

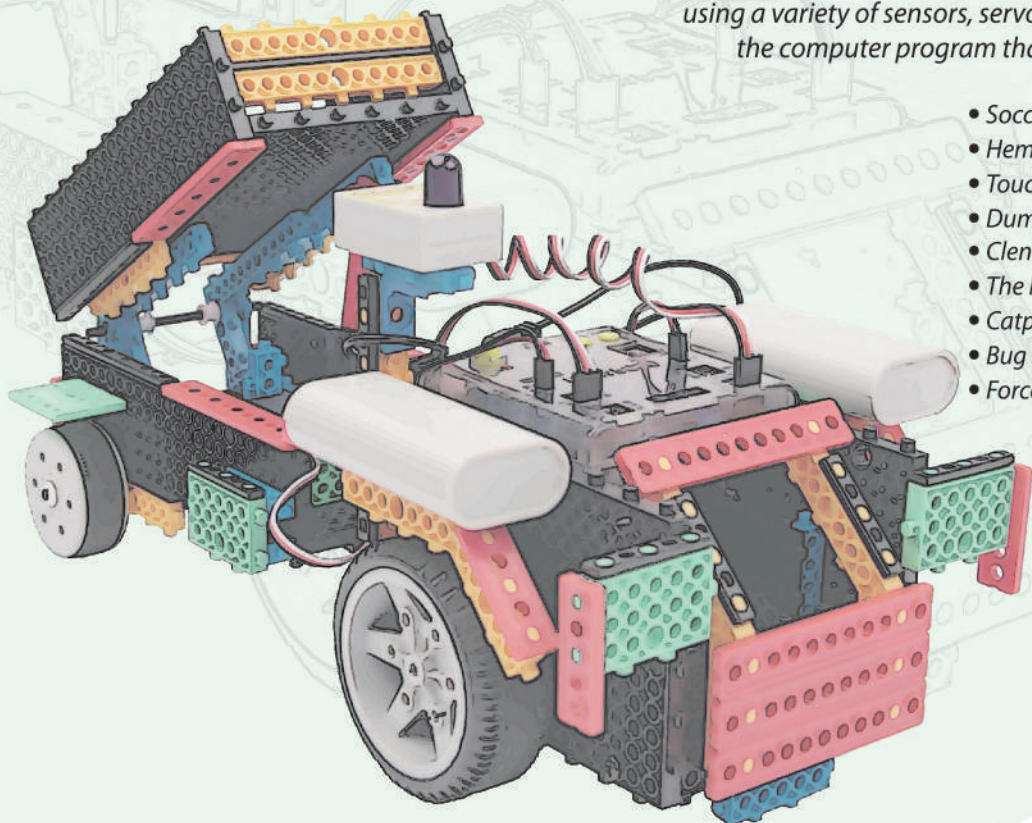


HUNA

Science Class

Intermediate Course

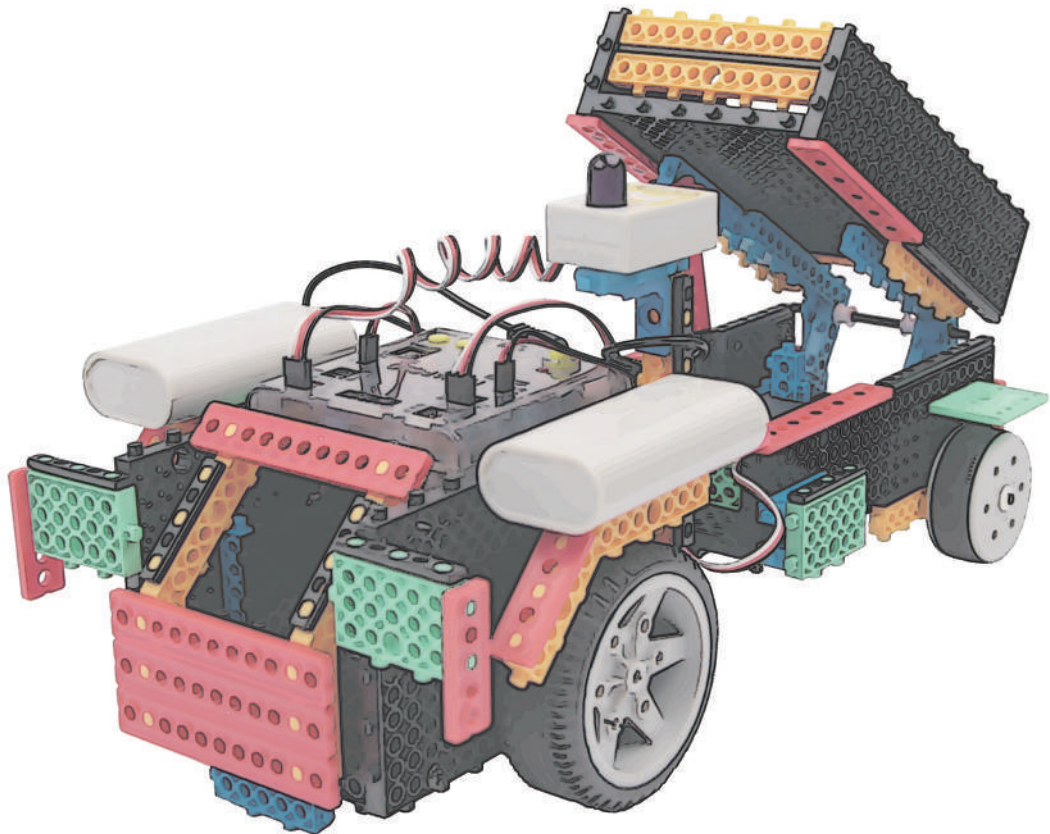
Learn the principles and configurations of robots using a variety of sensors, servo motor and the computer program that support it.



- Soccer Robot2
- Hemiptera
- Touch Battle Bot
- Dump Truk
- Clener Bot
- The little car 'Bumboo'
- Catpult
- Bug Battle Bot
- Forceps Robot

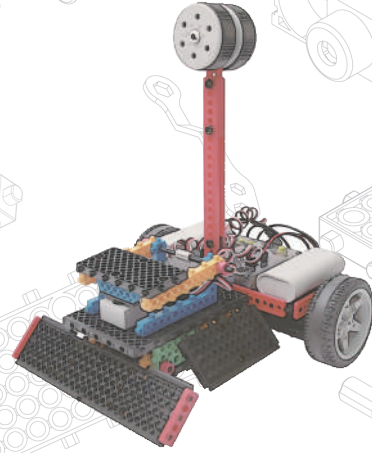
HUNA science Class

Intermediate Course



HUNAROBO SCIENCE CLASS INTERMEDIATE COURSE

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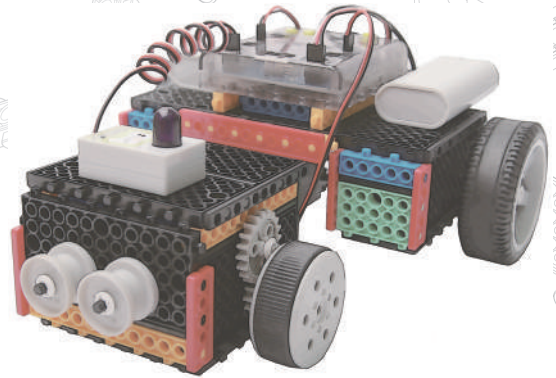
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HUNAROBO SCIENCE CLASS INTERMEDIATE COURSE

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HUNAROBO 2 Education Program

Educational Development Program

- The whole programs focus on the development of scientific, robotic and other technological skills.
- Development of basic scientific knowledge and creative thinking skills, to solve complex problems and program development to raise problem solution-oriented abilities and to create novel solutions.

Training Features

- Challenges and promotes problem-solving skills and improve concentration.
- Improve leadership and communication skills through small group activities.
- Education linked to kindergarten and elementary school science curriculum
- Under the guidance of a teacher, the goal will be achieved through self-assembly to promote a good learning environment.

HUNAROBO 2 (Intermediate Course)

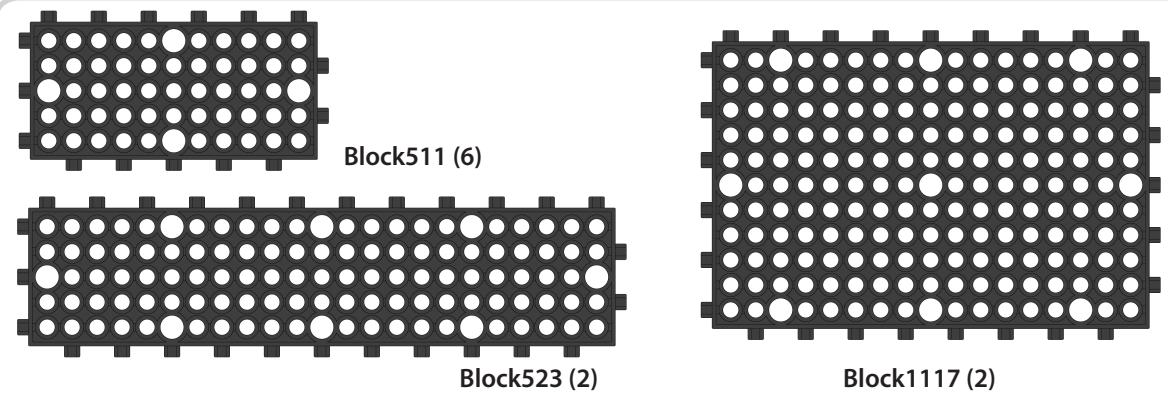
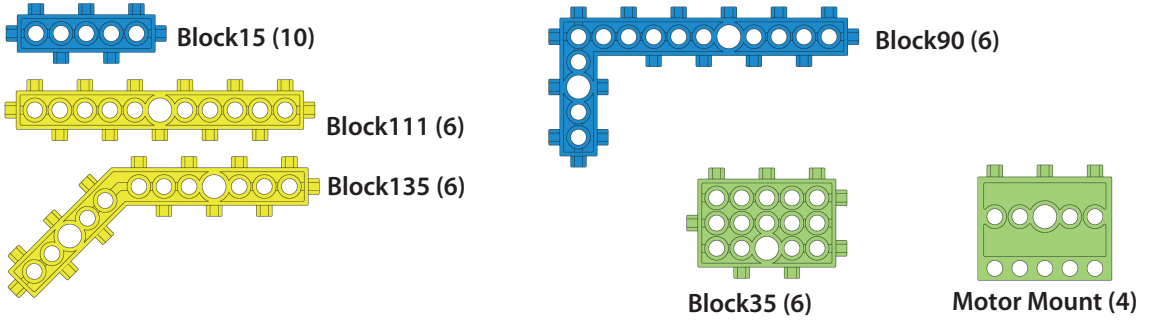
In this Intermediate Course for HUNAROBO2, we will learn the program below;

Division	The objects of study/Theme	The contents of study/Activities
1 Human & Robot	The robot's eyes - The light sensor	Introducing the Hunarobo program
	The robot's ears - The sound sensor	Making a remote-controlled soccer robot (Soccer Robot2) : [remote control / game]
	The robot's brain - The binary numbers (Light ON/OFF)	Making a robot to perceive cliff with infrared sensors (Hemiptera) : [Drop Checker]
	The robot's skin - The touch sensor	Making a battle robot that uses touch sensors and a servo motor (Touch Battle Bot) : [remote control/ game]
2 Energy	Energy - fossil fuels	Making a robot with wheels and shafts that use the power of motorized tools : Building various devices (Dump Truck): [remote control]
	Green energy - solar, wind, water power	Understanding green energy and making my own environment - friendly robot
	Potential energy - Water power	Making a robot utilizing various sensors (Cleaner Bot) : [infrared sensor / CdS sensor]
	Kinetic energy	Making four-wheel-drive robots with DC motors and a servo motor (The little car 'Bumboo') : [remote control]
3 The laws of motion	The first law of motion - Inertia	Understanding the law of inertia, and making a catapult (Catapult) : [remote control]
	The second law of motion - Acceleration	Making a bug battle bot that moves with six legs (Bug Battle Bot) : [remote control]
	The third law of motion - Action and reaction	Learning about servo motors and making a robot that utilizes a servo motor (Forceps Robot) : [remote control / game]
	The robot's muscle -motor	Creating your own robot with sensors, servo motors, HunaRobo program

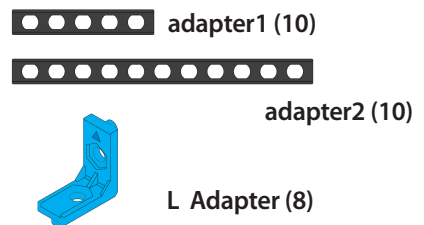
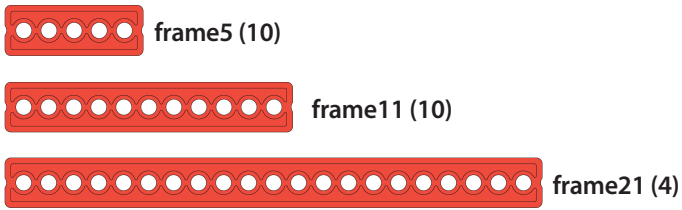
List of the parts

Block

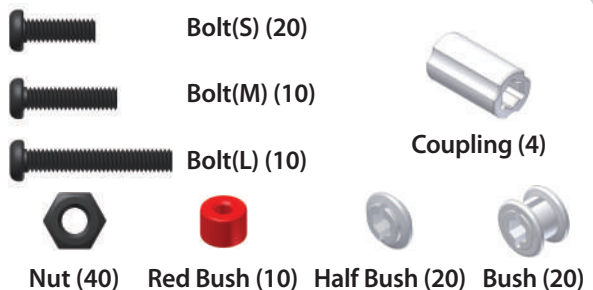
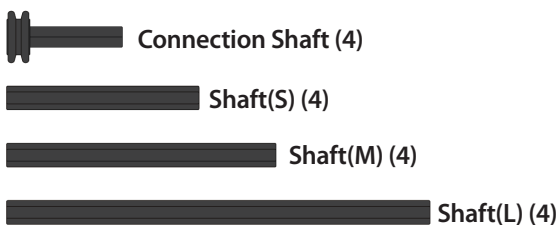
The form and color of some parts may be different when compared to actual parts due to continues improvement of production quality.



Frame / Adapter



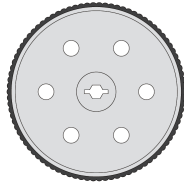
Shaft / Bush / Bolt



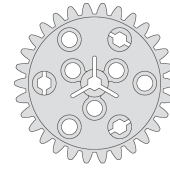
Wheel/ Gear



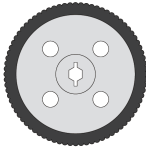
Wheel(L) (2)



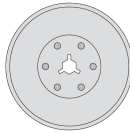
Wheel(M) (2)



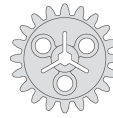
Gear(L) (2)



Wheel(S) (2)



Guide Wheel (2)

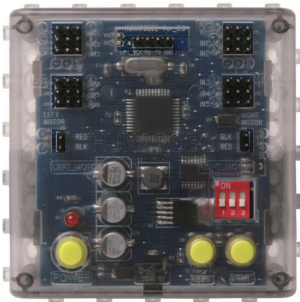


Gear(M) (2)



Gear(S) (2)

Electronic Part



HunaRobo2 MainBoard (1)



Touch Sensor Board (2)



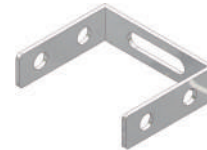
CdS Sensor Board (1)



Servo Motor(1)



Servo Horn(1)



Servo Bracket(2)

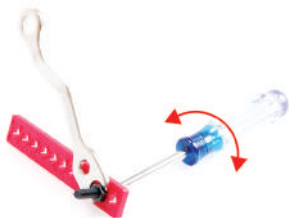


Screwdriver



Spanner

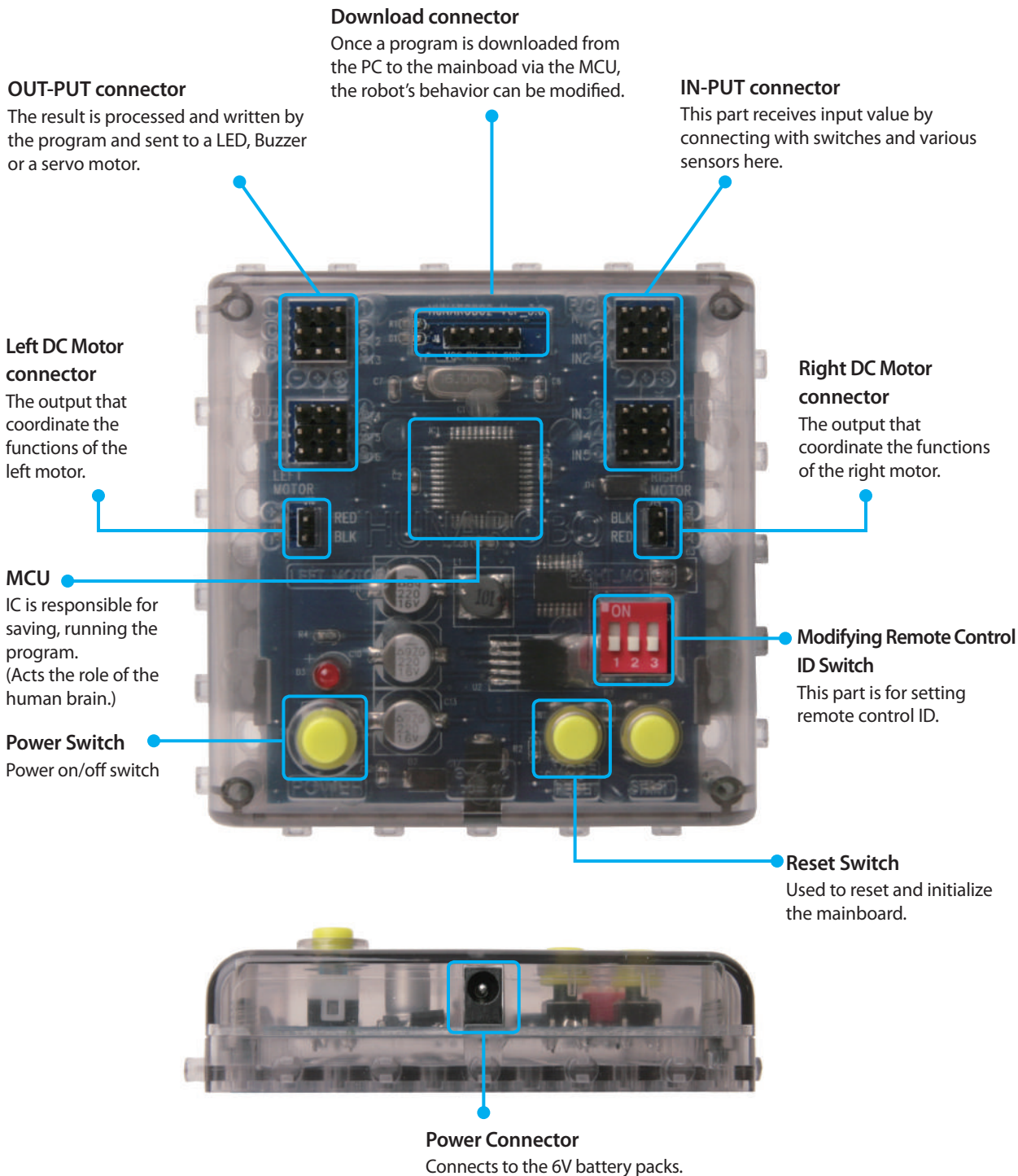
How to use a screwdriver and a spanner? ⇄



1. When holding a screwdriver; Turn right to tighten and turn left to loosen.
2. When tightening or loosening a bolt, hold it firmly to keep the nut in place.

Electronic parts

Mainboard Assembly/ Function of each feature



Touch Sensor Board



Switch

Switch is used to turn the input signal ON/OFF.

CdS Sensor Board

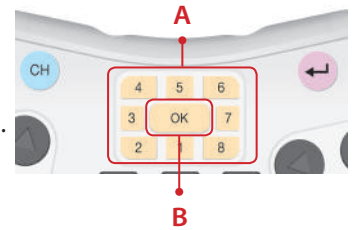


Light Sensor

Light is received and affects the behavior of the sensor.

Setting remote control ID

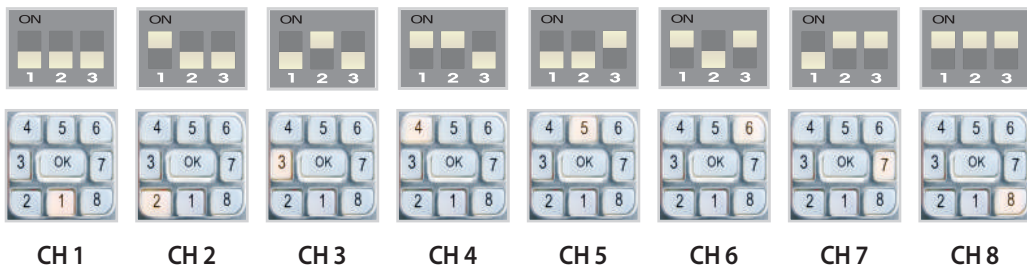
1. Press CH button while holding ← button.
The A panel ID LED turns on and shows you what mode you chose.
2. Press CH button while holding ← button and choose your ID. (Number 1~8)
3. After selecting ID, if you release ← Button and press CH button, ID will be selected.
4. The LED on the mainboard will blink 3 times and it will turn off automatically.
That means the ID Selection is finished.
5. If you press ← button, you can see your selected ID.



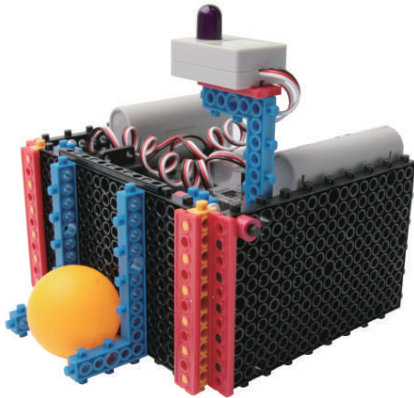
**If there is a problem, repeat steps 1-5 carefully.*

How to set up communication ID

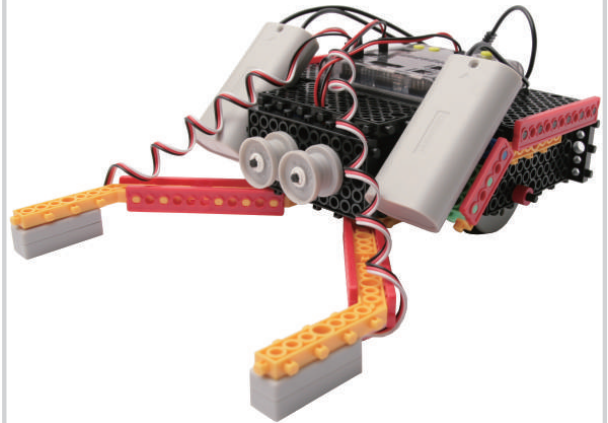
* The maximum number of channels can be set as shown below without interference.
Use the picture to assign the channels to the communication ID.



