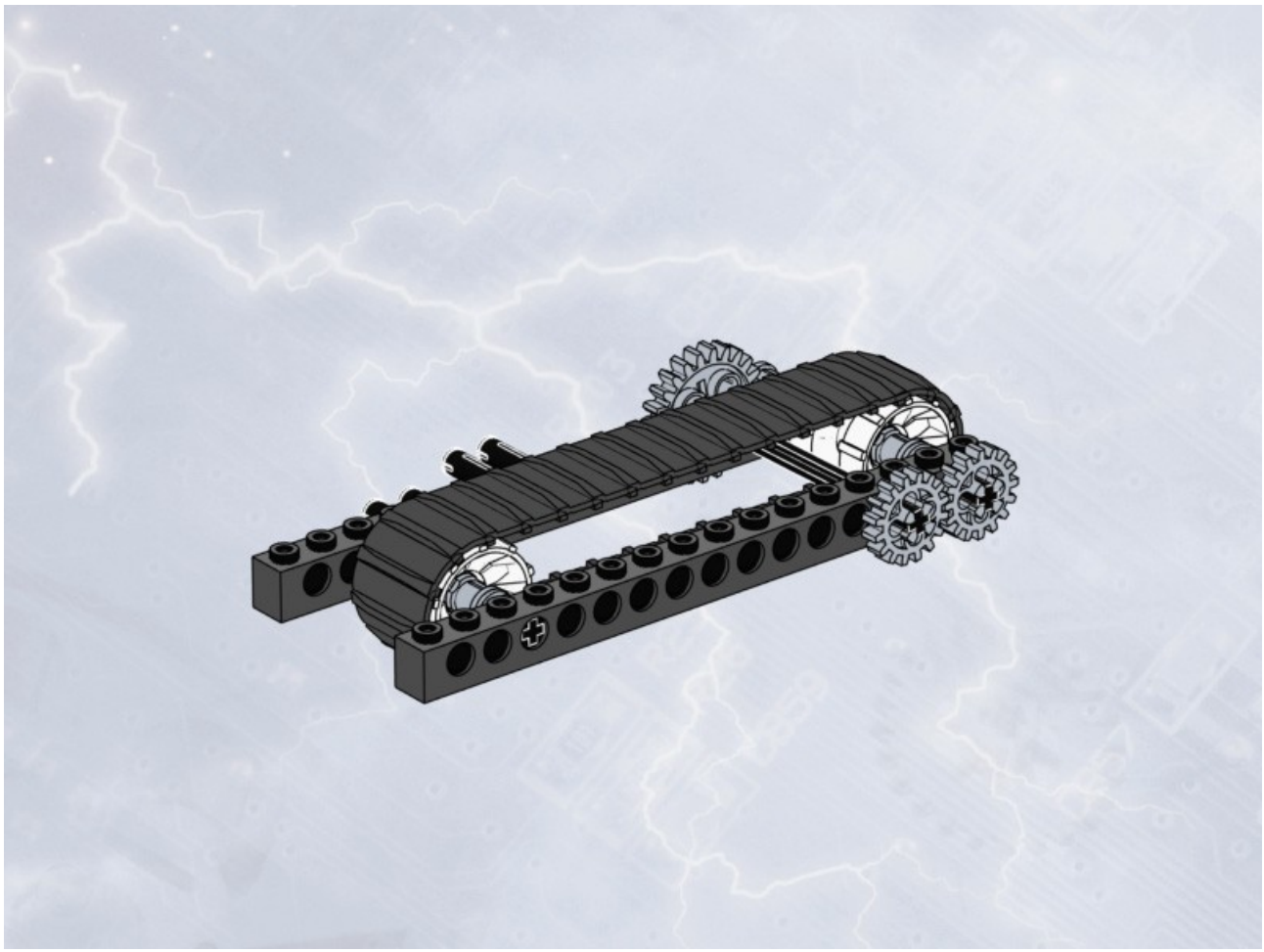

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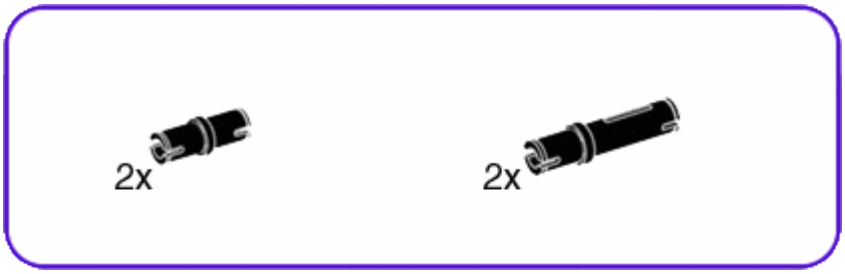

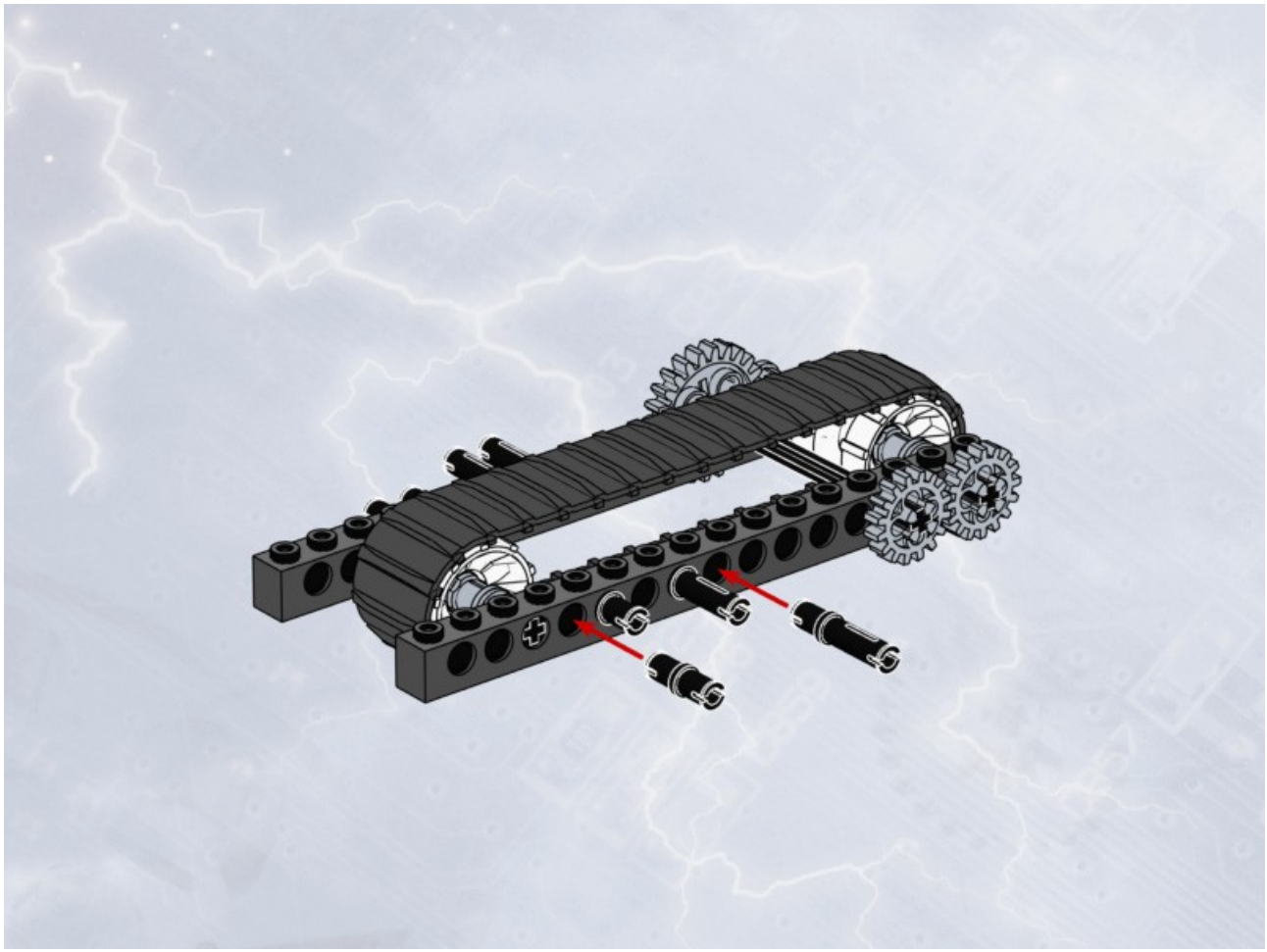

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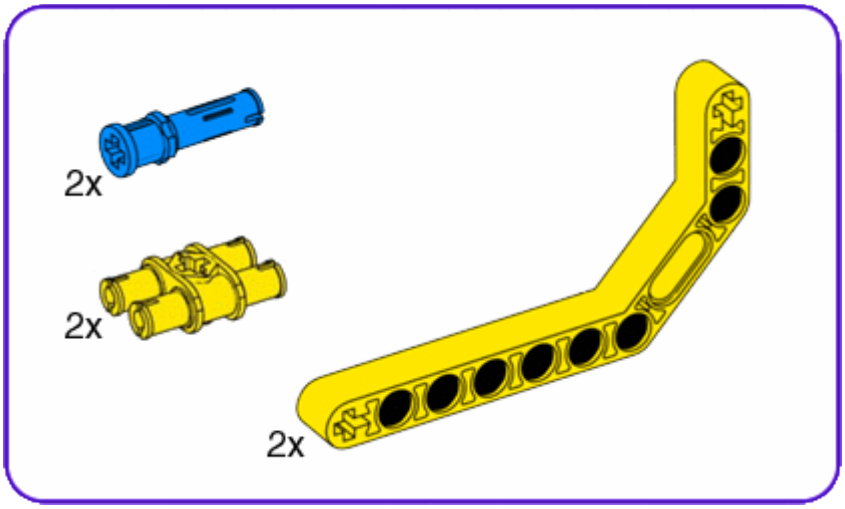

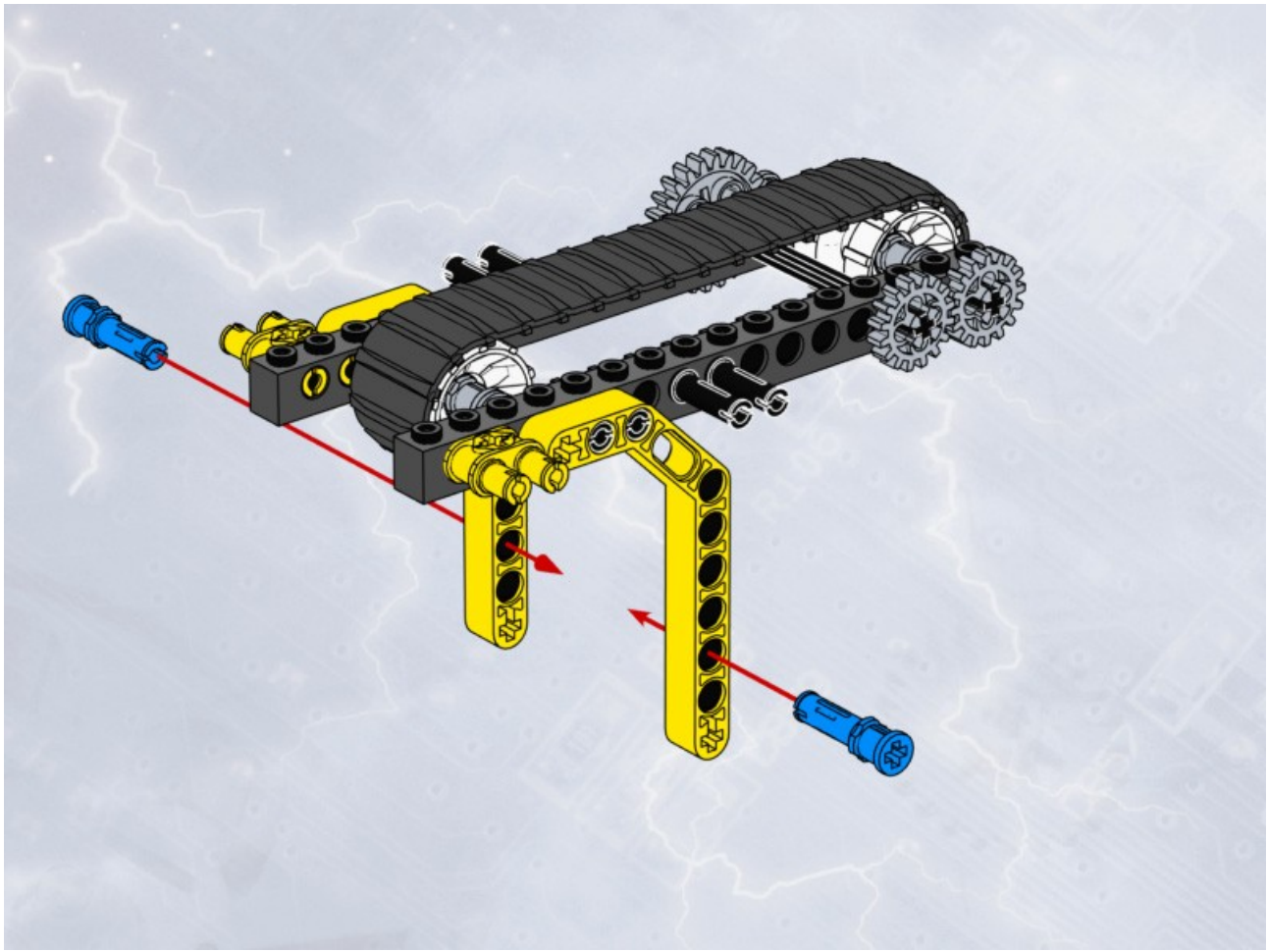

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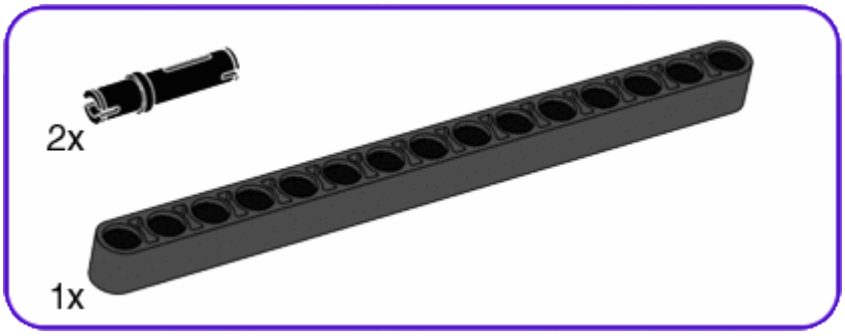

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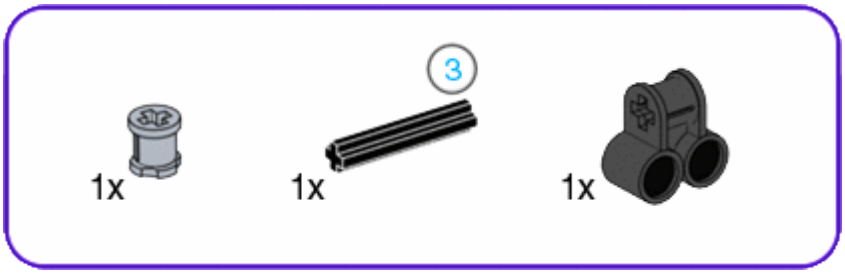

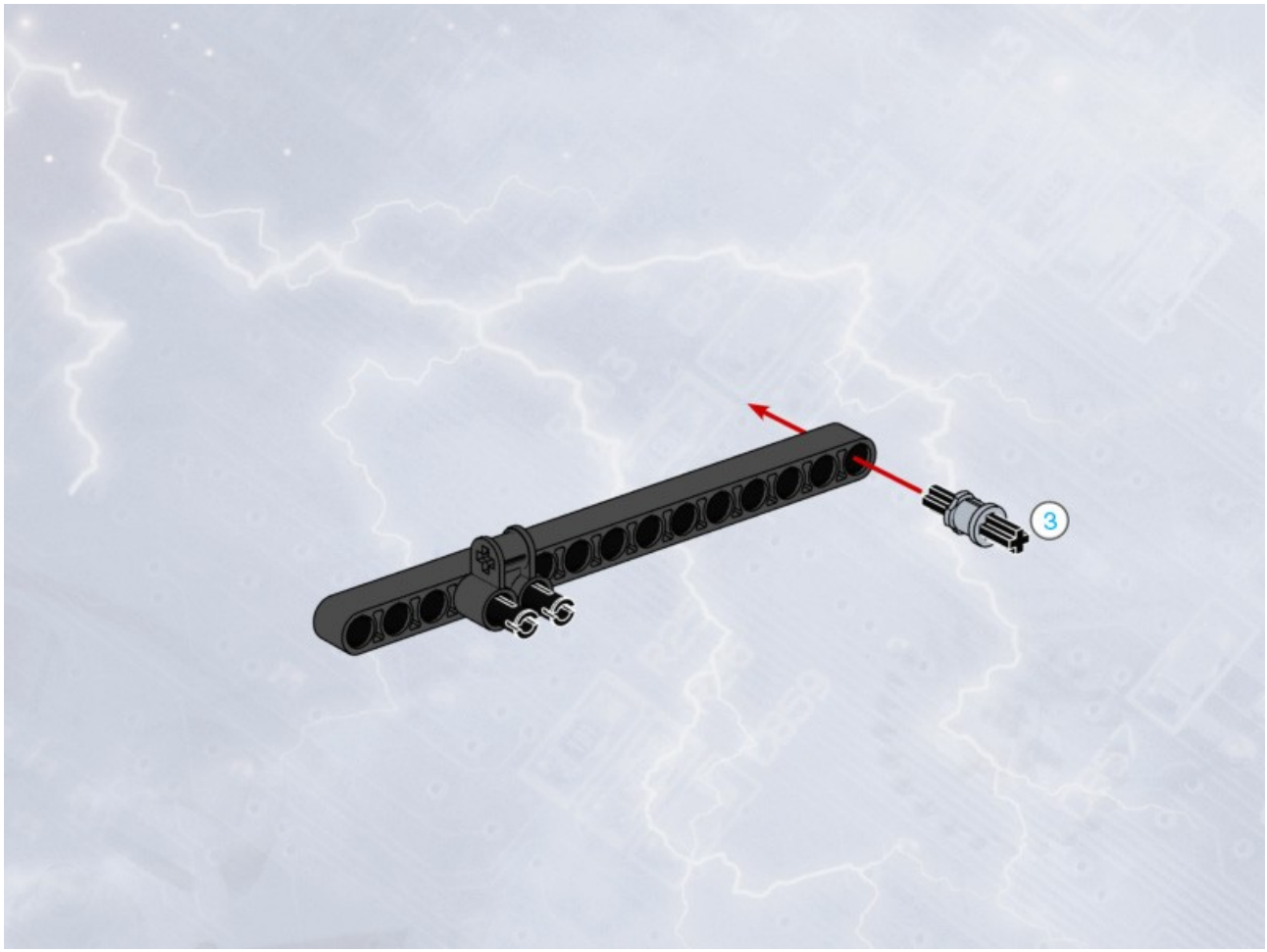

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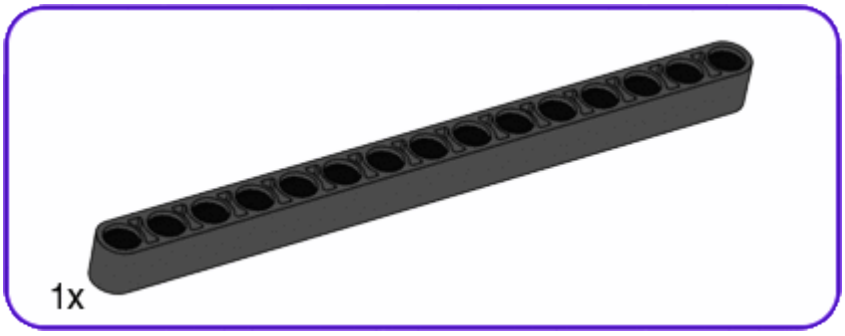

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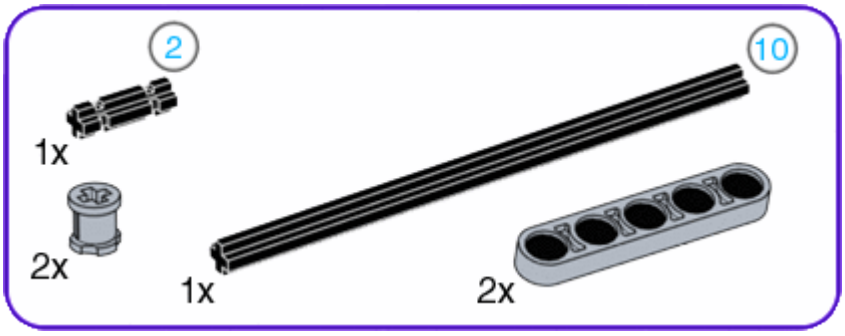

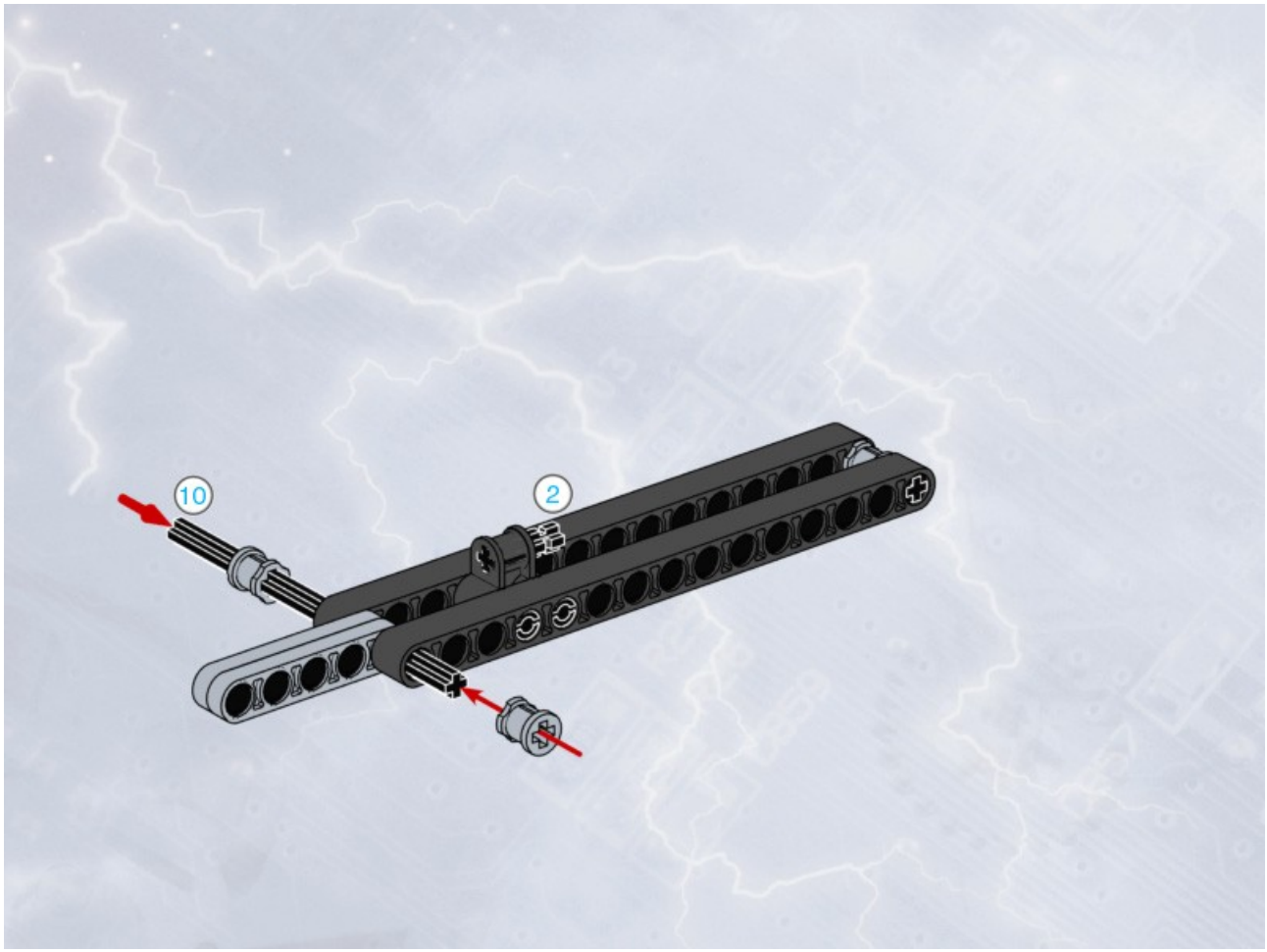

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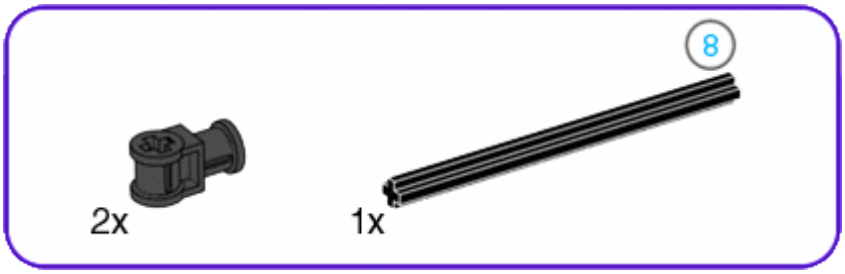

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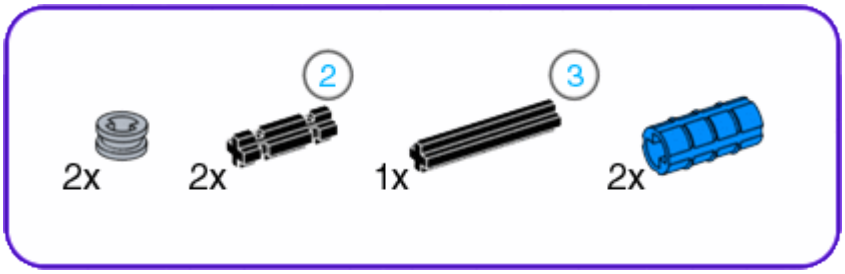

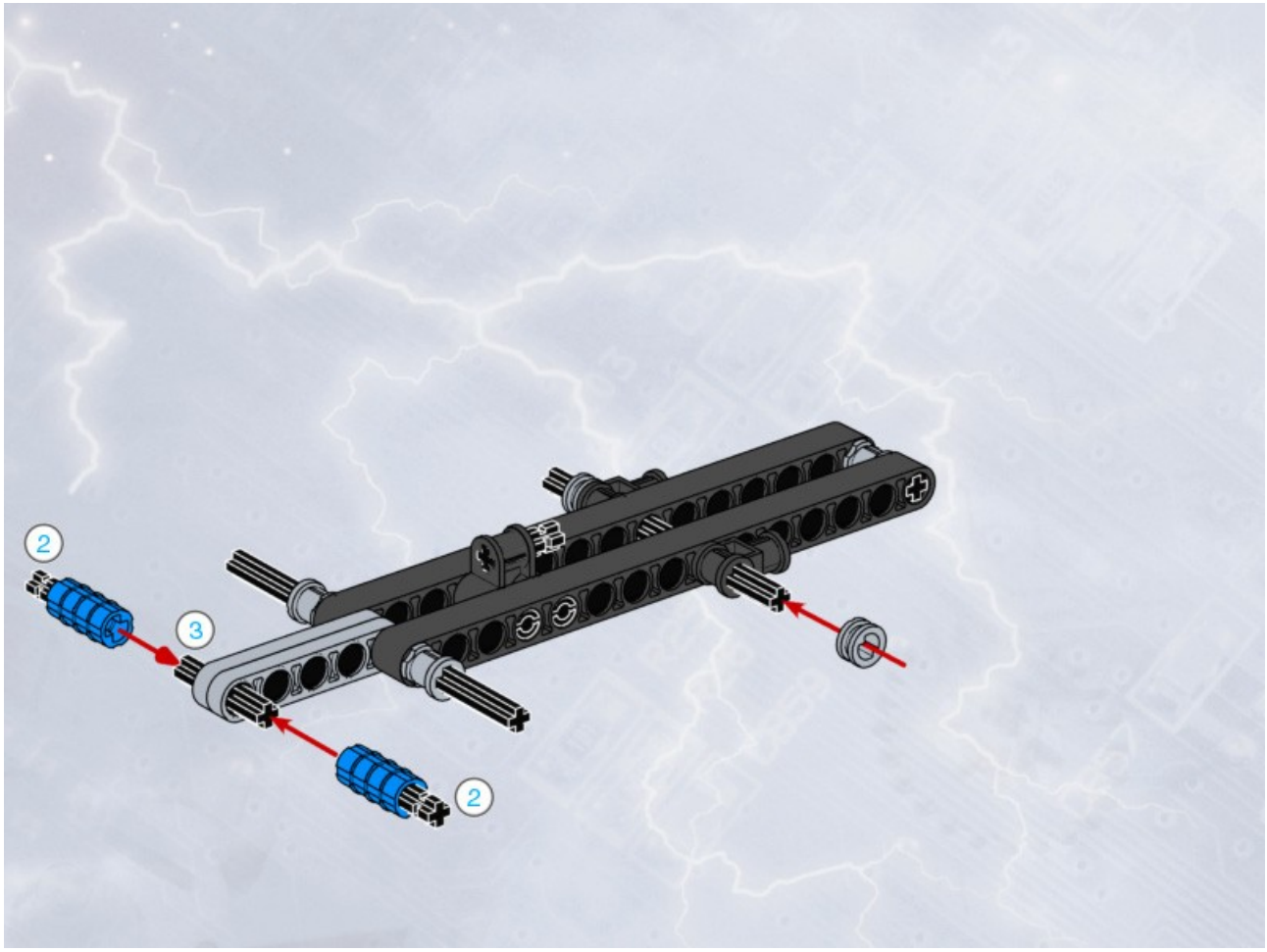

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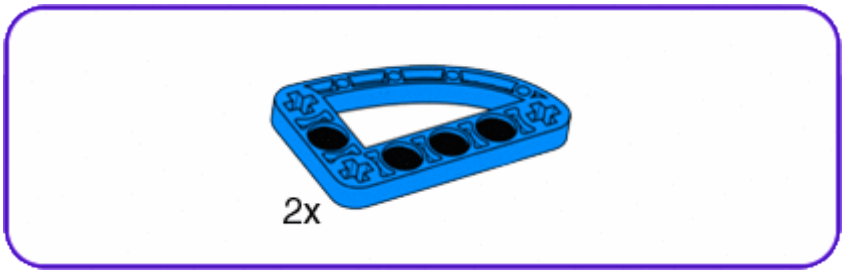

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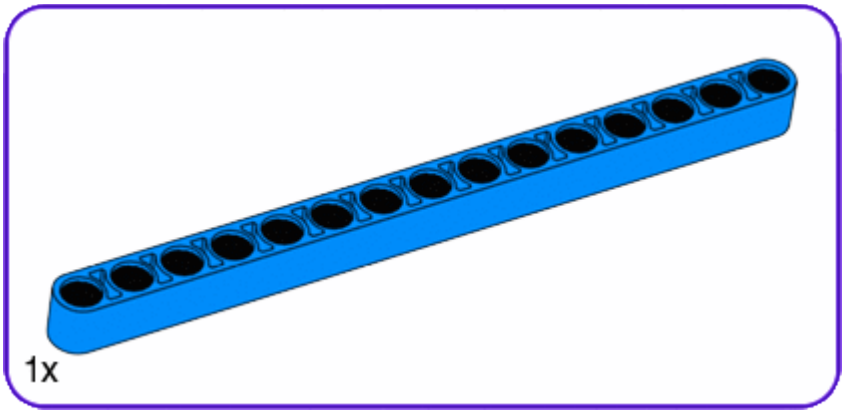

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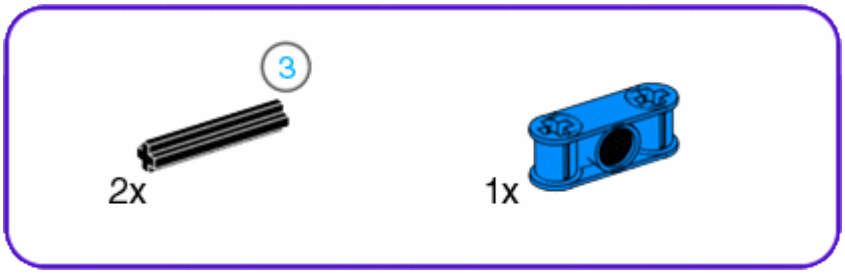

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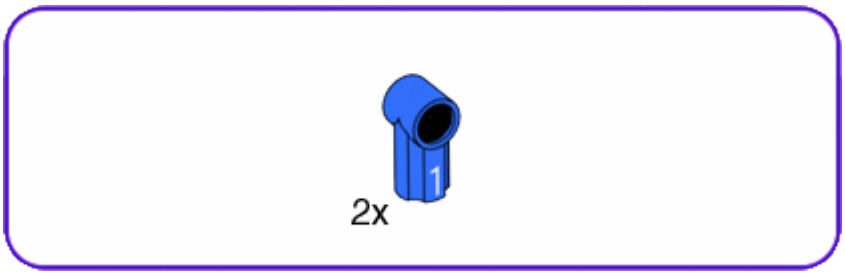

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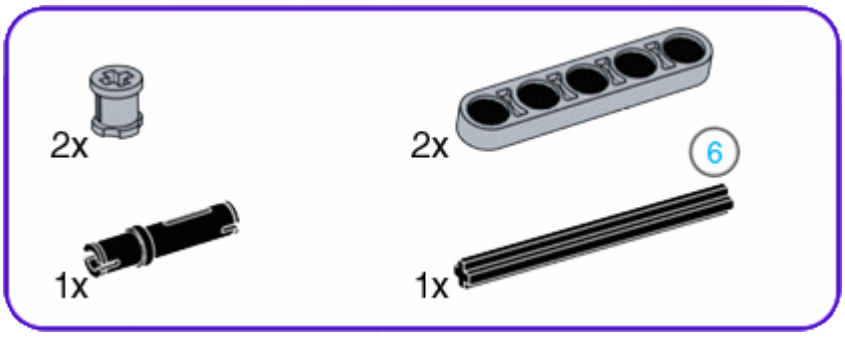

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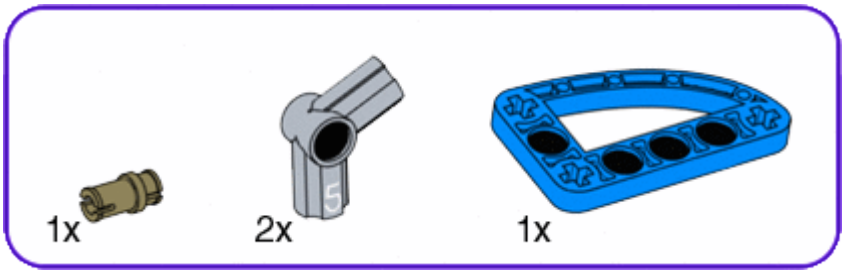

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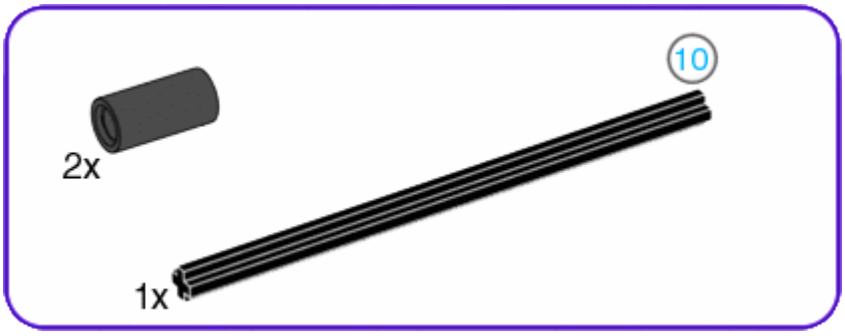

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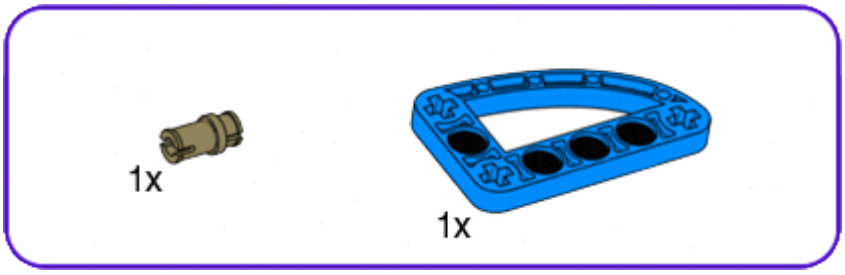

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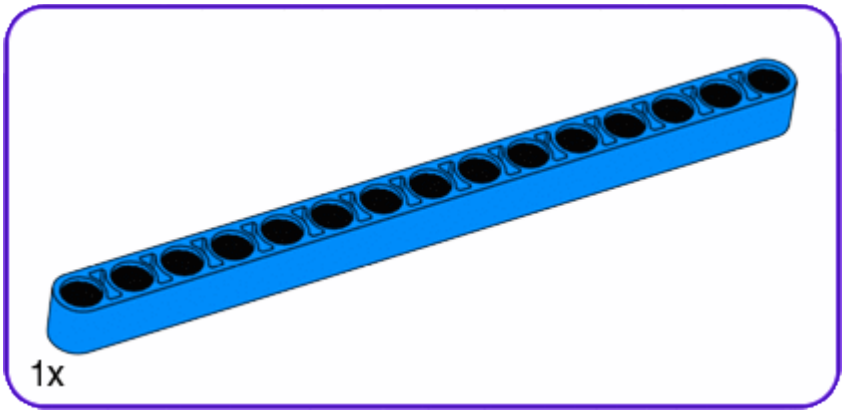

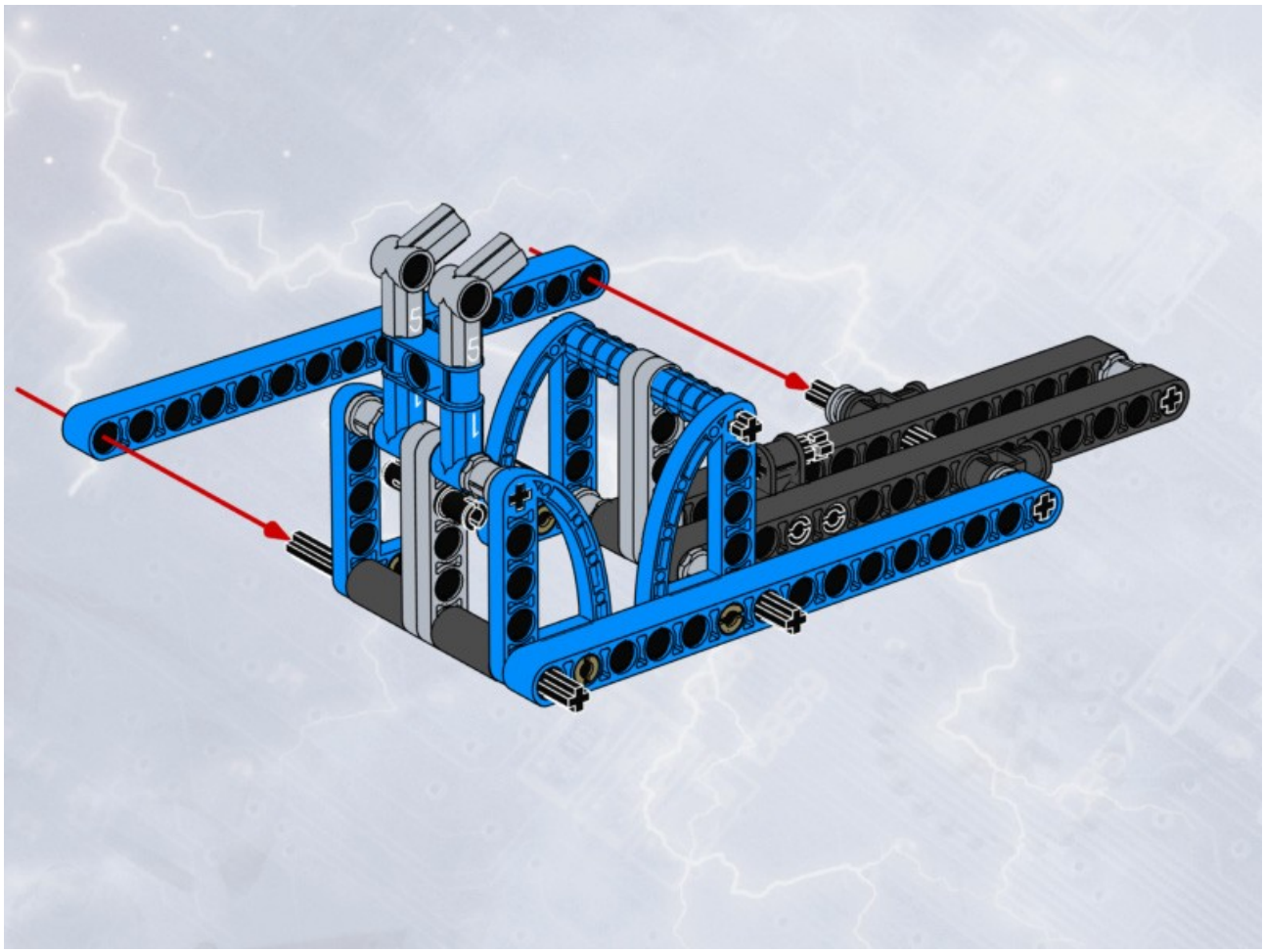

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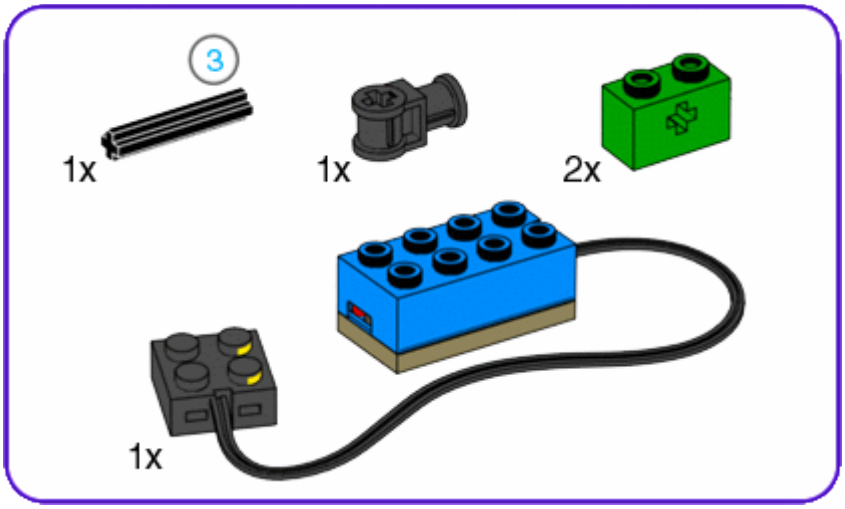

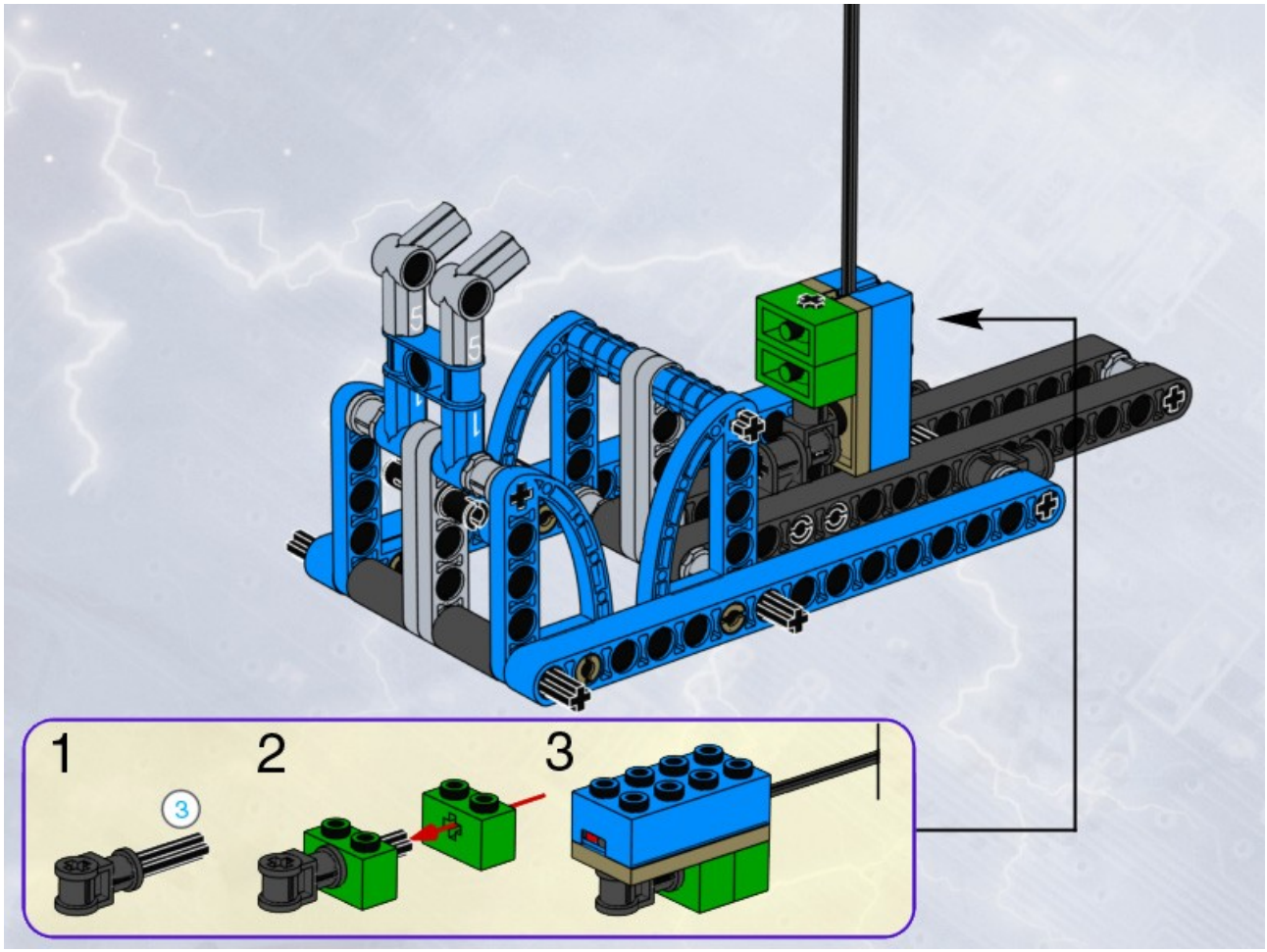

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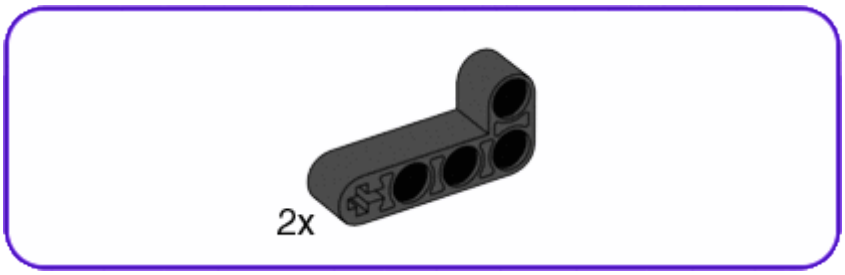

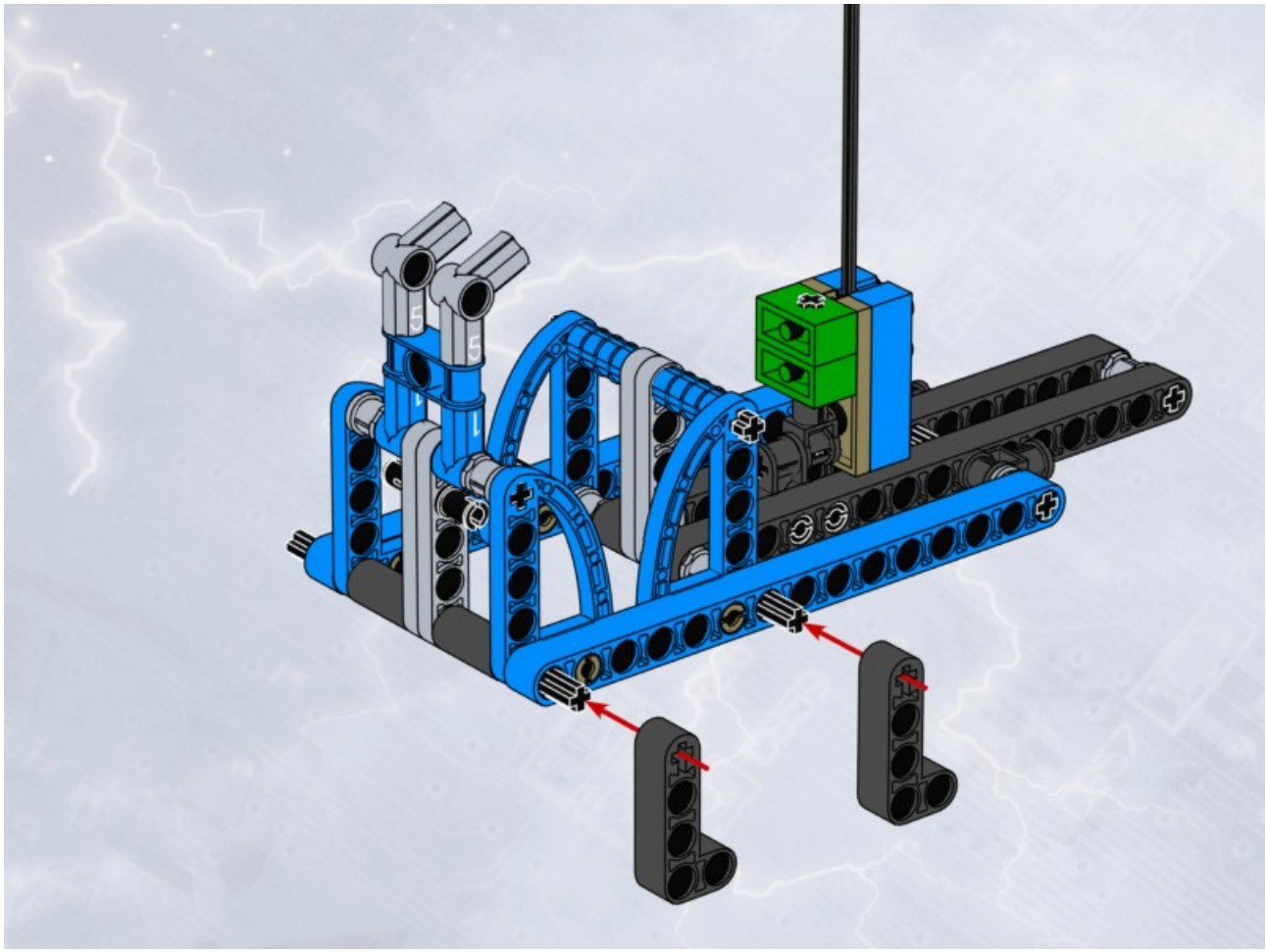

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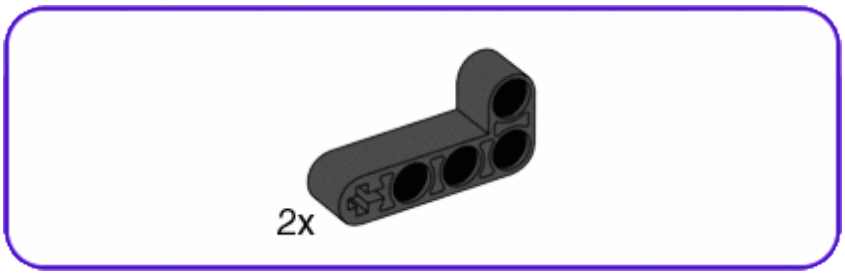

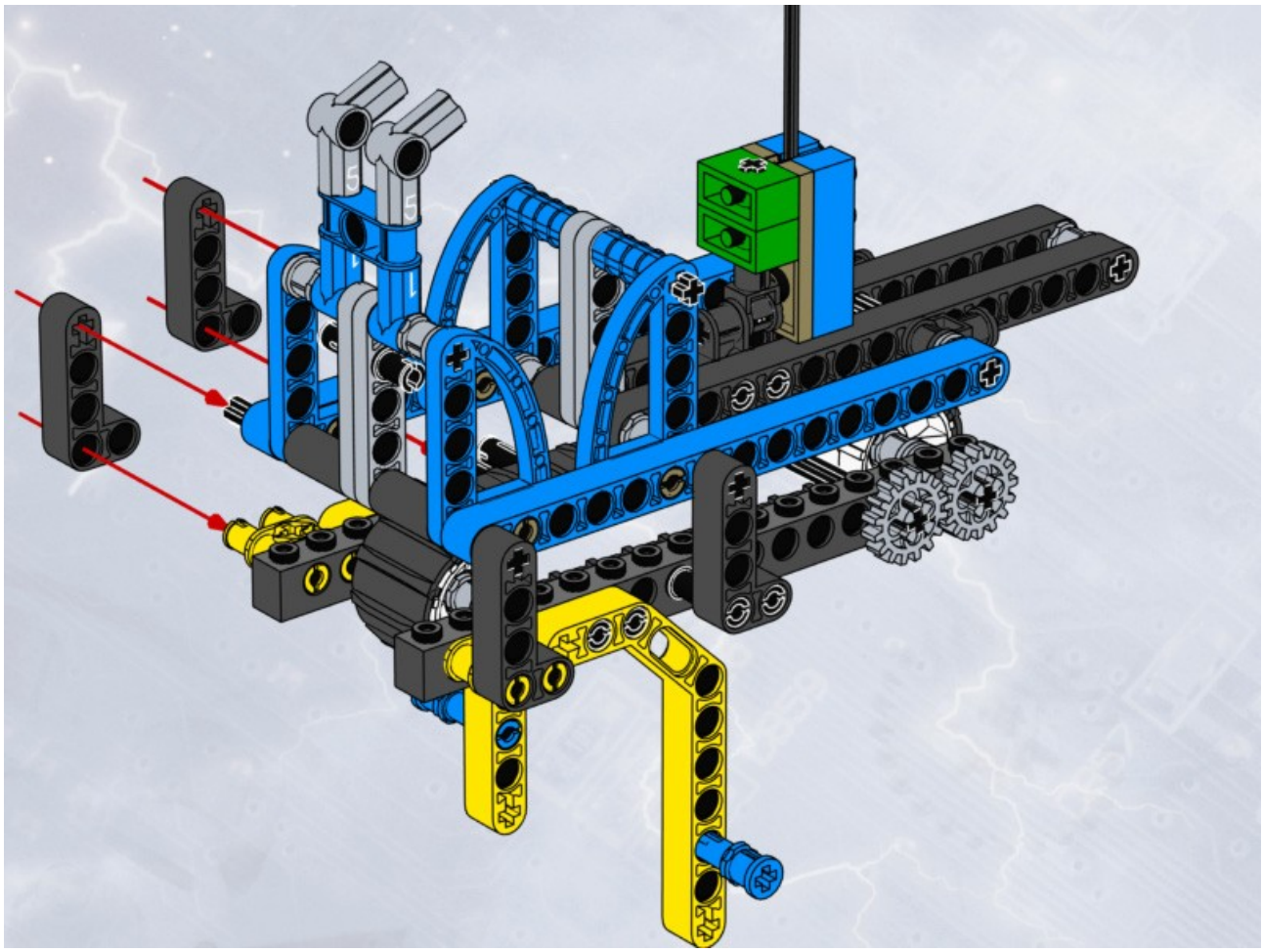

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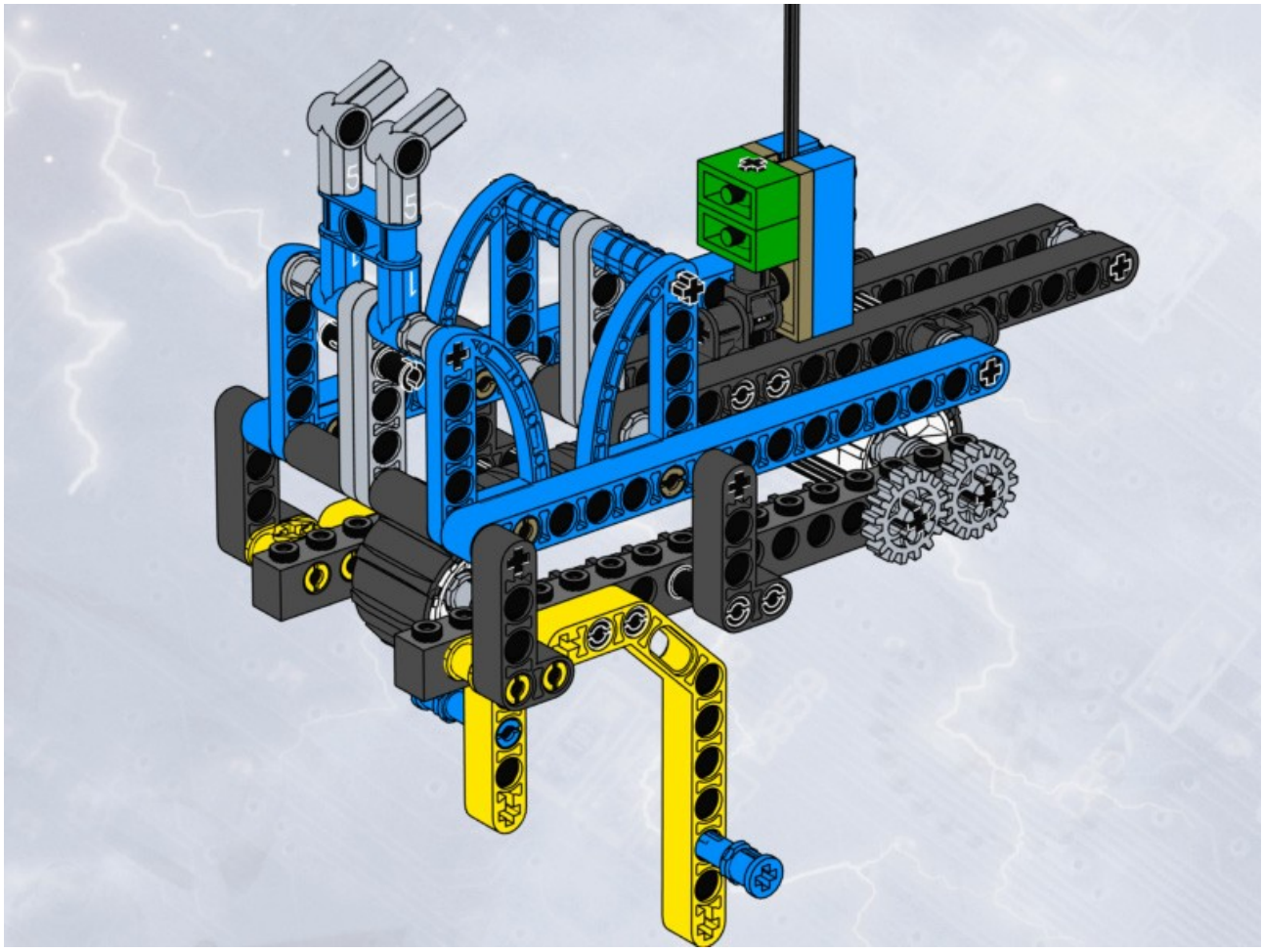
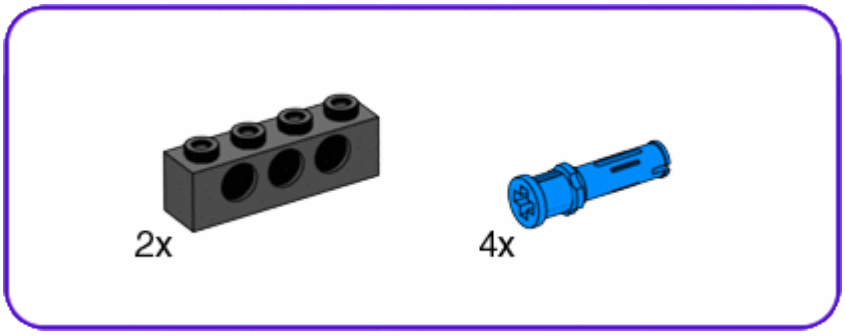


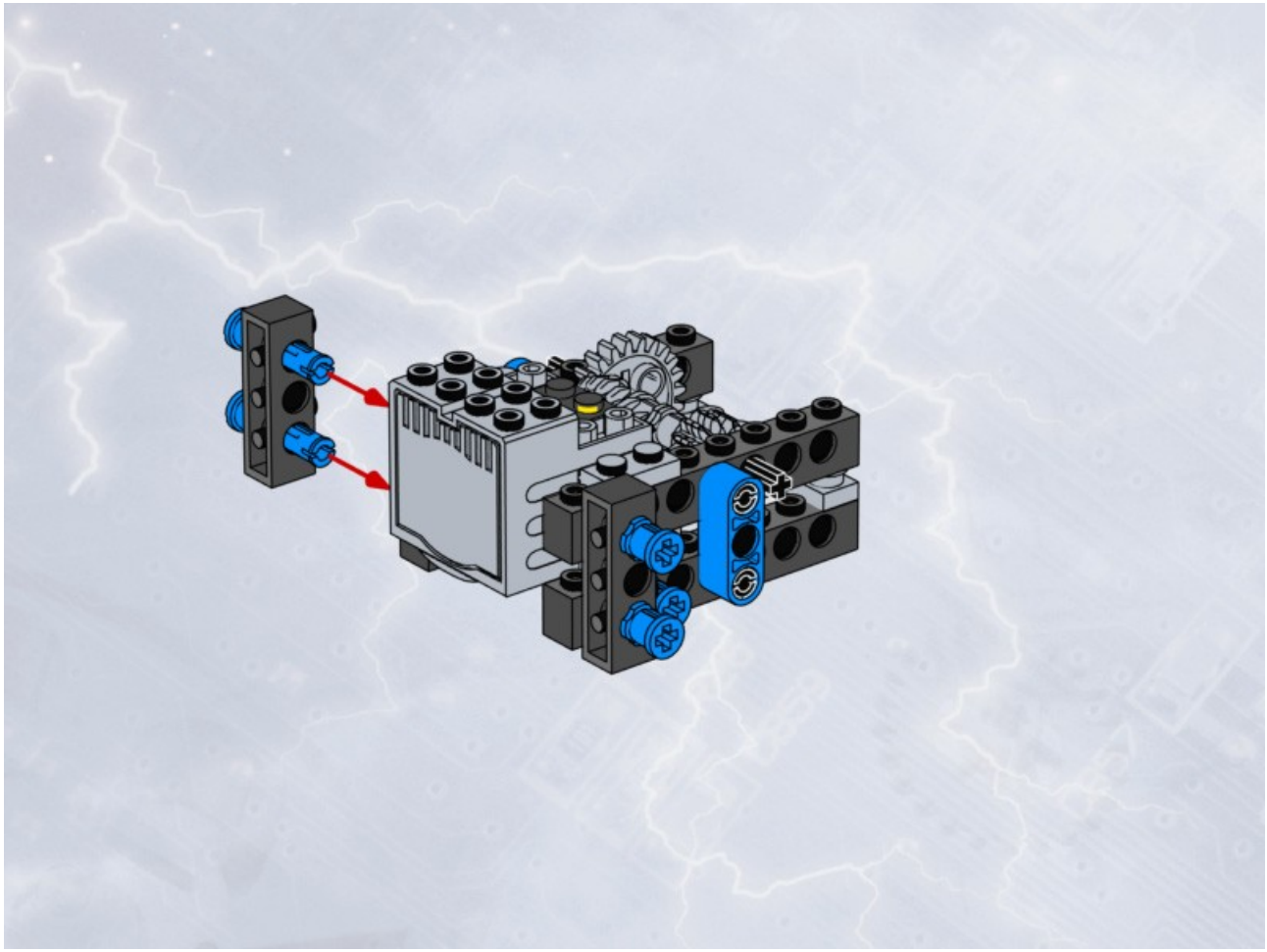
Cleaner Module

The Cleaner Module actually incorporates a Motor Module 2 so make sure you have built one of these before starting this module.

