



ENGINEERING MAKERSPACE ALIEN ROBOTS

創客工程 機械魔獸

EXPERIMENTS



7445

138 PCS

6+

STEAM

LEARN ABOUT LEVERS
AND LINKAGES
了解槓桿和連桿



10 MODELS
TO BUILD



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On pages 7-8 you can see all the models at a glance.

在第 7-8 頁上，您可以一目了然地看到所有模型。



Learn more about levers, including the anchor pin lever, on pages 9-12. Learn about linkages on page 45-46.

了解更多關於槓桿的信息，包括第 9-12 頁上的扳手。了解第 45-46 頁的連桿結構。



TIPS FOR ASSEMBLY 組裝小技巧

TIPS FOR ASSEMBLY
組裝小技巧

For more assembly tips,
please refer to
更多組裝小技巧，請參考



PEG REMOVER 扳手



Side A of the lever can be used to easily remove pegs.

扳手的 **A** 面可以用來輕鬆拆卸結合鍵。

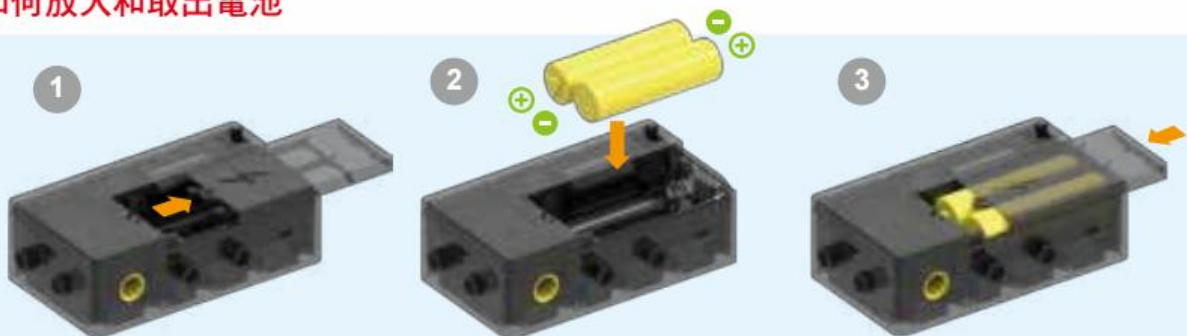


Side B can be used to loosen firmly inserted parts, such as axle.

B 面可用於鬆開牢固插入的部件，如自轉軸鍵。

BATTERIES 電池

How to insert and remove the batteries
如何放入和取出電池



Open the battery compartment by sliding the lid open. Insert two batteries. Make sure you fit the positive and negative ends into the compartment in the direction indicated (with the correct polarity). Then close the compartment. When it is time to replace the batteries, remove the old batteries and insert the new ones with the correct polarity.

打開蓋子，才能打開電池盒。插入兩塊電池。確保按照指示的方向，符合正確極性，將正極和負極端裝入電池倉。然後關上蓋子。當需要更換電池時，請取出舊電池並以正確的極性放入新電池。



SAFETY INFORMATION 安全資訊

Warning! Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.

Keep the packaging and the instructions as they contain important information.

Warning! Do not aim at eyes or face.

Store the experiment materials and assembled models out of the reach of small children.

The models are intended for indoor use. Do not use your models in a sandbox.

Safety Advice for Batteries

- »» Two AA batteries (1.5-volt, type LR6) are required for operation.
- »» The supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.
- »» Different types of batteries (e.g., rechargeable and standard) or new and used batteries are not to be mixed.
- »» Do not mix old and new batteries.
- »» Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- »» Batteries are to be inserted with the correct polarity. Press them gently into the battery compartment. See page 2.
- »» Always close the battery compartment with the lid.

Dear Parents and Supervising Adults,

Before starting the experiments, read through the instruction manual together with your child and discuss the safety information. Check to make sure the models have been assembled correctly, and assist your child with the experiments.

We hope you and your child have a lot of fun with the experiments!

- »» Non-rechargeable batteries are not to be recharged. They could explode!
- »» Rechargeable batteries are only to be charged under adult supervision.
- »» Rechargeable batteries are to be removed from the toy before being charged.
- »» Exhausted batteries are to be removed from the toy.
- »» Dispose of used batteries in accordance with environmental provisions, not in the household trash.
- »» Be sure not to bring batteries into contact with coins, keys, or other metal objects.
- »» Avoid deforming the batteries.
- »» Please remove the batteries if the toy is likely to be unused for a long time.

Notes on Disposal of Electrical and Electronic Components

The electronic components of this product are recyclable. For the sake of the environment, do not throw them into the household trash at the end of their lifespan.

They must be delivered to a collection location for electronic waste, as indicated by the following symbol:

Please contact your local authorities for the appropriate disposal location.



SAFETY INFORMATION 安全資訊

警告！本套組不適合3歲以下的幼童使用。其中包含細小零件可能被幼童吞嚥或吸入，產生窒息危險。

因內含重要訊息，請將包裝盒與說明書妥善保存。

警告！不要瞄準眼睛或臉。

請將實驗材料和組裝模型存放在幼童無法取得之處。

請在室內環境中遊玩，勿在沙坑中使用本套組的模型。

電池的安全建議

- ›› 操作需要兩個AA電池（1.5伏特，LR6型）。
- ›› 供電終端不得短路。短路會導致導線過熱並導致電池爆炸。
- ›› 不同類型的電池（如可充電電池和標準電池）或新電池和舊電池不得混用。
- ›› 請勿混用舊電池和新電池。
- ›› 請勿混用鹼性，標準（碳鋅）或可充電（鎳鎘）電池。
- ›› 電池將以正確的極性插入。輕輕地將它們按入電池盒。見第2頁。
- ›› 請務必用蓋子關閉電池盒。
- ›› 非充電電池不能被充電。若強行充電，可能會導致電池爆炸！
- ›› 請在成人監督下，對充電電池進行充電。
- ›› 在充電前，請將充電電池從電池盒取出。
- ›› 請將耗盡的電池從電池盒中取出。
- ›› 請按照環保規定處理廢舊電池，勿將廢舊電池丟入家庭的一般垃圾桶。
- ›› 請勿將電池與硬幣，鑰匙或其他金屬物體接觸。
- ›› 請避免電池變形。
- ›› 如果長時間不使用本套組的模型，請取出電池。

親愛的父母：

在實驗開始之前，請仔細閱讀使用說明書並和您的孩子一起討論安全資訊。請仔細檢查模型以確保有將模型正確組裝，並協助您的孩子進行實驗。

我們希望您和您的孩子在使用本套組時能獲得樂趣與完成有趣的實驗！

電子及電氣設備廢棄物處理說明

該產品的電子設備屬於可回收利用的垃圾。為了環保，在電子設備壽命結束時，請不要把它們丟入家庭一般垃圾。必須將其交付給電子垃圾回收站，如右圖所示：

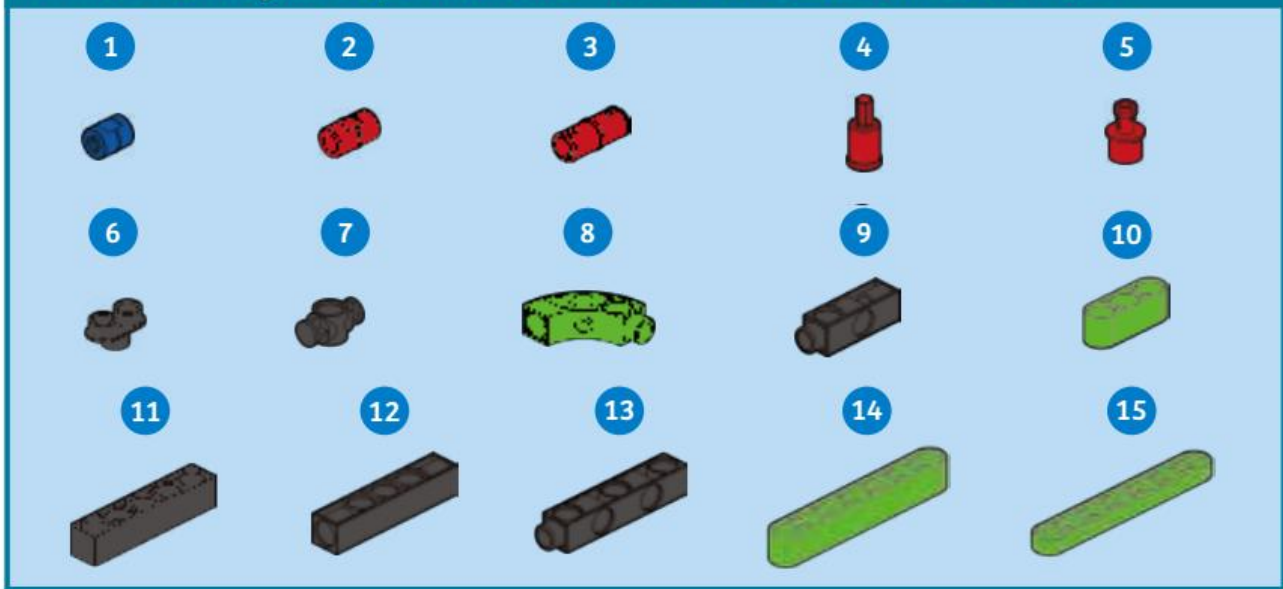
請聯繫當地政府的相關處理場所。





KIT CONTENTS 包裝內容

What's inside your experiment kit: 你的實驗包裡面有什麼零件呢？



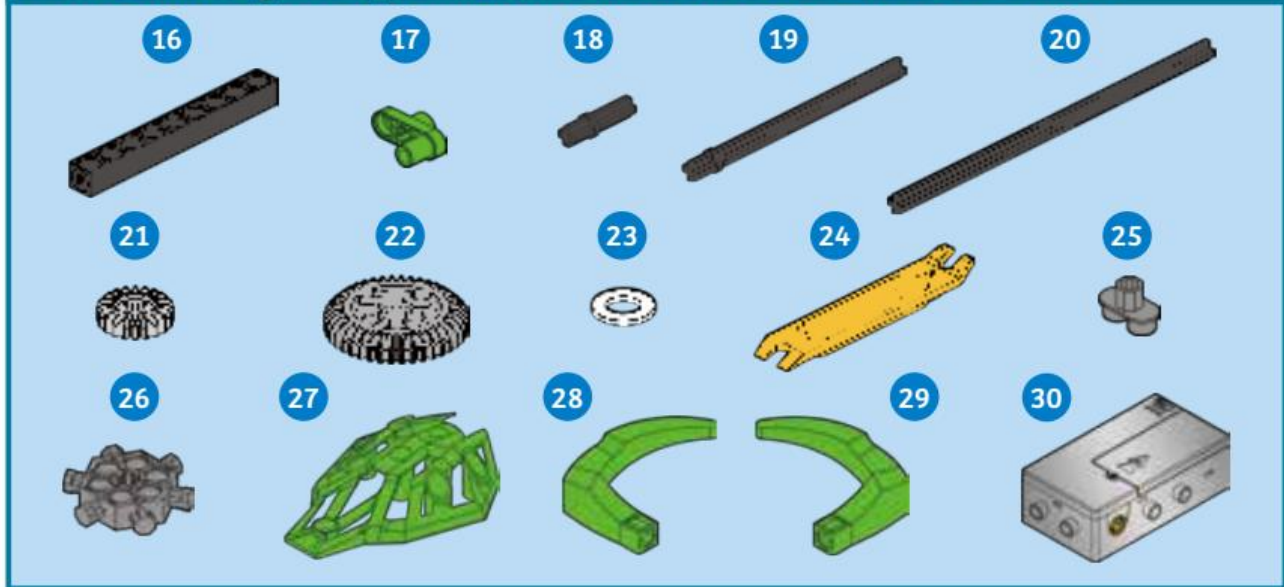
Checklist: Find – Inspect – Check off 清單：查找 - 檢查 - 核對

✓ NO. 號碼	Description	零件名稱	QTY. 數量	ITEM NO. 品號
<input type="radio"/>	1 B-SHORT PEG	B- 短結合鍵	30	7344-W10-C2B
<input type="radio"/>	2 C-LONG PEG	C- 長結合鍵	10	7061-W10-C1R
<input type="radio"/>	3 C-20mm AXLE CONNECTOR	C-20mm 軸扣鍵	16	7413-W10-T1R
<input type="radio"/>	4 C-CAM CONNECTOR	C- 凸輪連結鍵	4	7413-W10-S1R
<input type="radio"/>	5 C-AXLE	C- 自轉軸鍵	4	7026-W10-H1R
<input type="radio"/>	6 C-TWO-IN-ONE CONVERTER	C- 二合一結合鍵	2	7061-W10-G1D
<input type="radio"/>	7 C-1 HOLE CONNECTOR	C-2 凸單孔轉向結合器	3	7430-W10-B1D
<input type="radio"/>	8 C-BENDED ROD	C-3 孔 1/4 弧長條	2	7061-W10-V1G3
<input type="radio"/>	9 C-3 HOLE DUAL ROD	C-3 孔超長條	1	7413-W10-Y1D
<input type="radio"/>	10 C-3 HOLE ROUND ROD	C-3 孔圓角長條	6	7404-W10-C1G2
<input type="radio"/>	11 C-5 HOLE ROD	C-5 孔長條	8	7413-W10-K2D
<input type="radio"/>	12 C-5 HOLE ROD FRONT CLOSED	C-5 孔長條側有孔	2	7413-W10-K3D
<input type="radio"/>	13 C-5 HOLE DUAL ROD BOTTOM CLOSED	C-5 孔超長條底無孔	2	7413-W10-W1D
<input type="radio"/>	14 C-7 HOLE ROUND ROD	C-7 孔圓角長條	6	7404-W10-C2G2
<input type="radio"/>	15 C-7 HOLE PROLATE ROD	C-7 孔圓角扁長條	6	7404-W10-C3G2

You will also need:
 2 x AA batteries (1.5 Volt, type LR6)
您還需要：
 2個AA電池(1.5伏特·LR6型)

KIT CONTENTS 包裝內容

What's inside your experiment kit: 你的實驗包裡面有什麼零件呢？



Checklist: Find – Inspect – Check off 清單：查找 - 檢查 - 核對

✓ NO. 號碼	Description	零件名稱	QTY. 數量	ITEM NO. 品號
<input type="radio"/>	16 C-9 HOLE ROD	C-9 孔長條	4	7407-W10-C1D
<input type="radio"/>	17 C-3 HOLE CRANK	C-3 孔曲軸	2	7409-W10-H1G1
<input type="radio"/>	18 C-30mm AXLE II	C-30mm II 軸	2	7413-W10-N1D
<input type="radio"/>	19 C-100mm AXLE II	C-100mm II 軸	1	7413-W10-L2D
<input type="radio"/>	20 C-150mm AXLE I	C-150mm I 軸	1	7026-W10-P1D
<input type="radio"/>	21 C-20T GEAR	C-20T 齒輪	2	7026-W10-D2S
<input type="radio"/>	22 C-40T GEAR	C-40T 齒輪	4	7346-W10-C1S
<input type="radio"/>	23 C-WASHER	C- 墊片	2	R12#3620
<input type="radio"/>	24 B-PEG REMOVER	B- 扳手	1	7061-W10-B1Y
<input type="radio"/>	25 C-TWO-IN-ONE FIXTURE	C- 八角二合一結合鍵	6	7445-W10-D1S
<input type="radio"/>	26 C-6-PIN HUB CONNECTOR	C-45 度多向結合器	2	7445-W10-A1S
<input type="radio"/>	27 C-MAIN BODY PIECE	C-M 型飾片	2	7445-W10-C1G
<input type="radio"/>	28 C-CLAW PIECE A	C-B 型腳(左)	3	7445-W10-B1G
<input type="radio"/>	29 C-CLAW PIECE B	C-B 型腳右)	3	7445-W10-B2G
<input type="radio"/>	30 C-28X MOTOR WITH SWITCH	C-28 倍開關馬達盒	1	7441-W85-A

OVERVIEW 概述

Alien Snake-Bot
異種蛇



Insectoid-Bot
機械昆蟲



Bipedal Robot
雙足機器人



Playground Swing
遊樂場鞦韆



**Build these
functional models
one at a time!**

同時打造出這些不同功能的
模型！

Rolling Dragon-Bot
滾滾龍



OVERVIEW 概述



Grabber Claw
機械爪



Roving Dino-Bot
神行恐龍



Alien Raptor
異形猛禽



Alien Frog-Bot
機械青蛙

Pumpjack
抽油機





CHECK IT OUT 知識補給站



THE LEVER

A **lever** is a simple machine used to raise or move an object; it consists of a rigid beam that can pivot on a fixed point, called the **fulcrum**. The side on which the load to be moved is located is called the **load arm**. The other side, on which the moving force is applied, is called the **force arm**.

»» **Everyday examples include seesaws, crowbars, and wrenches.**

These tools and toys take advantage of the fact that you can generate a great force by exercising a small force if you move farther away to do so.

PEG REMOVER



The peg remover in your experiment kit also uses a lever like this so that you can take the components apart more easily. The pivot point is between the two lever arms, so we call it a **"double-sided lever."**

»» **A wheelbarrow uses a different kind of leverage to reduce the amount of force needed to lift a load.**



In this case, the wheel of the wheelbarrow is the pivot (fulcrum) of the lever. The two lever arms constitute the distance to the center of gravity of the load and the distance to the hold point of the wheelbarrow. Because both lever arms are on the same side, this type of lever is called a **"one-sided lever."** But the principle is the same as with the peg remover!

CHECK IT OUT 知識補給站



槓桿

槓桿是一個簡單機械，用於提升或移動物體；有一個橫樑可以在一個固定點上旋轉，此固定點稱為**支點**。放置負載的一側被稱為**負載臂（抗力臂）**。施加動力的另一側稱為**施力臂**。

>>> 日常生活的例子包括蹺蹺板、撬棍和扳手。

這些工具運用一個科學原理：如果施力臂的長度比抗力臂長，只需要使用微小的力量就可以產生強大的效果。



扳手

實驗套件中的扳手也使用這樣的槓桿，以便你可以更輕鬆地拆下零件。支點位於兩個槓桿臂之間，所以我們稱之為「**雙面槓桿**」。

>>> 單輪推車使用不同類型的槓桿來減少載送貨物所需的力量。



在這種情況下，單輪推車的輪子是槓桿的支點。兩個槓桿臂構成到負載的距離以及到單輪推車把手的距離。

因為兩個槓桿臂都在同一側，所以這種槓桿稱為「**單側槓桿**」。但原理與扳手相同！



CHECK IT OUT 知識補給站

THE FORCES ON A LEVER

The fulcrum is the spot on the bottom of the peg remover that doesn't move when the tool is used to pry up a peg. The two arms pivot around this point.

Load Arm and Force Arm

When you press on the handle with enough effort force for the peg to come out of its hole, the part separator tool is in a state of balance or equilibrium in its work. The arm of the lever on the effort side is longer in proportion to the degree that the effort force is smaller. The opposite happens on the load side. The load arm is shorter in proportion to the degree that the load force is greater. If the effort arm is twice as long as the load arm, then there is a balance when the effort force is half as great as the load force. Effort force (kg) times the distance on the effort arm from the exertion point of the effort force to the fulcrum (m) is equal to load force (kg) times the distance from the load force to the fulcrum on the load arm (m). Written a little differently, this is how the equation goes:

$$\begin{aligned} \text{effort force} \times \text{effort arm length} \\ = \\ \text{load force} \times \text{load arm length} \end{aligned}$$

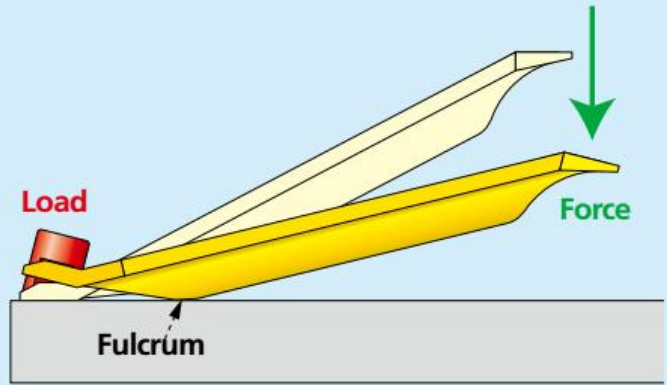
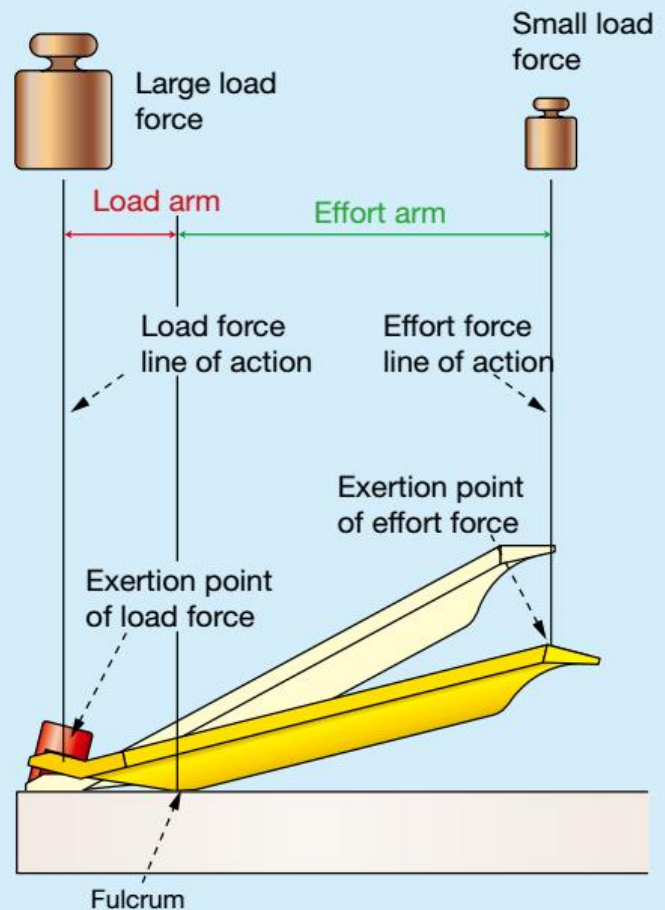


Diagram: Lever



»» Look for levers in the models you build!