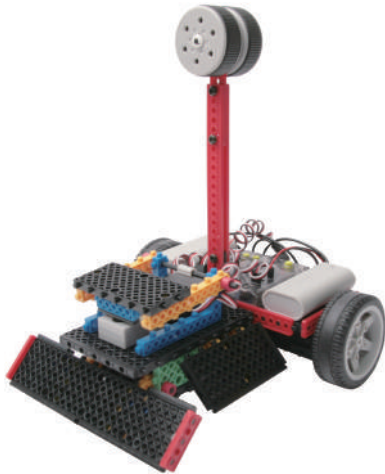
What robots are we going to assemble? ⇄



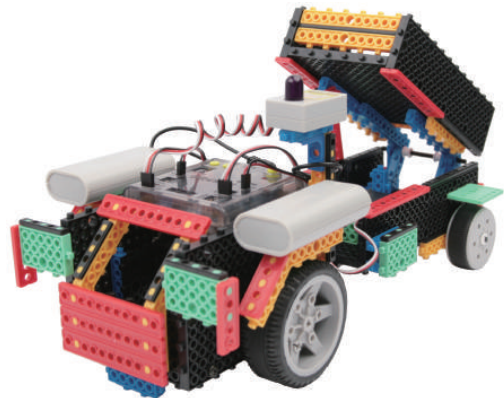
< Soccer Robot2 >



< Hemiptera >

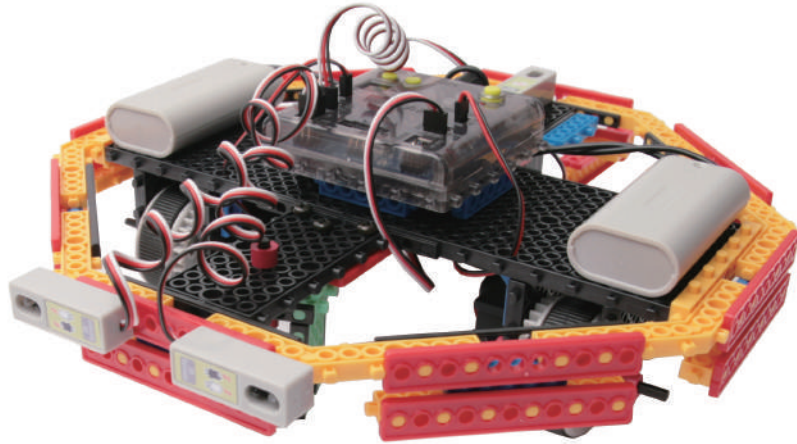


< Touch Battle Bot >

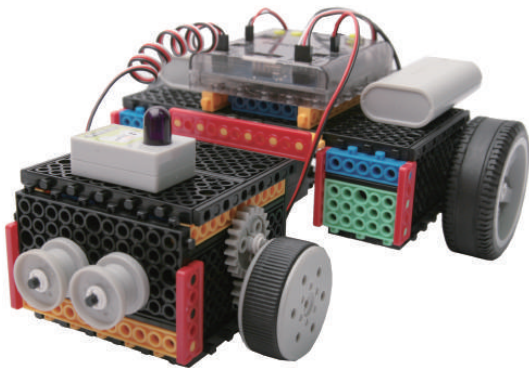


< Dump Truck >

What robots are we going to assemble? ⇄



< Cleaner Bot >



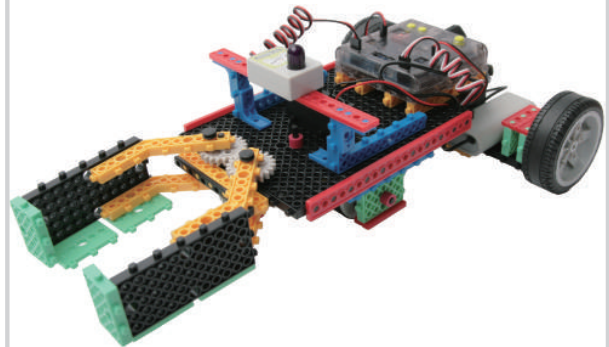
< The little car 'Bumboo' >



< Catapult >



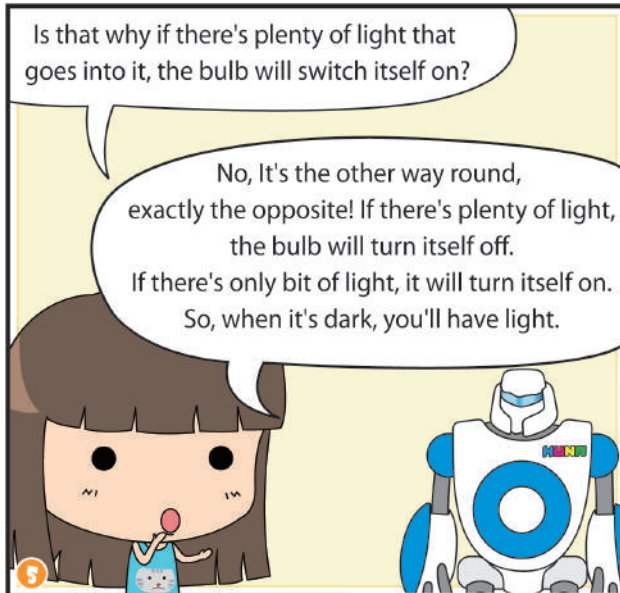
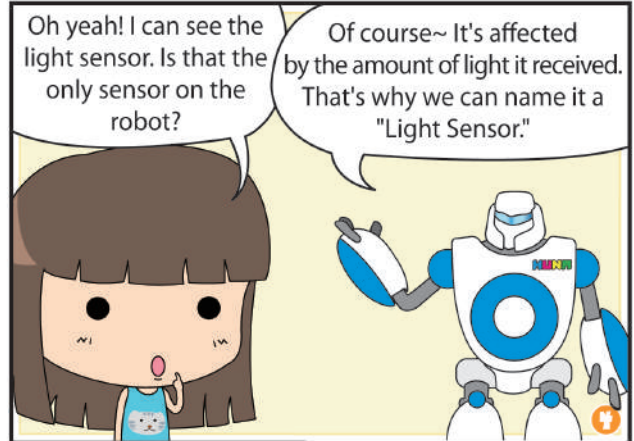
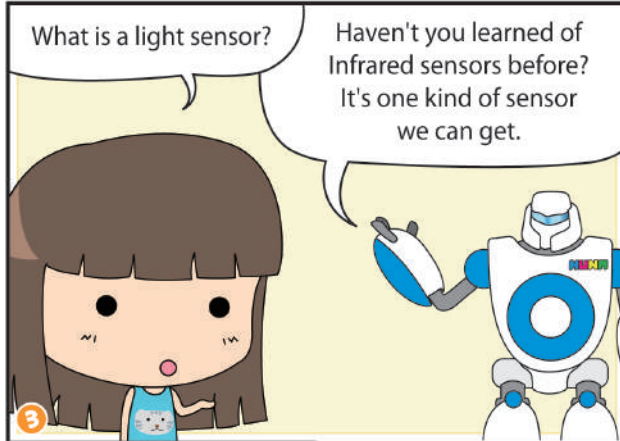
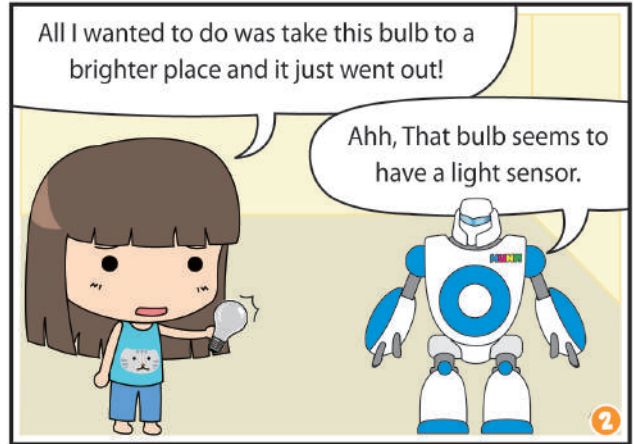
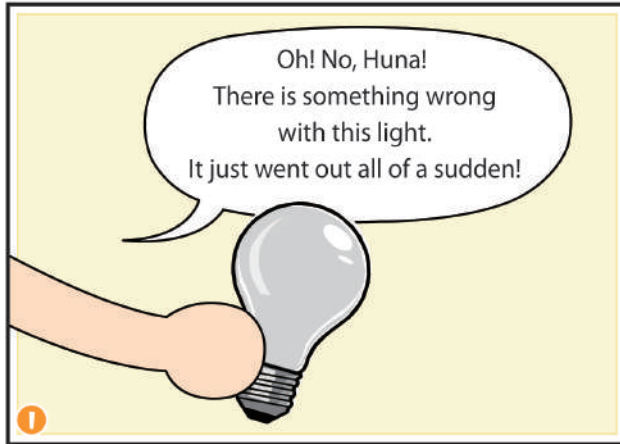
< Bug Battle Bot >



< Forceps Robot >



The robot's eyes - The light sensor



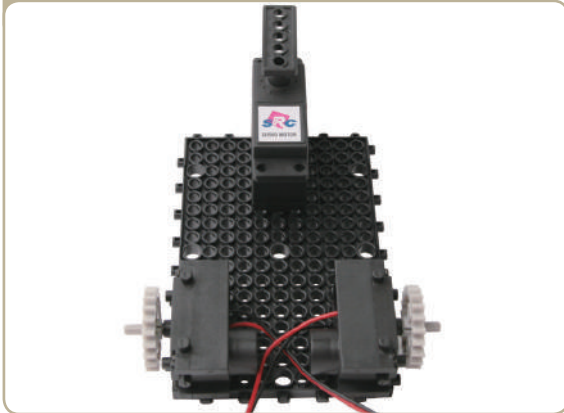


Let's
Make it 1

How to use the basic Hunarobo program

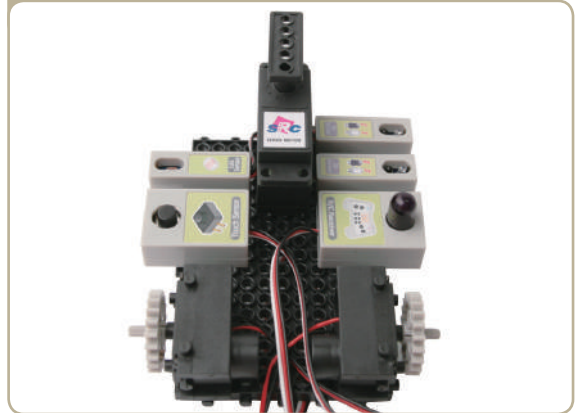
Creating an educational model for the basic program

1



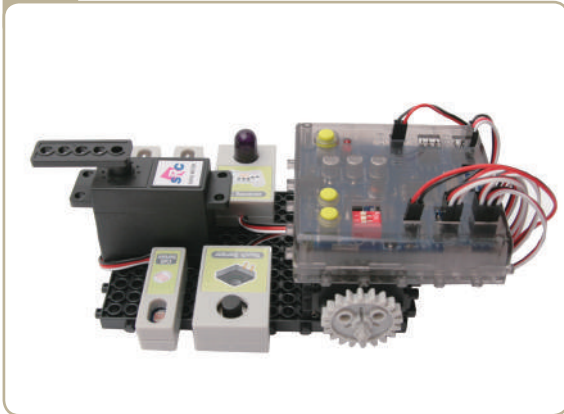
Connect servo motor and DC motors to 「block1117」, then insert medium gears to the shaft of DC motor.

2



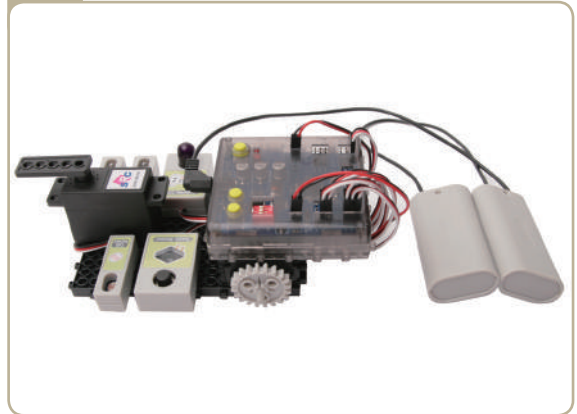
Attach remote control receiver board and various sensors.

3



The mainboard is attached on the top of DC motor.

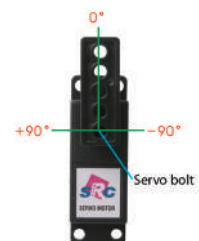
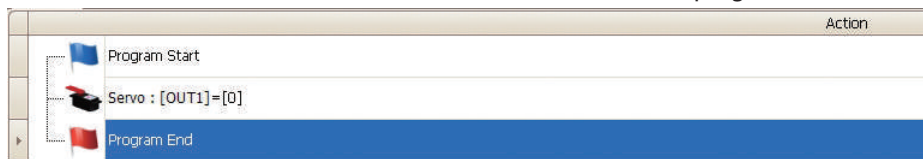
4



Connect battery cases to mainboard.

Servo Motor-Zero Point Adjustment

1. Connect the servo motor to the mainboard. You can write the program in the following way.



2. After downloading the program, power off and on again.

3. Fix servo motor horn to the servo motor with a small servo bolt as illustrated in the picture .

How to operate the DC motor

Left motor and right motor move forward at speed level 10.(Maximum speed)

	Action
1.	Program Start
	DC Motor 1 : [Both MOTOR1]=[Forward],[Speed=10]
	Program End
2.	Program Start
	DC Motor 1 : [L_MOTOR1]=[Forward],[Speed=10]
	DC Motor 1 : [R_MOTOR1]=[Forward],[Speed=10]
	Program End

No.1 and No.2 are exactly the same programs. However, program No.1 is used to control the two motors together, and program No.2 is used to control the motors separately. Let's try to change the program to the mainboard in different ways.

How to operate the Servo motor

Servo motor connected to the OUTPUT port 1 is rotated by 90 degrees.

	Action
	Program Start
	Servo : [OUT1]=[90]
	Program End



To adjust zero point of the servo motor connected to OUTPUT port 1

	Action
	Program Start
	Servo : [OUT1]=[0]
	Program End



Servo motor connected to the OUTPUT port 1 is rotated by -90 degrees.

	Action
	Program Start
	Servo : [OUT1]=[-90]
	Program End

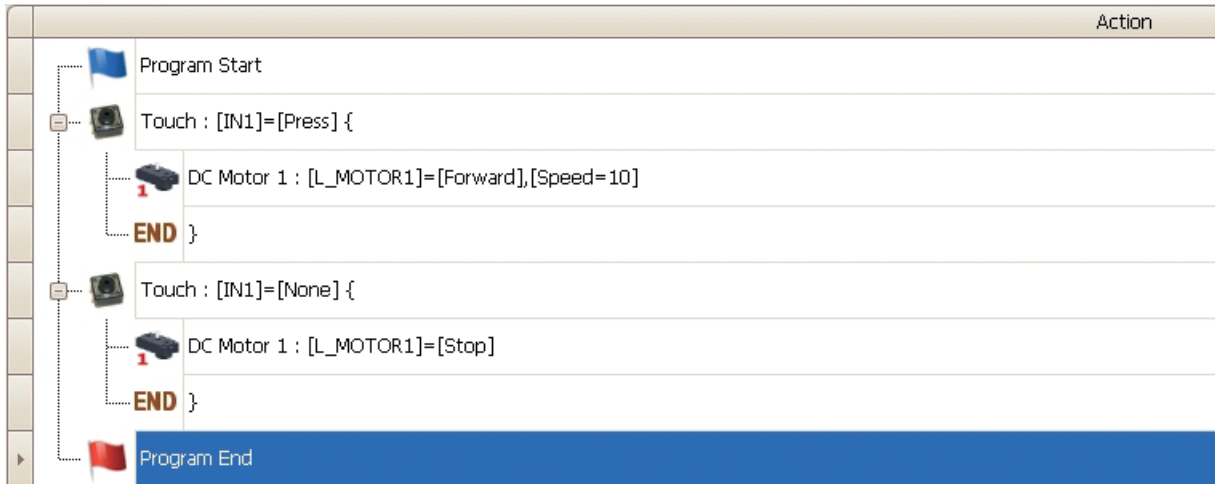


* Let's change the degree of servomotor by modifying the program.

Creating Conditional(IF/END)Sentences

1. Creating a conditional sentence for sensor

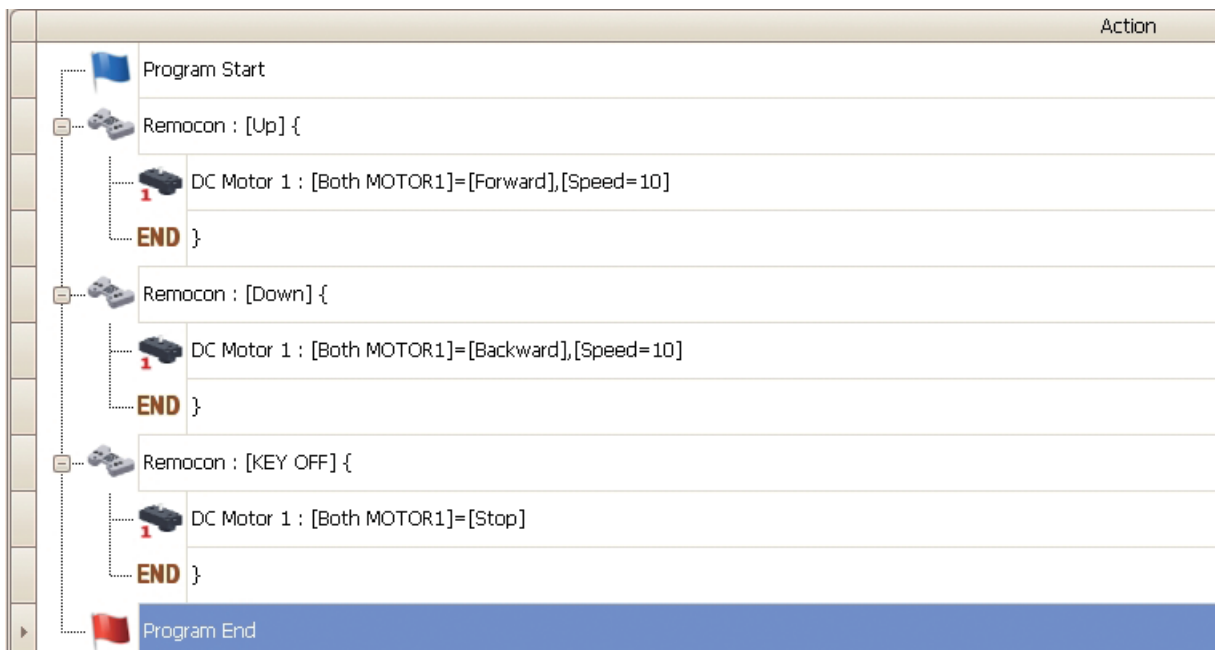
- When pressed touch sensor connected to INPUT port 1, left DC motor will work. When not pressed, the left DC motor will not move.



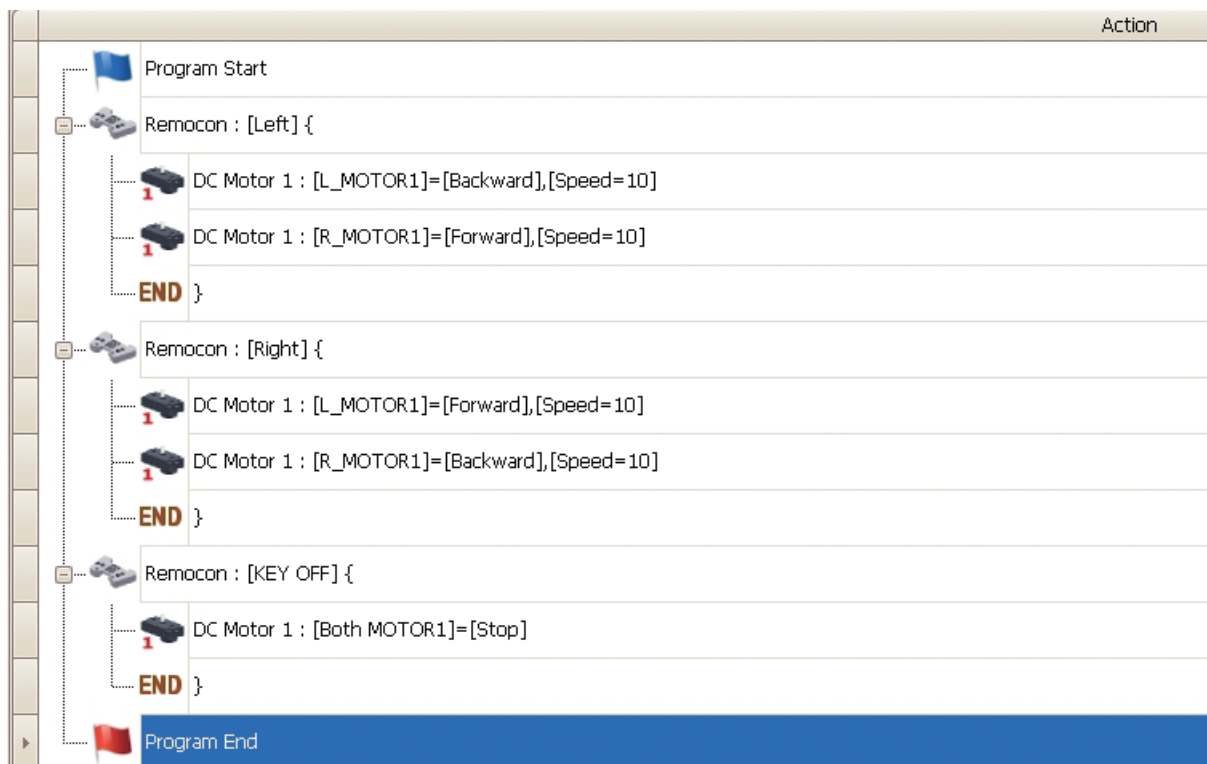
♣ Let's change the program of the Infrared sensor and CdS sensor in the same way.

2. Creating a conditional sentence for remote control

- If one press the directional keys(△ ▽) of the remote control, both DC motors will move back and forth.



- If one press the directional keys (< >) of the remote control, both DC motors will move opposite directions from each other.

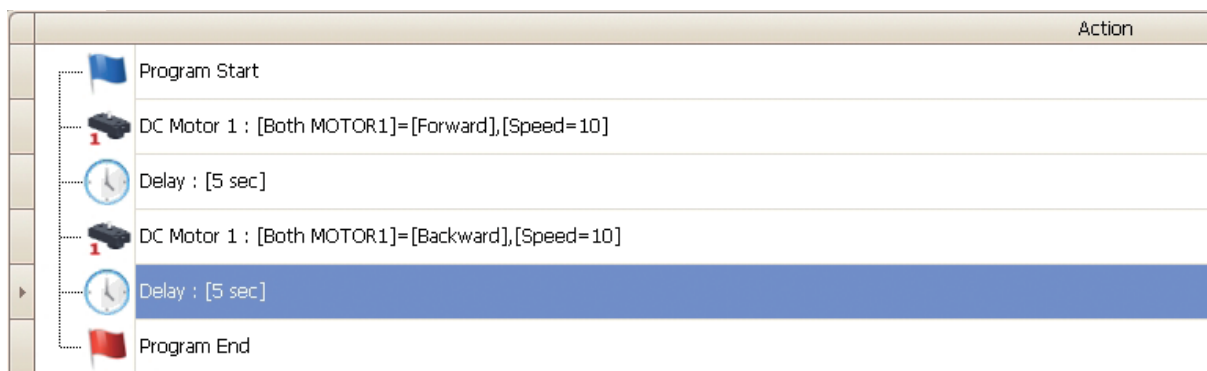


*** Note: When creating remote control conditional sentences, it is necessary to enter 'KEY OFF' conditional sentence, then the robot will operate smoothly.**

♣ Let's create various programs by using remote control FUNCTION keys (F1/F2 ~ ~)

Creating a time delay

- DC motors move forward for 5 seconds , then go into reverse.





Let's talk about the LED

Hey Huna! There is a small light bulb attached to my robot eye. Wow, my robot eyes are blinking!

Oh, those are LED bulbs! we say LED, but it actually stands for light emitting diodes.

1

LED? what's a light-emitting diode? What is it ...? it's such a difficult word...

Wait! Let me explain! If an electrical current would flow into the space where steel the two metal ends meet, the LED will emit light.

As far as we know, most electronic goods use LEDs for the indication of number and letters.

2

What are the advantages of using LED?

If energy A would change into energy B, the particles of energy A will disappear. So energy B will be less than energy A.

But LED's convert electric energy into light energy. Because of this, we can save more electric energy. No electric energy is wasted.

3

And it better for the environment as well. because it doesn't use mercury. Mercury causes much of the world's pollution.

WOW~ I'm really impressed with LED. I want to know more.

4

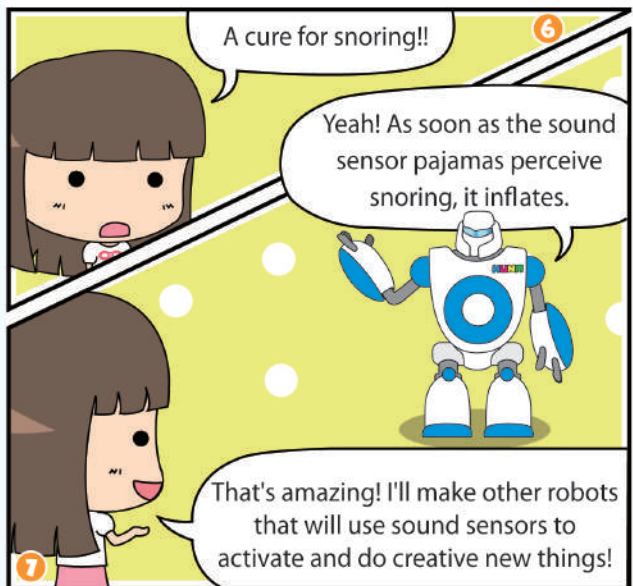
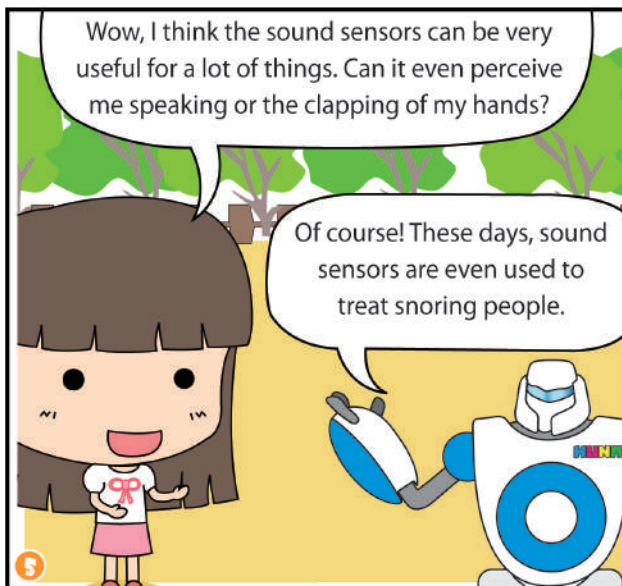
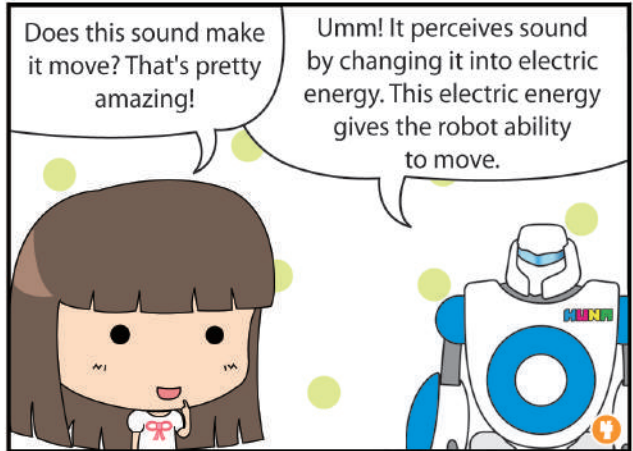
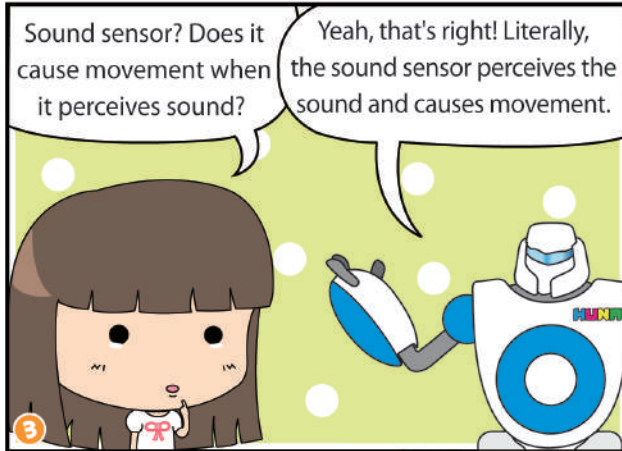
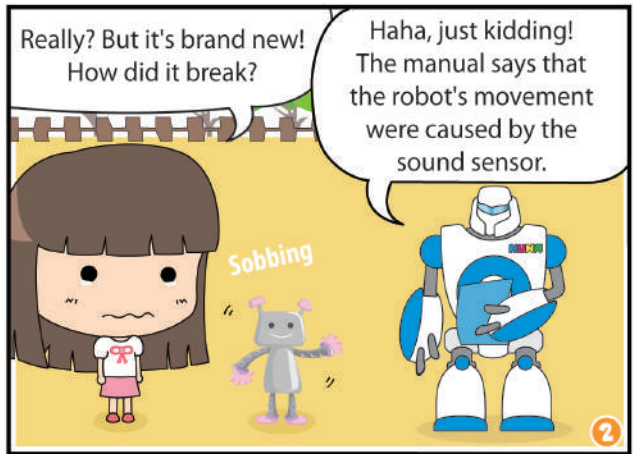
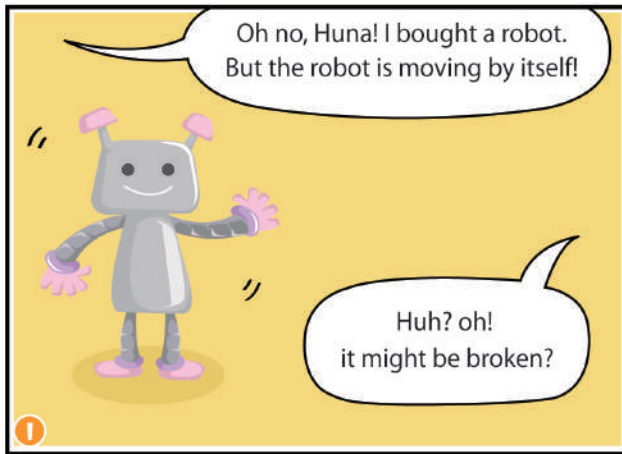
Well, LEDs are small. But the period of their lights brightening is quite long. And LEDs have various colors!