The power from the motor is then transferred to two identical revolving cleaning devices, both use a small transparent frame to hold two 12 tooth angle gears to direct the power 90-degrees downwards toward the table surface.

1





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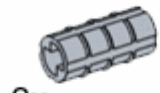

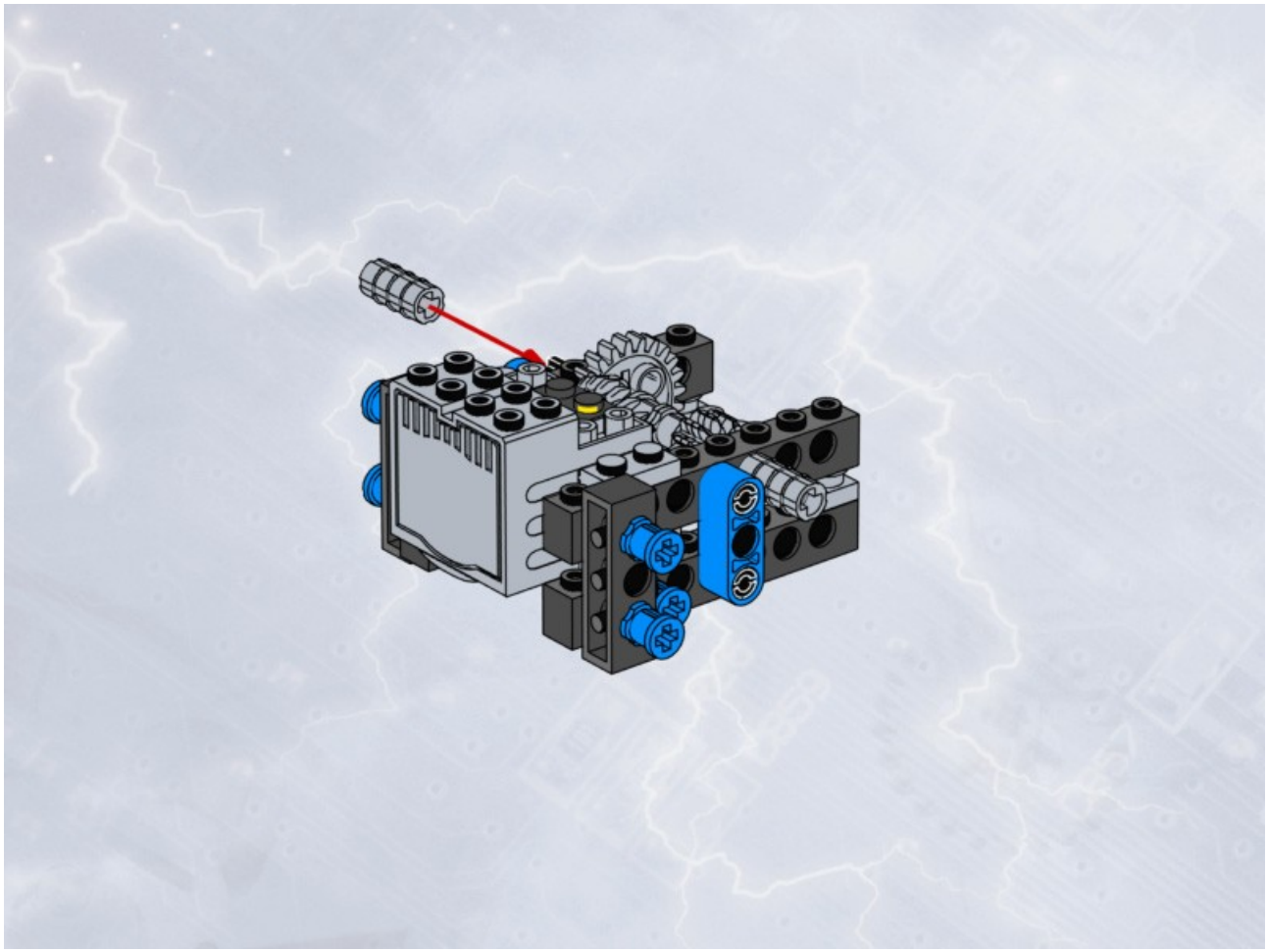

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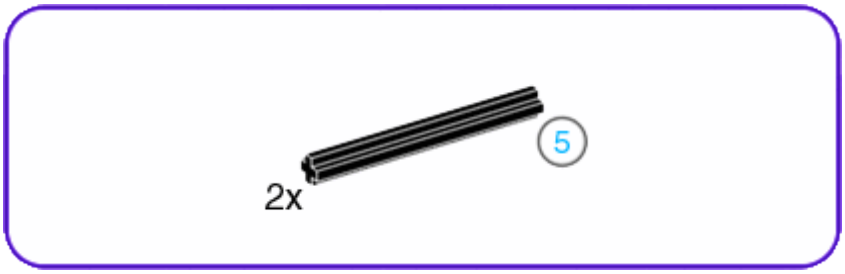

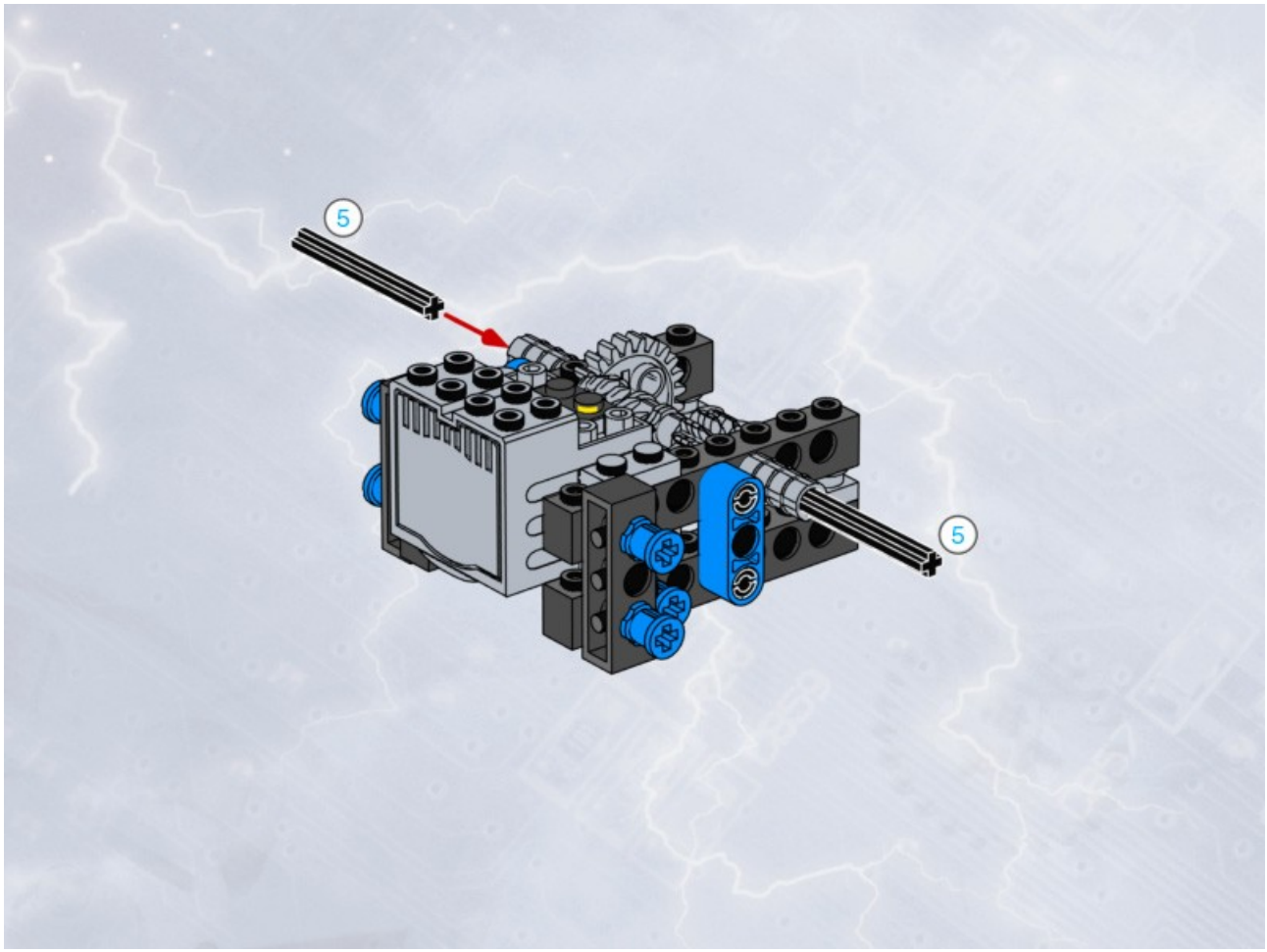

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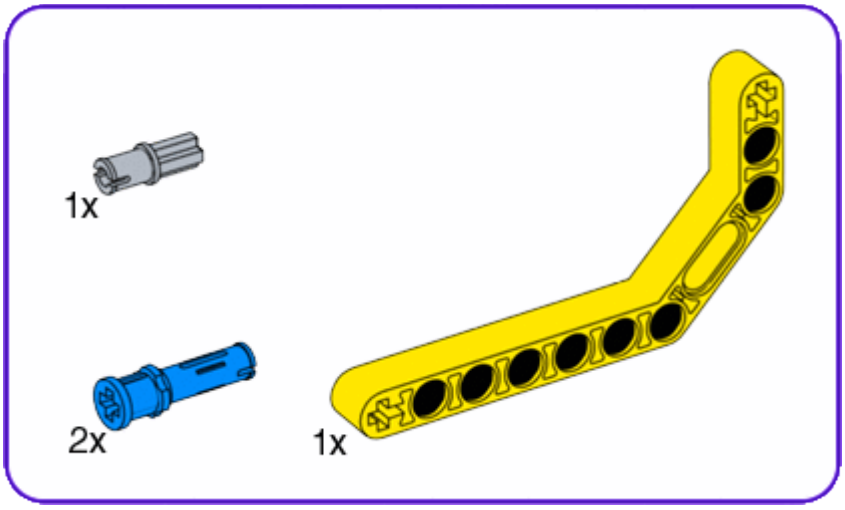

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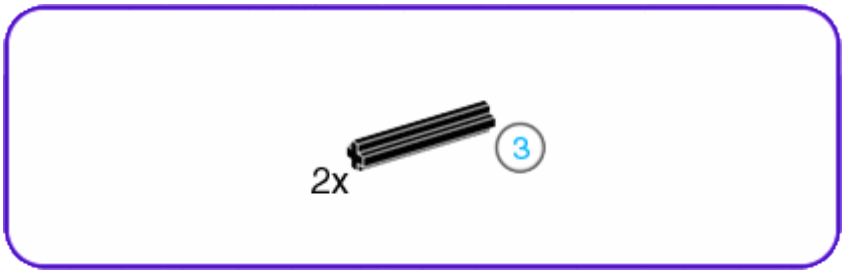

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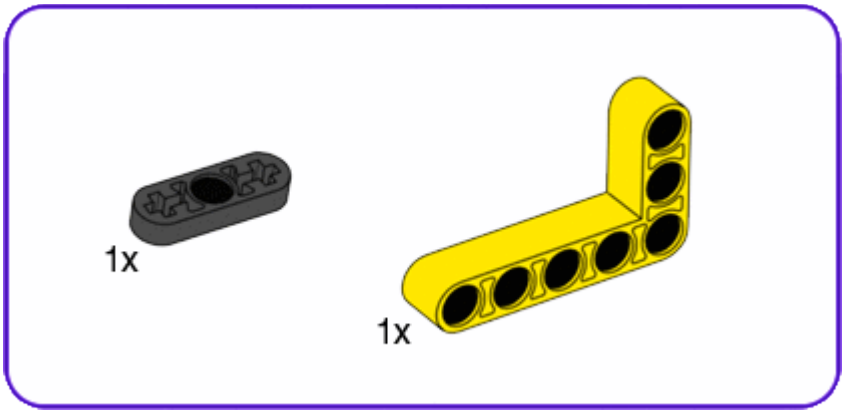

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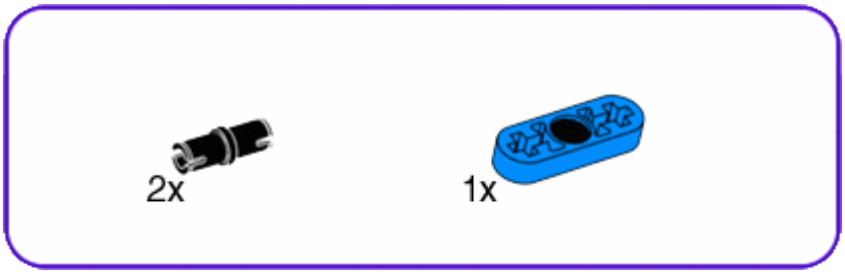

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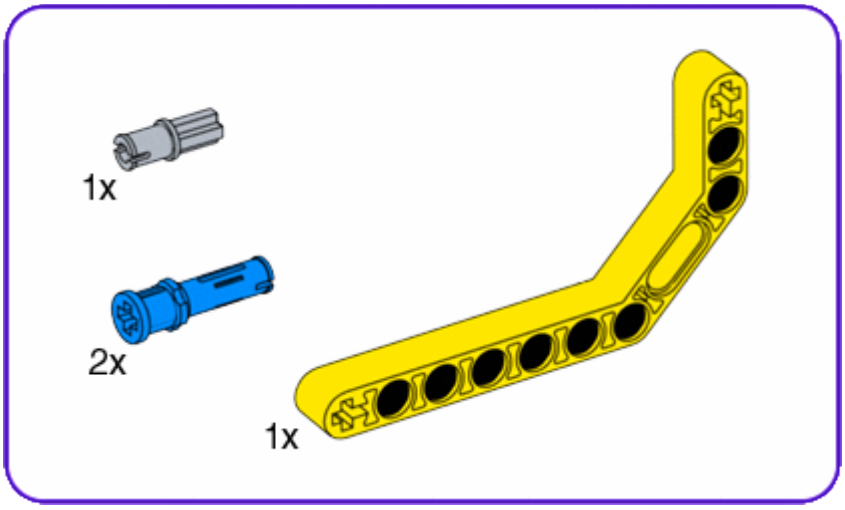

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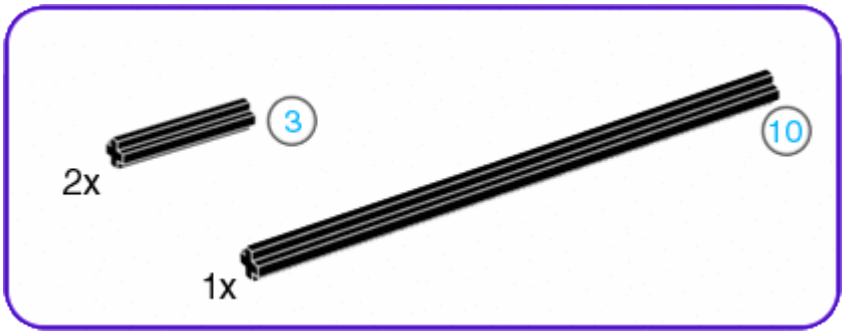

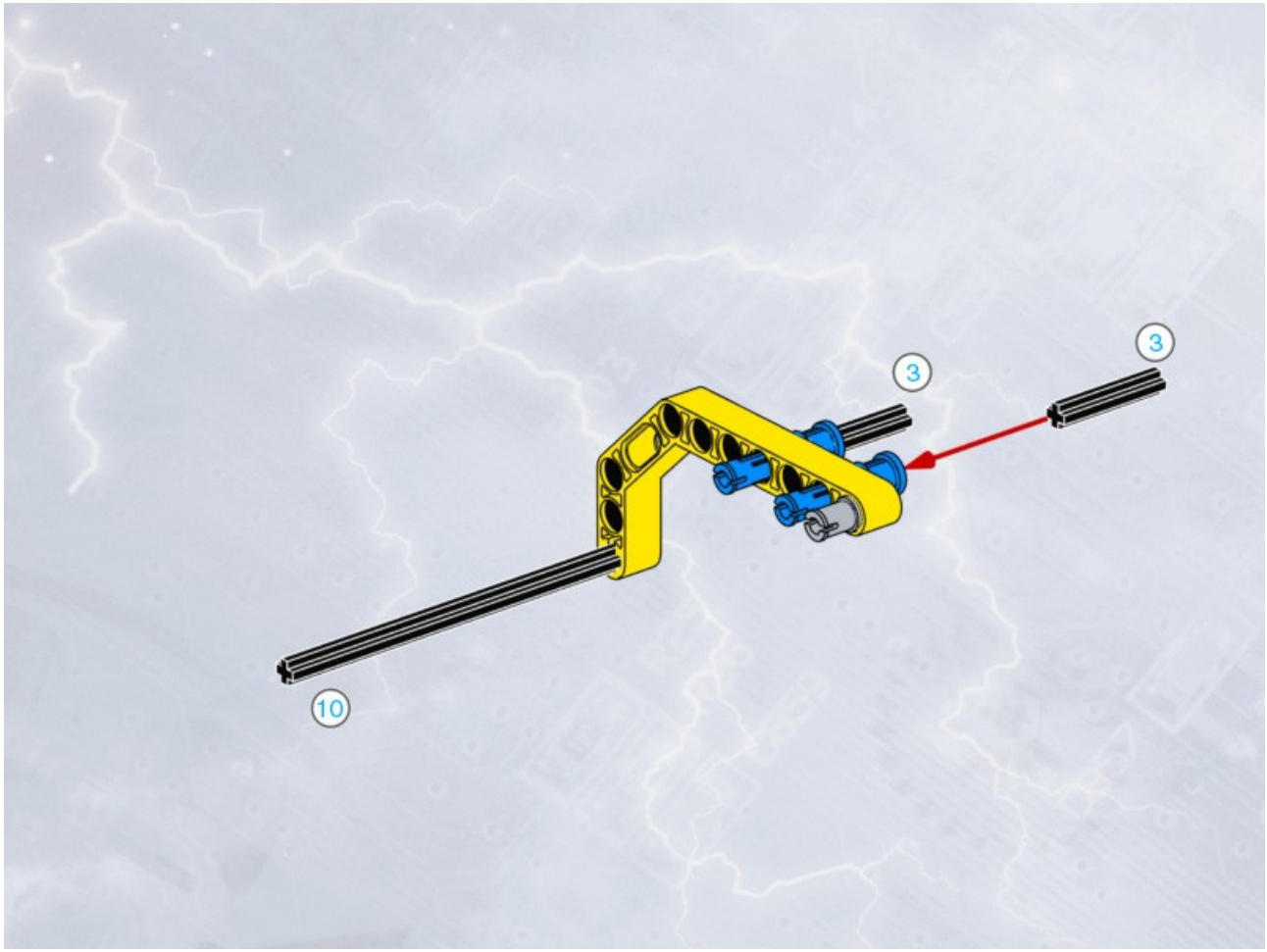

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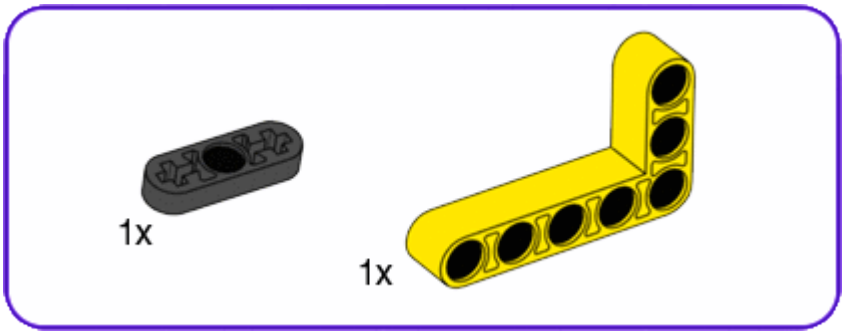

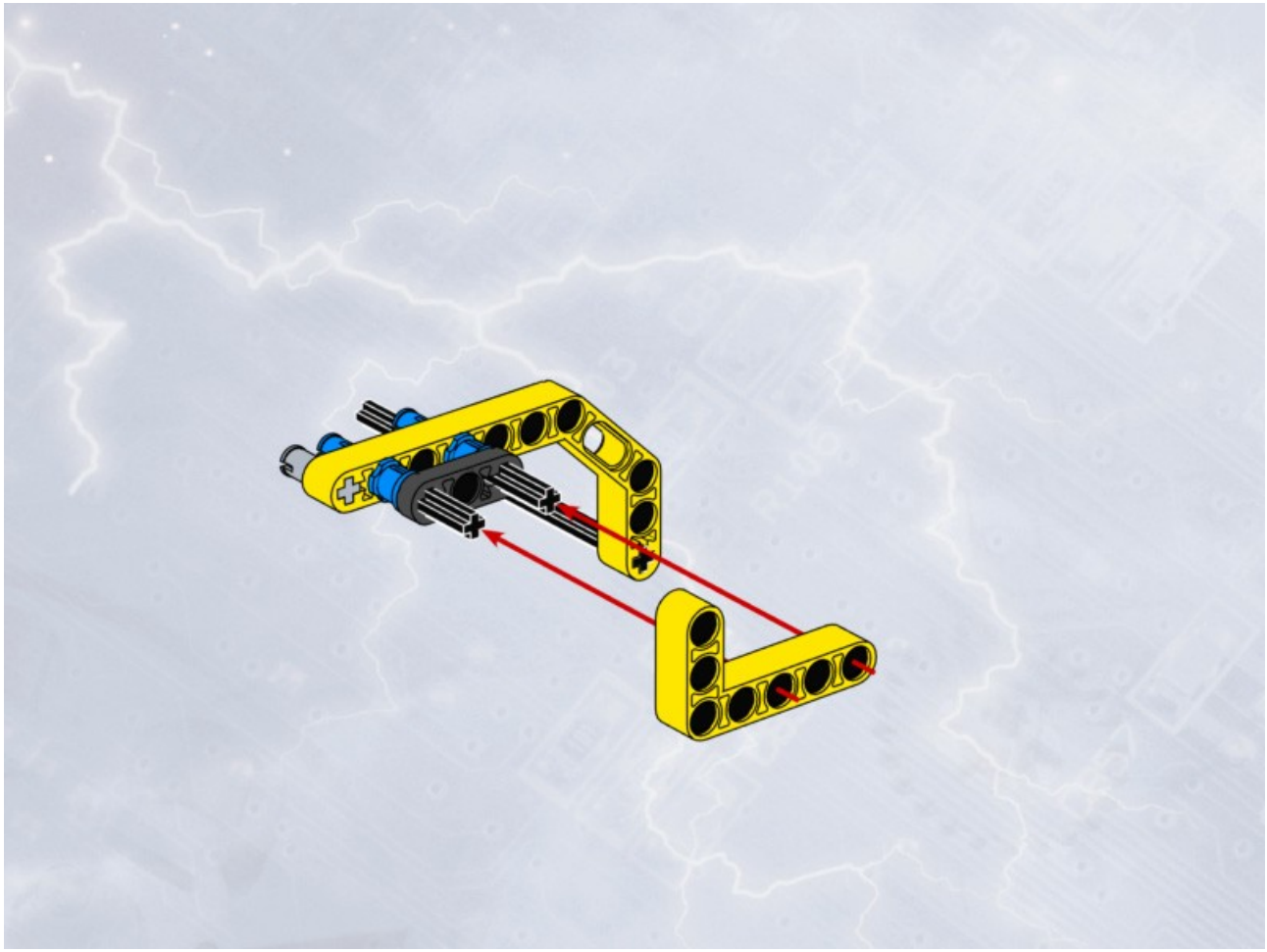

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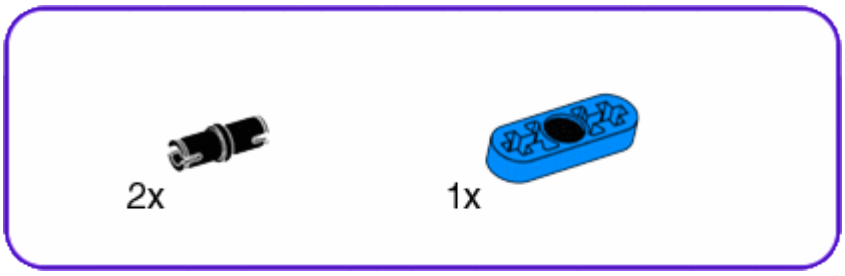

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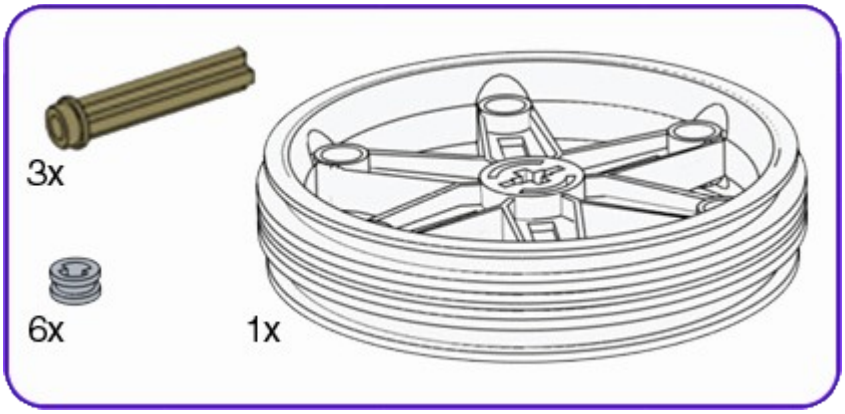

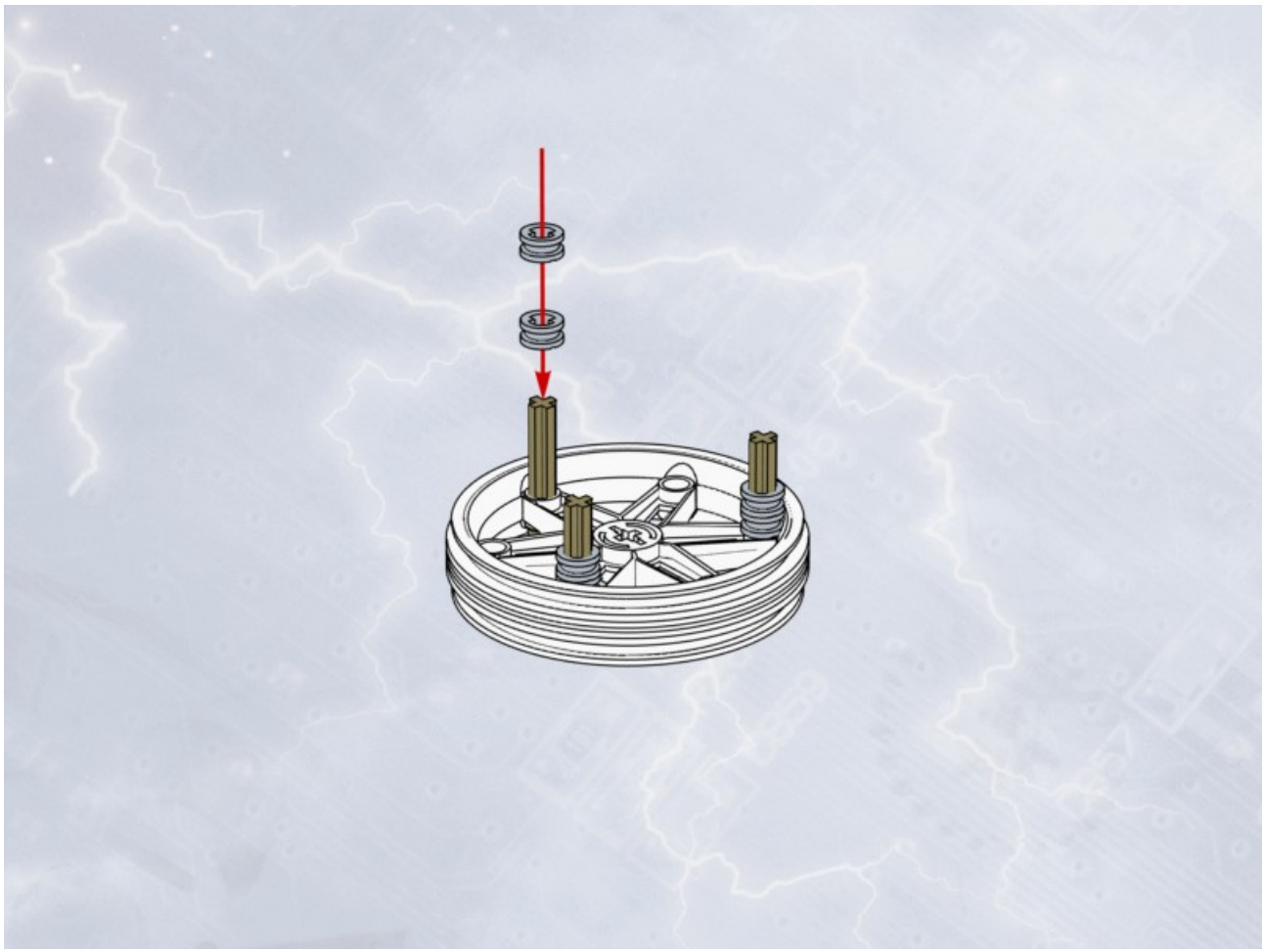

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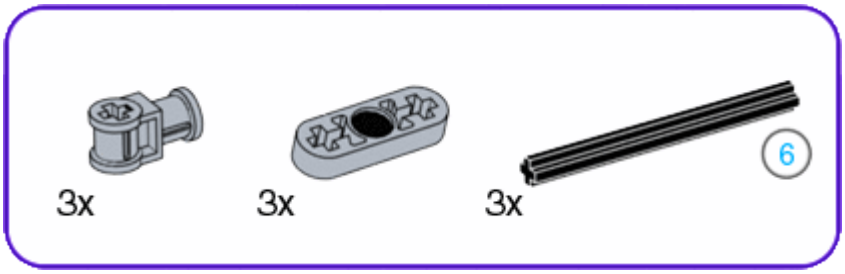

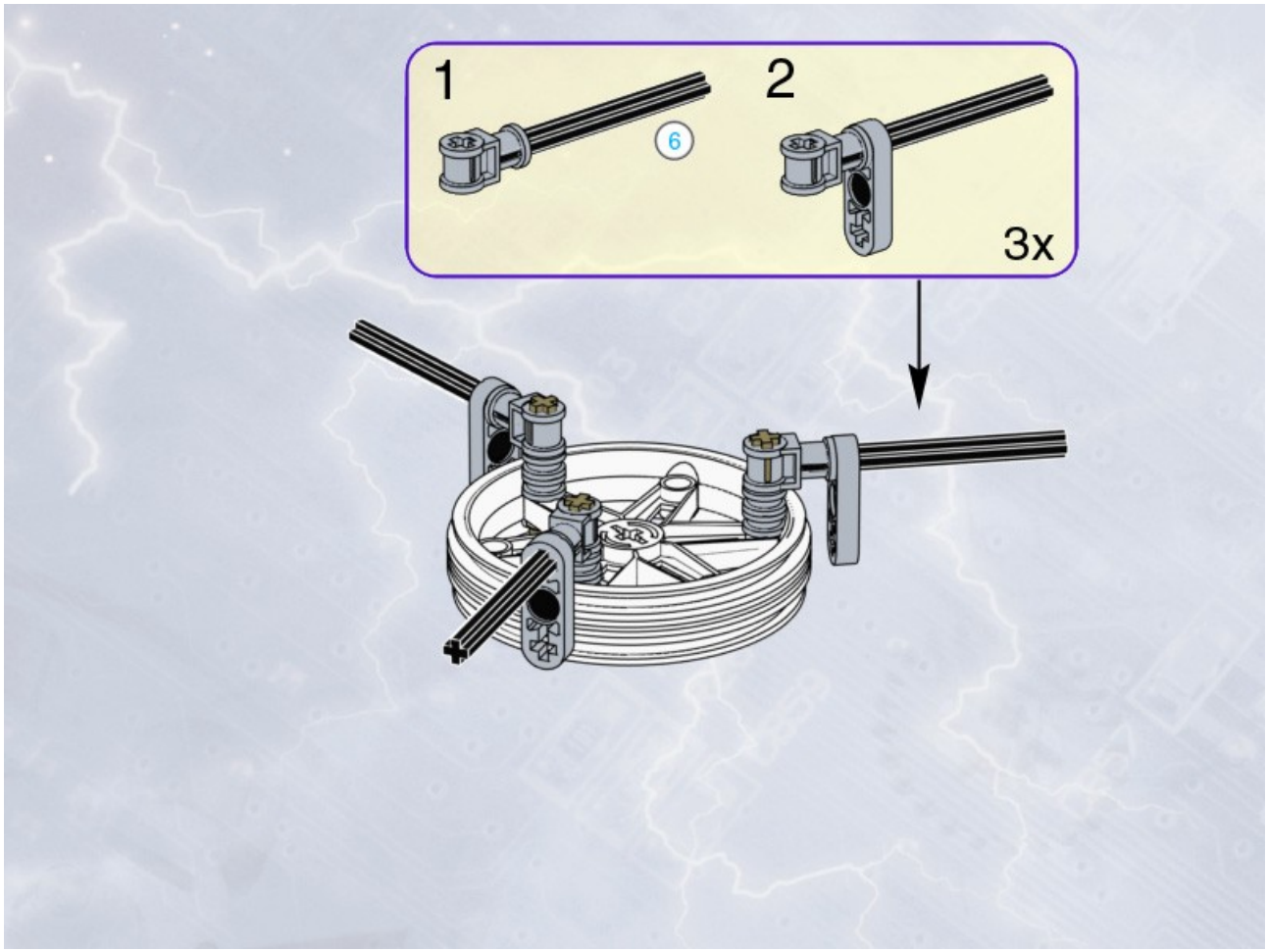

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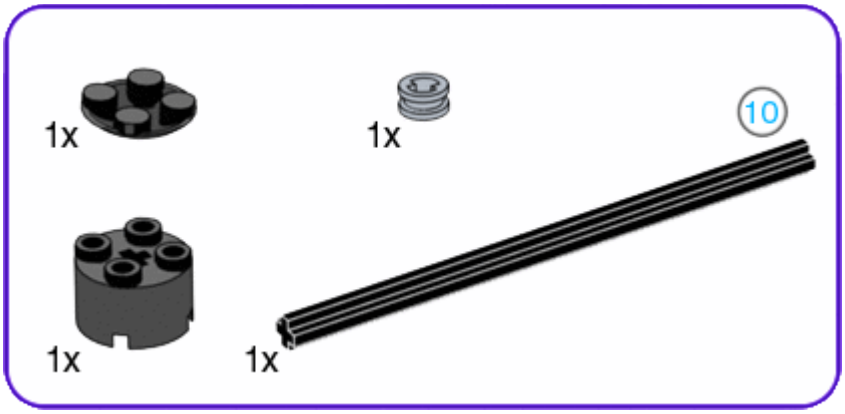

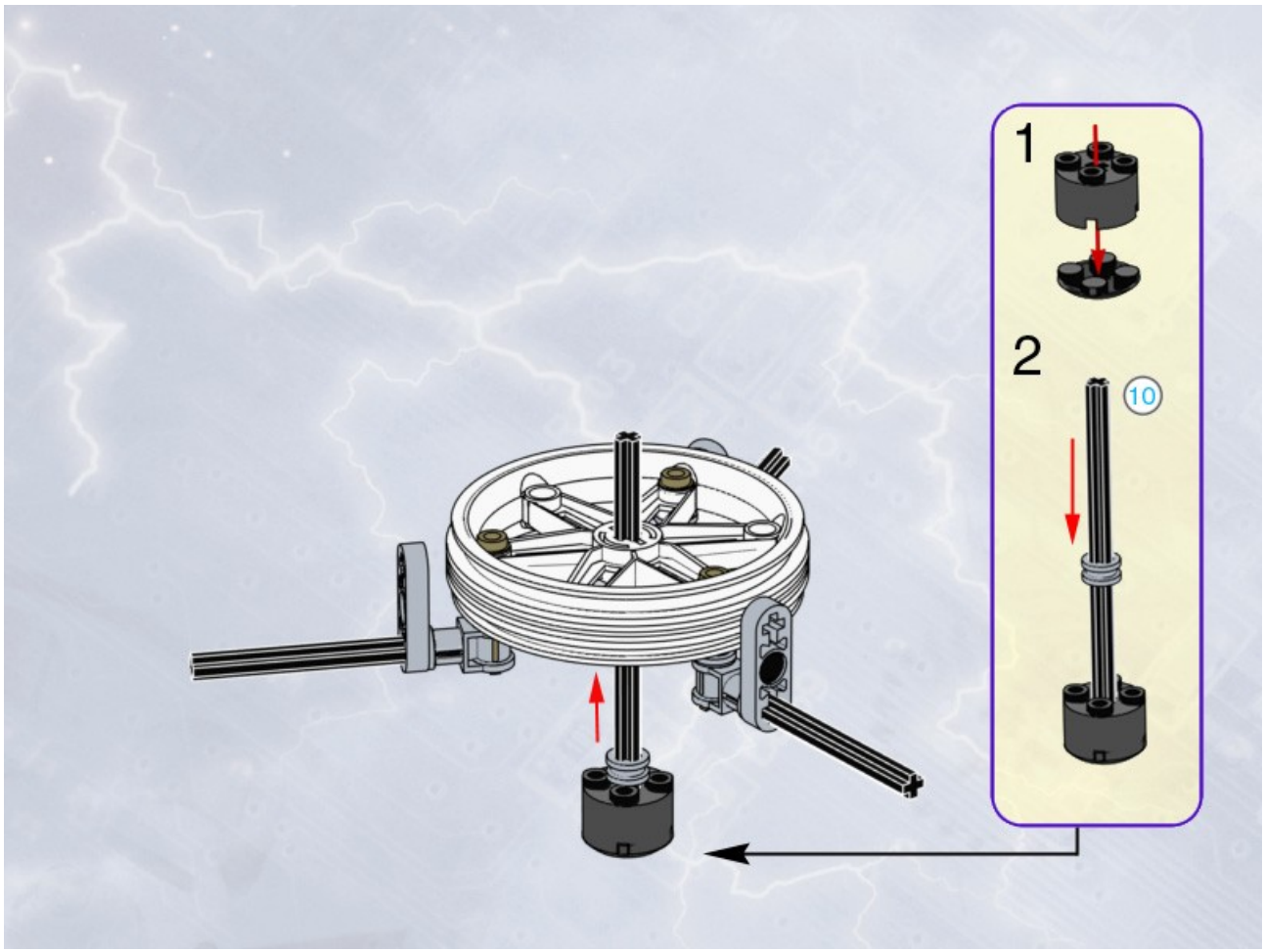

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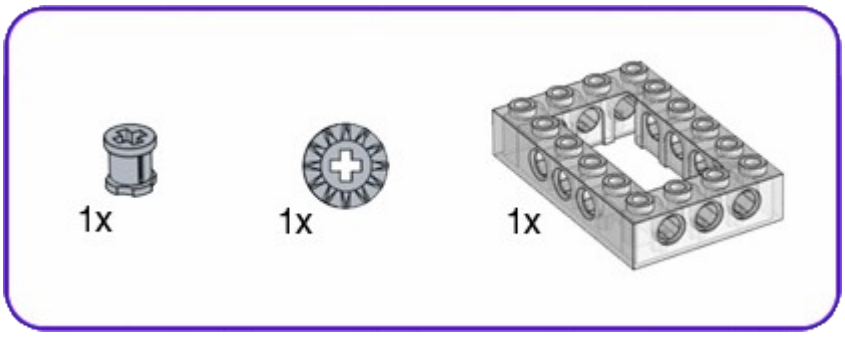

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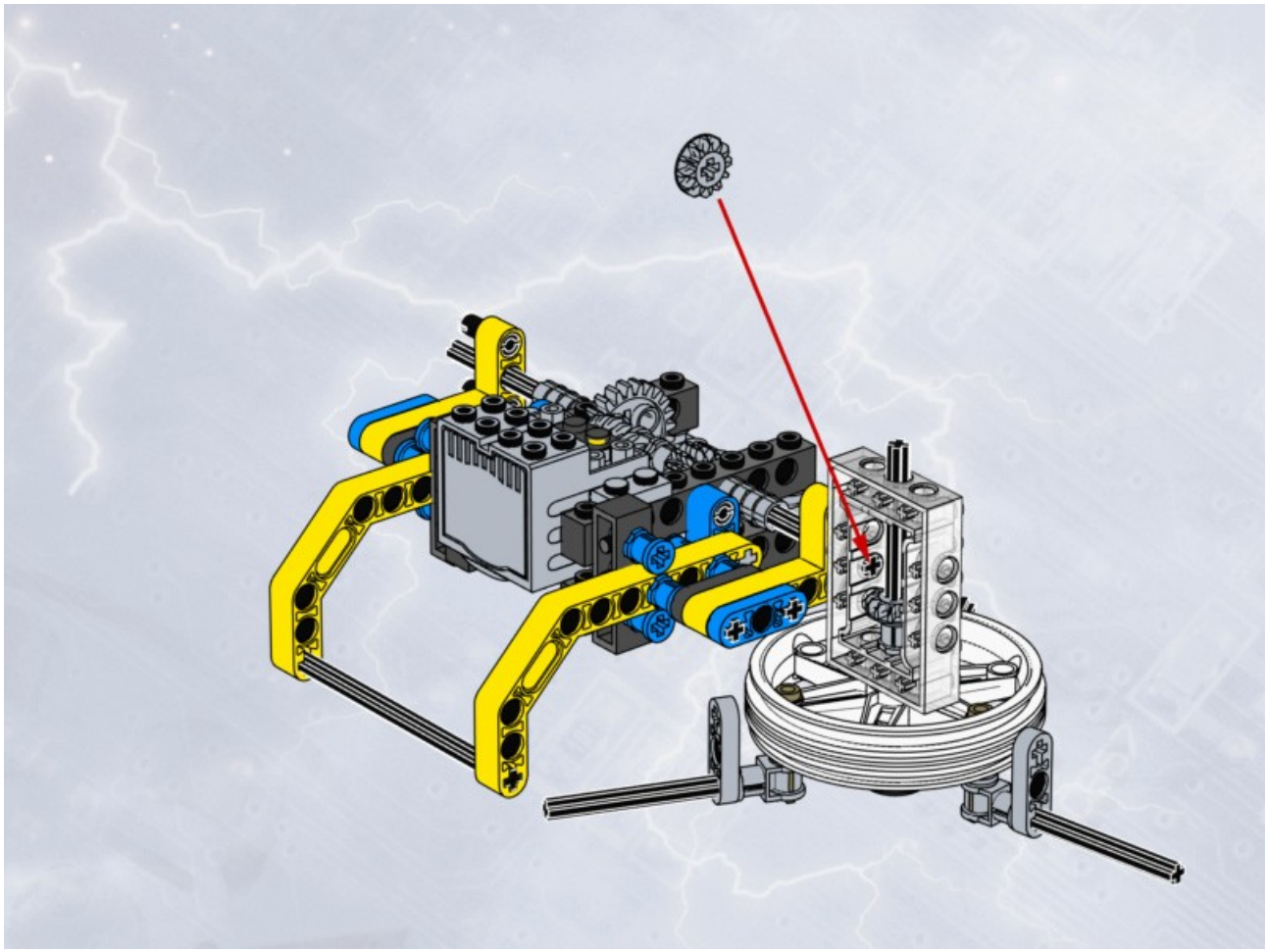

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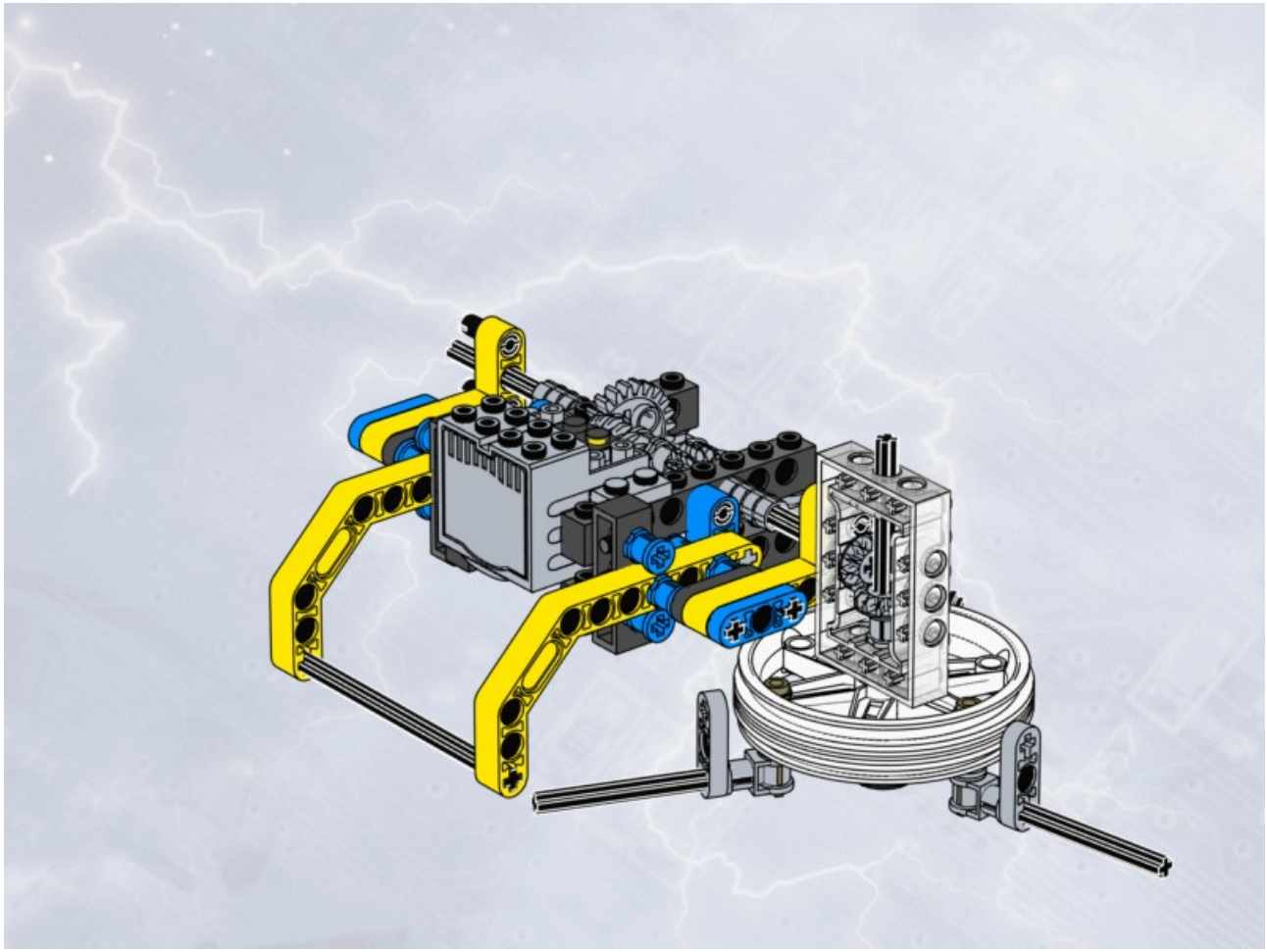

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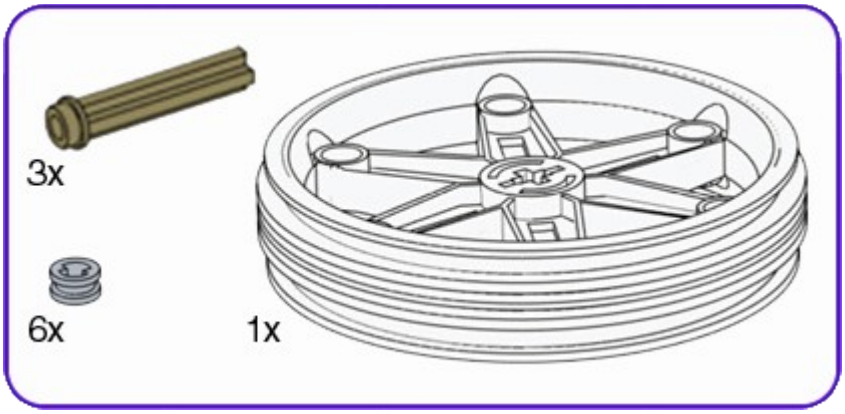

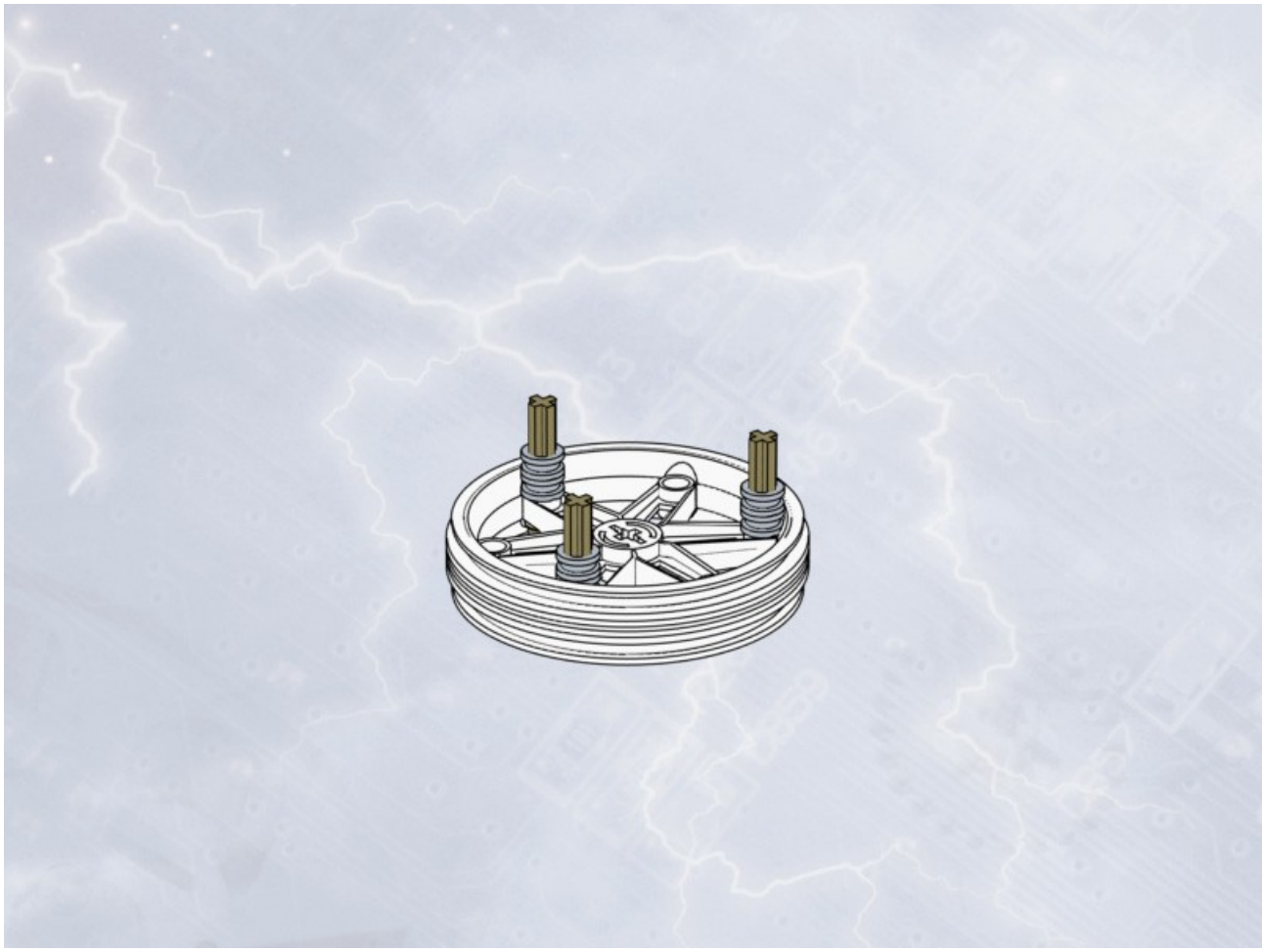

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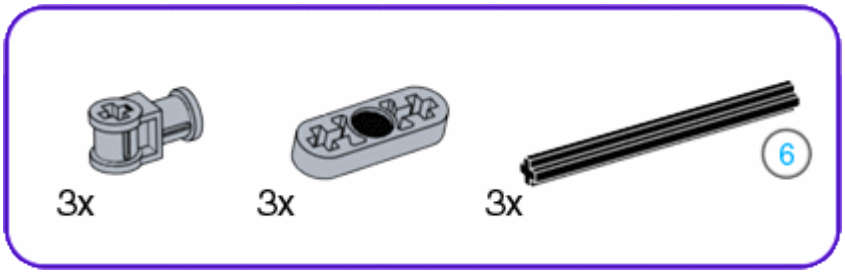

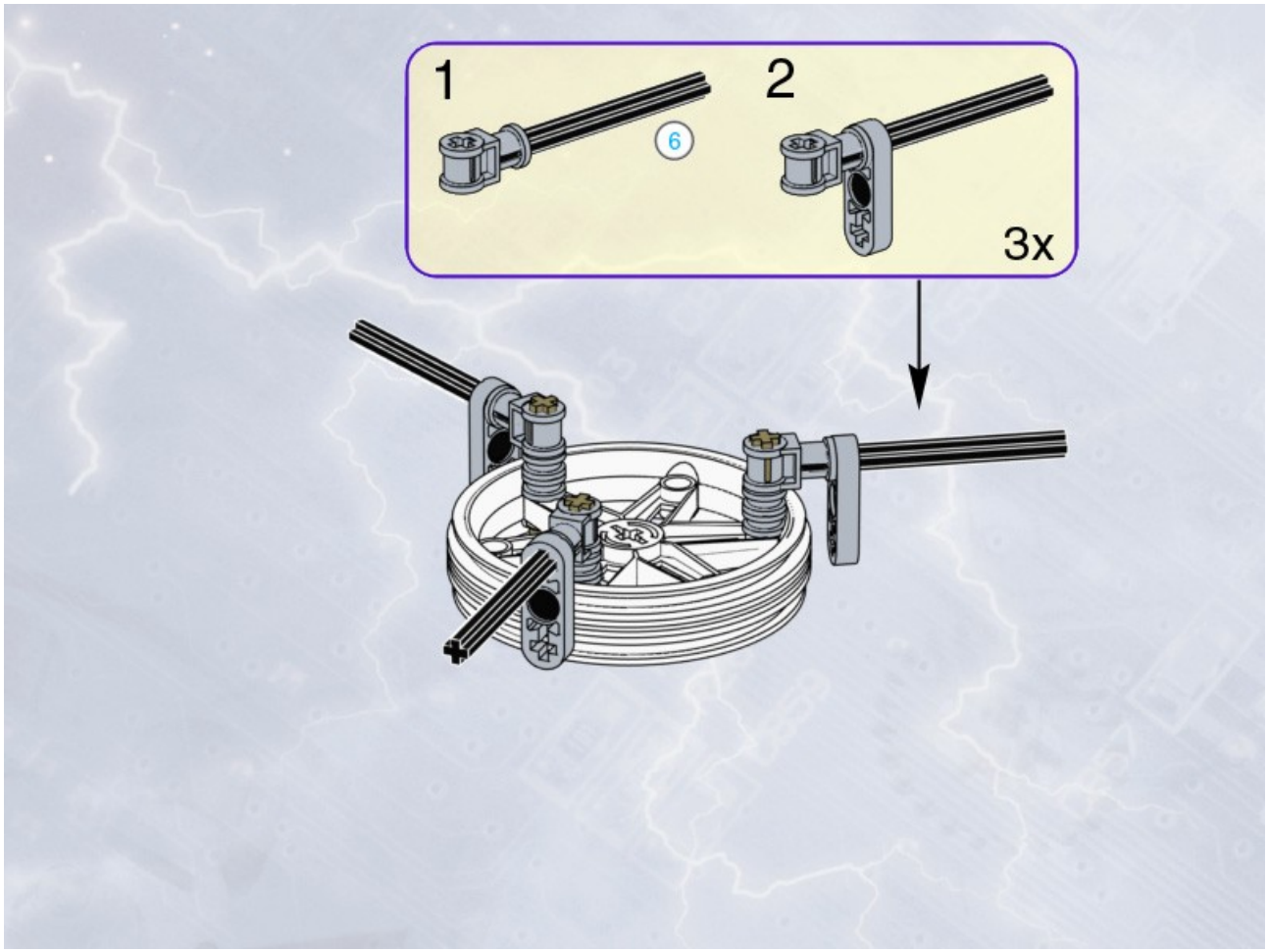

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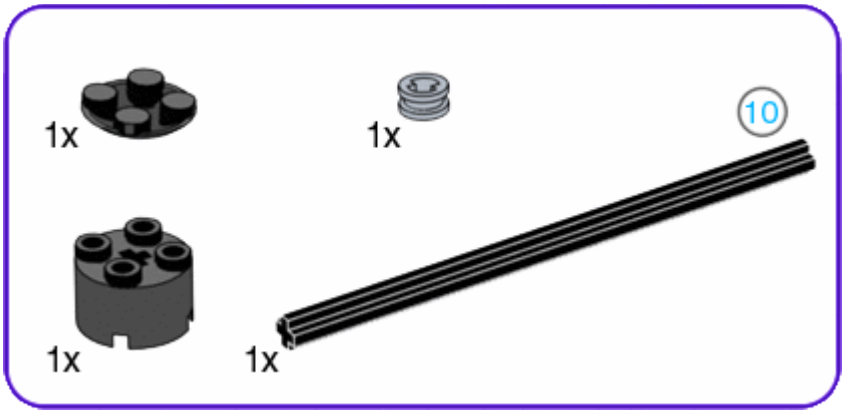