CHECK IT OUT 知識補給站

槓桿上的力量

支點是扳手底部的一個點，當使用工具撬起一個結合鍵時，它不會移動。支點兩端的力臂會繞著這一個支點轉動。

抗力臂和施力臂

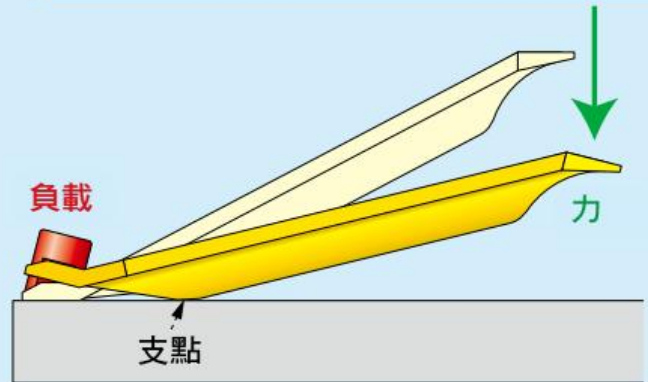
當你用力將結合鍵從孔中拉出時，手柄上的壓力足以使扳手處於平衡狀態或均衡狀態。若施力臂的距離較長，所需的施力就等比例地較小。相反的情況也發生在抗力臂。抗力臂的距離較短時，所需的負載力就會等比例地變大。

如果施力臂的長度是抗力臂的兩倍，那麼當施力是負載力的一半時，就會產生平衡。作用力的大小 (kg) 乘以作用點到支點 (m) 的施力臂距離等於從負載力 (kg) 乘以抗力臂的距離 (m)。公式為：

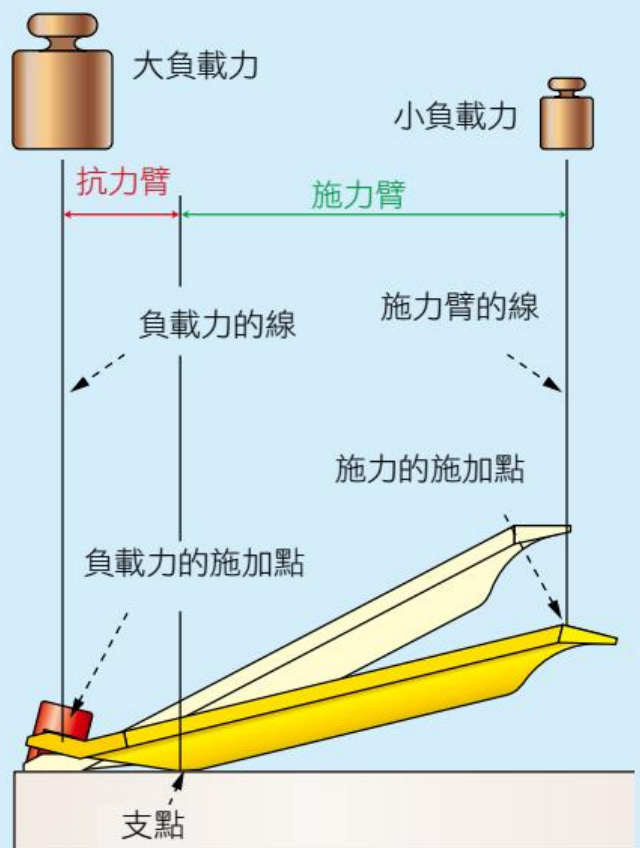
施力 × 施力臂長度

=

負載力 × 抗力臂長度



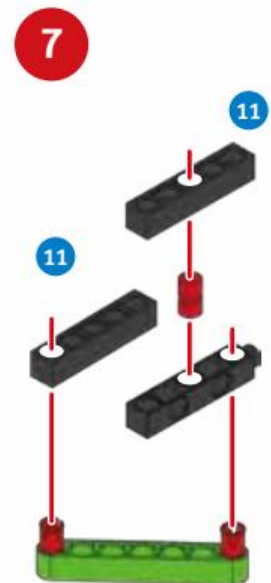
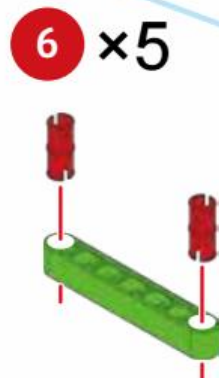
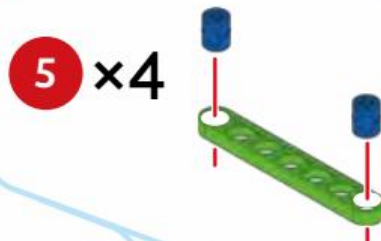
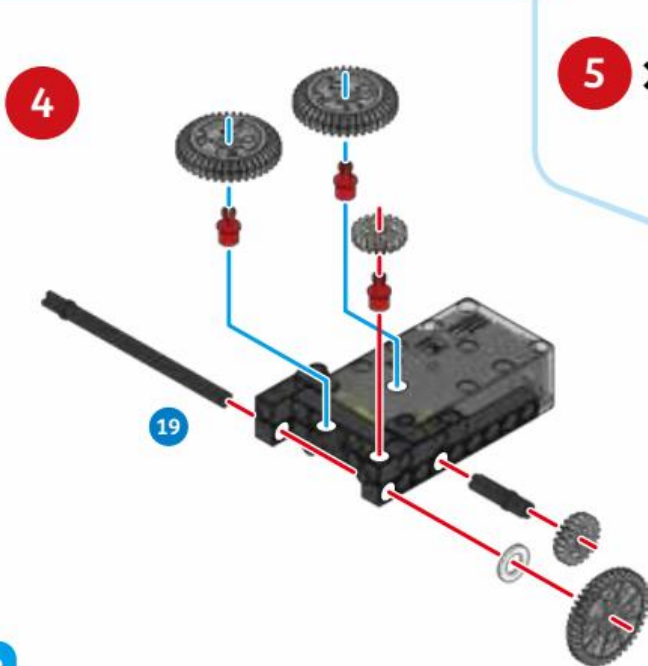
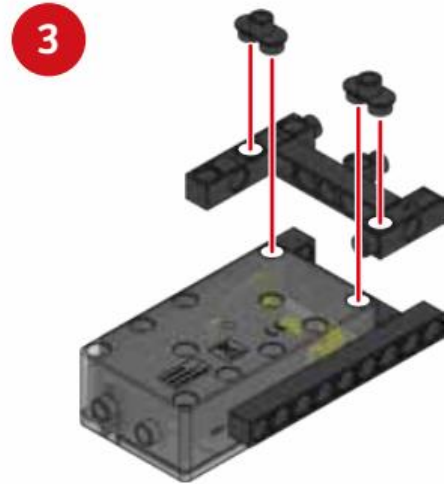
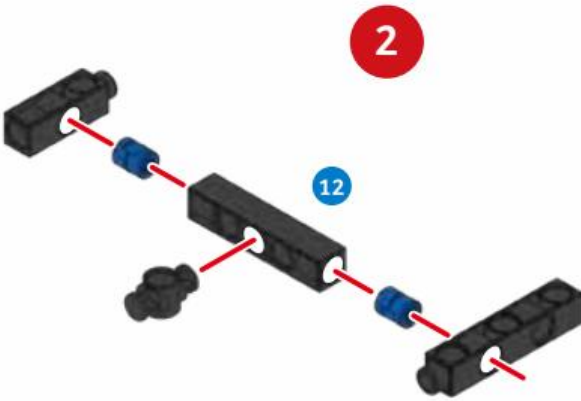
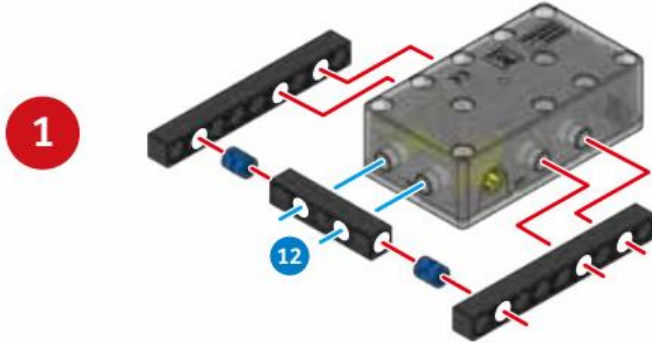
圖表：槓桿



>>> 找找看，在你建立的模型中有哪些用到槓桿原理？

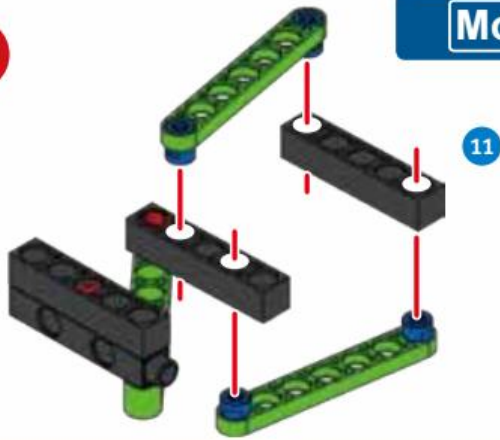


異種蛇 Alien Snake-Bot Model 模型 1

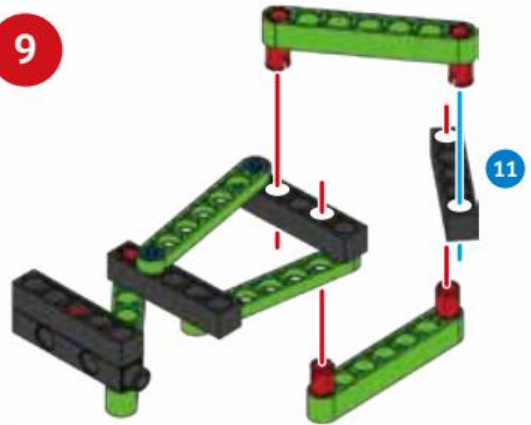


Model 模型 1 Alien Snake-Bot 異種蛇

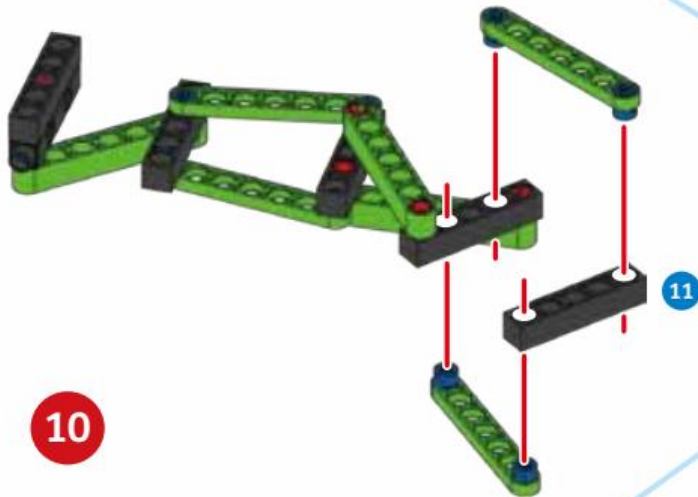
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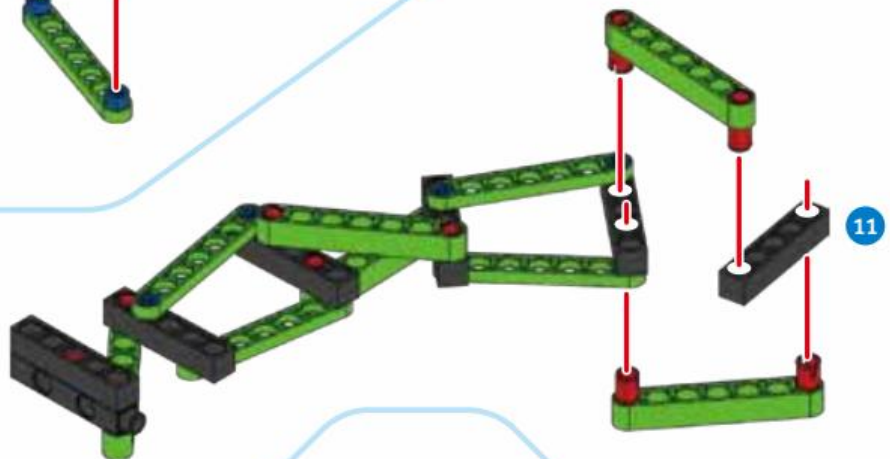
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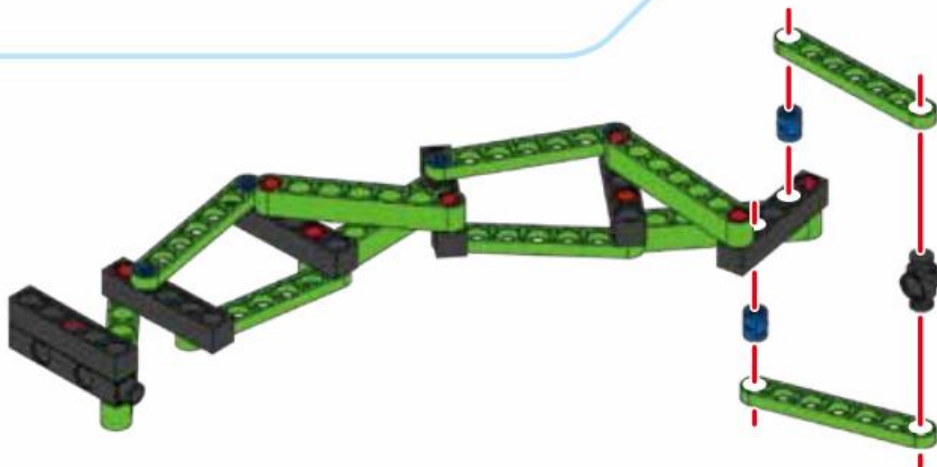
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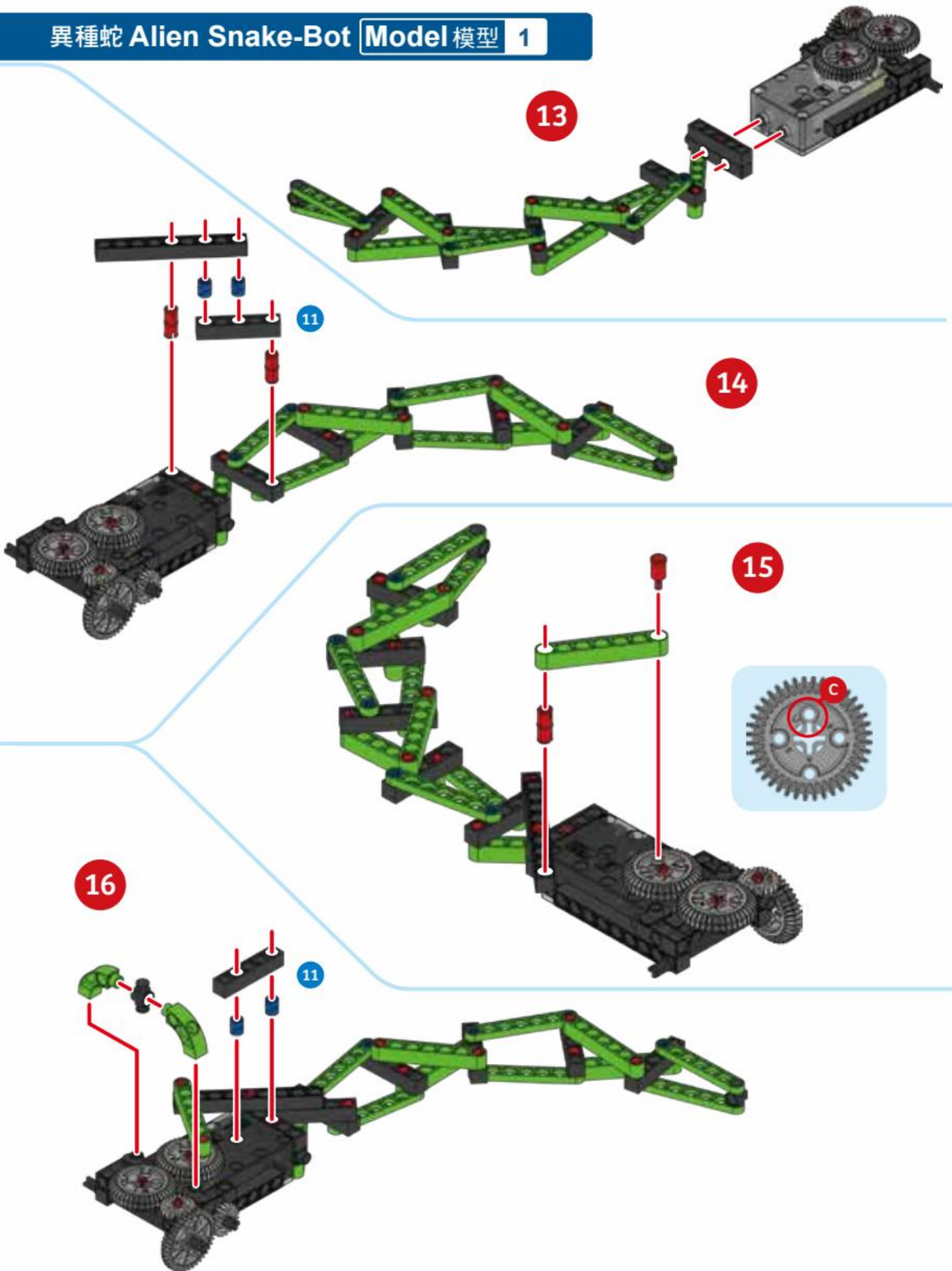


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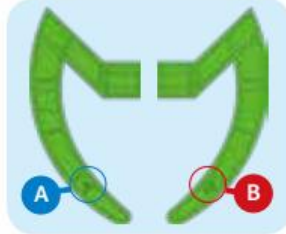
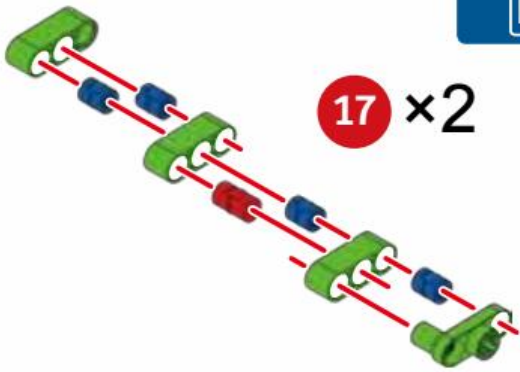




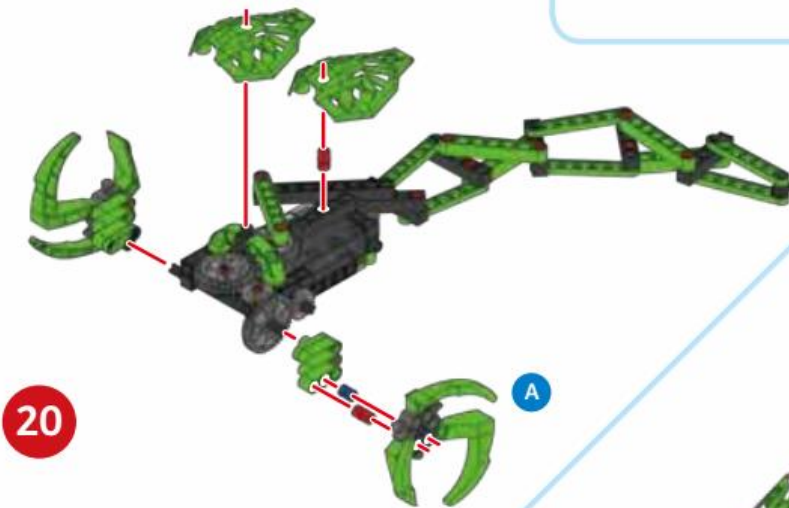
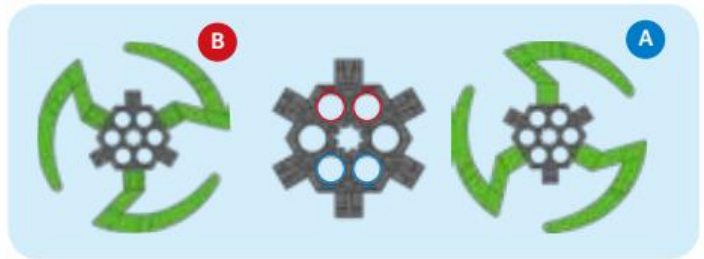
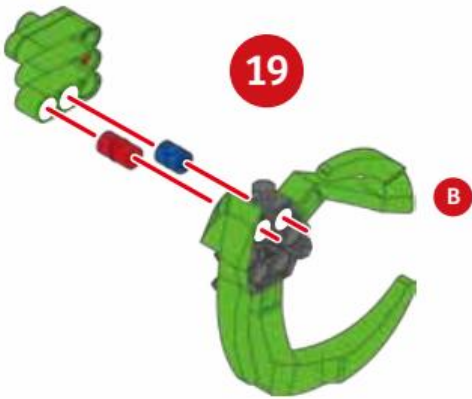
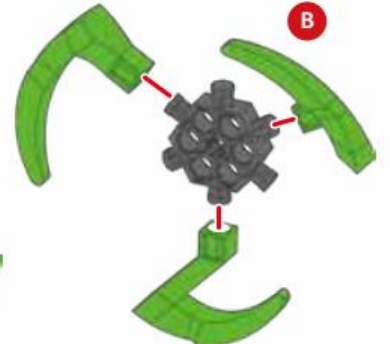
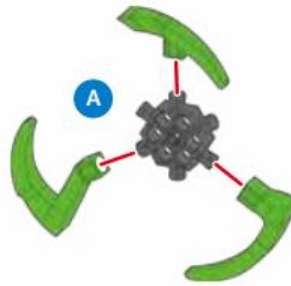
異種蛇 Alien Snake-Bot Model 模型 1



Model 模型 1 Alien Snake-Bot 異種蛇

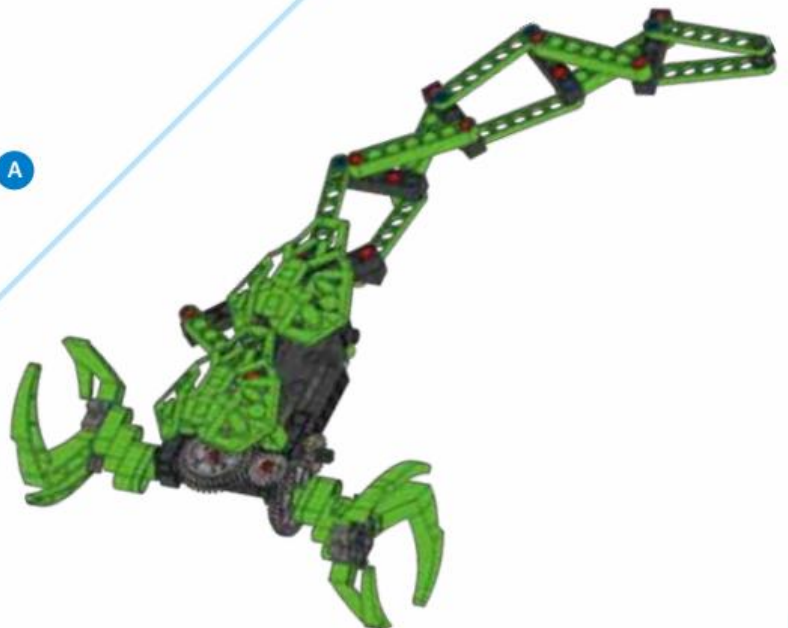


18



21

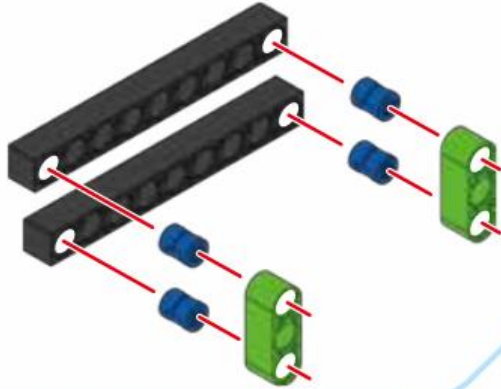
Done!
完成!



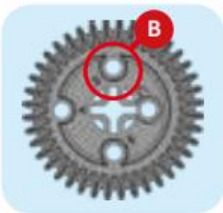
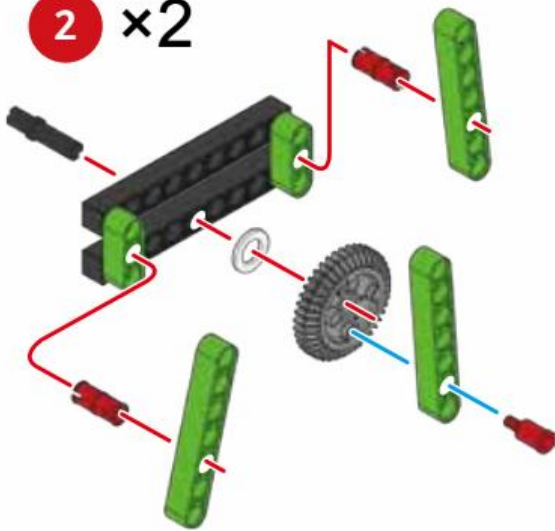