There are other colors? If so, I want to change the color of robot's eyes.

5

Robot story 1

The robot's ears-the sound sensor





Making a remote controlled soccer robot



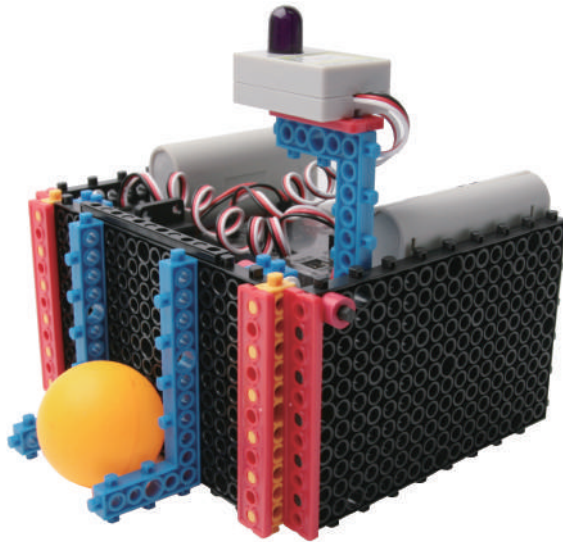
Soccer Robot2



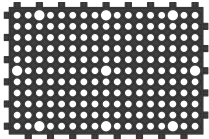

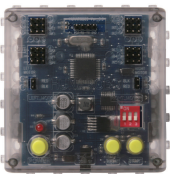










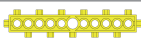









Robot soccer tournaments are coming in contact with the public with it's cutting-edge science and technology, by combining state of art of technology with the flair of soccer.

The soccer robot is powered by a DC motor, and it scores goals with a servo motor.

*** After completing the assembly, divide the class into teams and play football against each other.**

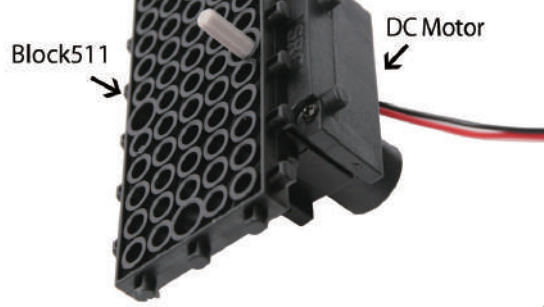


Prepare parts for assembly

	Block1117	x3		Frame11	x6	
				Frame5	x2	
				Adapter2	x1	
	Block511	x3		L Adapter	x8	
				Shaft(M)	x2	
	Block90	x3		Red Bush	x4	
				Half Bush	x2	
	Block111	x2		Bolt(S) / Nut	x2	
	Block35	x4				
	Block15	x4		Wheel(M)	x2	
	Servo Motor	x1				
	DC Motor	x2		Battery Case	x1	

1

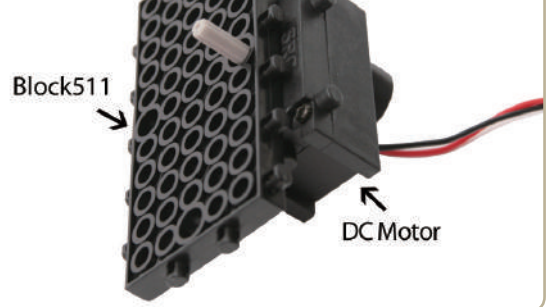
Right Wheel



Connect a DC motor to 「block511」.

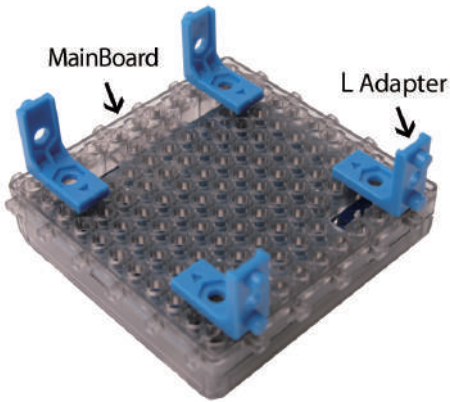
2

Left wheel



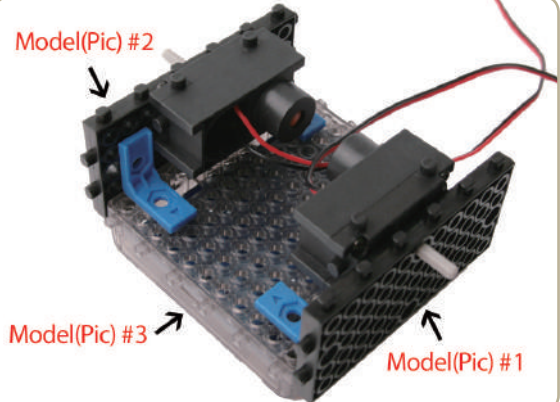
Connect a DC motor to 「block511」.

3



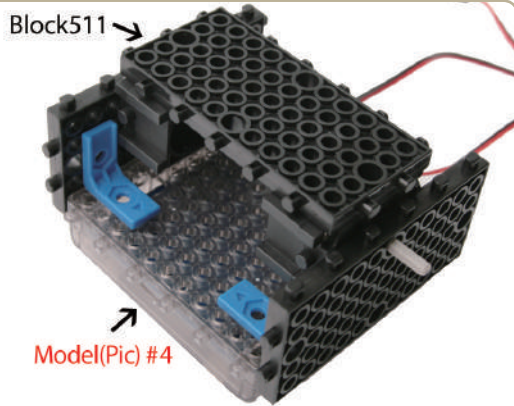
Attach four 'L' adapters on the main board.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

4



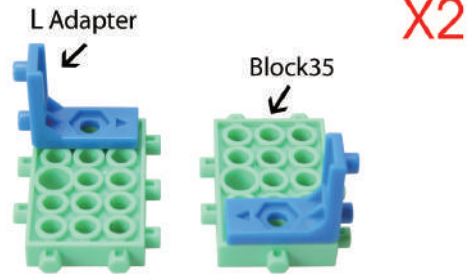
Connect model(Pic)#1 and model(pic)#2 to model(Pic)#3.

5



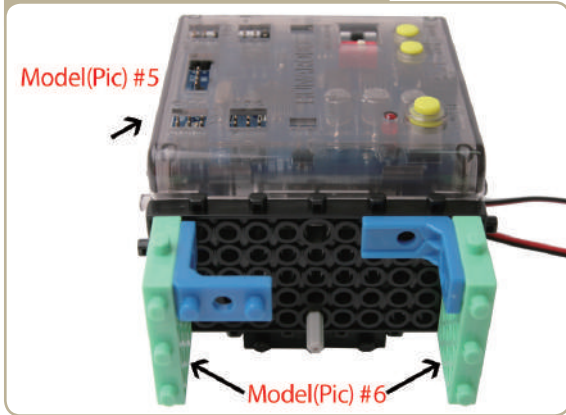
Model(Pic) #4

6



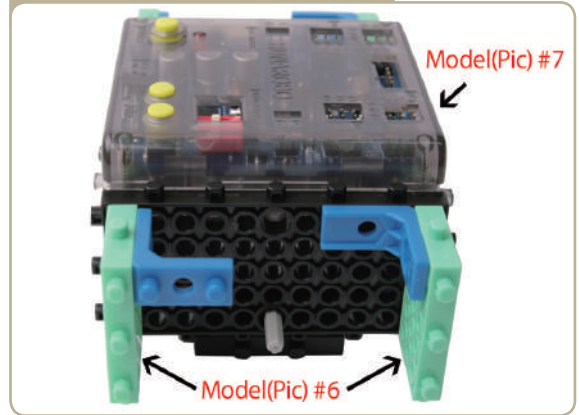
Attach 'L' adapters to 「block35」. Pay close attention to the arrows(▲) that indicate how the adapters should be attached. (Assemble two identical models.)

7 (Left part of wheel protector)



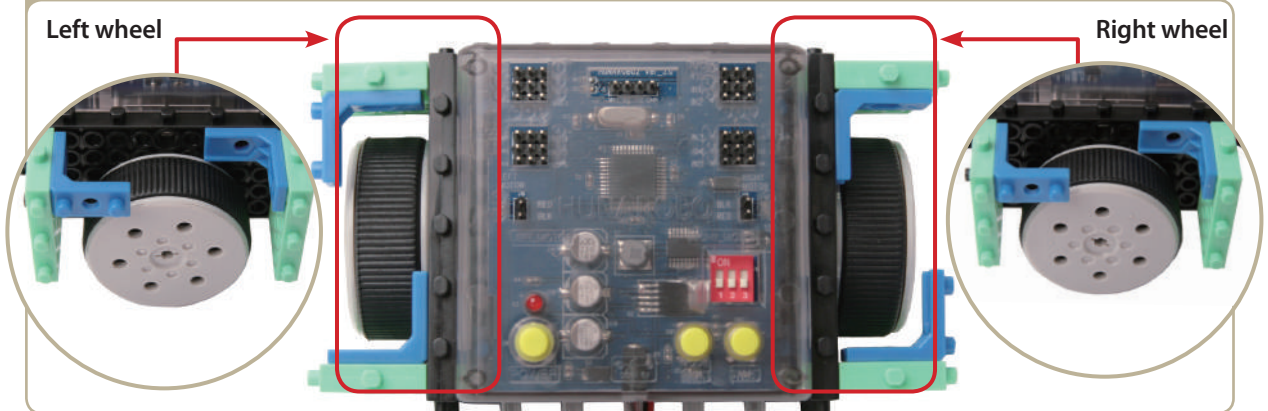
Connect one previously constructed parts of model(pic)#6 to model(pic)#5.

8 (Right part of wheel protector)



Connect one previously constructed parts of model(pic)#6 to the opposite side of model(pic)#7.

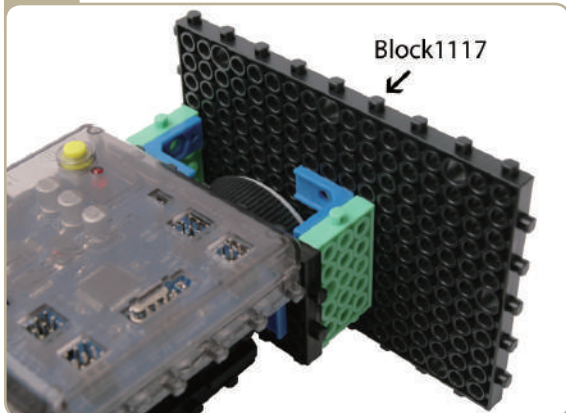
9



Connect a medium wheel to the shaft of left DC motor.

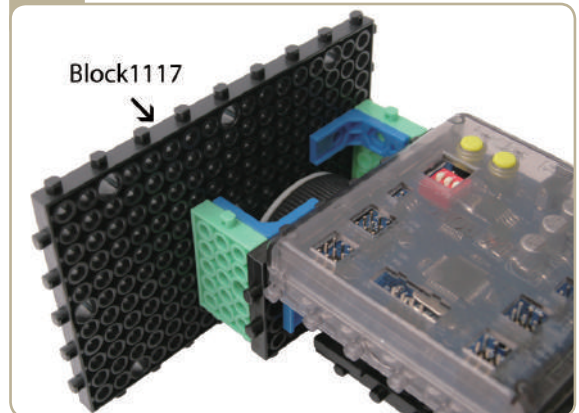
Connect a medium wheel to the shaft of right DC motor.

10



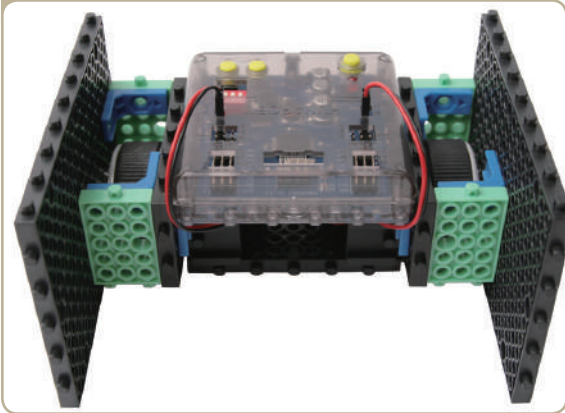
Connect a 「block1117」 to the left wheel protector of model(pic)#9.

11

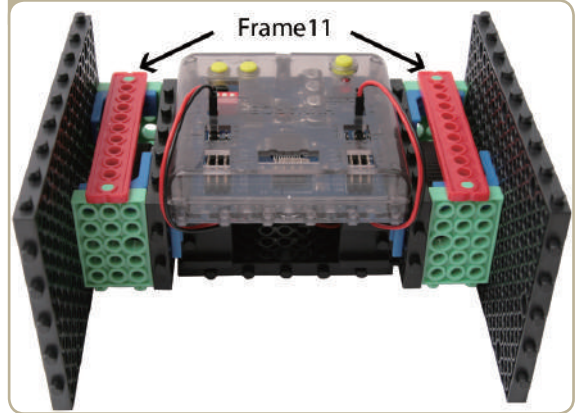


Connect a 「block1117」 to the right wheel protector of model(pic)#9.

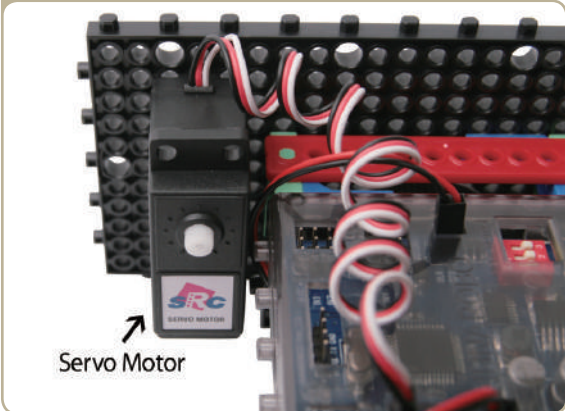
12(Completed of model(pic)#11)



13

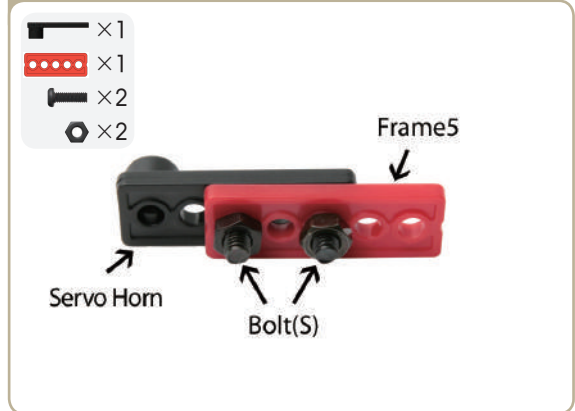


14



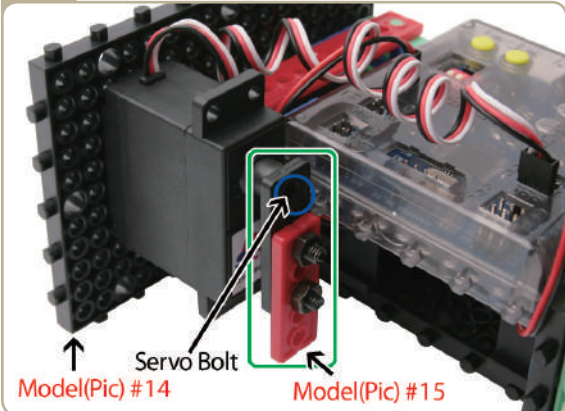
Connect a servo motor to the right hand side of the interior of model(pic)#13.

15



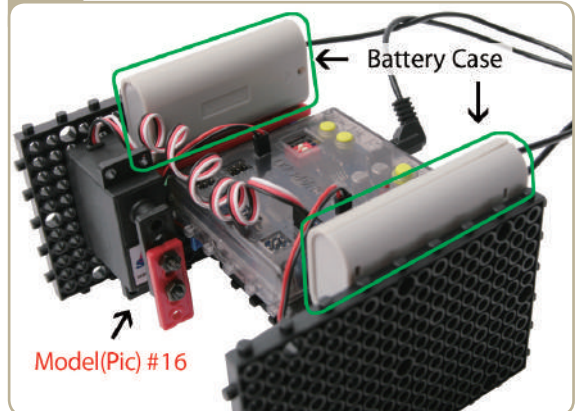
Fix a 「frame5」 with two short bolts and nuts to servo horn.

16



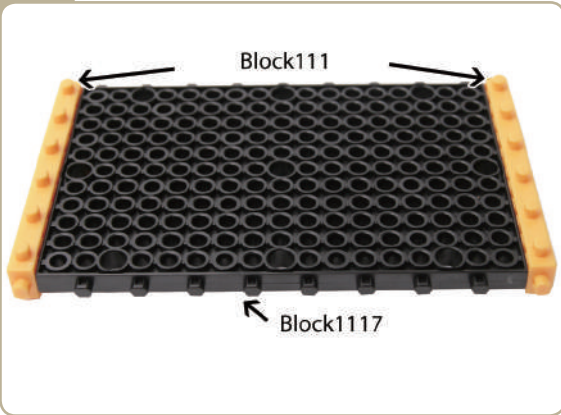
After adjusting zero point of servo motor, fix model(pic)#15 with a small servo bolt .

17

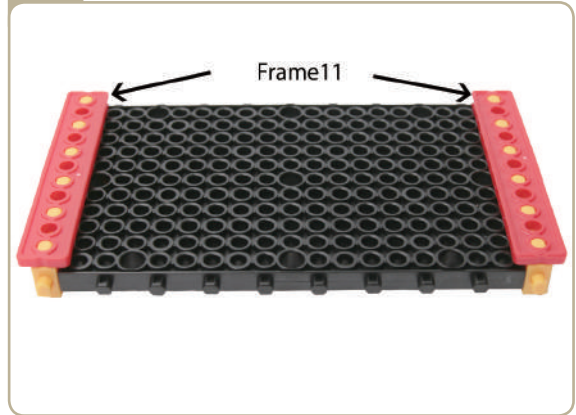


Connect battery cases to model(pic)#16.

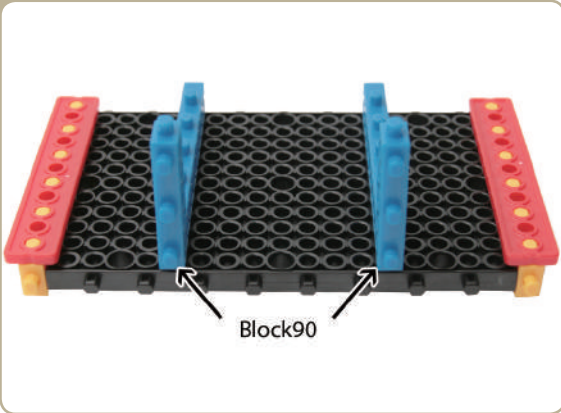
18



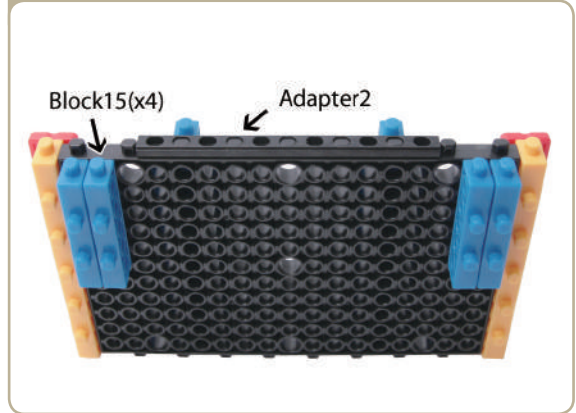
19



20

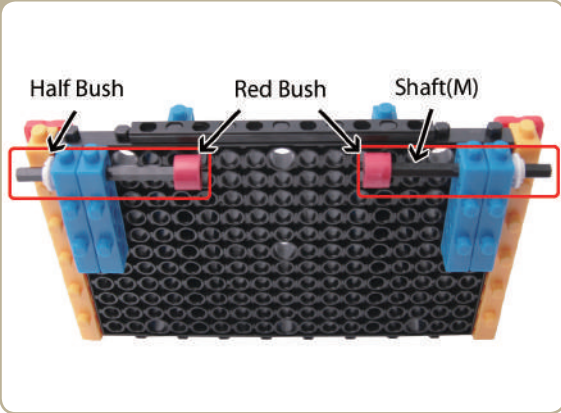


21



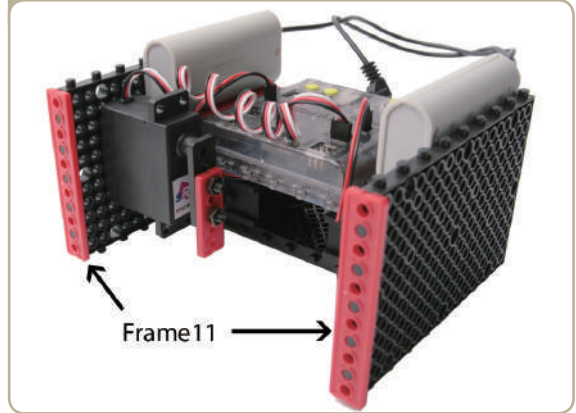
Attach four 「block15」s to the bottom of model(pic)#20, then attach a 「adapter2」.

22



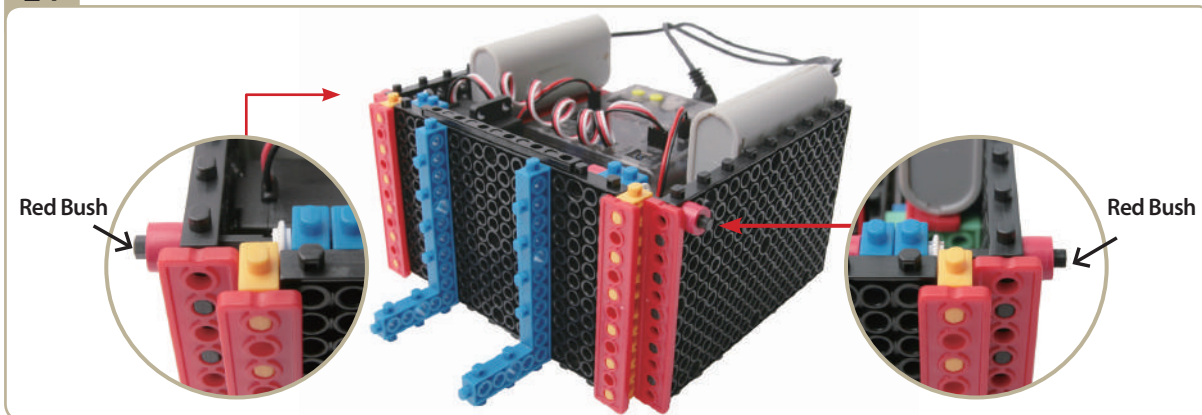
Connect medium shafts with half bushes and red bushes to model(pic)#21.