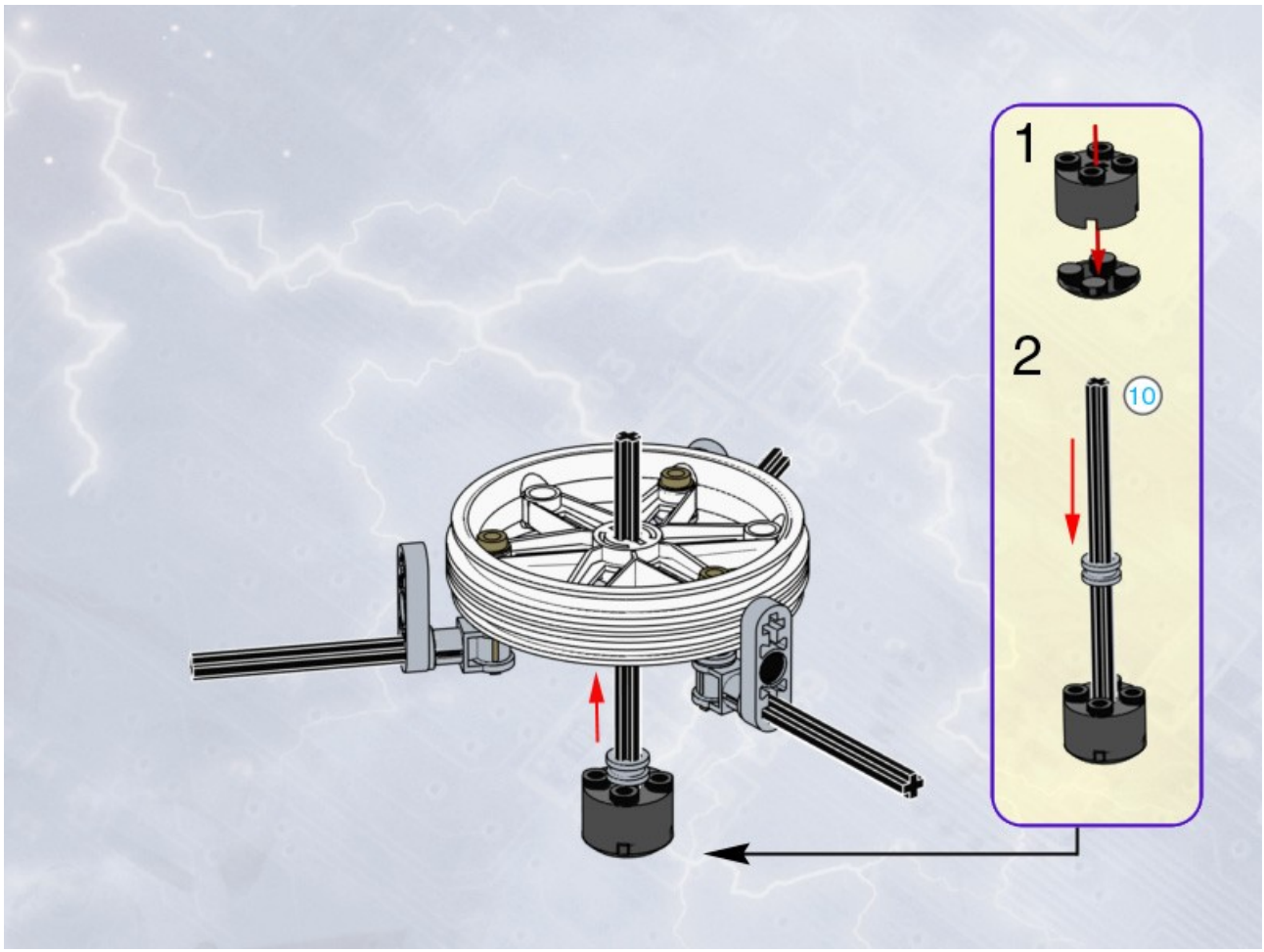

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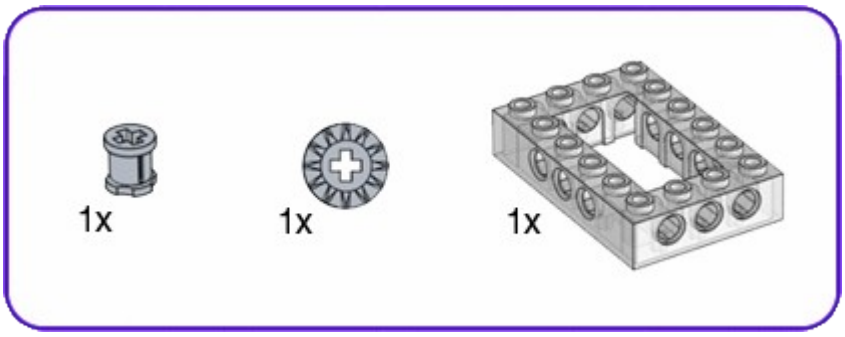

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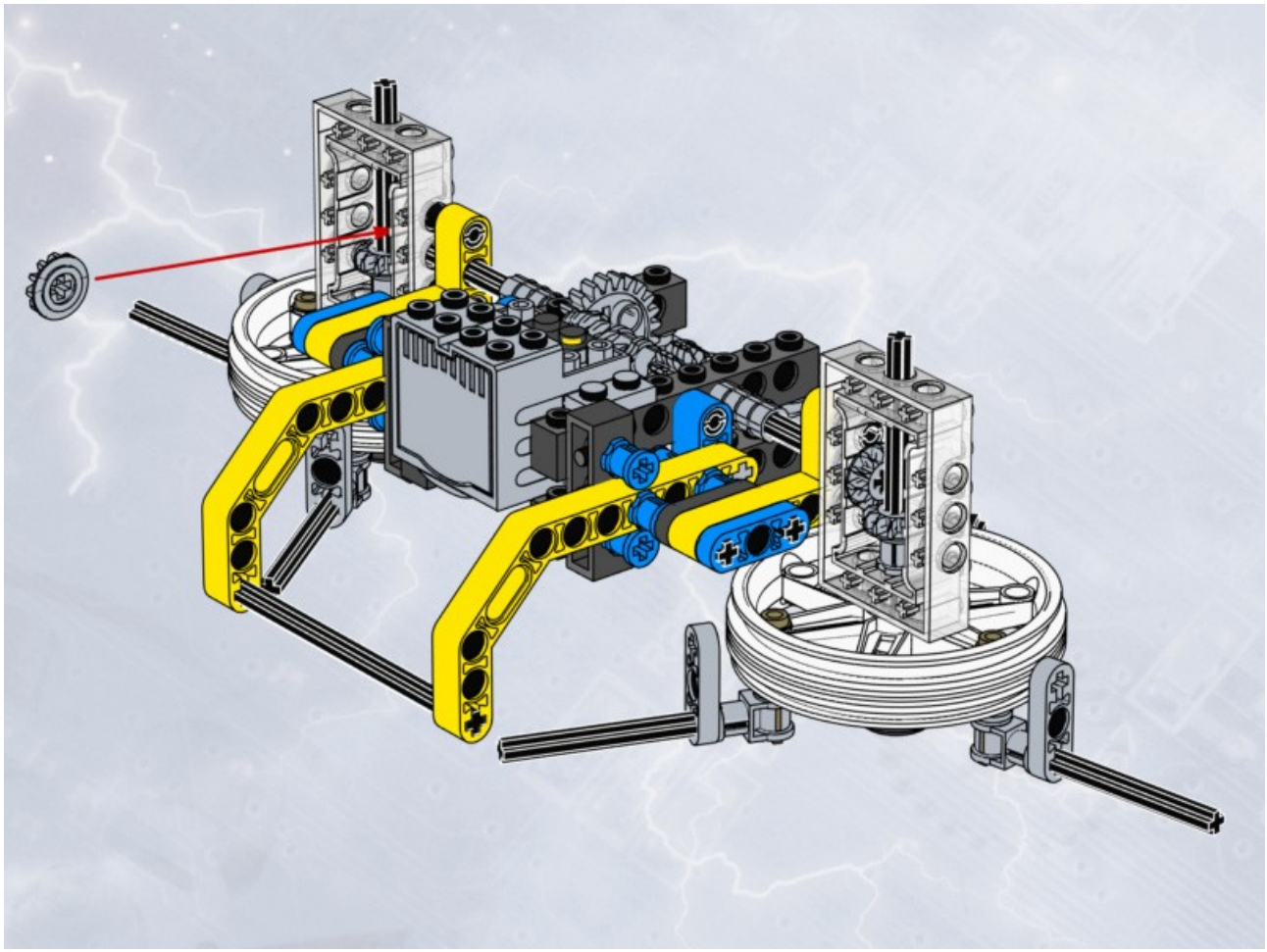

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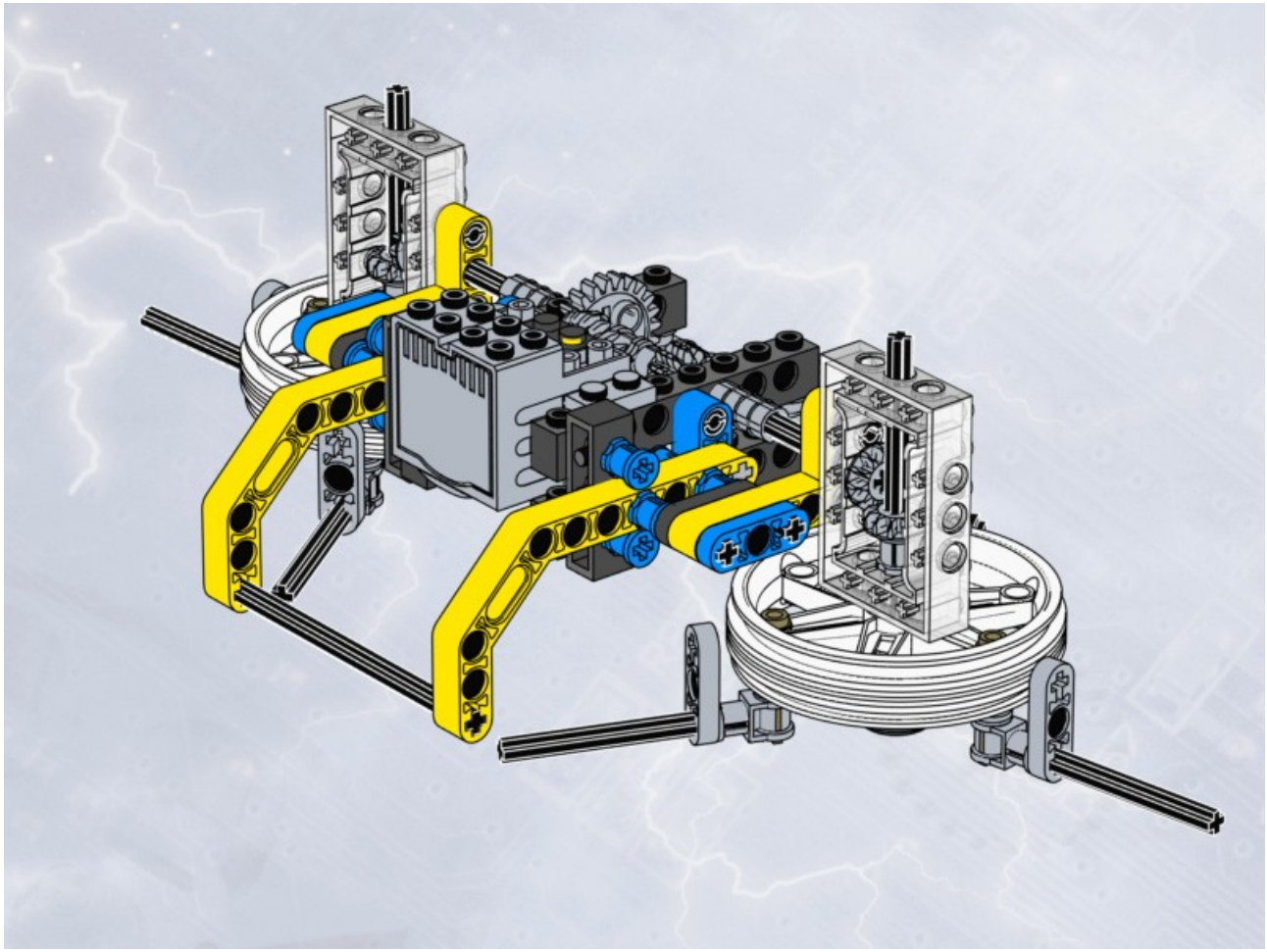
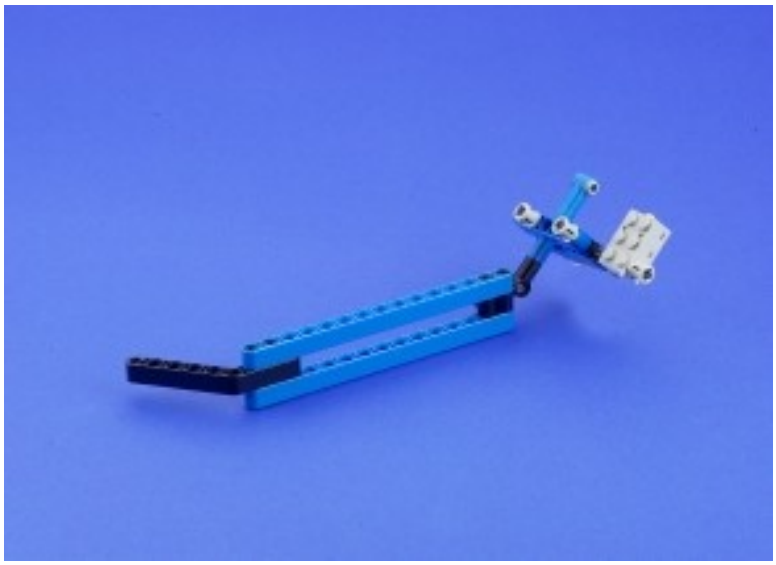


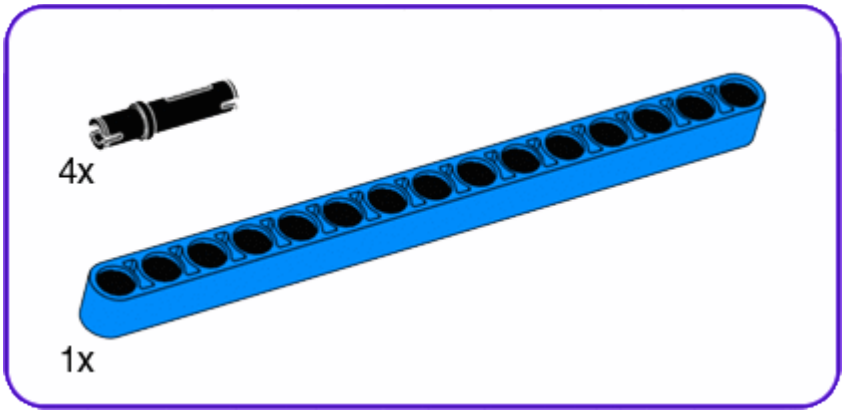
Right Table Sensor



Using a simple lever mechanism the Table Sensor Module uses a Touch Sensor to detect the edge of a table.

When the black angle beam on the front of the Module drops over the edge the other end pushes against the Touch Sensor.

1



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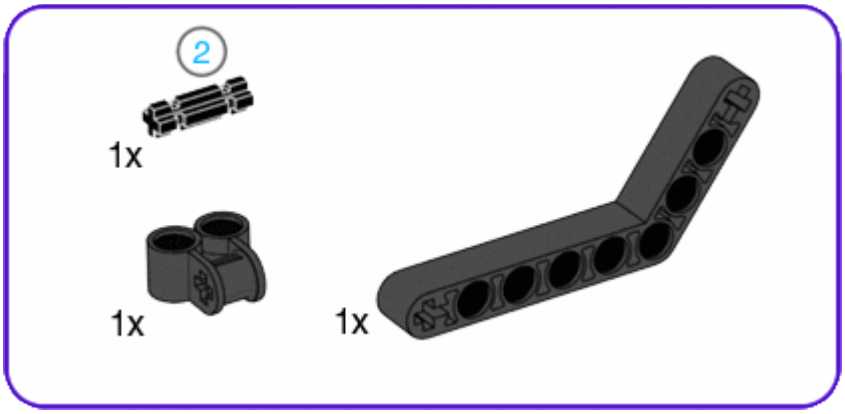

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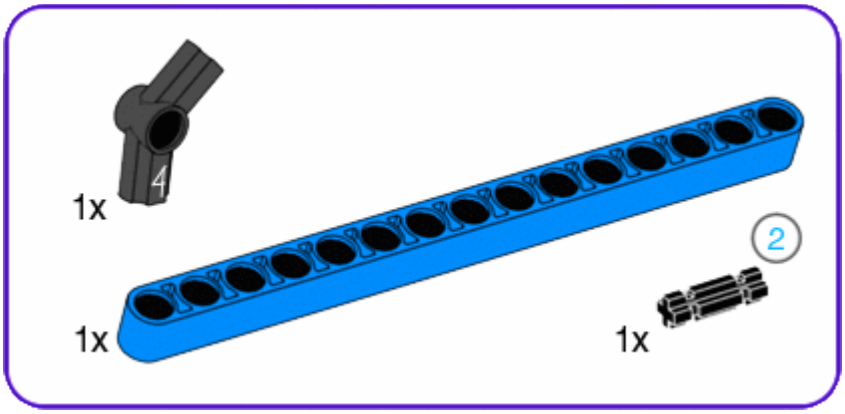

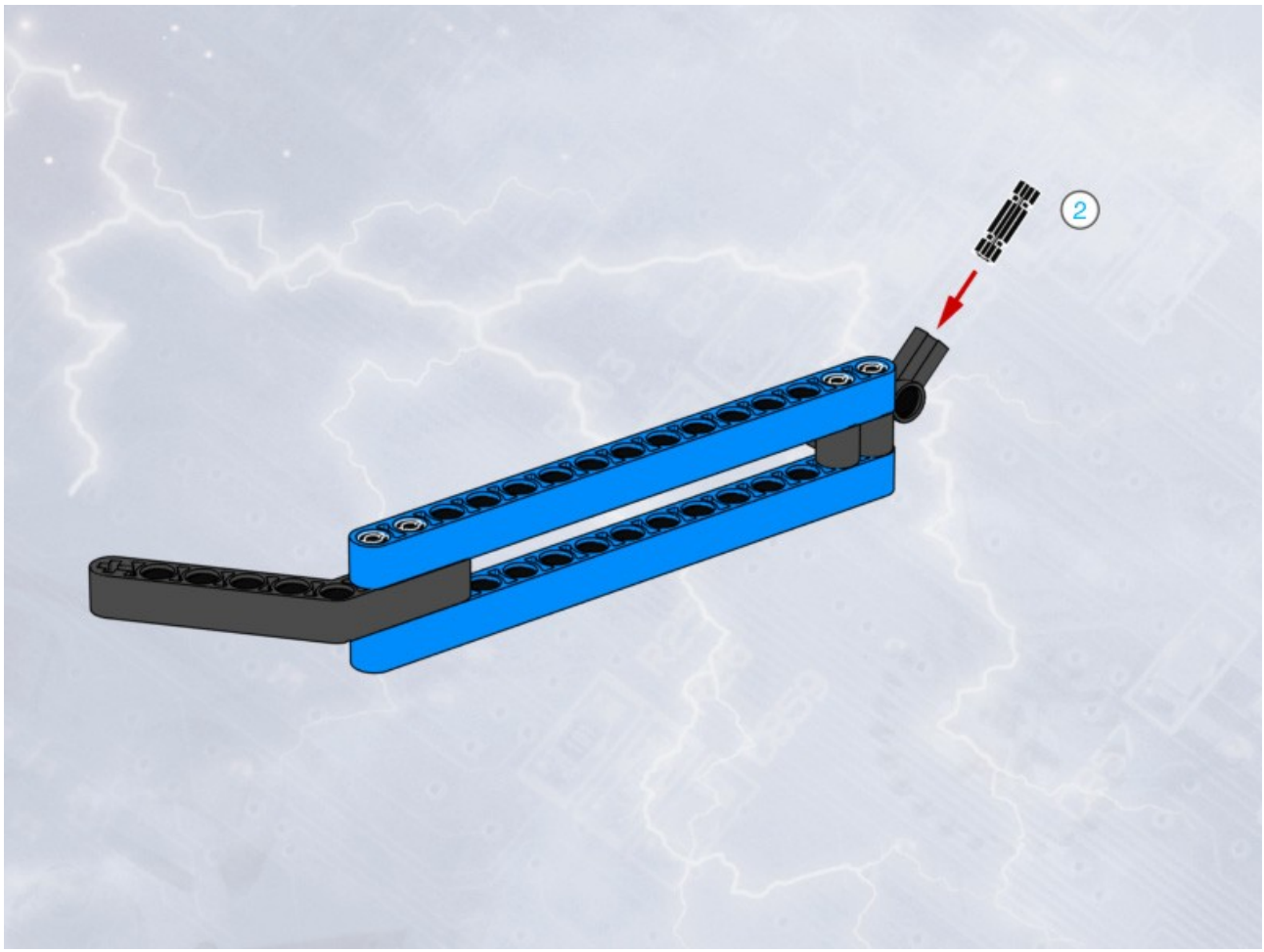

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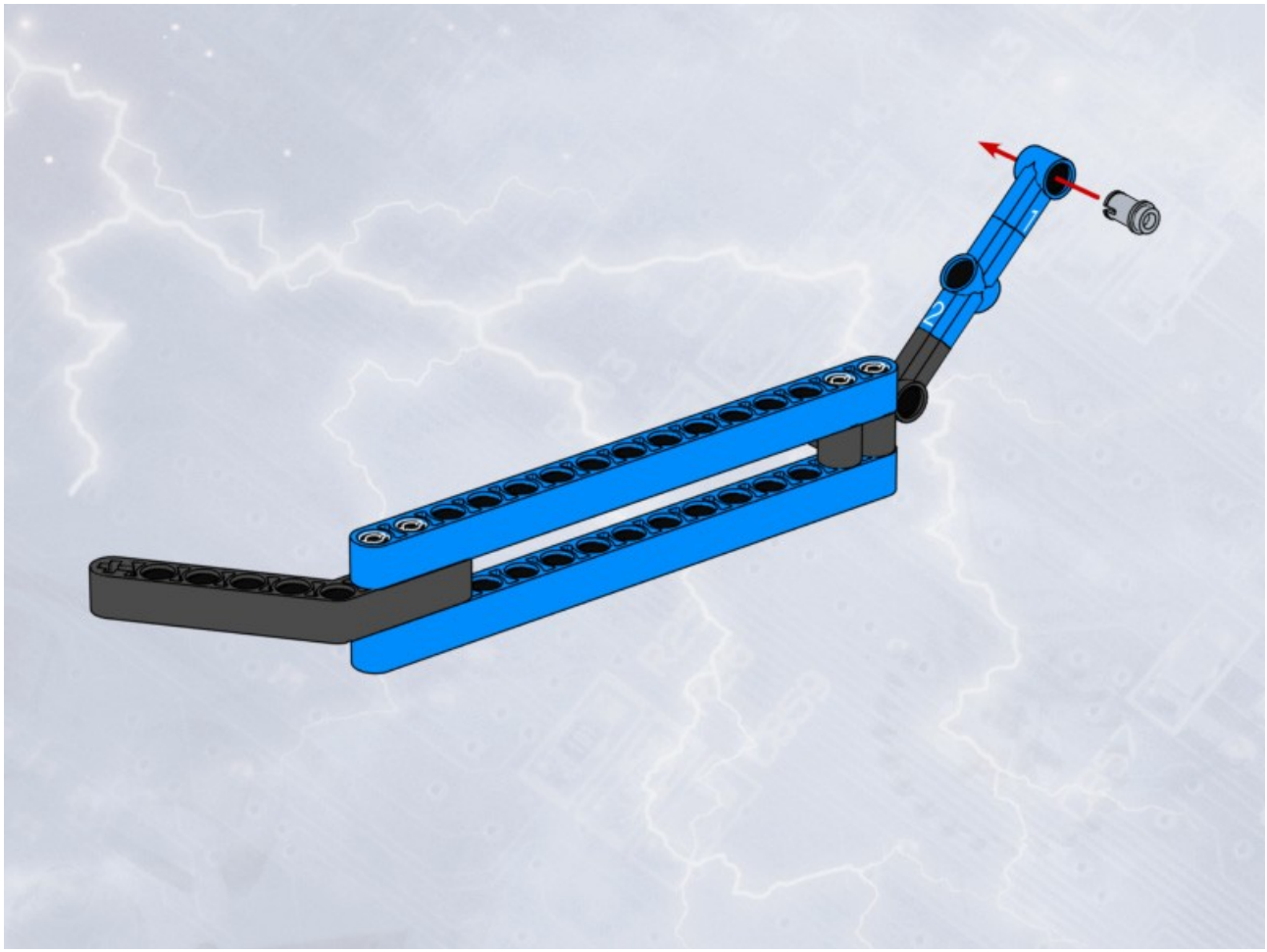

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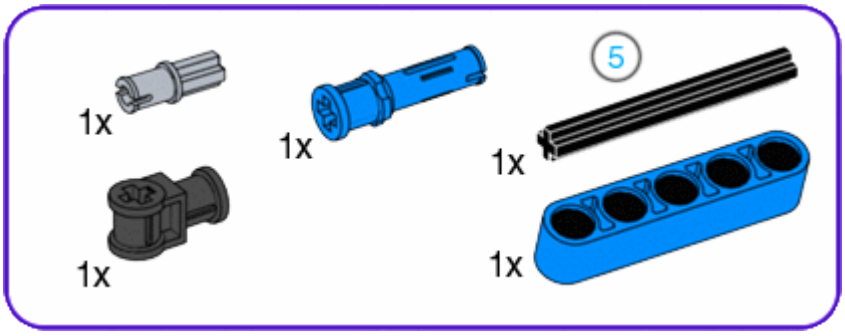

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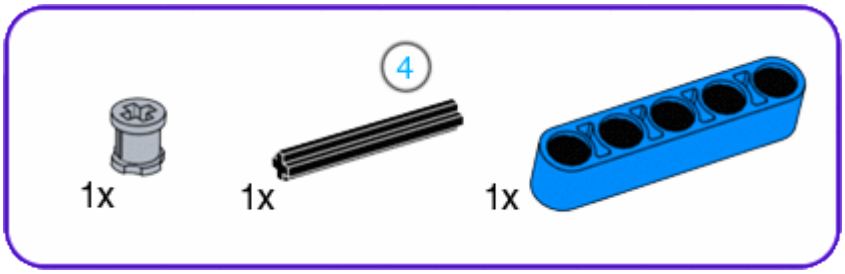

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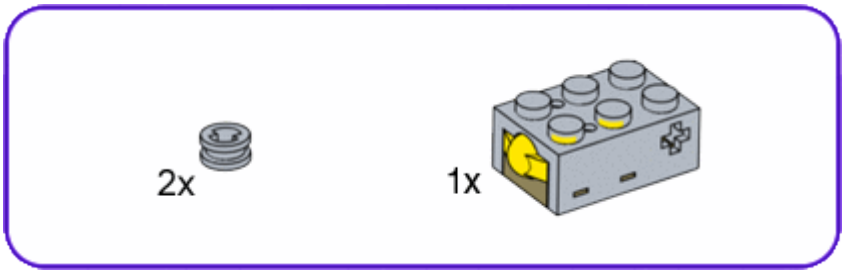

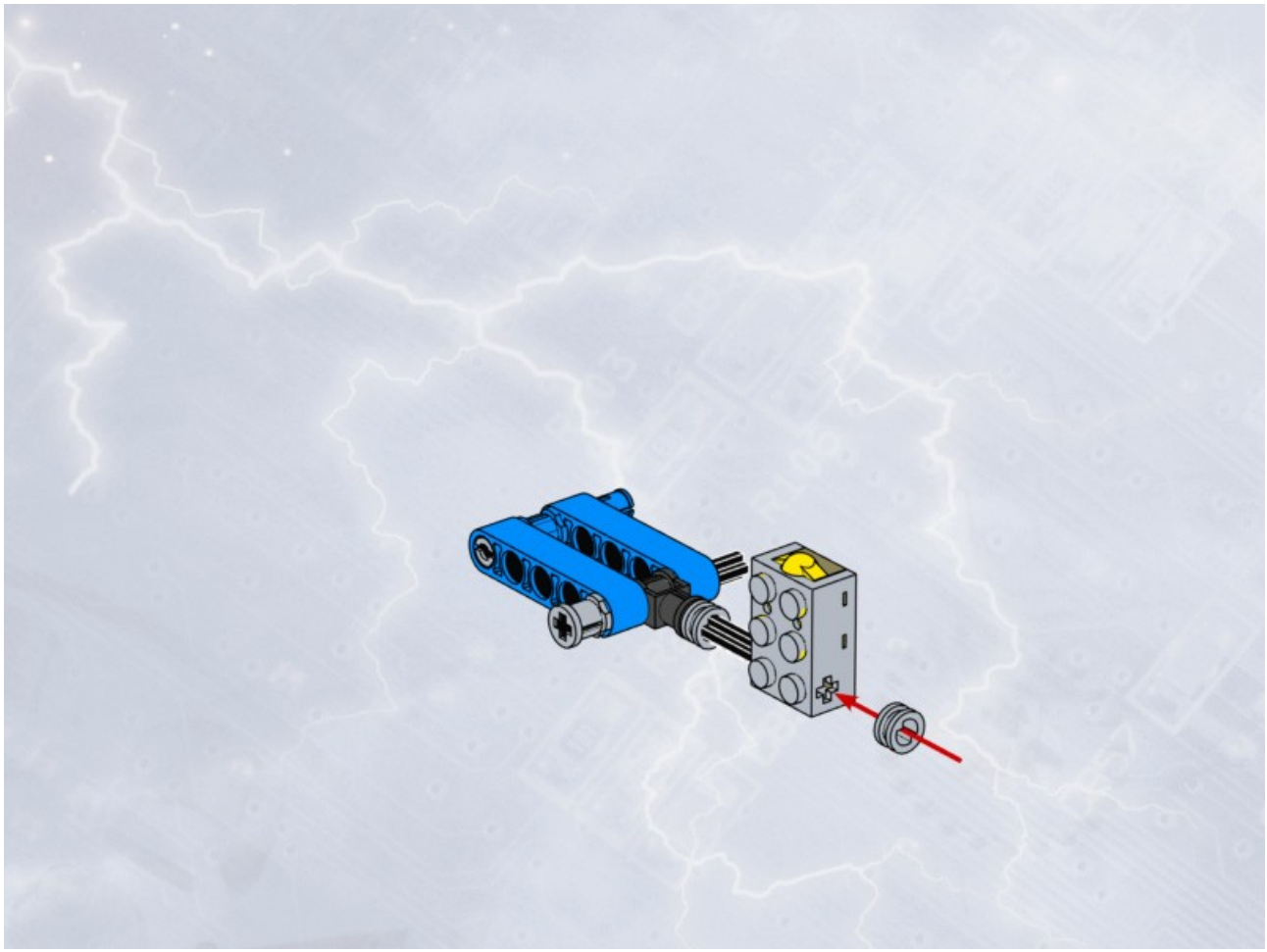

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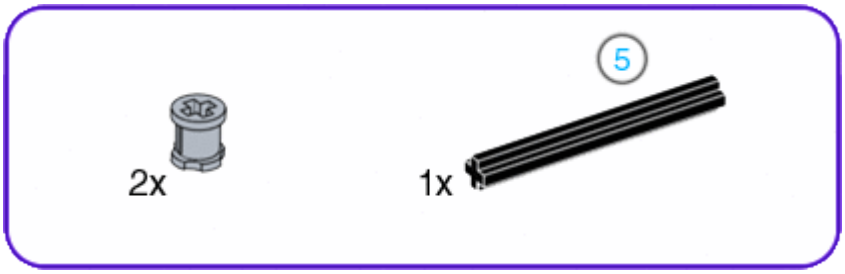

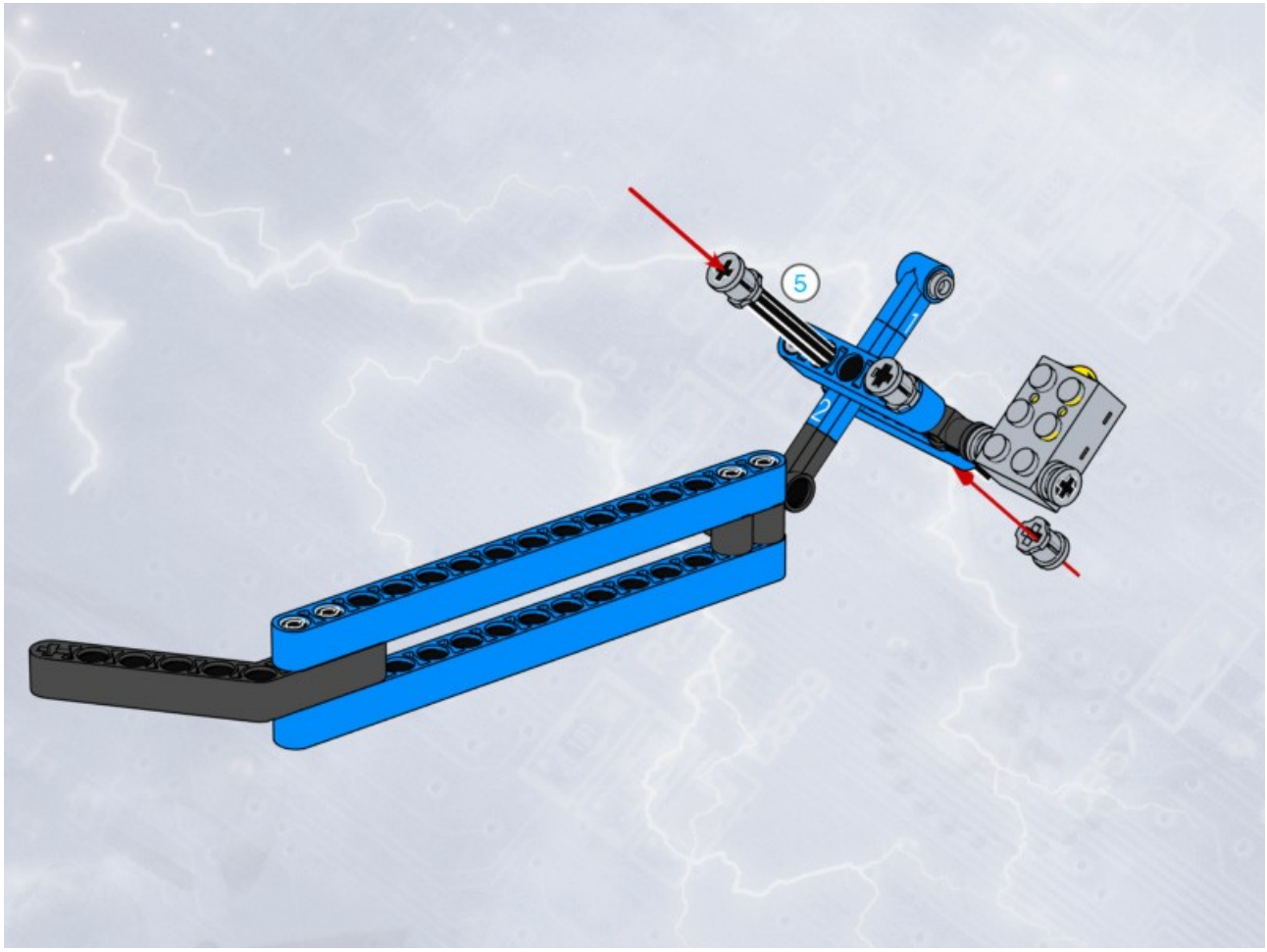

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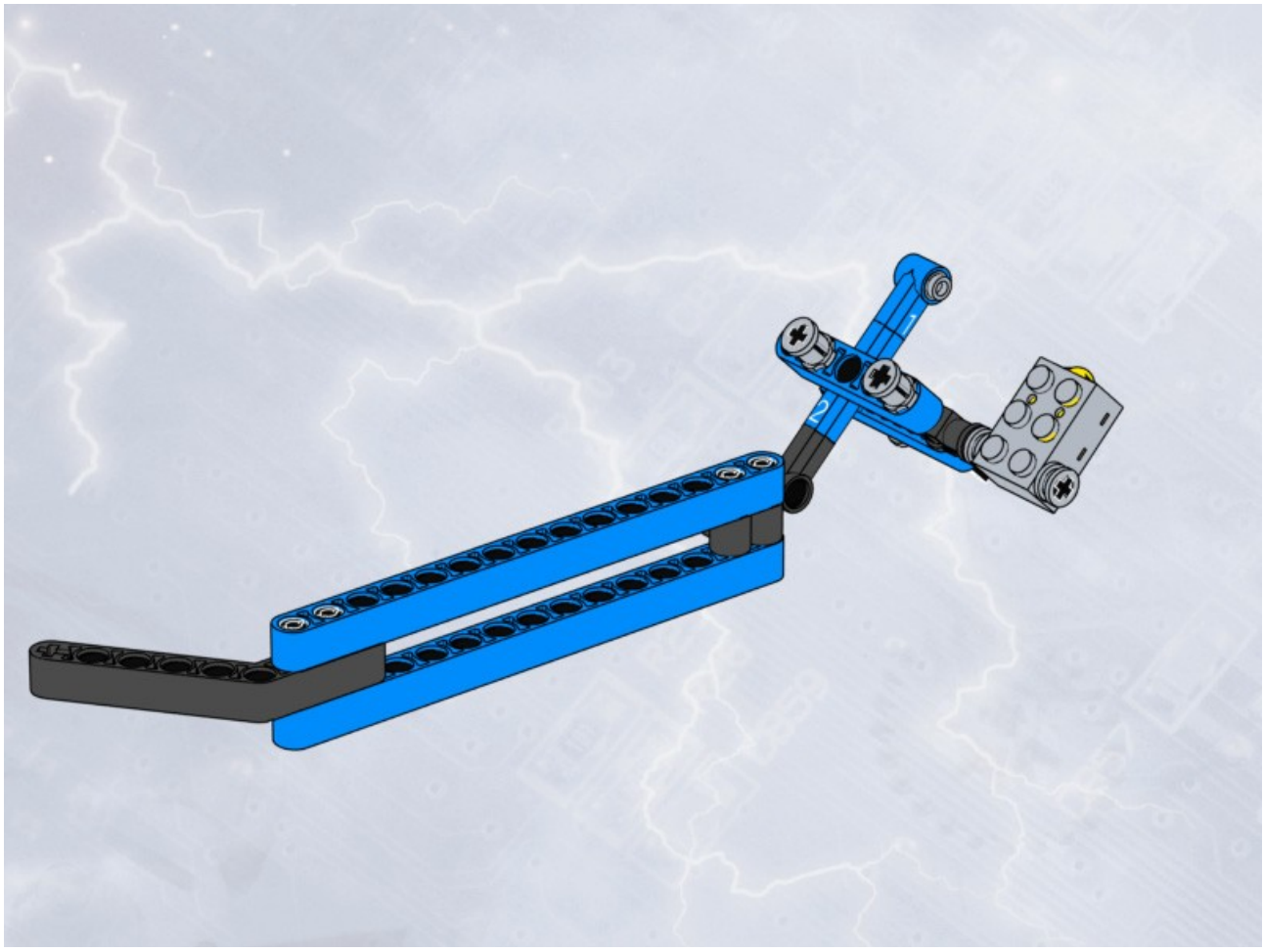
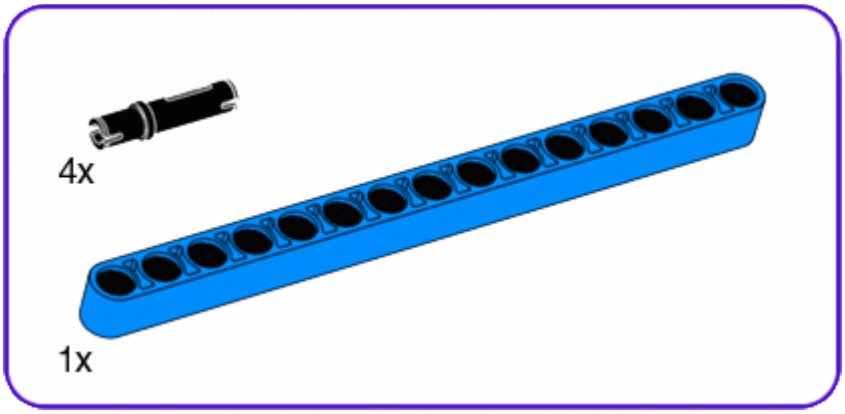


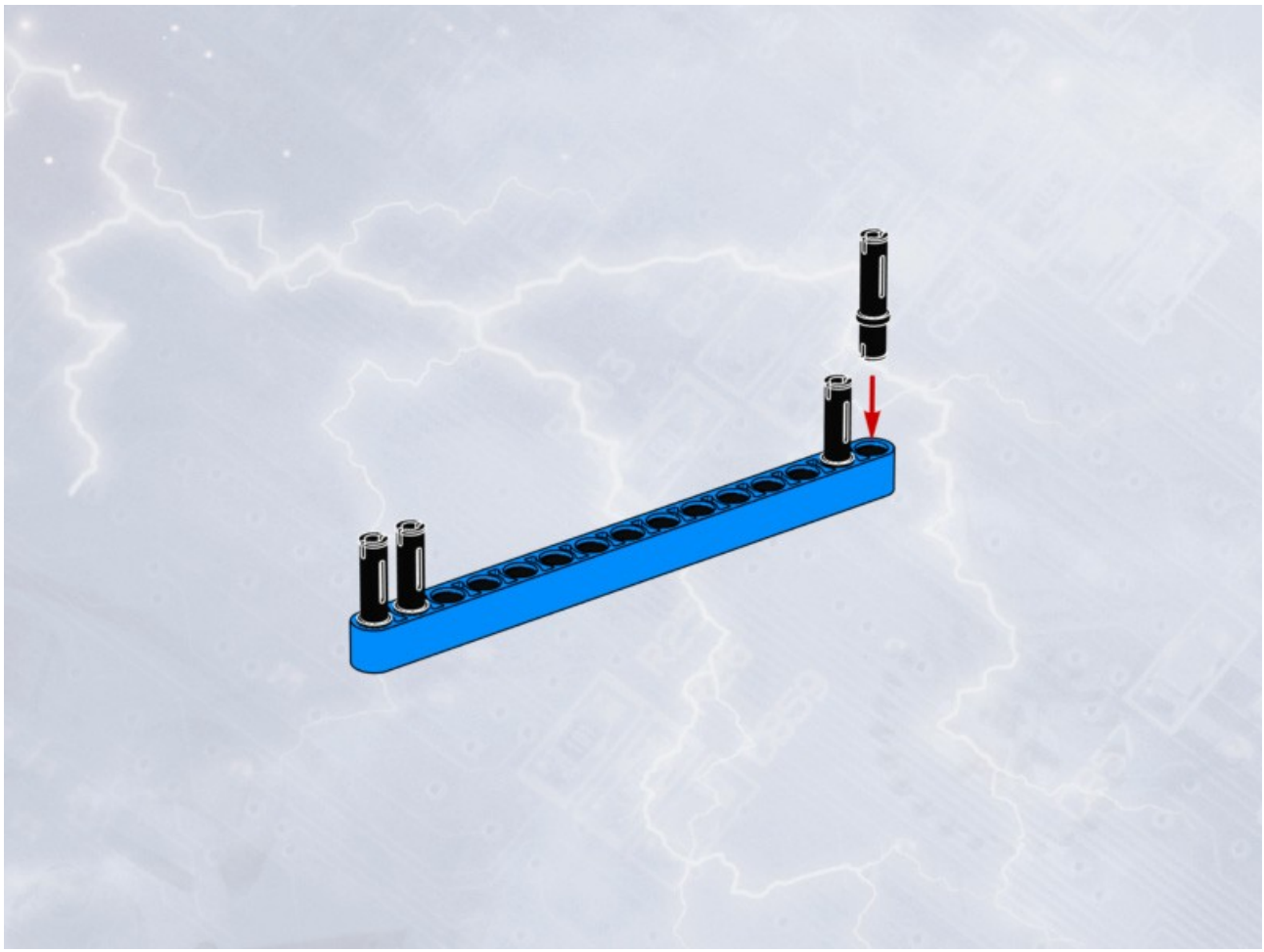
Left Table Sensor

Using a simple lever mechanism the Table Sensor Module uses a Touch Sensor to detect the edge of a table.

When the black angle beam on the front of the Module drops over the edge the other end pushes against the Touch Sensor.

1





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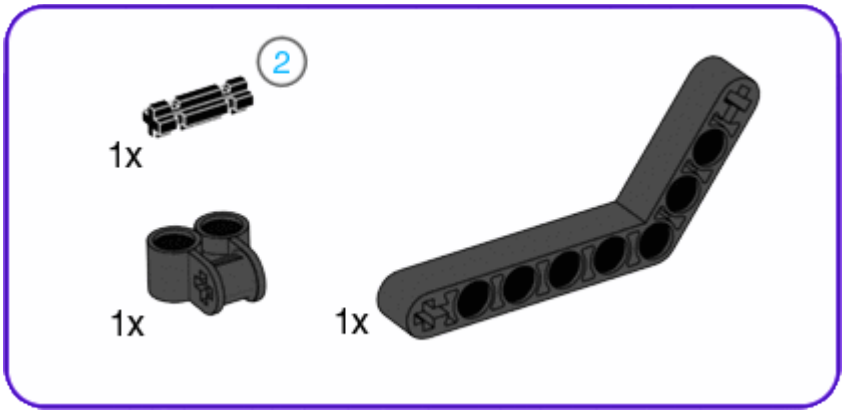

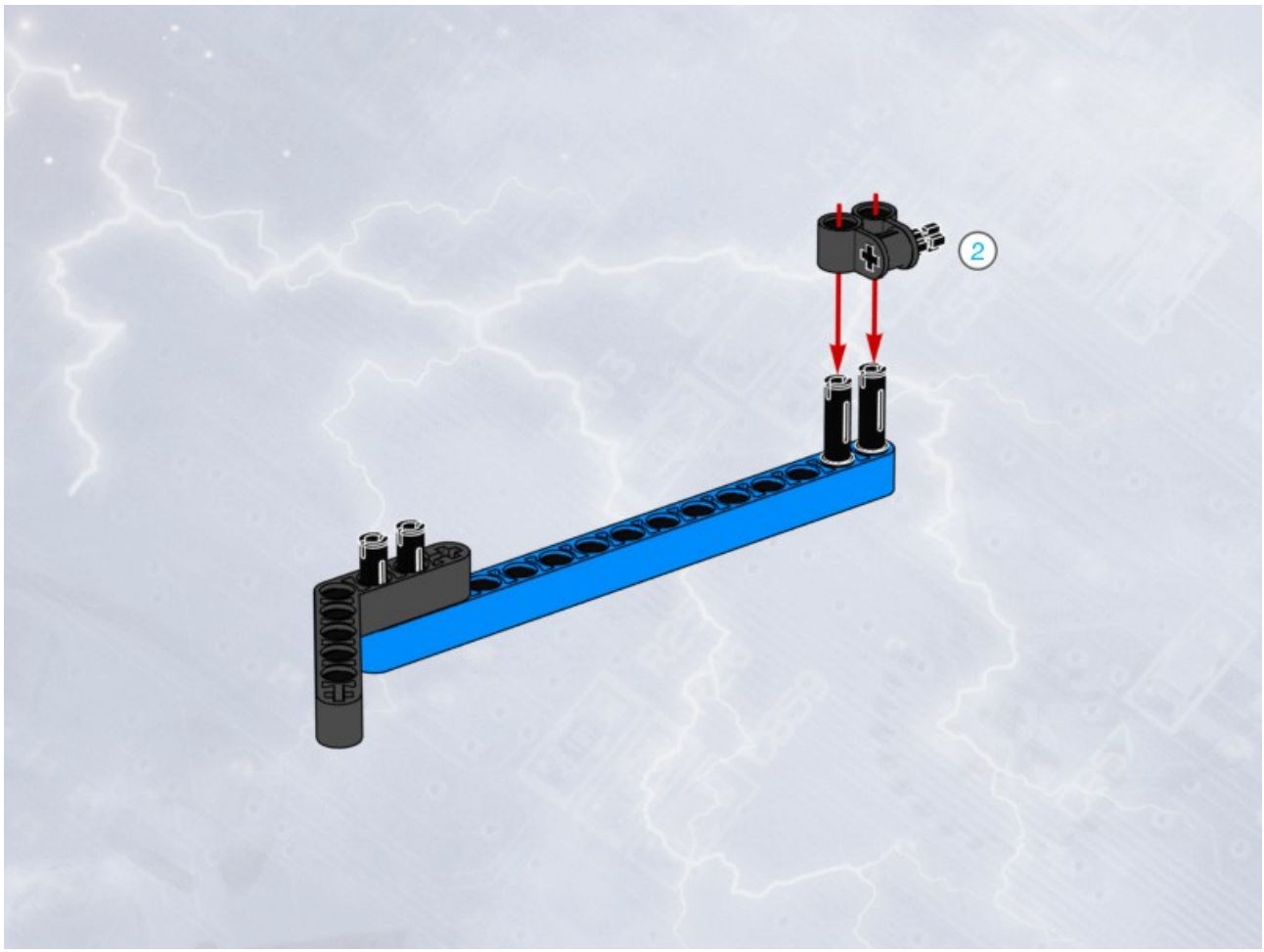

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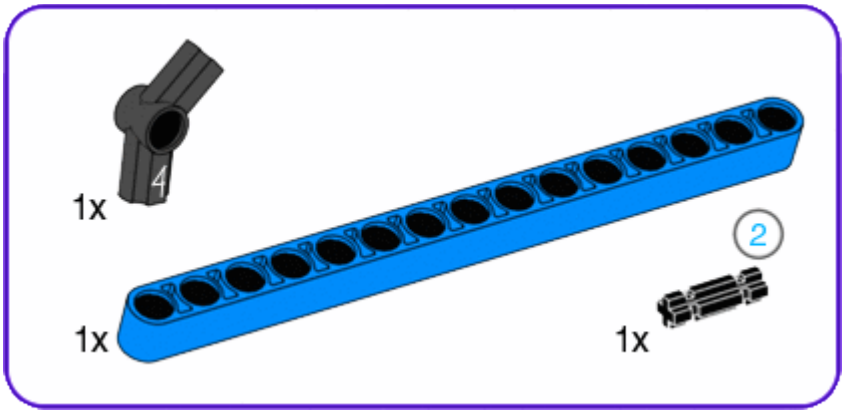

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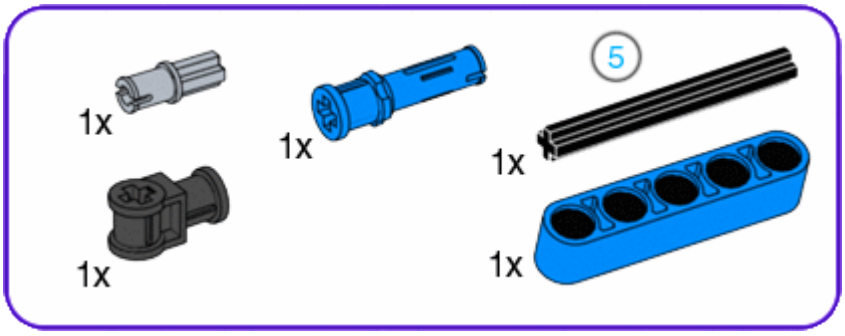

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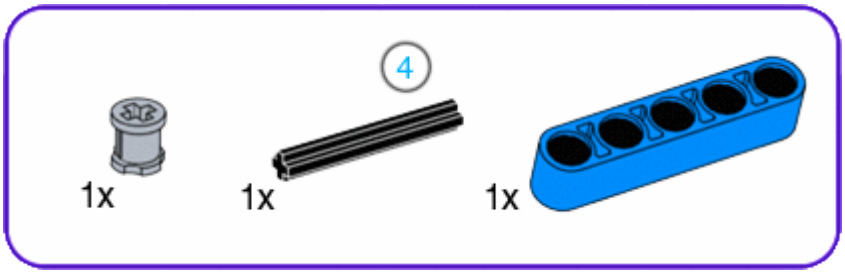

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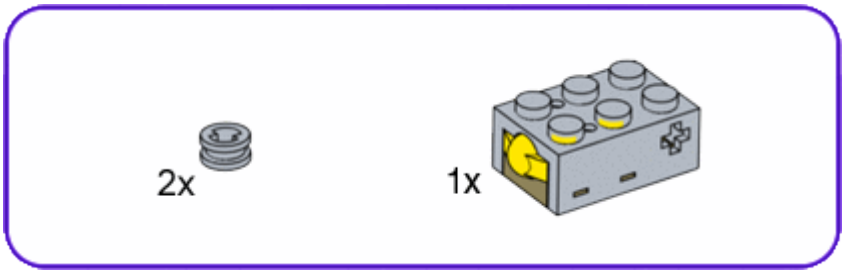

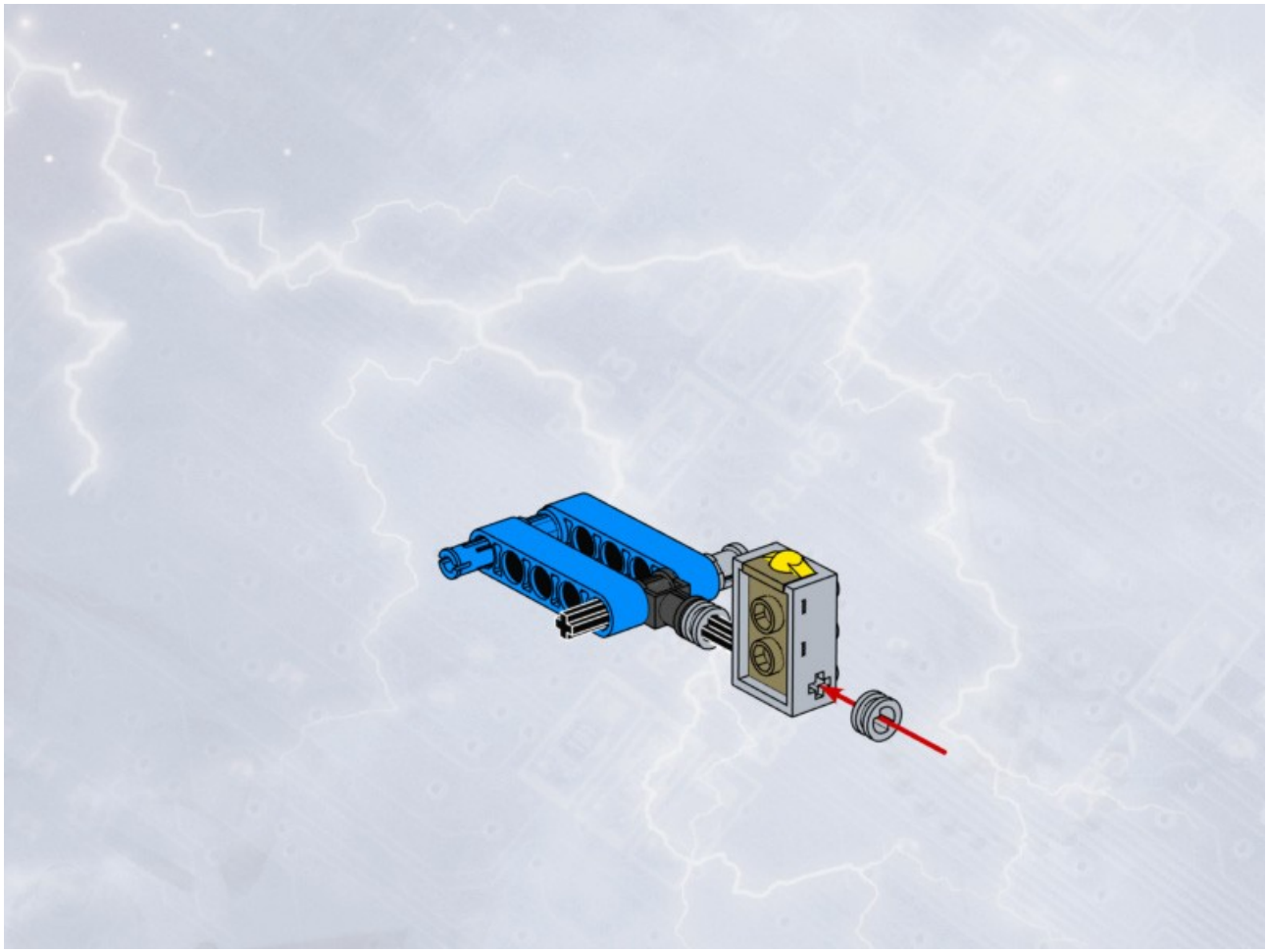

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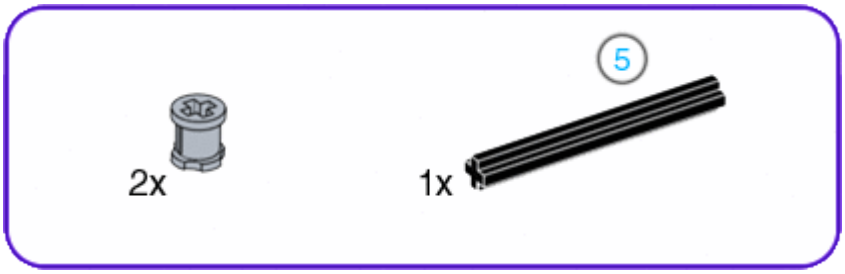

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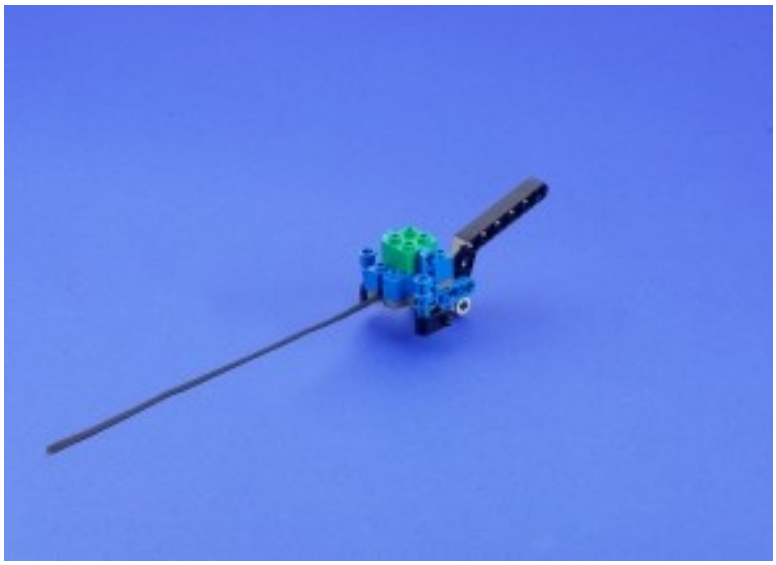
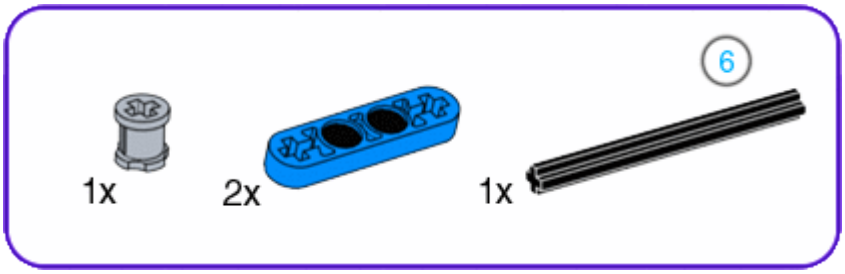
Rear Table Sensor



The Rear Table Sensor makes use of a Light Sensor to detect the edge of a table.