機械昆蟲 Insectoid-Bot Model 模型 2

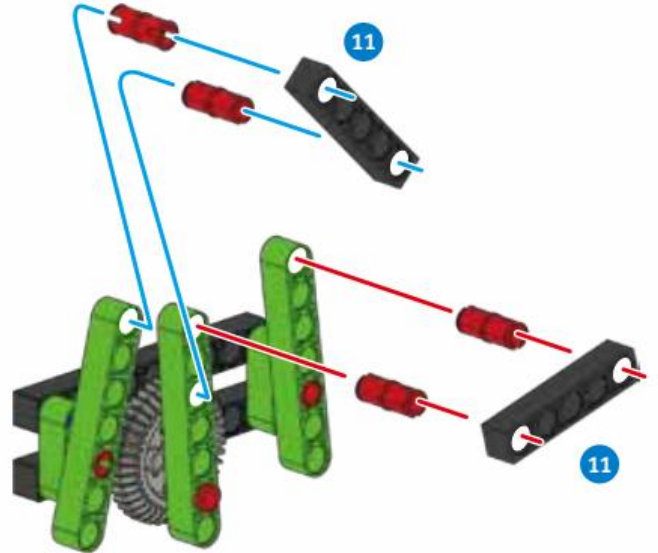
1 × 2



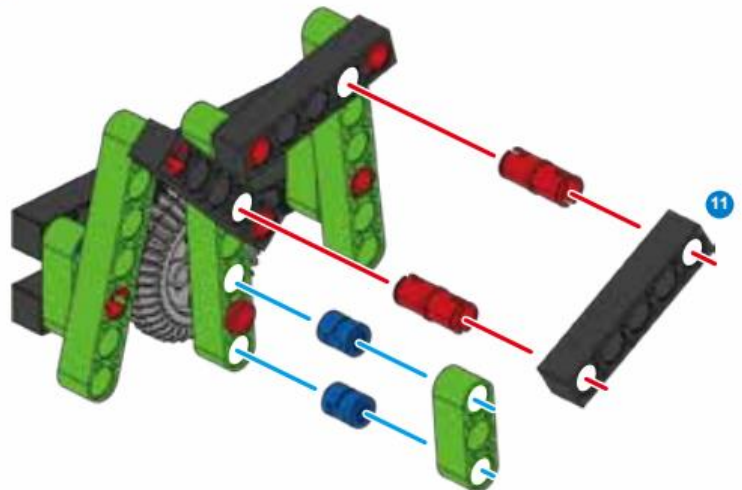
2 × 2



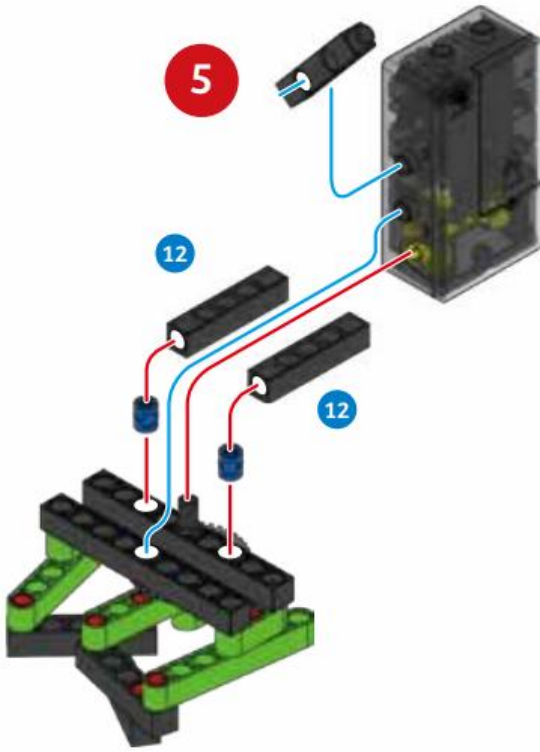
3 × 2



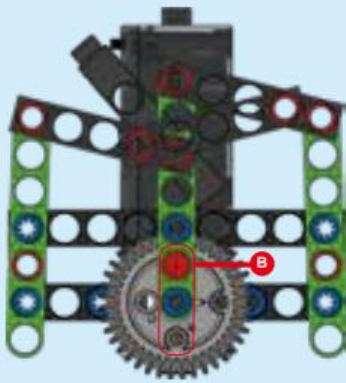
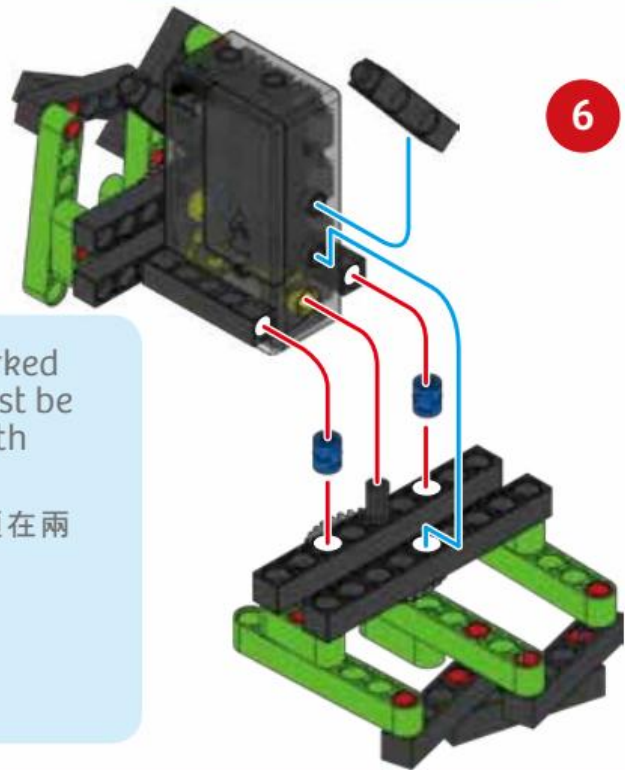
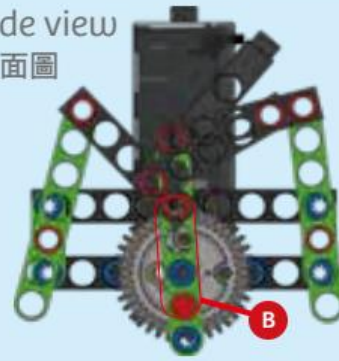
4 × 2



Model 模型 2 Insectoid-Bot 機械昆蟲

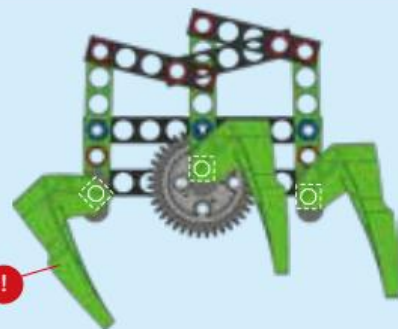
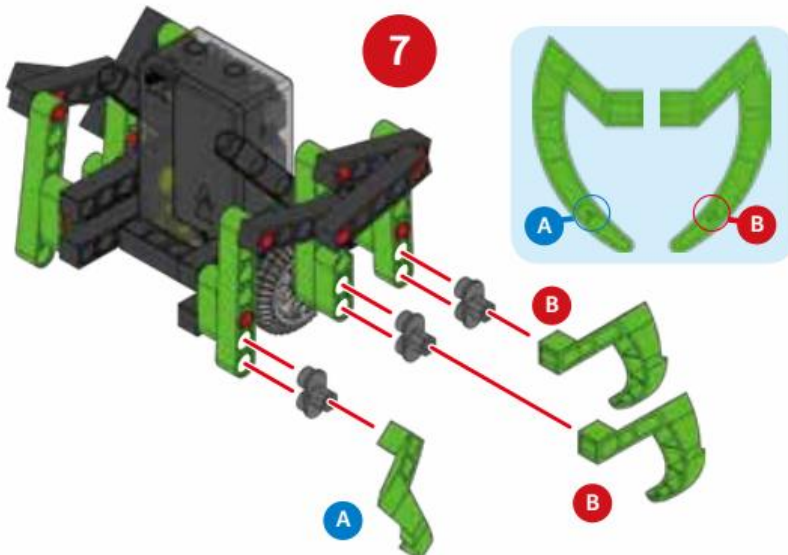


Side view
側面圖



The holes marked with the B must be vertical on both sides.

標有 B 的孔必須在兩側都是垂直的。

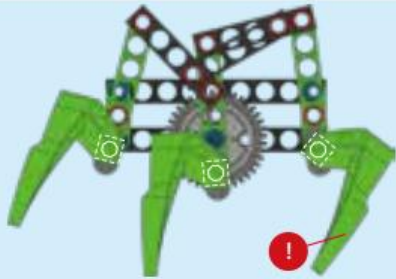


Note! This part is angled differently than the others.

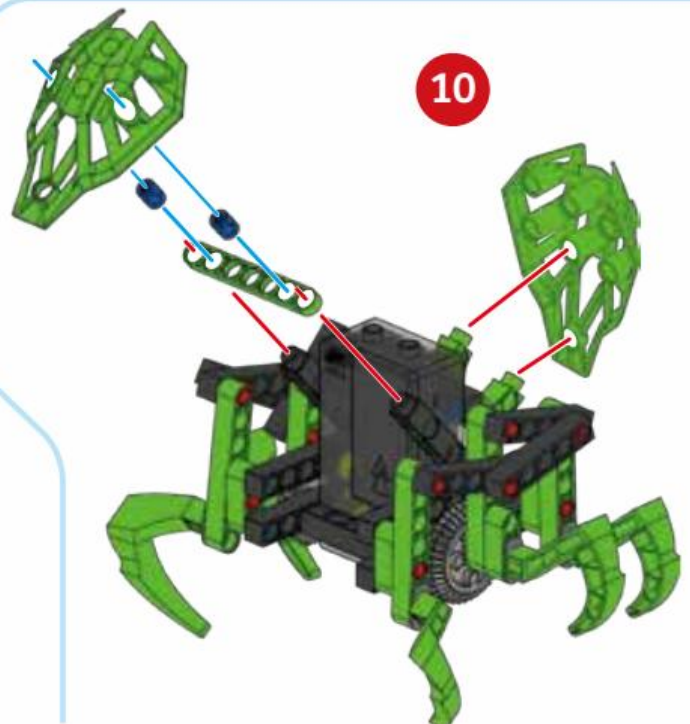
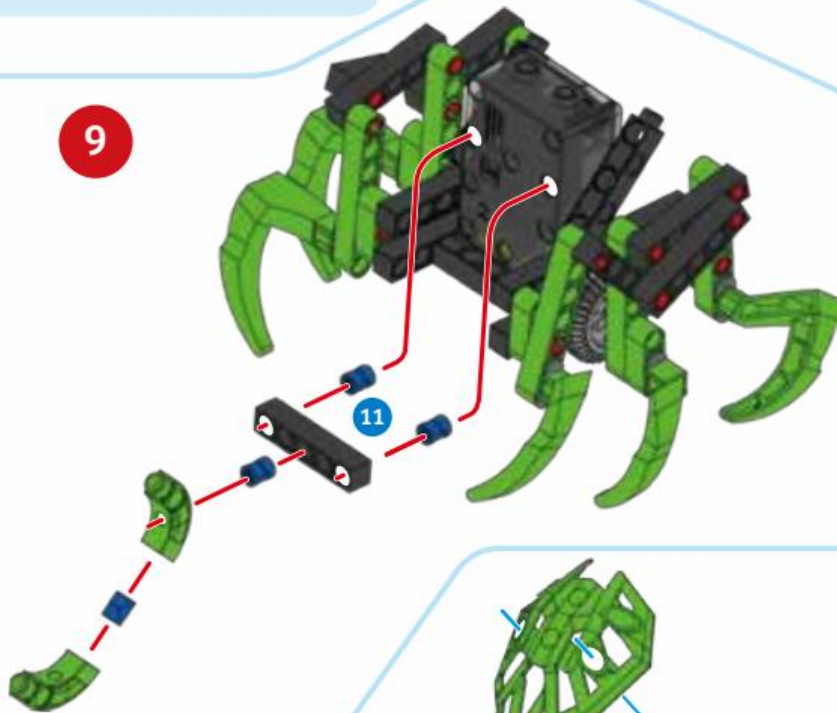
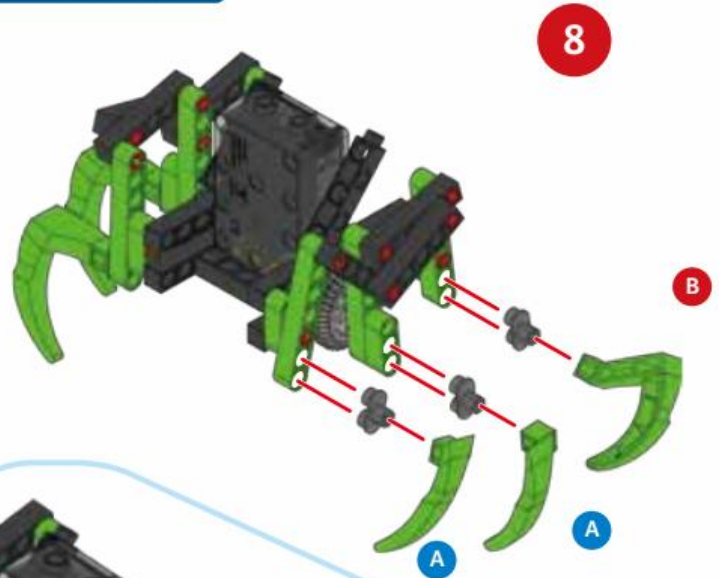
注意！這個零件的角度與其他角度不同。



機械昆蟲 Insectoid-Bot Model 模型 2

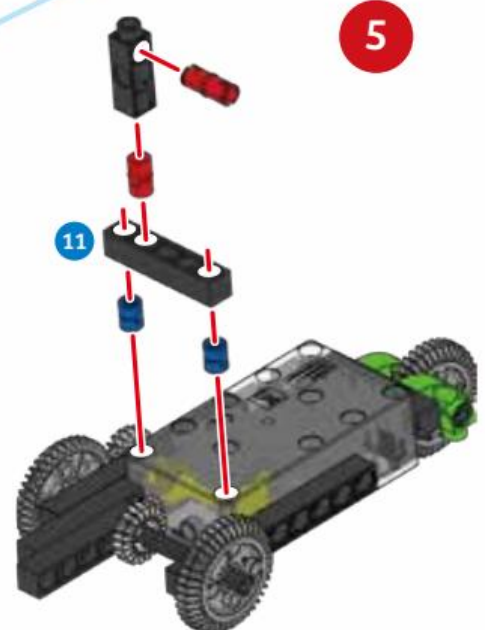
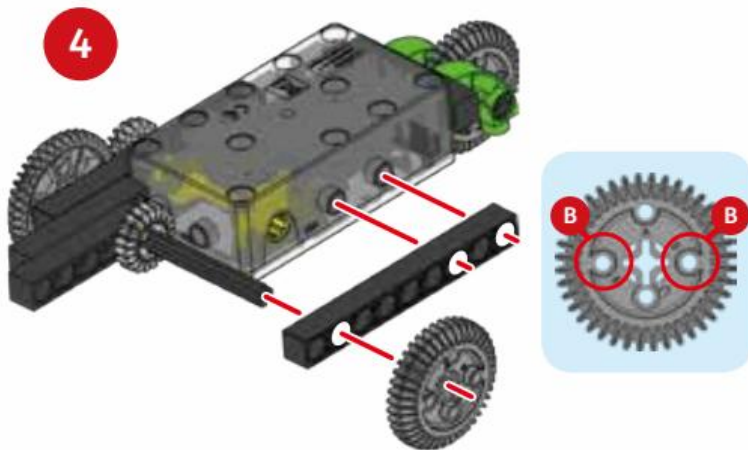
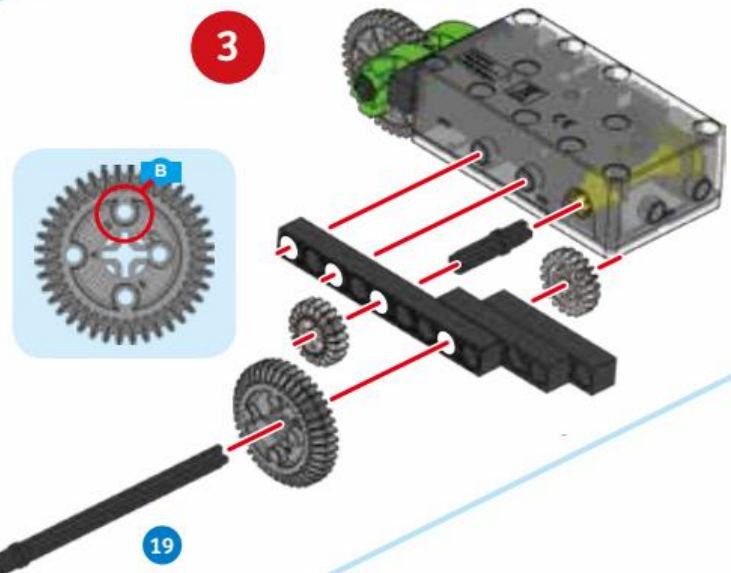
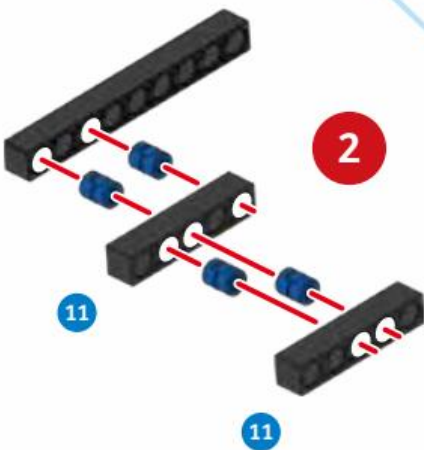
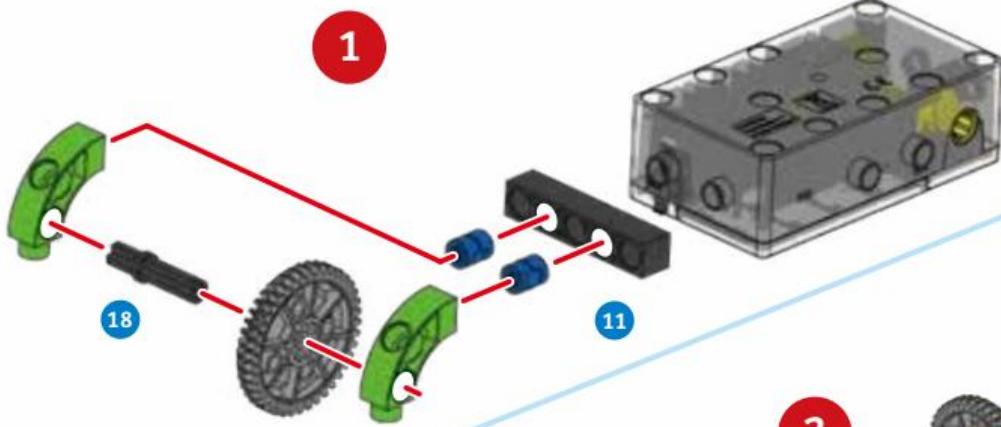


Note! This part is angled differently than the others.
 注意！這個零件的角度與其他角度不同。



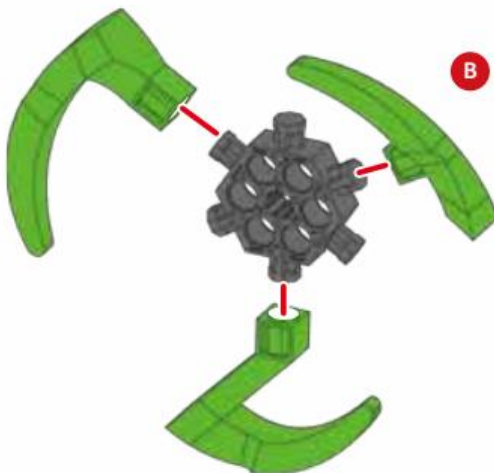
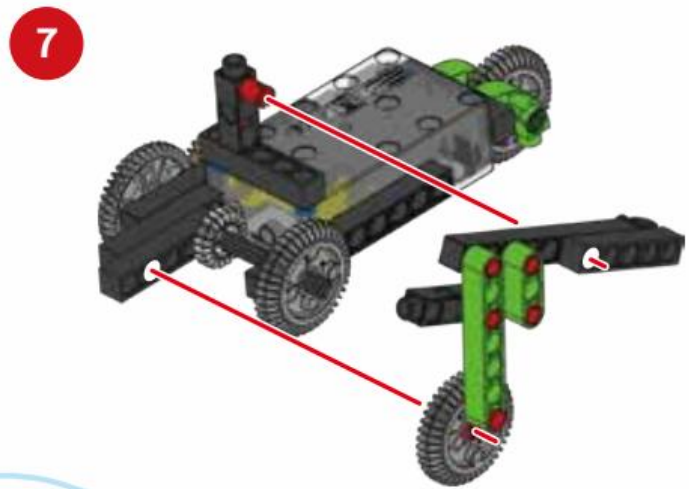
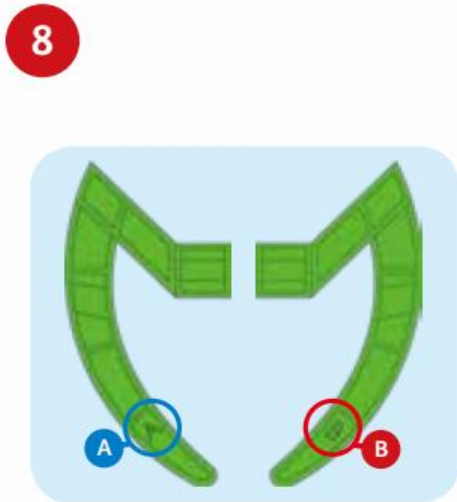
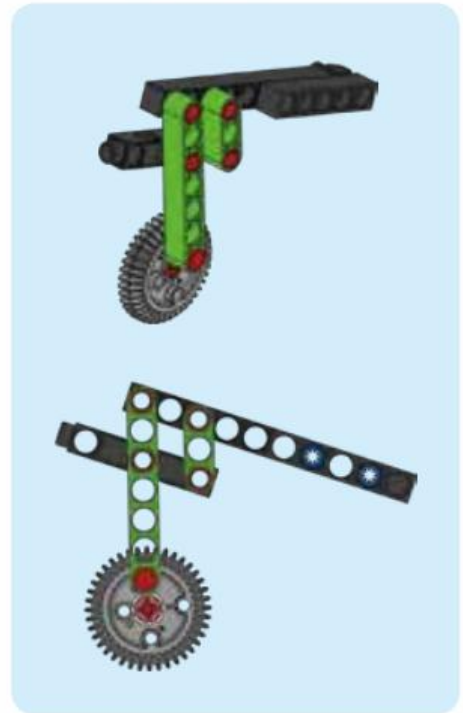
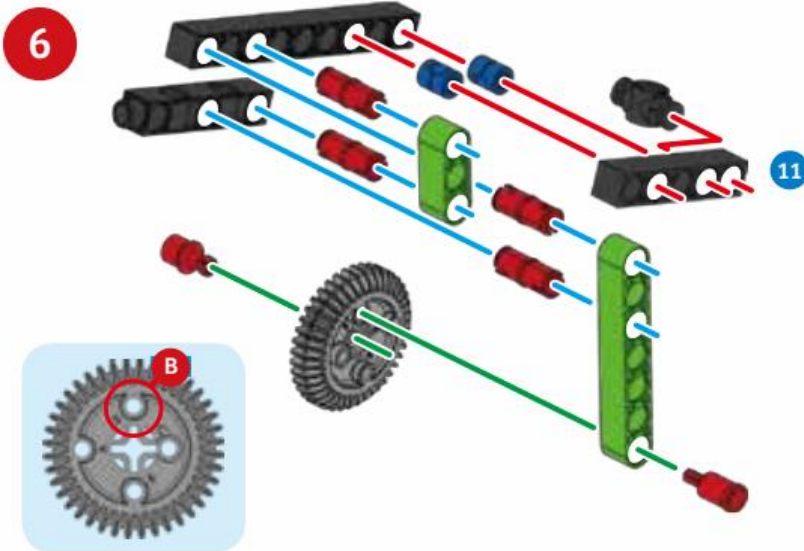
Done!
完成!

Model 模型 3 Rolling Dragon-Bot 滾滾龍





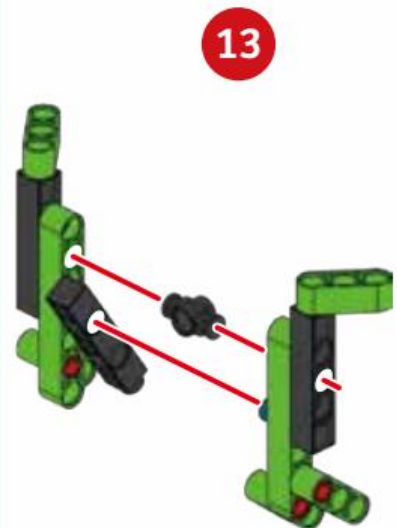
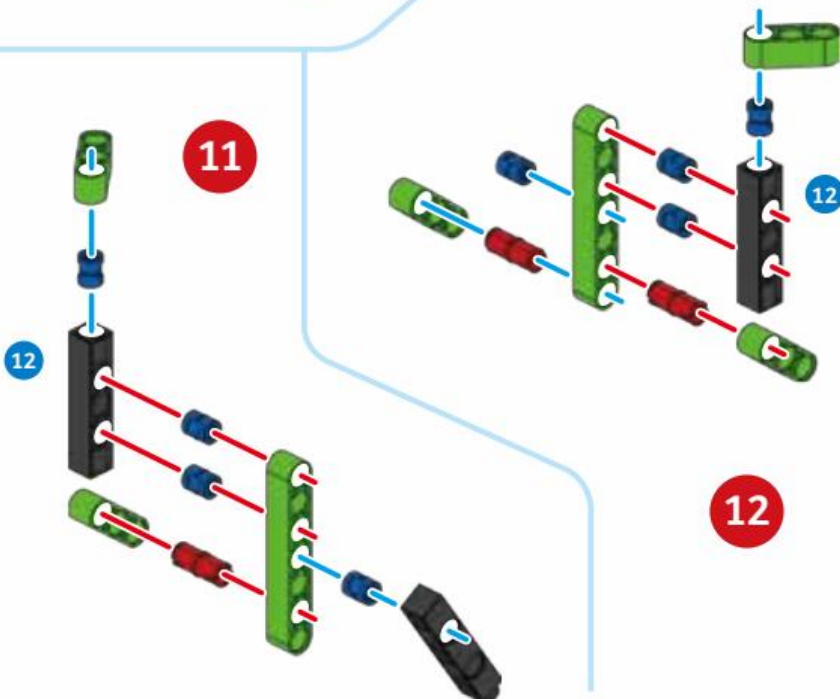
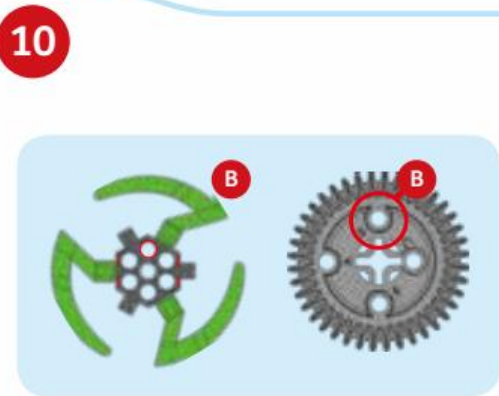
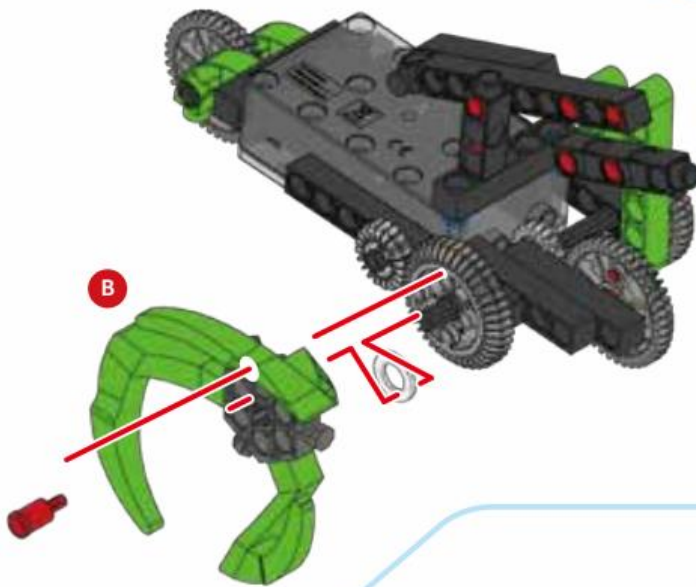
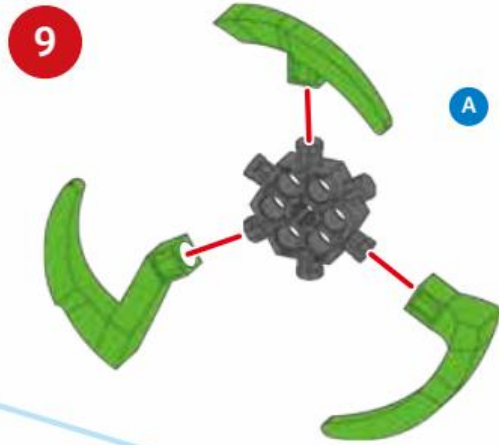
滾滾龍 Rolling Dragon-Bot Model 模型 3