23



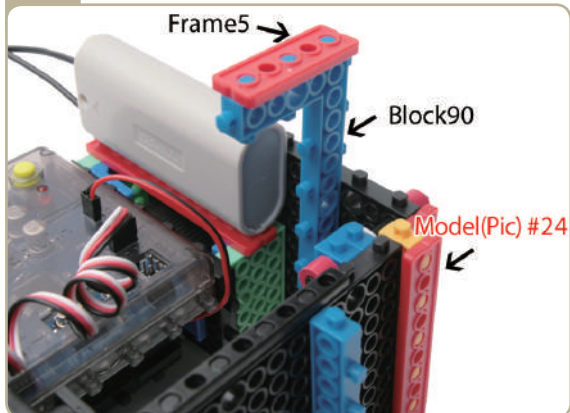
Attach two 「frame11」s to model(pic)#17.

24



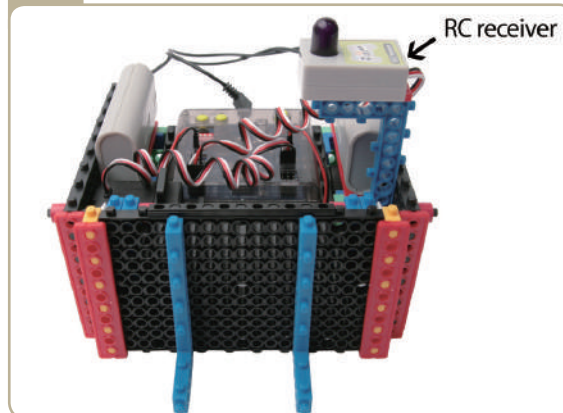
Connect model(pic)#22 to model(pic)#19 with red bushes.

25



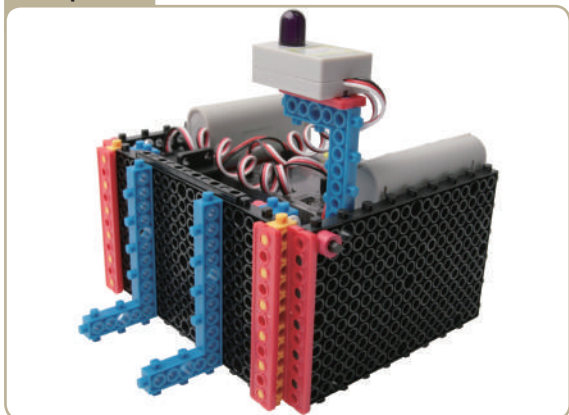
Attach a 'block90' and a 'frame5' to model(pic)#24.

26



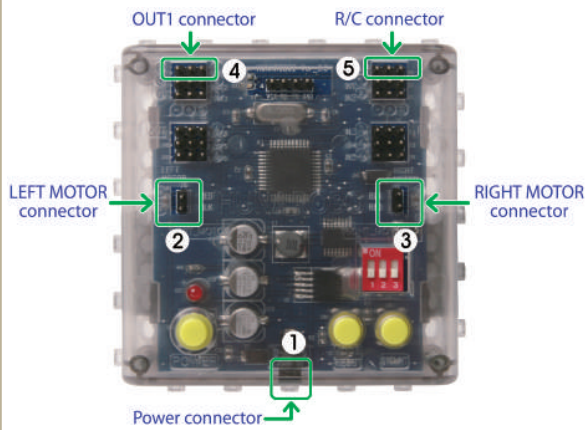
Connect RC receiver board to model(pic)#25.

Completed



How to operate the Soccer robot2

Connecting the mainboard



Connect in this order.

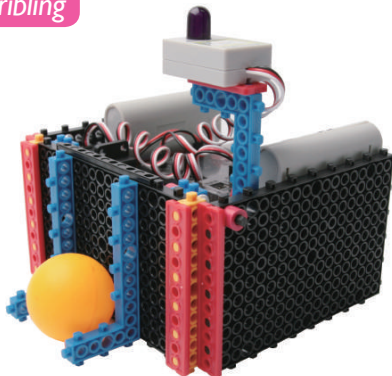
1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

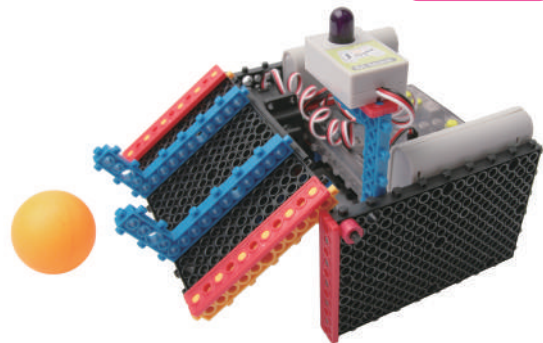
Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program

Ball Dribbling



Shooting




























- Using the motion patterns as reference, let's write the program.

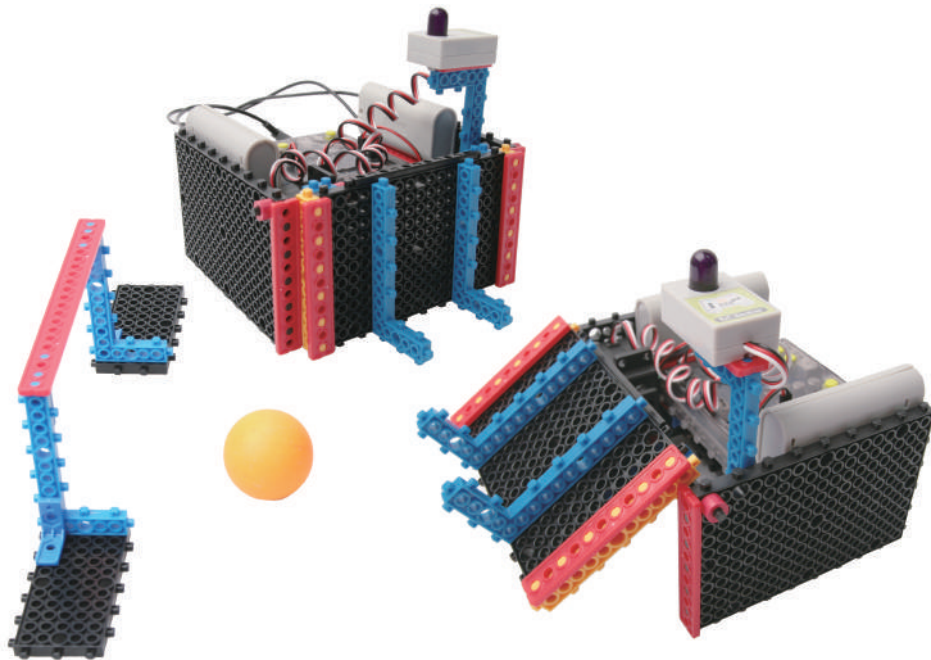
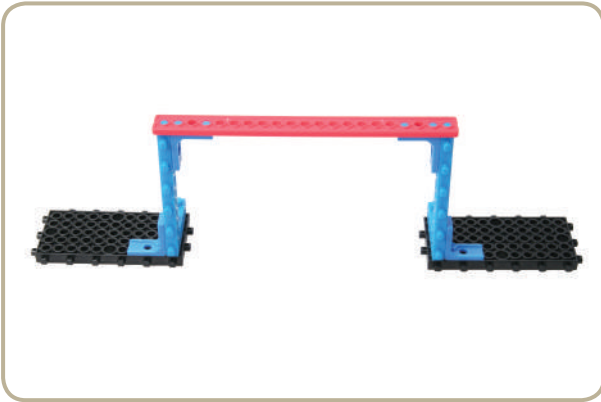
Program Download

1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on. (Power OFF \rightarrow Power ON)

Program Example

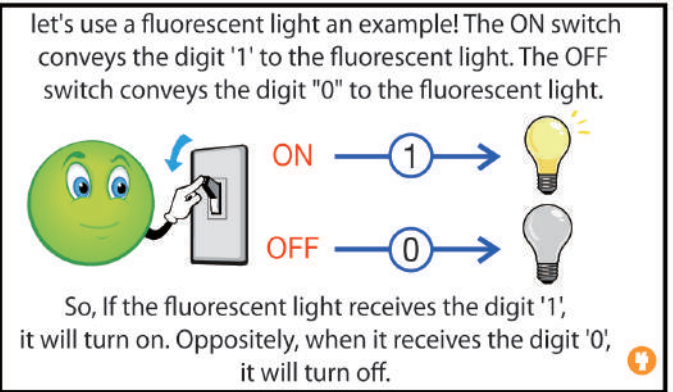
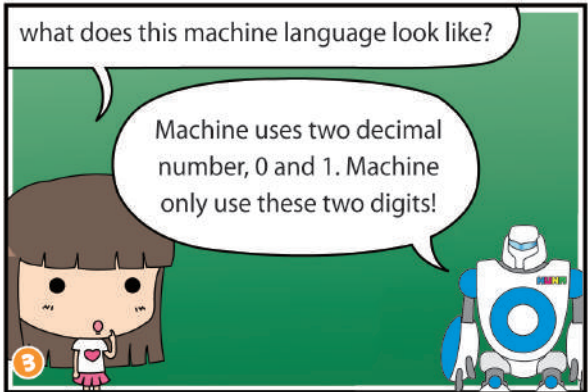
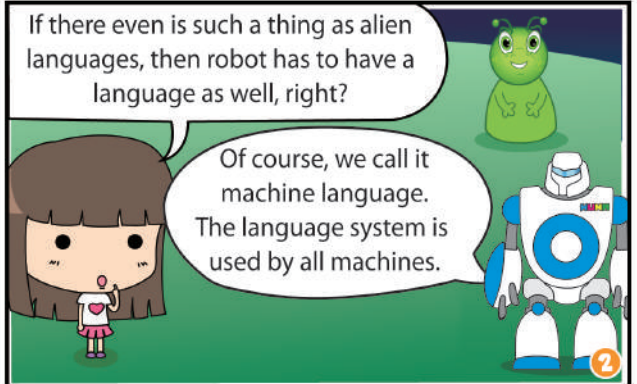
Action	No
 Program Start	0
 Remocon : [Up] {	1
 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	2
END }	3
 Remocon : [Down] {	4
 DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	5
END }	6
 Remocon : [Right] {	7
 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	8
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	9
END }	10
 Remocon : [Left] {	11
 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	12
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	13
END }	14
 Remocon : [Up + Right] {	15
 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	16
 DC motor 1 : [R-MOTOR1]=[Stop]	17
END }	18
 Remocon : [Up + Left] {	19
 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	20
 DC motor 1 : [L-MOTOR1]=[Stop]	21
END }	22
 Remocon : [KEY OFF] {	23
 DC motor 1 : [Both MOTOR1]=[Stop]	24
END }	25
 Remocon : [F1] {	26
 Servo : [OUT1]=[80]	27
 Delay : [1 sec]	28
 Servo : [OUT1]=[0]	29
END }	30
 Servo : [OUT1]=[0]	31
 Program End	32

Assembling a Soccer Goalpost

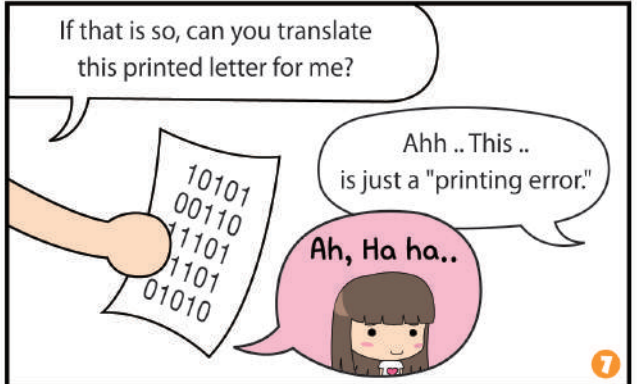
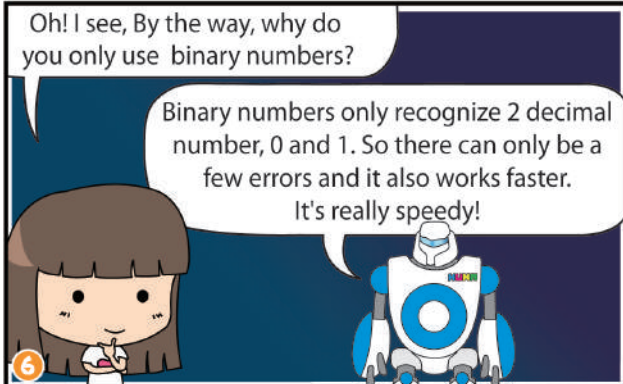




The robot's brain - The binary numbers (Light Bulb ON / OFF)



0 → 0	4 → 100
1 → 1	5 → 101
2 → 10	6 → 110
3 → 11	7 → 111



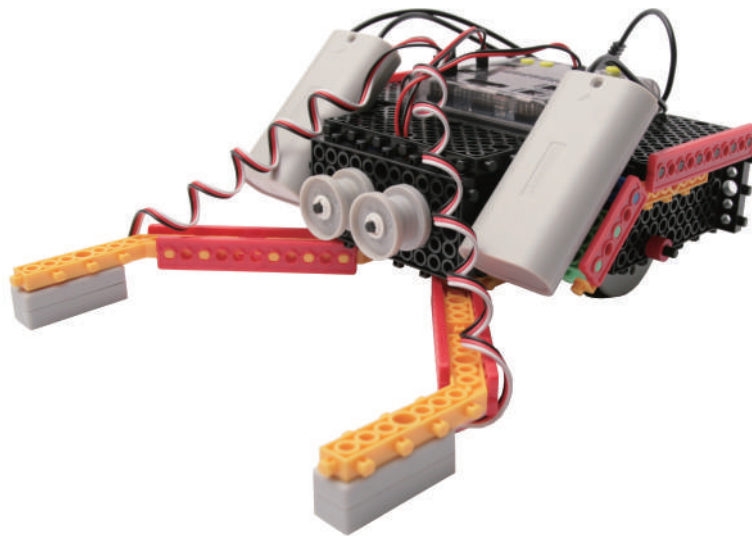
Let's Make it 3 *Making a robot that perceives cliffs using an Infrared sensor*



Cliff Sensing Robot 'Hemiptera'



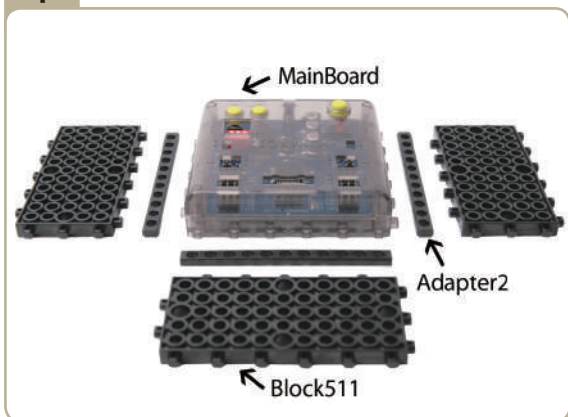
'Hemiptera' is a model that resembles the appearance of a squash insect. They tend to live on leaves by sticking on them. These insect may live on the ground, and even at sea. As they camouflage themselves with the environment around them. Squash bug's body sizes vary from 1.1mm to even 65mm. They have long flat bodies, and their wings can have different shapes and sizes.



Prepare parts for assembly

	Block523 ×1		Frame11 ×6	
			Frame5 ×2	
	Block511 ×8		Adapter2 ×3	
			Adapter1 ×2	
	Block135 ×6		L Adapter ×8	
			Shaft(M) ×2	
	Block35 ×2		Shaft(L) ×2	
	Block15 ×6		Half Bush ×4	
	Wheel(M) ×2		Red Bush ×6	
			Gear(S) ×2	
			Gear(L) ×2	
	DC Motor ×2		Guide Wheel ×2	

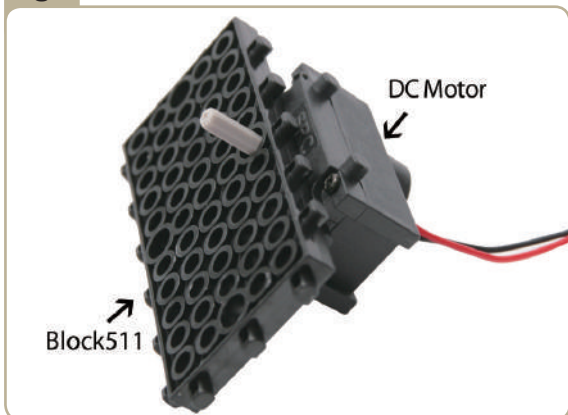
1



2

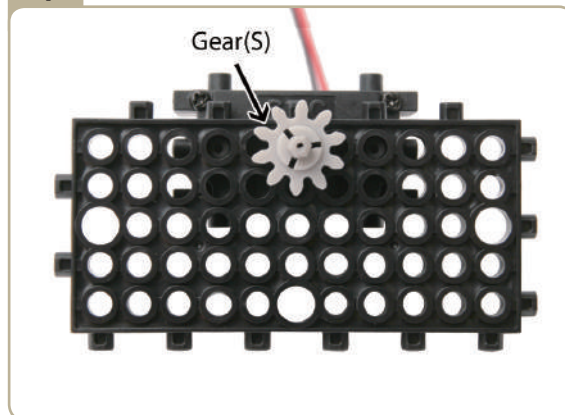


3



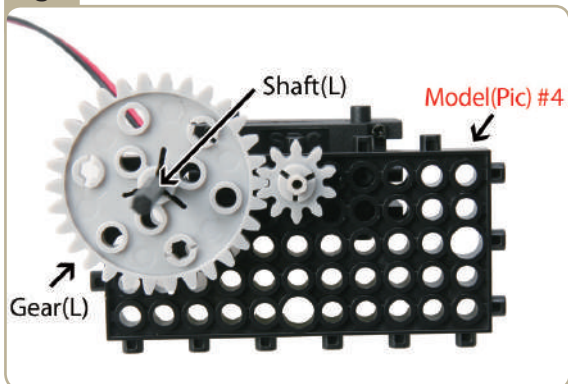
Connect a DC motor to 「block511」.

4



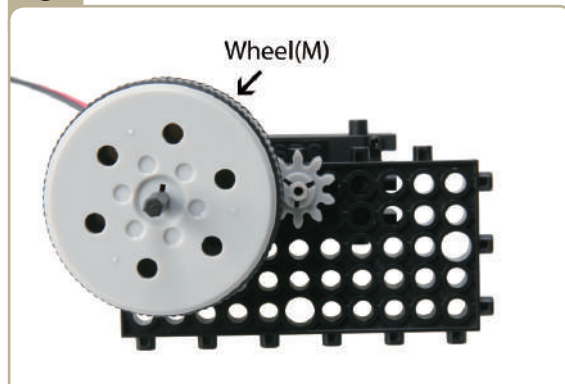
Insert a small gear to the shaft of DC motor.

5



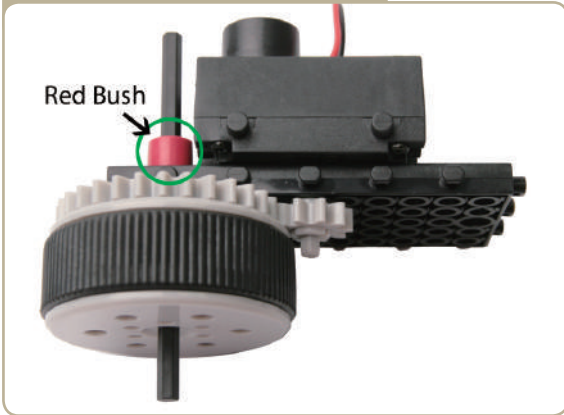
Align the large gear with small gear as illustrated above. Use a long shaft to connect model(pic)#4. (The back side fastens with a red bush.)

6

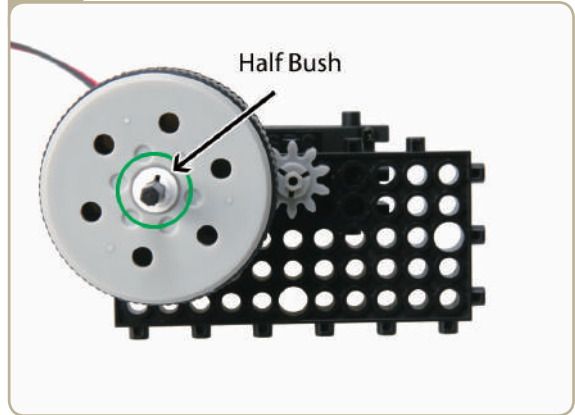


Insert a medium wheel to the long shaft of model(pic)#5.

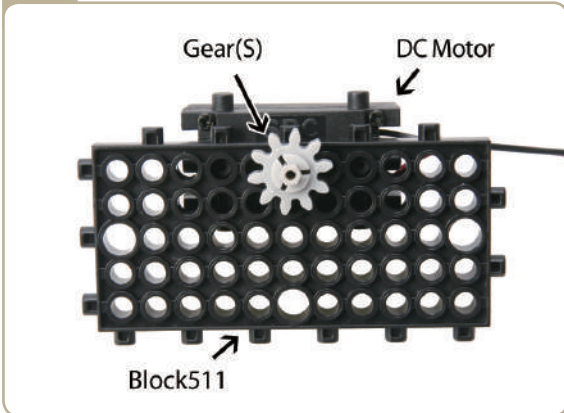
7 (Back of model(pic)#6)



8

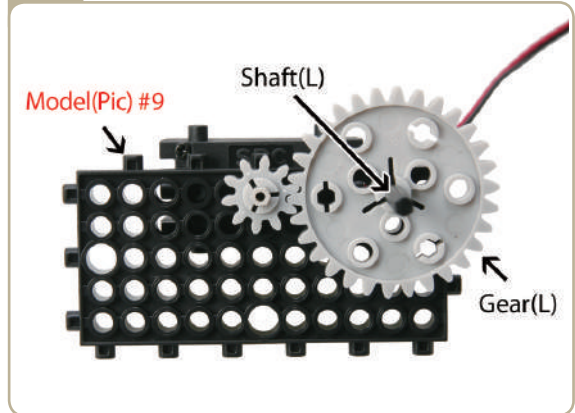


9



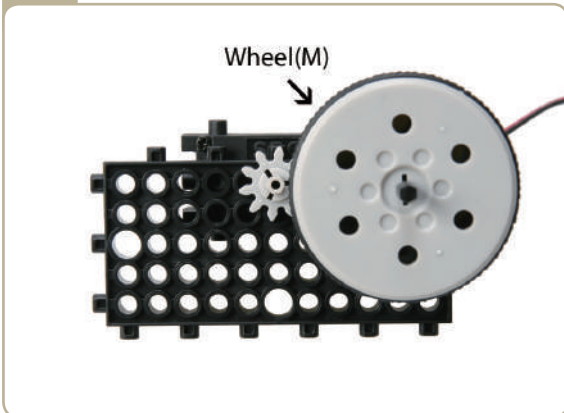
Connect a DC motor to 「block511」, then insert a small gear to the shaft of DC motor.

10



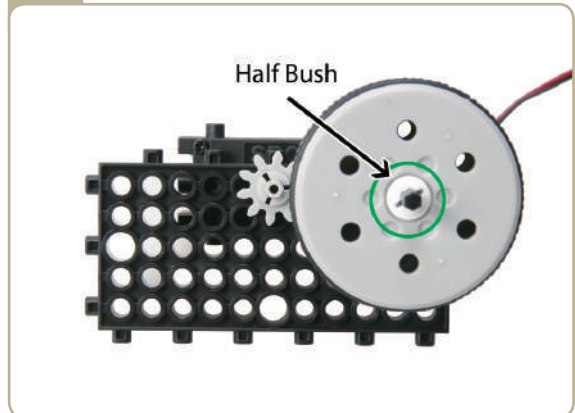
Align the large gear with small gear as illustrated above. Use a long shaft to connect model(pic)#9. (The back side fastens with a red bush.)

11

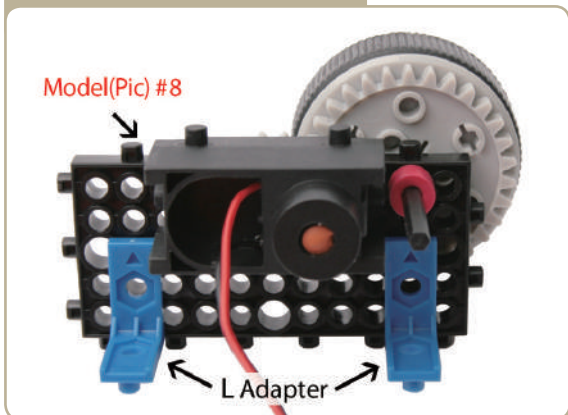


Insert a medium wheel to the long shaft of model(pic)#10.