The angle beam is positioned to cover the Light Sensor while it is on a table surface. When the angle beam drops over an edge it moves away from the Sensor changing the level of light and allowing the RCX to detect the table edge.

1



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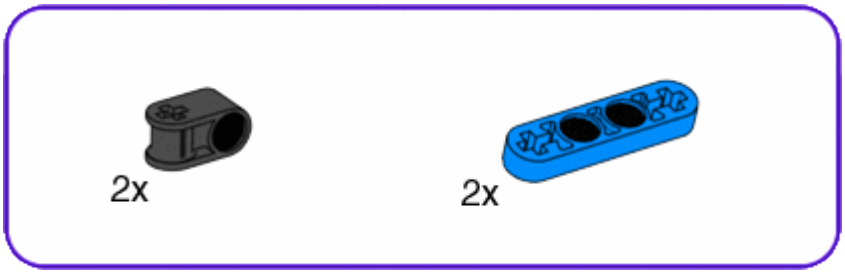

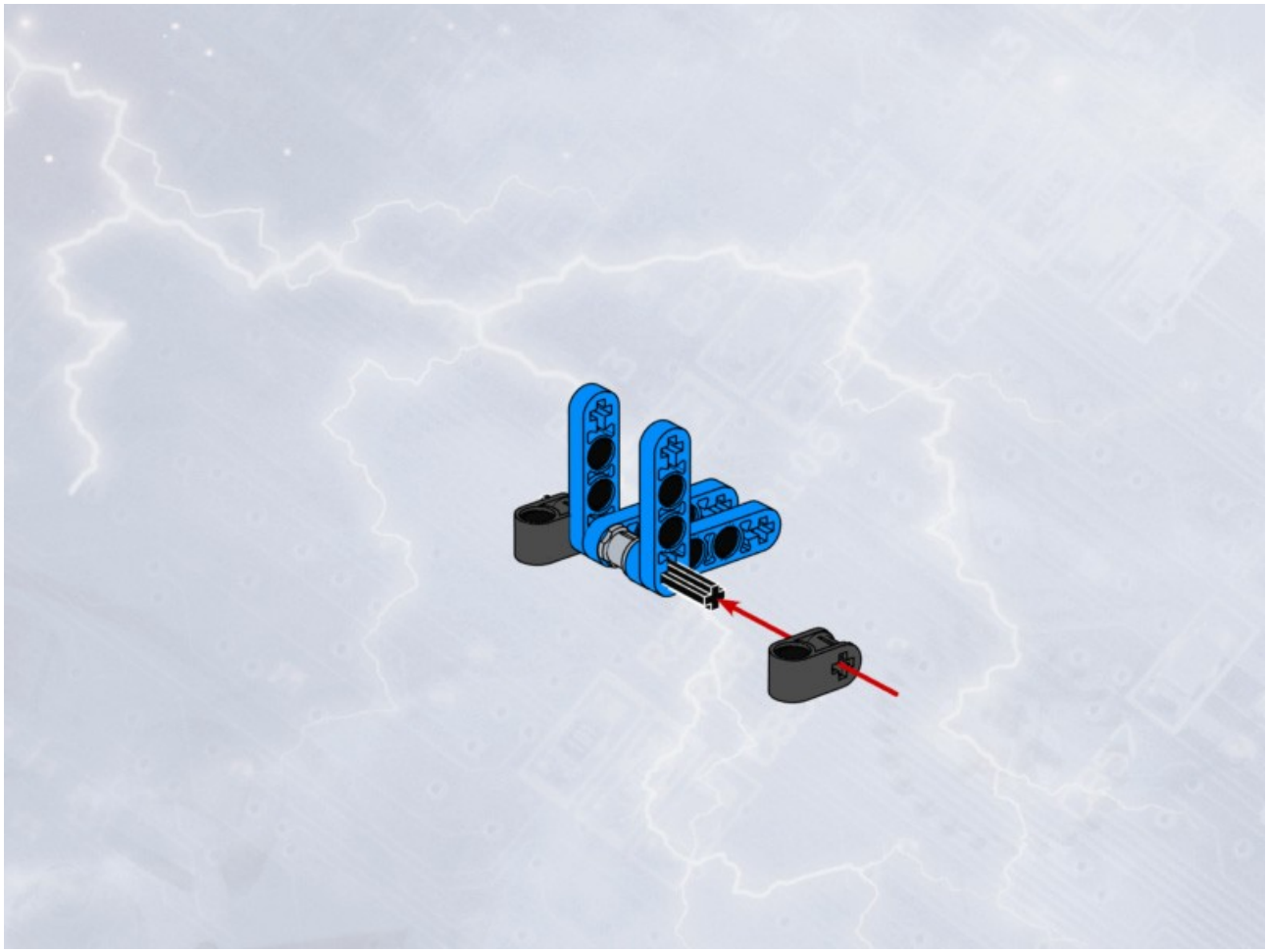

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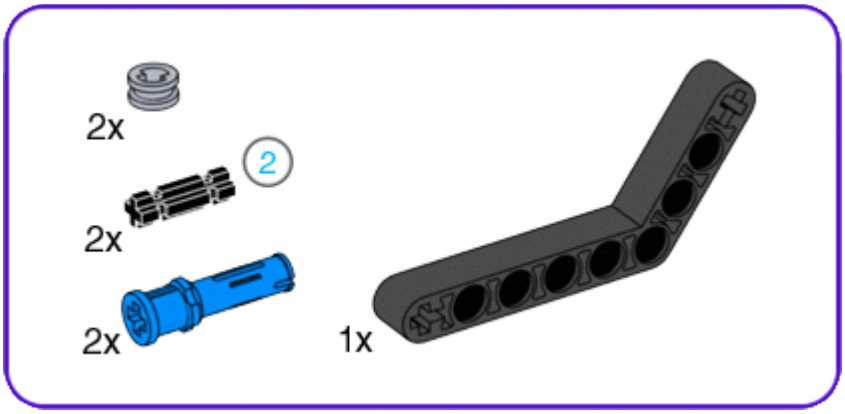

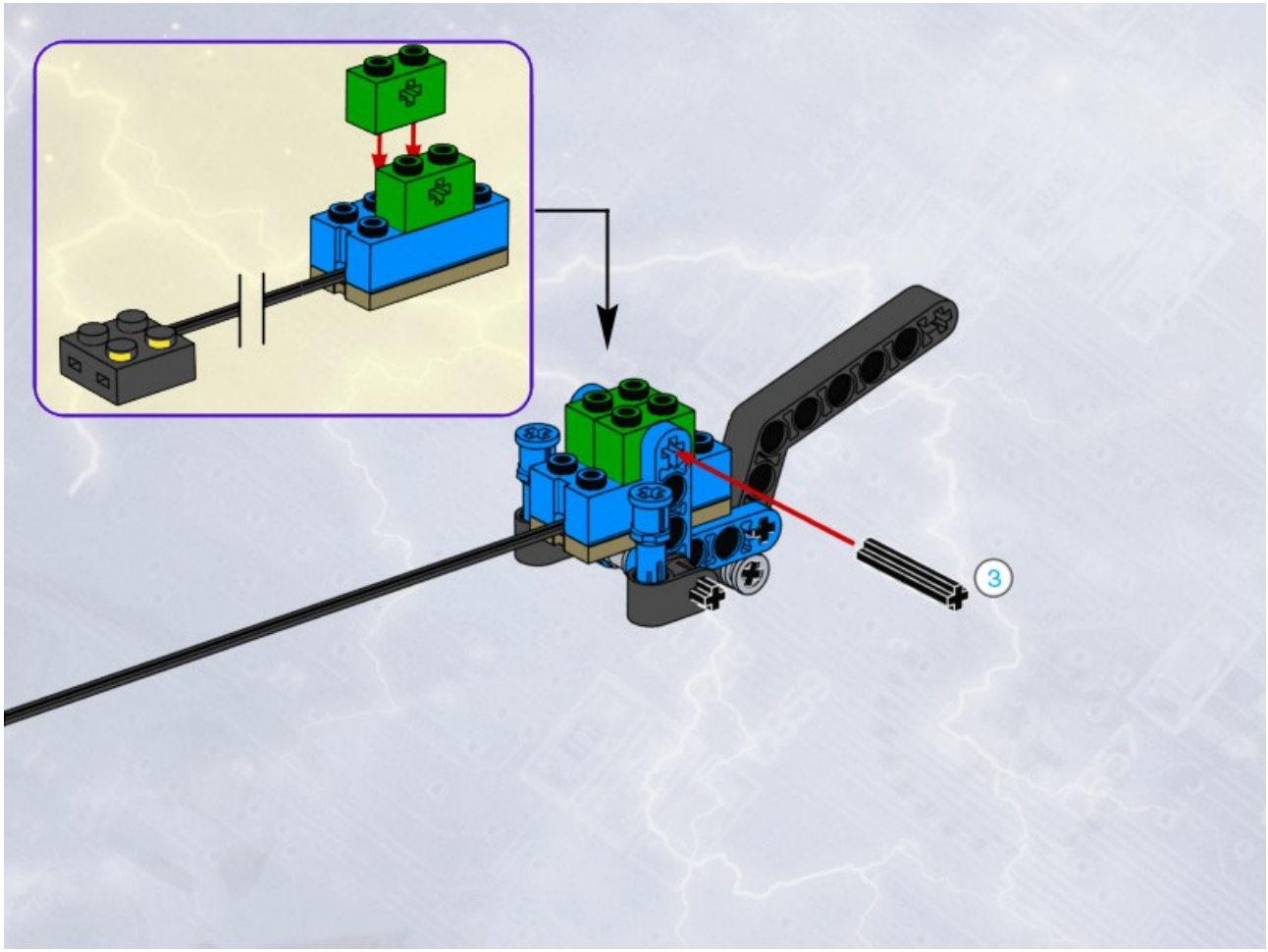

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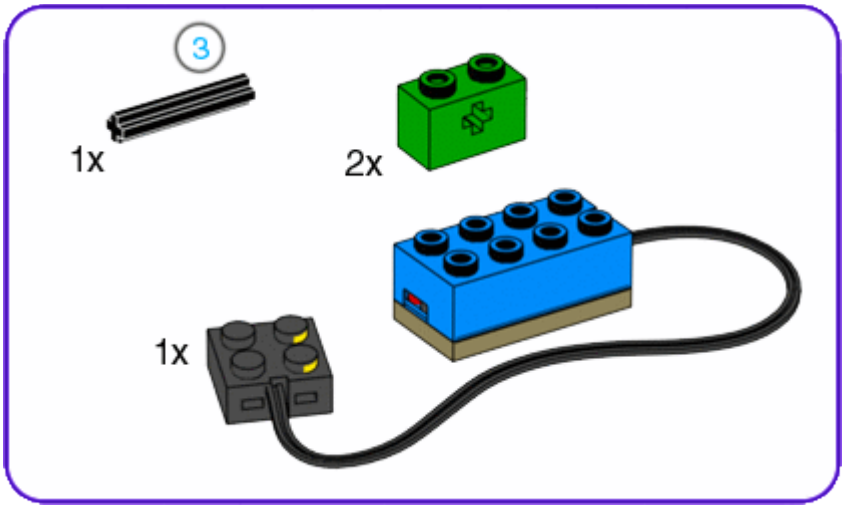

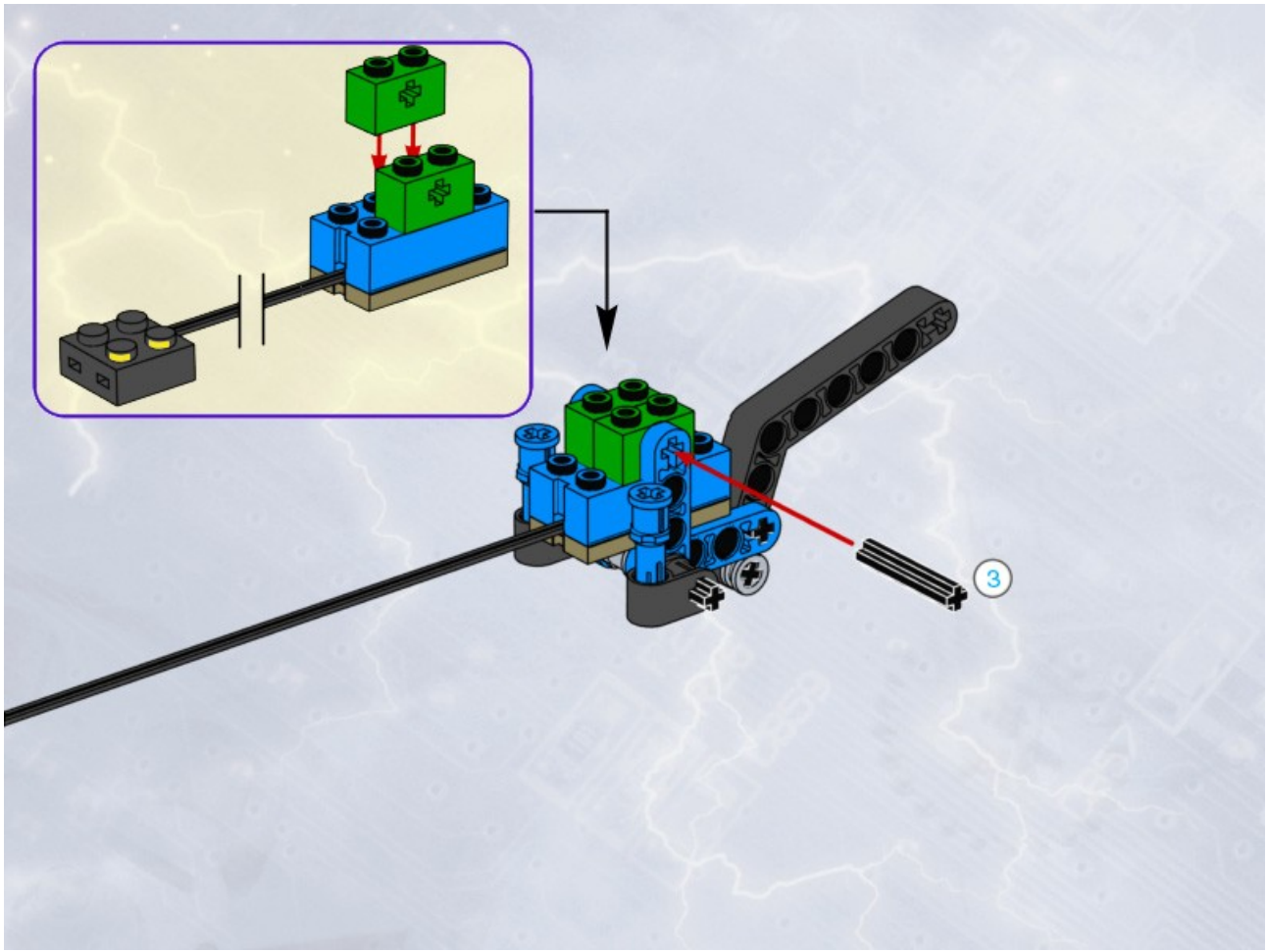

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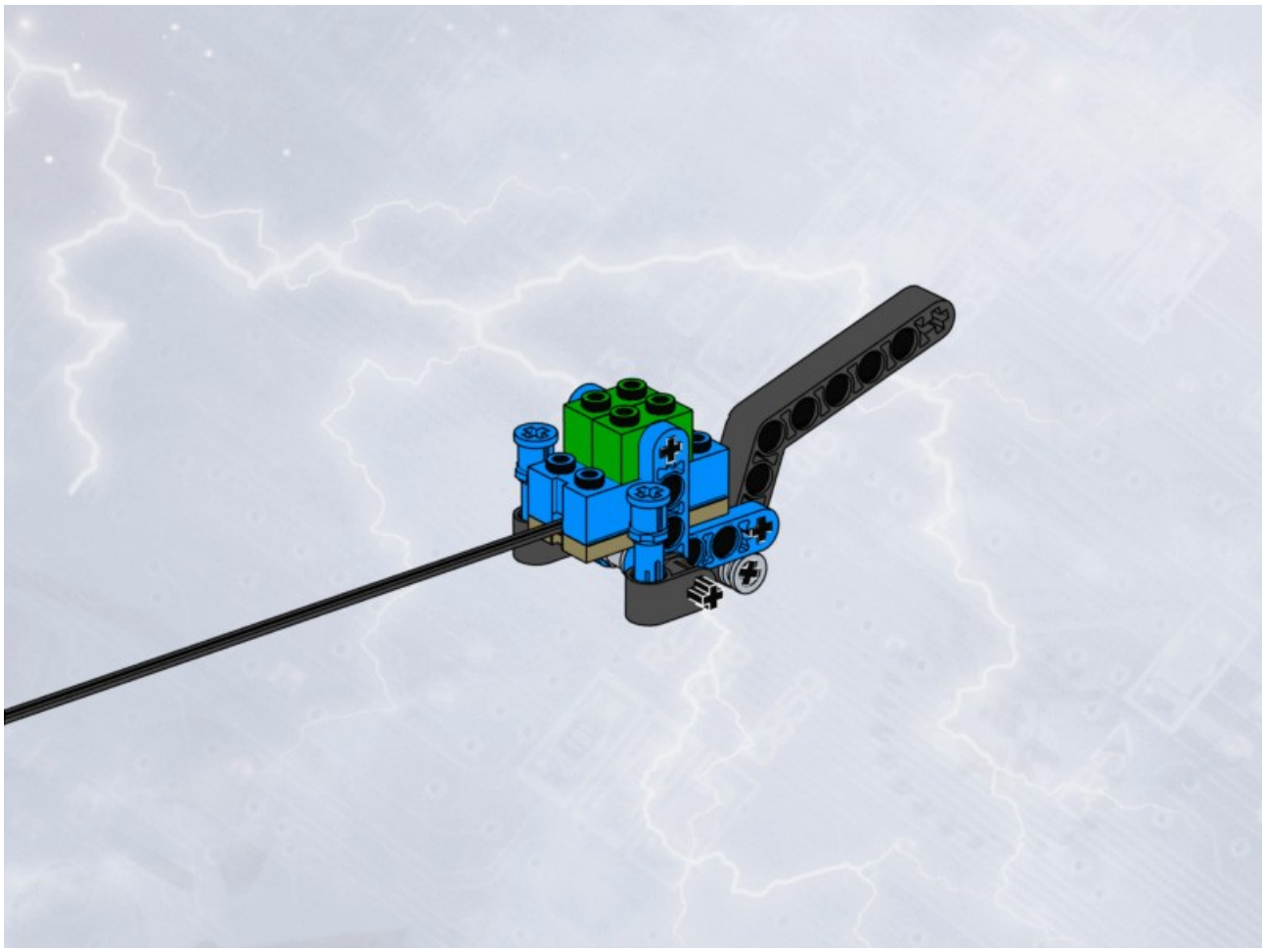


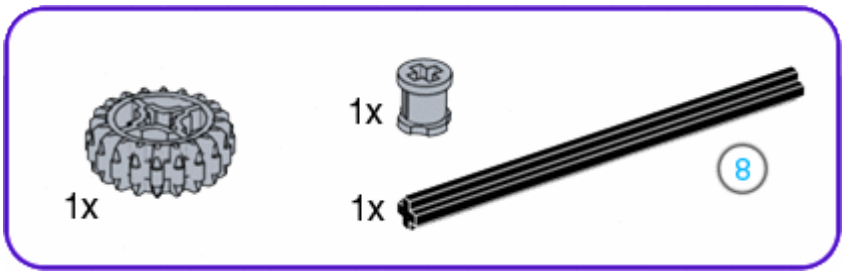
Pneumatics Module

The Pneumatic Module efficiently uses one motor to both control the valve and pump air to the Pneumatic ram on the Pen Module.

The direction the motor turns determines whether the pen moves up or down.

The white clutch gear allows the motor to continue turning once the valve is switched to keep pumping air until the pen has moved.

1



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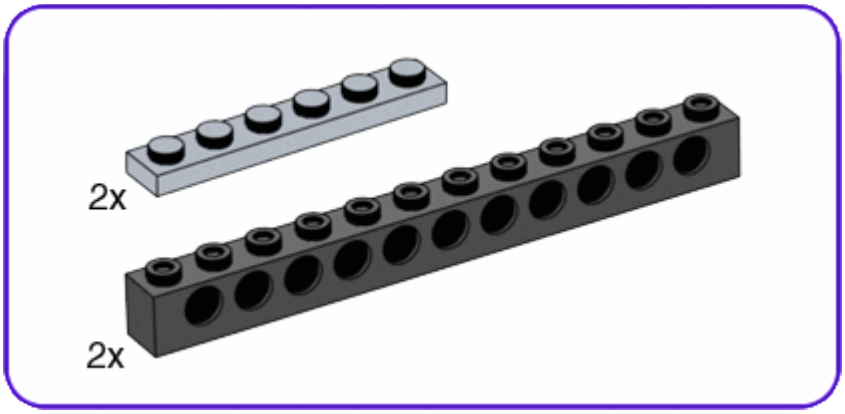

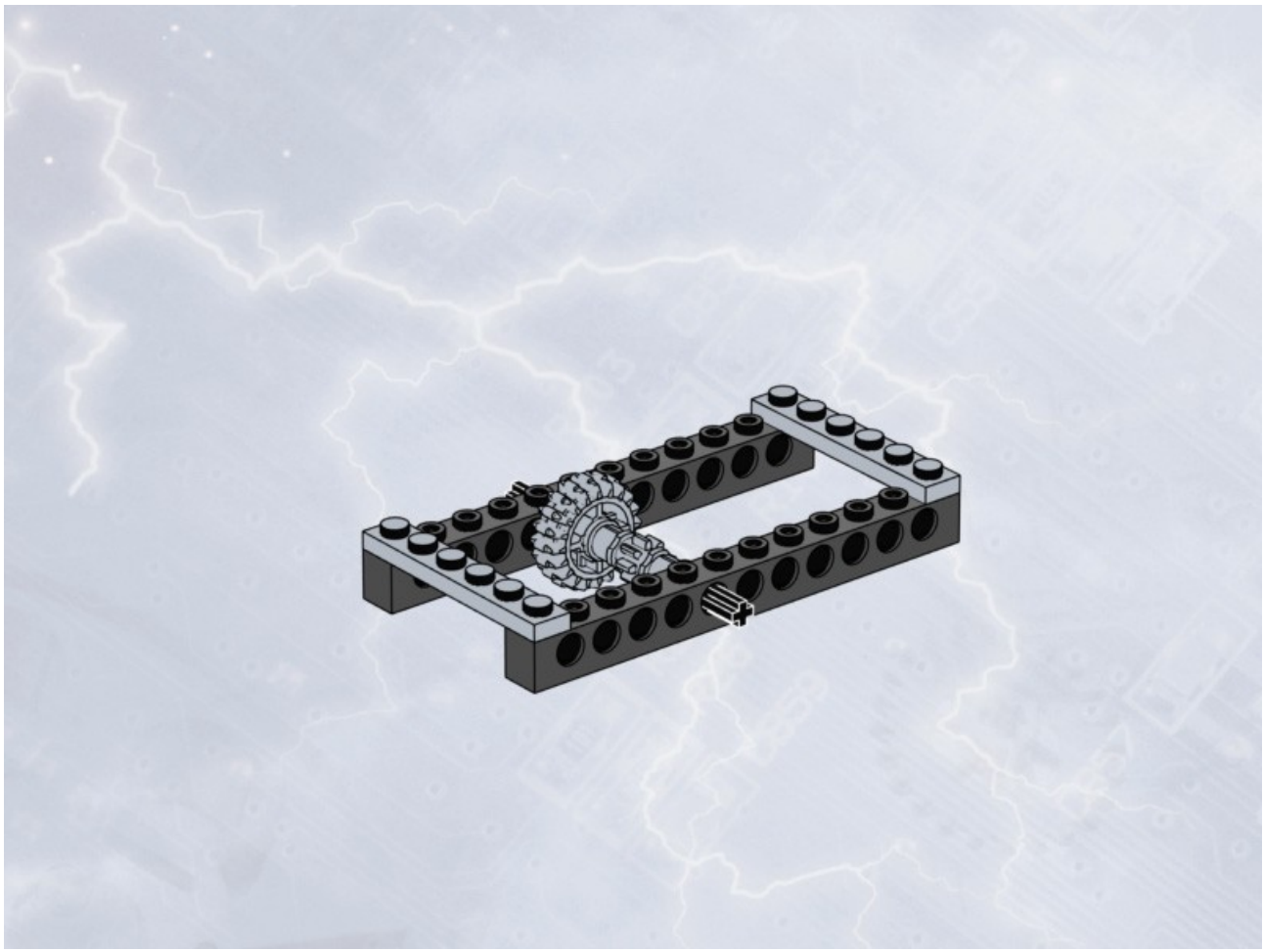

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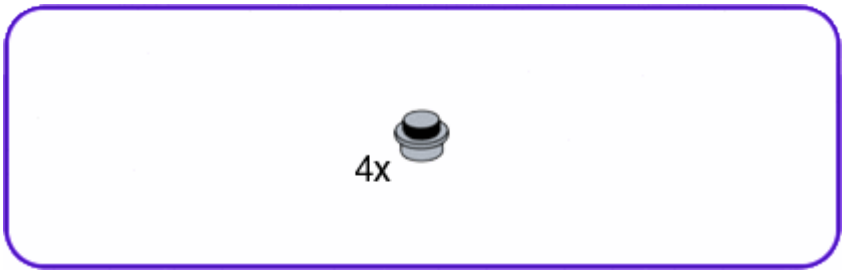

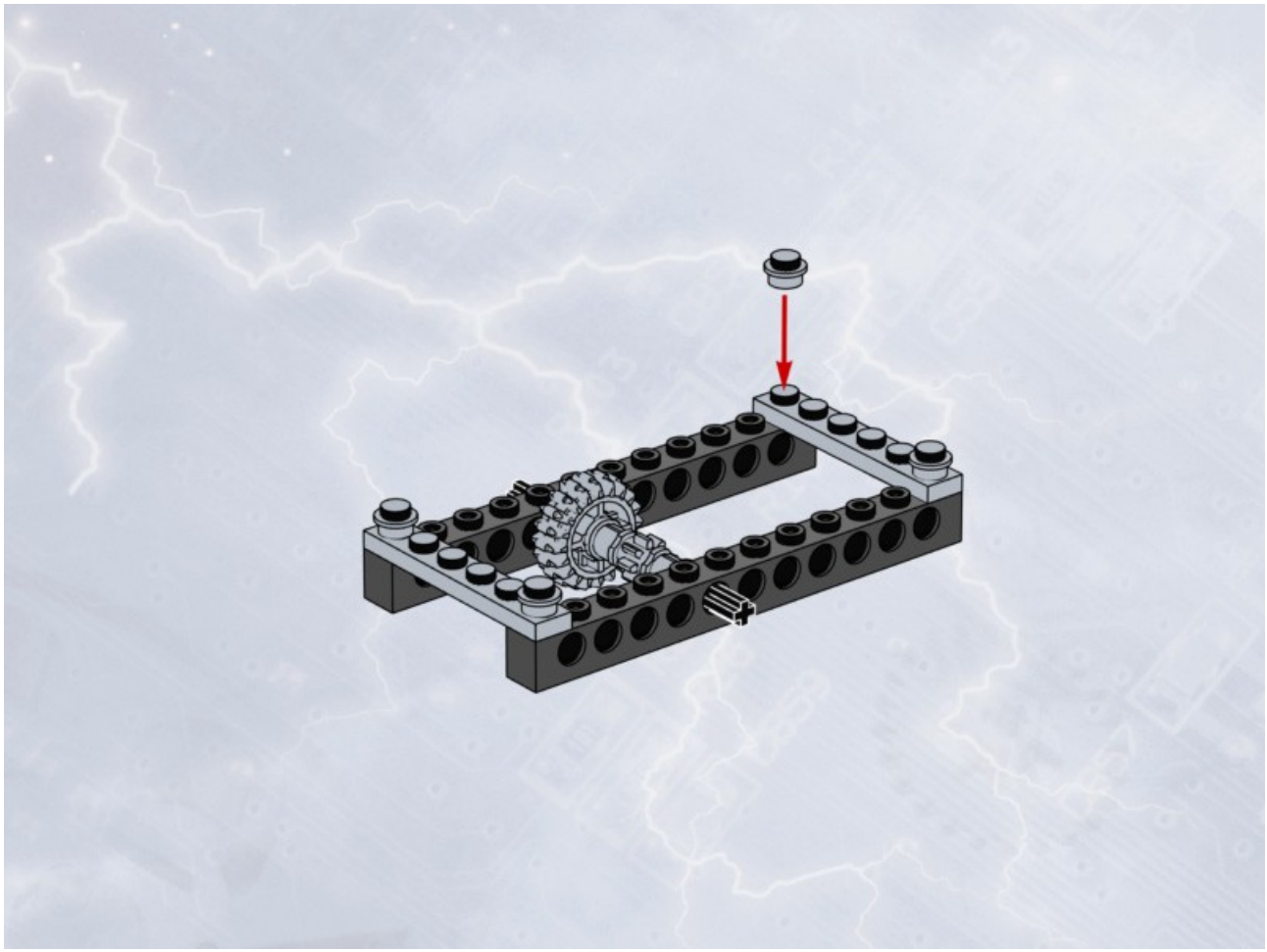

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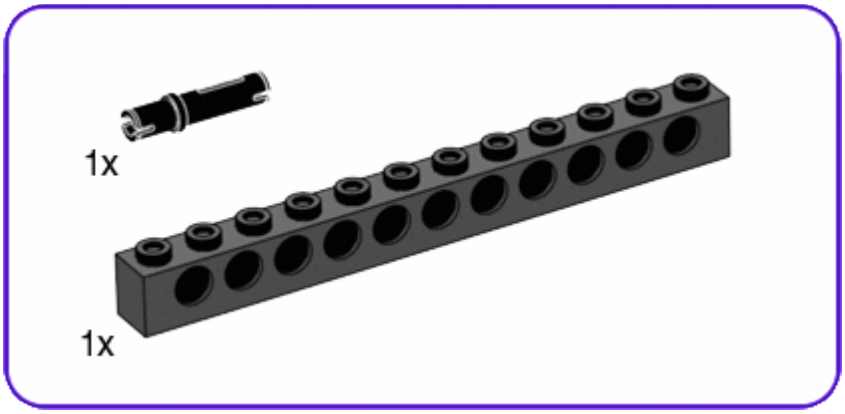

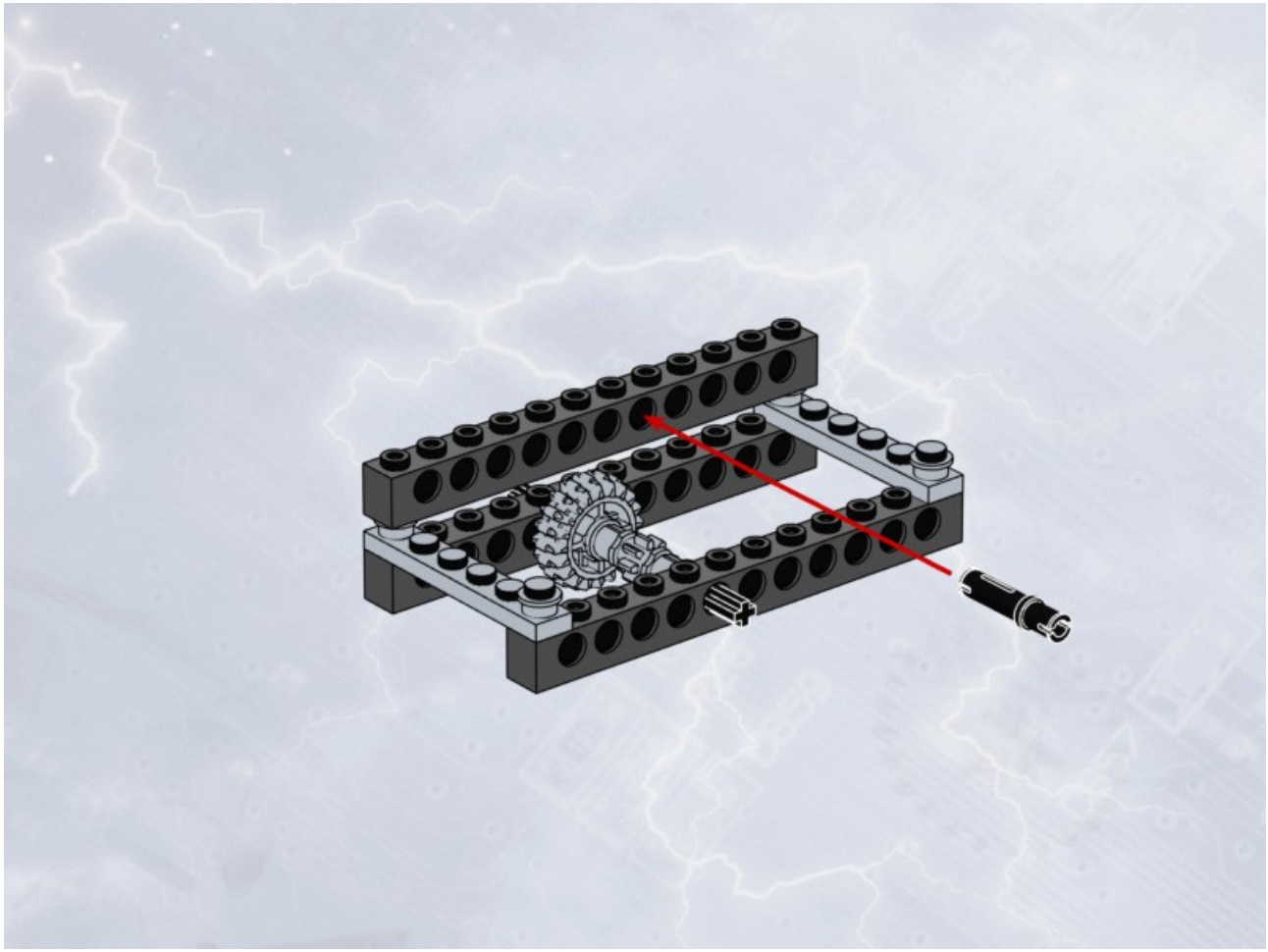

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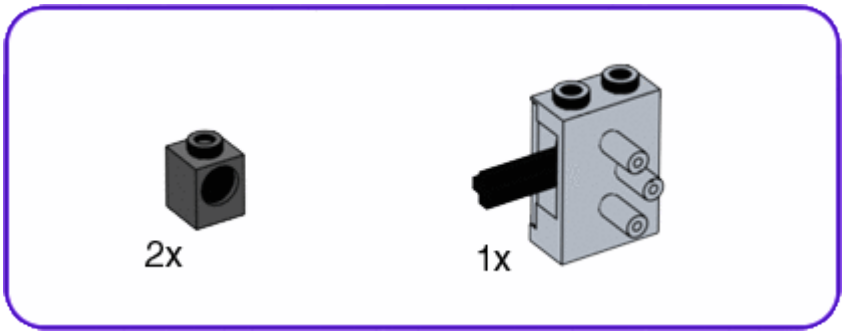

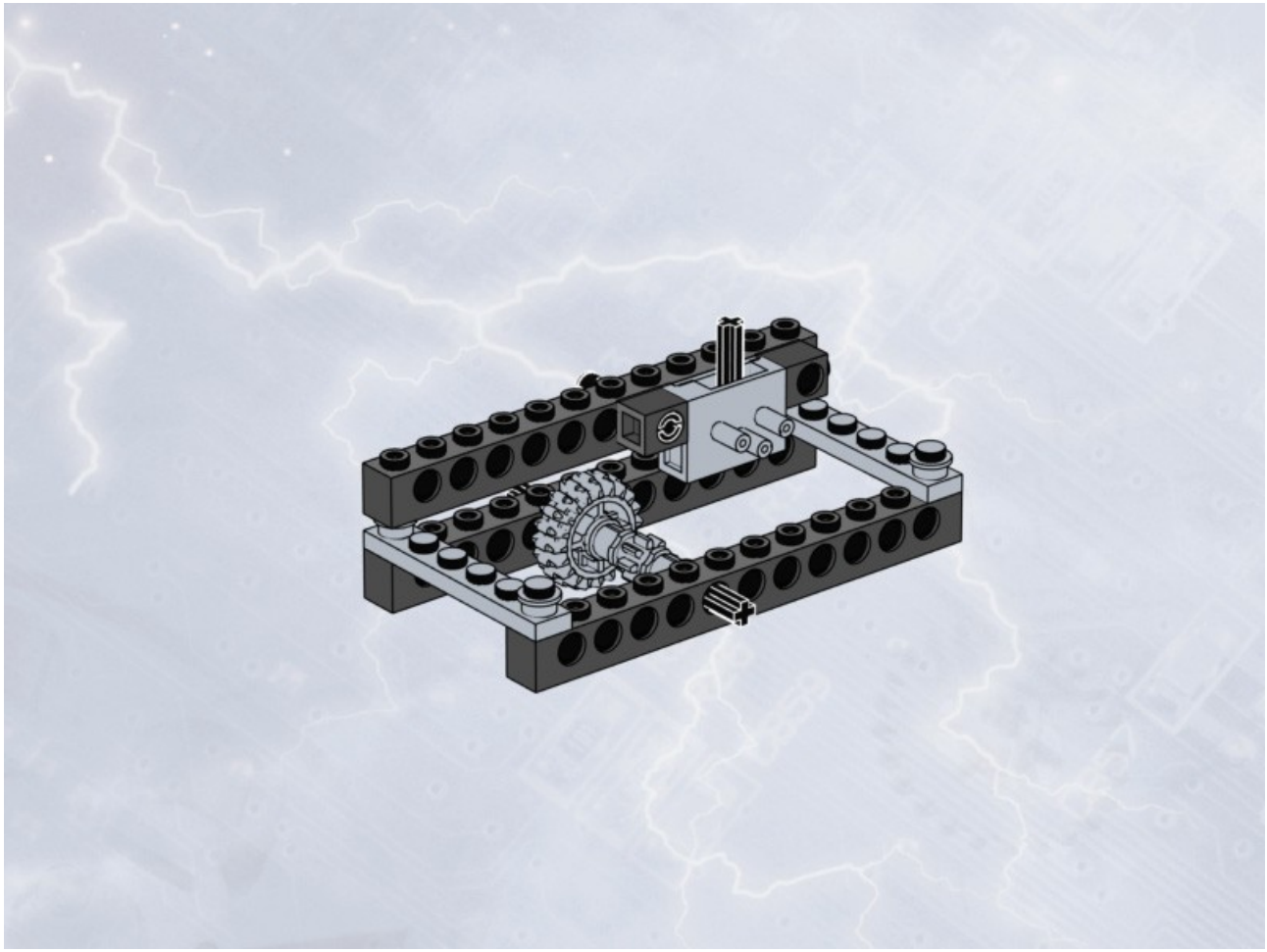

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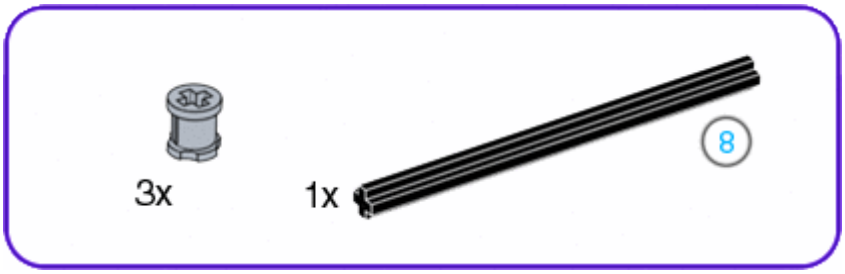

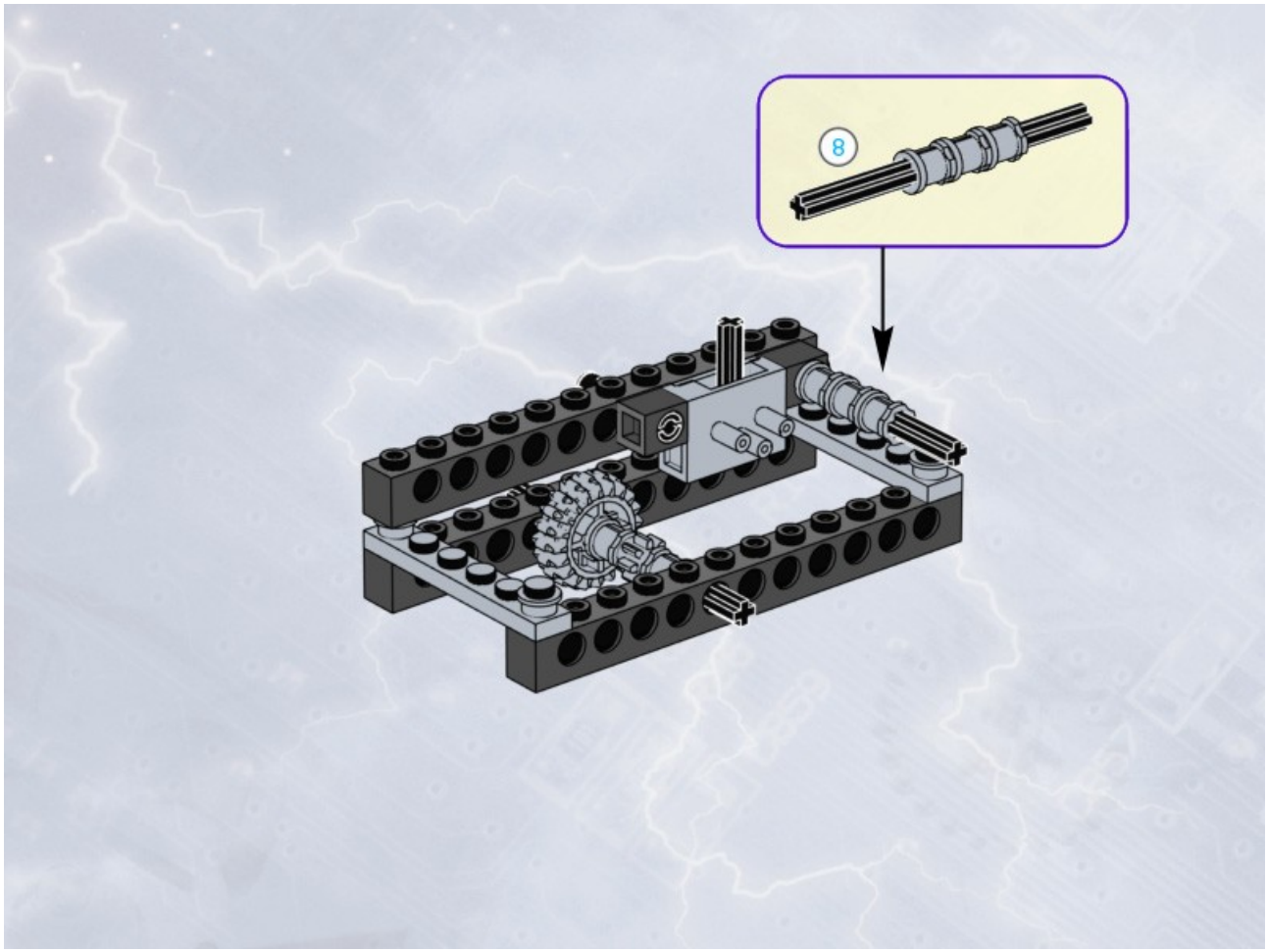

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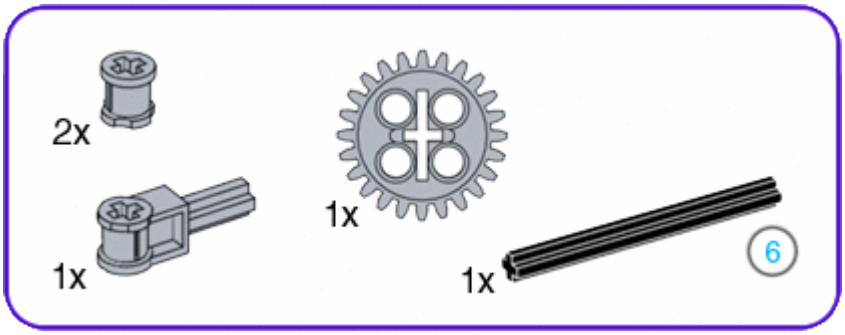

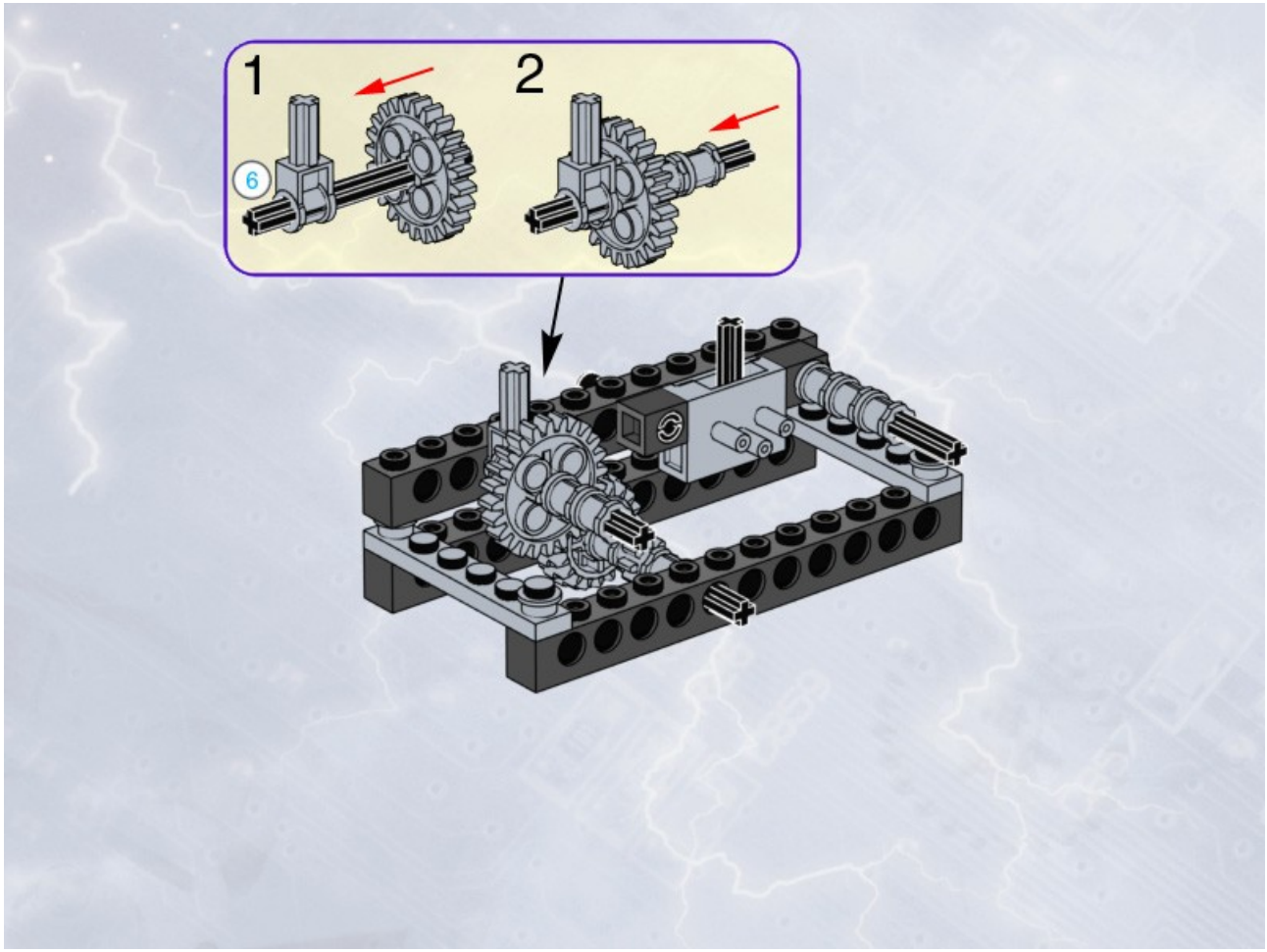

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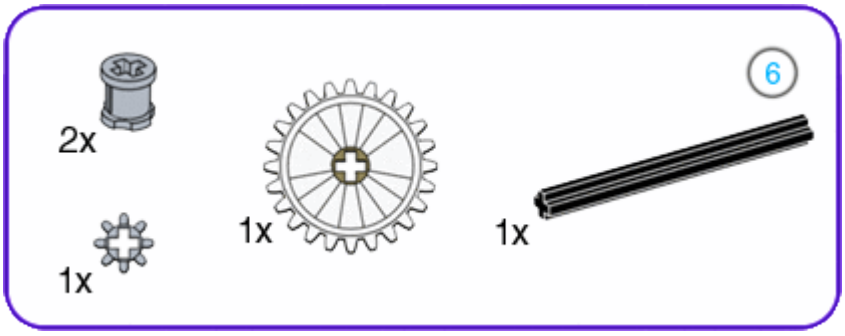

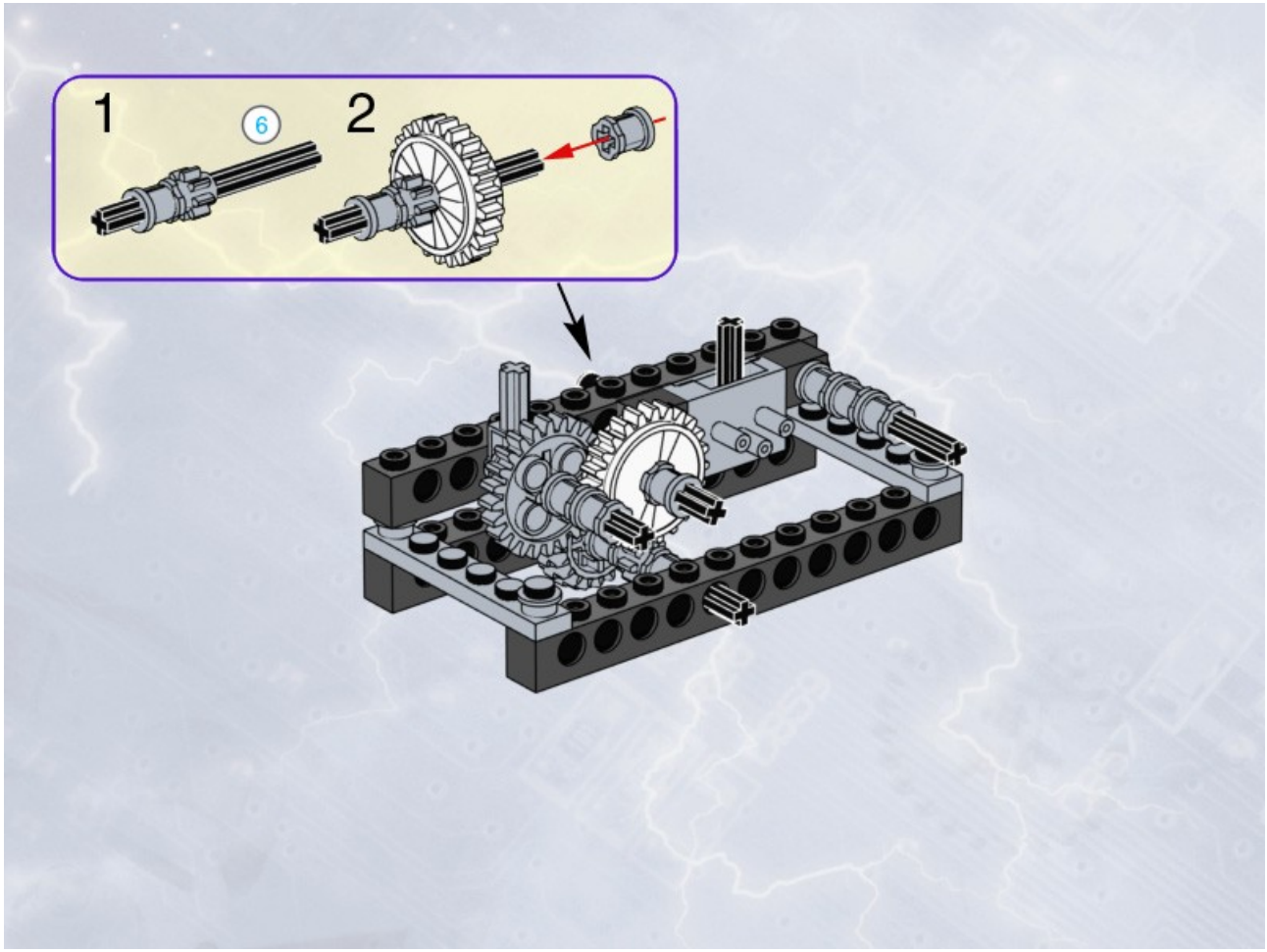

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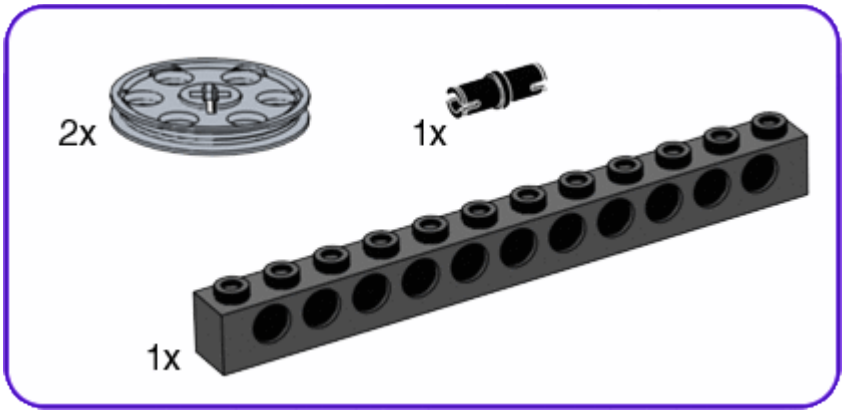

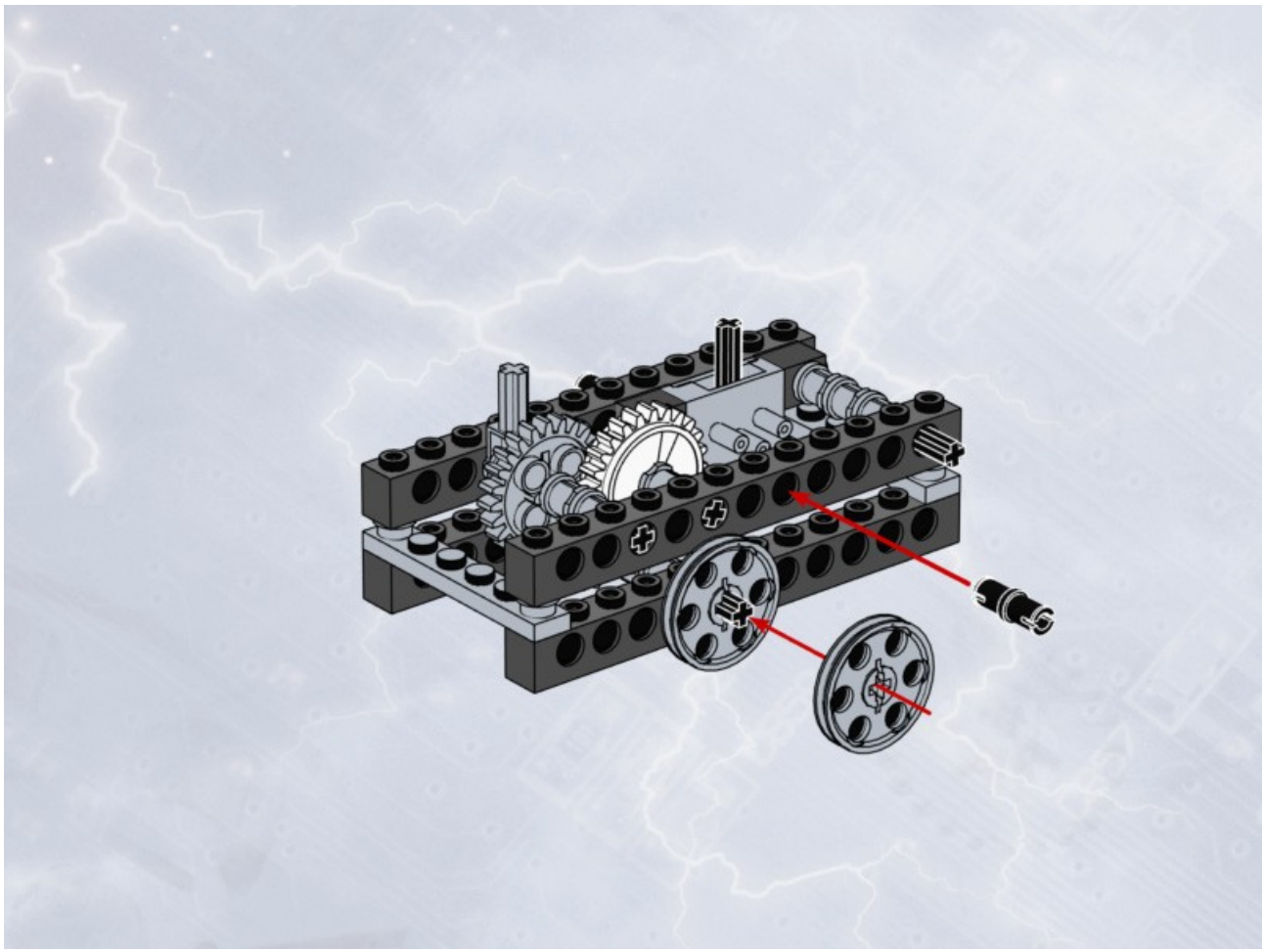

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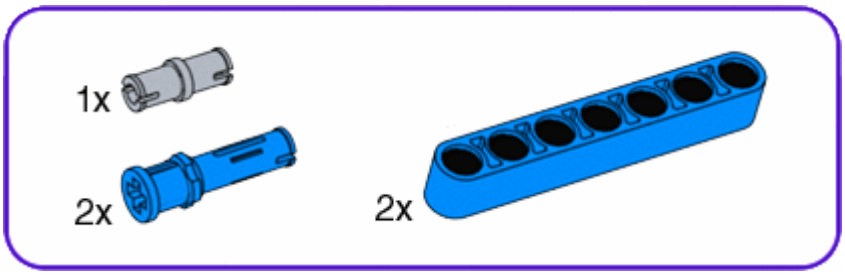