Model 模型 3 Rolling Dragon-Bot 滾滾龍



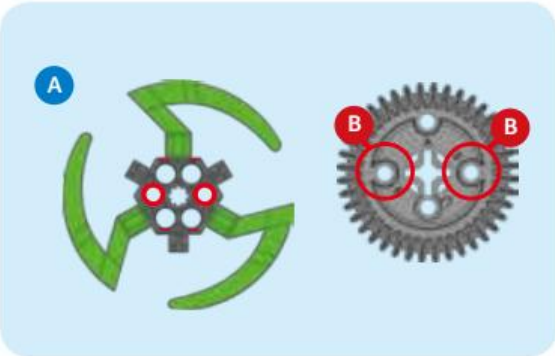
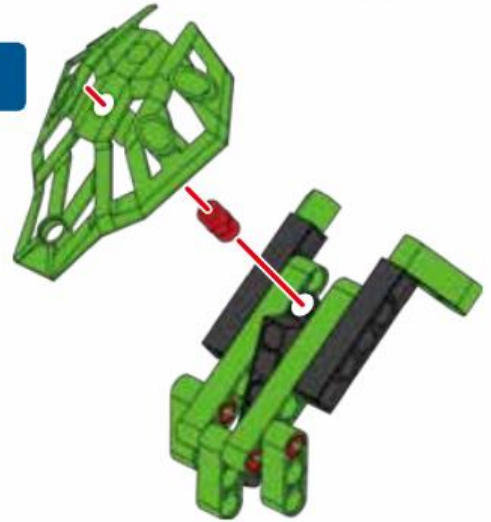
Note the markings.
請注意標記。



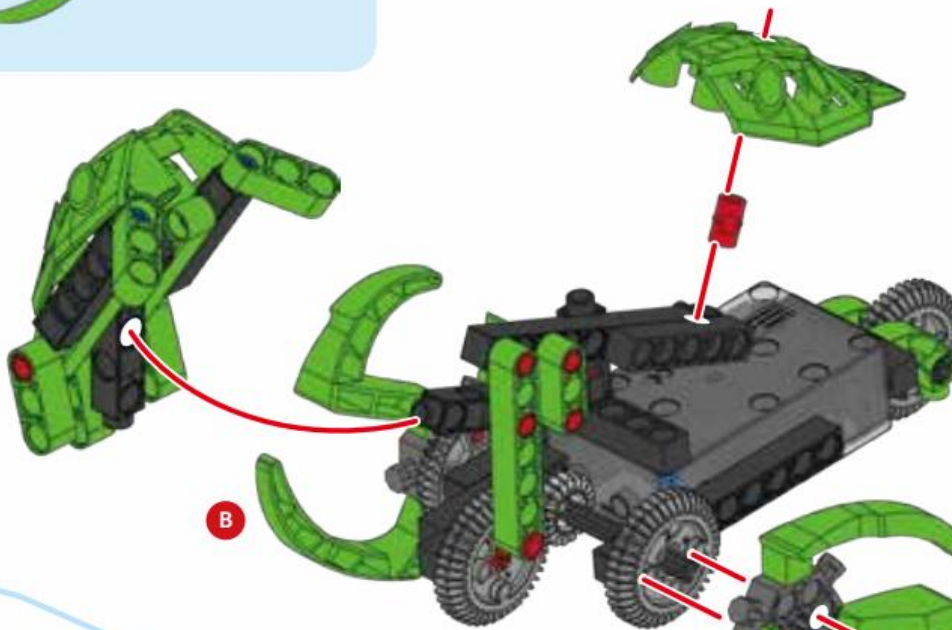


滾滾龍 Rolling Dragon-Bot Model 模型 3

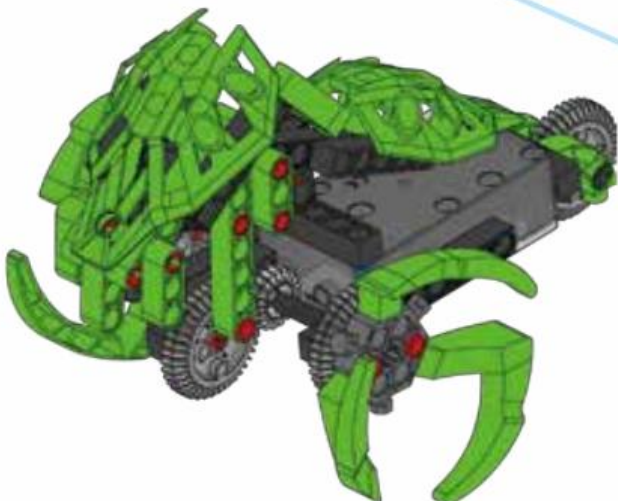
14



15

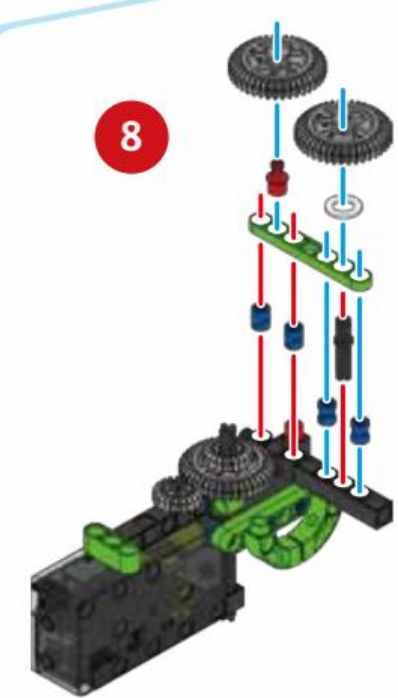
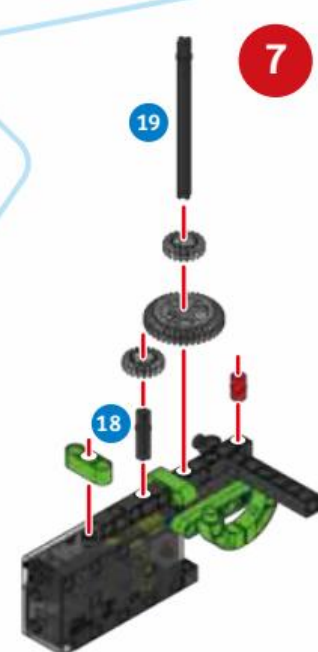
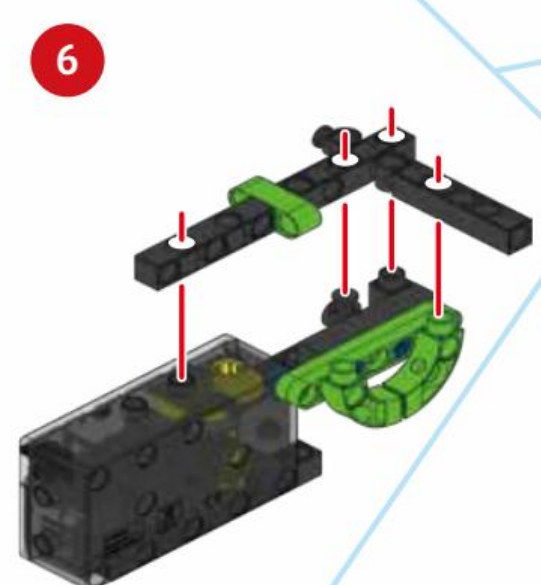
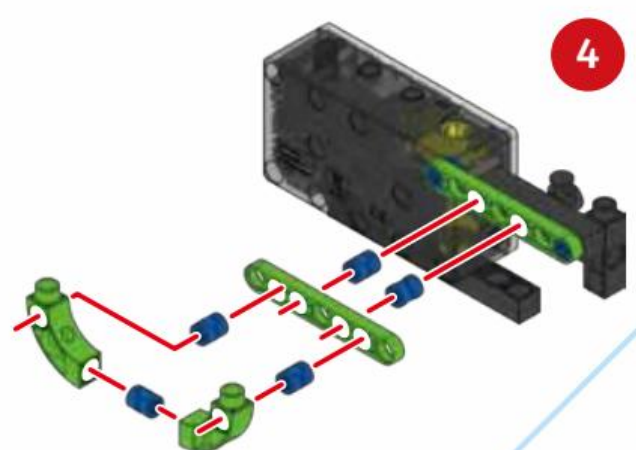
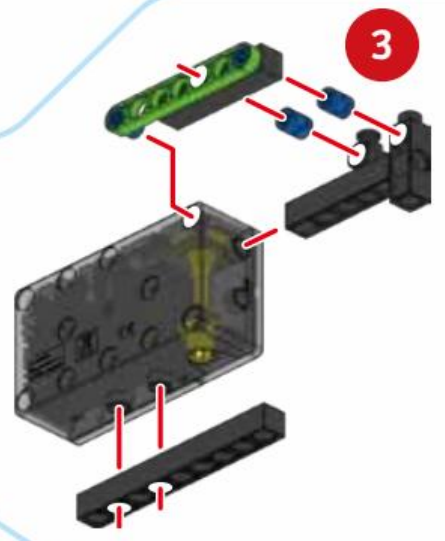
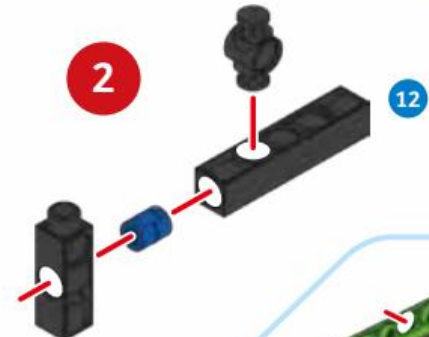
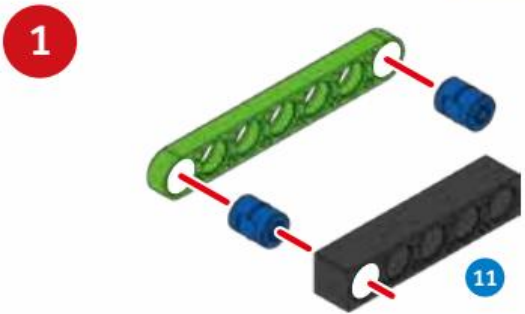


16



Done!
完成!

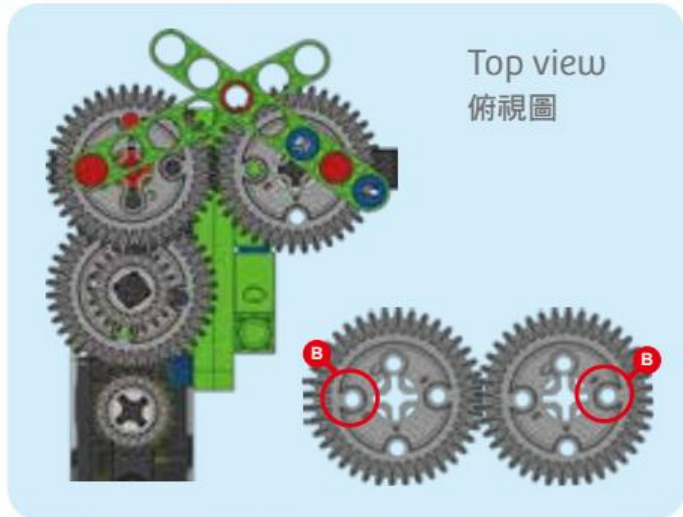
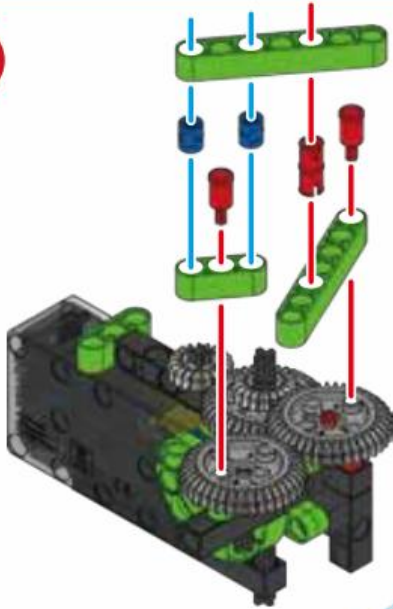
Model 模型 4 Grabber Claw 機械爪





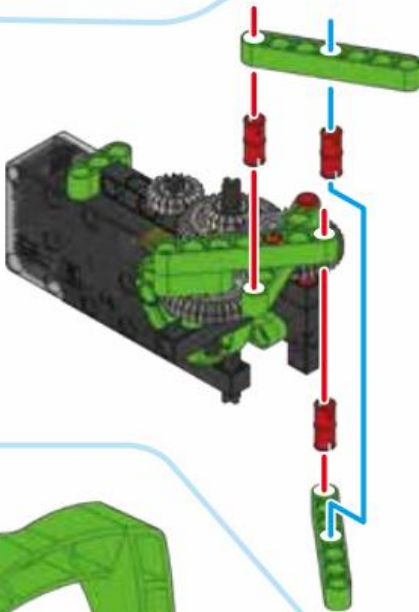
機械爪 Grabber Claw Model 模型 4

9

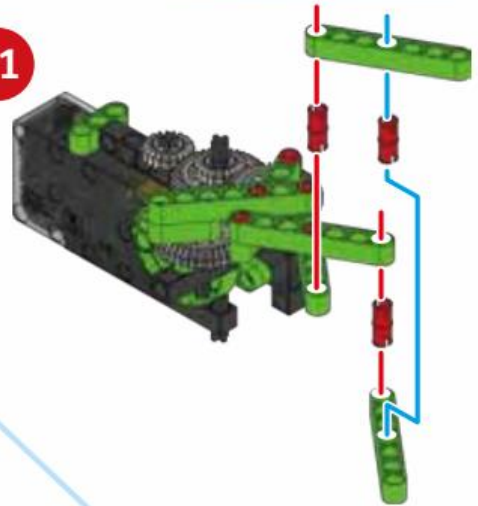


Top view
俯視圖

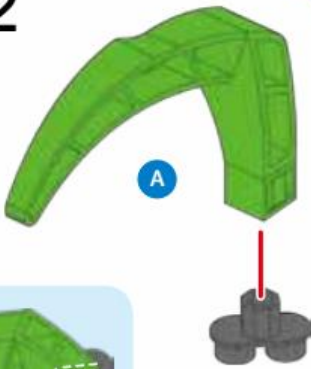
10



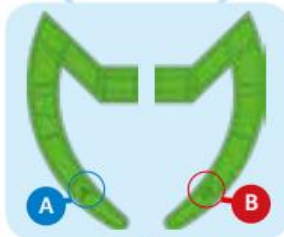
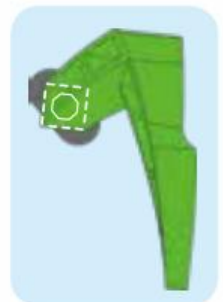
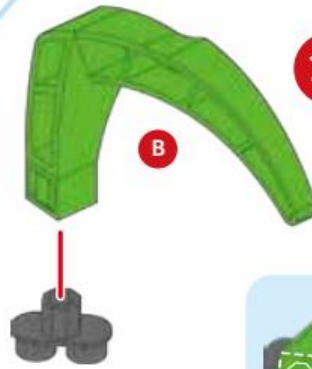
11



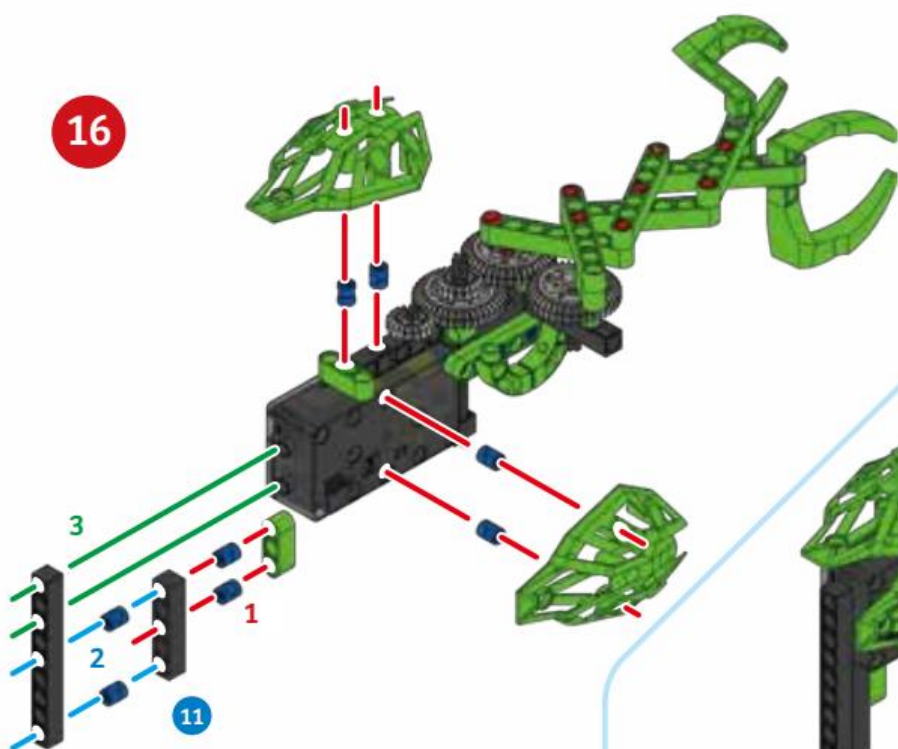
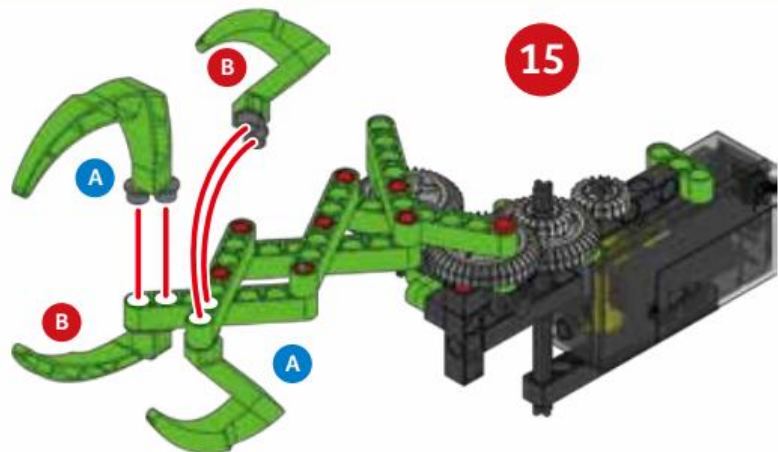
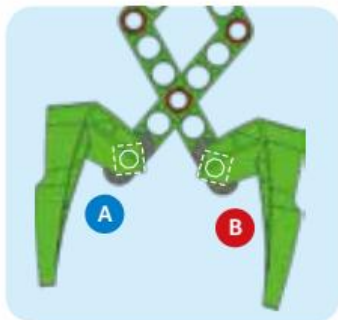
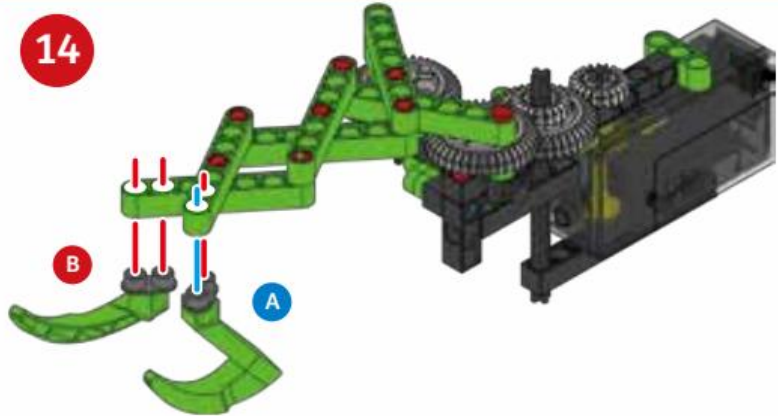
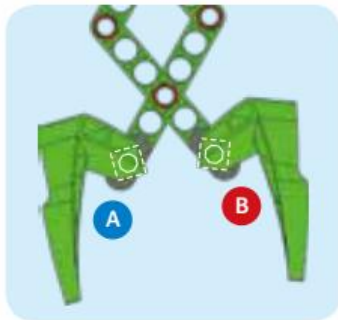
12 x2



13 x2



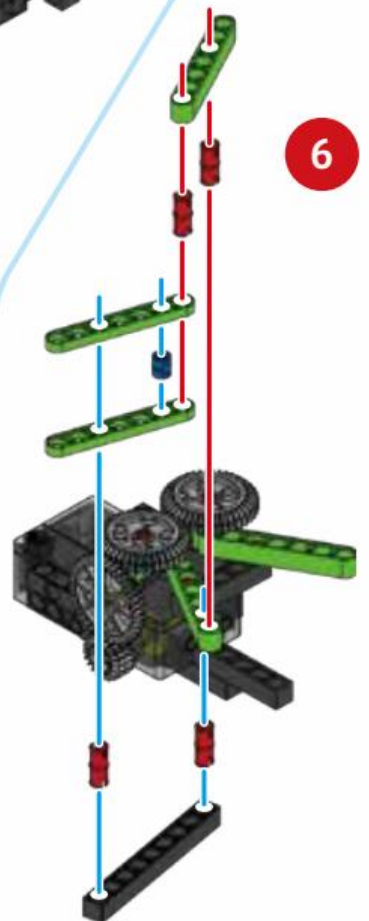
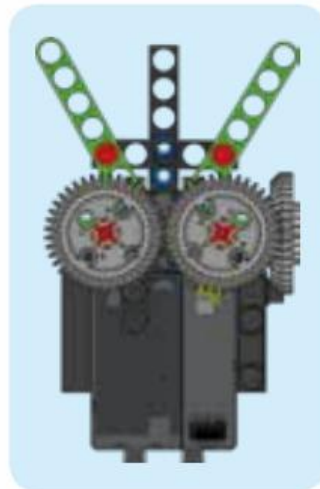
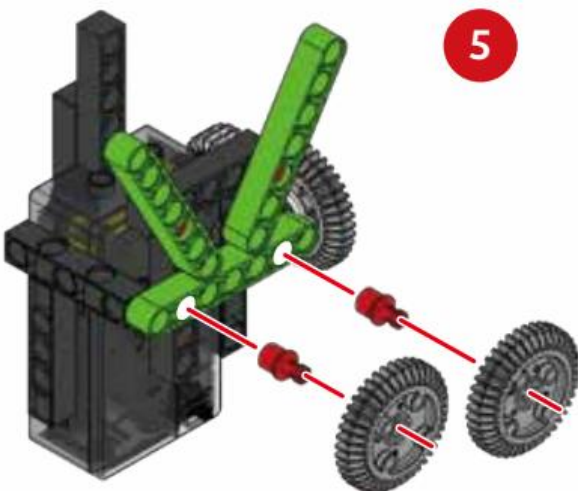
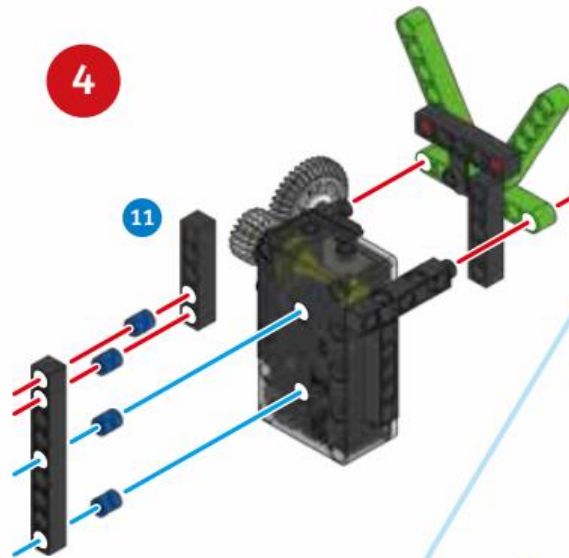
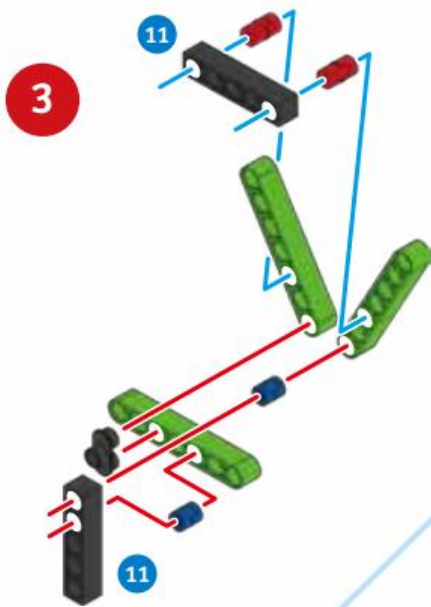
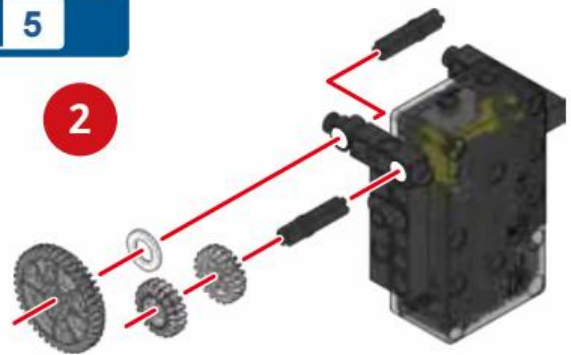
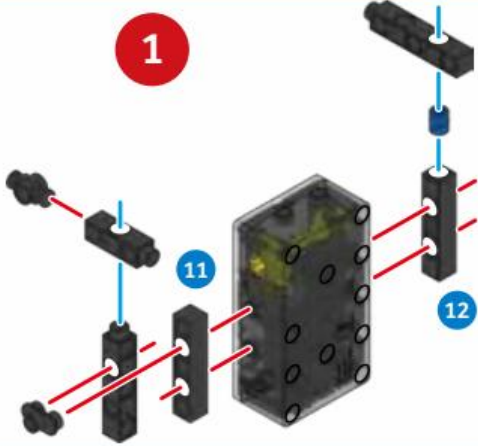
Model 模型 4 Grabber Claw 機械爪