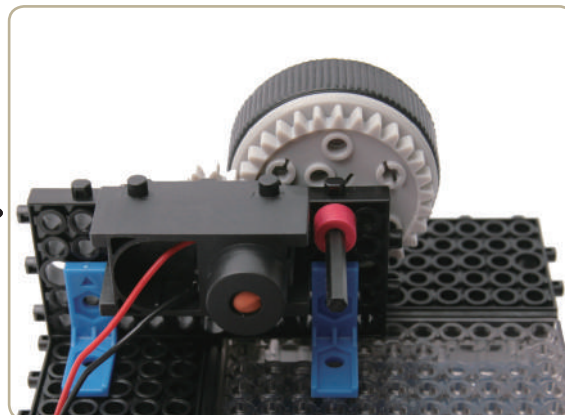
12



Back of model(Pic)#8

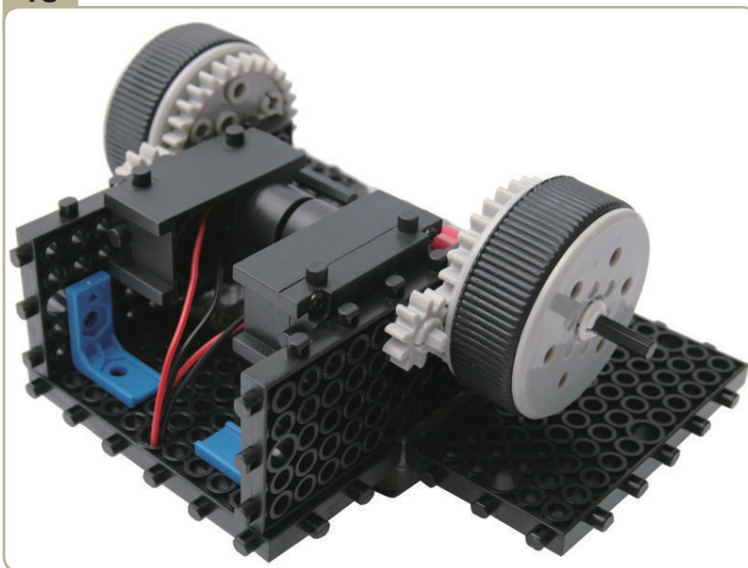


Attach two 'L' adapters to the back side of model(pic)#8. (Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)

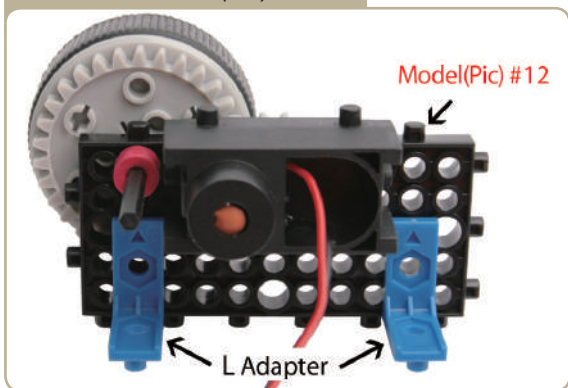


Turn model(pic)#2 upside down, then connect model(pic)#8 to it.

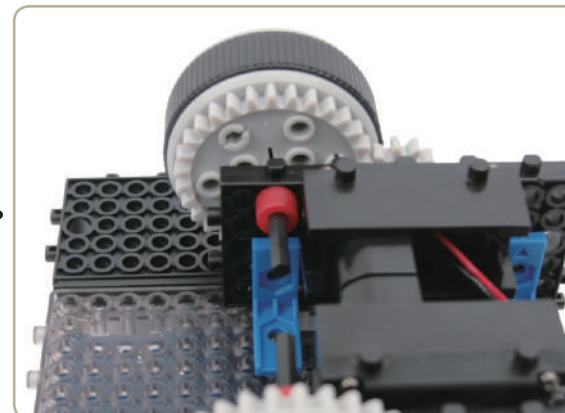
13



Back of model(Pic)#12

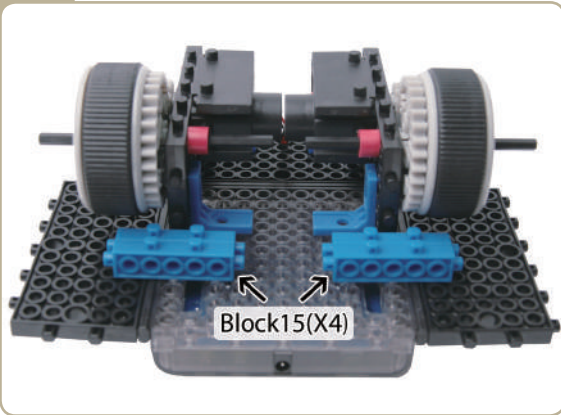


Attach two 'L' adapters to the back side of model(pic)#12. (Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)



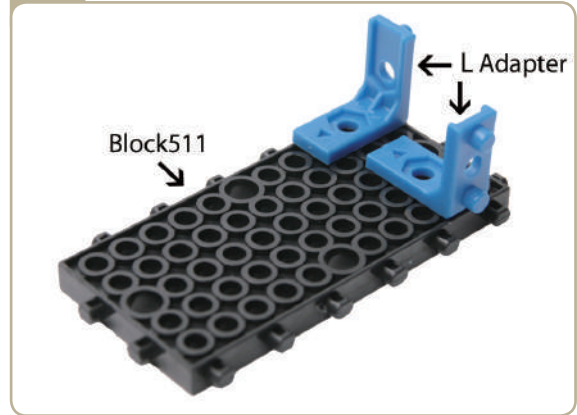
Turn model(pic)#2 upside down, then connect model(pic)#12 to it.

14



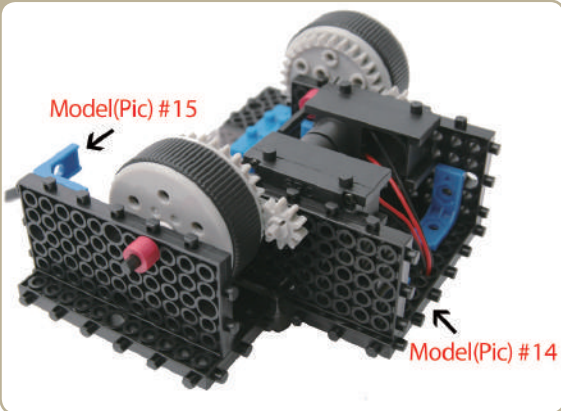
Attach four 「block15」s to the model(pic)#13.

15



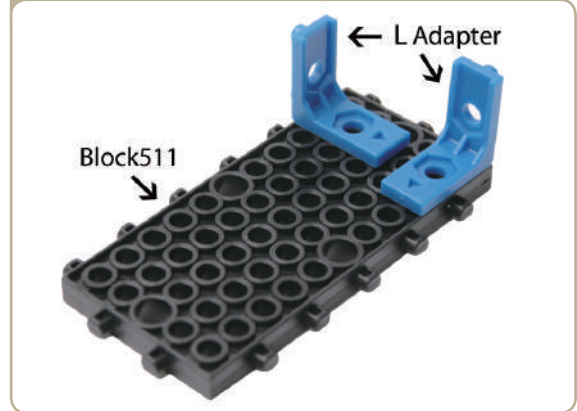
Attach two 'L' adapters to 「block511」.
(Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)

16



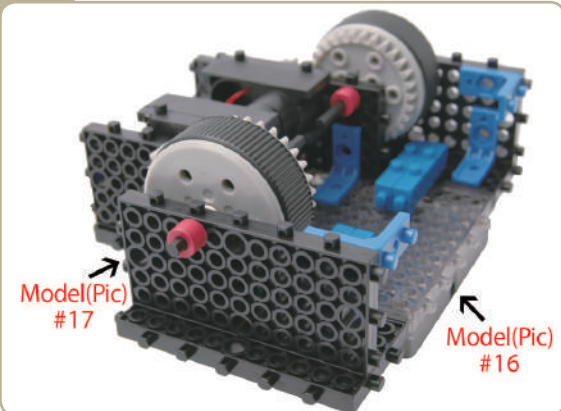
Connect model(pic)#15 to model(pic)#14 using a red bush.

17



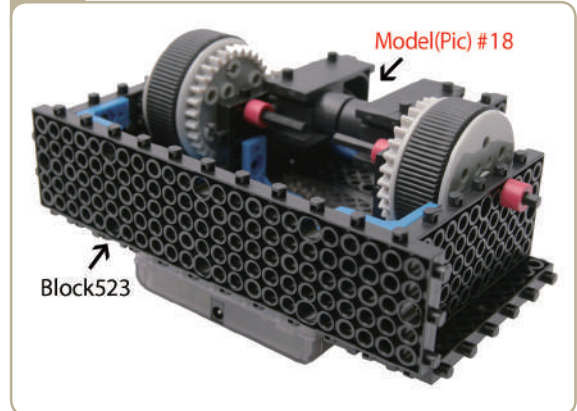
Attach two 'L' adapters to 「block511」.
(Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)

18



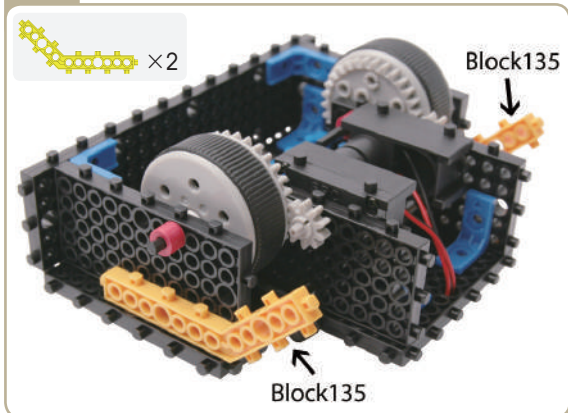
Connect model(pic)#15 to model(pic)#14 using a red bush.

19



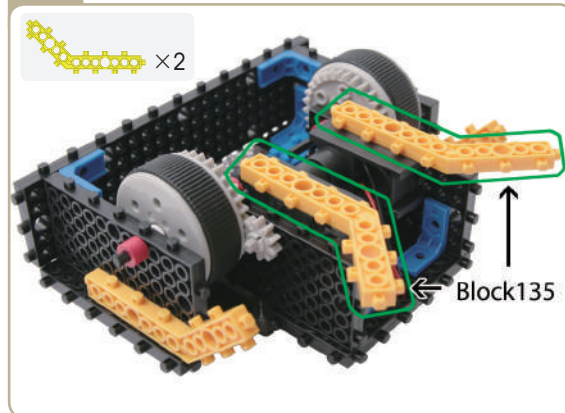
Attach a 「block523」 to model(pic)#18.

20



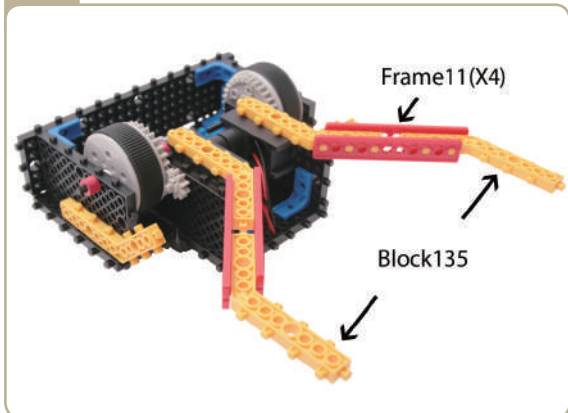
Attach two 「block135」s to model(pic)#19.

21



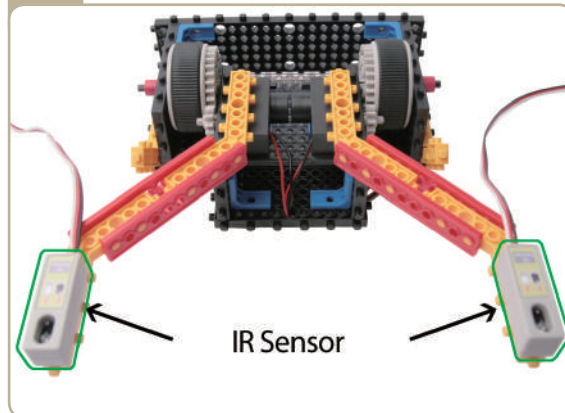
Attach two 「block135」s to model(pic)#20.

22



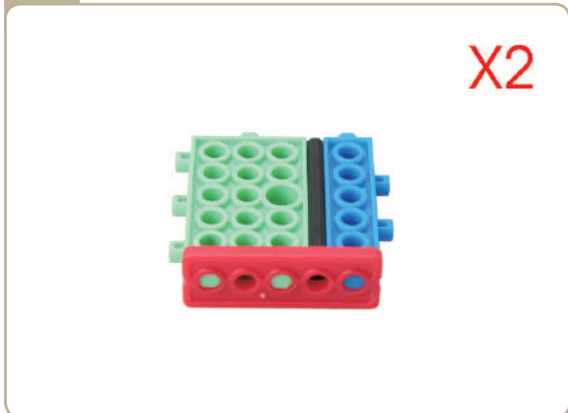
Attach two 「block135」s and four 「frame11」s to model(pic)#21.

23



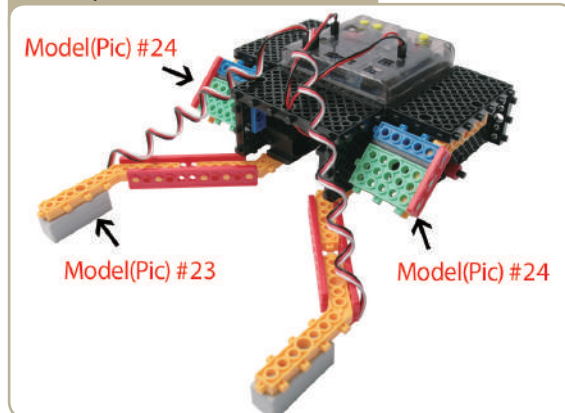
Attach two IR sensors to model(pic)#22.

24



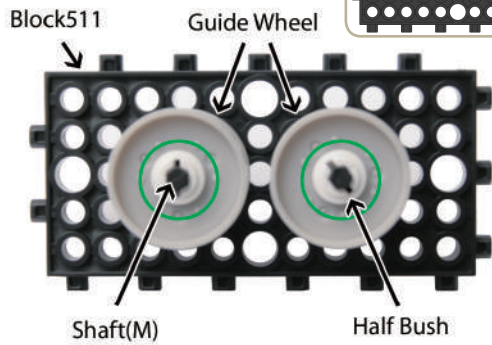
Connect a 「block15」 and a 「block35」 with a 「adapter1」, then attach a 「frame5」. (Assemble two identical models.)

25 (Upside of model(Pic)#24)



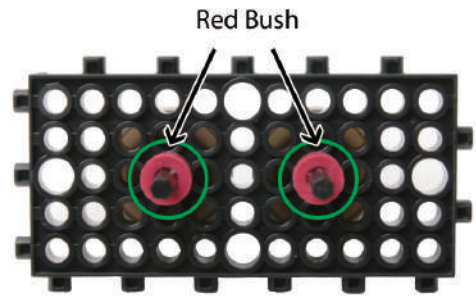
Attach two previously constructed parts of model(pic)#24 to model(pic)23.

26

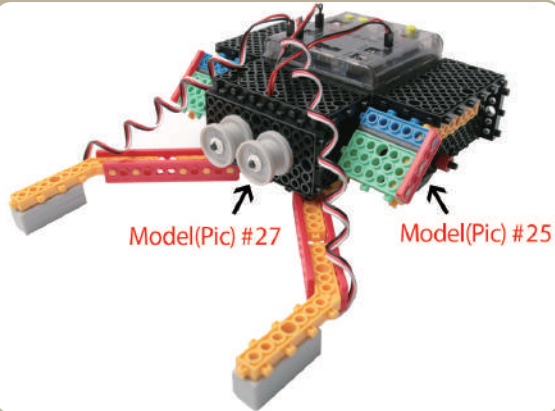


Connect medium shafts and guide wheels with half bushes to 'block511'. (The back side fastens with a red bush.)

27 (Back of model(pic)#26)

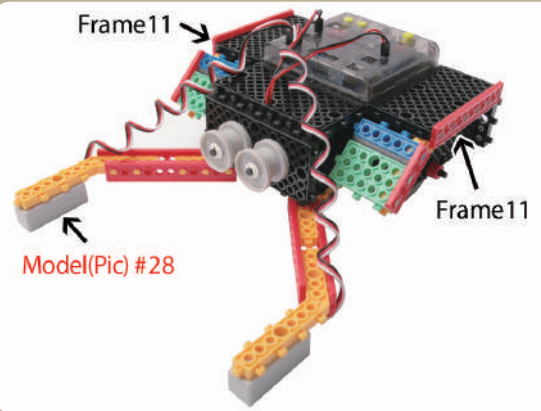


28



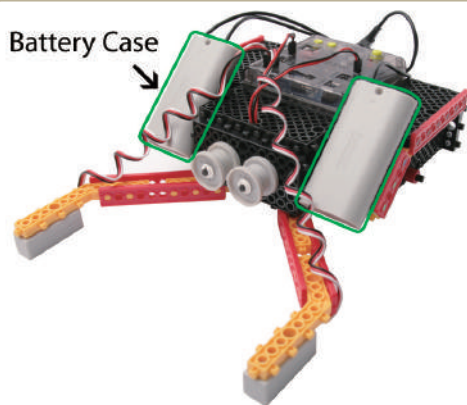
Combine model(pic)#26 to model(pic)#25.

29



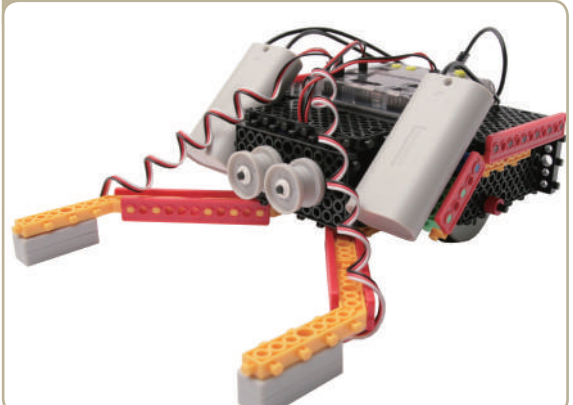
Attach two 'frame11's to model(pic)#28.

30



Connect battery cases to model(pic)#29.

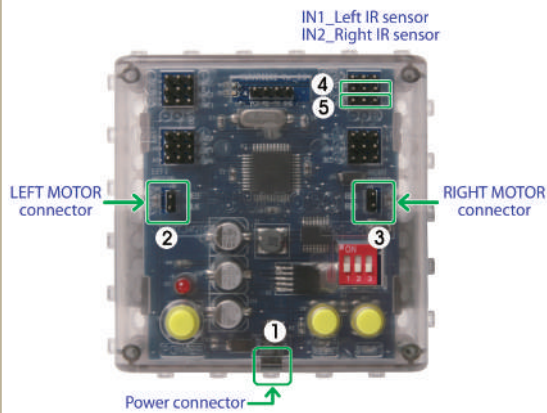
Completed





How to operate the Hemiptera

Connecting the mainboard



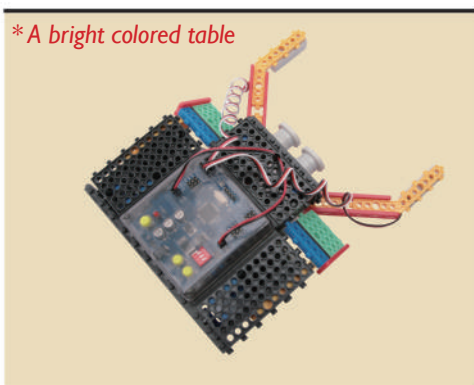
Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Left IR sensor to IN 1 of INPUT connector.
5. Connect Right IR sensor to IN2 of INPUT connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program














1. When left side Infrared sensor perceive a cliff, It will move backward. It will make a right turn and will go straight forward.
2. when right side Infrared sensor perceive a cliff, It will move backward. It will make a left turn and will go straight forward.

- Using the motion patterns as reference, let's write the program.

Program Download

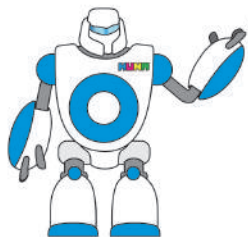
1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on.
(Power OFF \rightarrow Power ON)

Program Example

Action	No
 Program Start	0
IR : [IN1]=[None], [IN2]=[None] {	1
 DC motor 1 : [Both MOTOR1]=[Backward],[Speed=8]	2
END }	3
IR : [IN1]=[Sense], [IN2]=[None] {	4
 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=8]	5
 Delay : [1.5 sec]	6
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=8]	7
 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=8]	8
 Delay : [1 sec]	9
END }	10
IR : [IN1]=[None], [IN2]=[Sense] {	11
 Delay : [1.5 sec]	12
 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=8]	13
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=8]	14
END }	15
 Program End	16



Replacing the numbers with binary numbers



When modifying numbers with binary numbers, use the following rules.

- 1) Divide the number to be replaced by 2 decimal with 2, write the rest down.
- 2) Quotient is divided by 2, divided by 2 again, then write the remainder down.
- 3) Keep on dividing by 2 until the result is 1. Repeat the process.
- 4) When the division is done, write the bottom share and the remainders in the order as it was calculated.

$$2 \overline{)13}$$

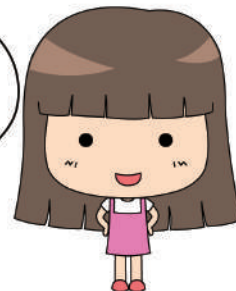
$$2 \overline{)6} \quad \dots \quad 1$$

$$2 \overline{)3} \quad \dots \quad 0$$

$$1 \quad \dots \quad 1$$

$$13 = 1101_{(2)}$$

To distinguish between the general number 1101 from 1101 binary number, a decimal is used. For instance 1101₍₂₎, Just add the decimal marker (2) behind the binary number.

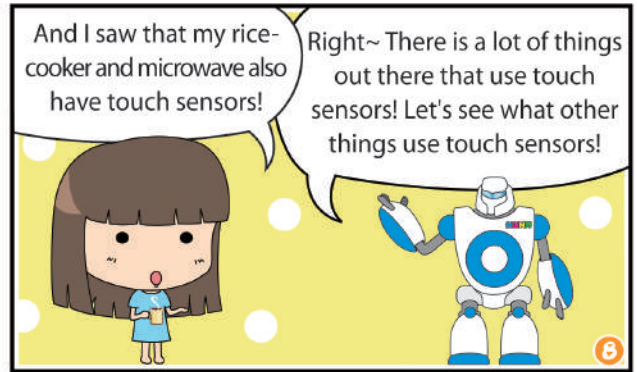
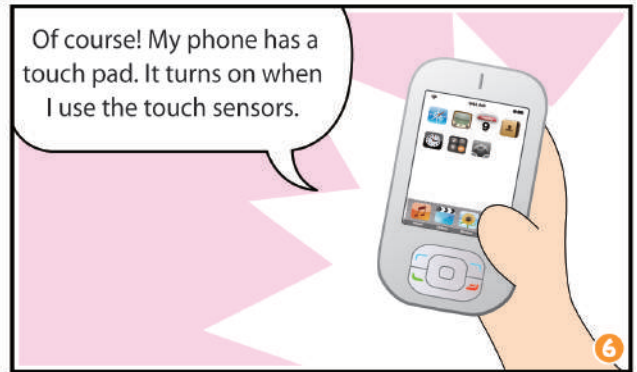
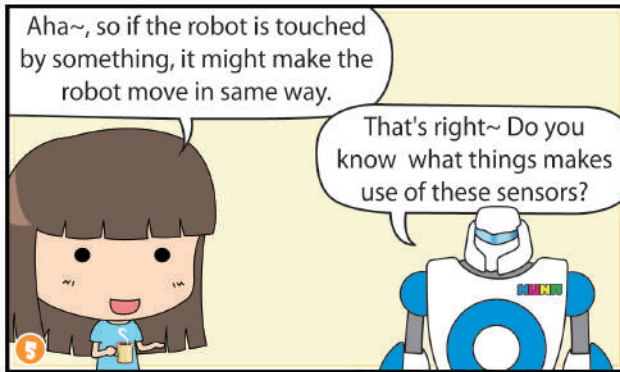
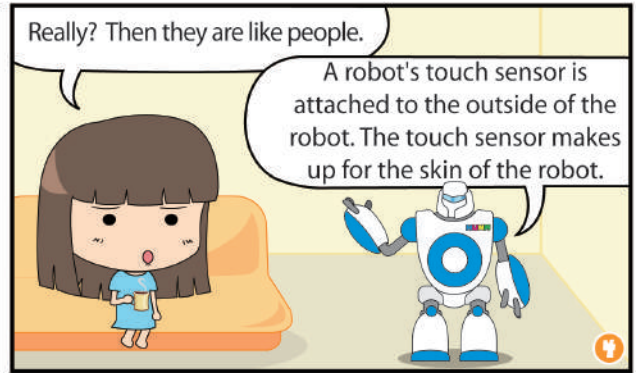
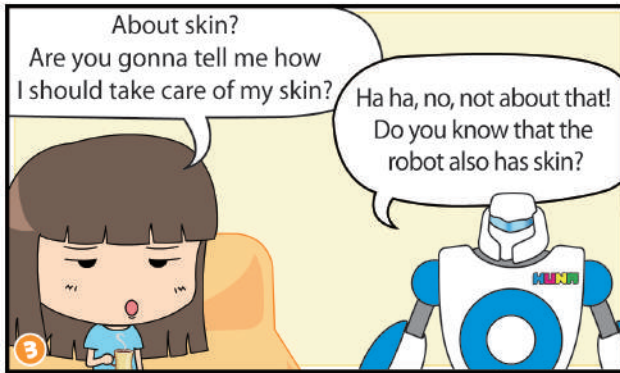
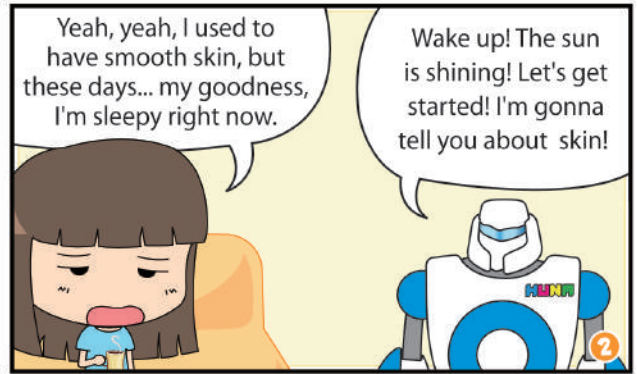
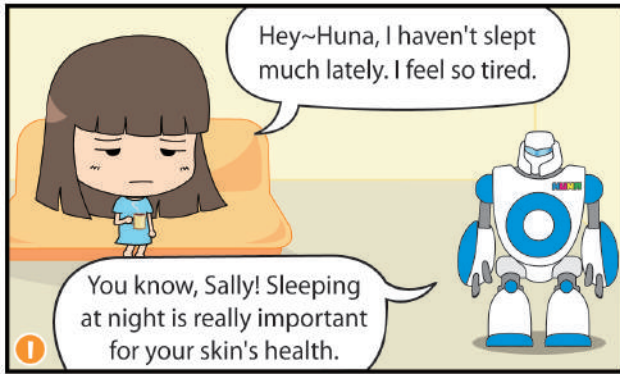


Please select one 2 digit number and convert the number into 2 decimal numbers.