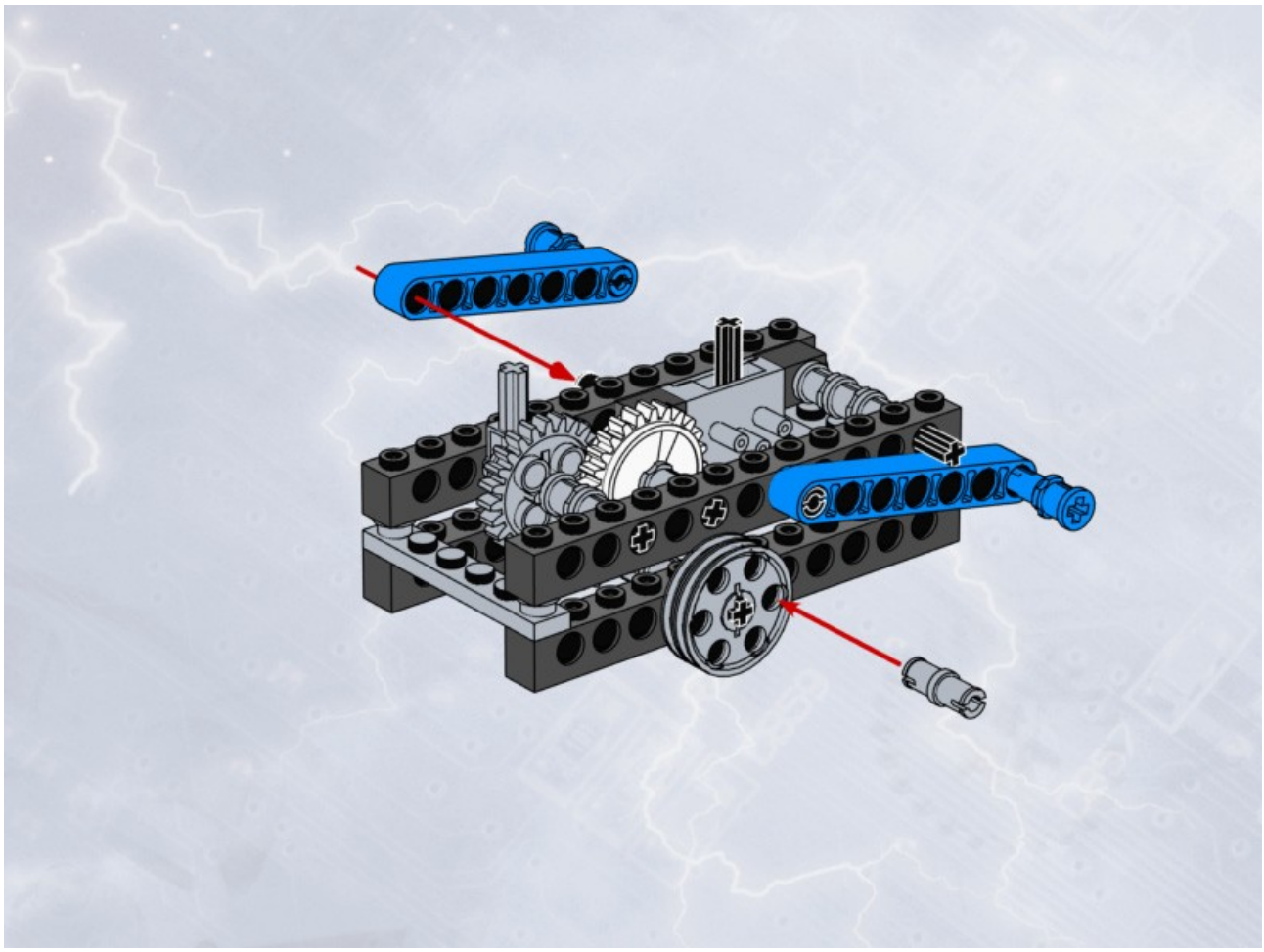

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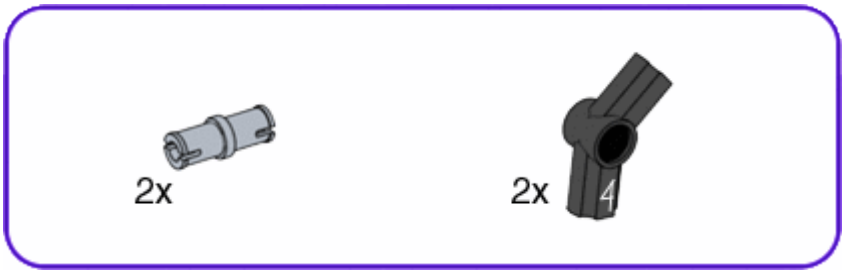

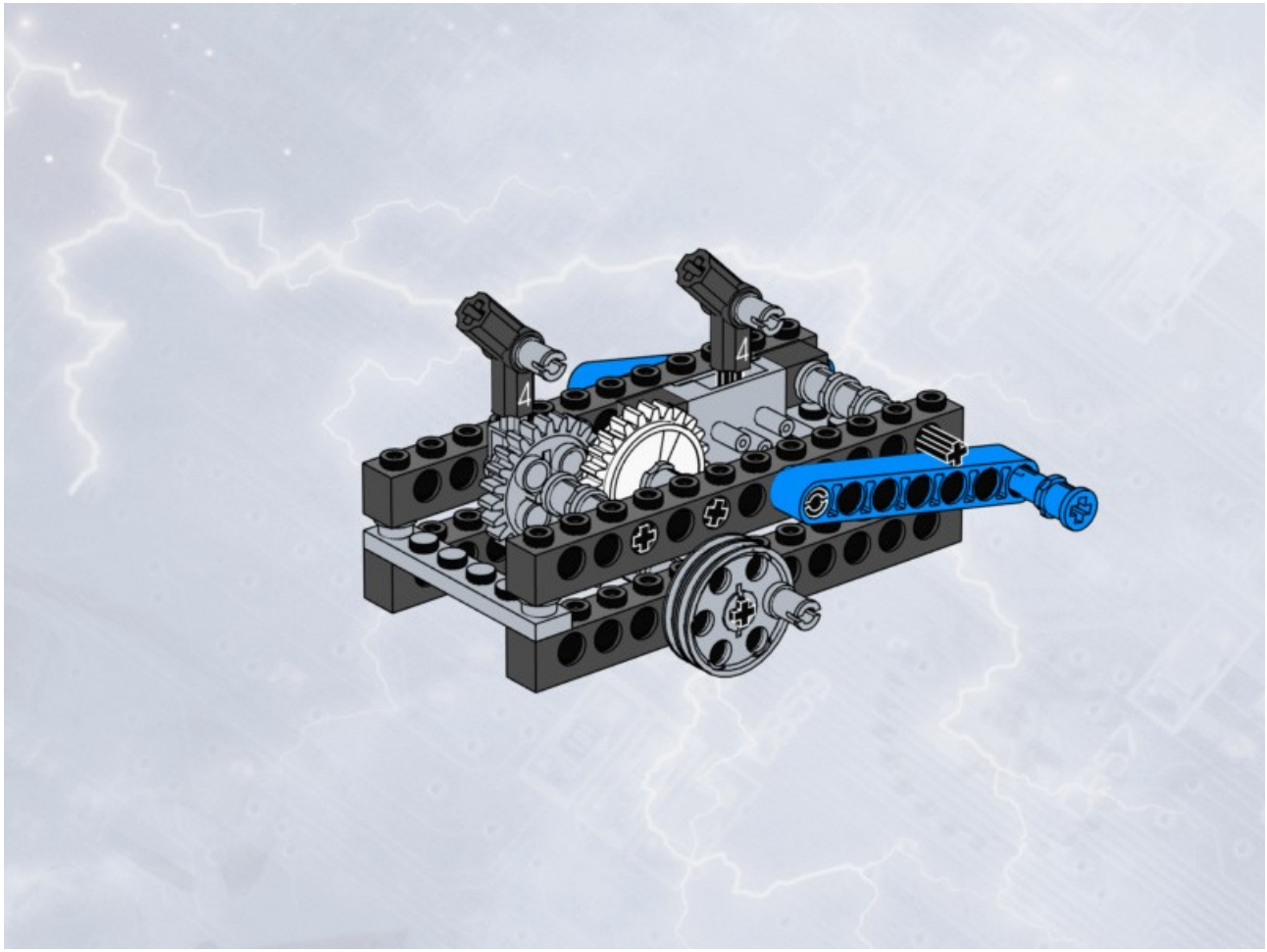

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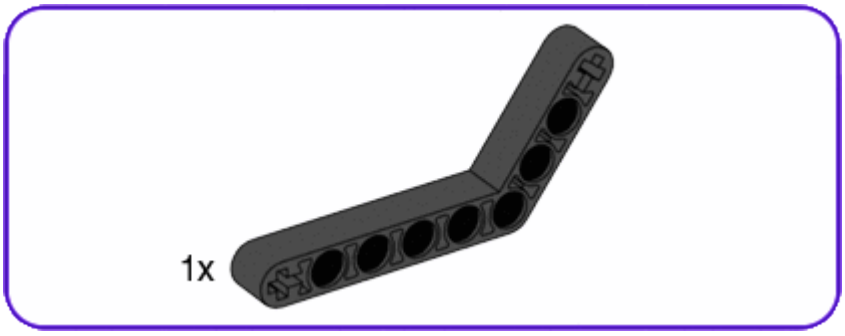

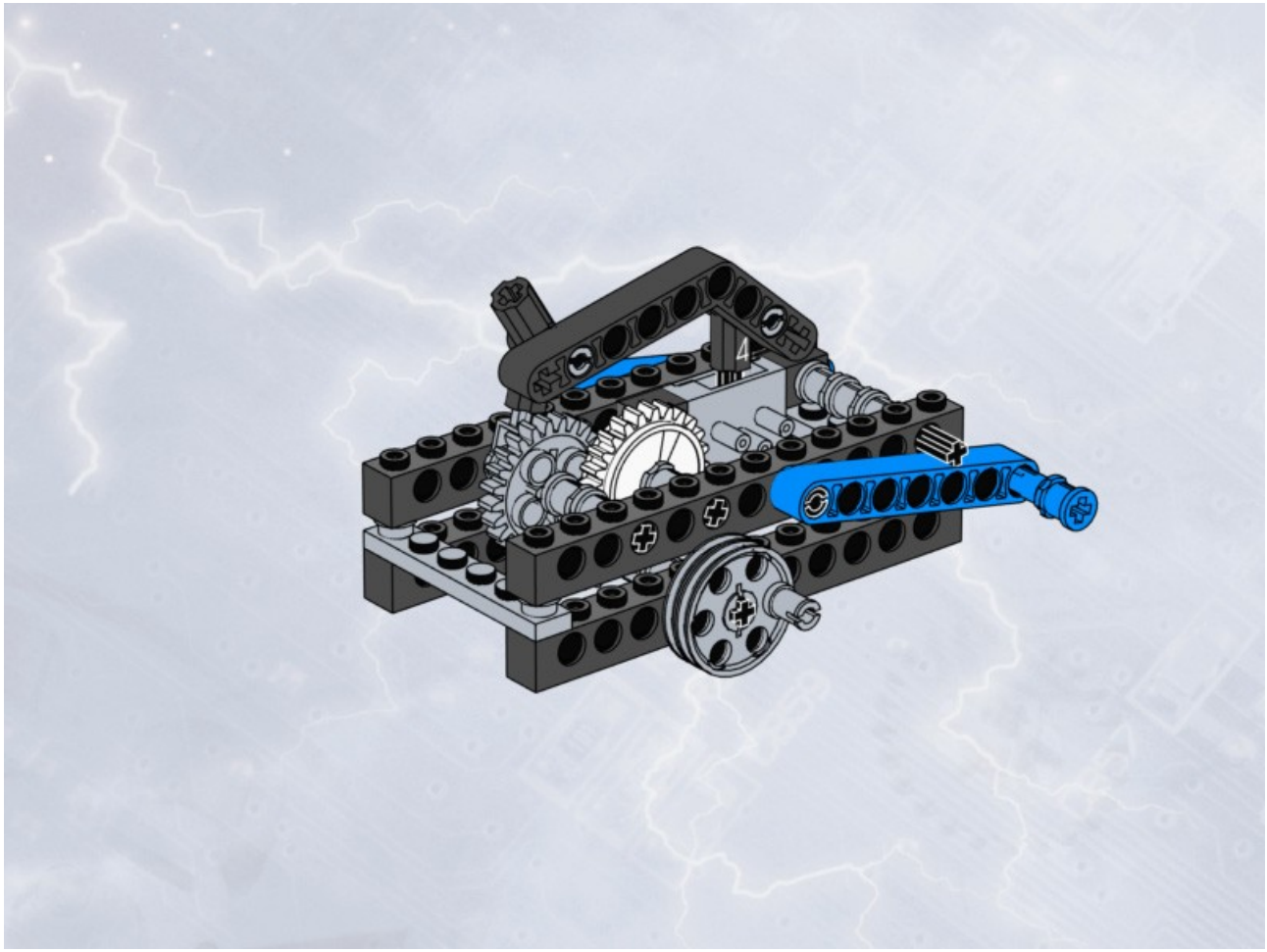

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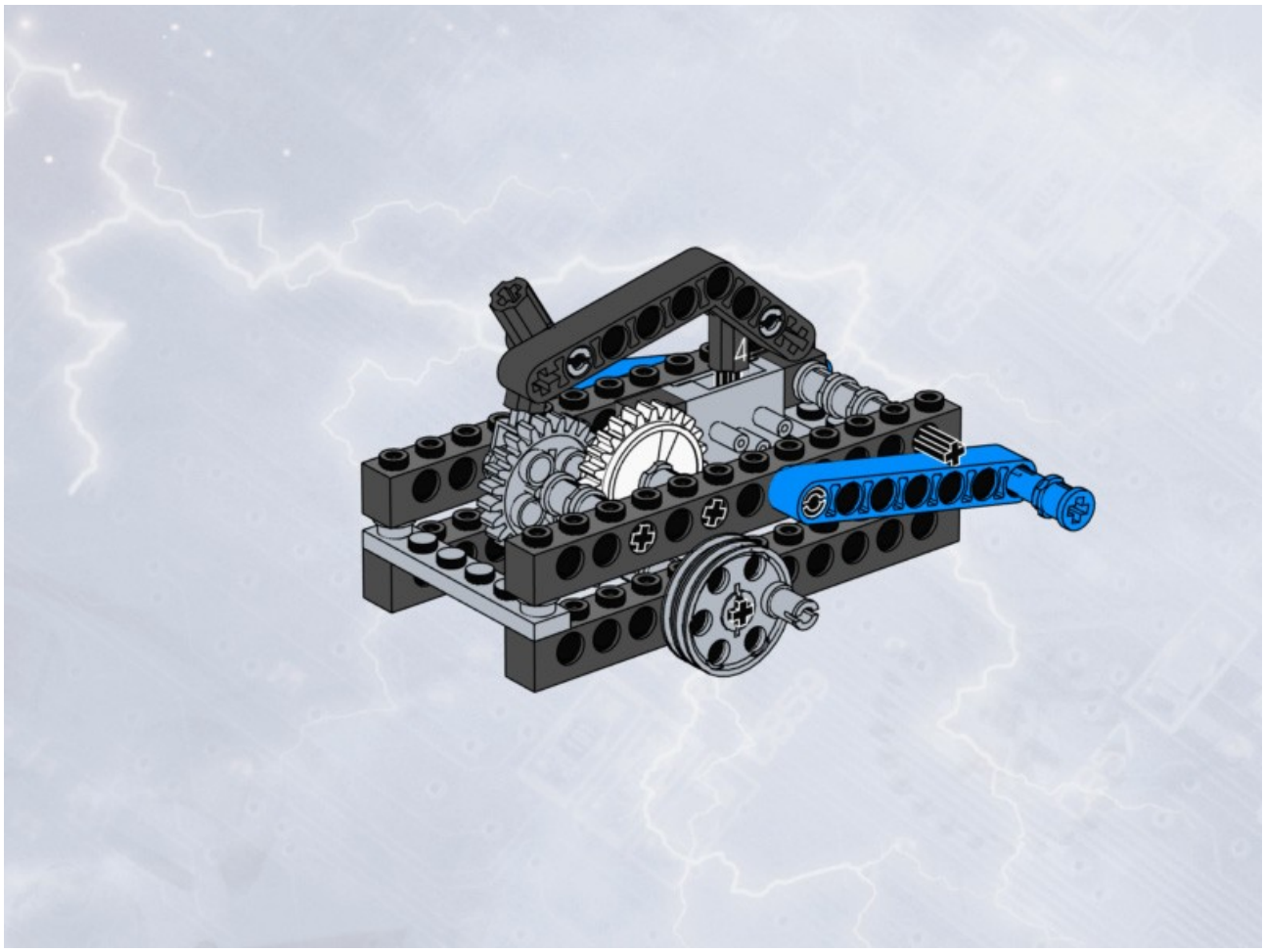


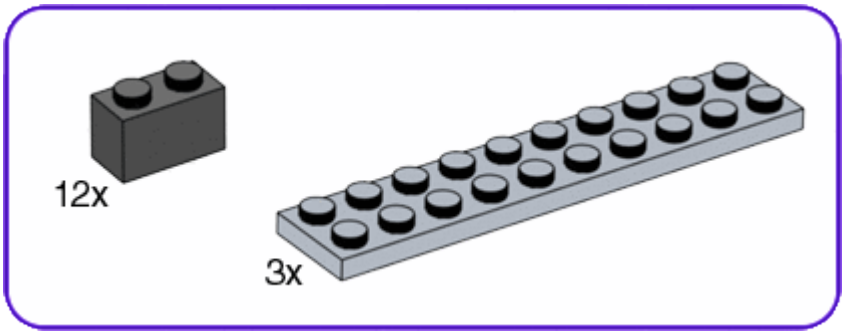
Plotter Table Module

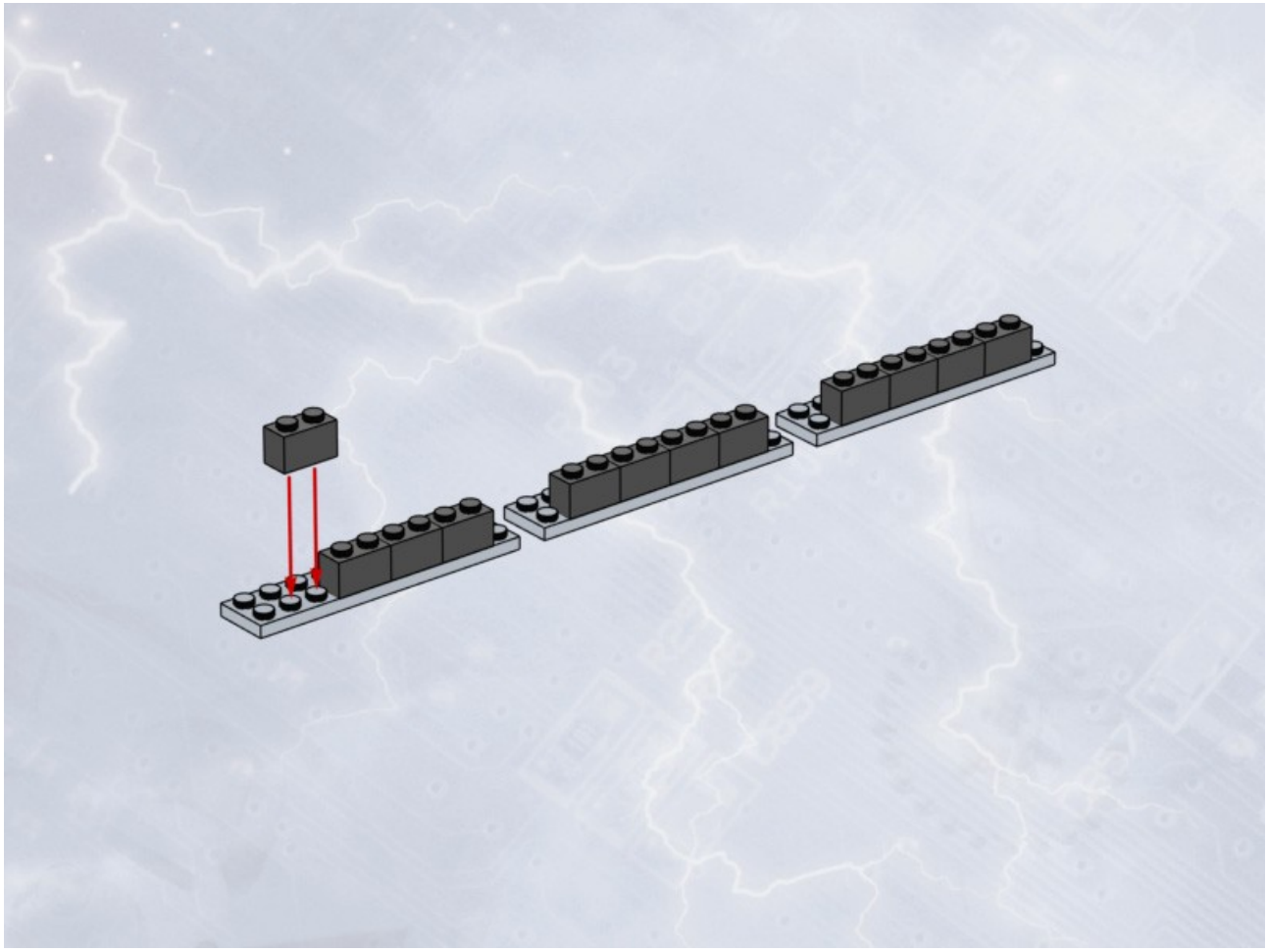
The Plotter Table Module holds a sheet of paper and can feed it back and forth via Motor Module 3.

It also provides a hard surface for the pen to press against.

The movement of this module allows vertical lines to be drawn on the paper. Combined with the horizontal movement of the Gear Rack Module any shape can be made.

1





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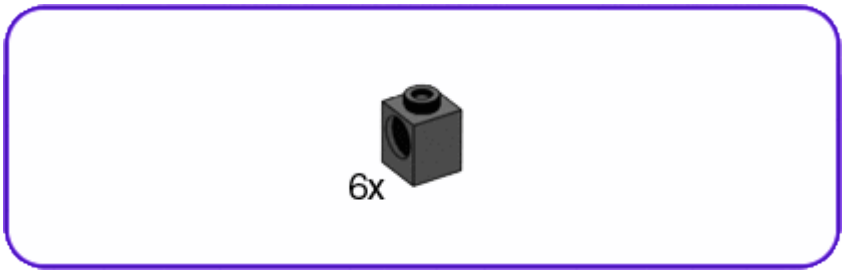

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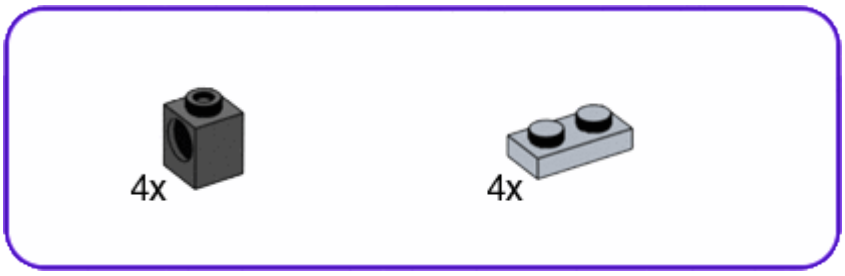

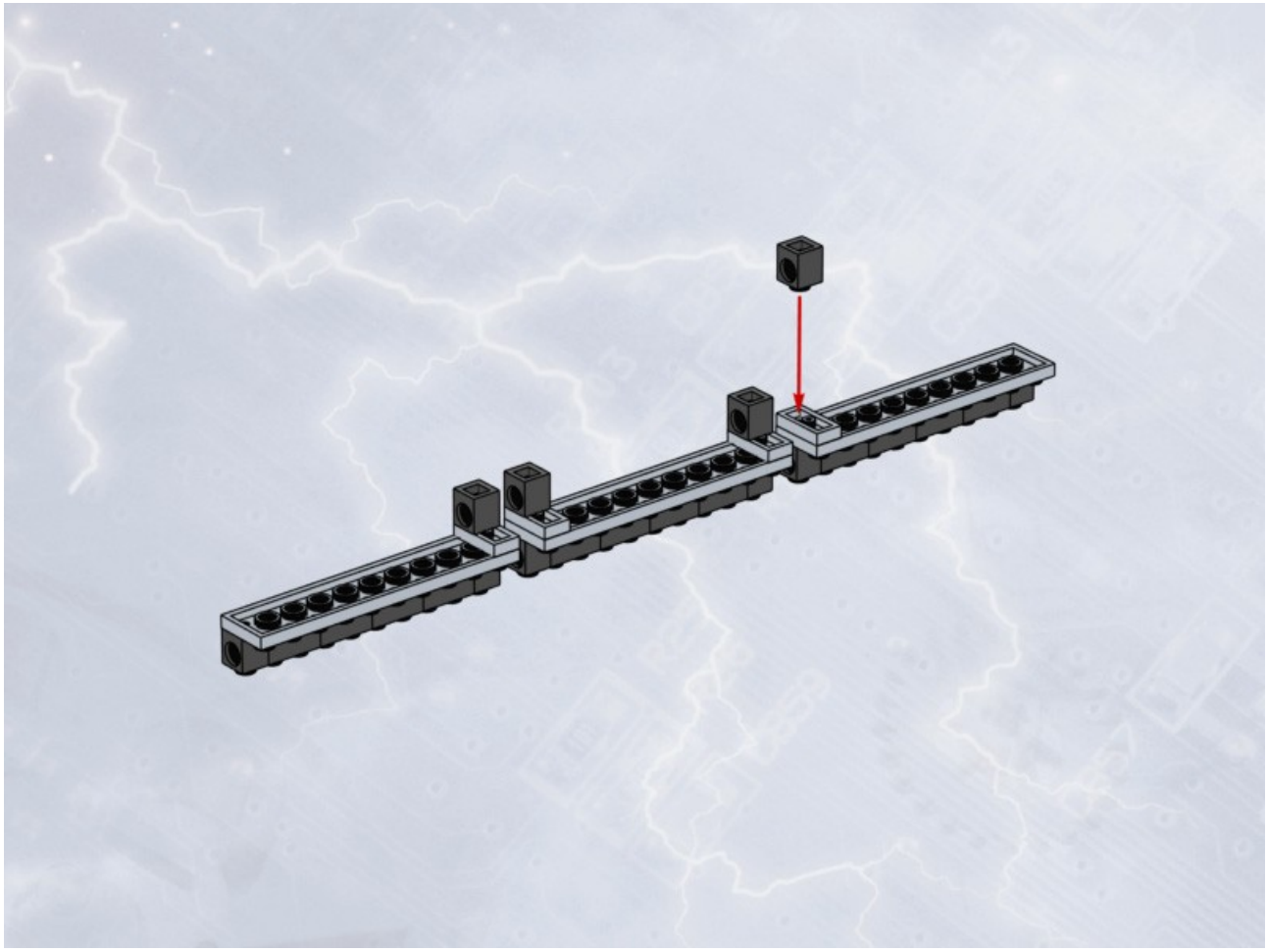

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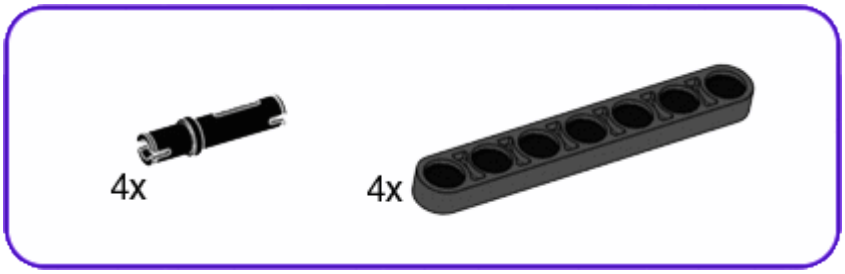

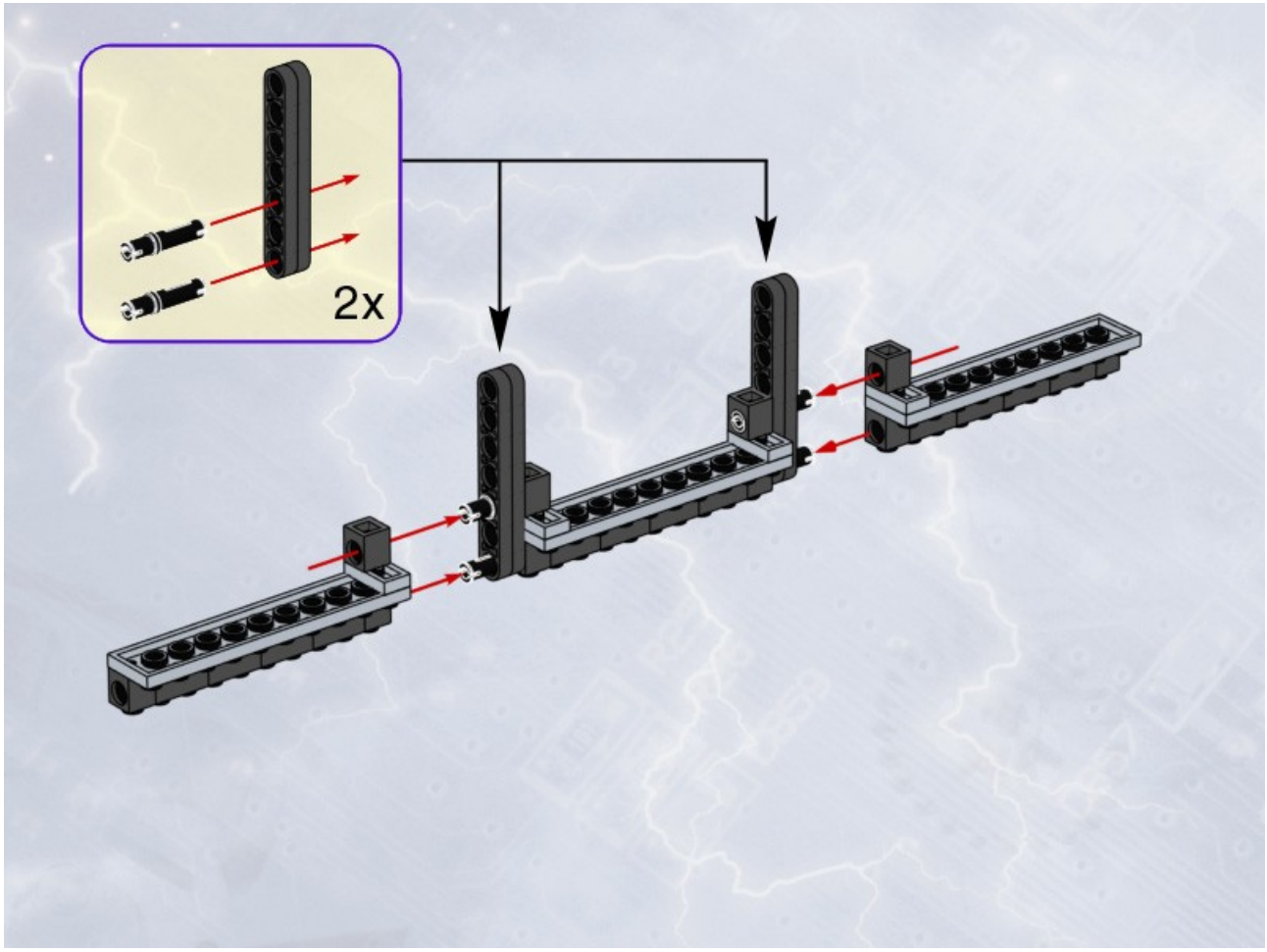

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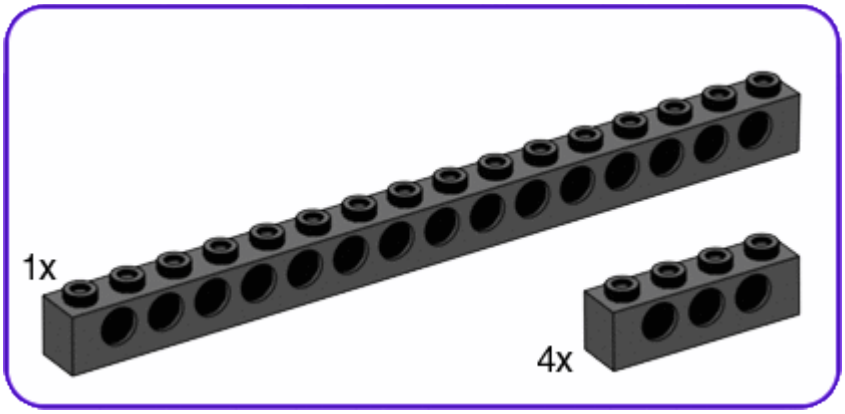

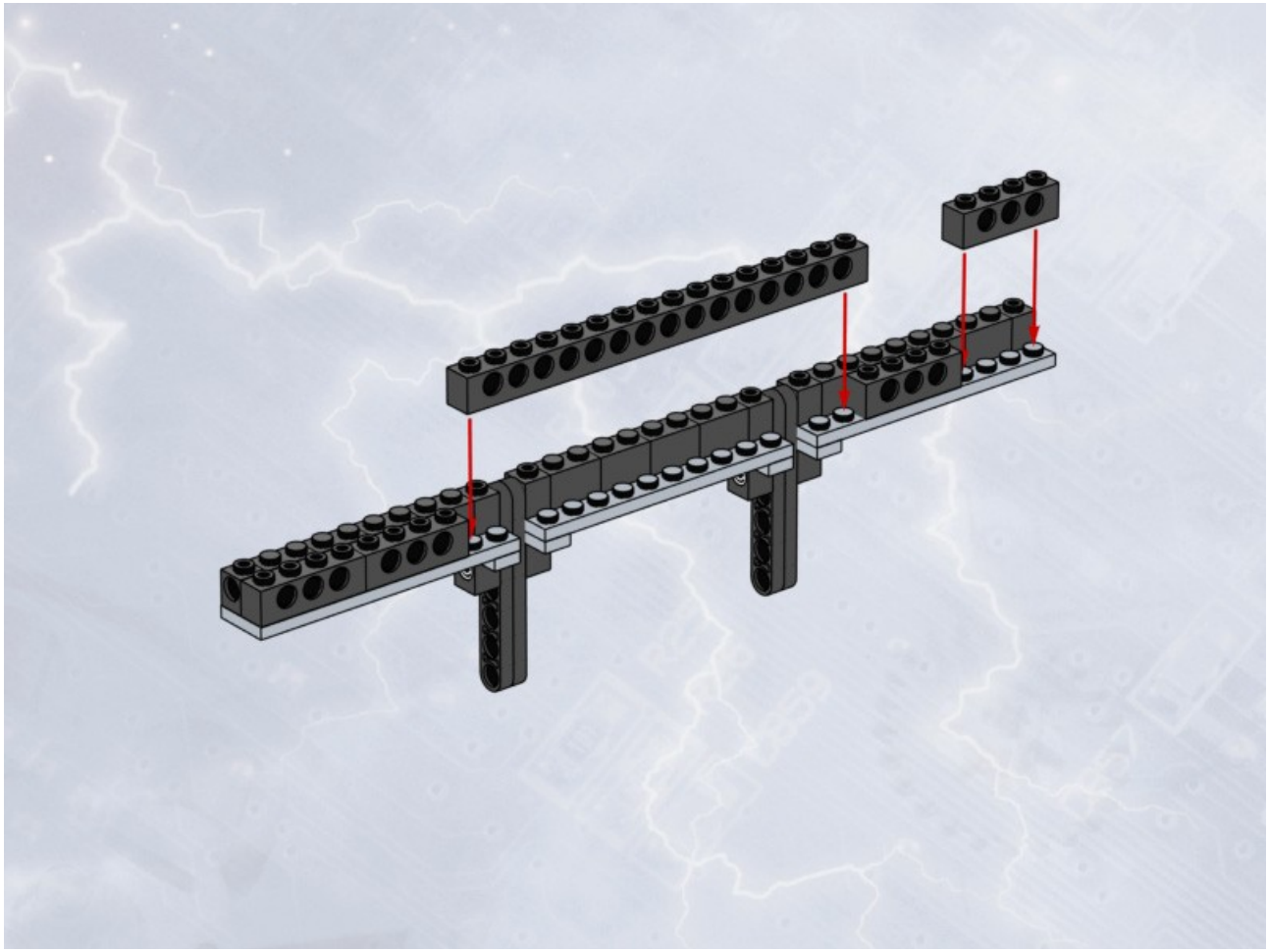

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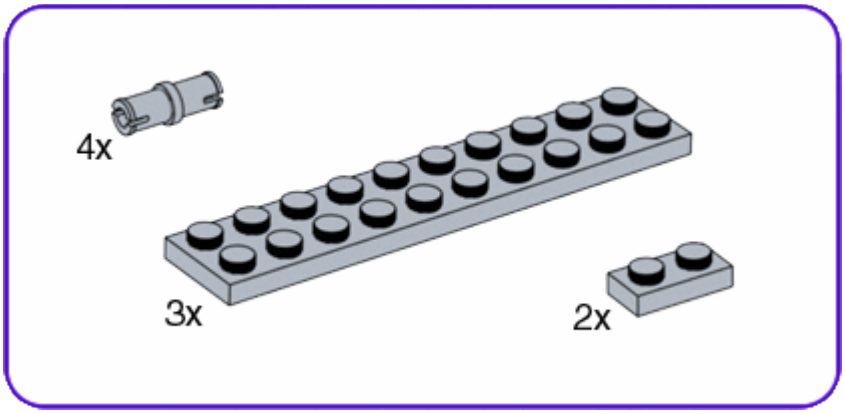

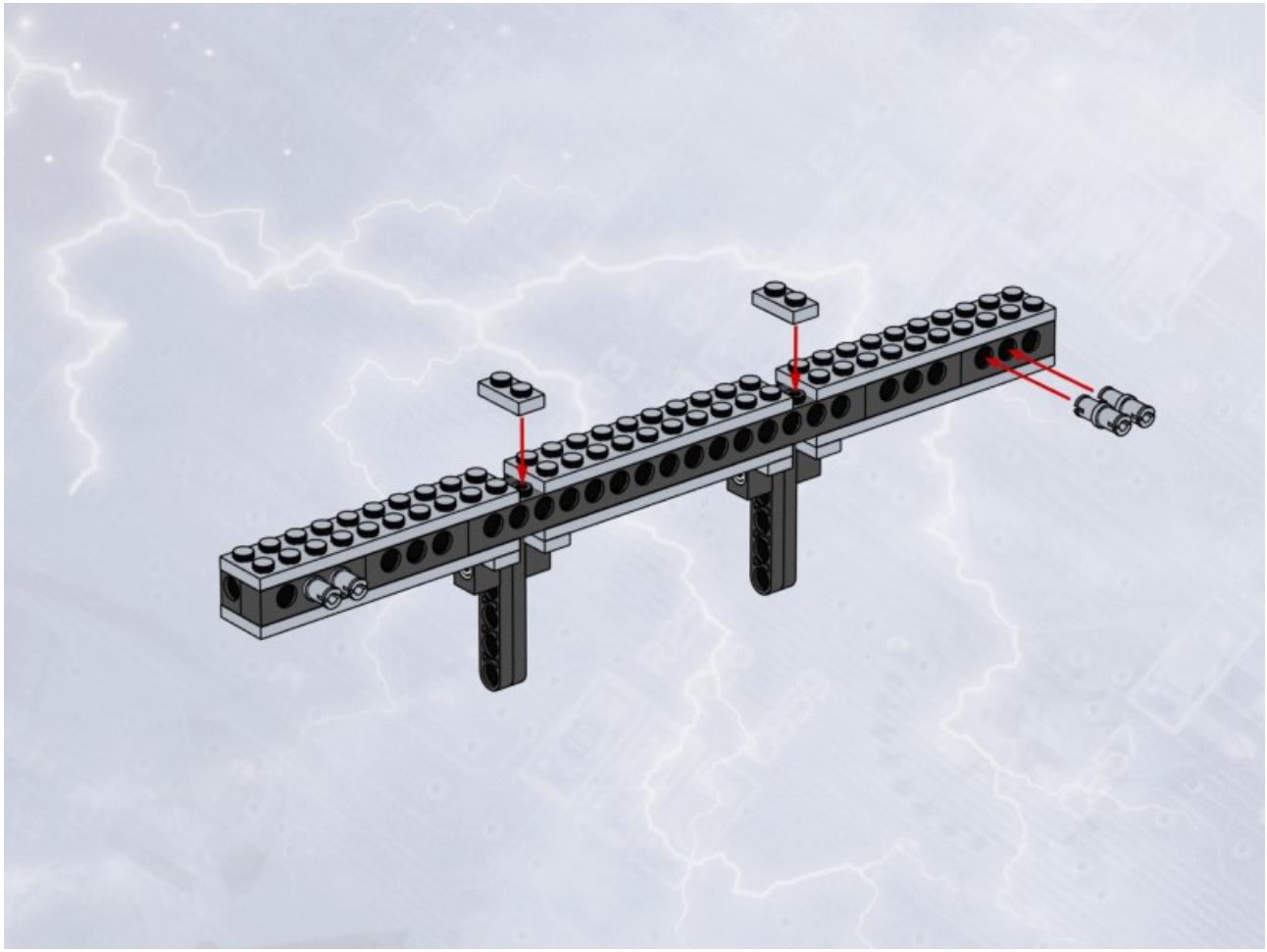

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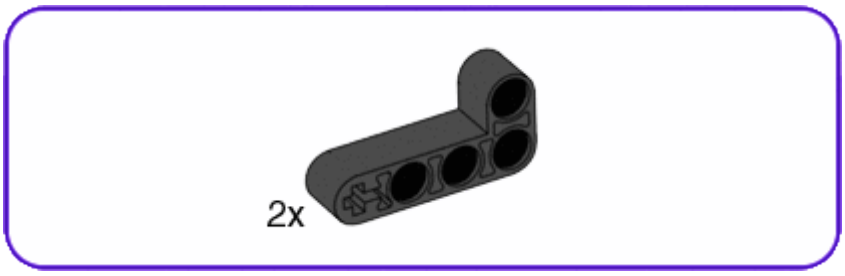

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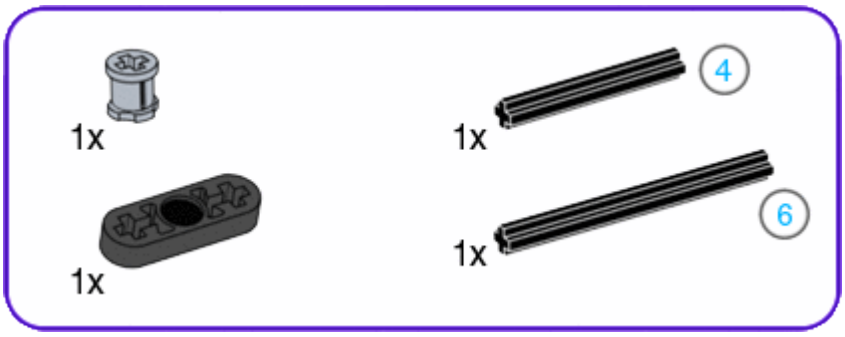

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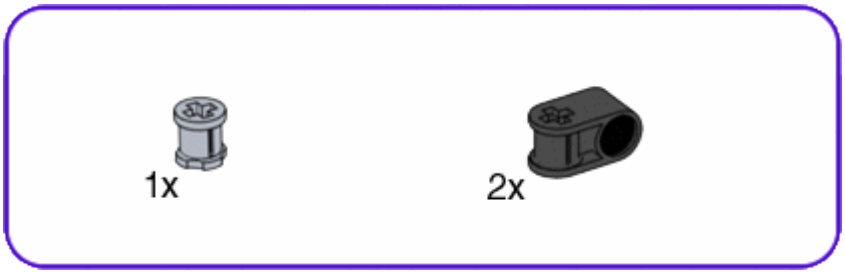

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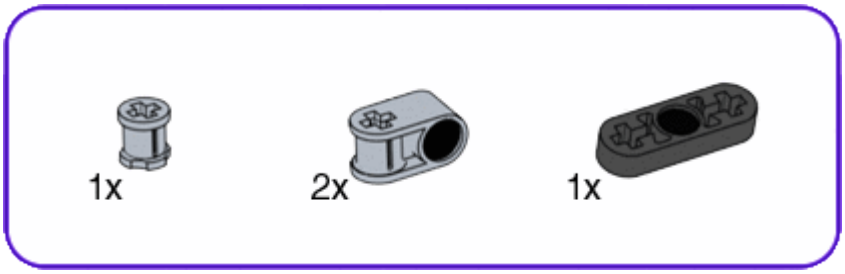

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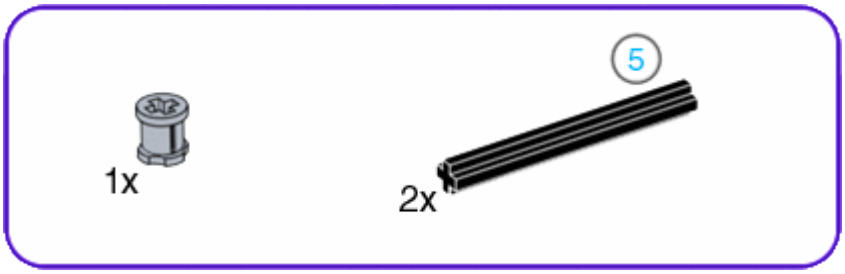

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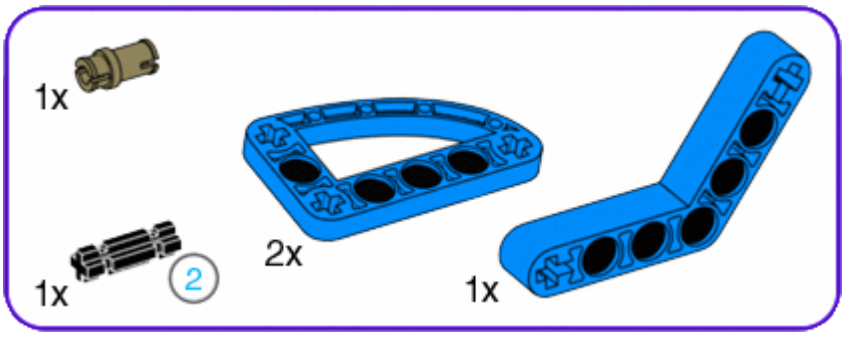

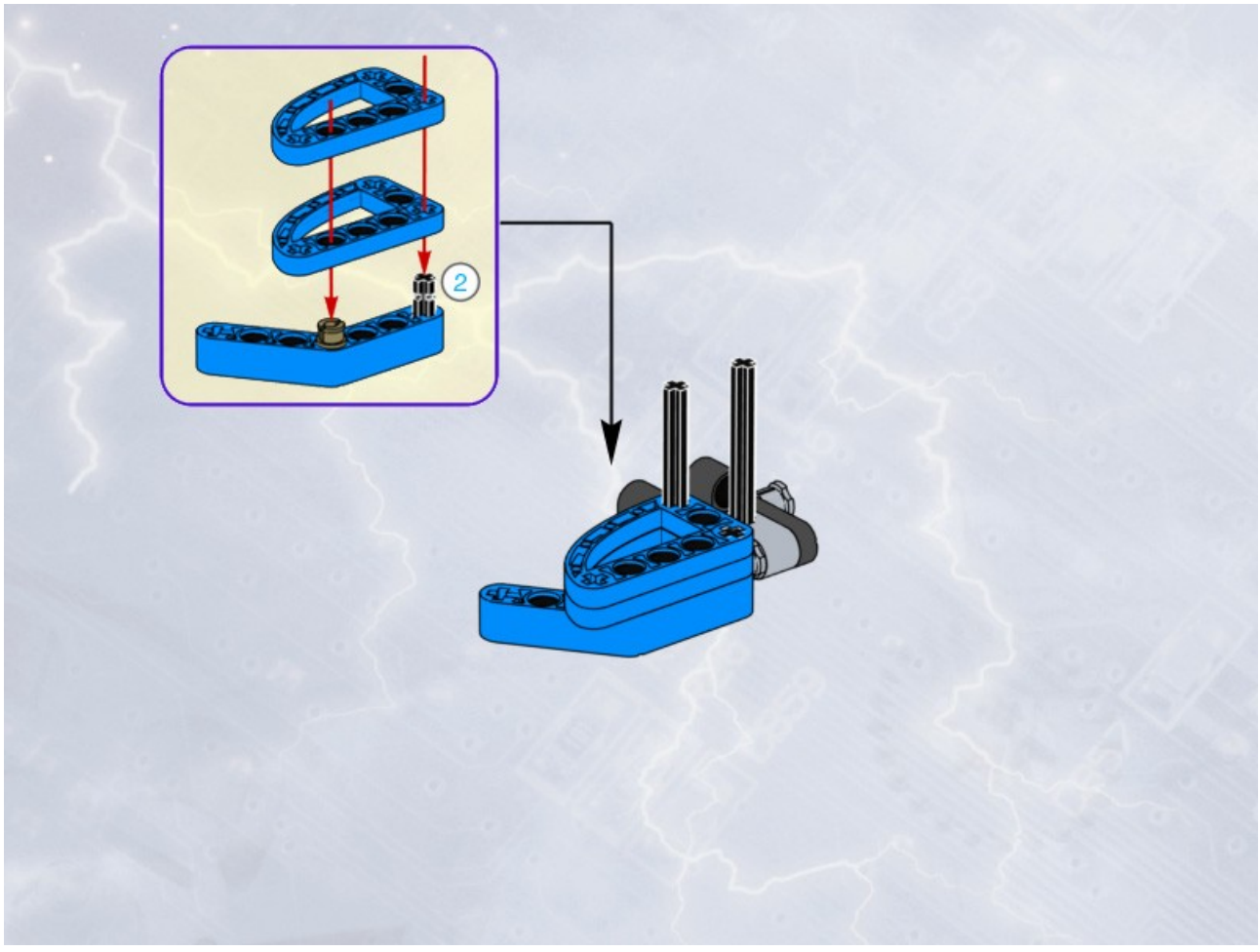

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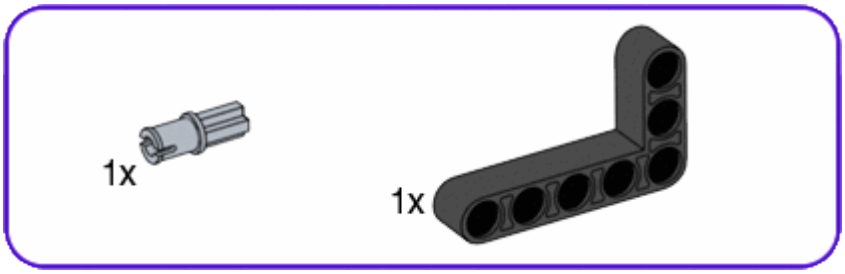

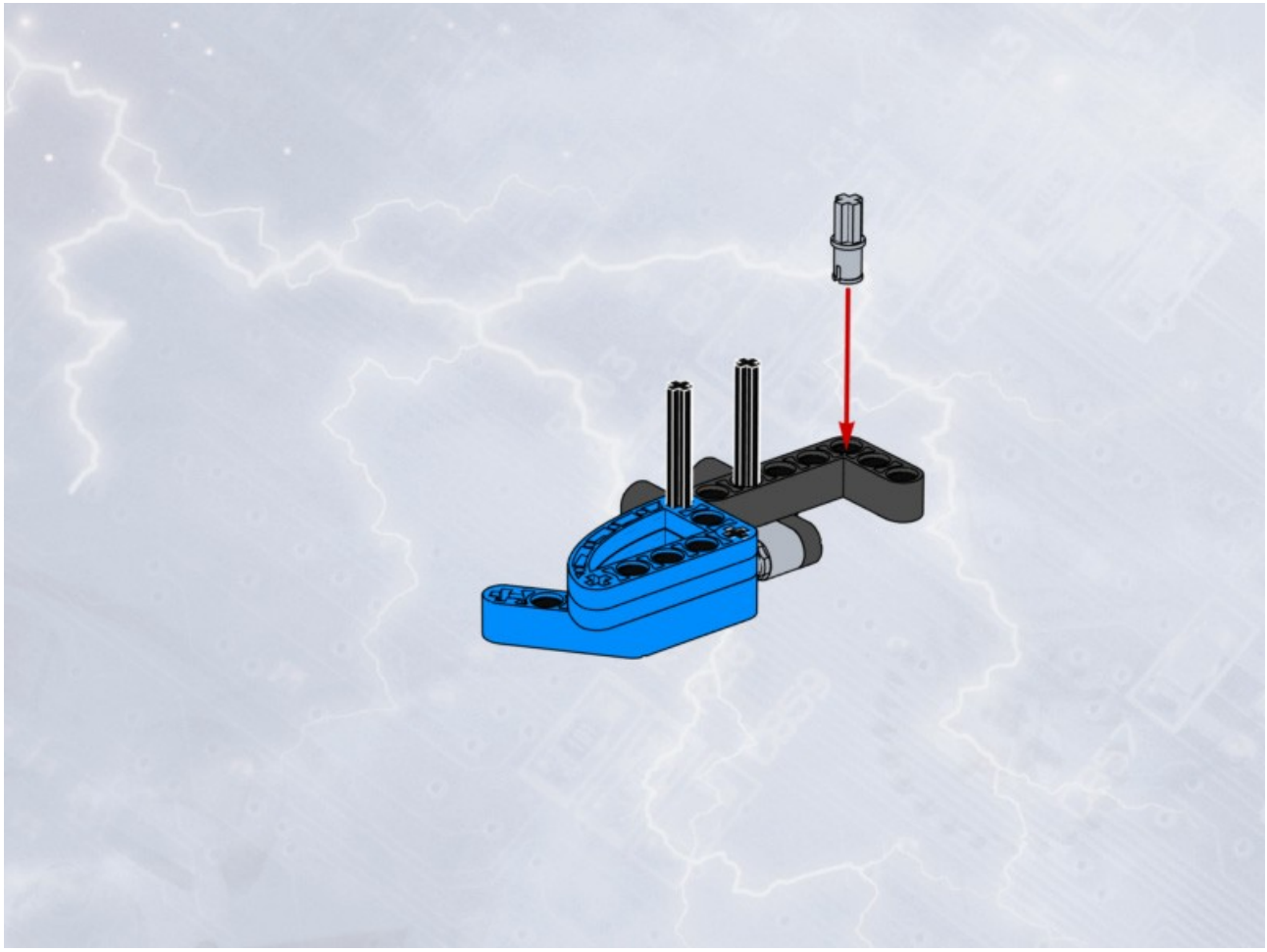

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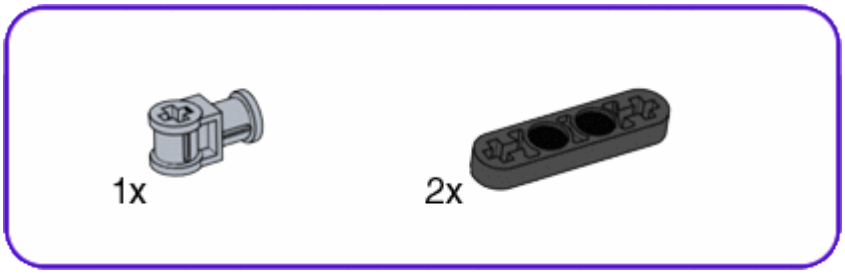

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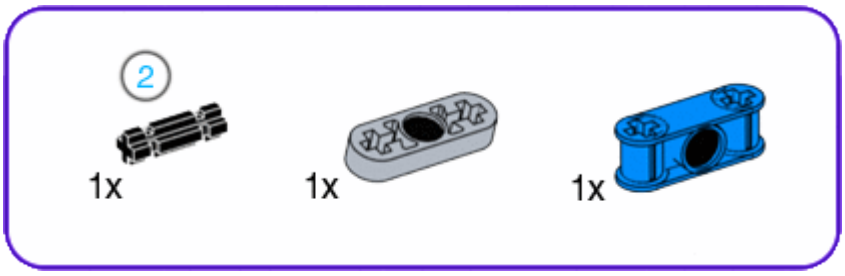

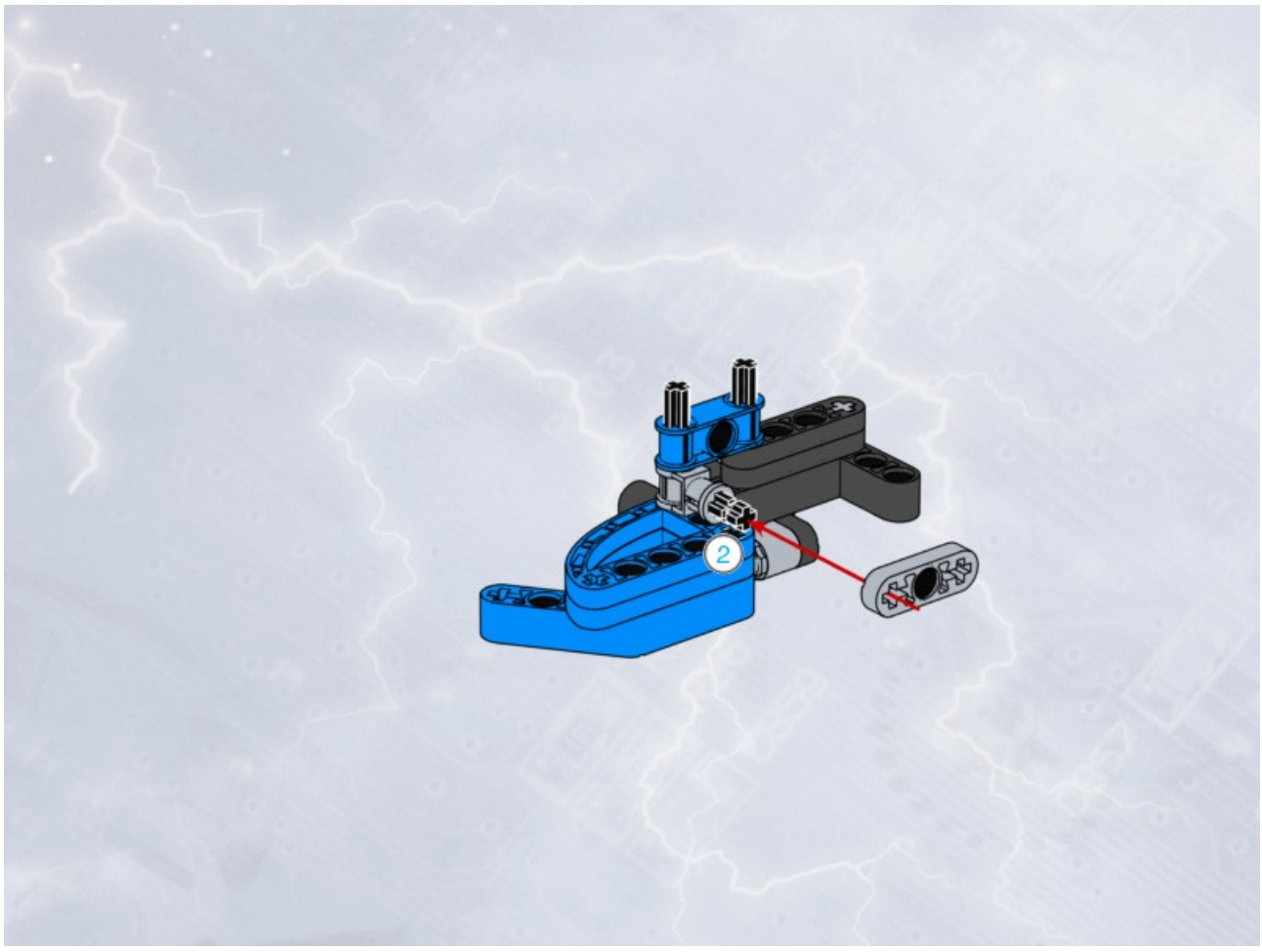

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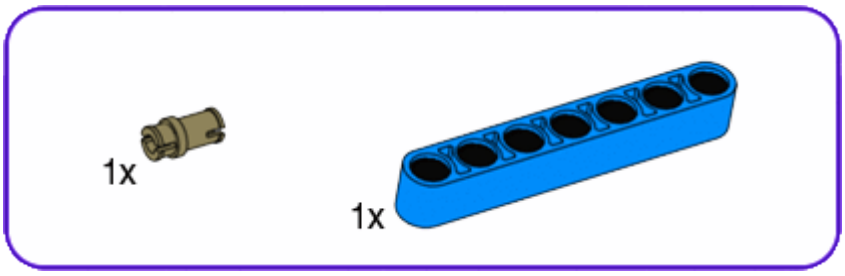