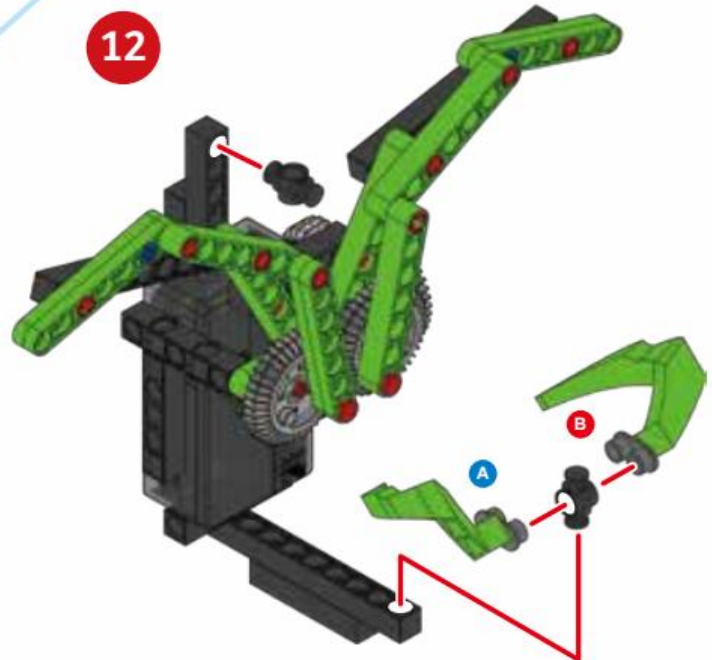
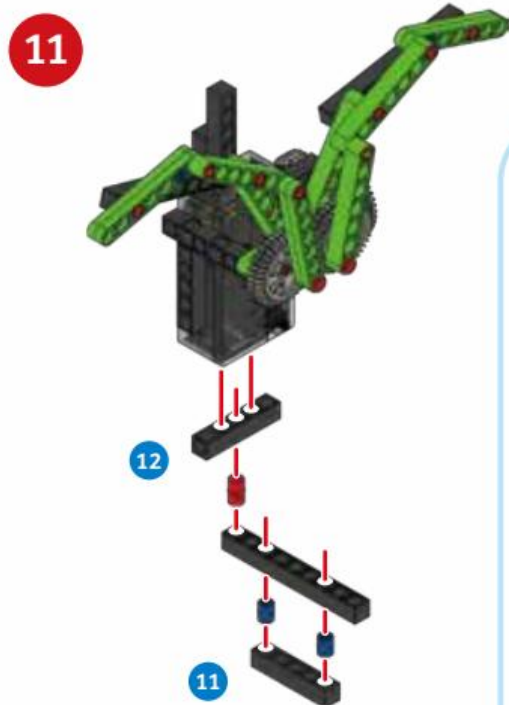
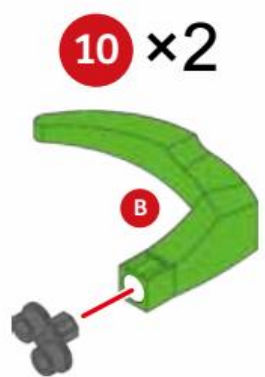
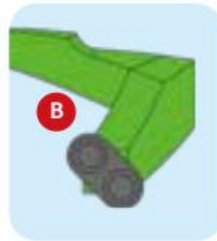
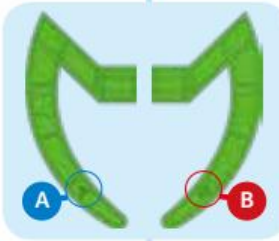
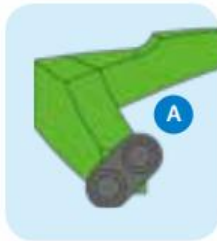
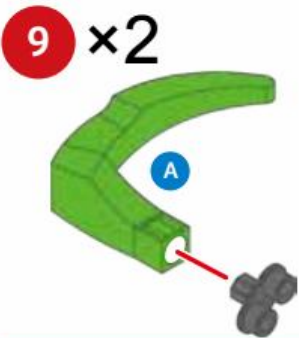
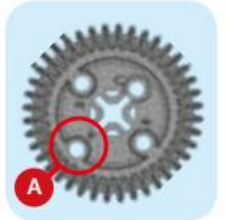
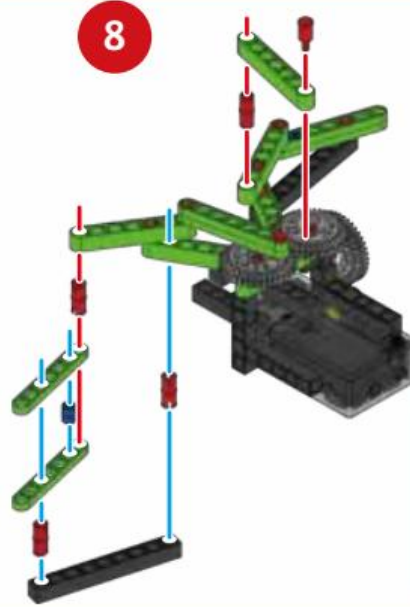
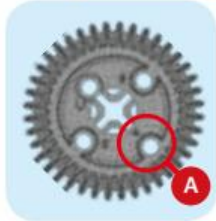
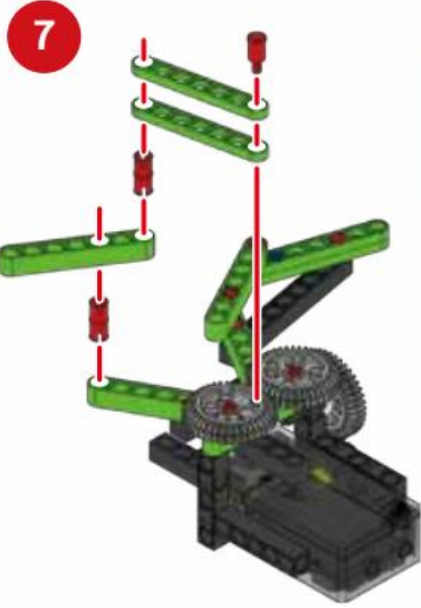
Done!
完成!



異形猛禽 Alien Raptor Model 模型 5

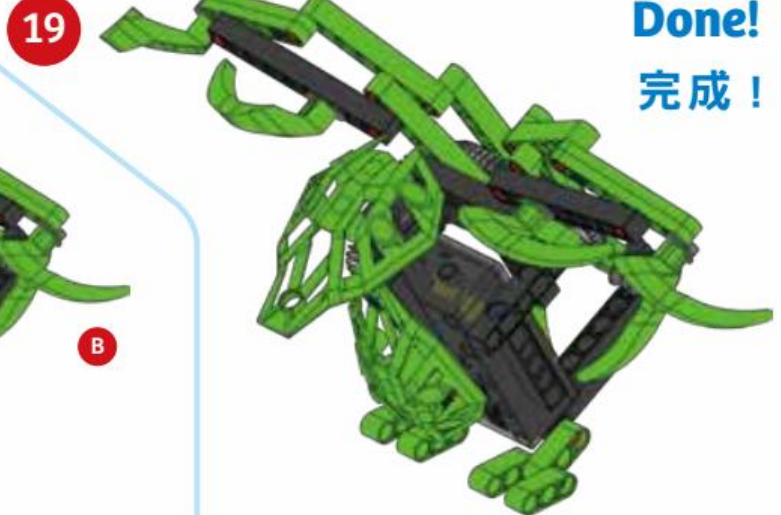
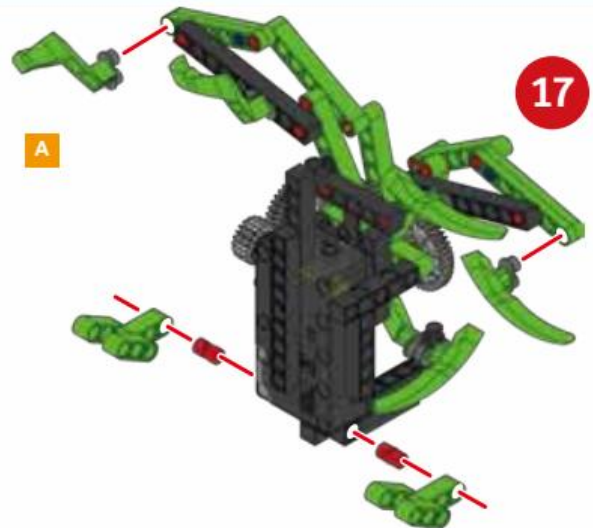
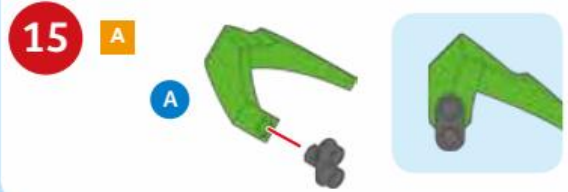
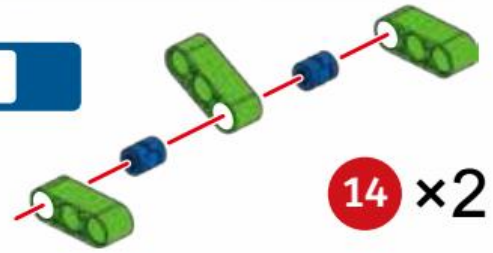
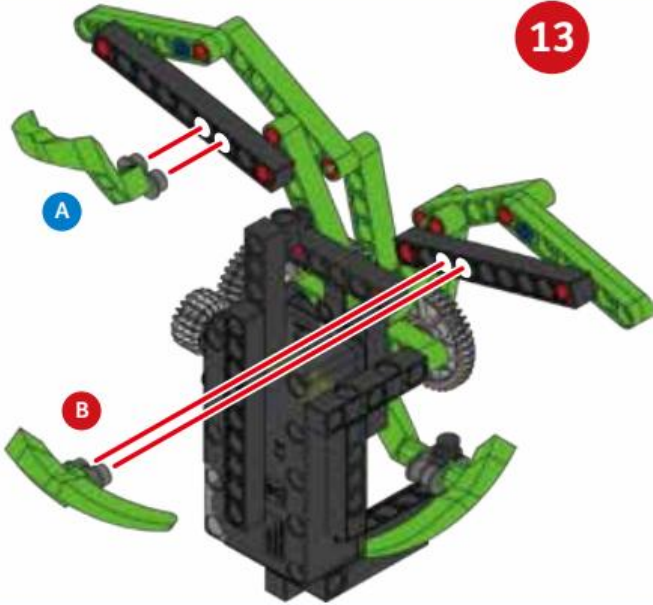


Model 模型 5 Alien Raptor 異形猛禽



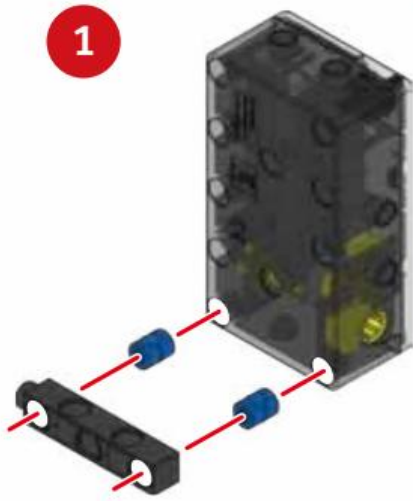


異形猛禽 Alien Raptor Model 模型 5

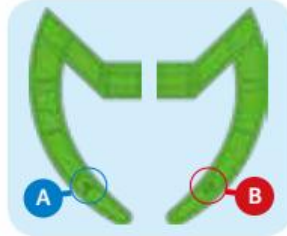


Done!
完成!

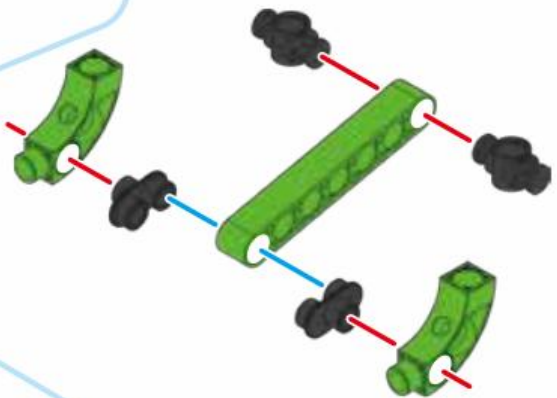
Model 模型 6 Roving Dino-Bot 神行恐龍



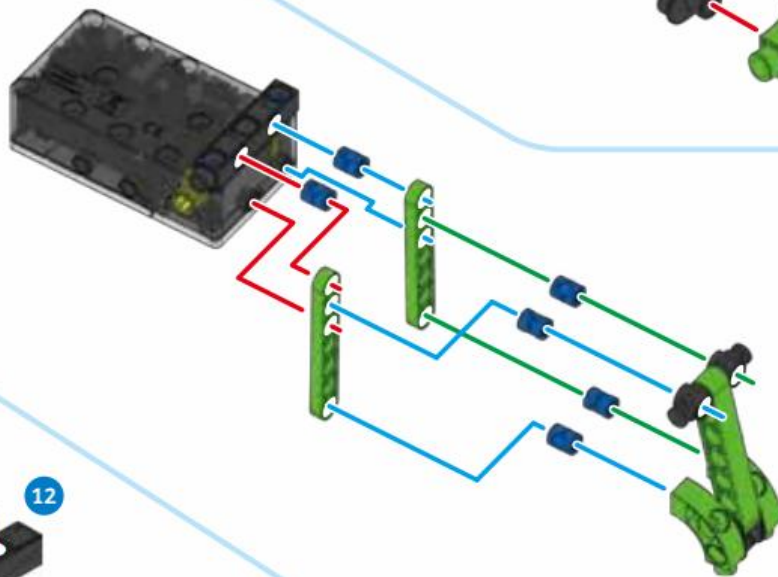
1



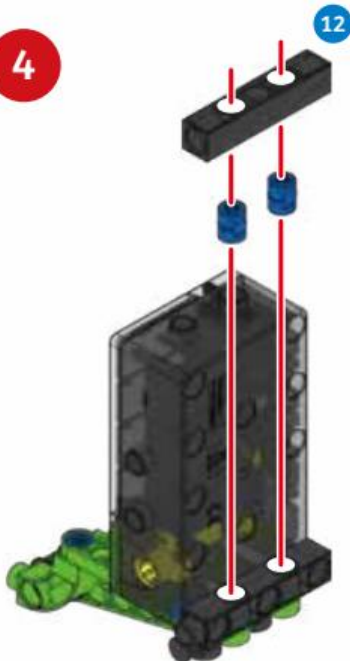
2



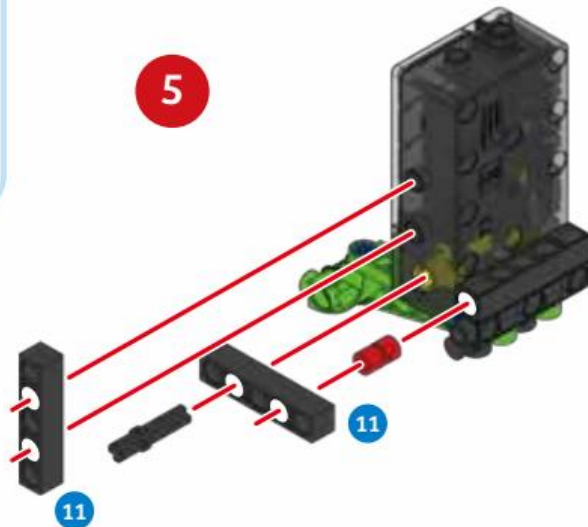
3



4

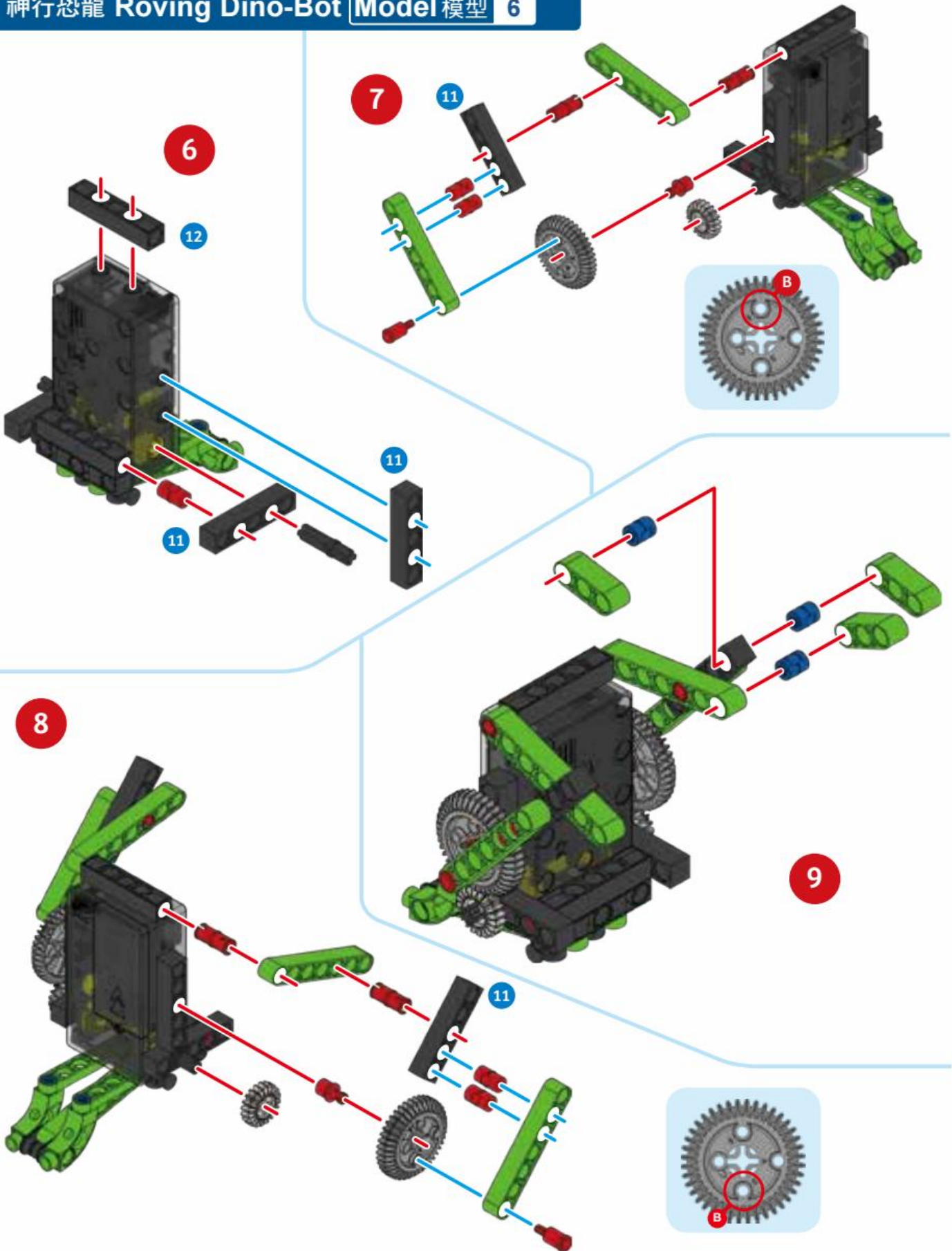


5

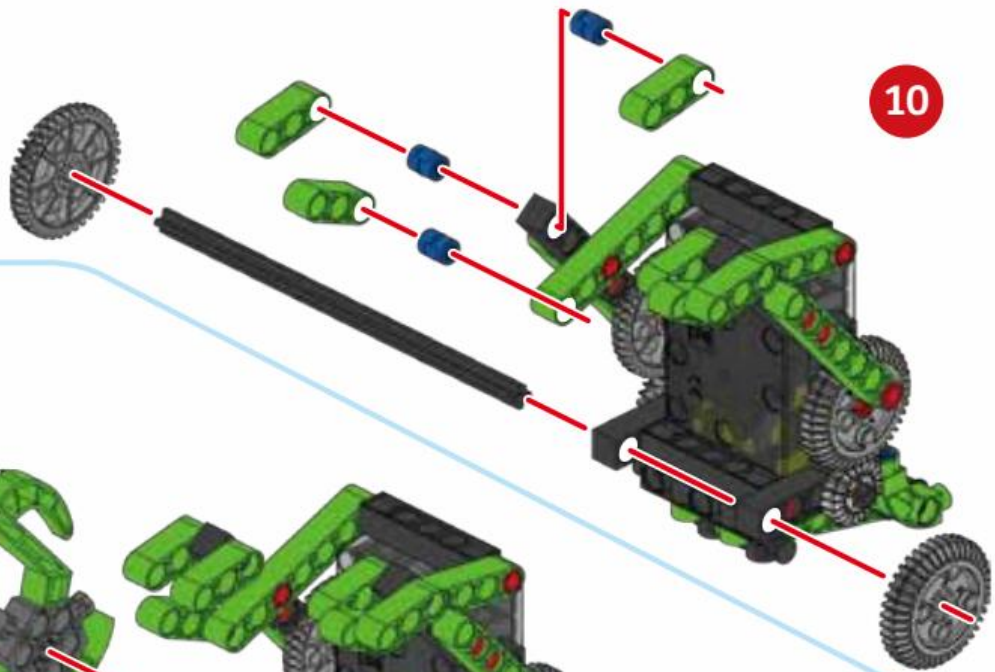




神行恐龍 Roving Dino-Bot Model 模型 6

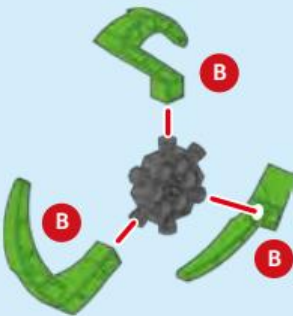
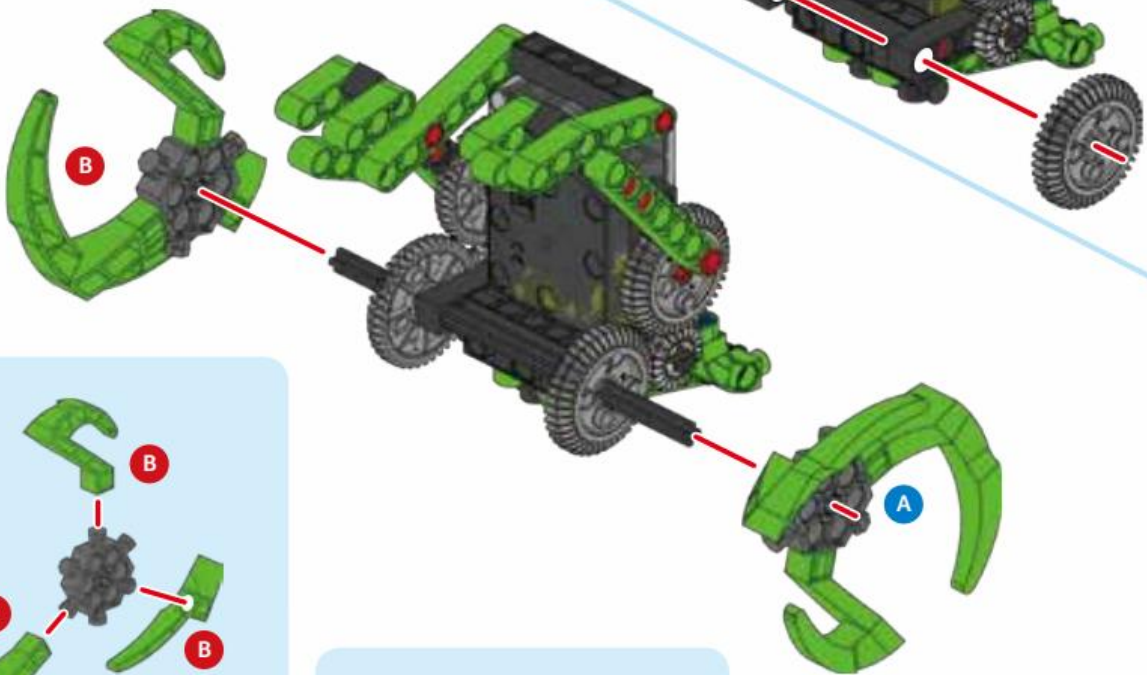