A spiral-bound notebook with several blank, lined pages for writing.



The Robot's Skin- The touch sensor



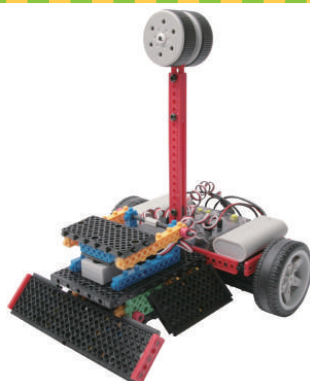
Let's Make it 3 Making a battle robot using a touch sensor and a servo motor



Touch Battle Bot



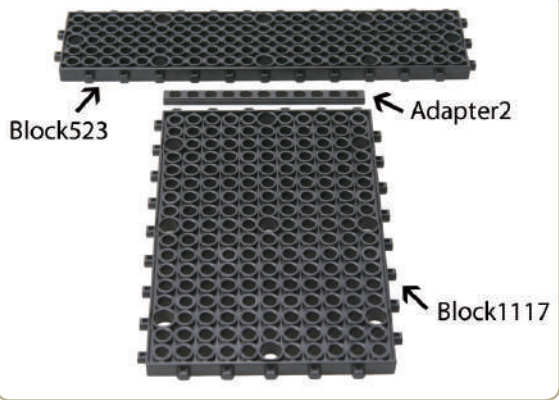
As this is the robot that is mainly used in the battle competition, it is important to improve the participant character and personality in accordance to the rules and regulations. Try to fight each others robot with weapons that are mounted to the inside of the stadium. The game is lost as soon as a robot is broken or if the robot's weapon or motion body have been destroyed. The game is also lost if a robot exist or passes the boundary the stadium.



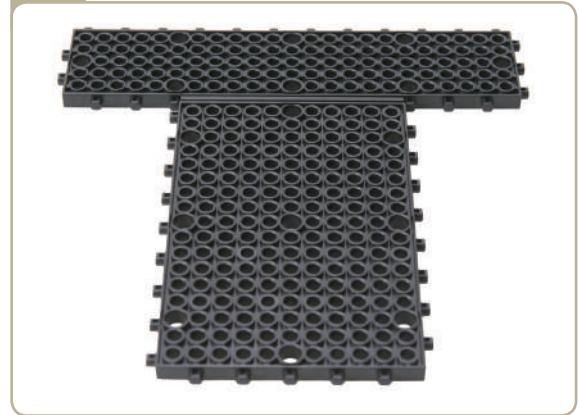
Prepare parts for assembly

	Block1117	x2		Frame21	x3	
				Frame11	x3	
				Frame5	x4	
	Block523	x3		Adapter2	x11	
				Adapter1	x5	
	Block511	x5		L Adapter	x14	
				Shaft(S)	x4	
				Shaft(M)	x1	
	Block90	x2		Red Bush	x4	
				Half Bush	x2	
	Block135	x8		Bolt(S)	x4	
				Bolt(M)	x3	
				Nut	x7	
	Block35	x4		Wheel(M)	x2	
	Motor Mount	x2				
	DC Motor	x2		Wheel(L)	x2	
	Servo Motor	x1				

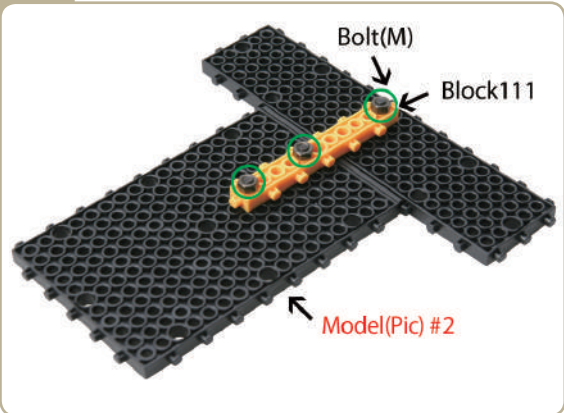
1



2

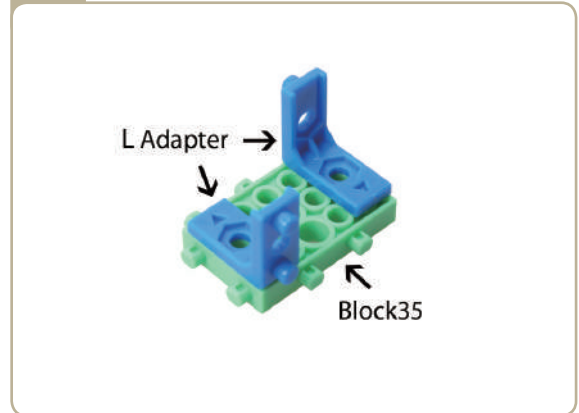


3



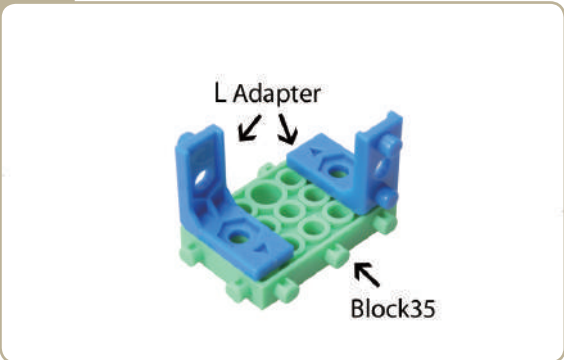
Fasten a 「block111」 with three medium bolts and nuts to model(pic)#2.

4



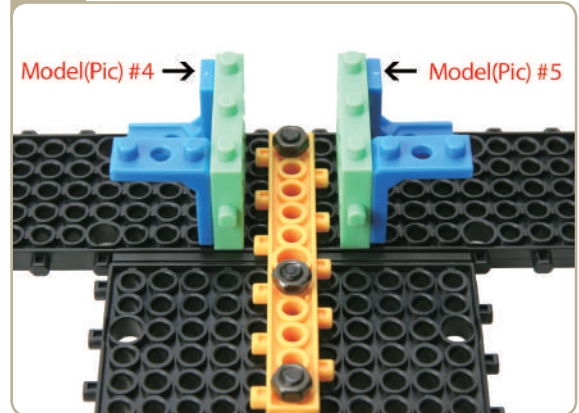
Attach two 'L' adapters to 「block35」. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

5



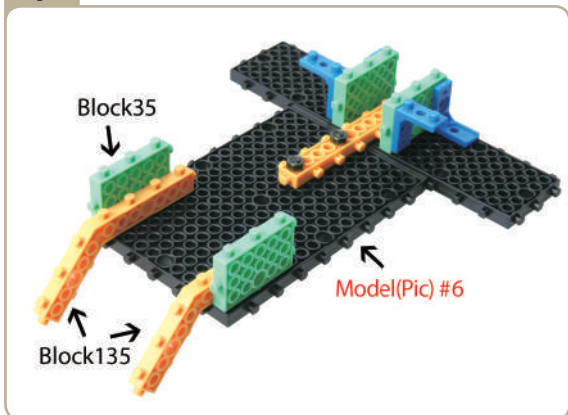
Attach two 'L' adapters to 「block35」. Pay close attention to the arrows(▲) that indicate how the adapters should be attached. (Alternative angle of model(pic)#4.)

6



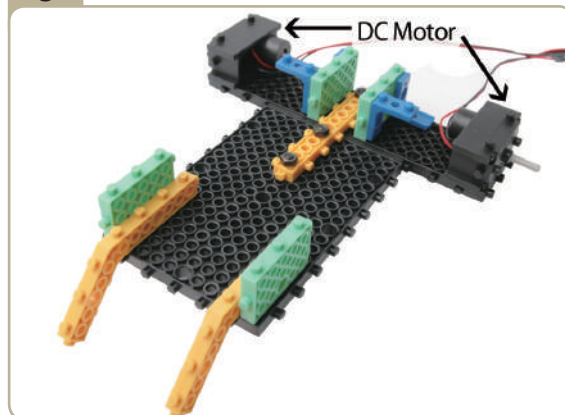
Attach model(pic)#4 and model(pic)#5 to the model(pic)#3.

7



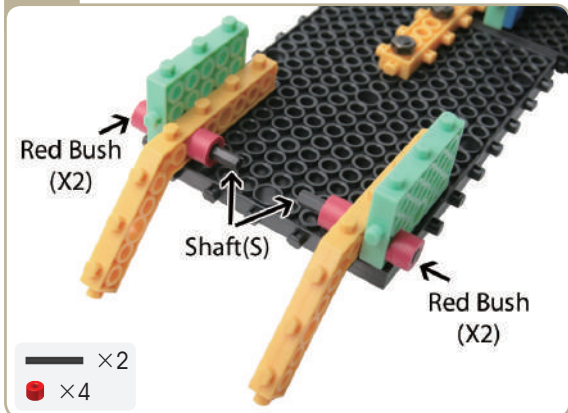
Attach two 「block35」s and two 「block135」s to model(pic)#6.

8



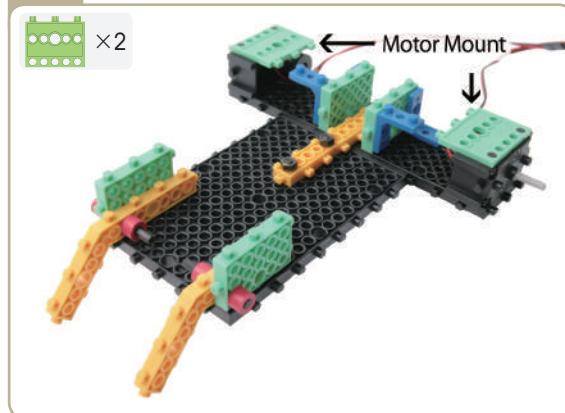
Connect DC motors to model(pic)#7.

9



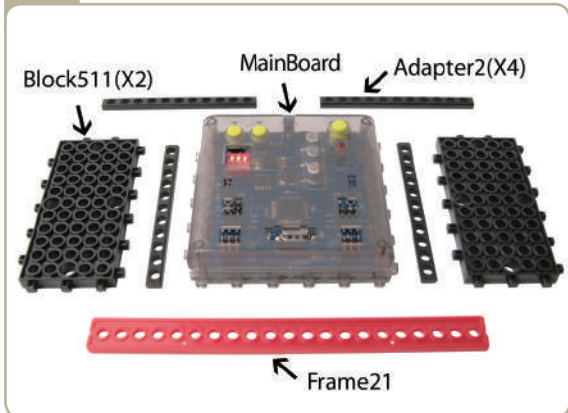
Connect two short shafts and four red bushes to model(pic)#8.

10

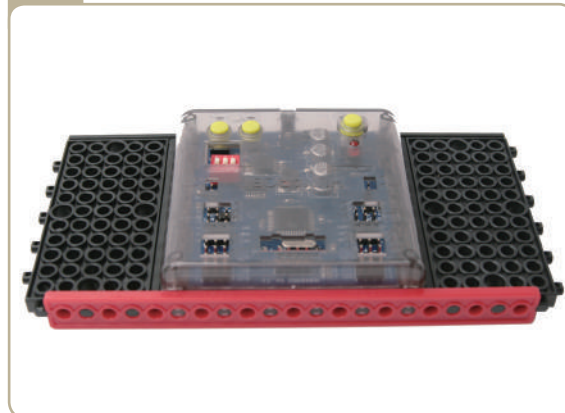


Attach two motor mounts to model(pic)#9.

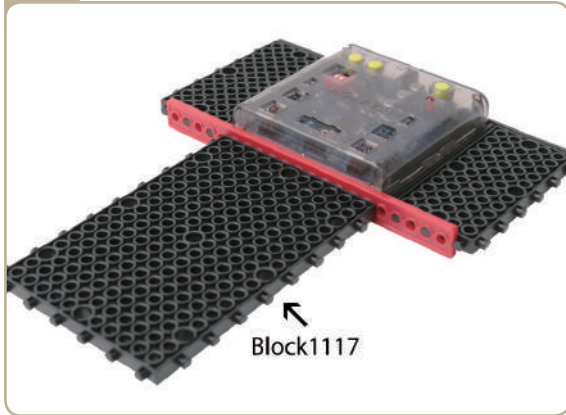
11



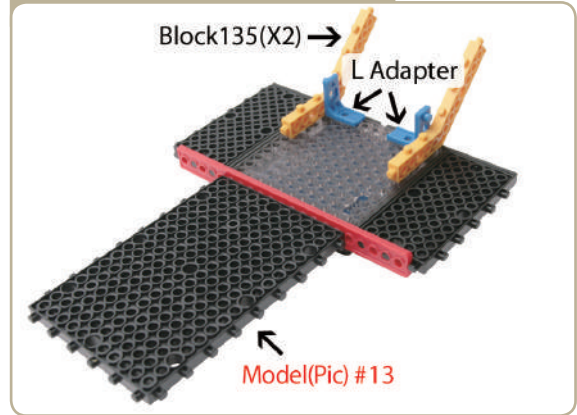
12



13

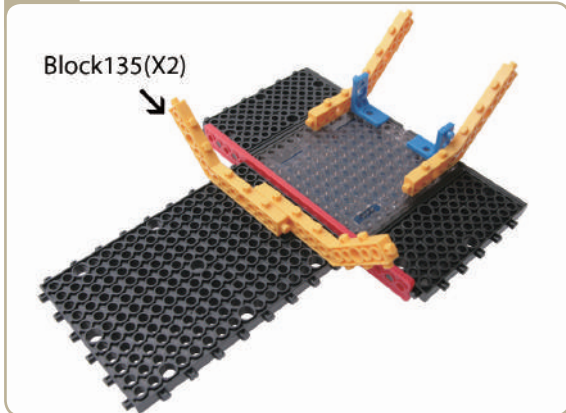


14 (Bottom of model(pic)#13)



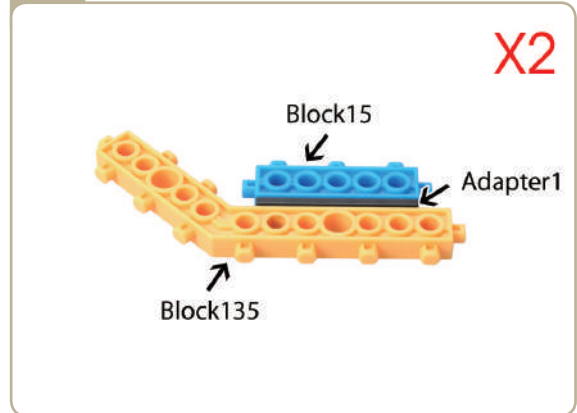
Attach two 'L' adapters to 'block135'. (Pay close attention to the arrows (▲) that indicate how the adapters should be attached.) Then attach it to model(pic)#13.

15



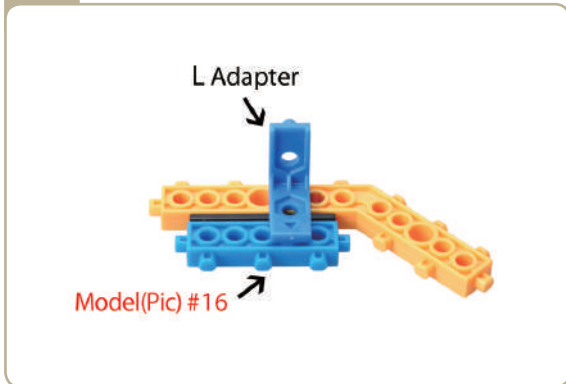
Attach two 'block135's to model(pic)#14.

16



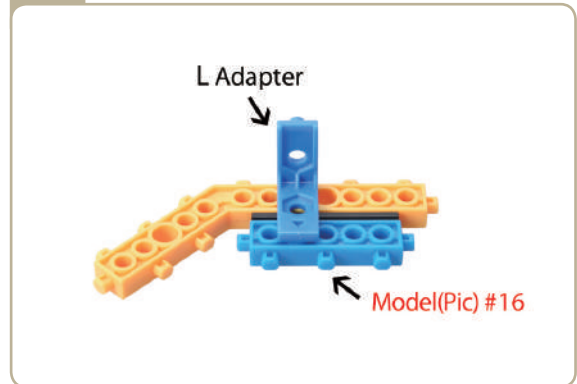
Attach a 'block135' to 'block15' with a 'adapter1'. (Assemble two identical models.)

17



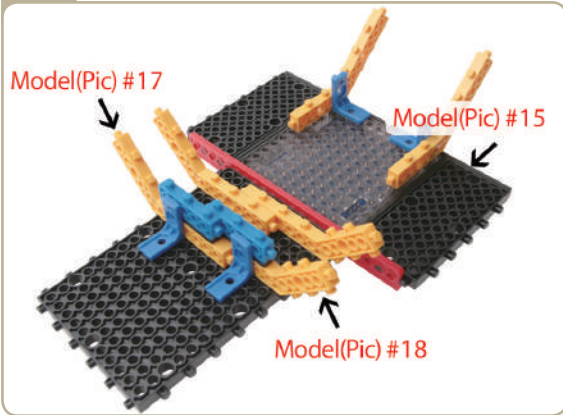
Attach a 'L' adapter to model(pic)#16. (Pay close attention to the arrows (▲) that indicate how the adapter should be attached.)

18



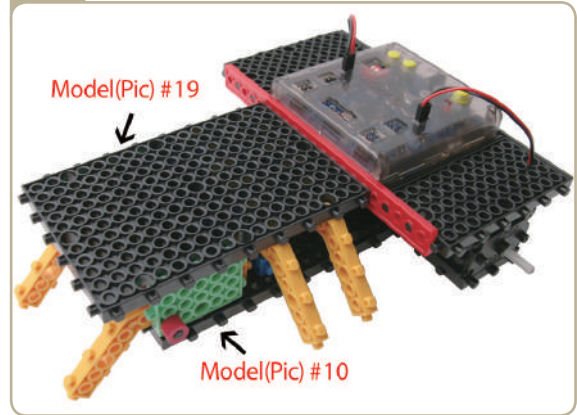
Attach a 'L' adapter to model(pic)#16. (Pay close attention to the arrows (▲) that indicate how the adapter should be attached.)

19



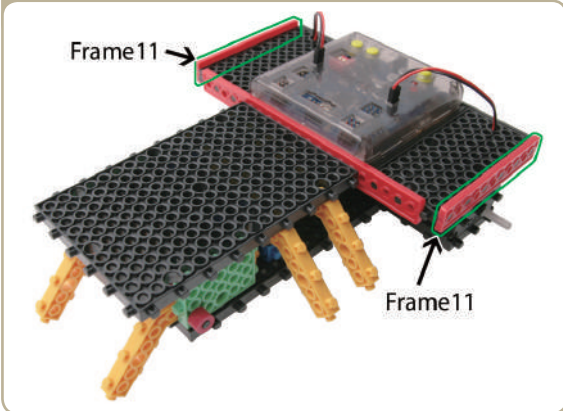
Connect model(pic)#17 and model(pic)#18 to the model(pic)#15.

20



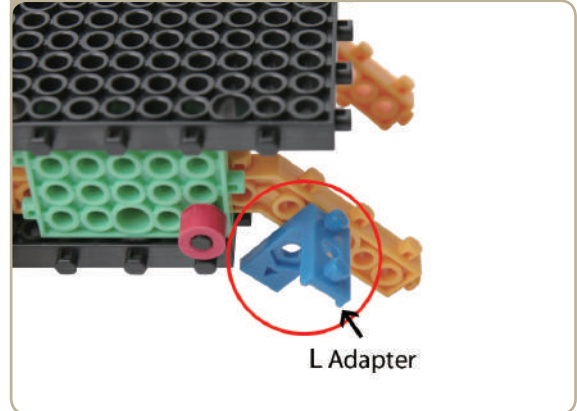
Combine model(pic)#19 with model(pic)#10.

21



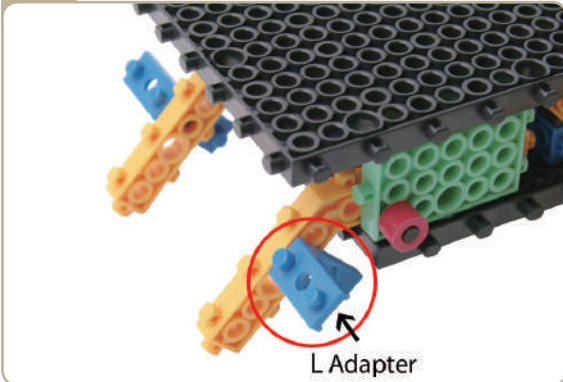
Attach two 'frame11's to model(pic)#20.

22



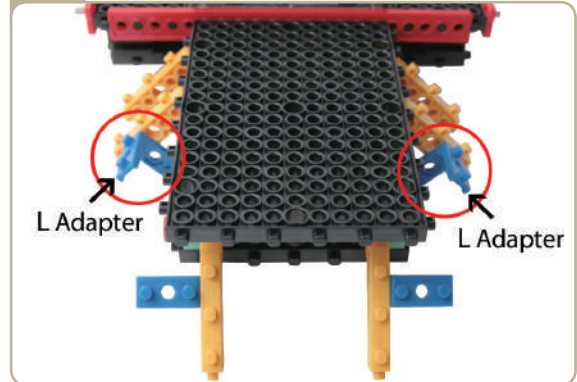
Attach a 'L' adapter to model(pic)#21. (Pay close attention to arrows(▲) that indicate how the adapter should be attached.)

23



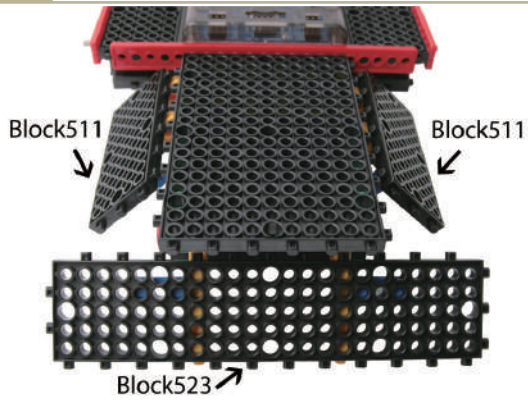
Attach a 'L' adapter to the opposite side of model(pic)#22. (Pay close attention to the arrows(▲) that indicate how the adapter should be attached.)

24



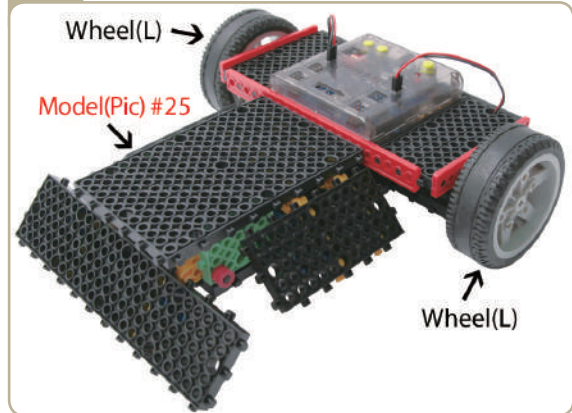
Attach two 'L' adapters to the side of model(pic)#23. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

25



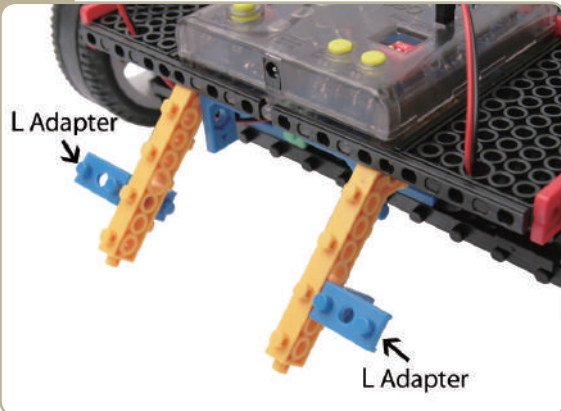
Attach a 「block523」 and two 「block511」s to model(pic)#24.

26



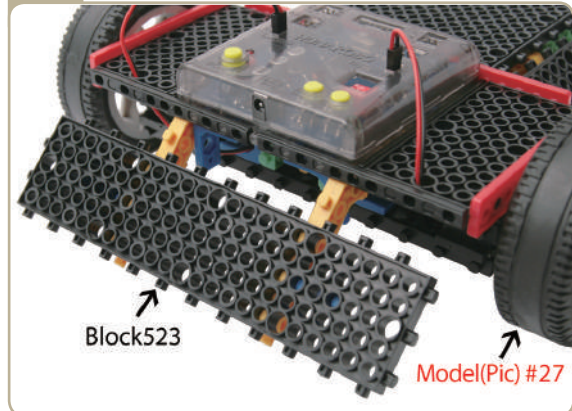
Connect large wheels to the shaft of DC motor.