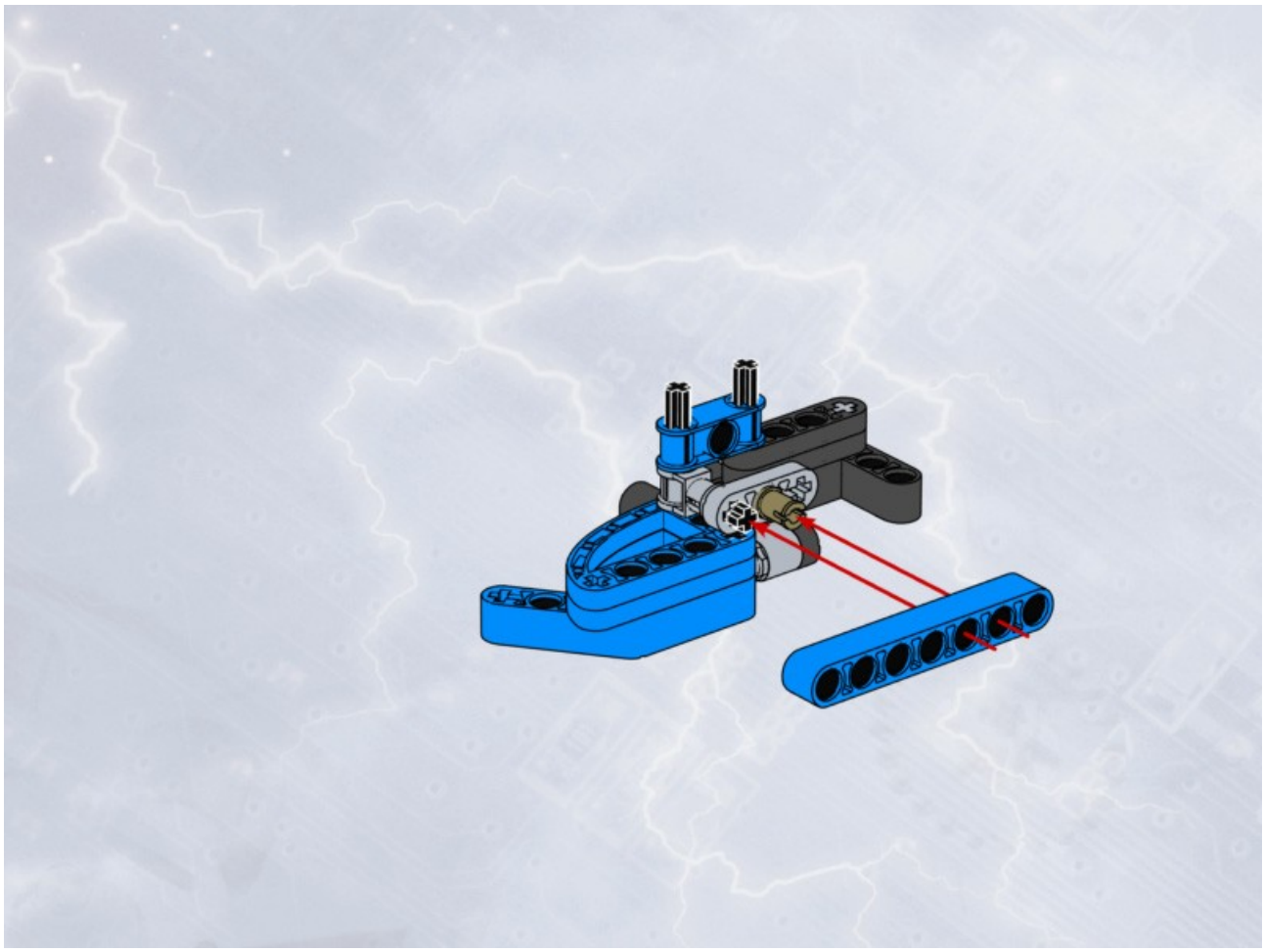

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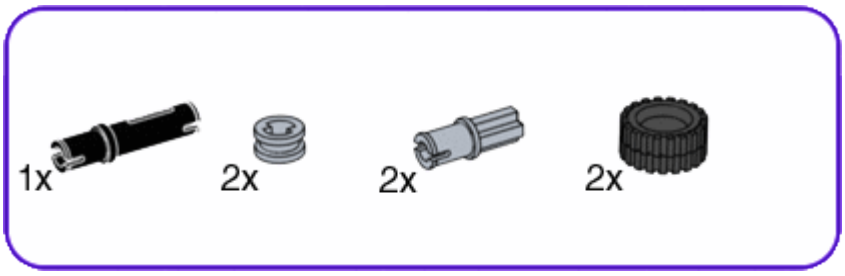

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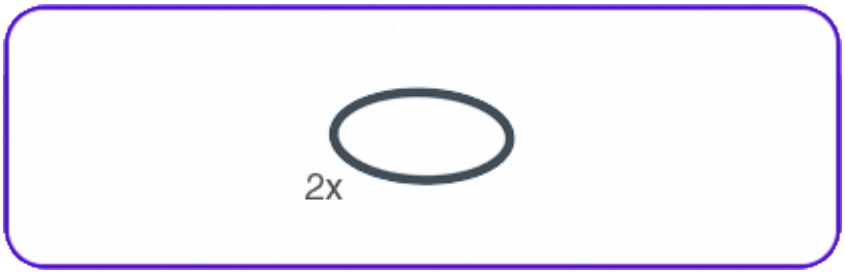

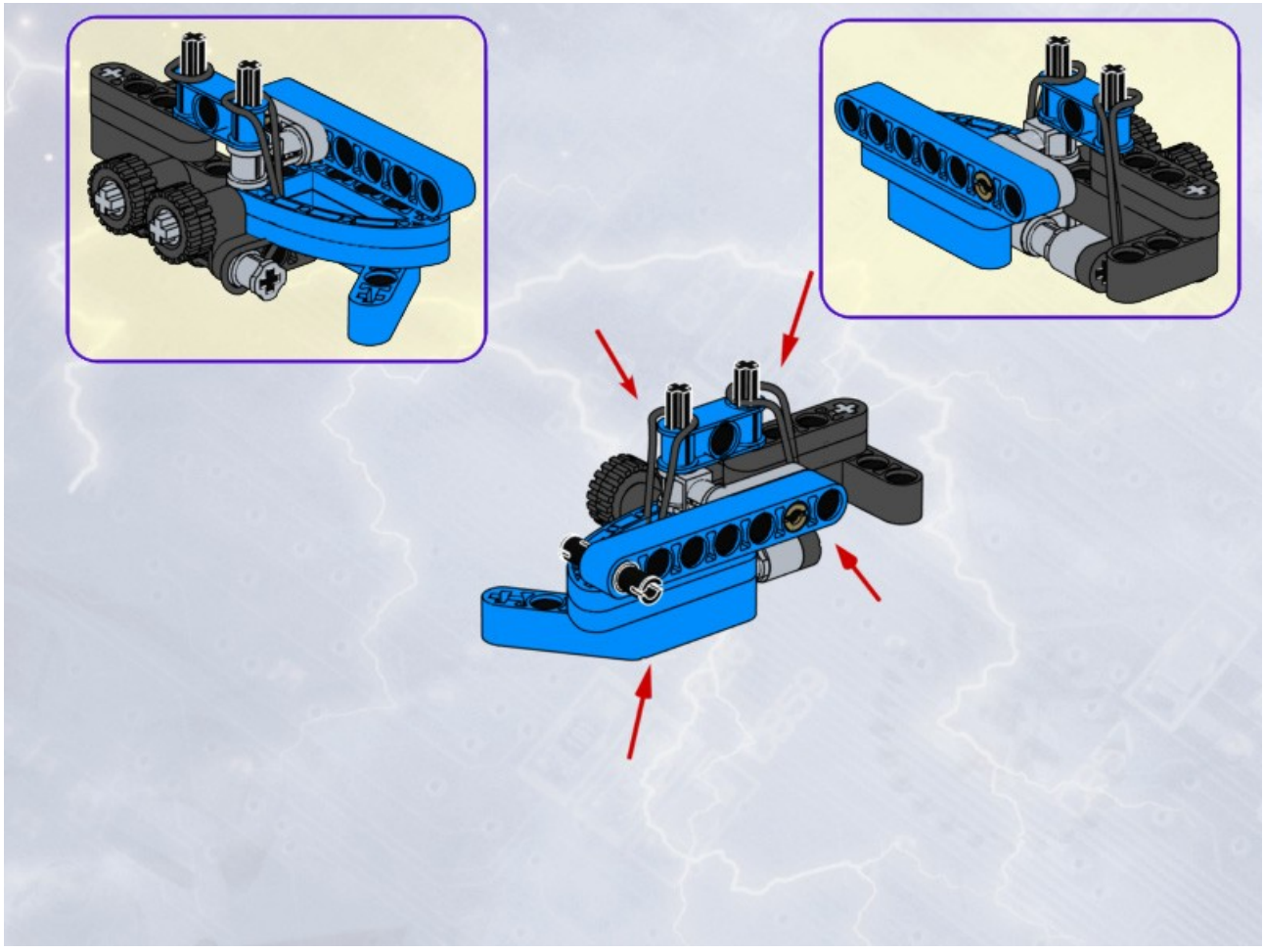

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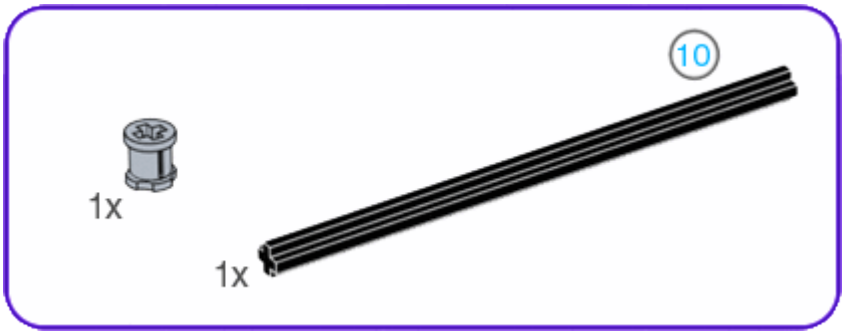

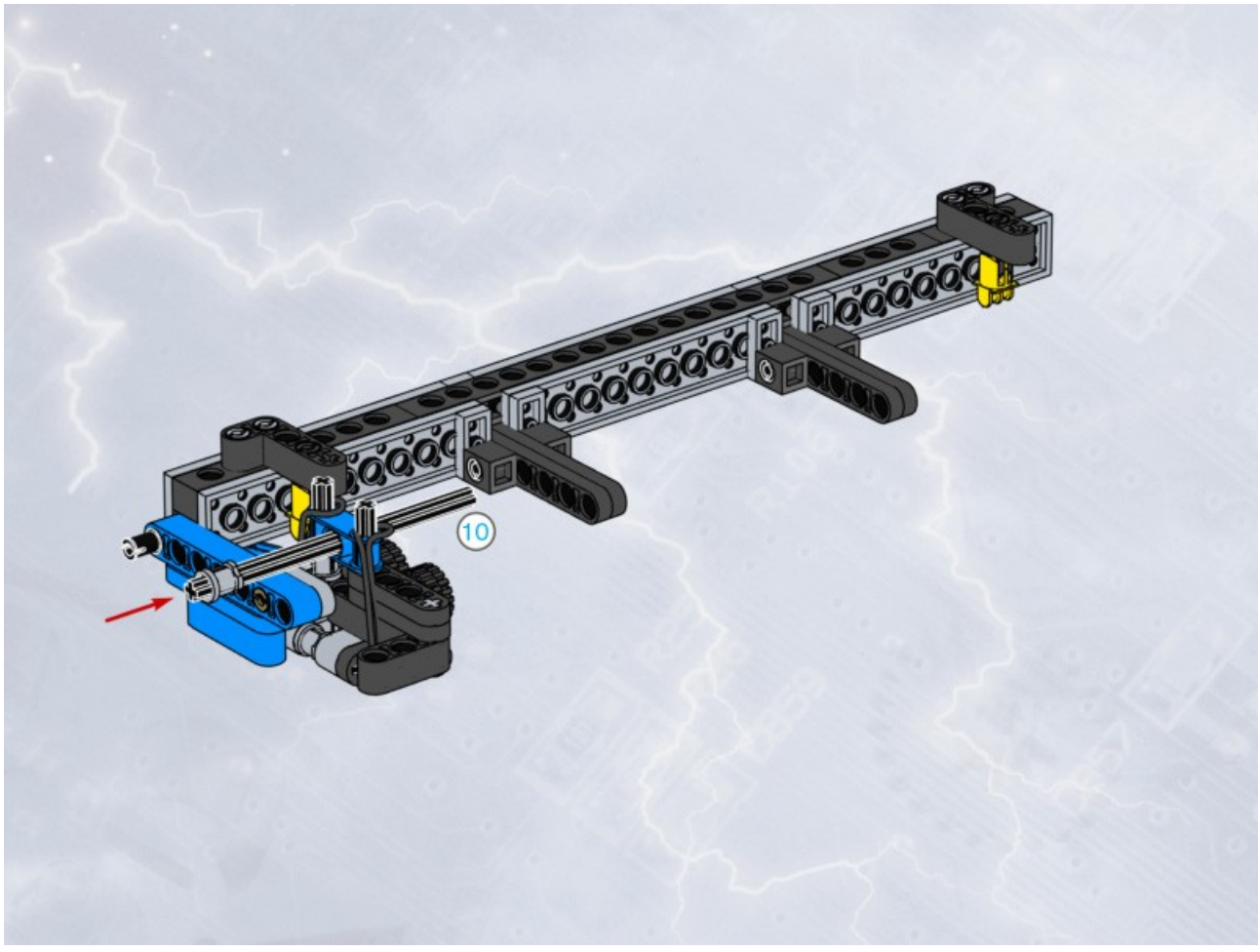

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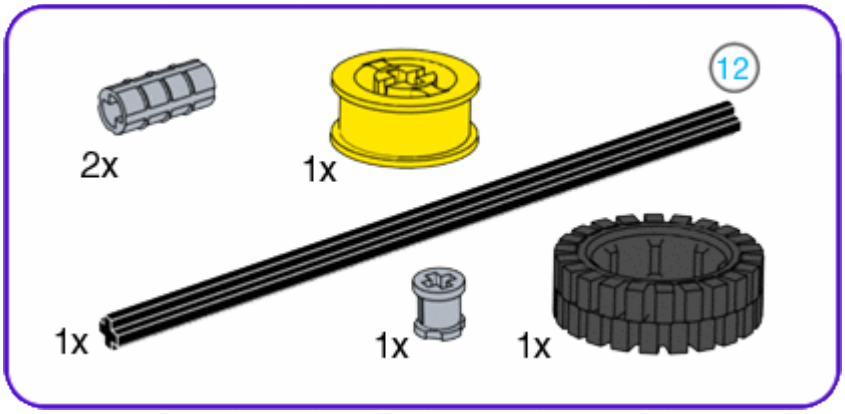

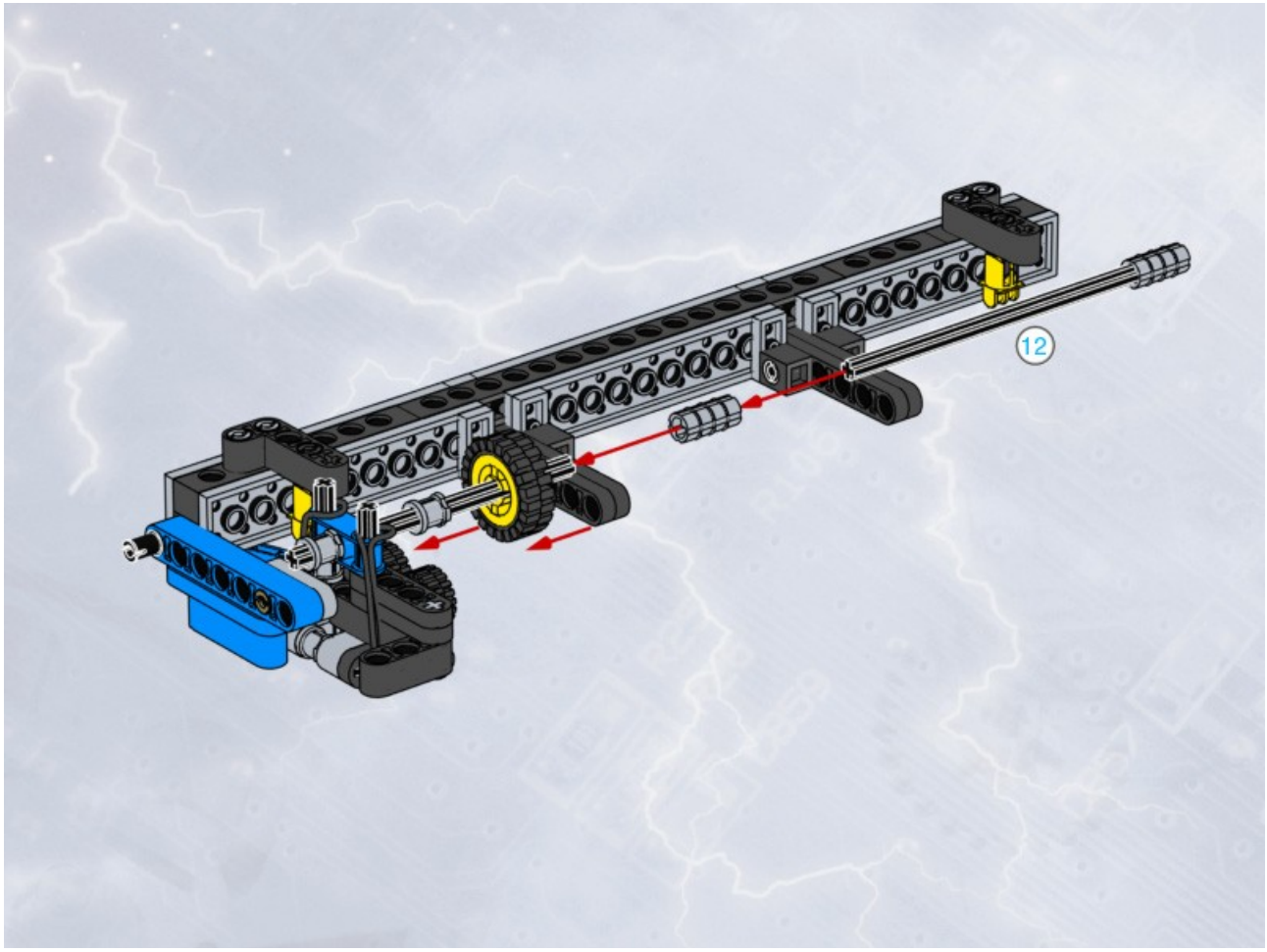

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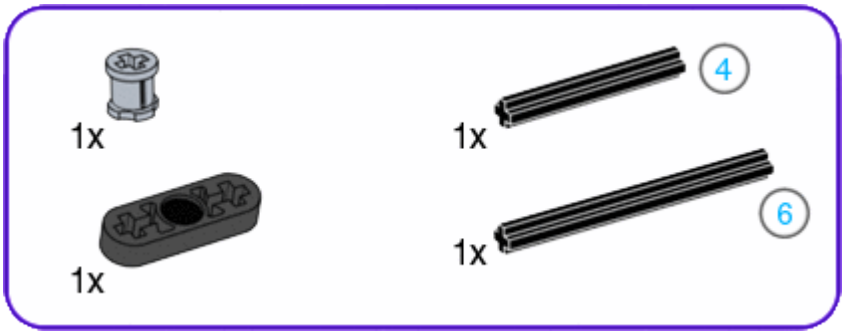

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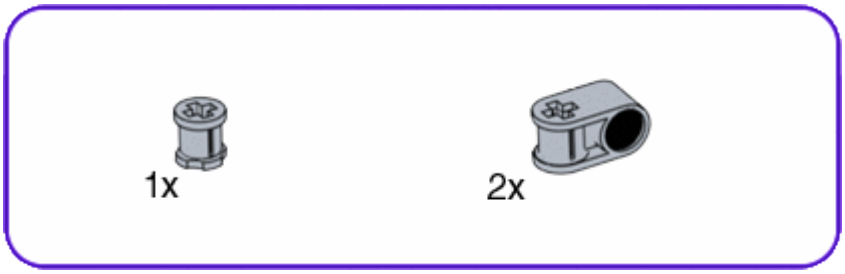

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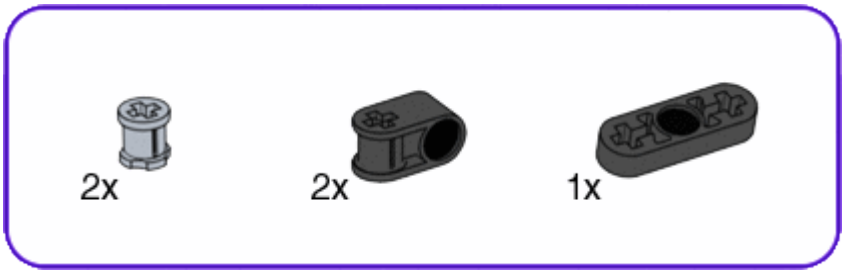

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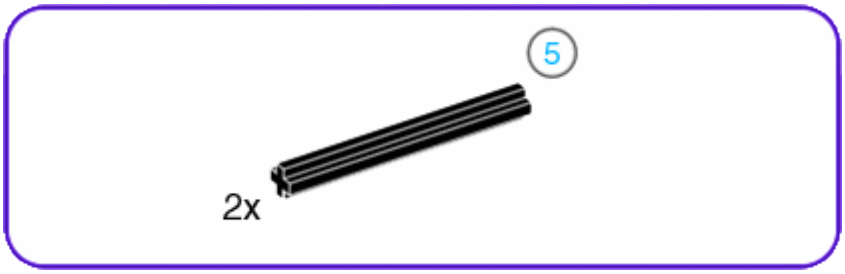

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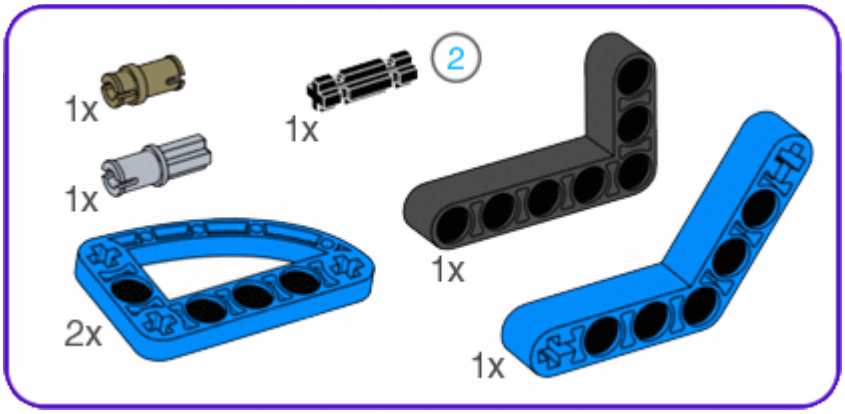

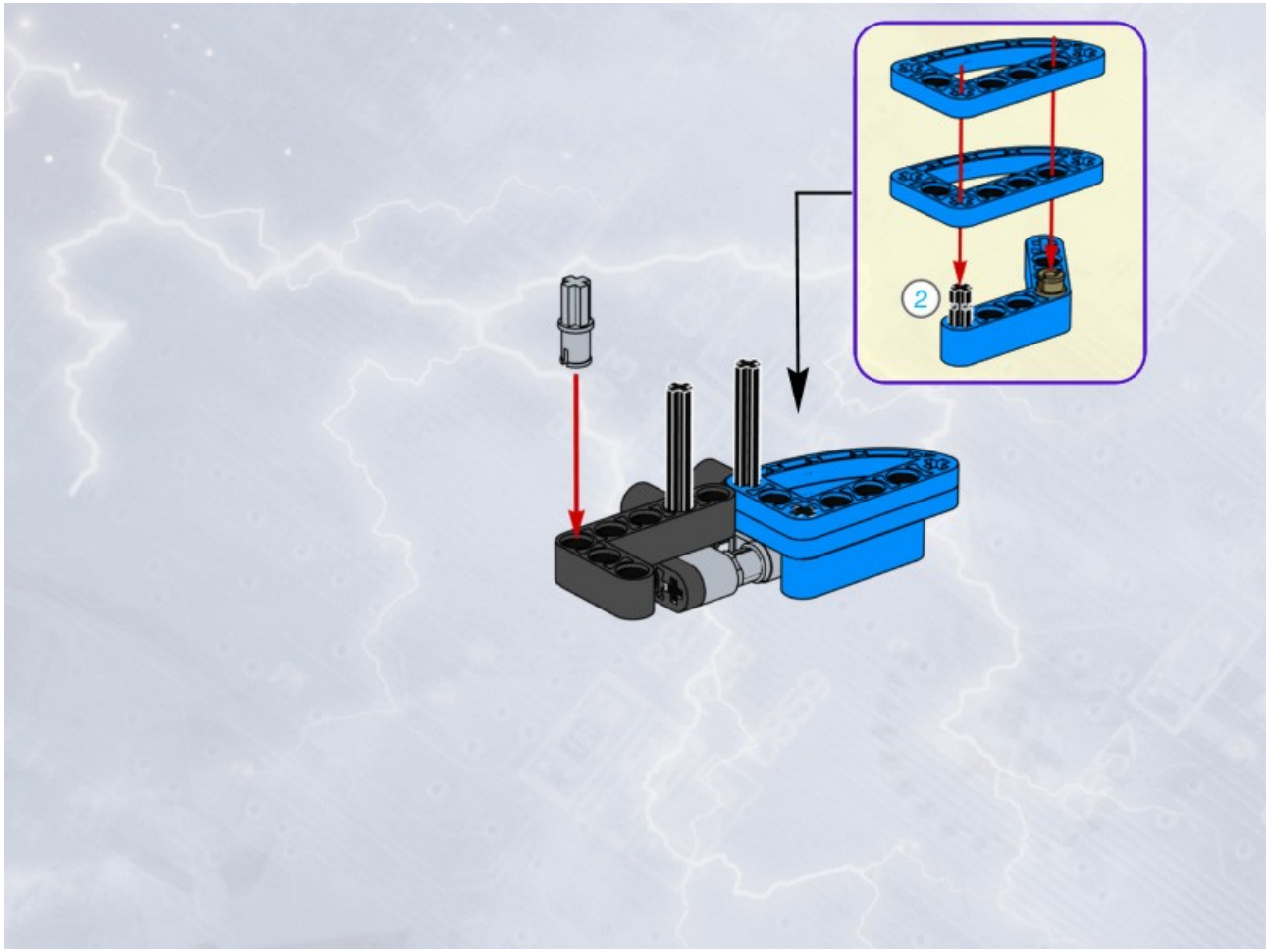

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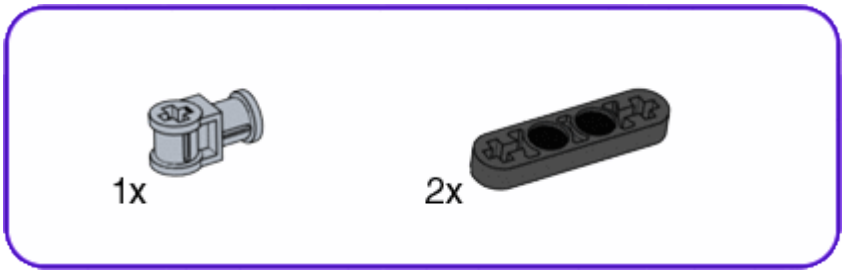

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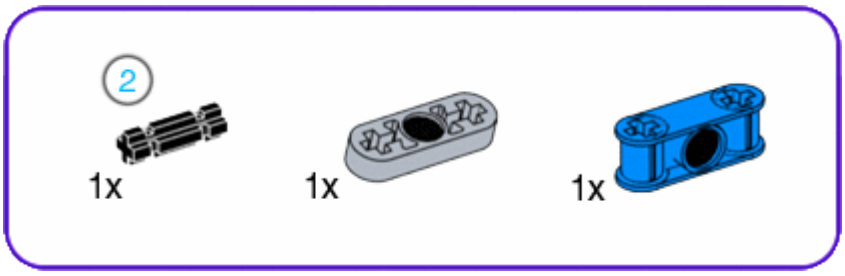

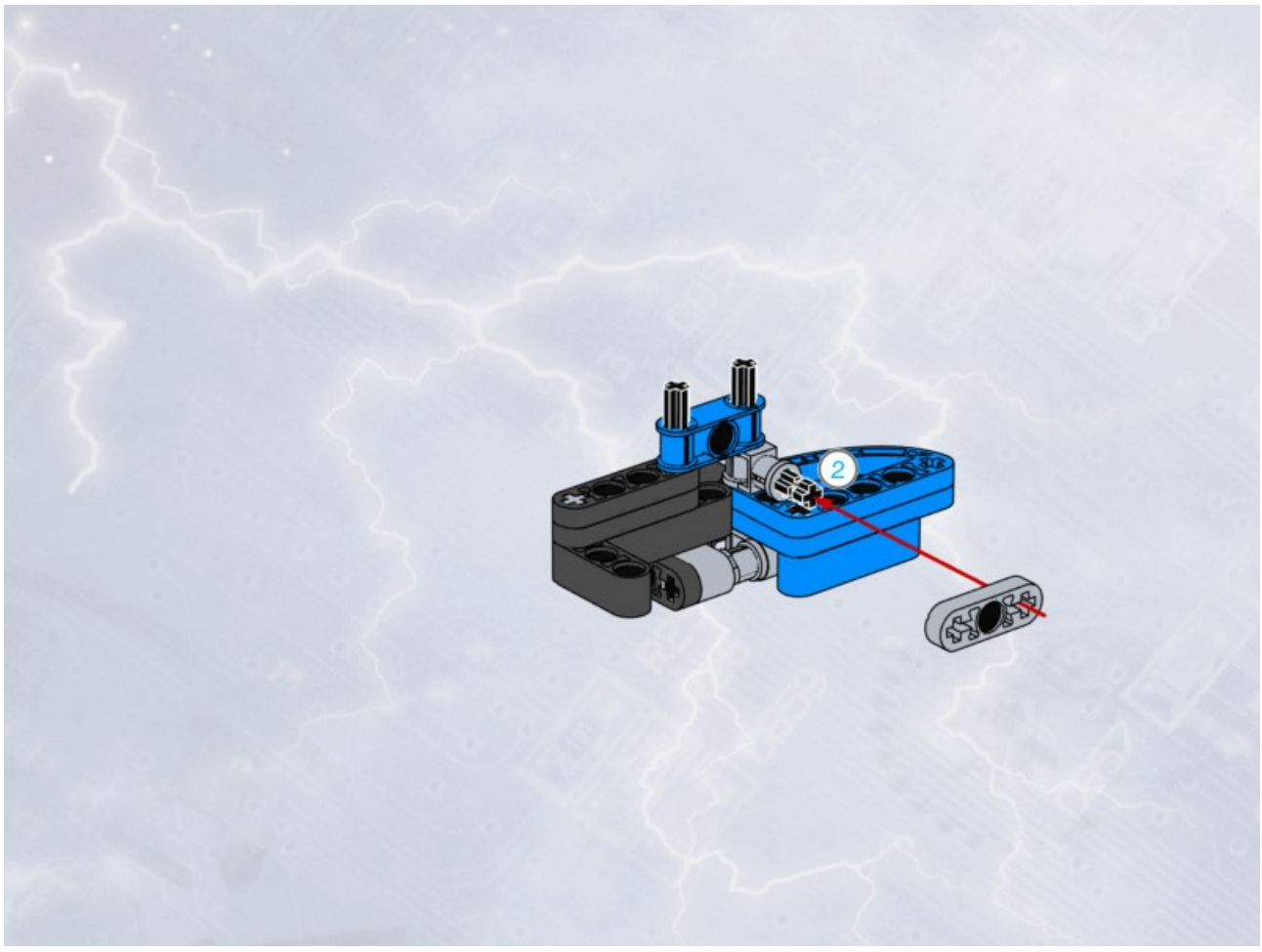

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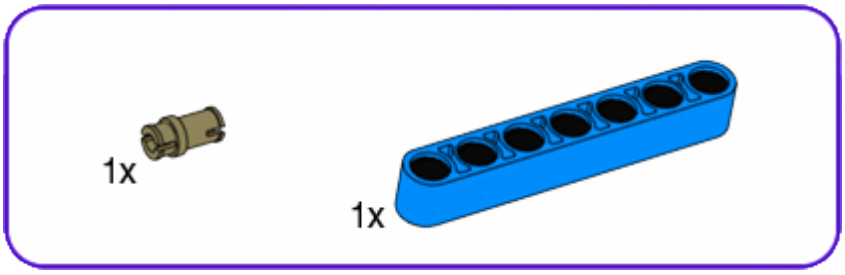

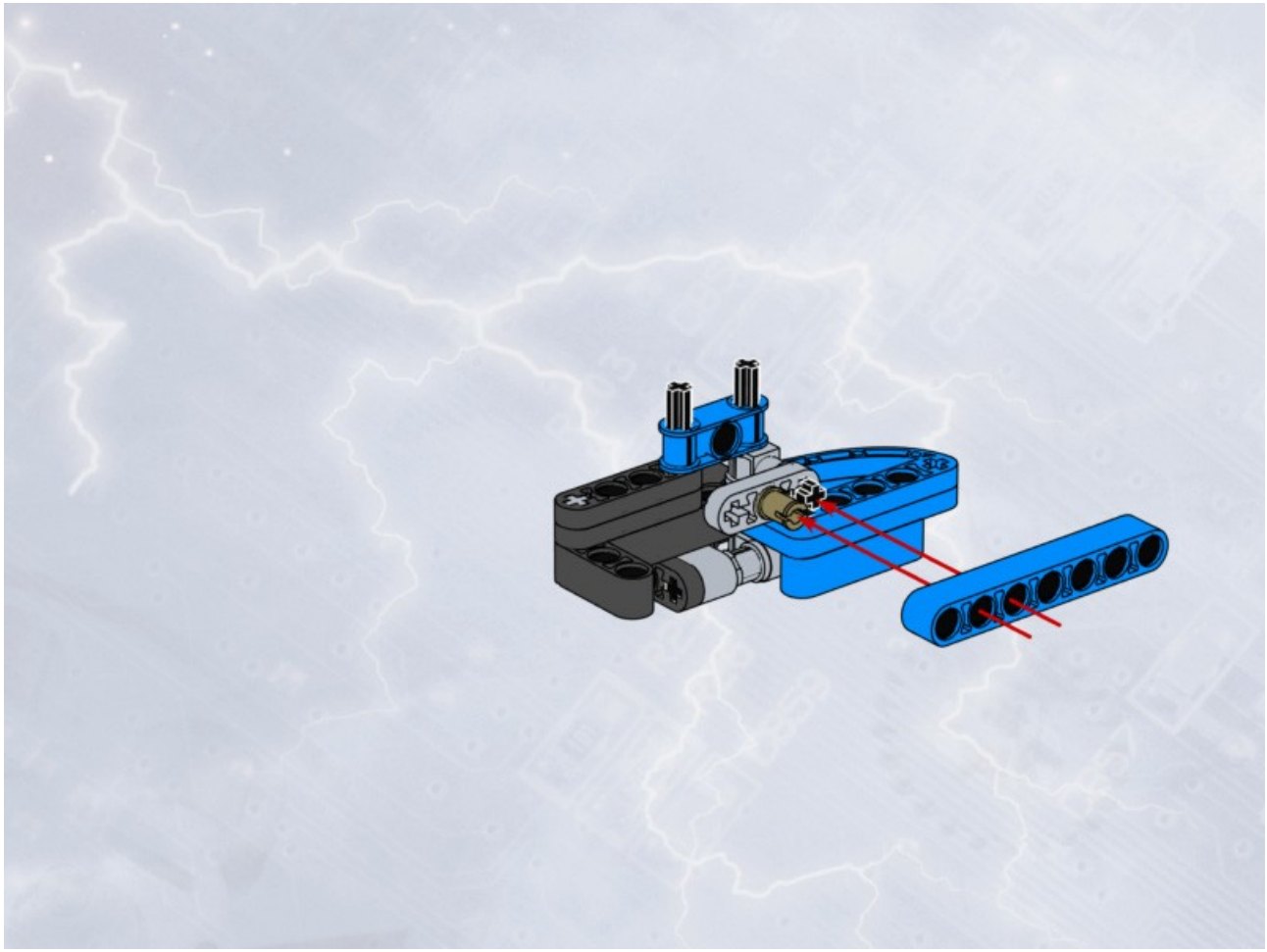

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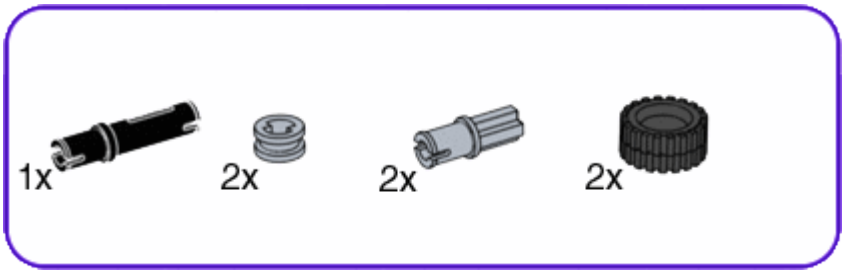

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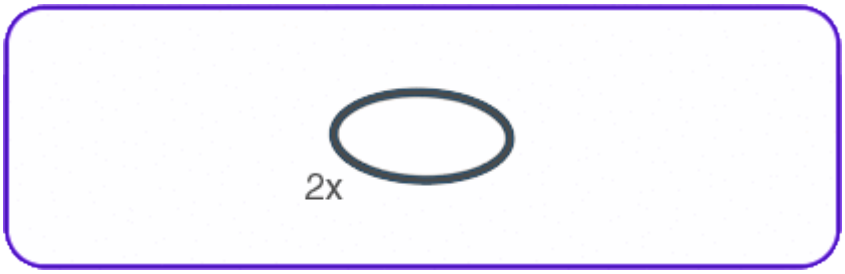

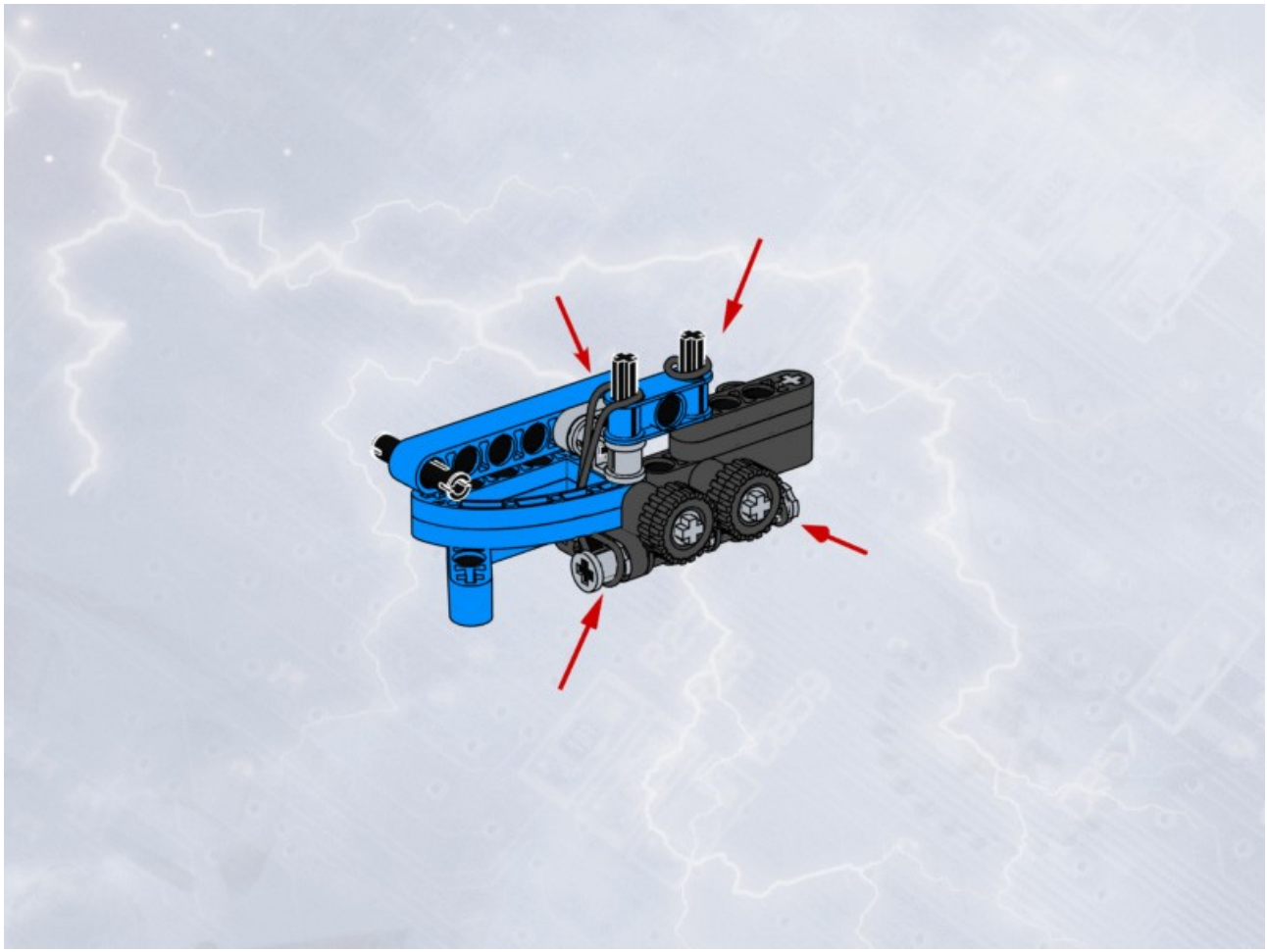

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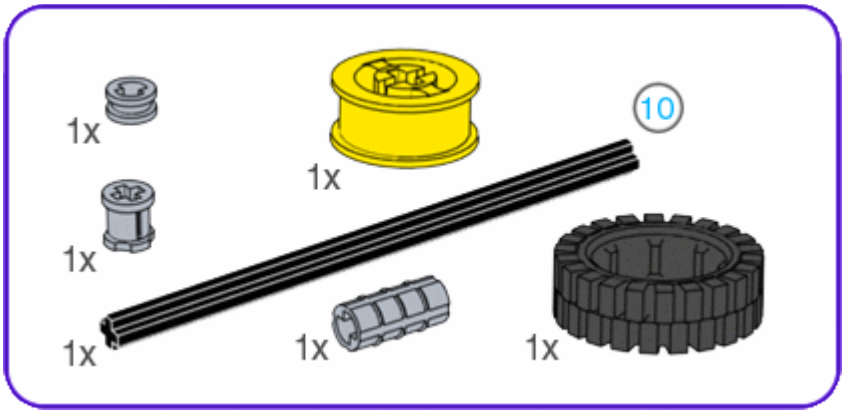

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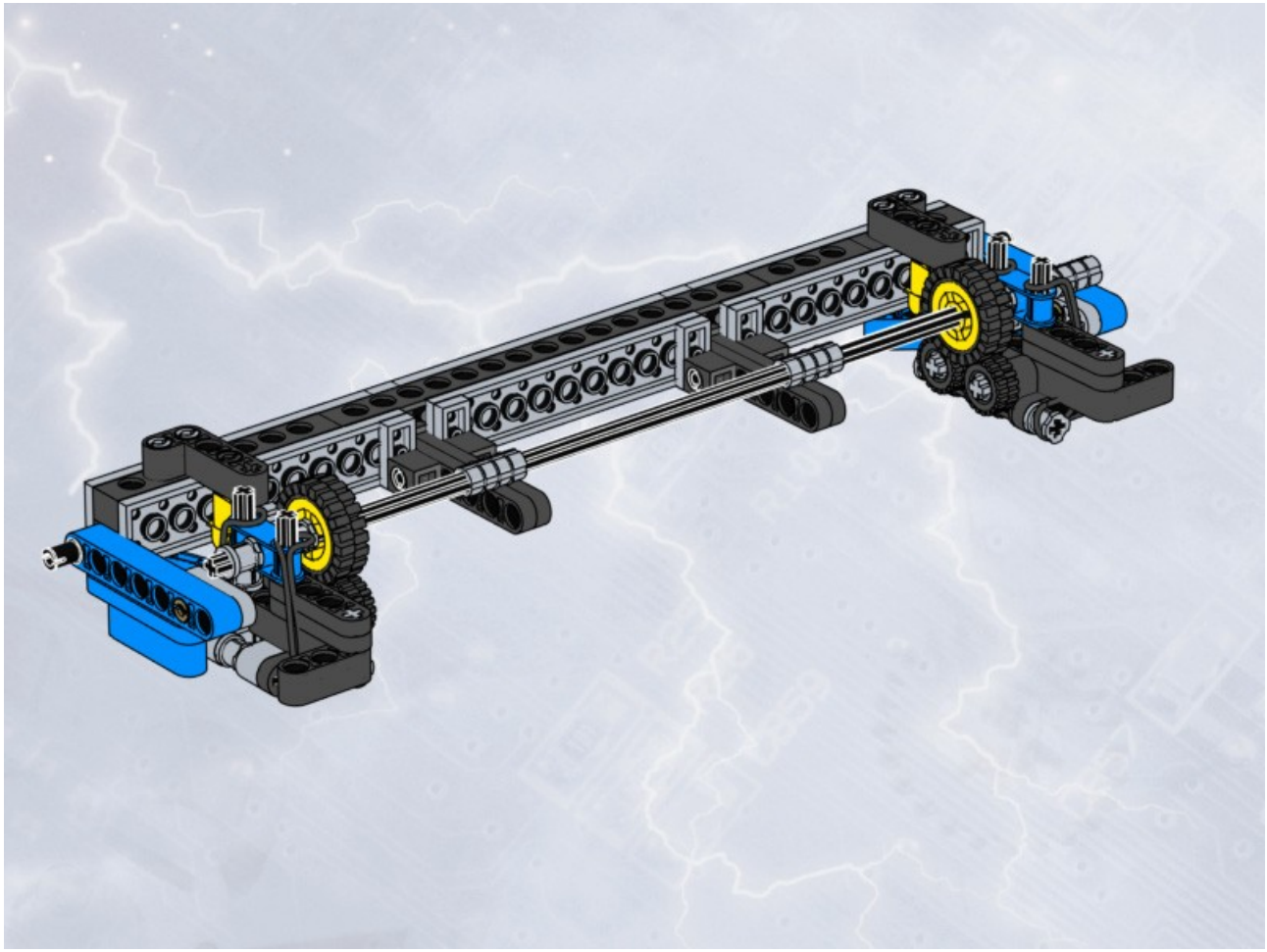


Gear Rack Module

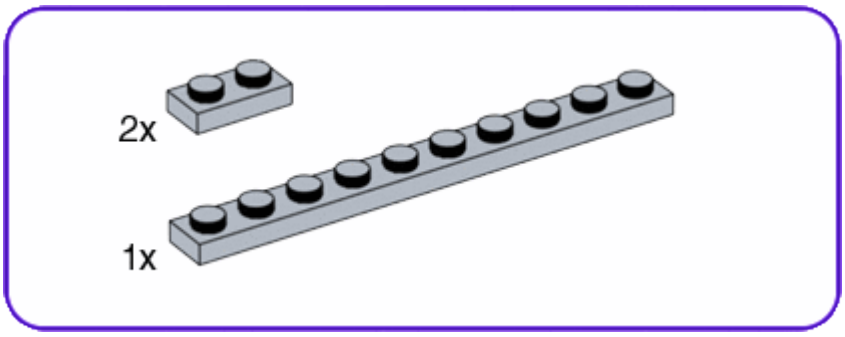
The Gear Rack Module is the overlying beam on which the Pen Module shuttles back and forth.

The Pen Module is attached along with a Motor Module 4 to the sliding carriage of the Gear Rack.

The teeth on the Gear Rack offer stable and precise movement, while the Cam on the Motor Module along with a touch sensor keeps track of how far it moves.

This allows horizontal lines to be drawn on the paper and combined with the vertical movement of the Plotter Table module any shape can be drawn.

1



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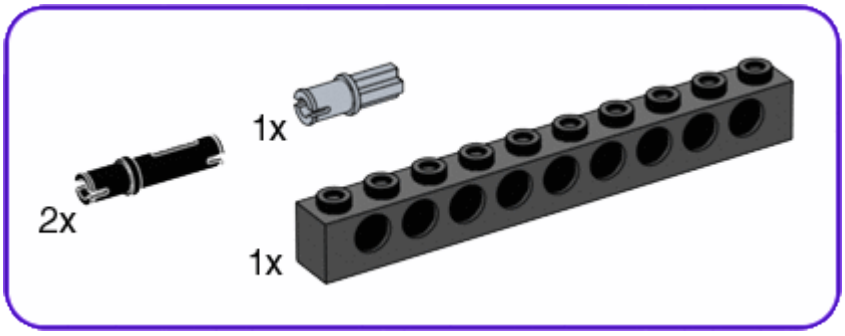

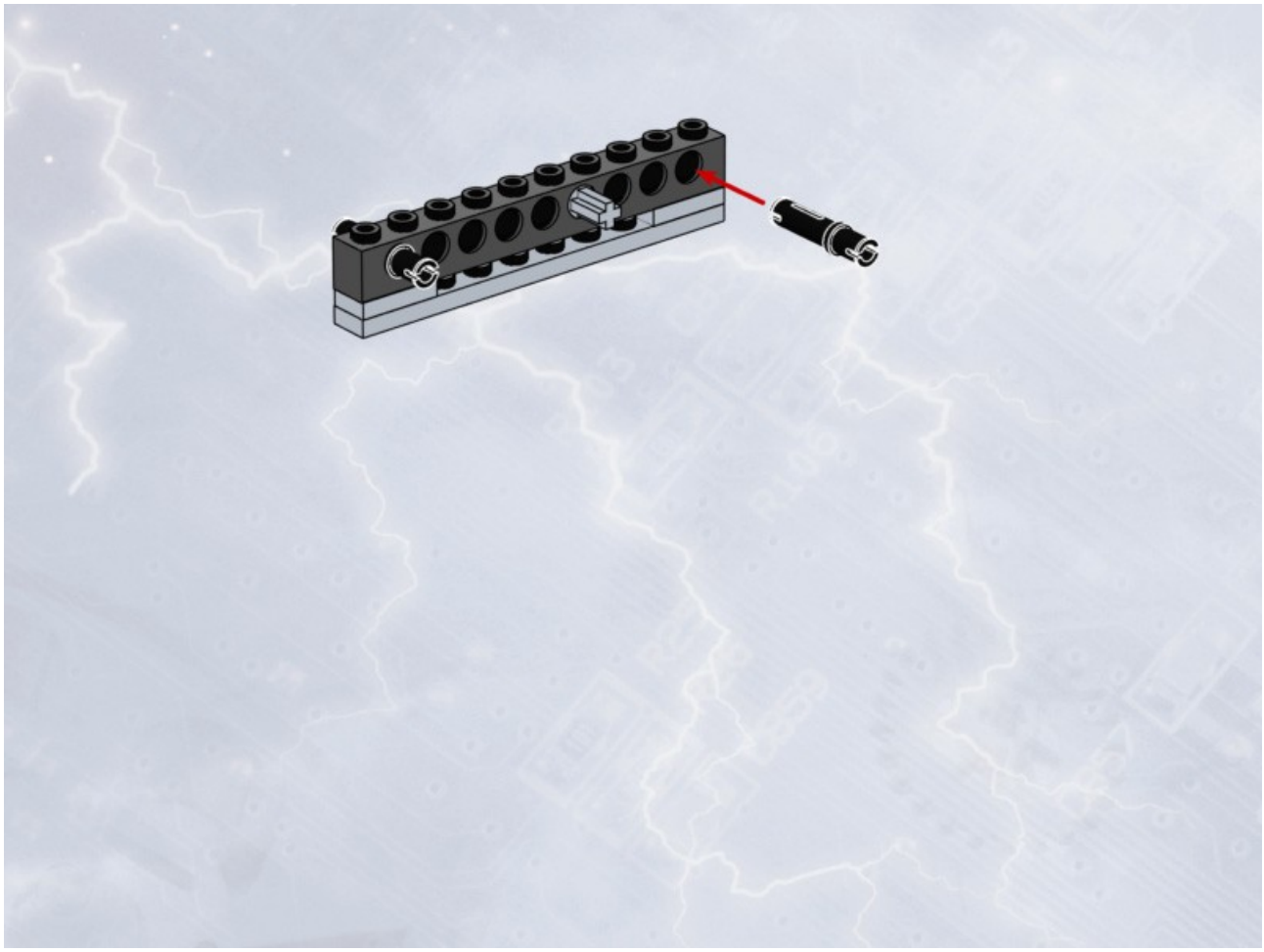

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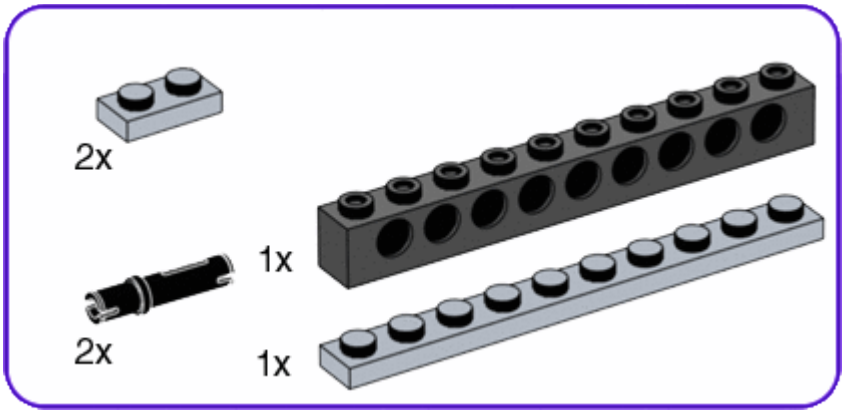

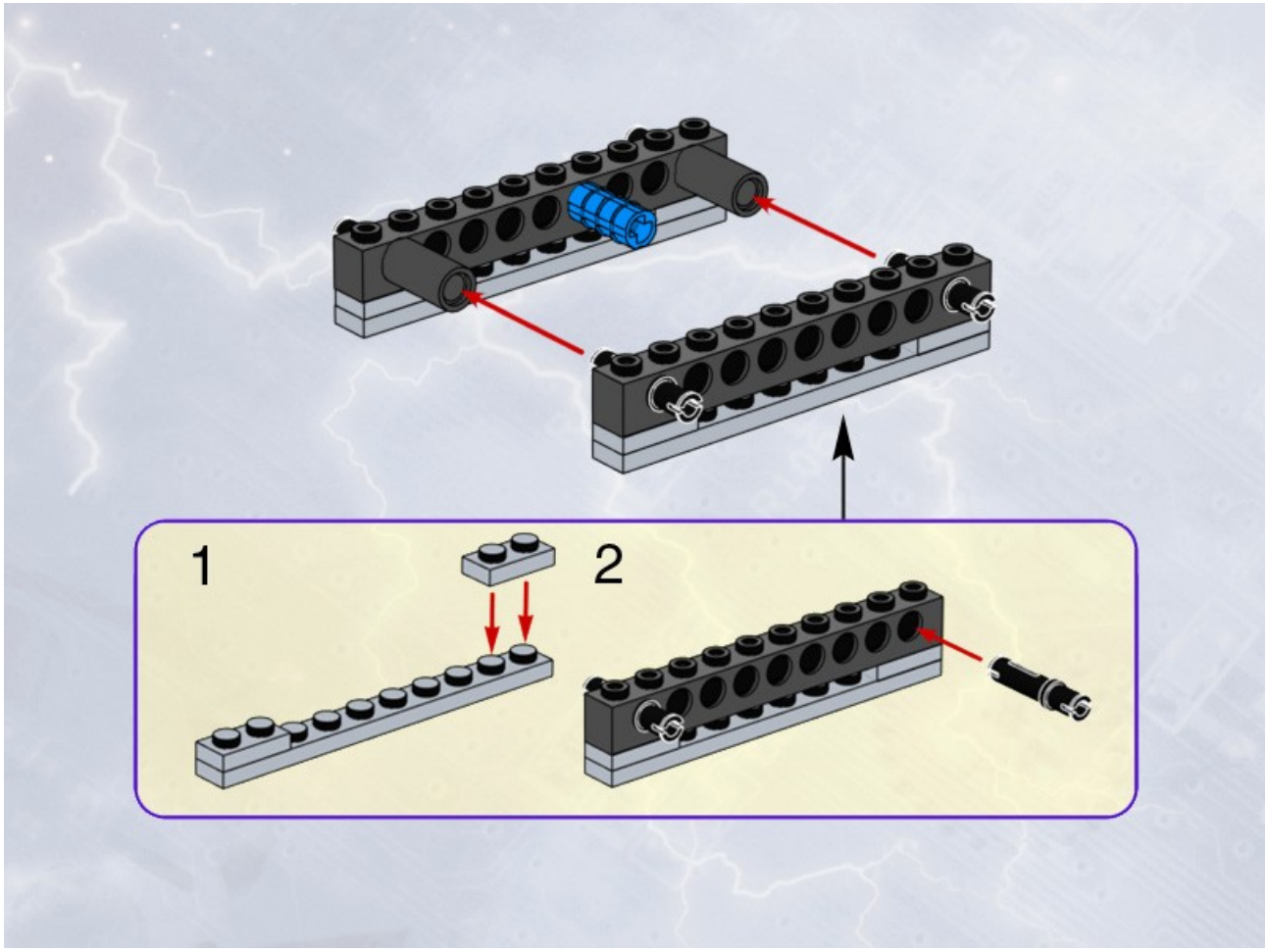

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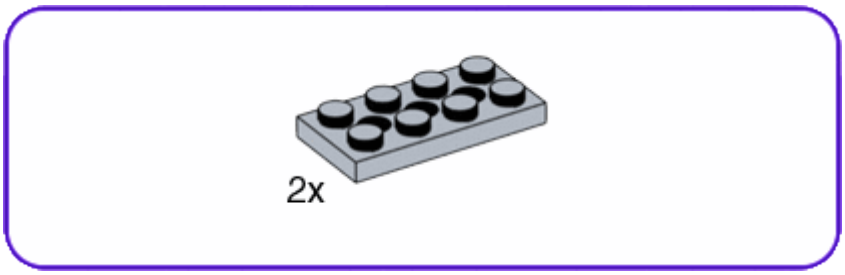