Model 模型 6 Roving Dino-Bot 神行恐龍

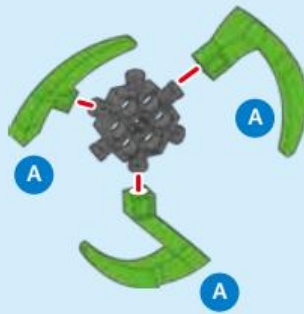


10

11



Note the markings.
請注意標記。

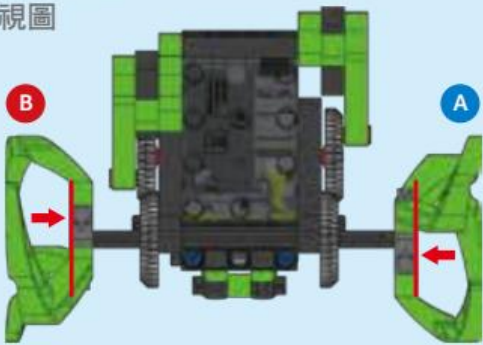


Note the markings.
請注意標記。

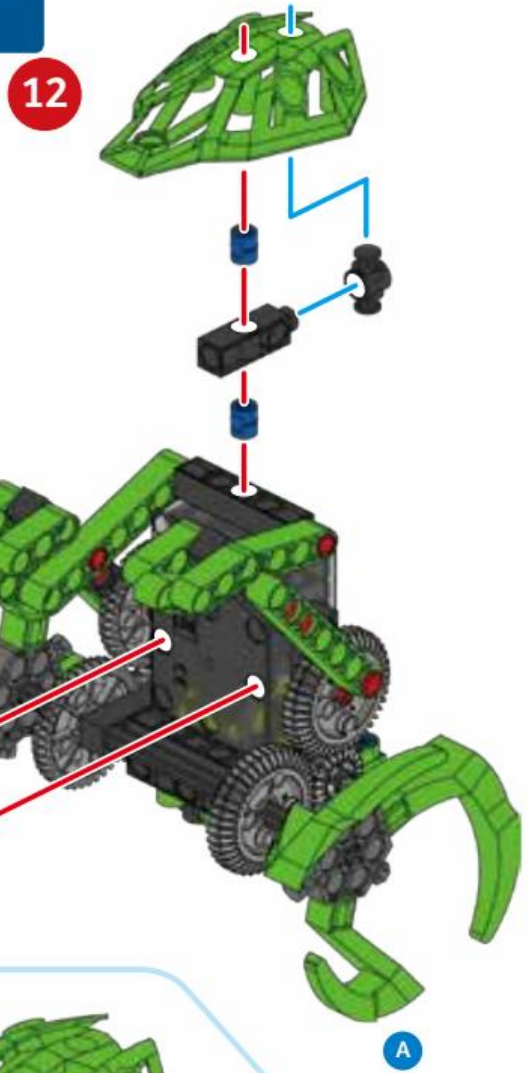


神行恐龍 Roving Dino-Bot Model 模型 6

Front view
前視圖

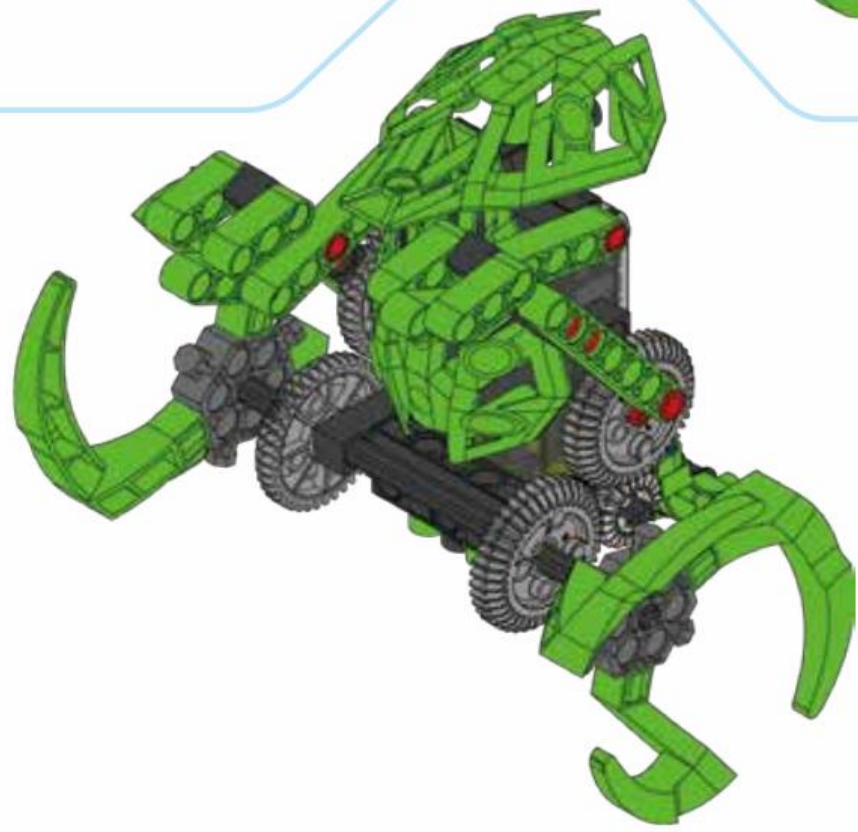


Note! The end of the axle is aligned with the outside of the wheel hub.
注意！軸的末端需與輪轂的外側對齊。

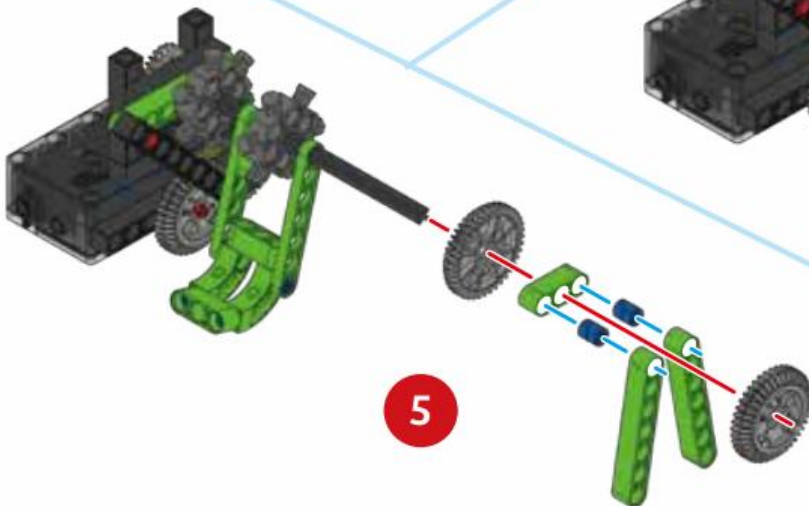
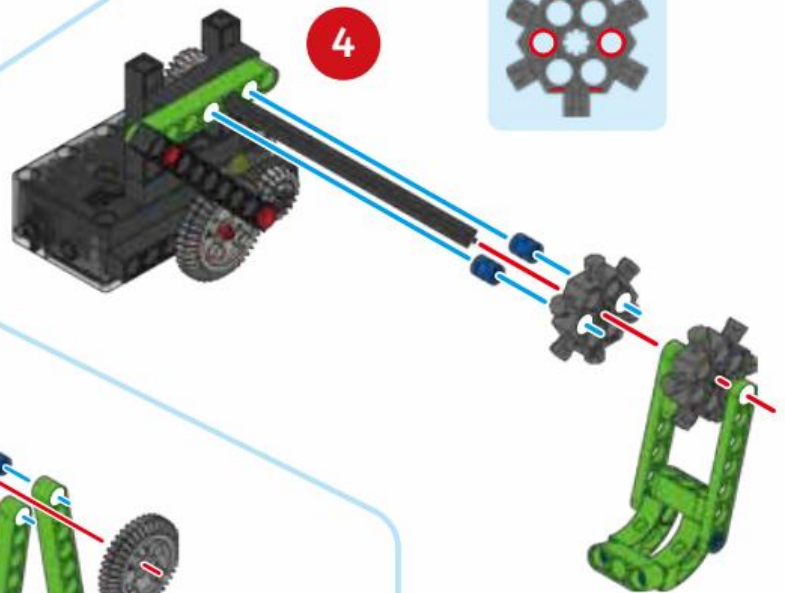
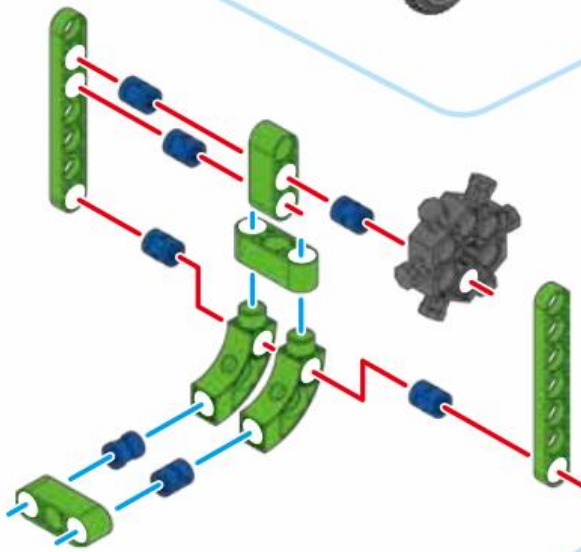
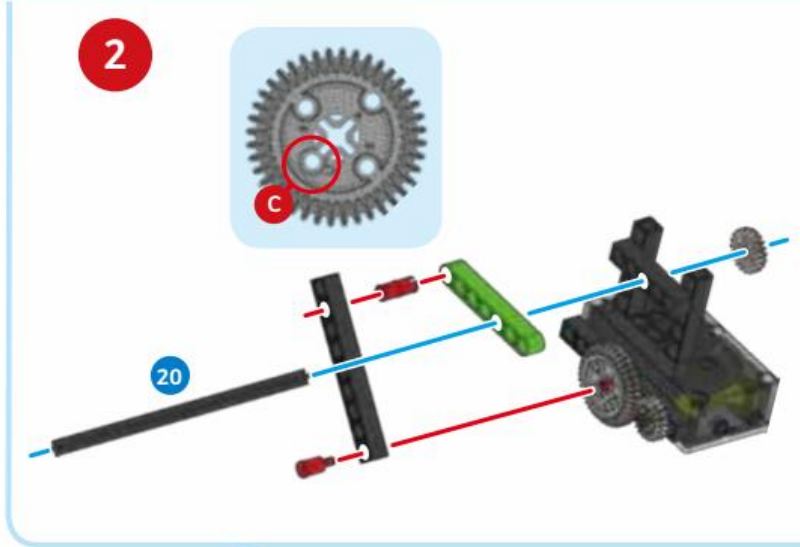
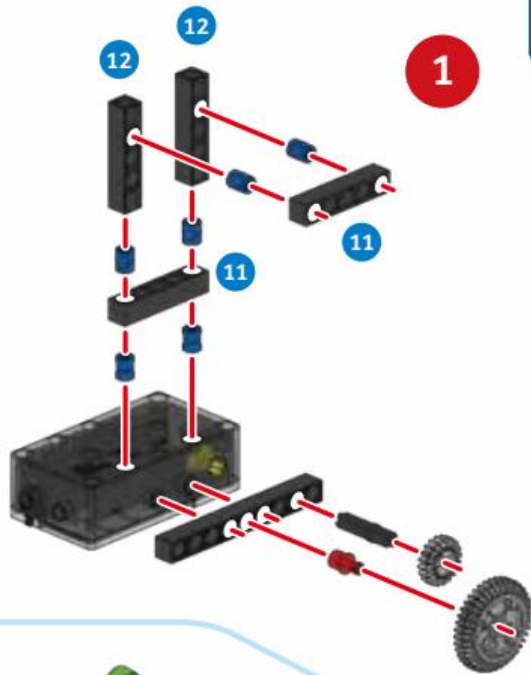


13

Done!
完成!

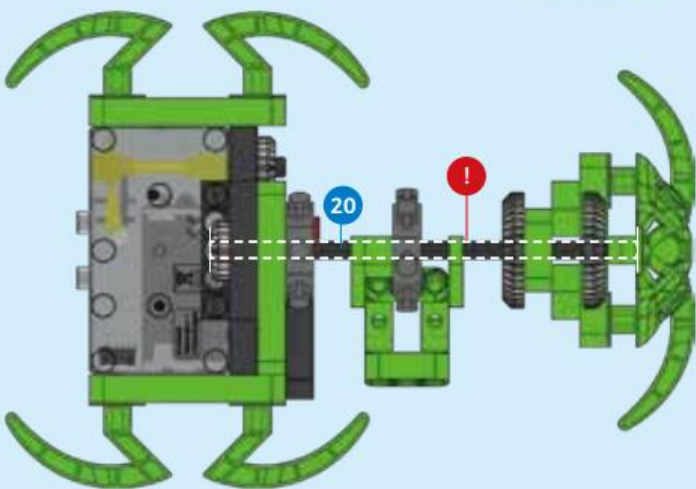
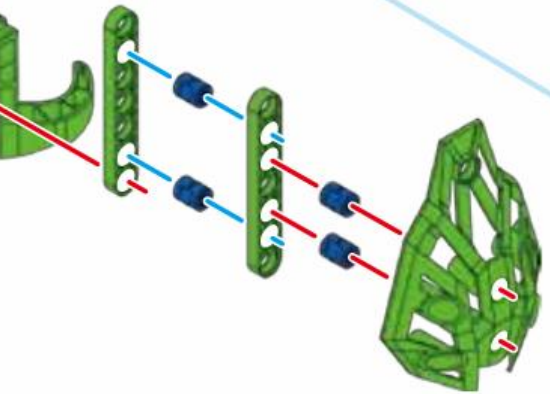
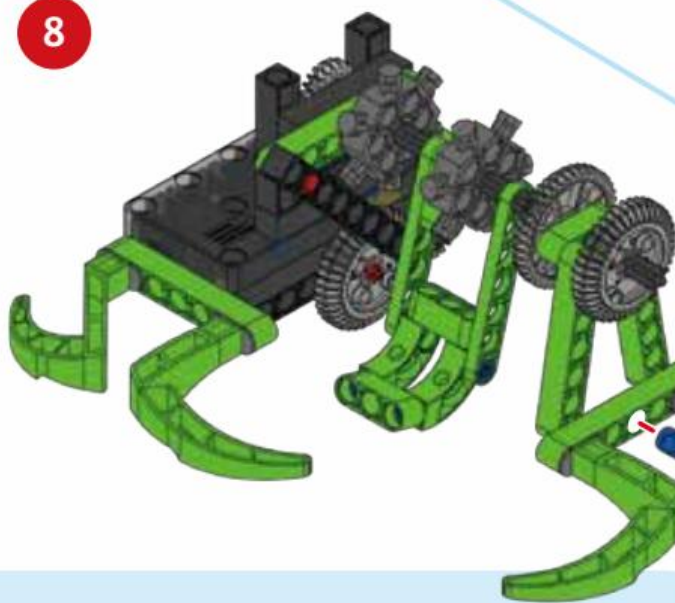
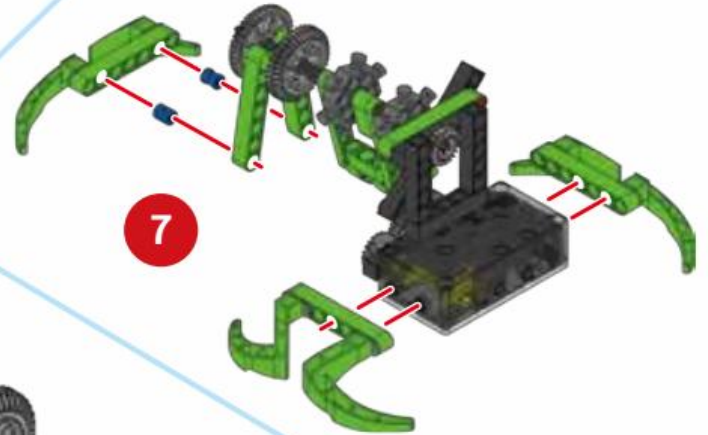
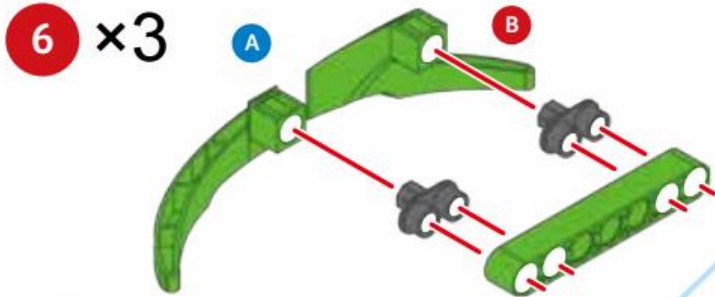
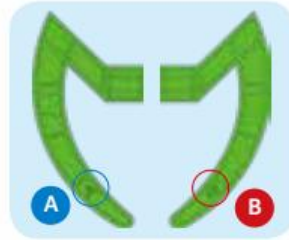


Model 模型 7 Playground Swing 遊樂場鞦韆





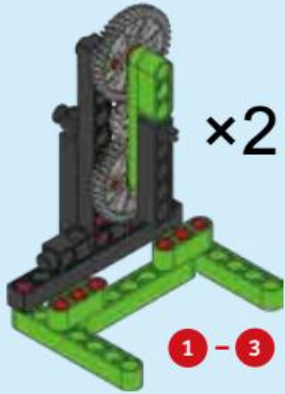
遊樂場鞦韆 Playground Swing Model 模型 7



Pay attention to the correct positions of each part. Adjust the parts to the positions in this view.

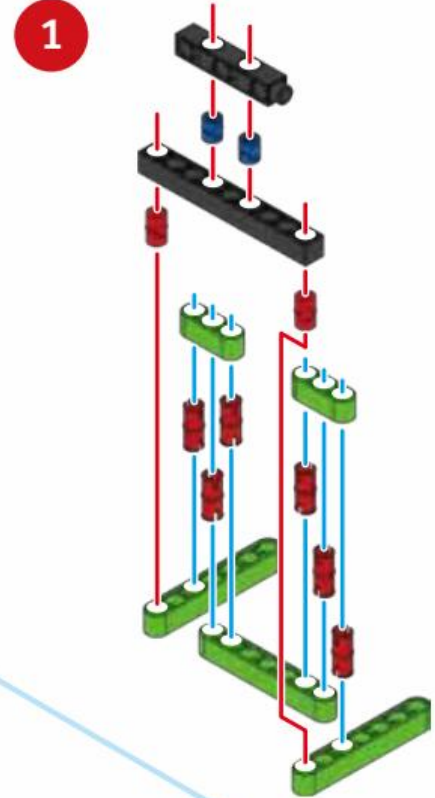
注意每個零件的正確位置。將零件調整到圖示中的位置。

Model 模型 8 Bipedal Robot 雙足機器人

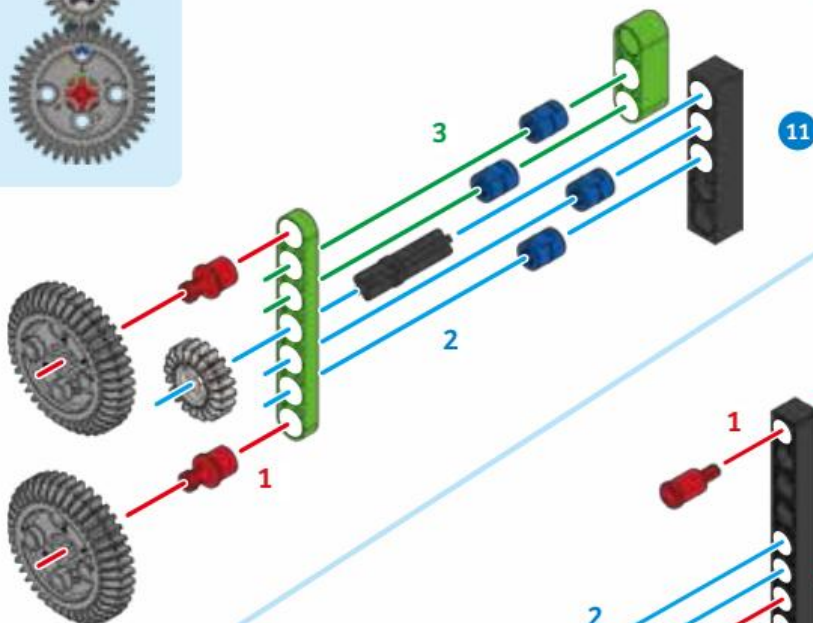


Repeat steps 1 through 3 to build two copies of this foot unit.

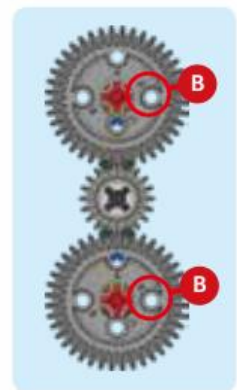
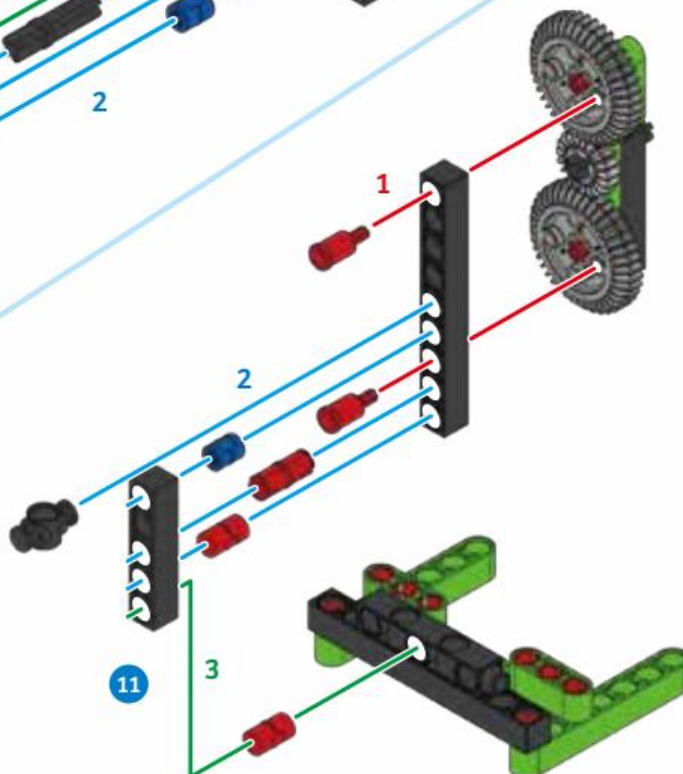
重複步驟 1 至步驟 3 一次以構建出模型所需的兩支腳。



2



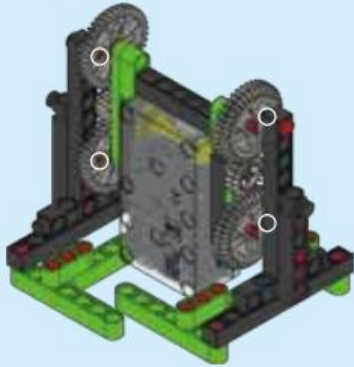
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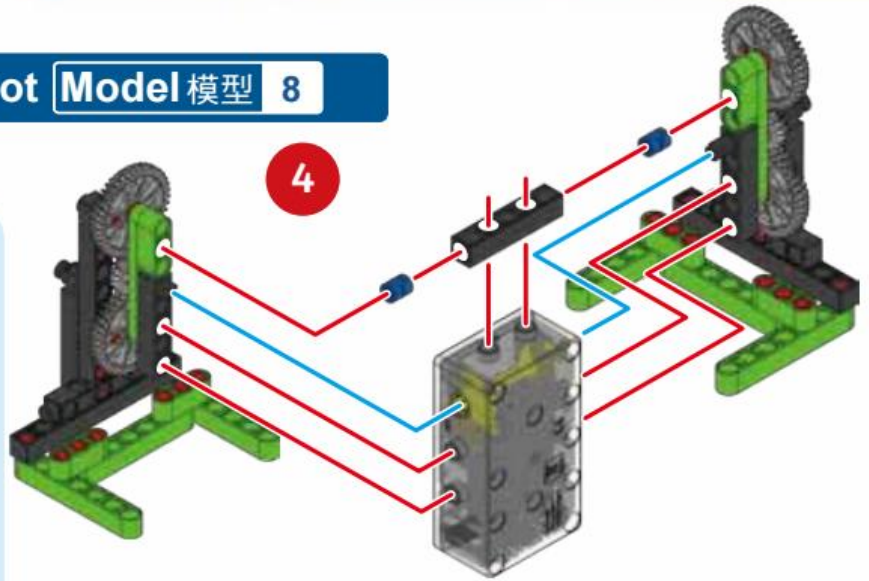
雙足機器人 Bipedal Robot Model 模型 8

Side view
側面圖

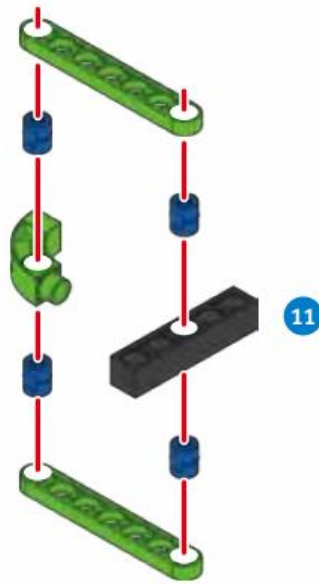


Note the relative position of the holes marked with the B on both sides.