27



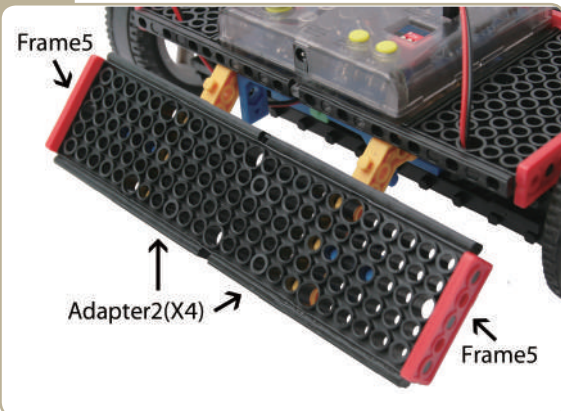
Attach two 'L' Adapters to the back side of model(pic)#26. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

28



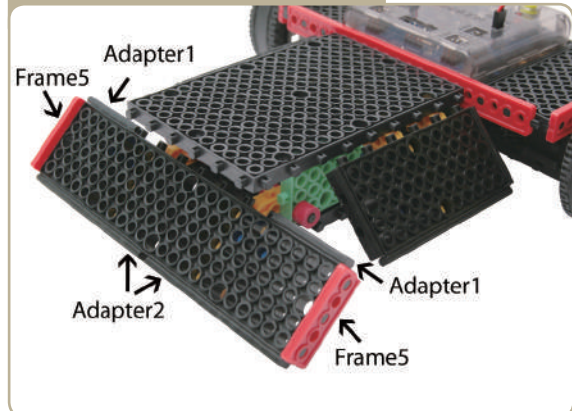
Attach a 「block523」 to model(pic)#27.

29



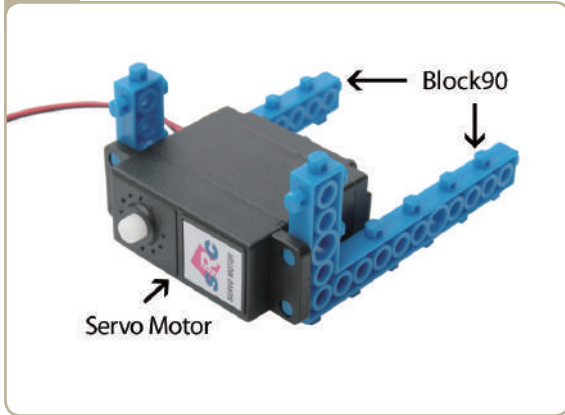
Attach four 「adapter2」s and two 「frame5」s to model(pic)#28.

30 (Front of model(Pic)#29)

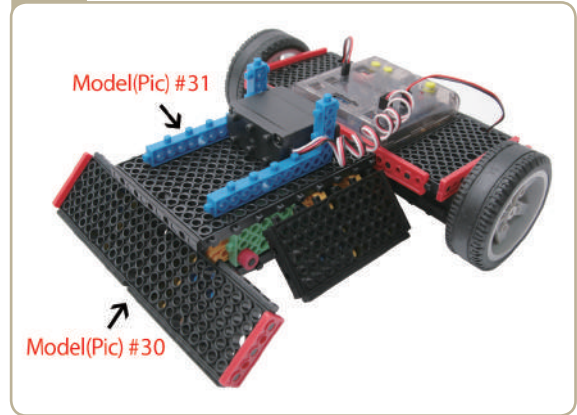


Attach two 「adapter1」s and two 「adapter2」s with two 「frame5」s to the front of model(pic)#29.

31

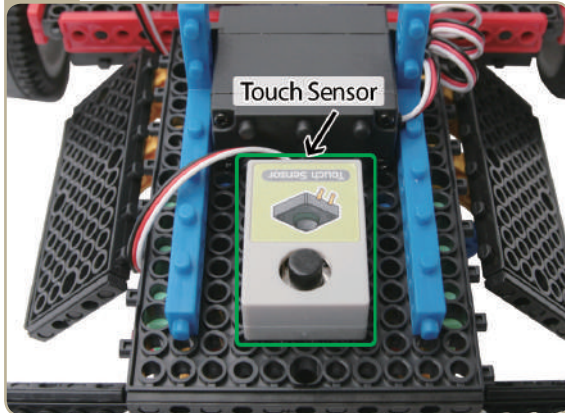


32



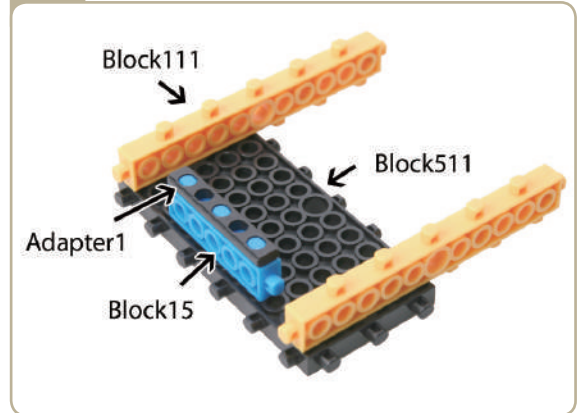
Combine model(pic)#31 with model(pic)#30.

33

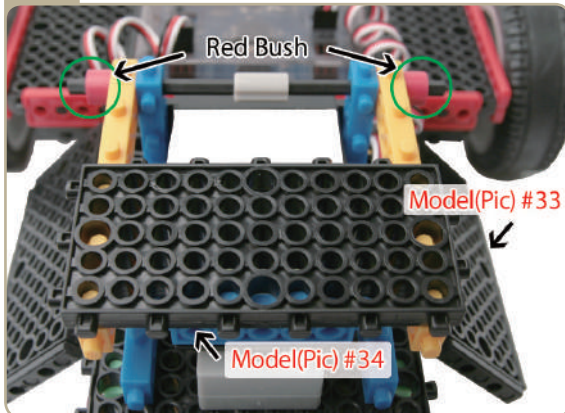


Connect touch sensor board to model(pic)#32.

34

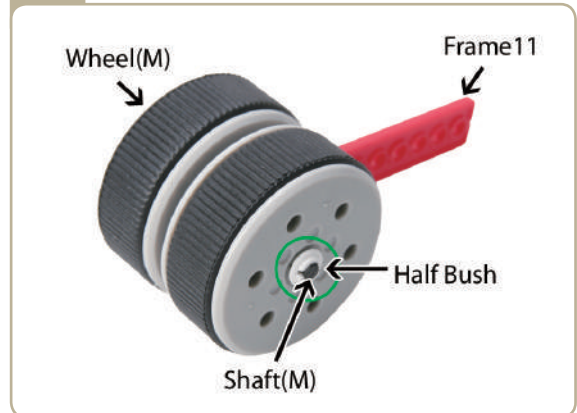


35



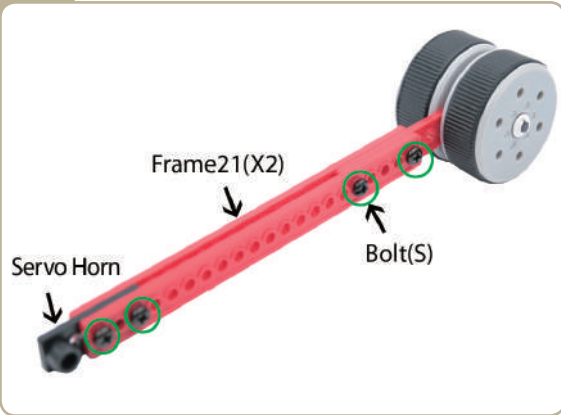
Connect model(pic)#34 to model(pic)#33 with two short shafts and a coupling, then fix them together with red bushes.

36



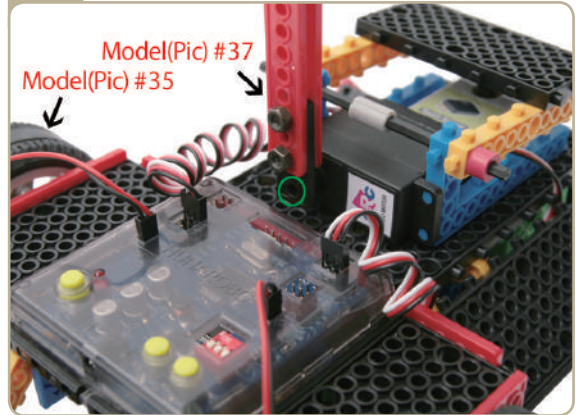
Connect two medium wheels and a 「frame11」 with a medium shaft. Fasten it with half bush on both side.

37



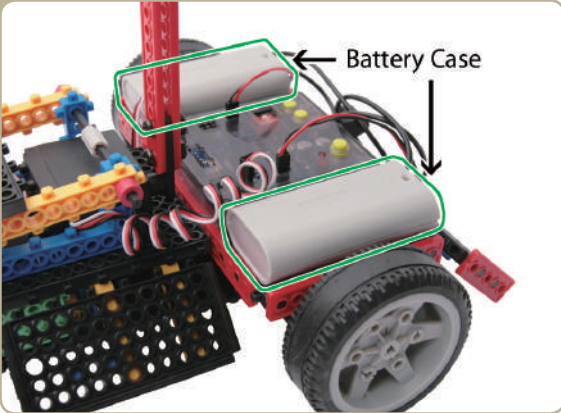
Fix two Frame21s and a servo horn with short bolts, nuts to model(pic)#36.

38



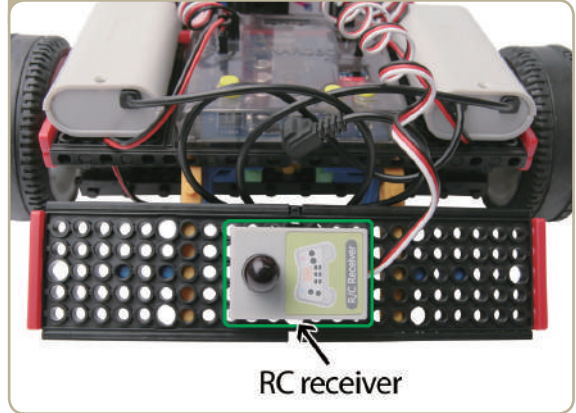
After connecting servo horn of model(pic)#37 to servo motor of model(pic)#35, then fix it with a servo bolt.

39



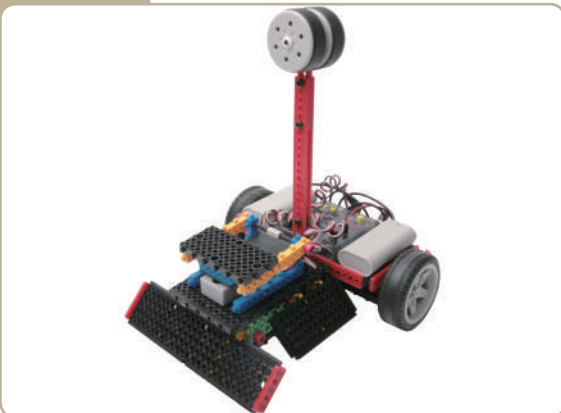
Connect battery cases to model(pic)#38.

40 (Back of model(pic)#39)



Connect RC receiver board to model(pic)#39.

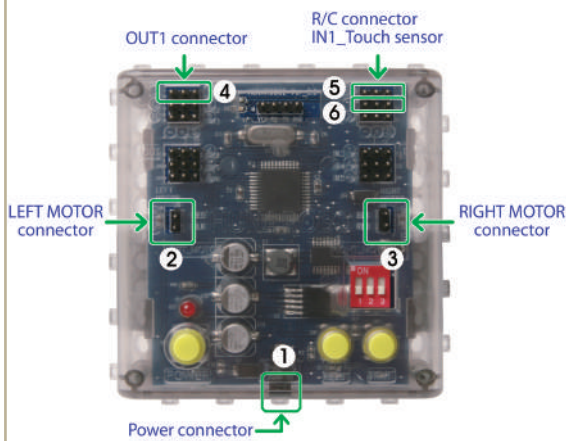
Completed





How to operate the Touch Battle

Connecting the mainboard



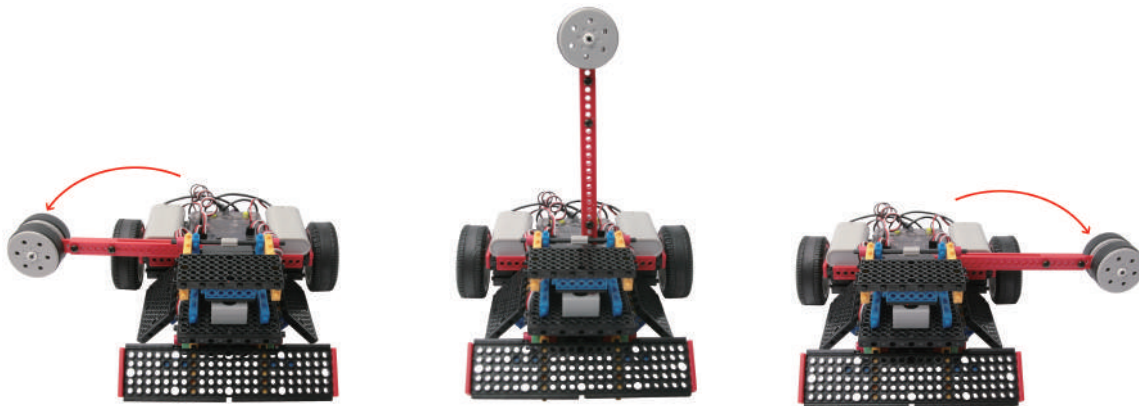
Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.
6. Connect Touch sensor to IN1 of INPUT connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program



- Using the motion patterns as reference, let's write the program.

Program Download

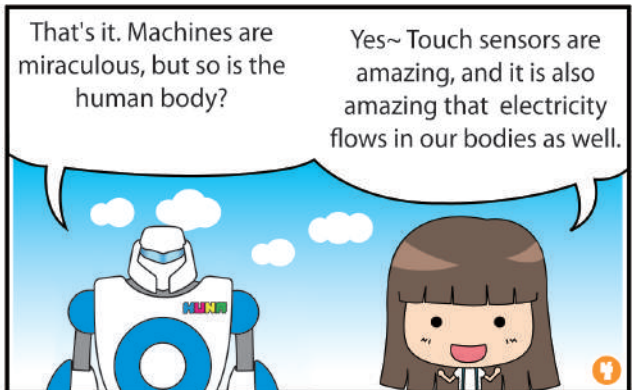
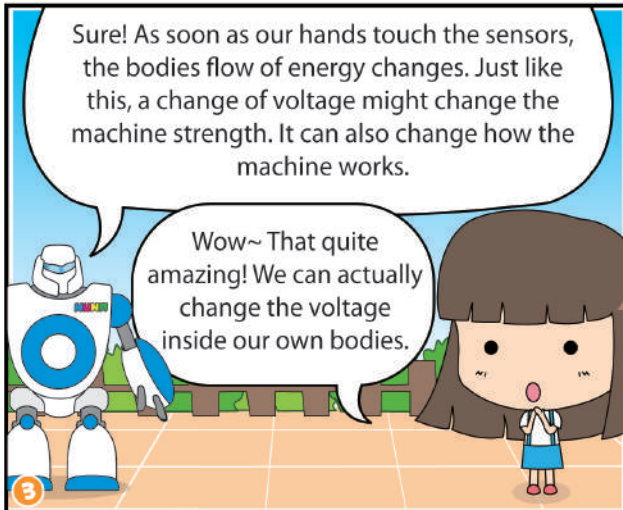
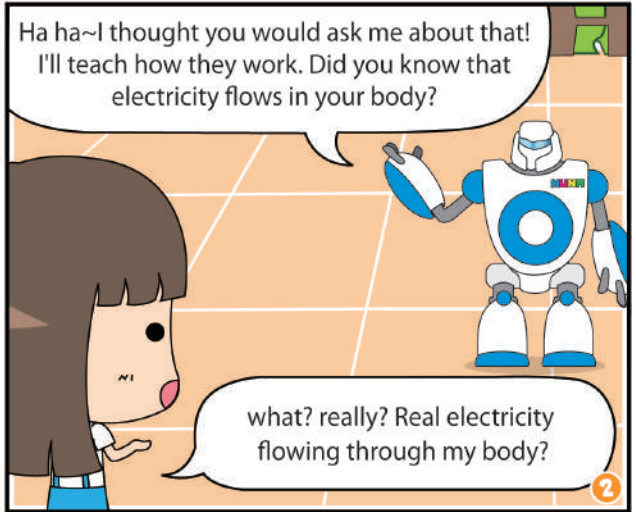
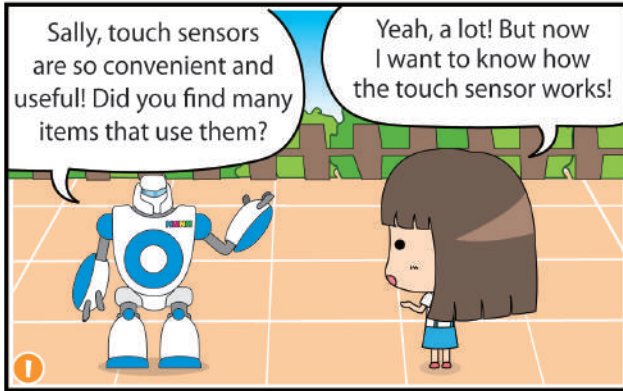
1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on.
(Power OFF → Power ON)

Program Example

Action	No
Program Start	0
Touch : [IN1]=[Press] {	1
DC motor 1 : [Both MOTOR1]=[Stop]	2
Delay : [5 sec]	3
END }	4
Touch : [IN1]=[None] {	5
Remocon : [Up] {	6
DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	7
END }	8
Remocon : [Down] {	9
DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	10
END }	11
Remocon : [Left] {	12
DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	13
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	14
END }	15
Remocon : [Right] {	16
DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	17
DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	18
END }	19
Remocon : [Up + Right] {	20
DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	21
DC motor 1 : [R-MOTOR1]=[Stop]	22
END }	23
Remocon : [Up + Left] {	24
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	25
DC motor 1 : [L-MOTOR1]=[Stop]	26
END }	27
Remocon : [F1] {	28
Servo : [OUT1]=[-70]	29
Delay : [0.5 sec]	30
Servo : [OUT1]=[0]	31
END }	32
Remocon : [F3] {	33
Servo : [OUT1]=[70]	34
Delay : [0.5 sec]	35
Servo : [OUT1]=[0]	36
END }	37
Remocon : [KEY OFF] {	38
DC motor 1 : [Both MOTOR1]=[Stop]	39
Servo : [OUT1]=[0]	40
END }	41
END }	42
Program End	43



How does the touch sensor work?



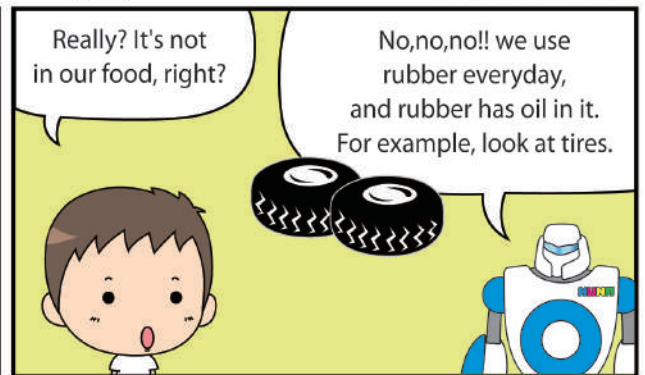
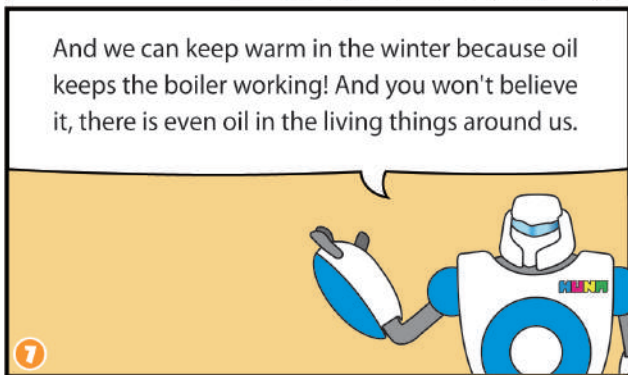
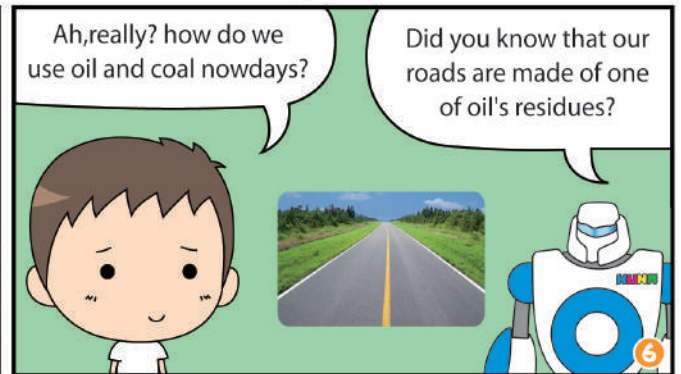
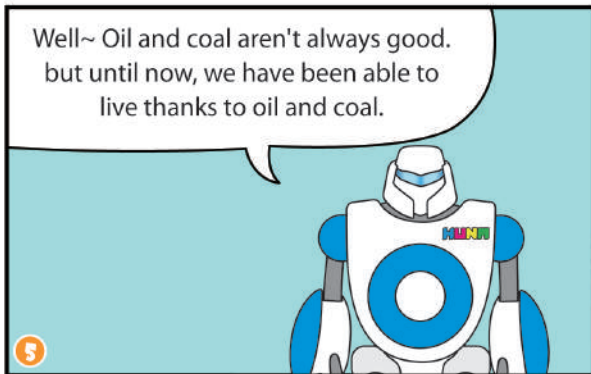
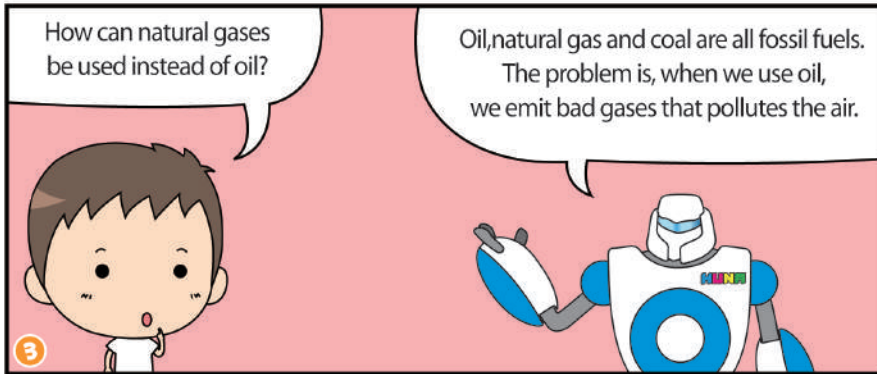
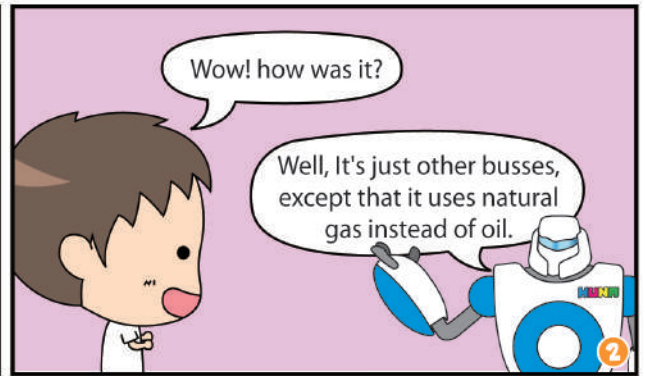
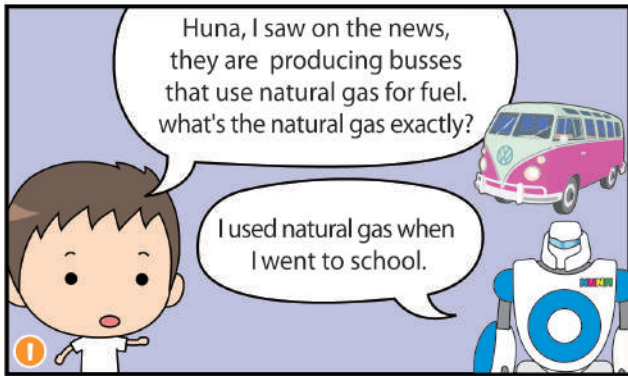
What other electrical equipment has touch sensors?

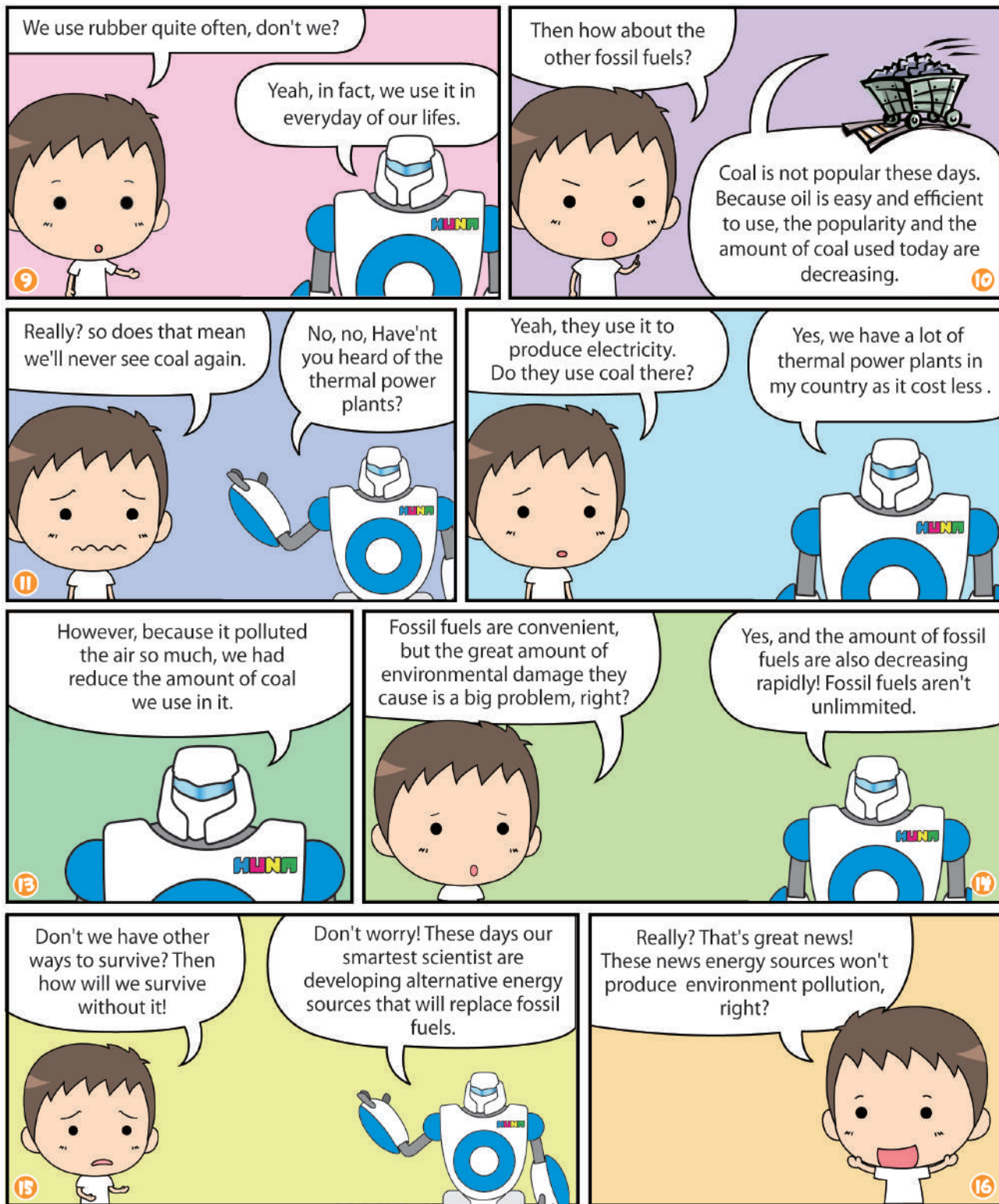


Handwriting practice lines for the question: What other electrical equipment has touch sensors?