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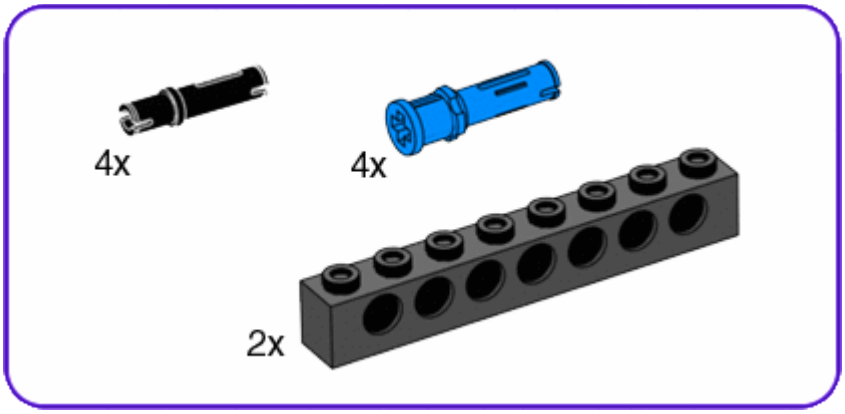

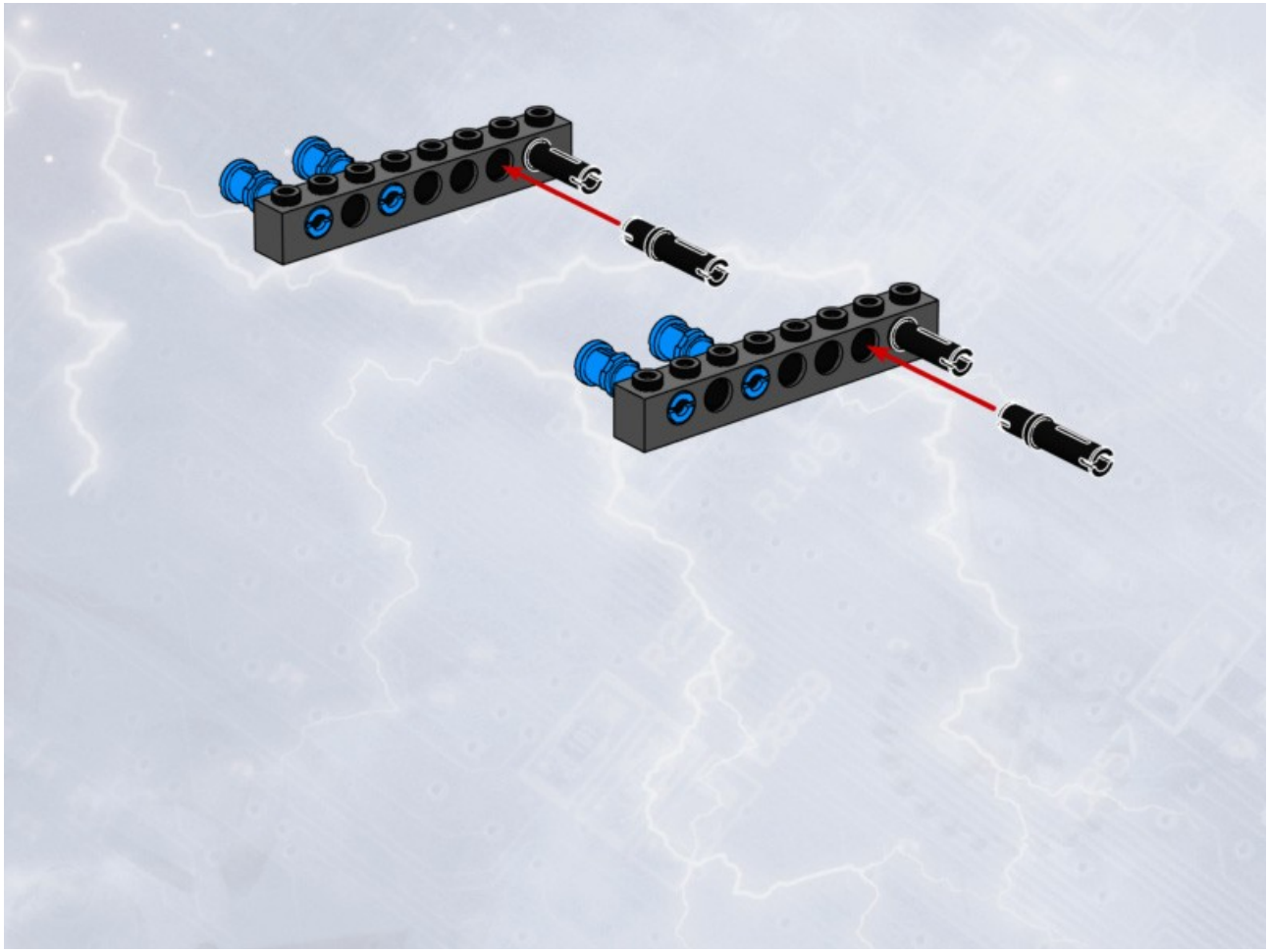

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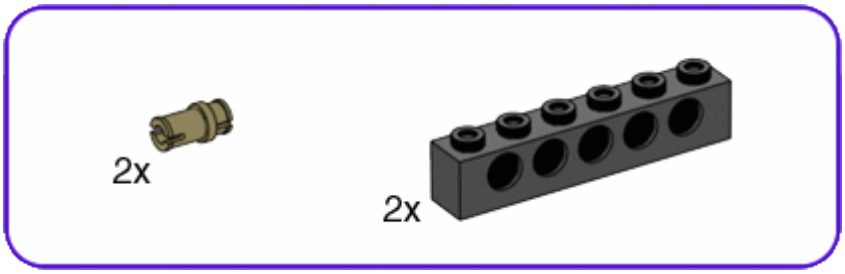

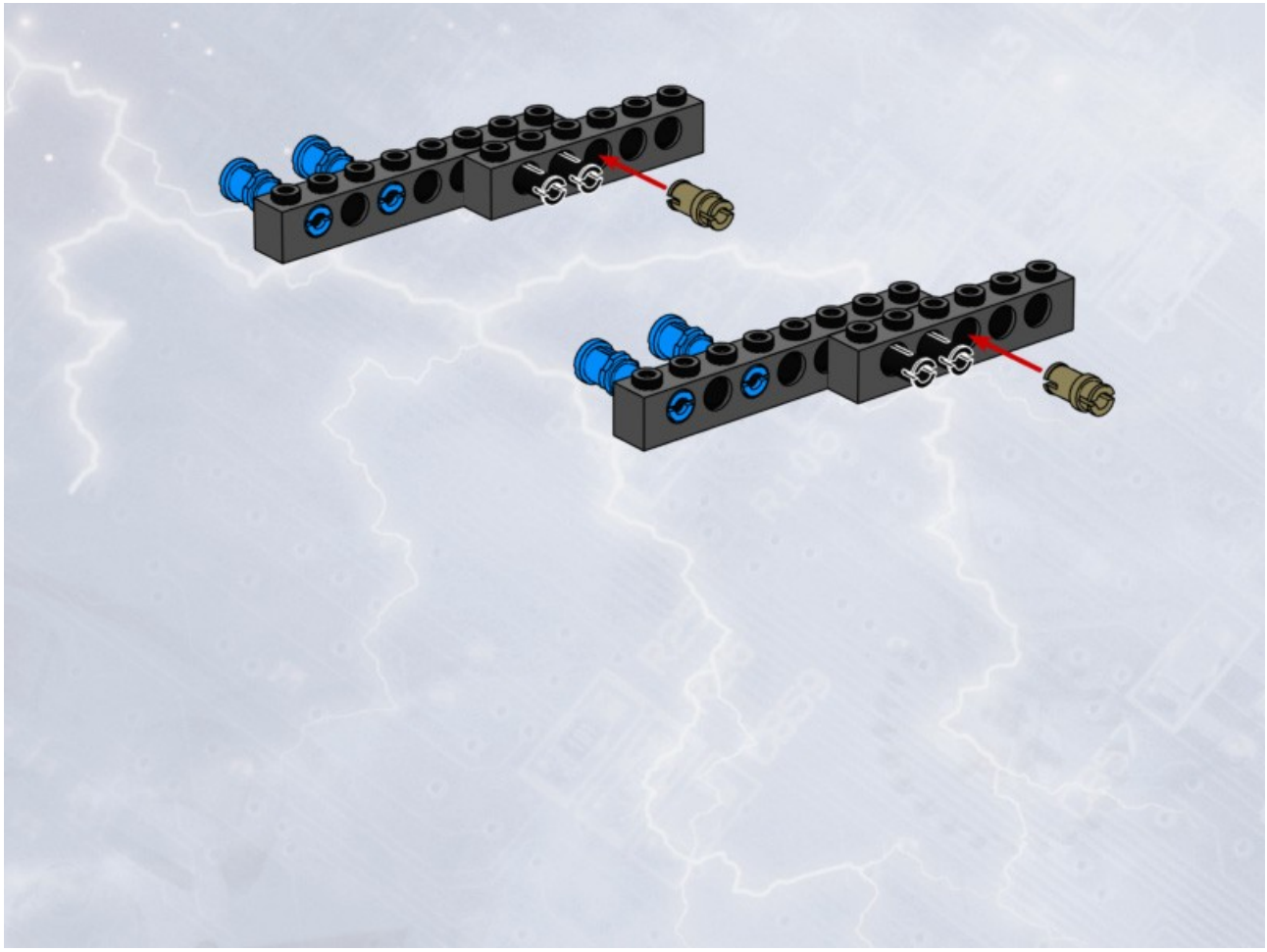

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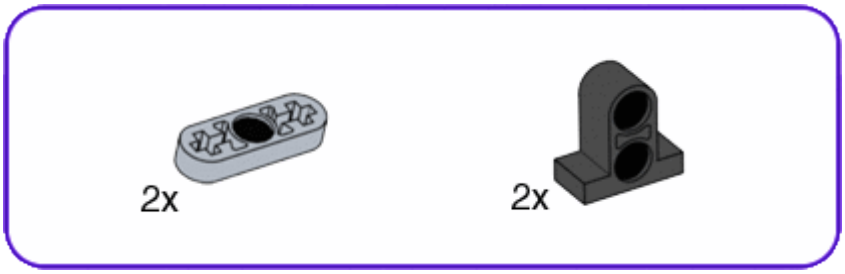

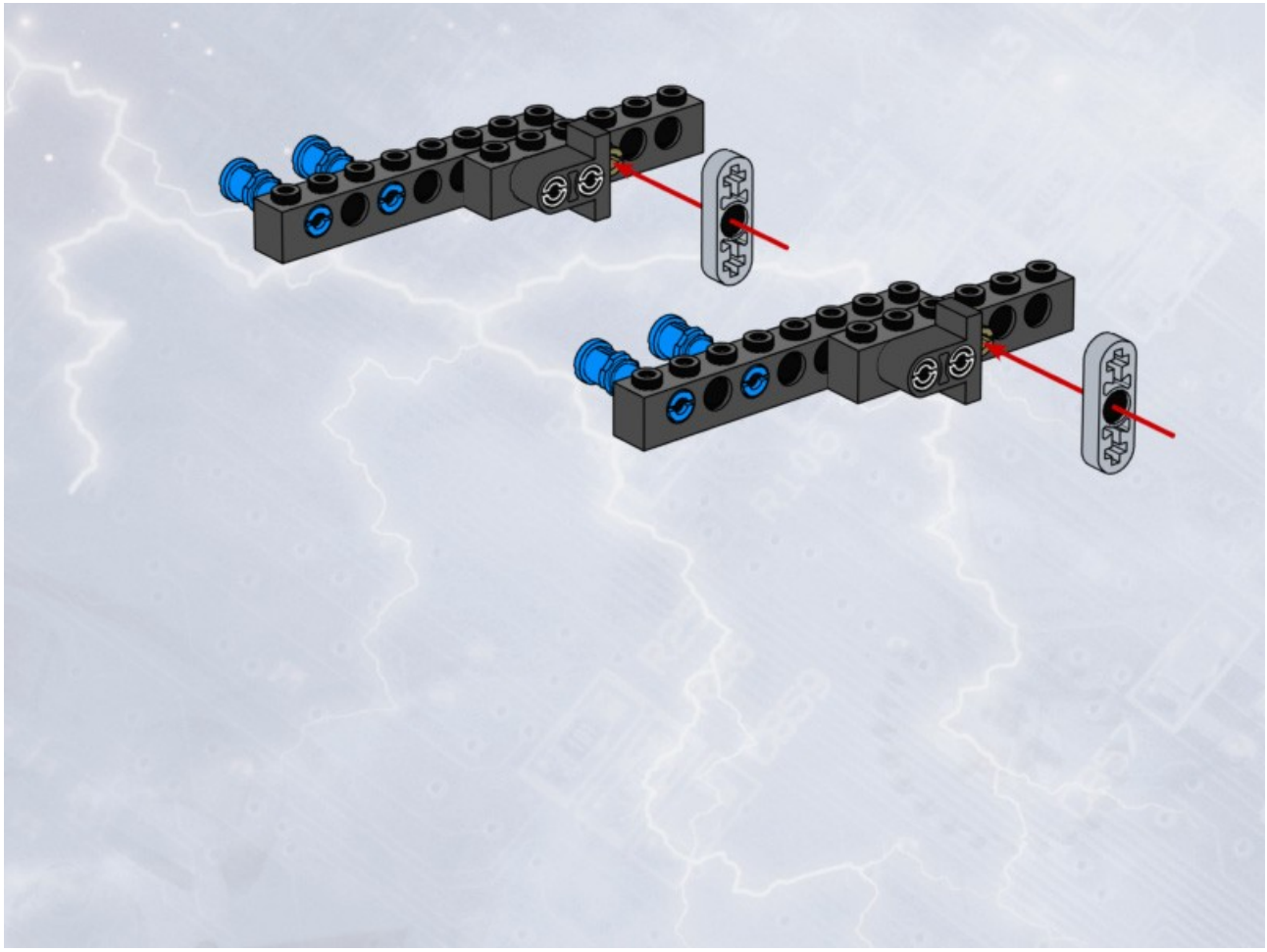

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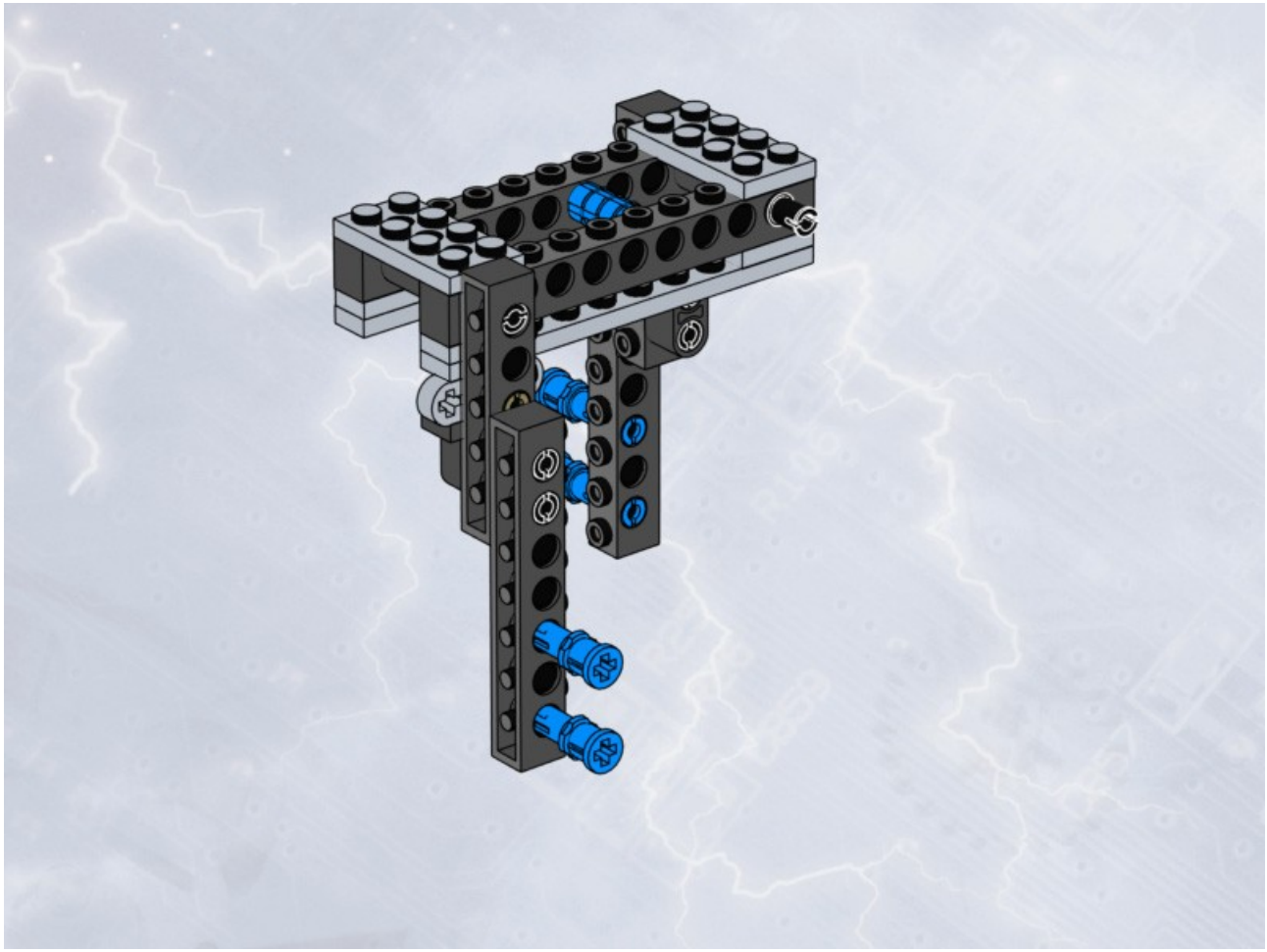

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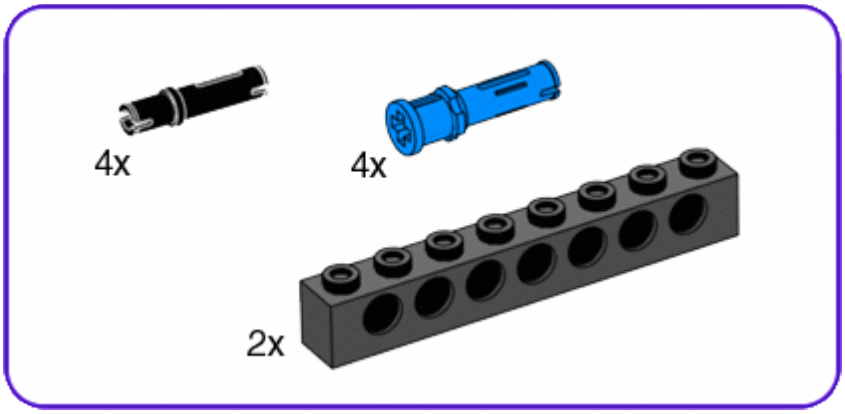

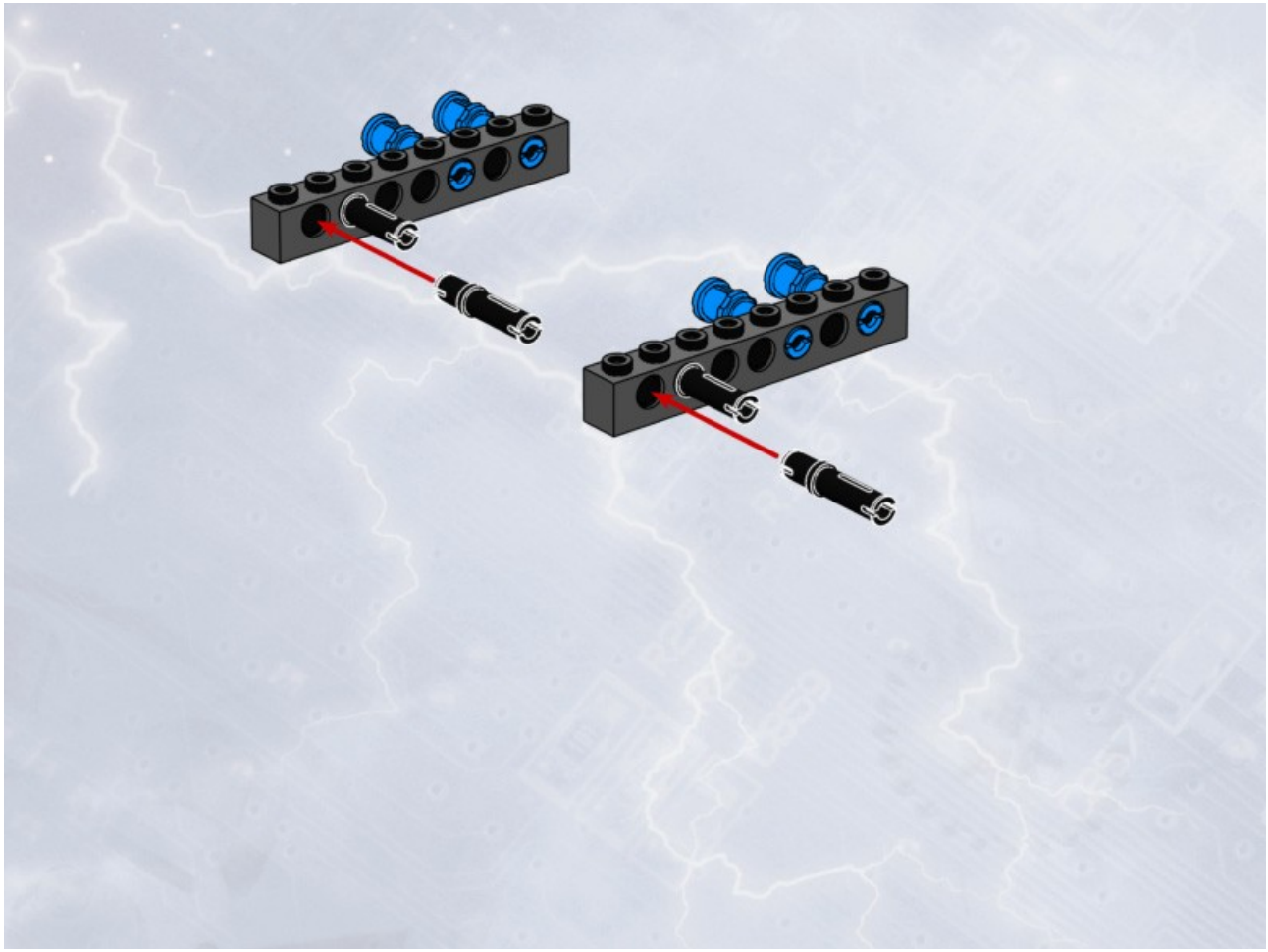

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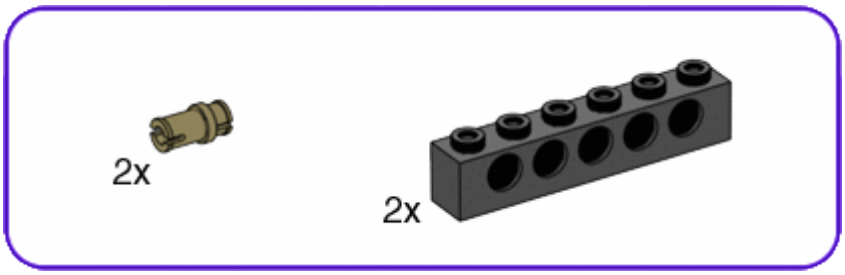

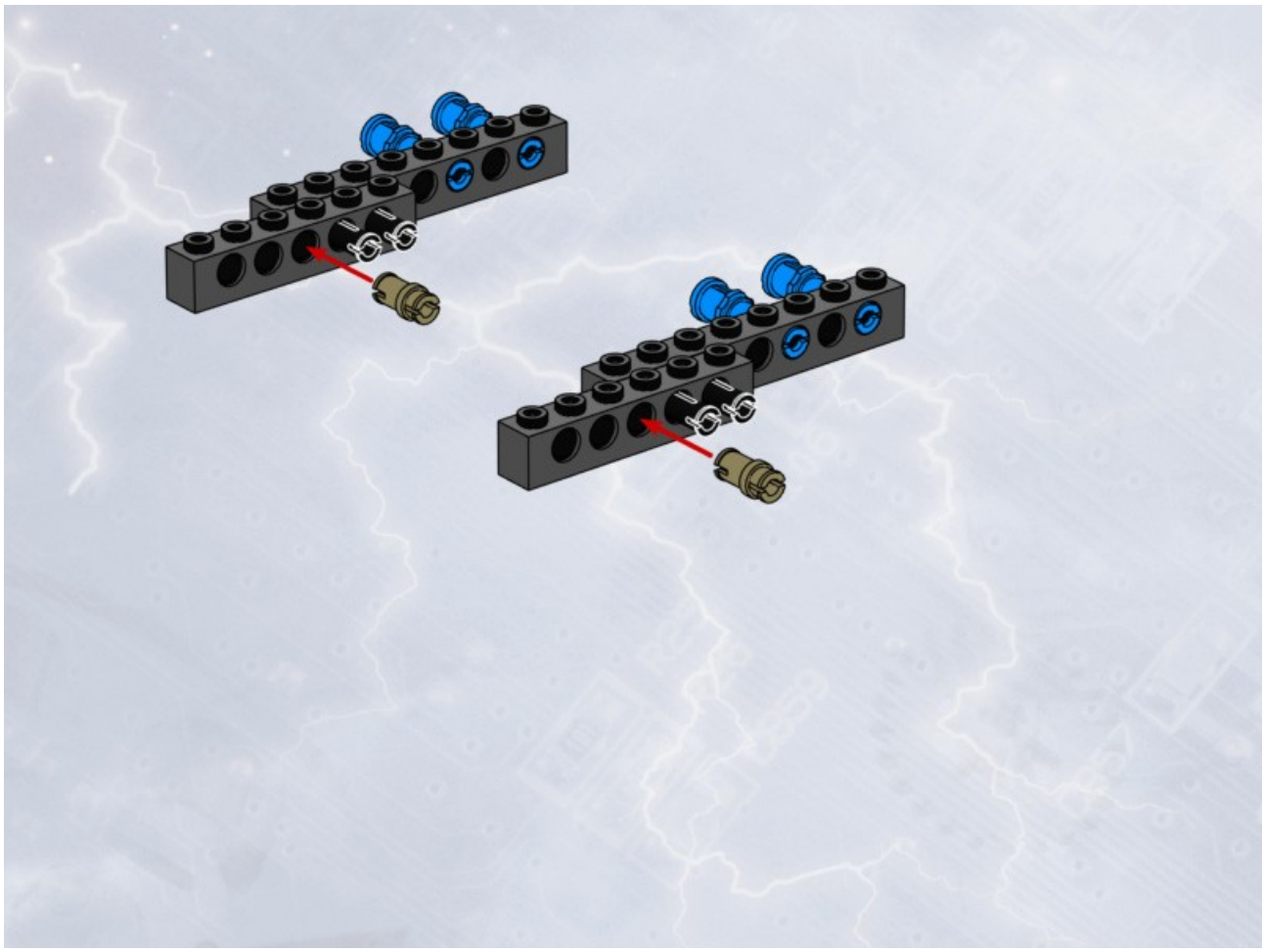

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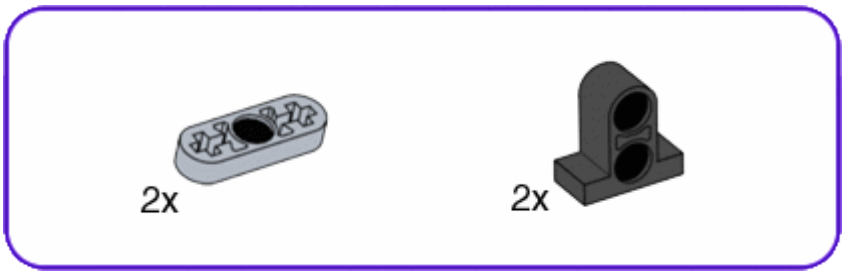

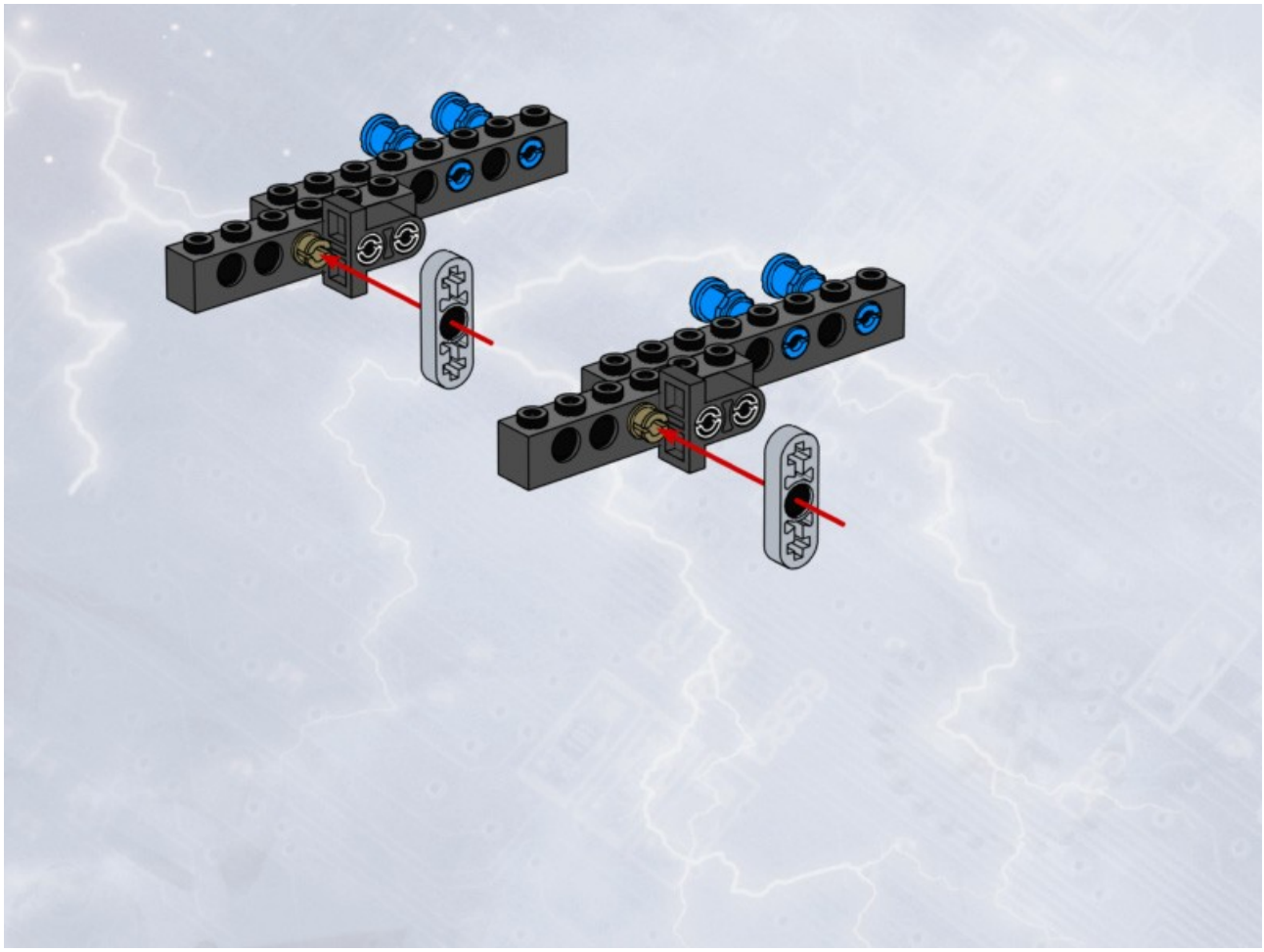

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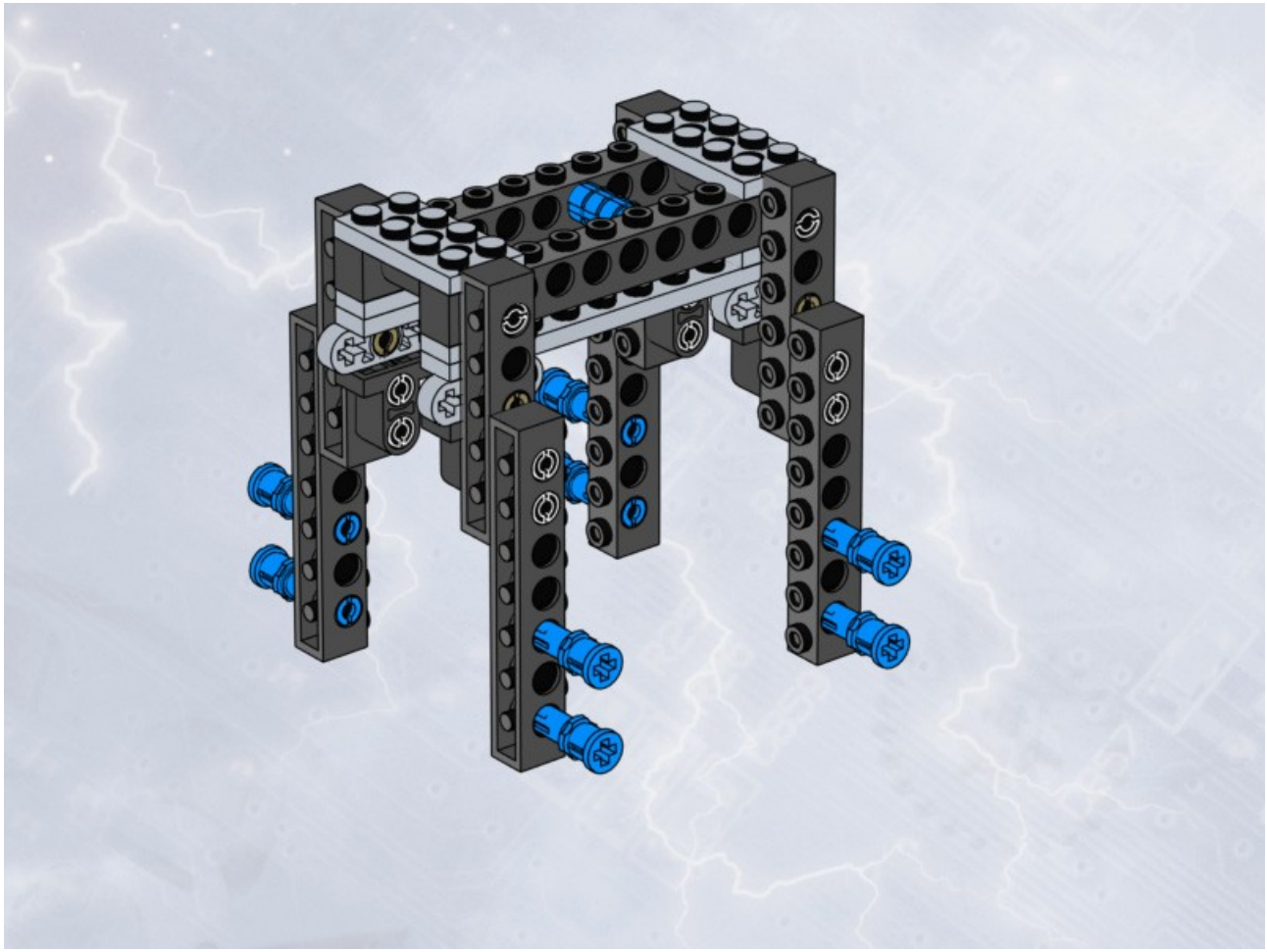

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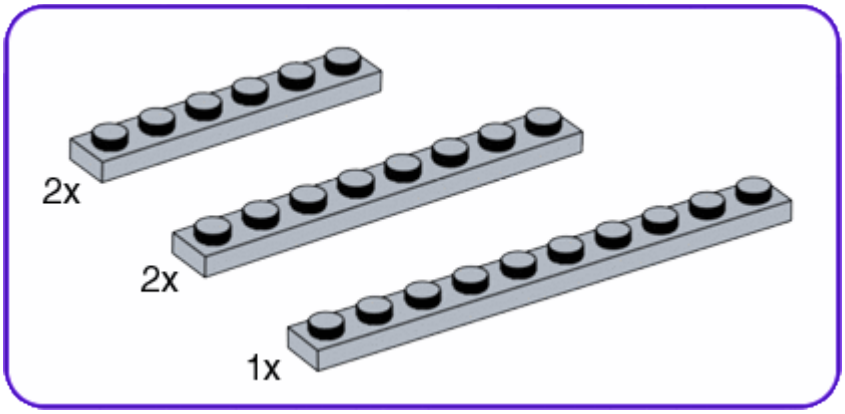

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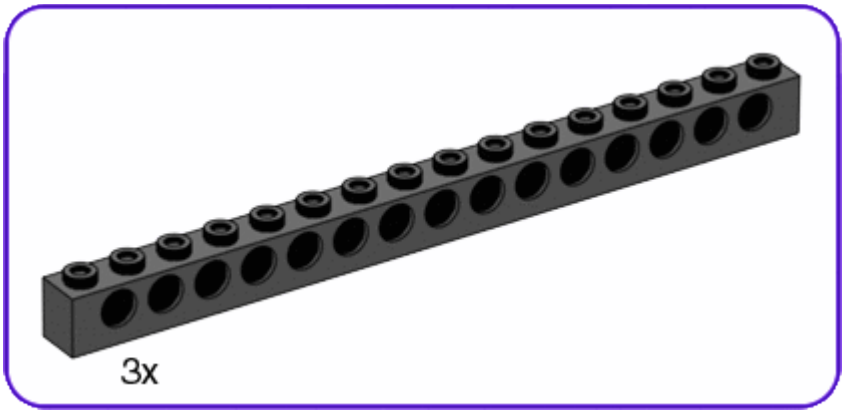

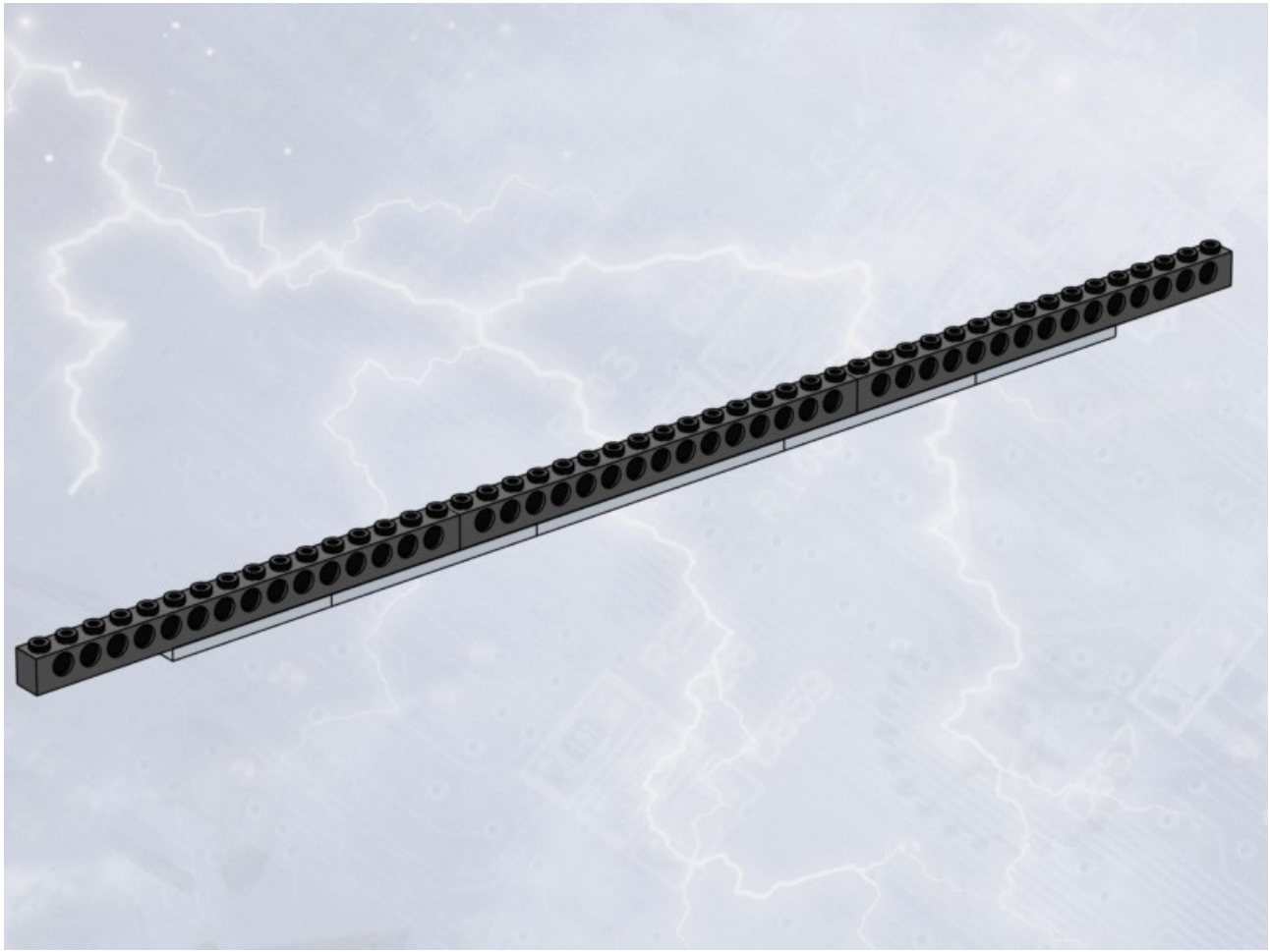

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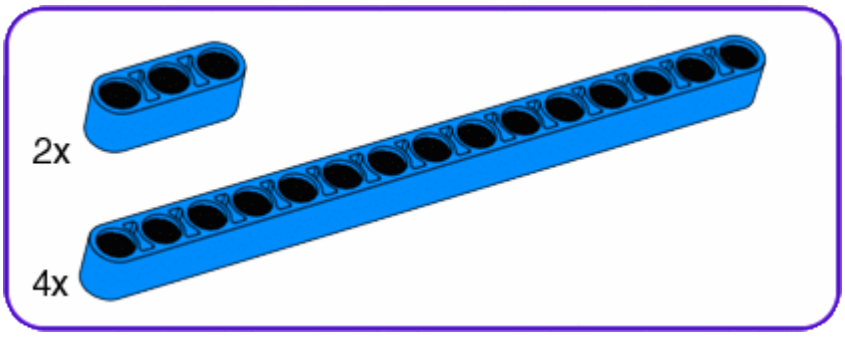

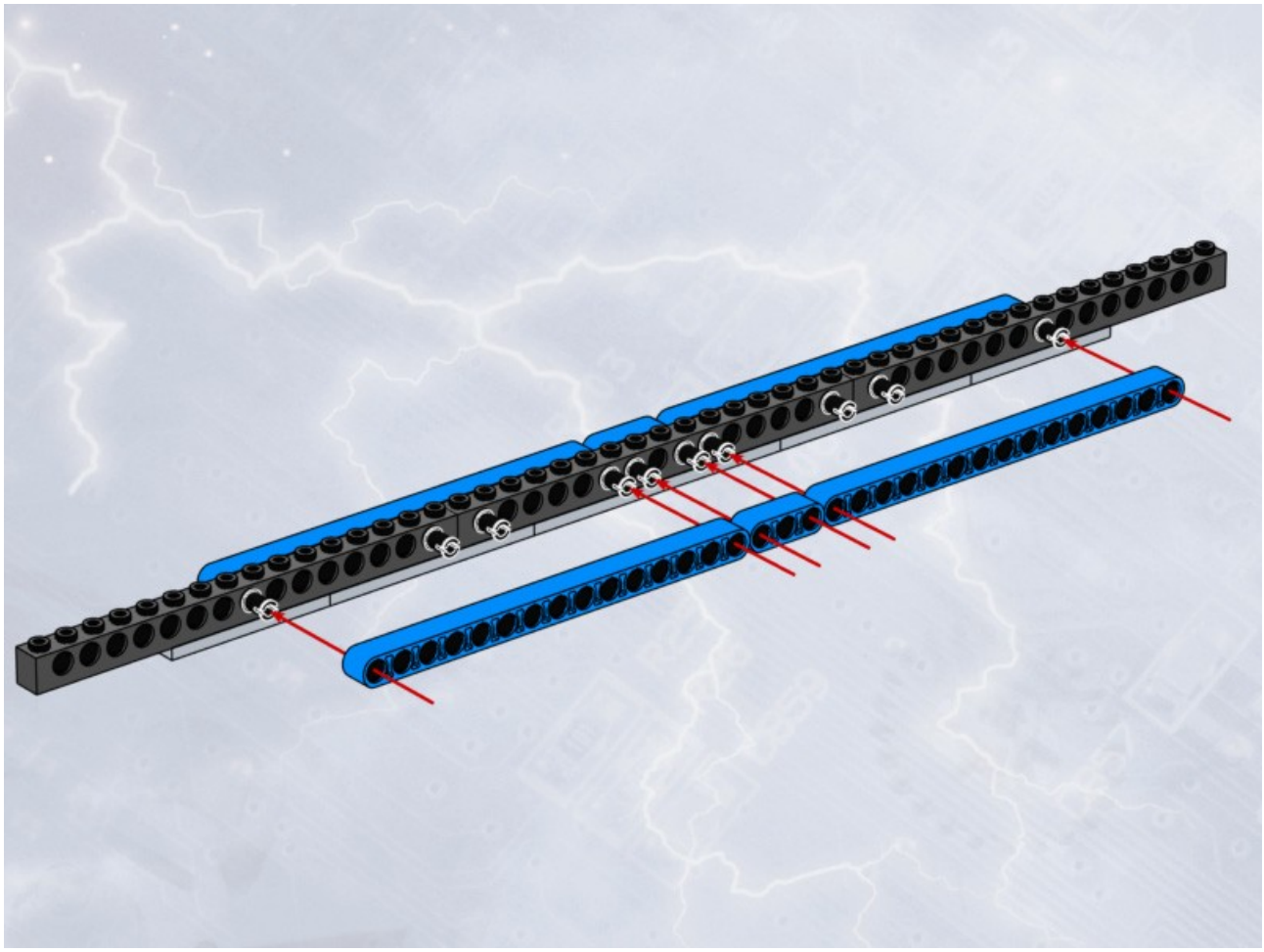

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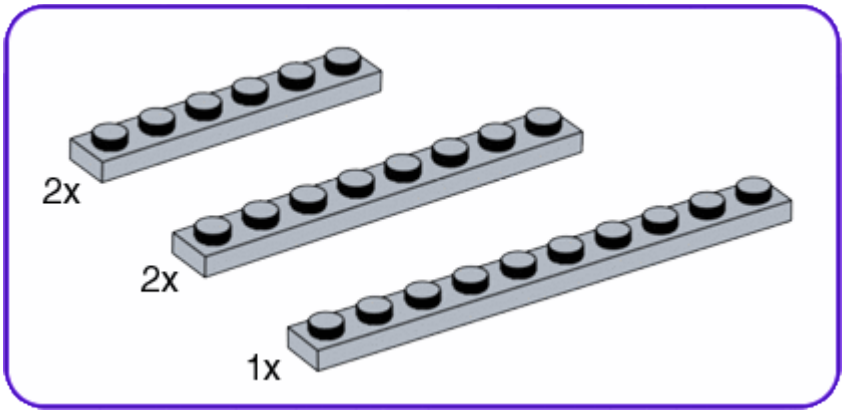

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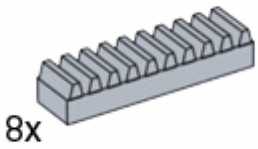

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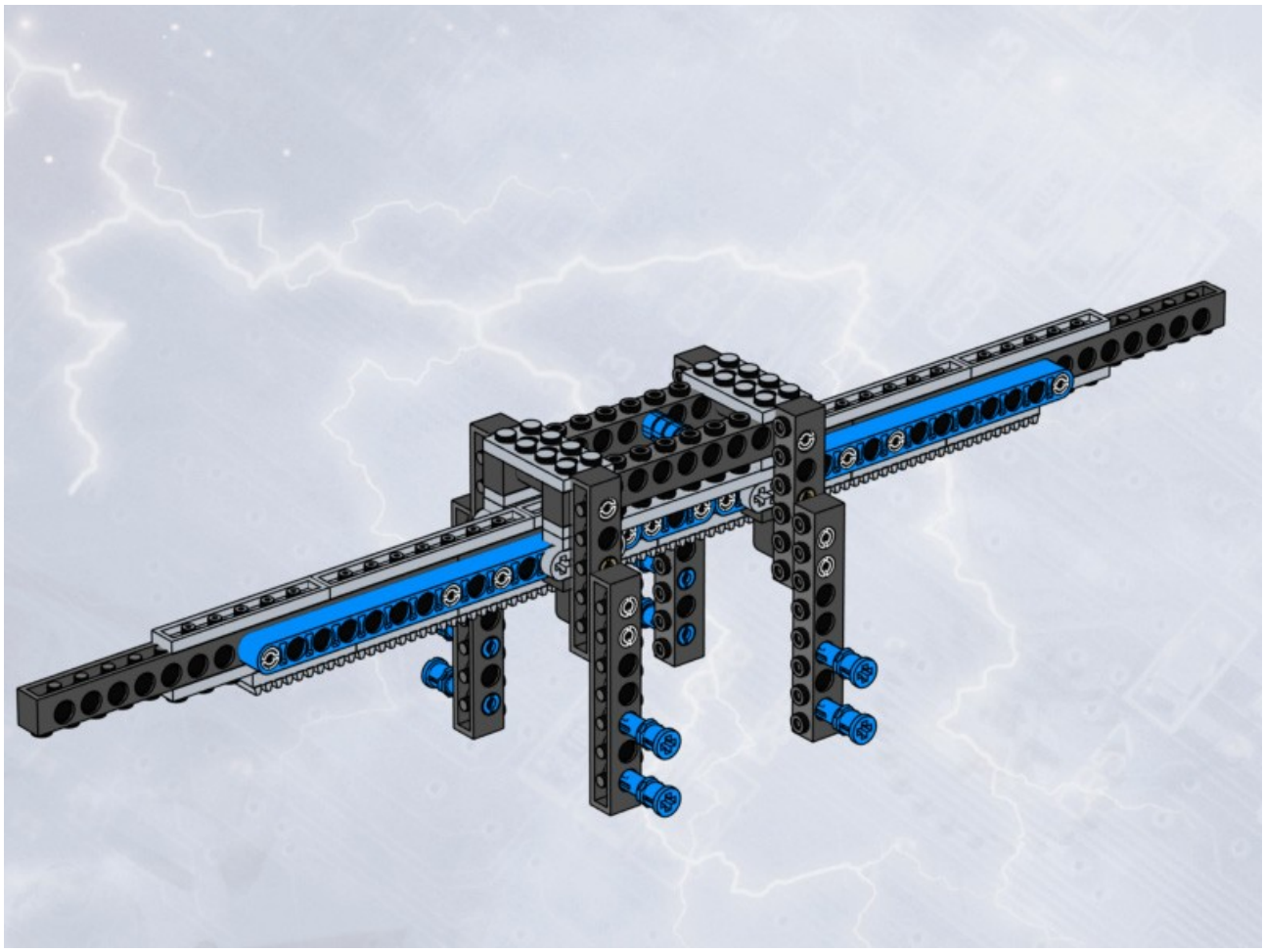


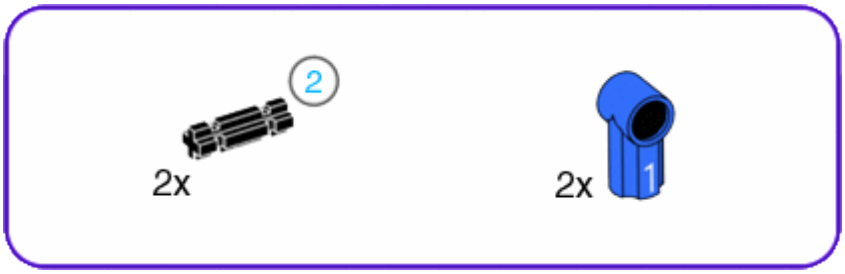
Pen Module

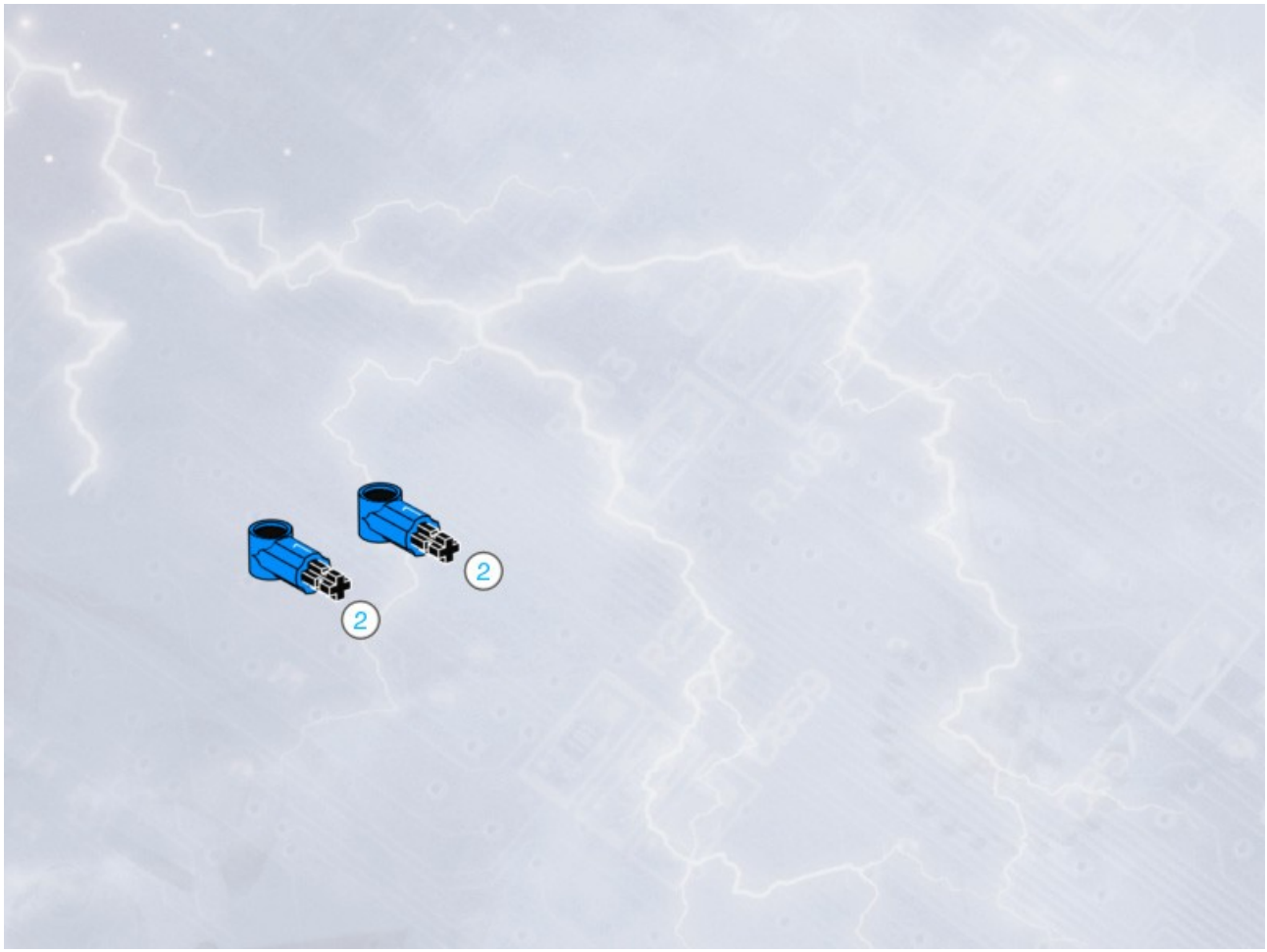
The Pen Module holds a pen in a sliding holder that is moved up and down by the Pneumatic ram.

Notice how the penholder has some give in it when the pen comes down so that it is not pressed too hard onto the paper.

Which of the tubes entering the Pneumatics receives air determines the direction the pen moves. This is controlled from the Pneumatics module.