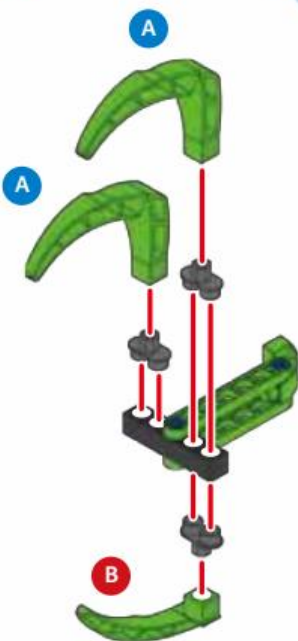
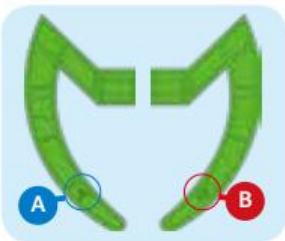
請注意兩側標有 B 的孔的相對位置。



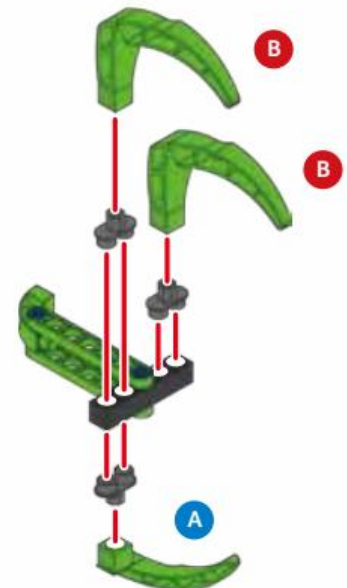
5 x 2



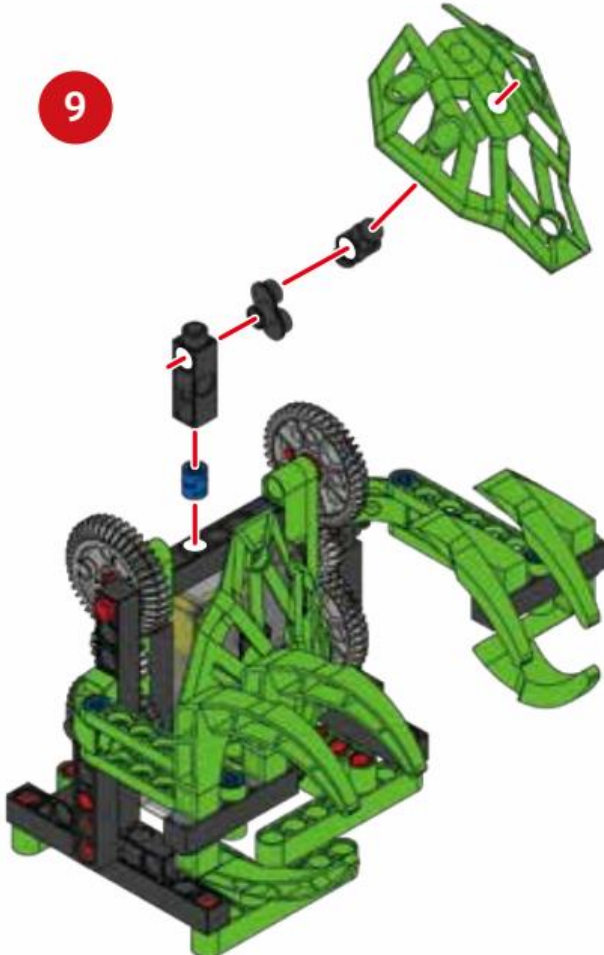
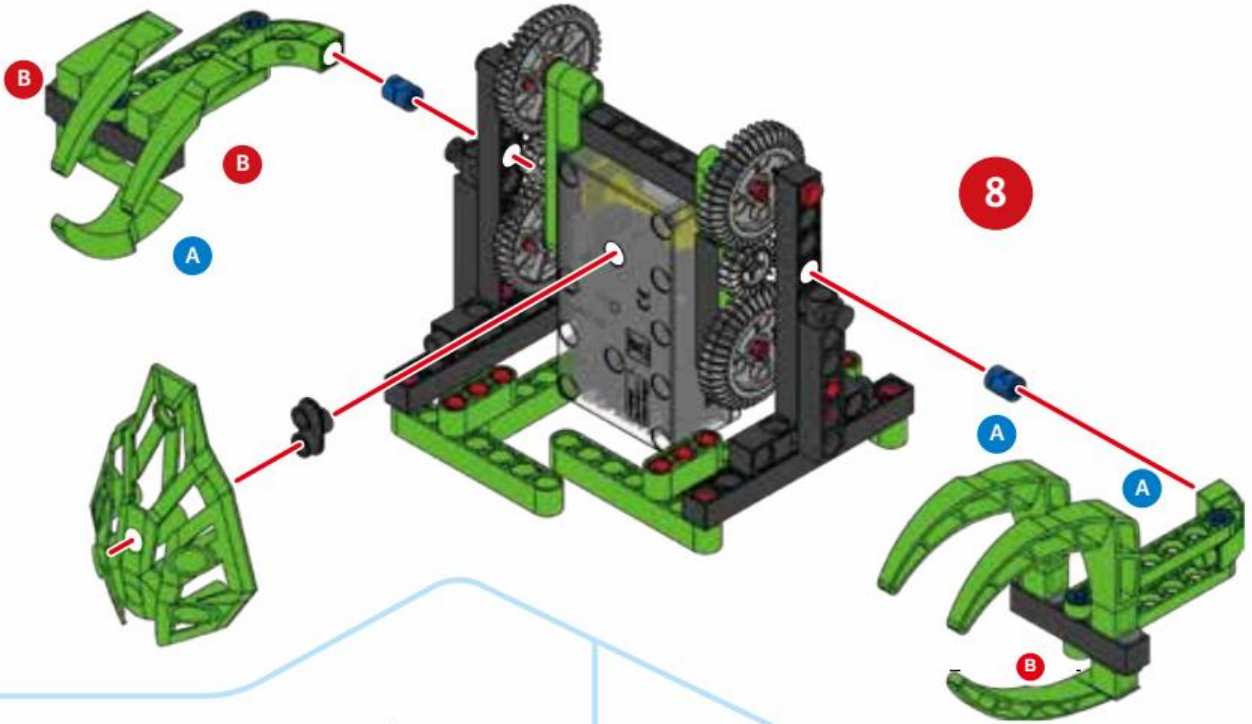
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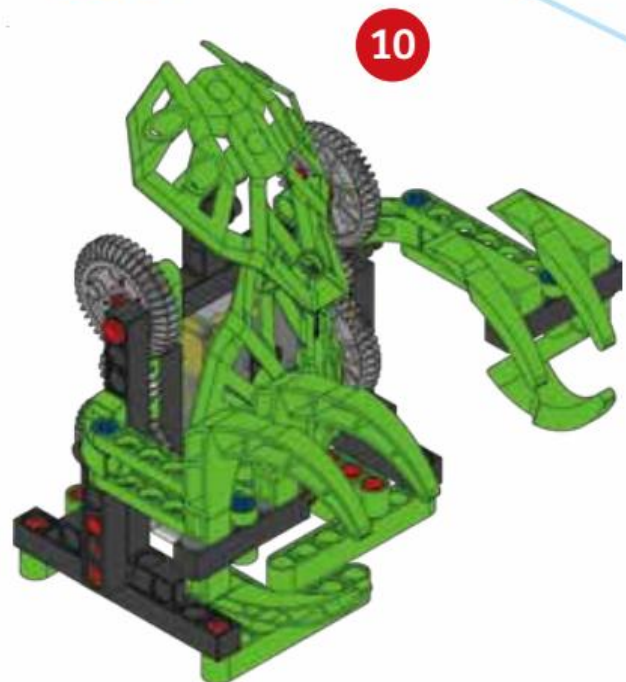
7



Model 模型 8 Bipedal Robot 雙足機器人



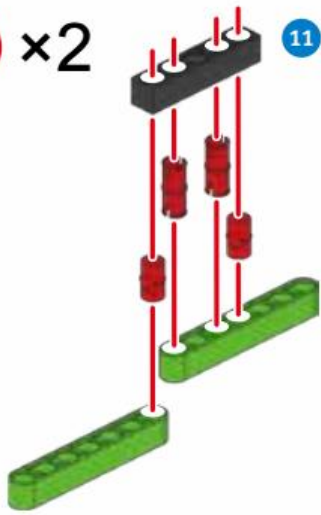
Done!
完成!



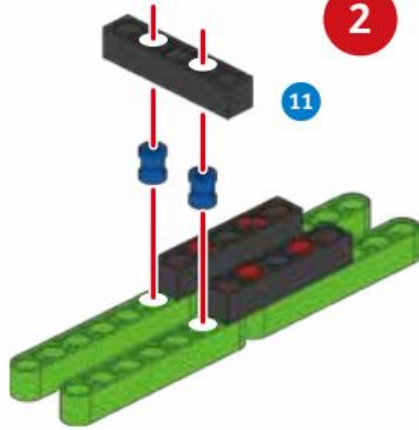


抽油機 Pumpjack Model 模型 9

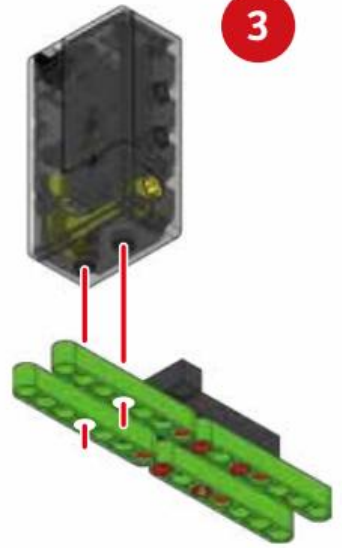
1 x2



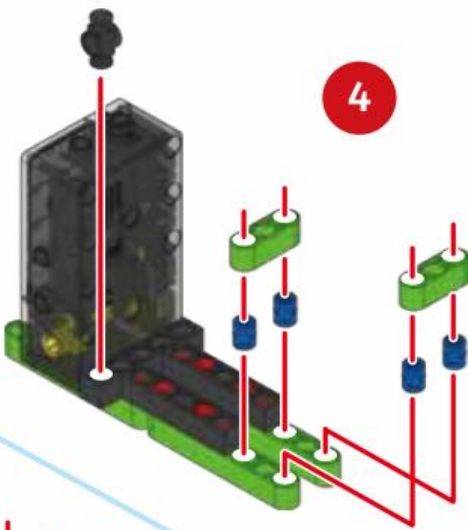
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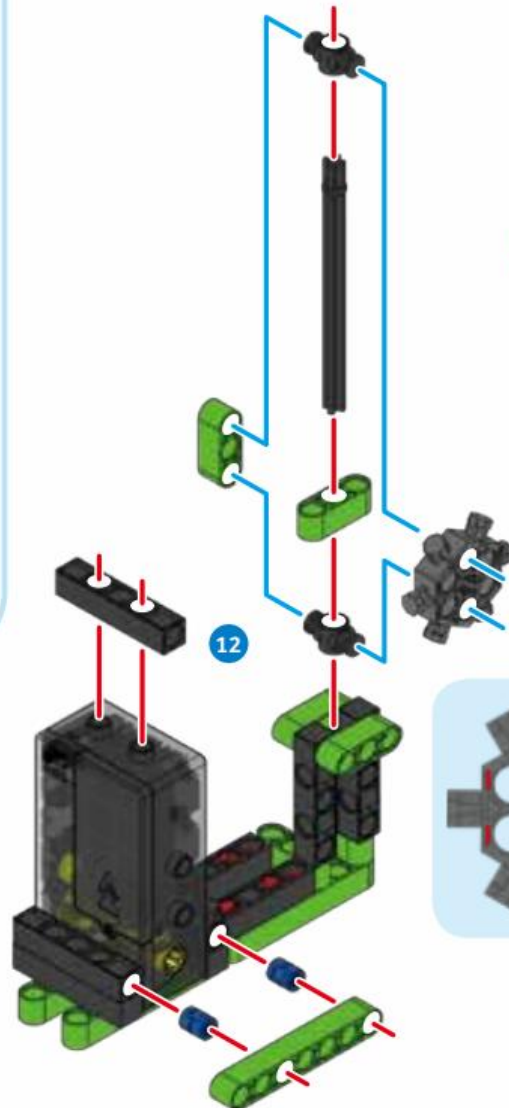
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4



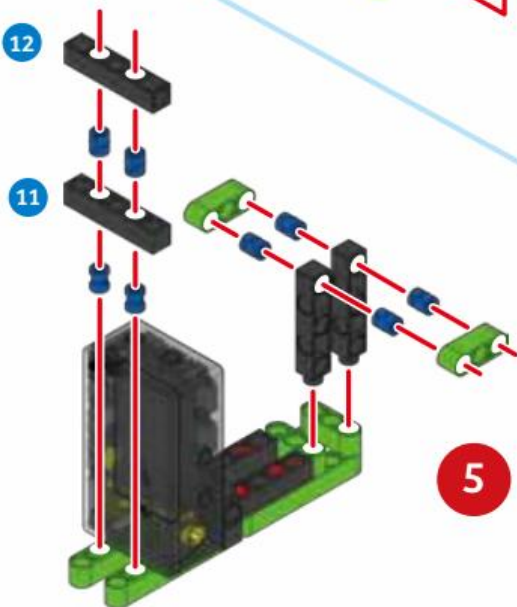
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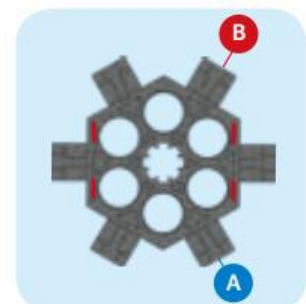
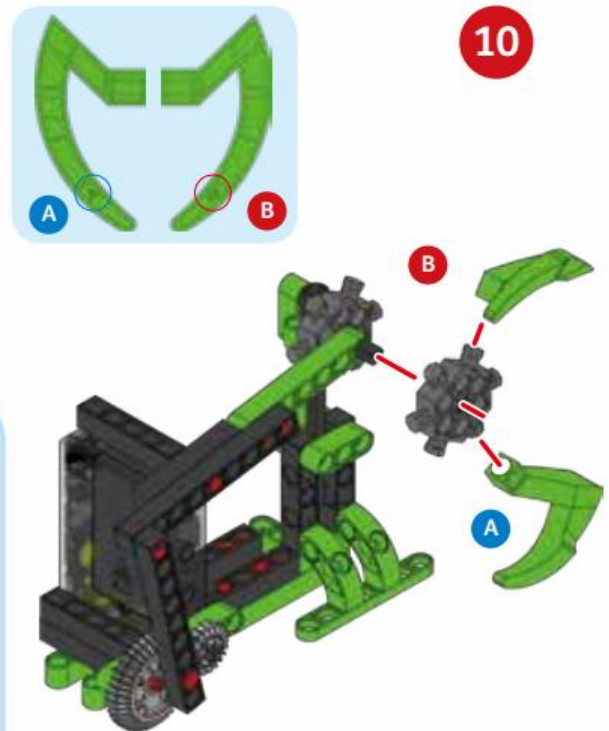
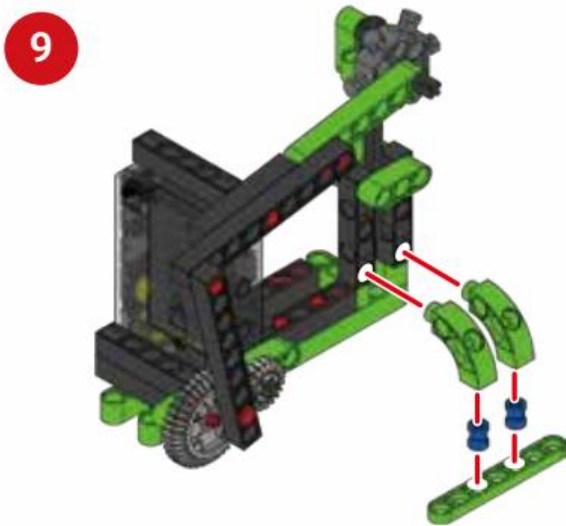
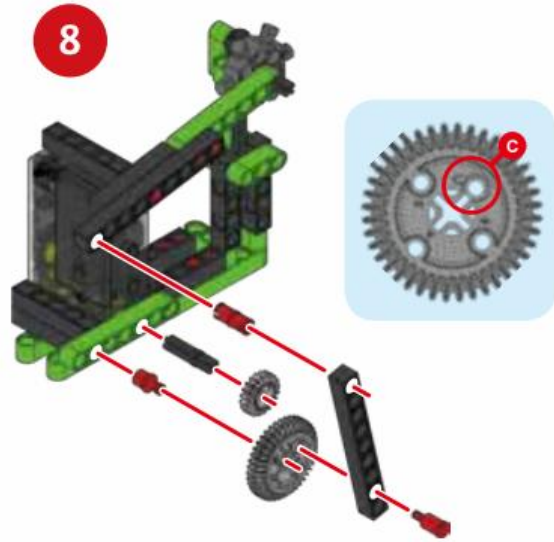
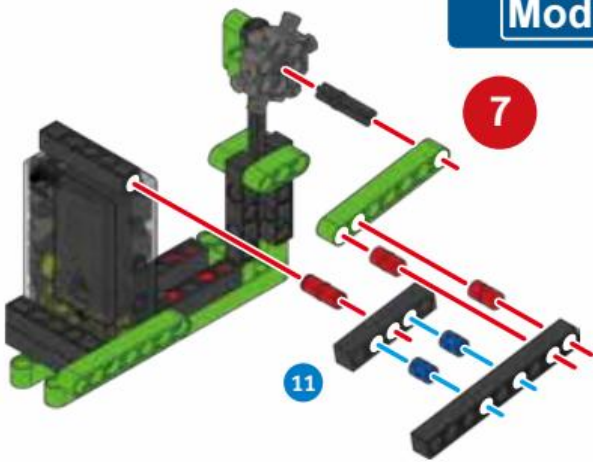
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11

5

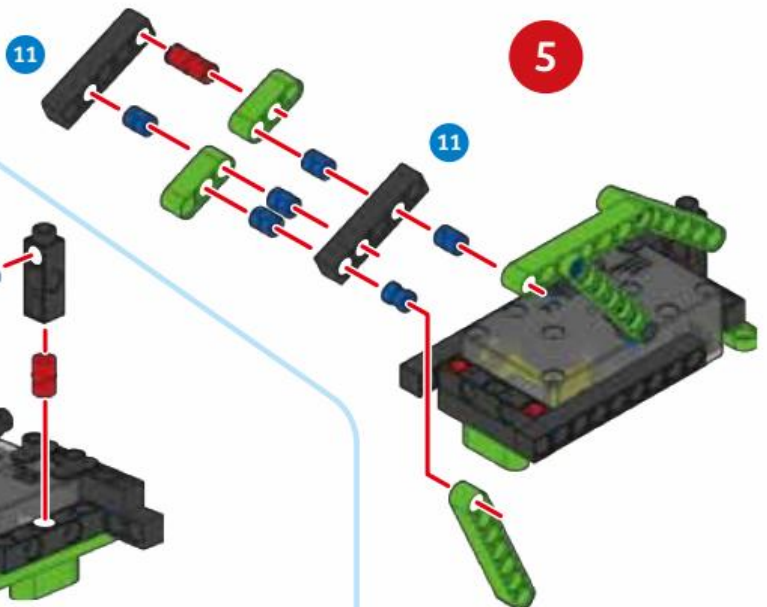
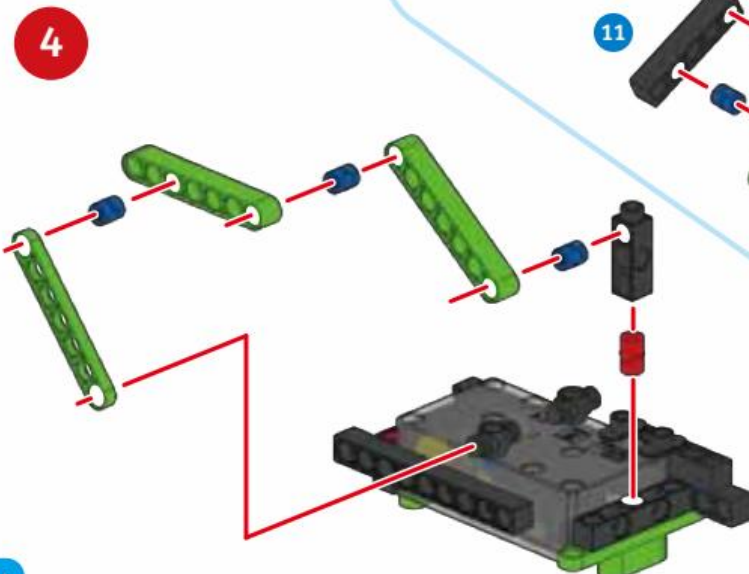
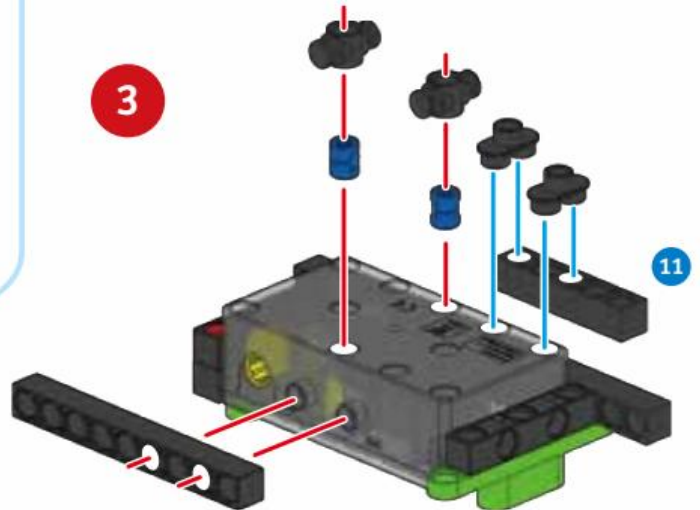
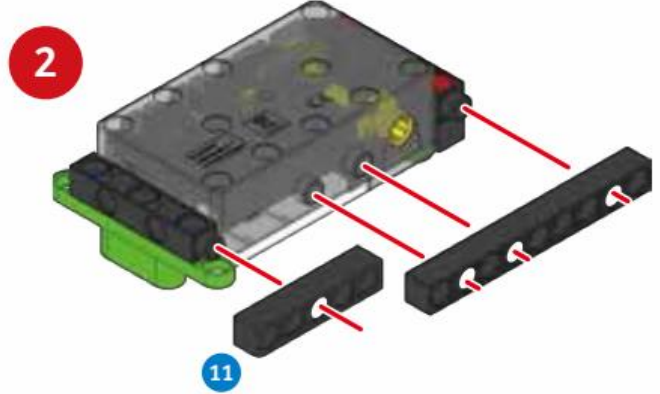
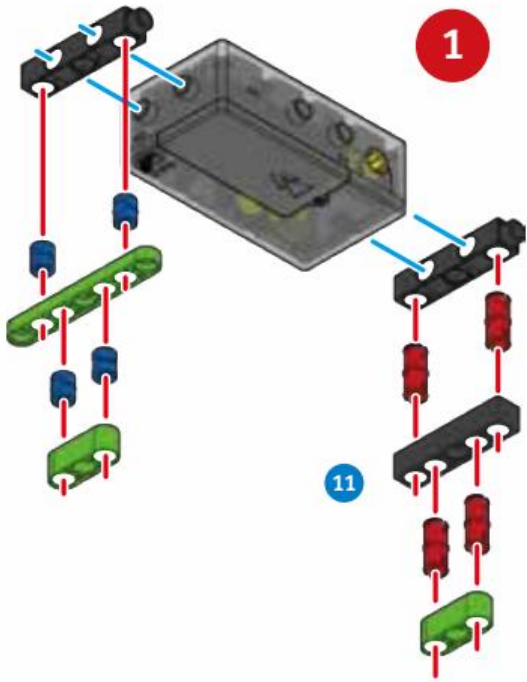


Model 模型 9 Pumpjack 抽油機

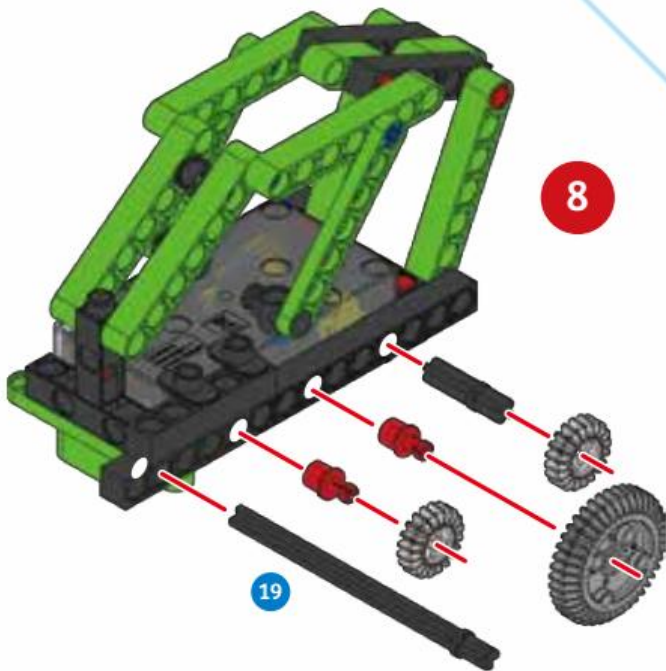
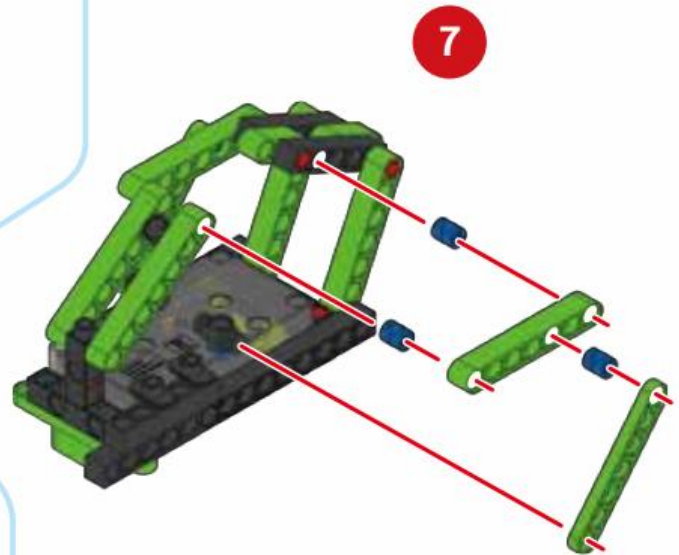
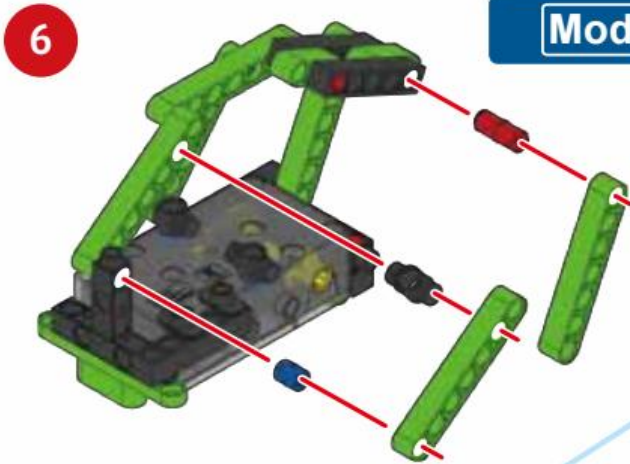




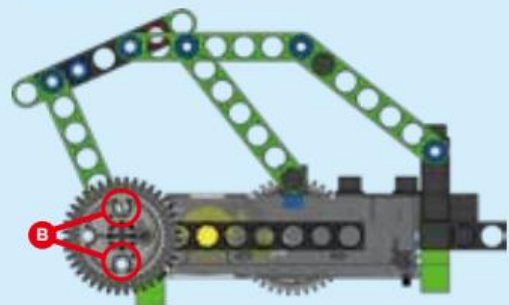
機械青蛙 Alien Frog-Bot Model 模型 10



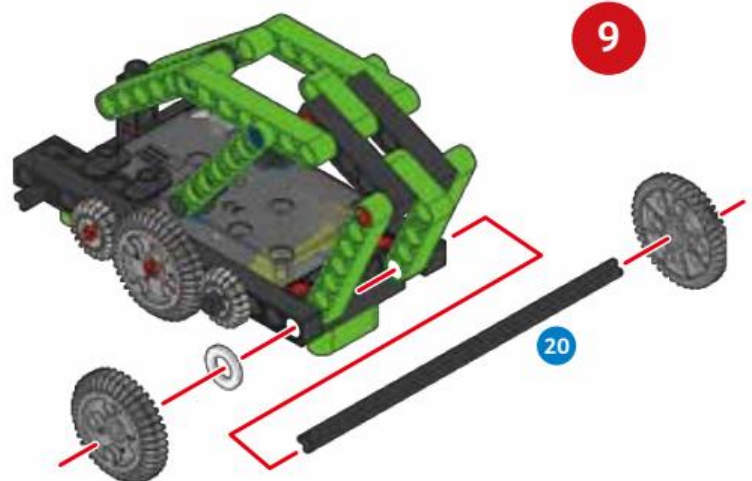
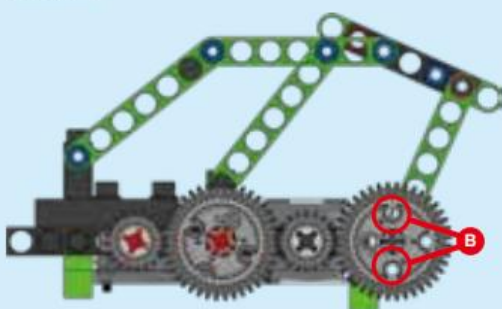
Model 模型 10 Alien Frog-Bot 機械青蛙



Side view
側面圖

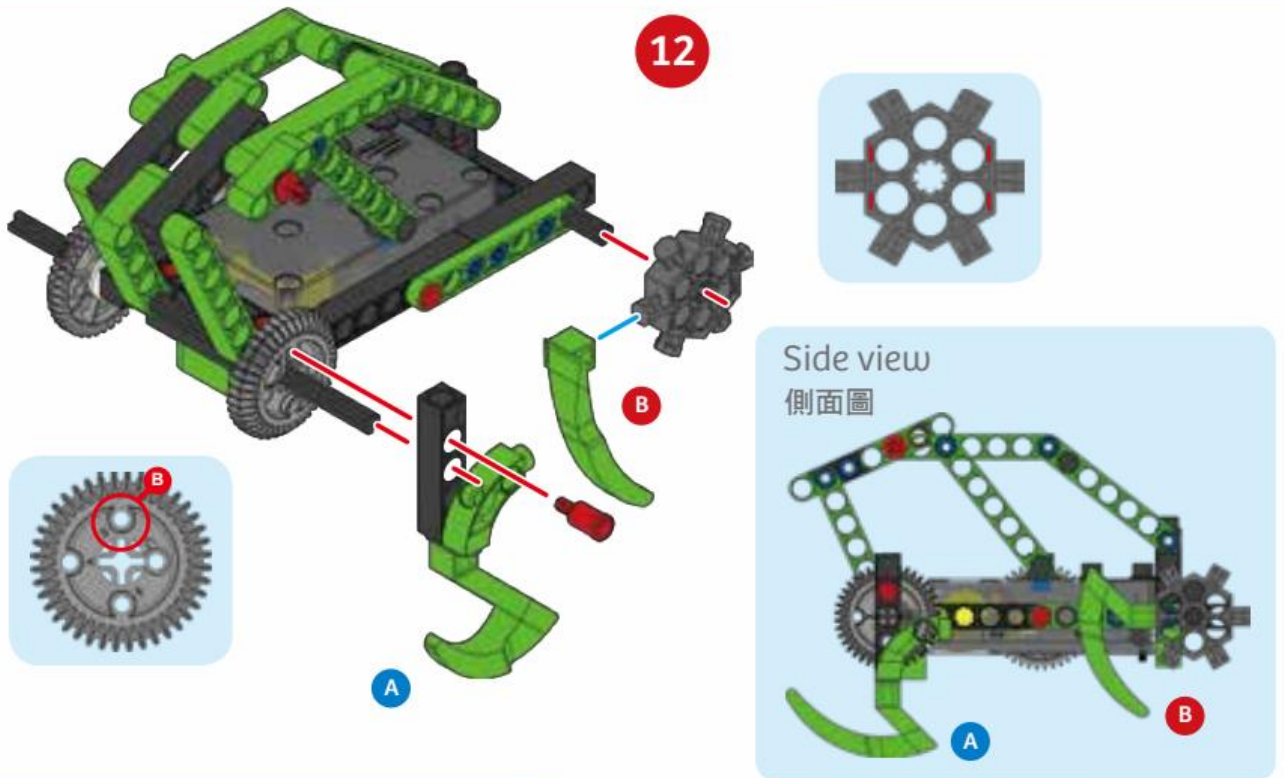
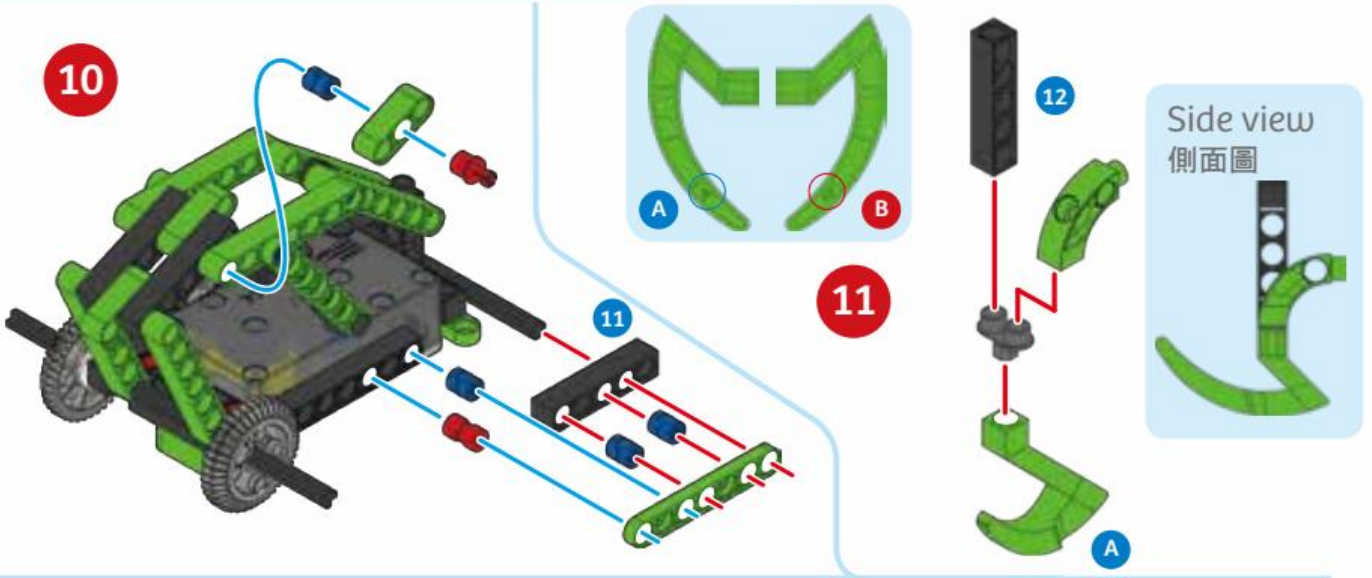


Side view
側面圖



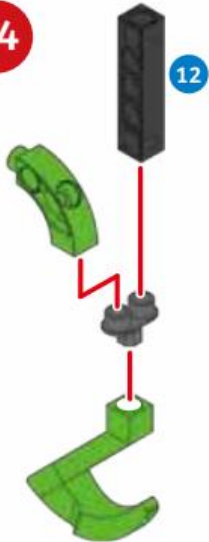


機械青蛙 Alien Frog-Bot Model 模型 10



Model 模型 10 Alien Frog-Bot 機械青蛙

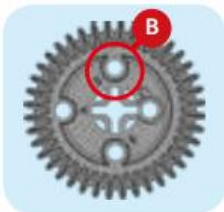
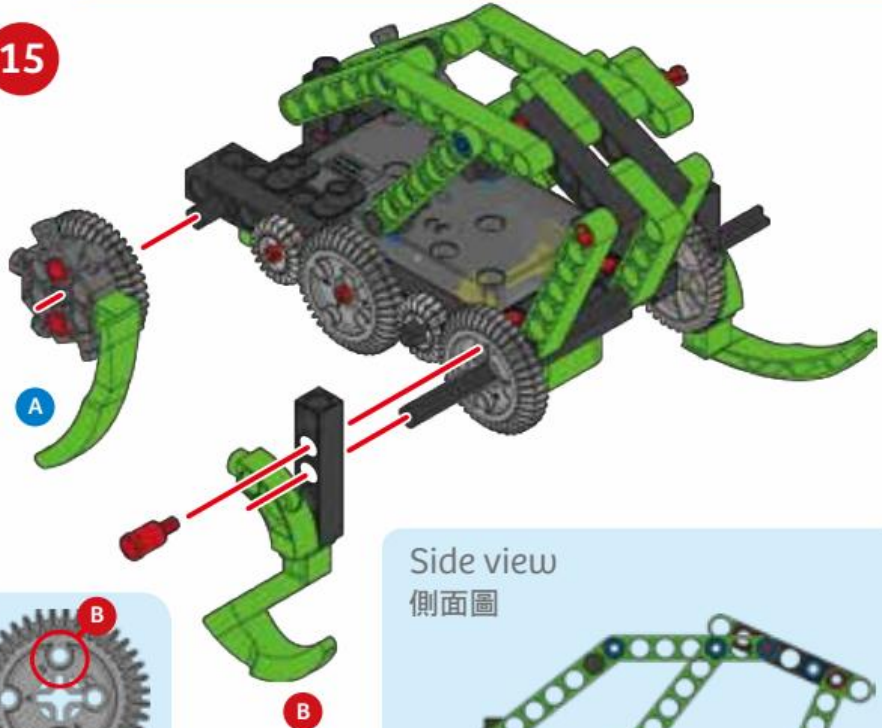
14



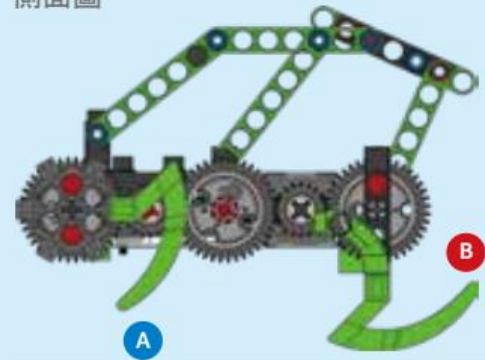
Side view
側面圖



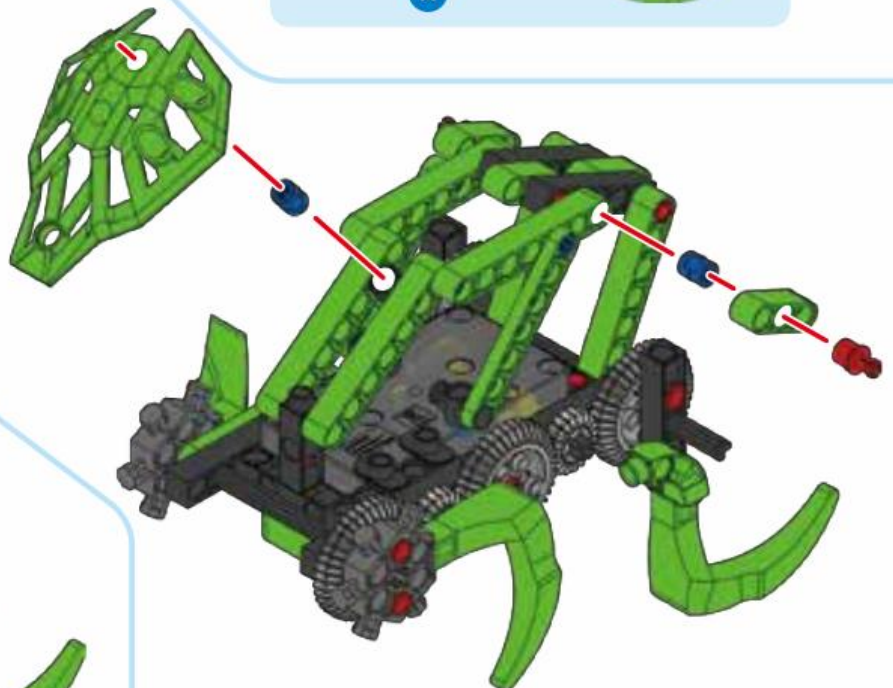
15



Side view
側面圖



16



17

Done!
完成!



CHECK IT OUT 知識補給站

All of the models in this kit make use of mechanisms called linkages.

A **linkage** is a mechanical assembly of rigid links (or rods) connected at movable joints. Picture the rigid rods in this kit linked together with the rotating joint pins: that is a linkage! Linkages can be **open** or **closed** chains, in which each link is connected to at least one other link. In open linkages, the end of a rod is not connected to another rod. In closed linkages, all of the rods' ends are connected to other rods.

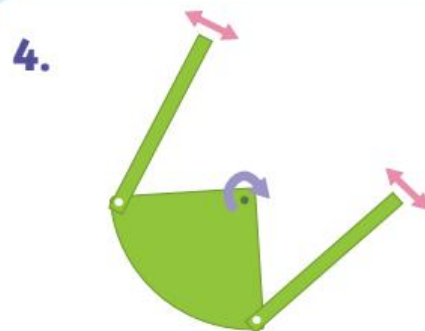
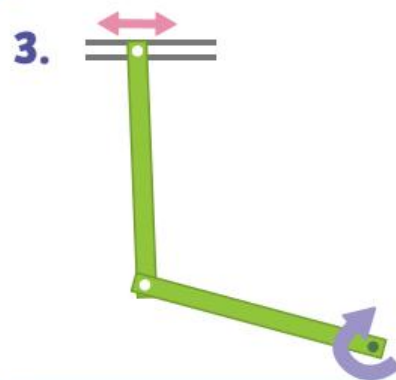
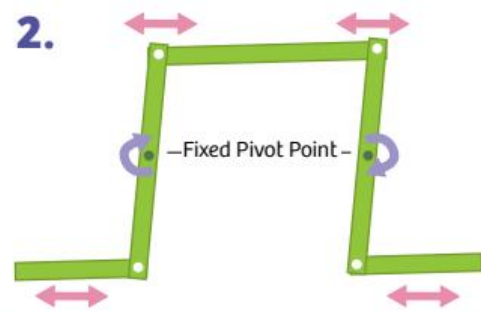
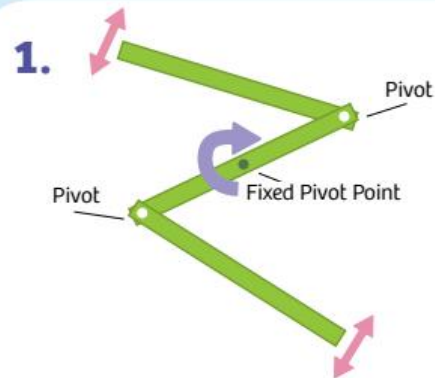
Engineers use linkages to change the **direction of a motion** or **change the size of a force**. Applying a force on one part of a linkage produces a predictable resulting force at another part of a linkage. Linkages can be used in very clever ways to achieve exactly the direction and magnitude of force desired.

Linkages are often grouped by the number of rods: **two-bar**, **three-bar**, and **four-bar linkages** are common.

Four very common types of linkages are as follows. Try building these linkages with the pieces in your kit.

- 1. Reverse Motion Linkage:** One rod moves in one direction when the other moves in the opposite direction.
- 2. Parallel Motion Linkage:** The rods move but at least two rods remain parallel to each other at all times.
- 3. Crank and Slider Linkage:** A rod moves along a straight line in a slider.
- 4. Bell Crank Linkage:** Horizontal movement is converted perpendicularly into vertical movement.

Make these linkages with your kit! Can you find all the linkages in the models you built?



>>> Did you know? A lever is a two-bar linkage!

CHECK IT OUT 知識補給站

連桿

該套組中的所有模型都使用了連桿的機構。連桿機構是活動關節與剛性長桿（或長條）互相連接的機械組合。本套組零件包內的剛性長桿與旋轉軸扣鍵相連接：這就是一個連桿！連桿可以是開放的或封閉的，其中每個長桿都至少連接到另外一個長桿。在開放連桿中，長條的末端不與另一長條相連接。在封閉連桿中，所有長條的末端都會連接到其他長條。

工程師使用連桿來改變運動的方向或改變力量的大小。在連桿的一部分上施加力會在連桿的另一部分產生可預測的力。若能將連桿使用得當，可以精確地執行所需力的方向和大小。

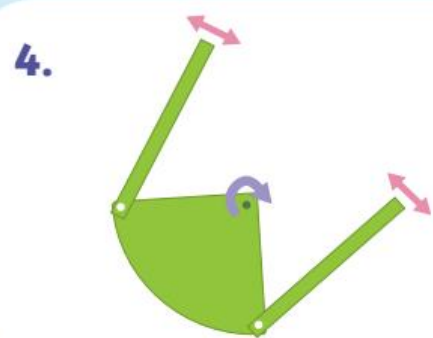
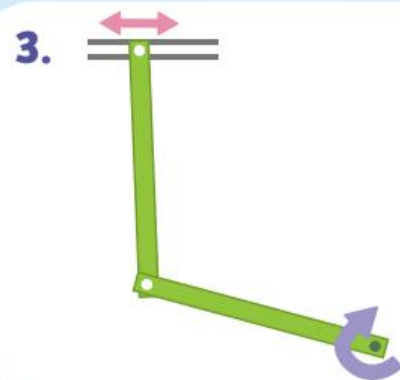
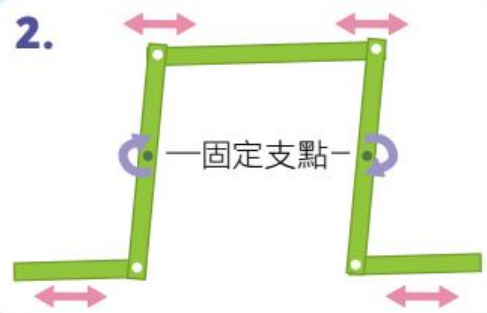
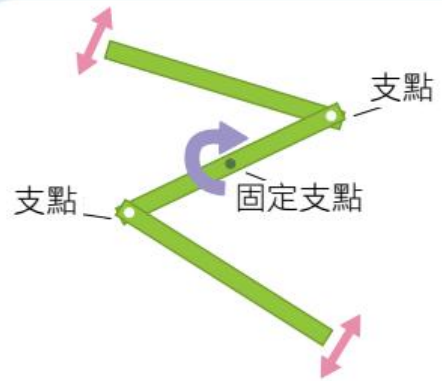
區分連桿的類別時，通常按照桿的數量：雙桿、三桿和四桿連桿都很常見。

以下為四種常見的連桿類型：

請試著使用本套組中的零件來組裝這些連桿機構。

1. **反向運動連桿**：當另一個長條向相反方向運動時，一個長條向另一個方向運動。
2. **平行運動連桿**：所有長條移動時，至少有兩個長條始終保持平行。
3. **曲柄和滑塊連桿**：一個長條與一個滑塊中都是沿著同一直線移動。
4. **雙臂曲柄連桿**：水平運動被轉換成垂直運動。

使用零件來組裝出這些神奇的連桿機構！你能找到模型中的所有連桿機構嗎？



>>> 你知道嗎？一個槓桿也是一個雙桿的連桿機構呢！

EXPERIMENTS



STRUCTURAL ENGINEERING
BRIDGES & SKYSCRAPERS
結構密碼-橋樑與摩天大樓
#7410
25 Models to build
323 PCS



MECHANICAL ENGINEERING
ROBOTIC ARMS
氣壓動能機械手臂
#7411
6 Models to build
204 PCS



CROSSBOWS & CATAPULTS
城堡攻防戰
#7406
10 Models to build
110 PCS



RCM CONSTRUCTION VEHICLES
萬能工程車
#7408
8 Models to build
227 PCS



MINI GYRO
陀螺儀飛輪機器人
#7395
20 Models to build
88 PCS



GECKOBOT
爬牆機器人
#7409
7 Models to build
176 PCS



ENGINEERING MAKERSPACE
GEARED-UP GADGETS
創客工程:齒輪彈力組
#7443
5 Models to build
114 PCS



ENGINEERING MAKERSPACE
KINETIC MACHINES
創客工程:動能彈力組
#7444
5 Models to build
108 PCS



ENGINEERING MAKERSPACE
OFF-ROAD ROVERS
創客工程:動能履帶車
#7446
10 Models to build
118 PCS



MADE IN TAIWAN

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