1





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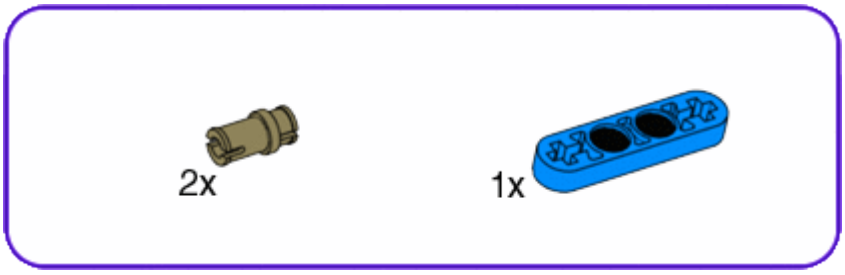

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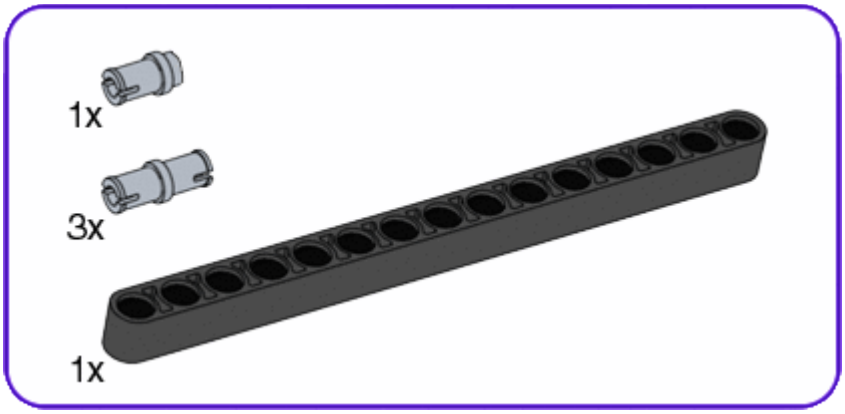

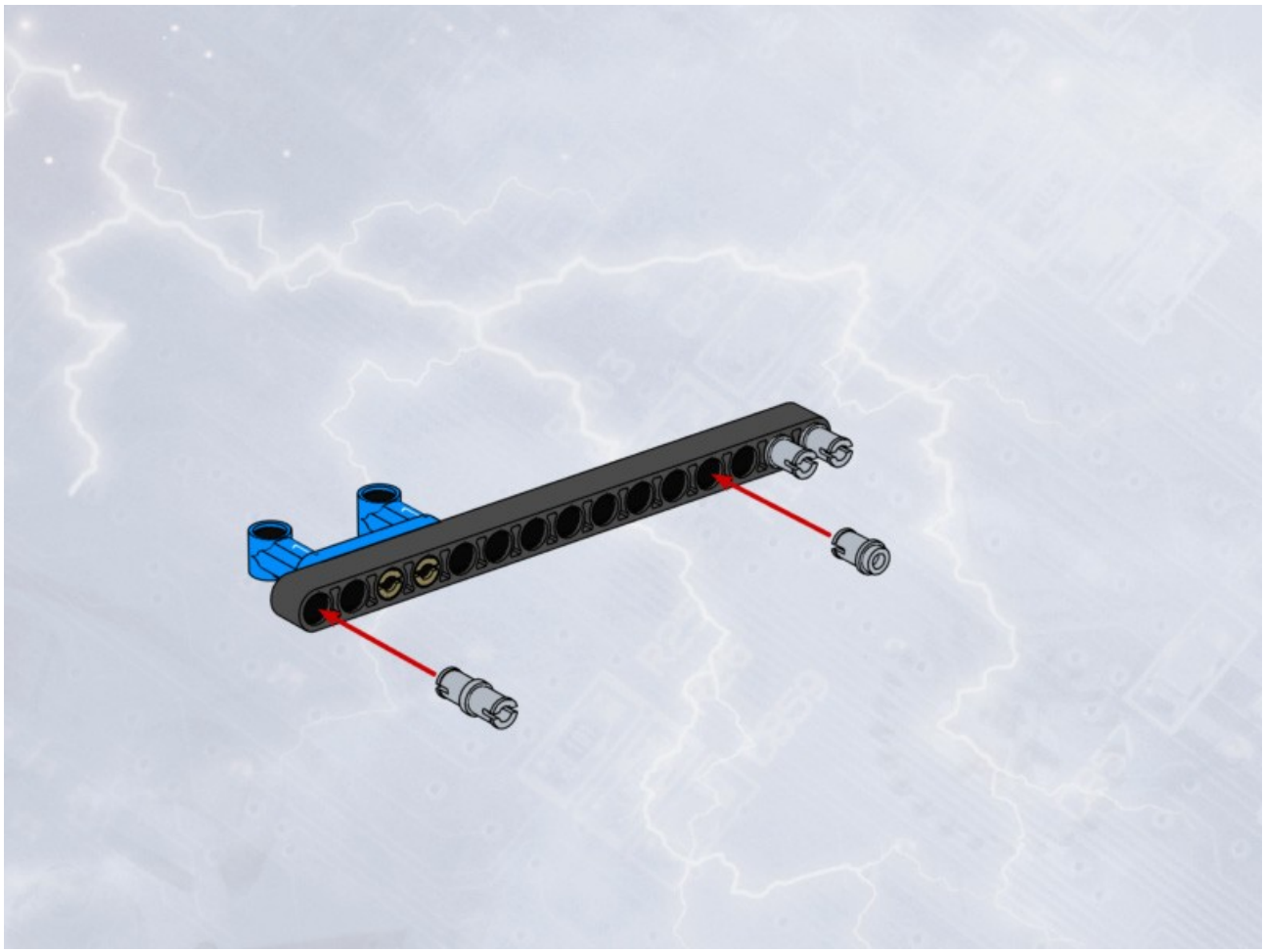

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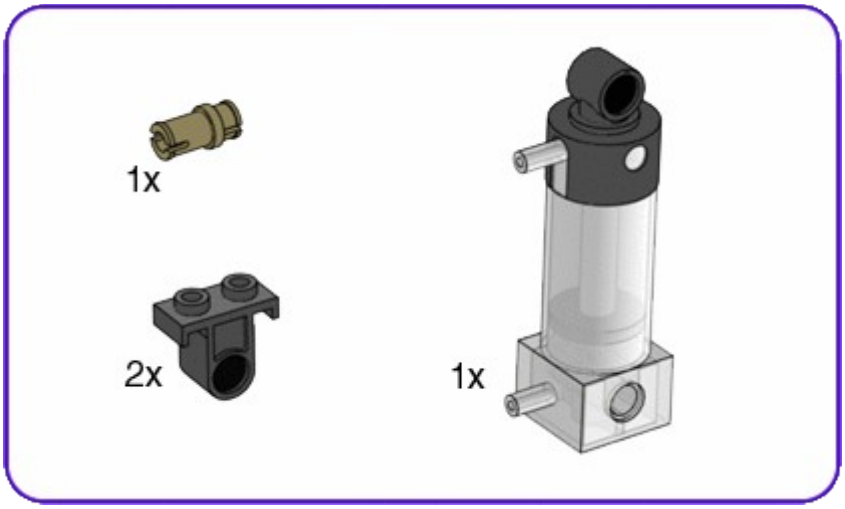

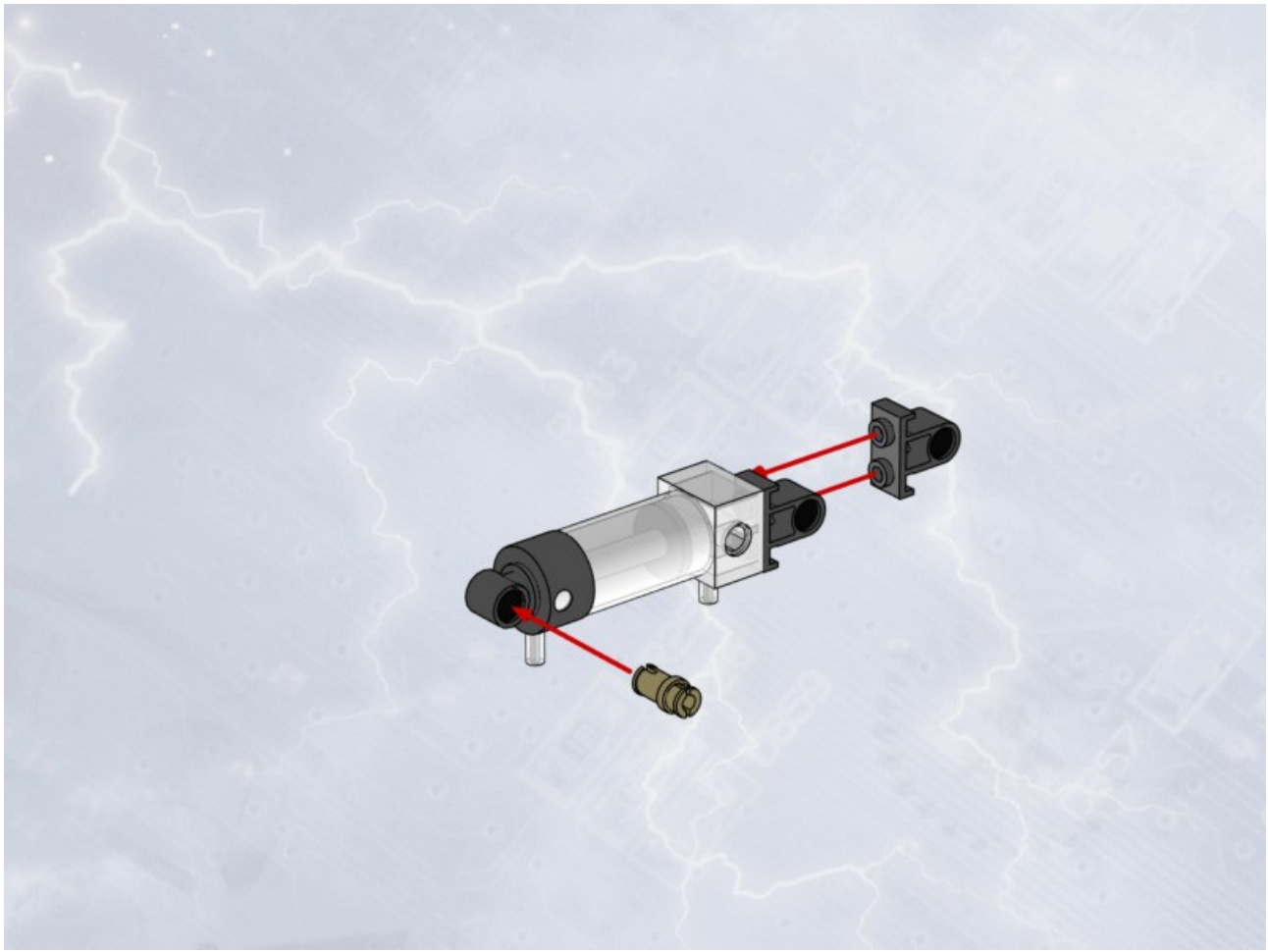

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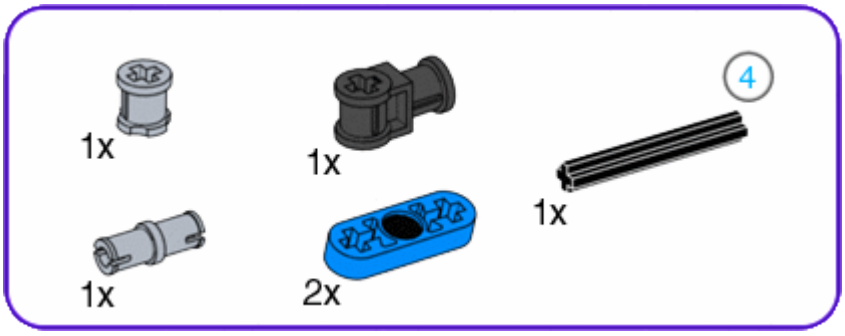

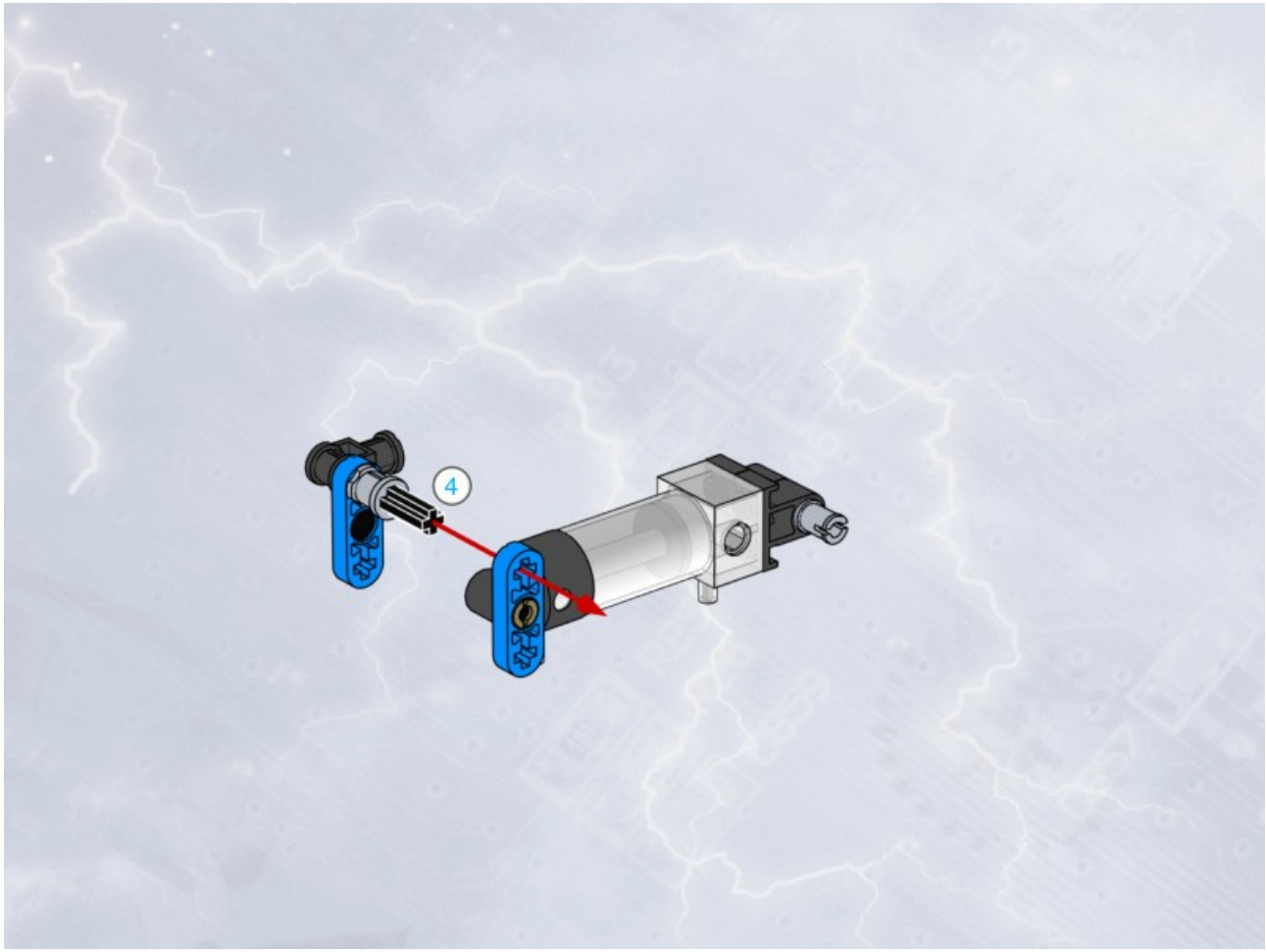

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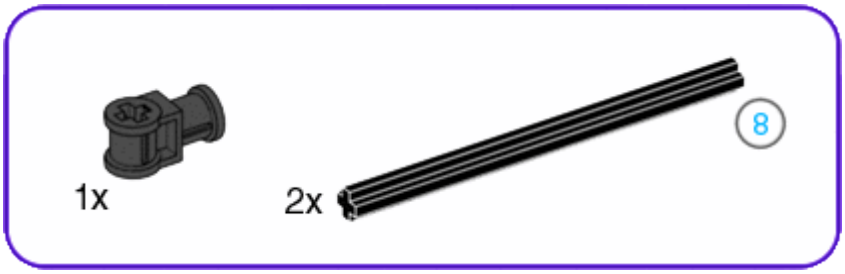

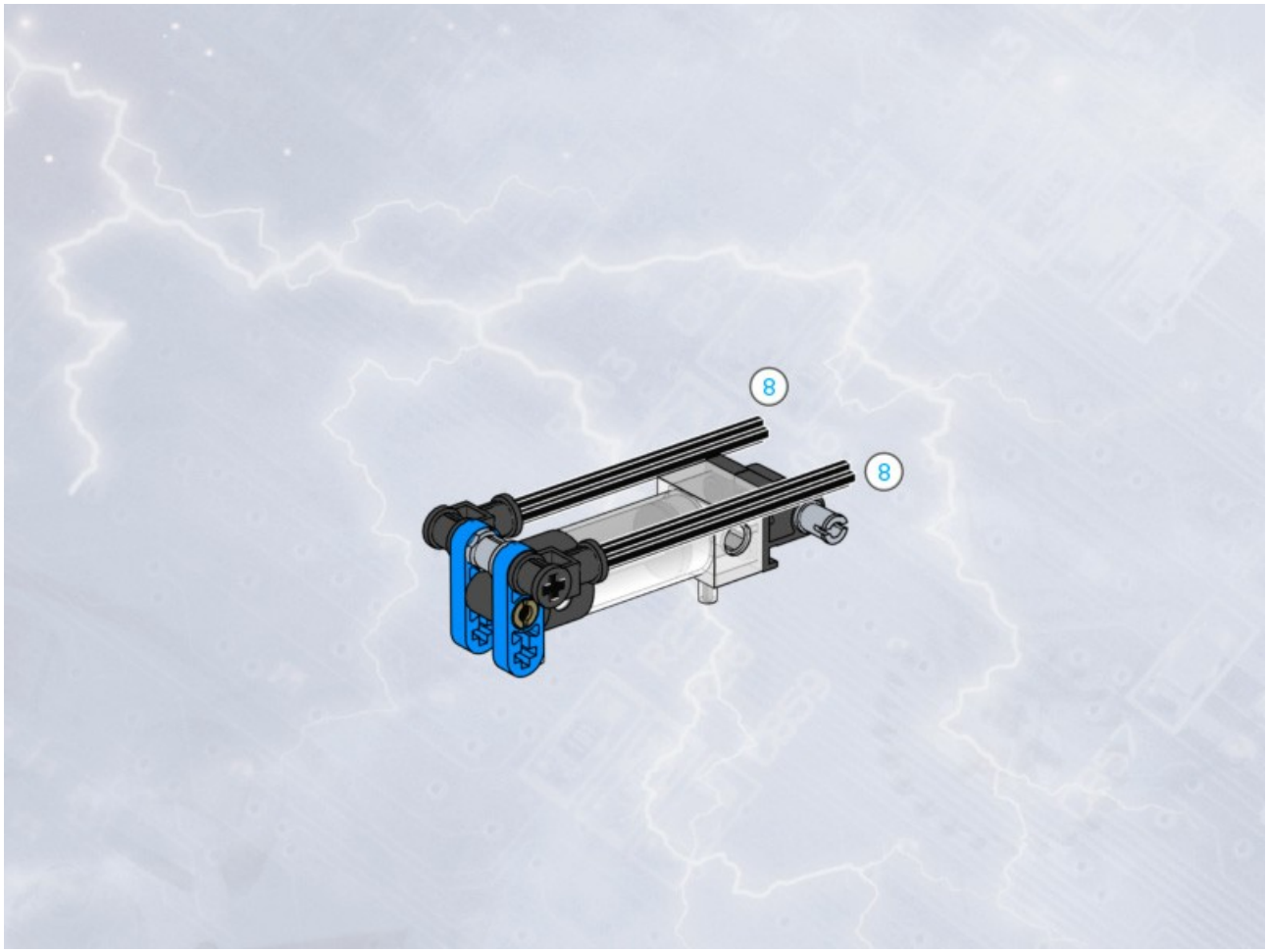

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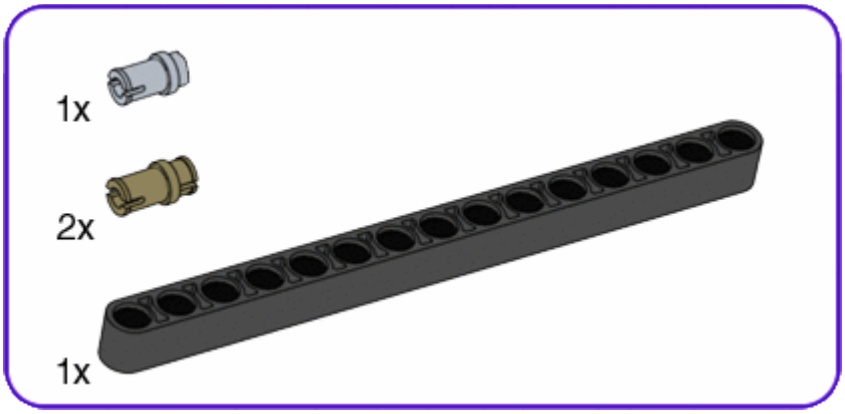

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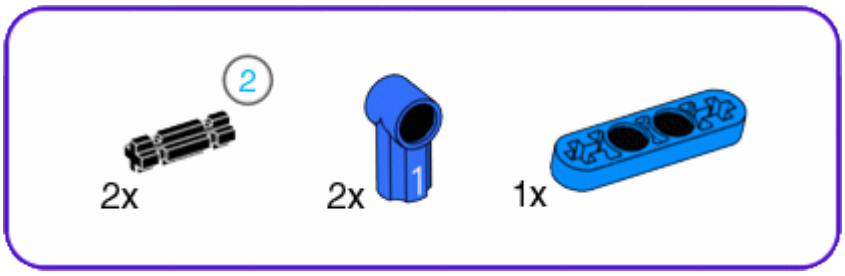

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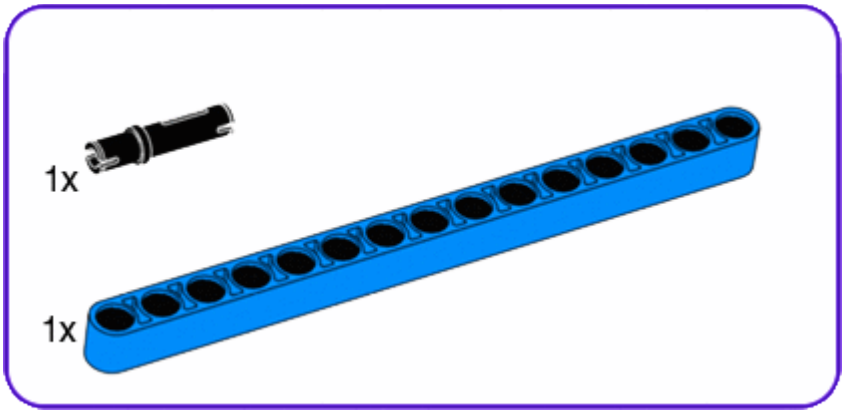

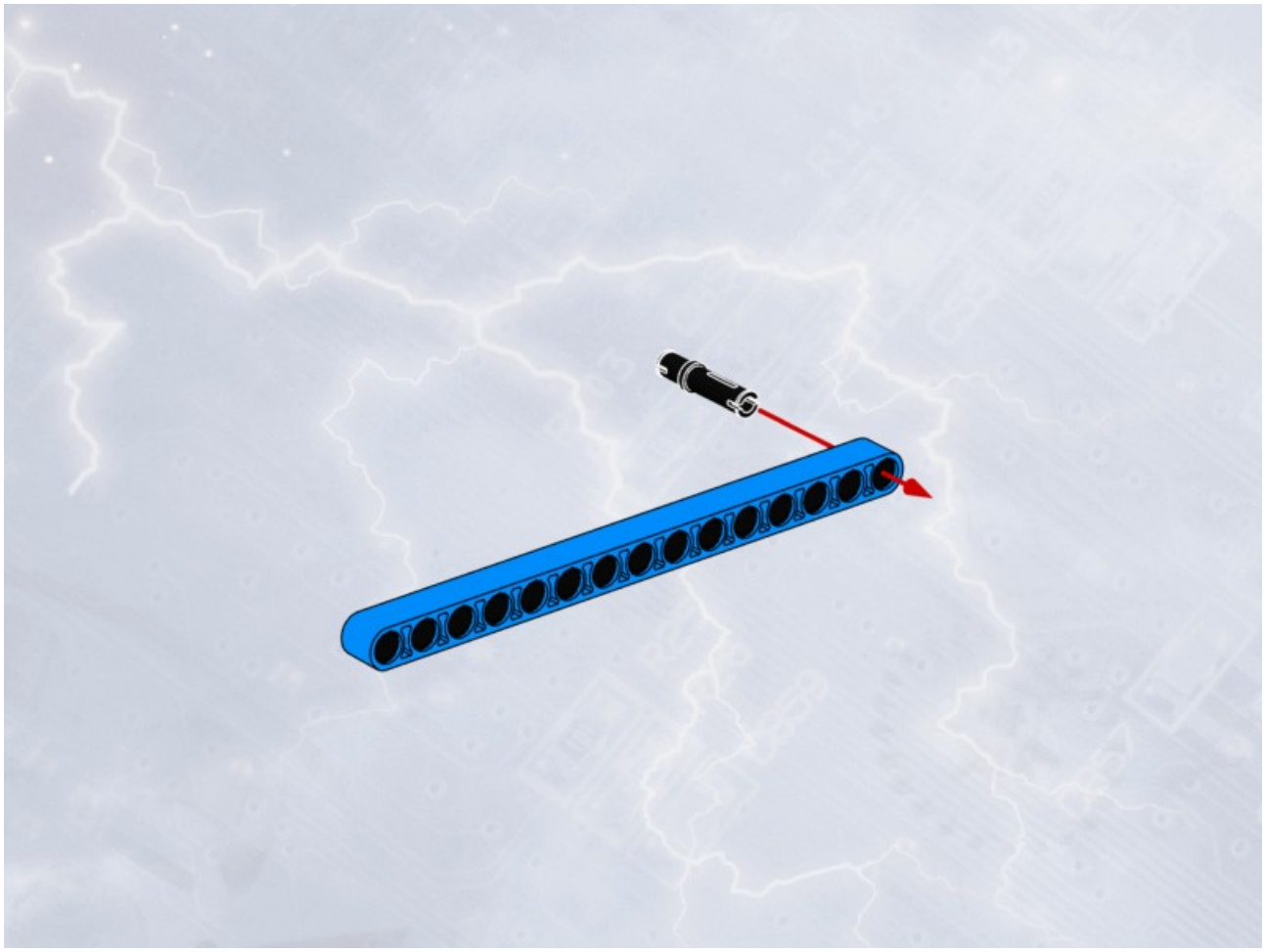

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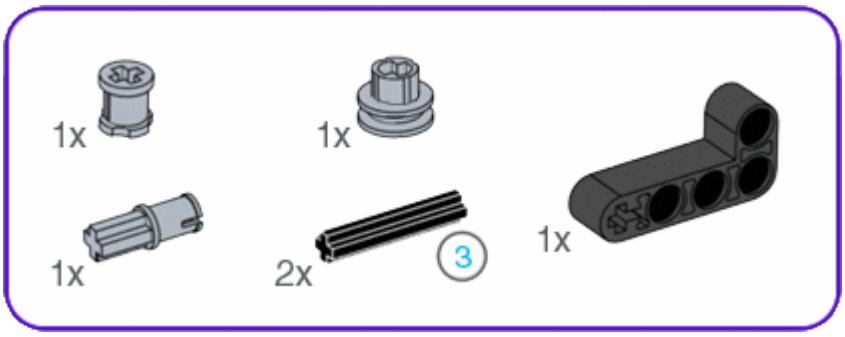

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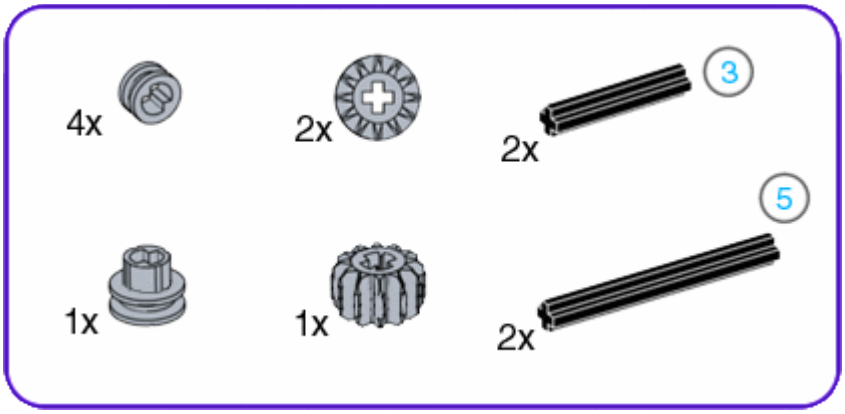

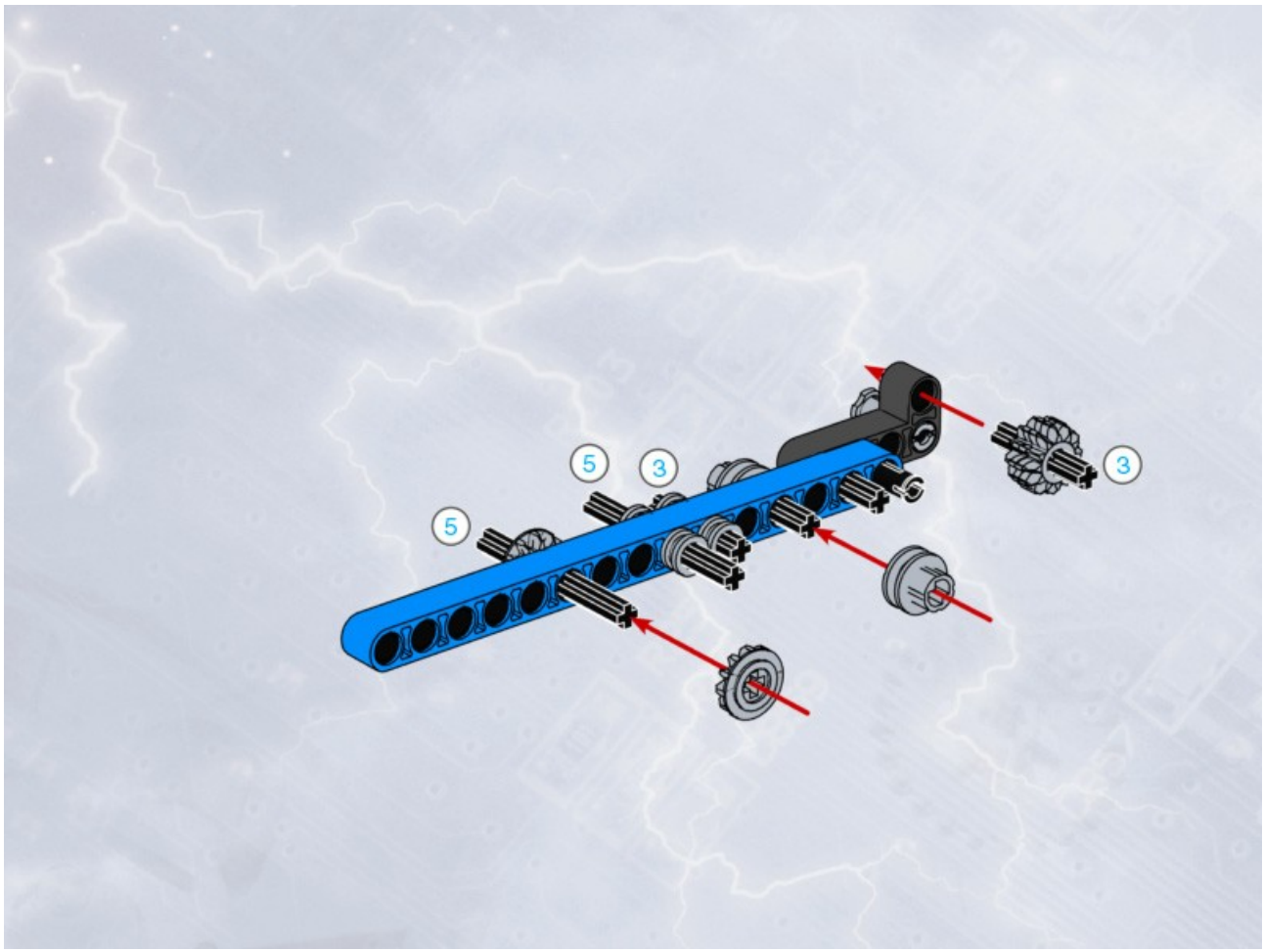

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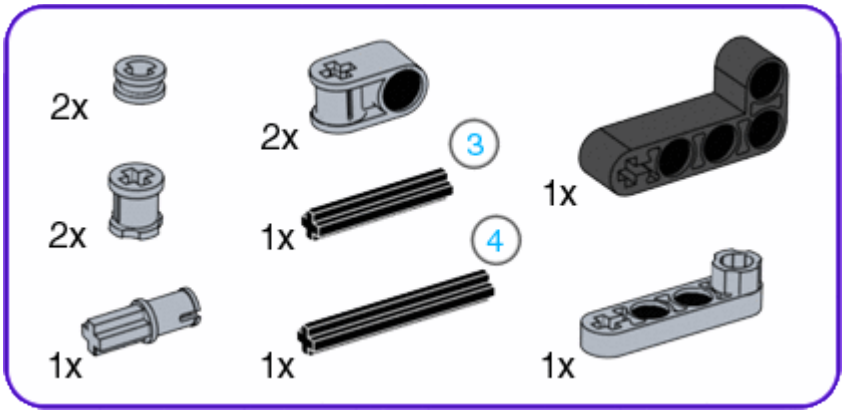

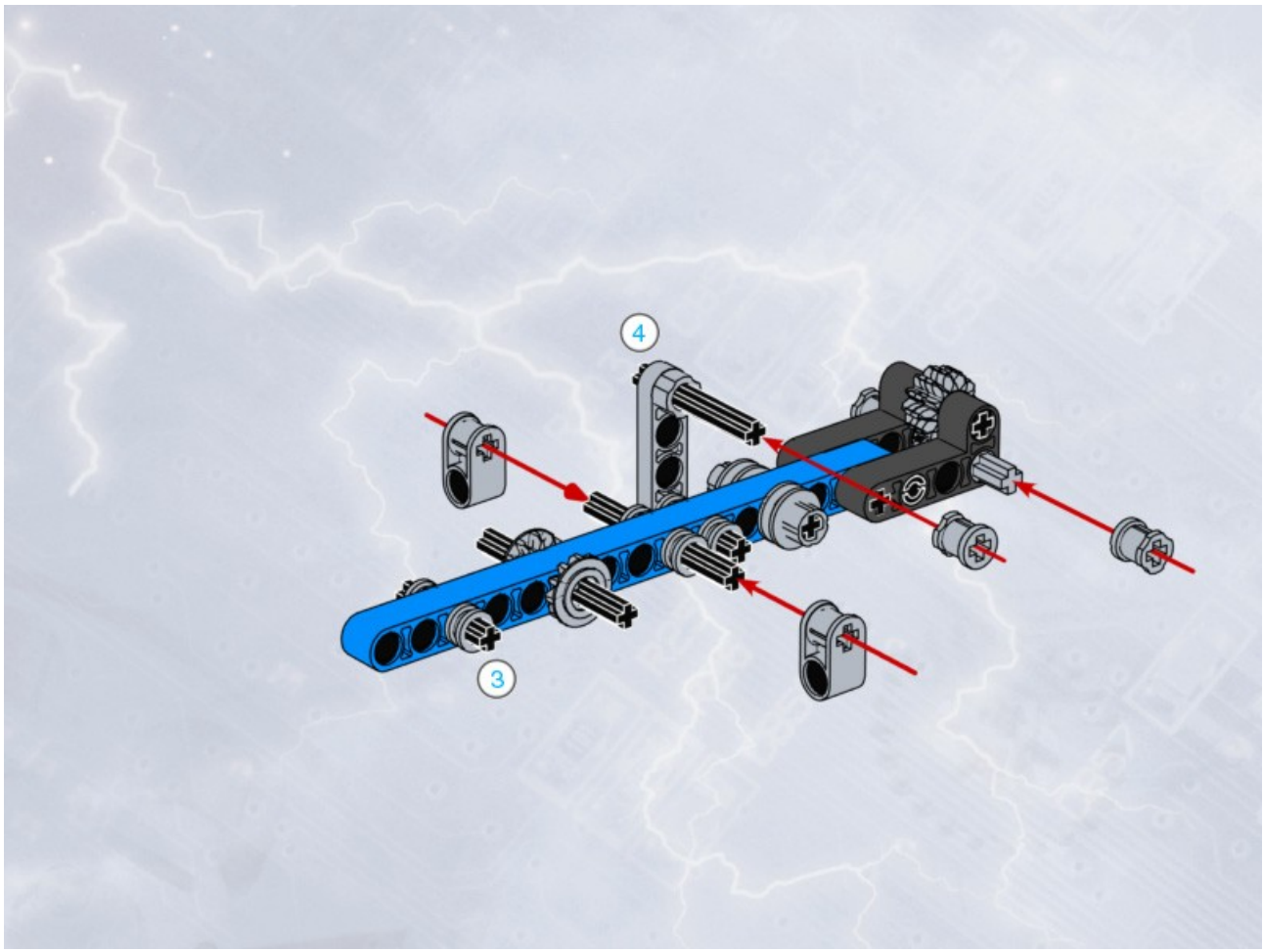

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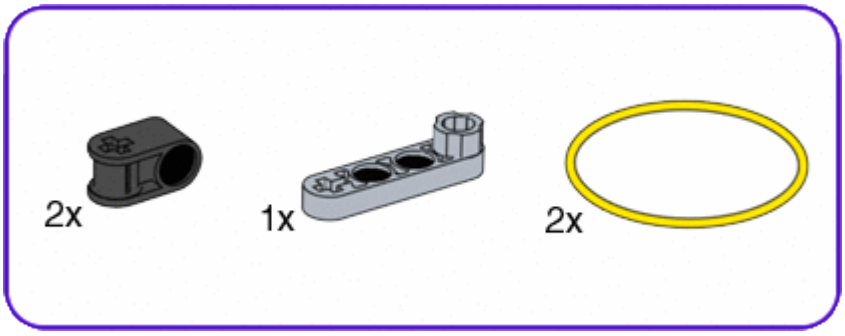

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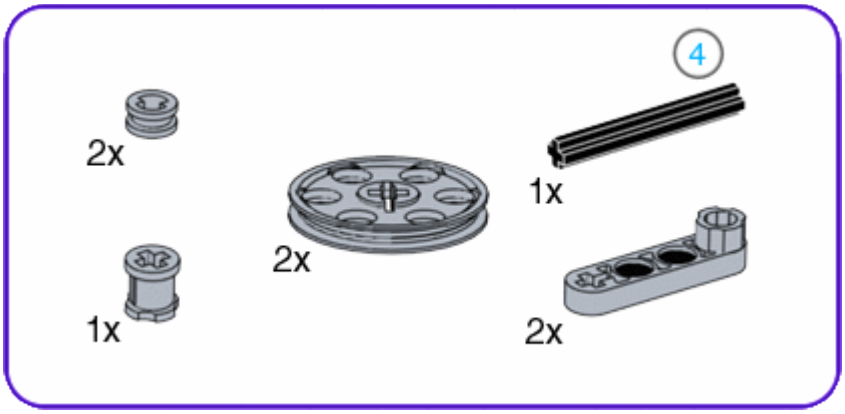

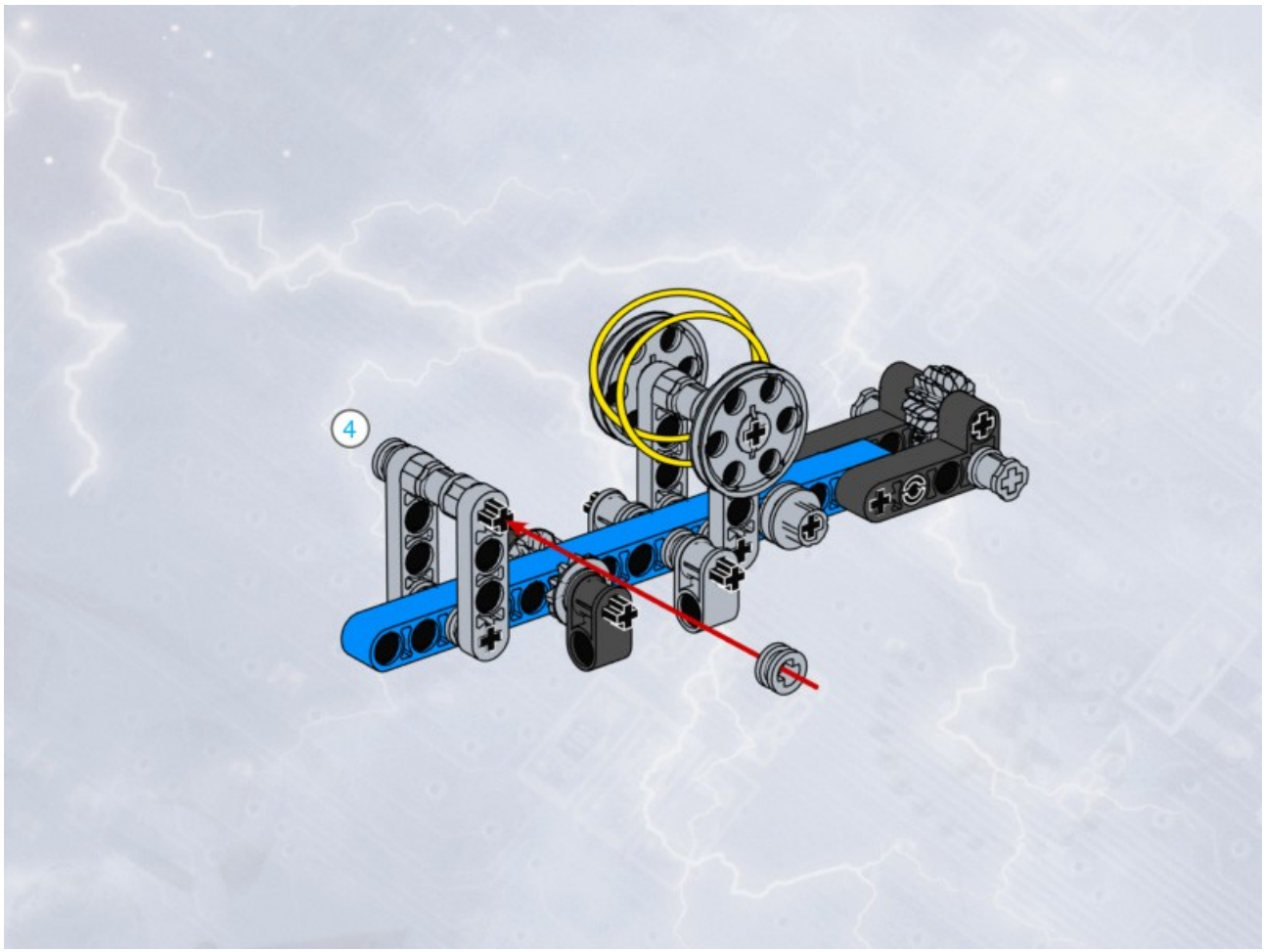

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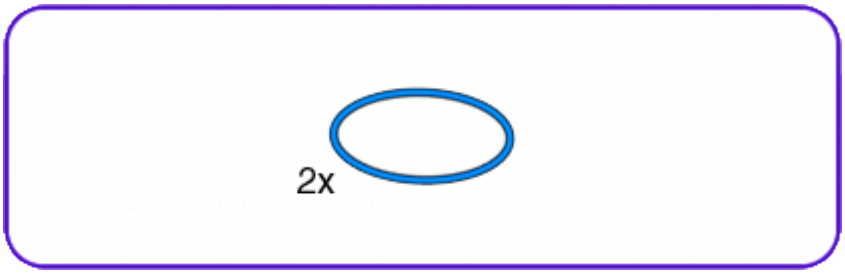

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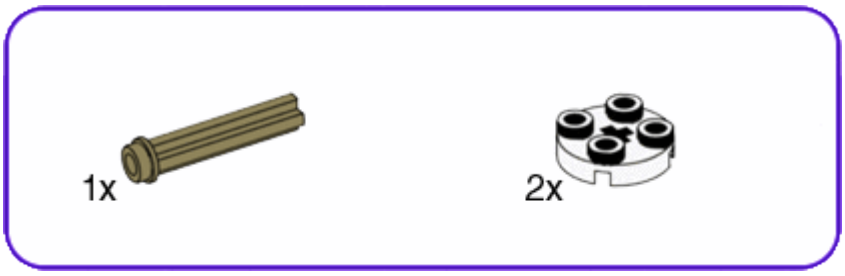

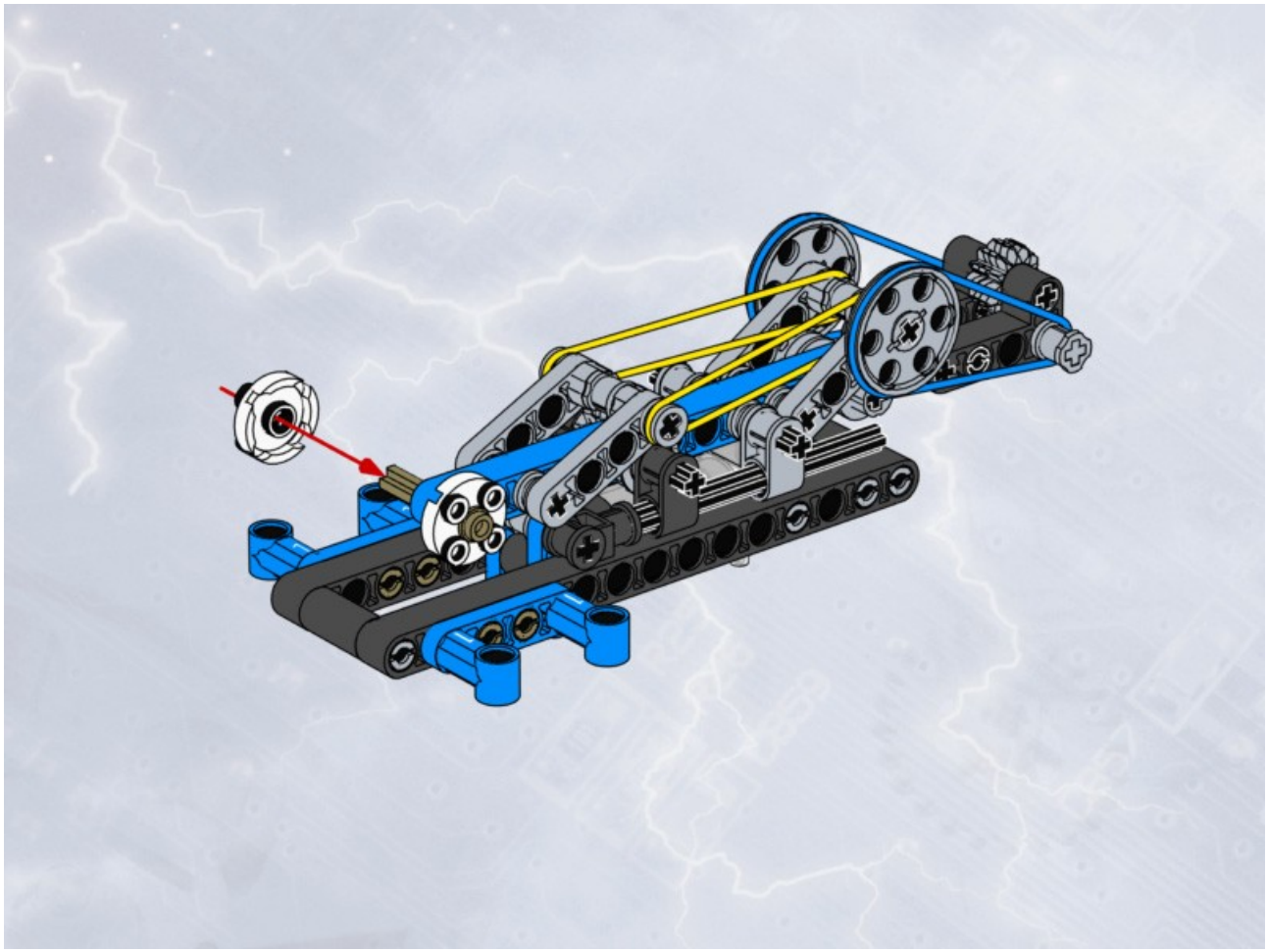

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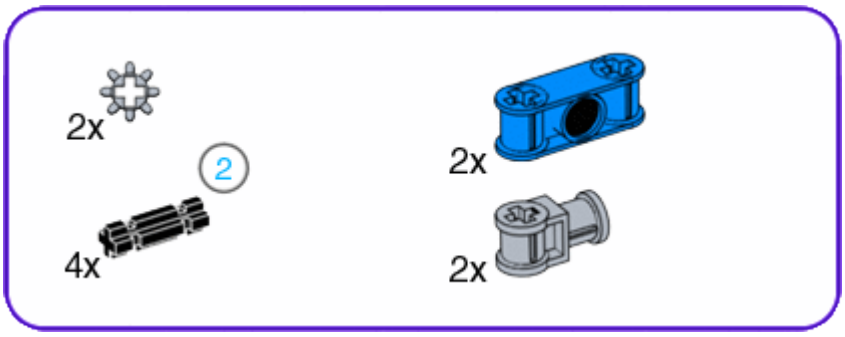

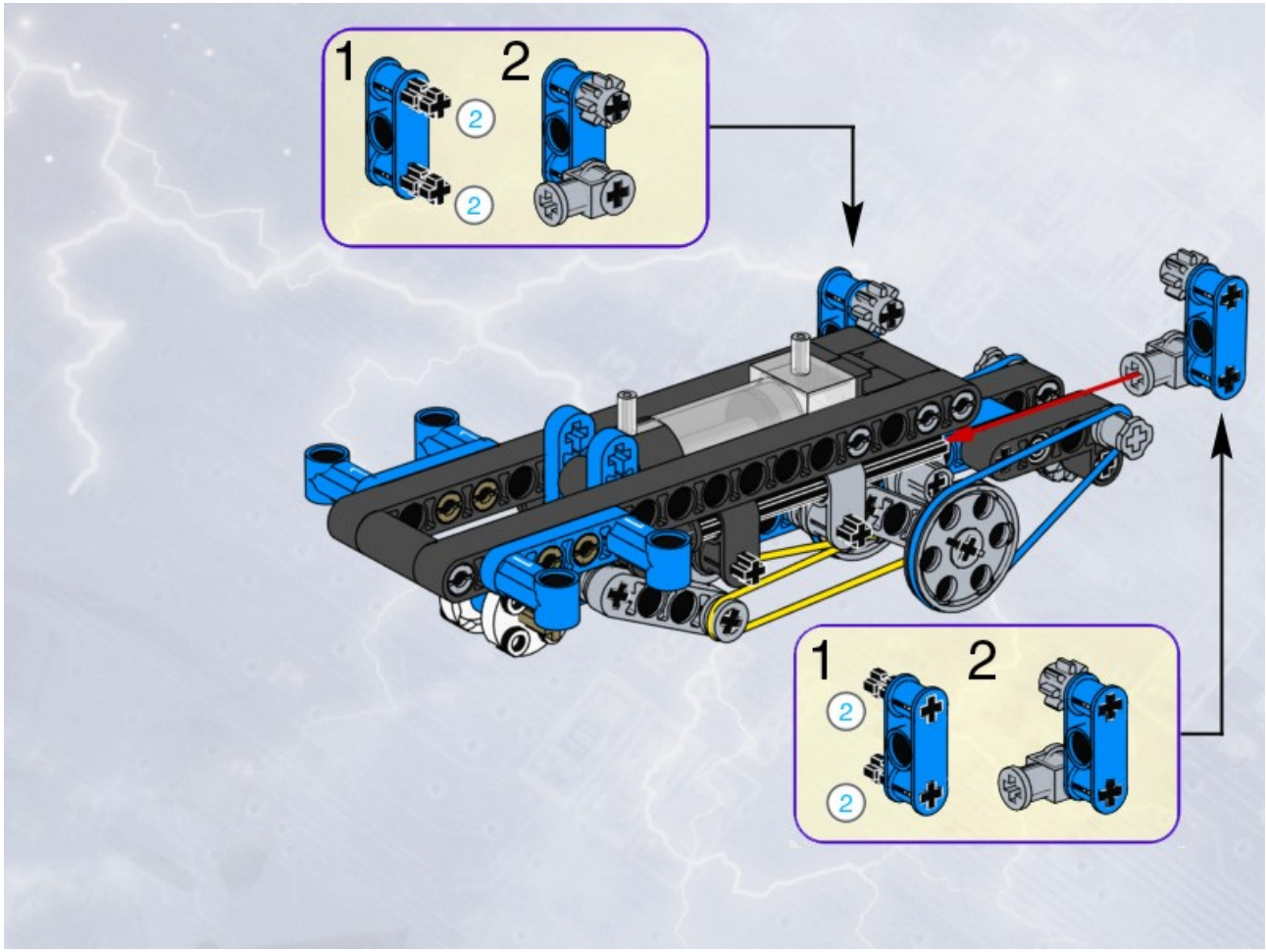

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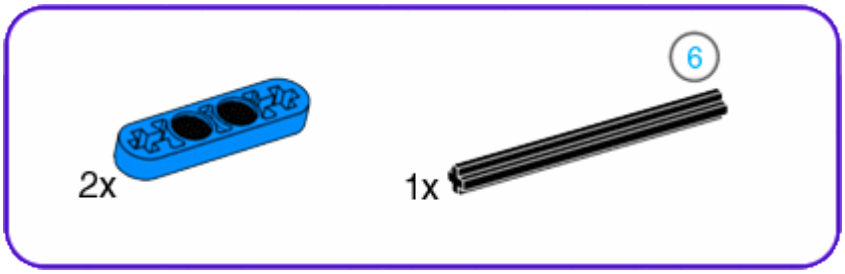

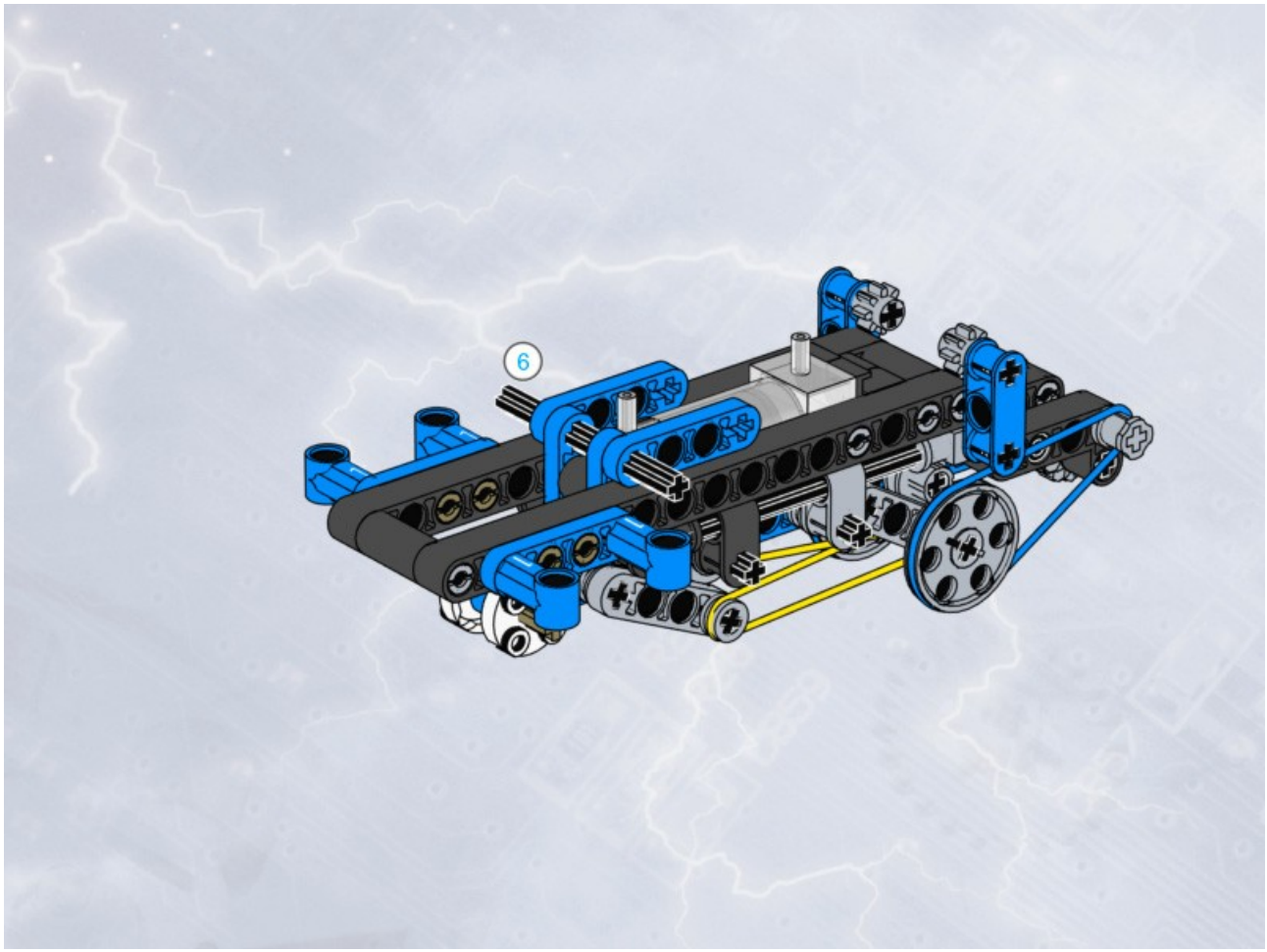

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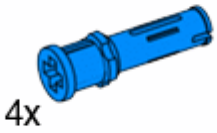

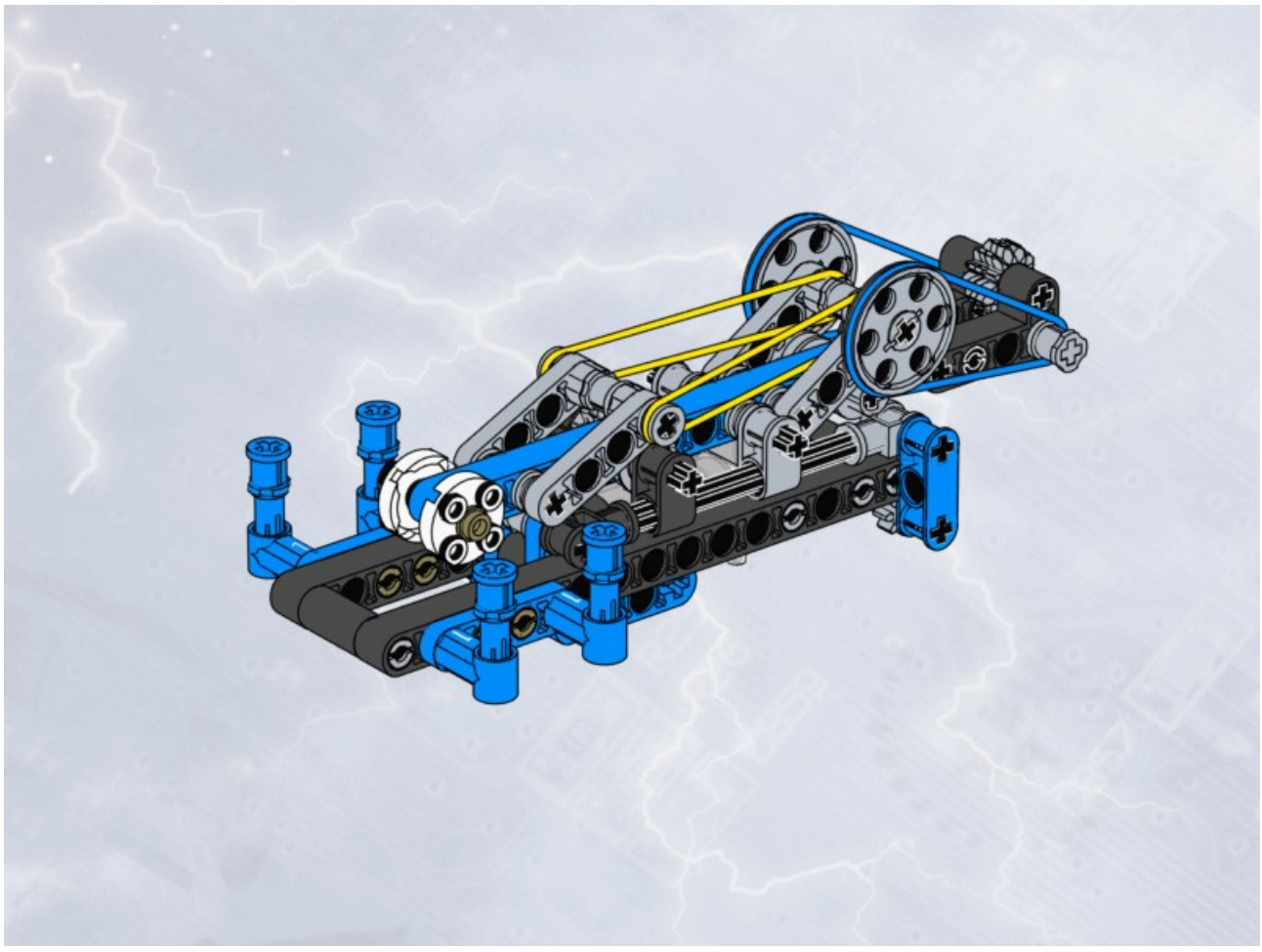

PARTS LIST


1/2 Bush
Round Plate 1x1
Plate 1x2 with Slide
Toothed Bar M=1, Z=10
TECHNIC Doub. Bearing PL 2x2
2M Cross Axle w. Groove
Cross Axle 3M
Cross Axle 5M
Cross Axle 10M
Cross Axle w. Bush
3M Cross Axle W. Knob
TECHNIC Brick 1x1
TECHNIC Brick 1x8
T-Beam w. Plate 1x2 w. Tube
T-Beam w. Plate 1x2 w. Knob
Double Conical Wheel Z12 1M
Double Conical Wheel Z20 1M
Bevel Gear Z20
Rim for Belt ø24x20
TECHNIC Ang. Beam 4x2 90 deg.
TECHNIC Ang. Beam 3x5 90 deg.


Angular Beam 90 Deg. 3x5
TECHNIC 3M Beam
TECHNIC 5M Beam
TECHNIC 7M Beam
TECHNIC 15M Beam
TECHNIC 15M Beam
Pneumatic Tube 150cm, 3800
Weld. Shifting Valve
Double Acting Cylinder 6M
Pneumatic Mini Pump
Worm Gear Block
Connector Peg w. Friction
Connector Peg w. Friction 3M
Connector Peg/Cross Axle
1 1/2M Connecting Bush

2M Fric. Snap w. Cross Hole

Catch w. Cross Hole

Catch w. Cross Hole

Link w. Snap w. Friction

Cross Block 90 deg.

Angle Element 135 deg. (4)

Cross Axle, Extension

Tube ø7,84 2M

Lever 1x4, without Notch

Lever 1x4, without Notch

Halfbeam Curve 3x5

Triangle

TECHNIC Lever 4M

TECHNIC Lever 3M

TECHNIC Lever 3M

TECHNIC Lever 3M

Double Cross Block

TECHNIC Cross Block 2x1

Tractor Tyre ø8/ø14

Rubber Band ø16 Internal


Bobbin
TECHNIC Angular Beam 4x4
TECHNIC Turntable
EL-Plate 2x2 w. Wire 52cm
Gear Motor
1mmx2M Cross Interlaced String
4x6 Brick, ø4,85 PC
6x8 Brick, ø4,85 PC
TECHNIC Angular Beam 3x7
TECHNIC Angular Beam 3x7
Disc Deco. No. 50 MINDSTORMS
Plate Round 2x2