It's really difficult to live without this!- Fossil fuel





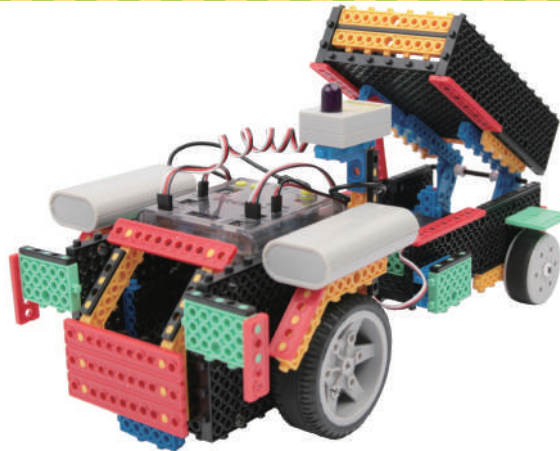


Making a model that uses various tools, such as wheels, shafts and electrical models



Dump Truck

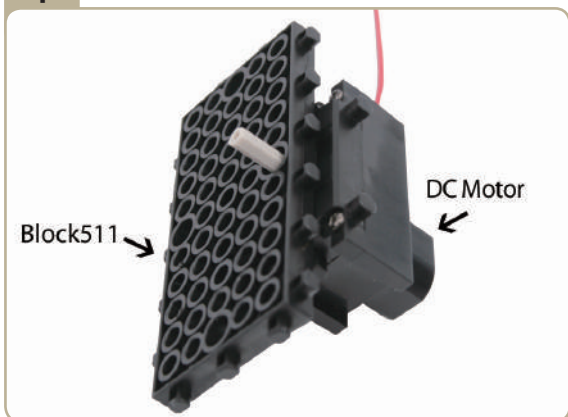
The dump robot is a model of the general dump truck that we use at most construction sites. The dump robot is a small robot made to resemble the function of dump truck. It is powered by 2 DC motors, and it's dumping mechanism is activated by the servo motor and remote control.



Prepare parts for assembly

	Block1117 ×4		Frame11	×13	
			Frame5	×6	
			Adapter2	×10	
	Block523 ×4		Adapter1	×7	
			LAdapter	×9	
	Block511 ×6		Connection shaft	×2	
	Block90 ×5		Shaft(S)	×1	
			Shaft(M)	×4	
	Block135 ×6		Shaft(L)	×1	
			Red Bush	×8	
	Block15 ×11		Bush	×4	
	Block111 ×6		Half Bush	×6	
	Block35 ×8		Gear(S)	×2	
	Motor Mount ×2		Gear(L)	×2	
	Servov Motor ×1		Wheel(M)	×2	
	DC Motor ×2		Wheel(L)	×2	

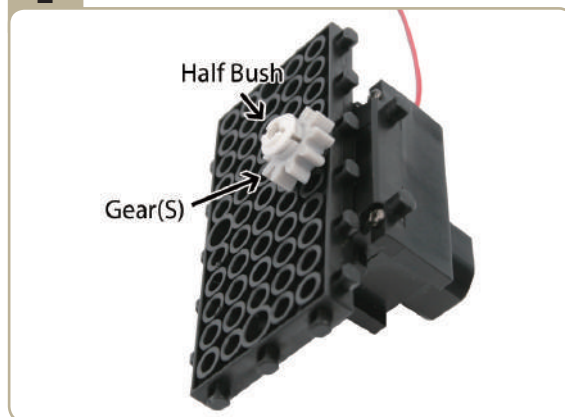
1



Block511

DC Motor

2

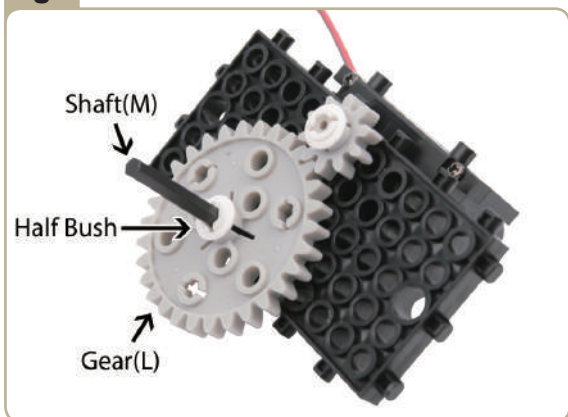


Half Bush

Gear(S)

Insert a small gear and a half bush to the shaft of DC motor.

3



Shaft(M)

Half Bush

Gear(L)

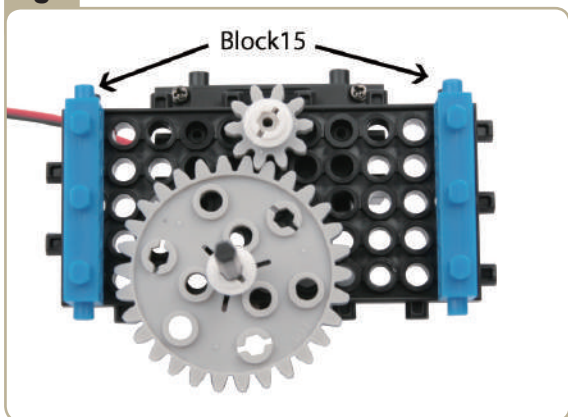
Align the large gear with small gear as illustrated above. Use a medium shaft and a half bush to connect model(pic)#2. (The back side fastens with a red bush.)

4 (Back of model(Pic)#5)



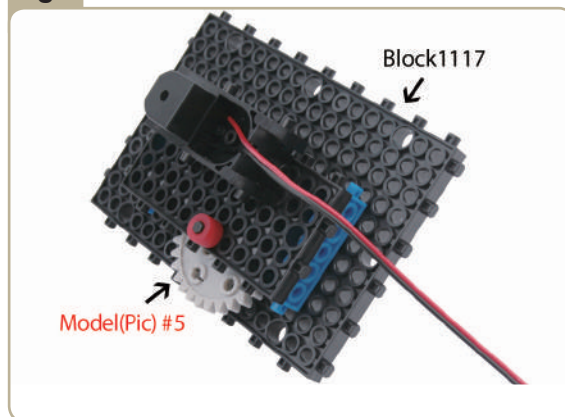
Red Bush

5



Block15

6

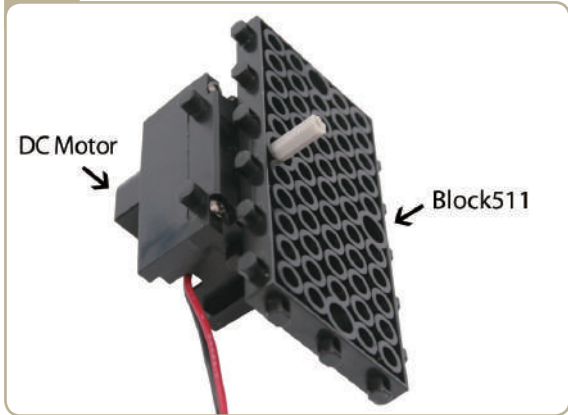


Block1117

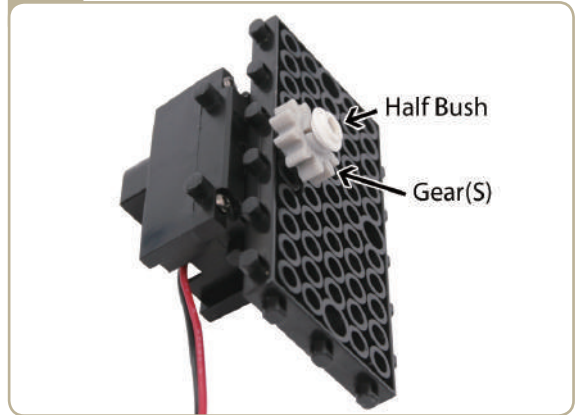
Model(Pic) #5

Attach a 「block1117」 to model(pic)#5.

7

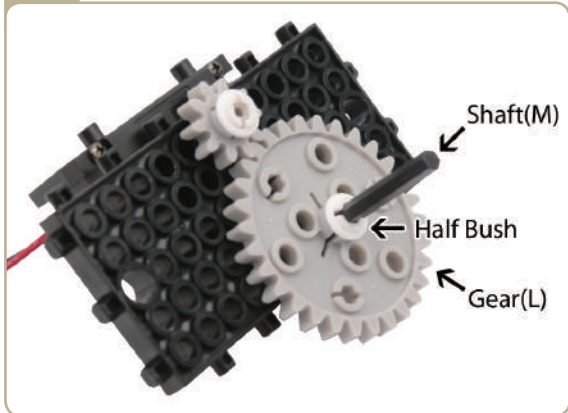


8



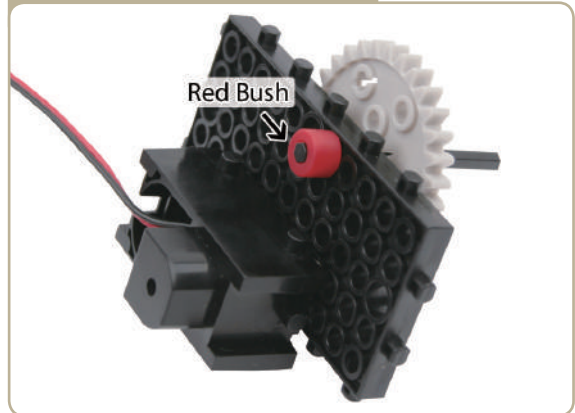
Insert a small gear and a half bush to the shaft of DC motor.

9

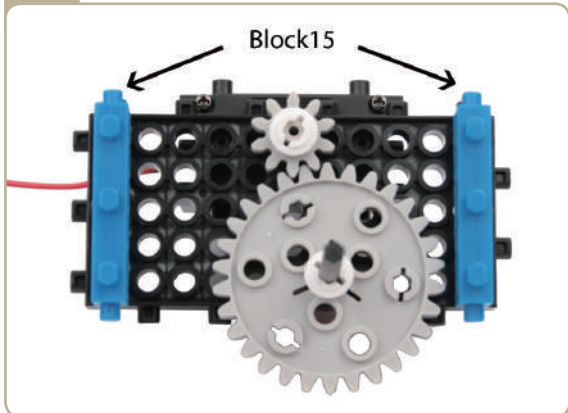


Align the large gear with small gear as illustrated above. Use a medium shaft and a half bush to connect model(pic)#8. (The back side fastens with a red bush.)

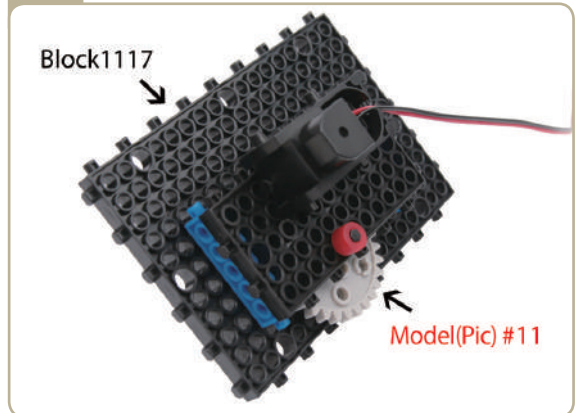
10 (Back of model(pic)#9)



11

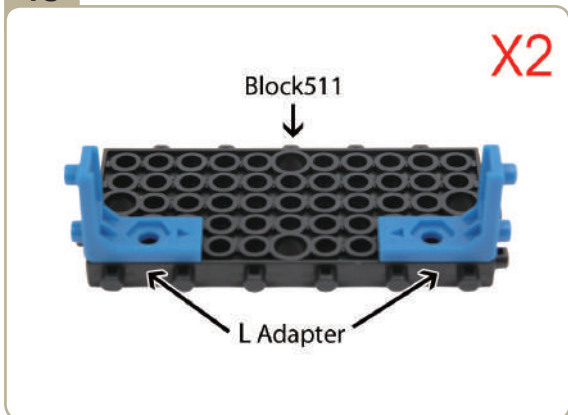


12



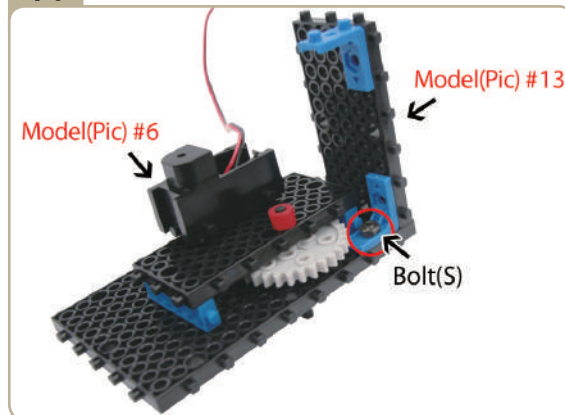
Attach a 「block1117」s to model(pic)#11.

13



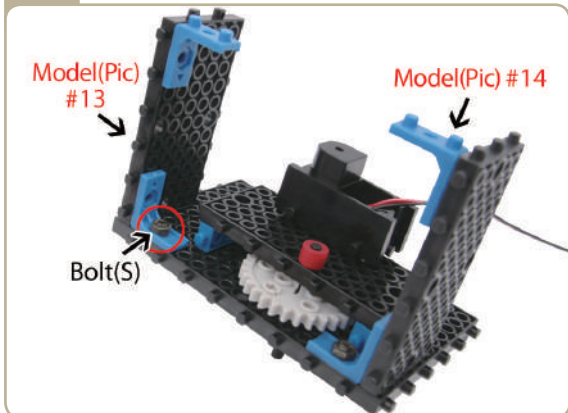
Attach two 'L' adapters to 「block511」. Pay close attention to the arrows (▲) that indicate how the adapters should be attached. (Assemble two identical models.)

14



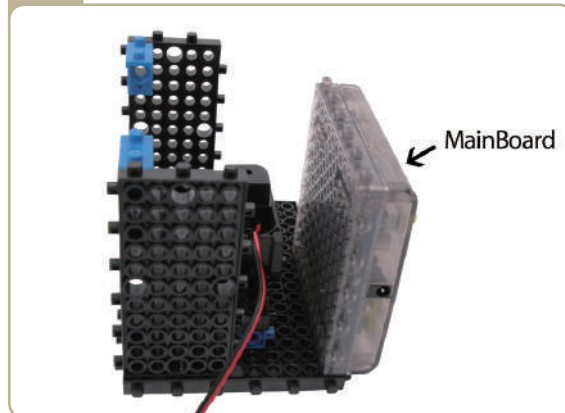
Connect model(pic)#13 to model(pic)#6 with short bolts and nuts.

15



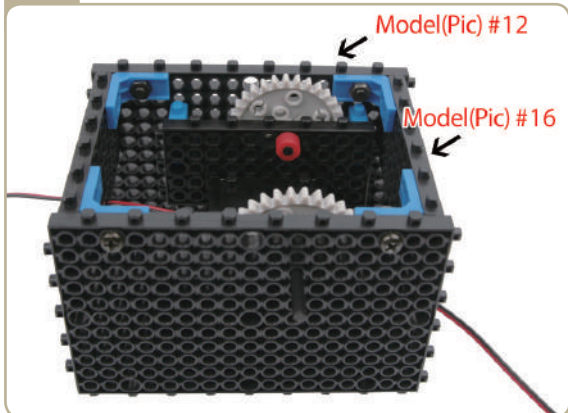
Connect model(pic)#13 to model(pic)#14 with short bolts and nuts.

16



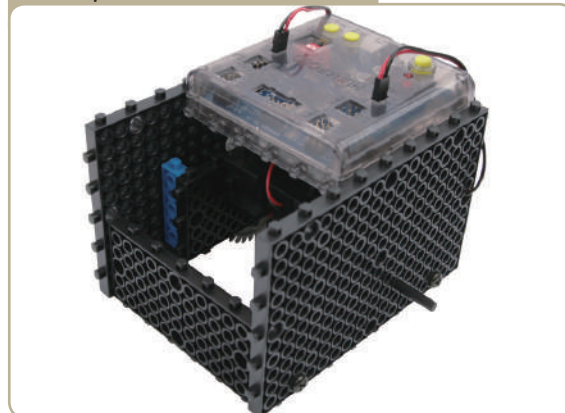
Connect mainboard to model(pic)#15.

17

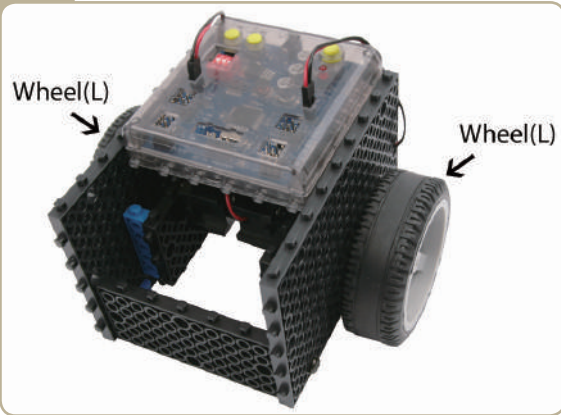


Combine model(pic)#12 with model(pic)#16.

18 (Upside of model(Pic)#17)

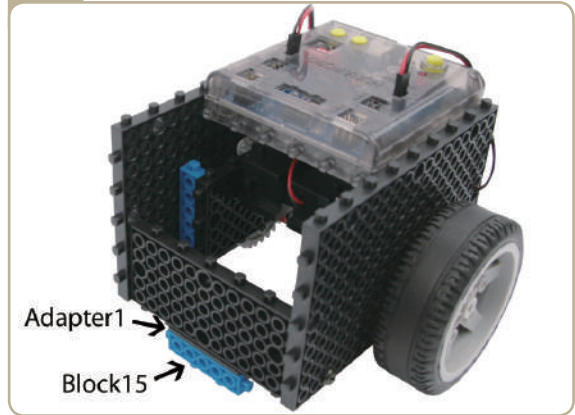


19

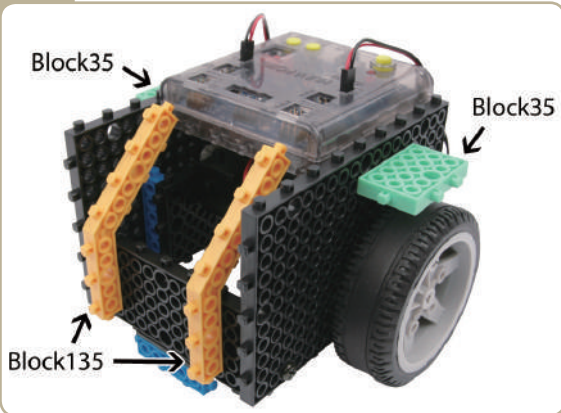


Connect two large wheels to the long shaft of model(pic)#18.

20

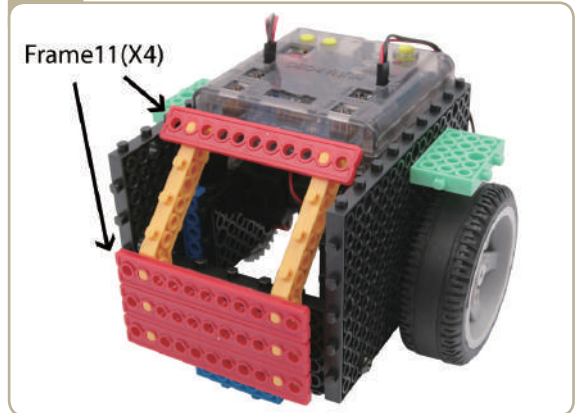


21



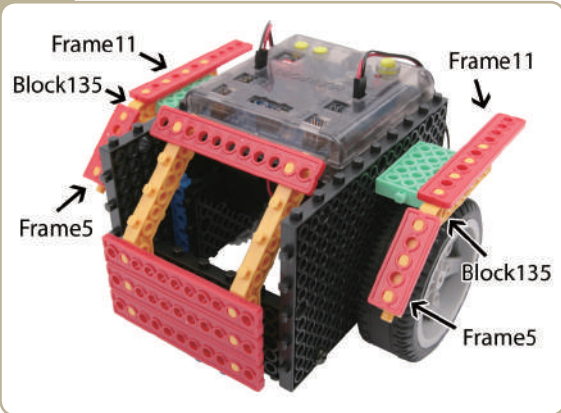
Attach two 「block135」s and two 「block35」s to model(pic)#20.

22



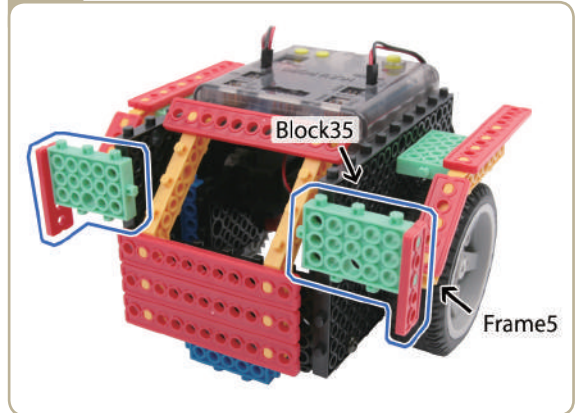
Attach four 「frame11」s to model(pic)#21.

23



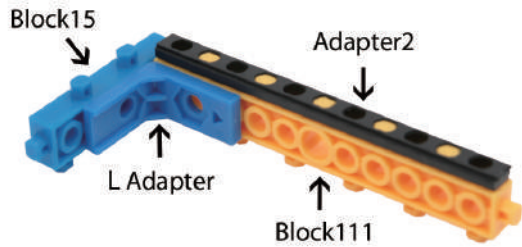
Attach two 「block135」s and two 「frame5」s, two 「frame11」s to model(pic)#22.

24



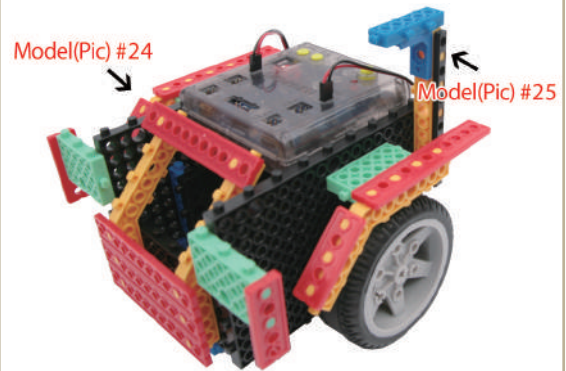
Attach two 「block135」s and two 「frame5」s to model(pic)#23.

25



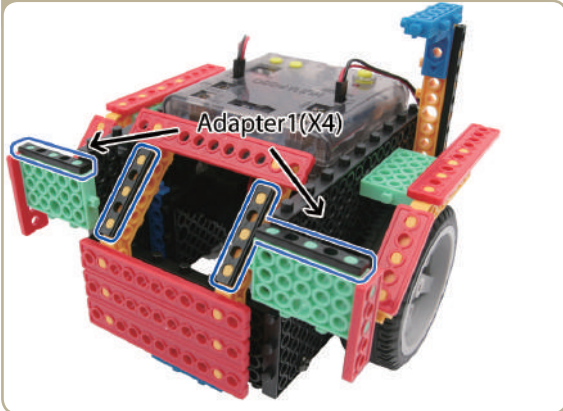
Attach a 'L' adapter to 'block111', then attach a 'block15', and a 'Adapter2'. (Pay close attention to the arrows(▲) that indicate how the adapter should be attached.)

26

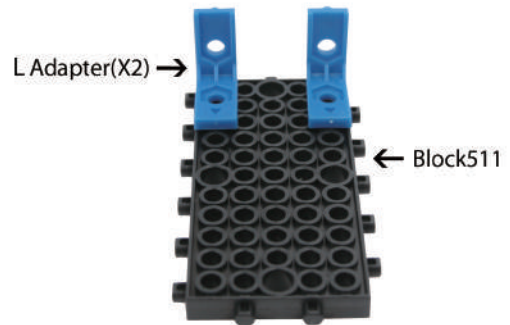


Combine model(pic)#24 with model(pic)#25.

27

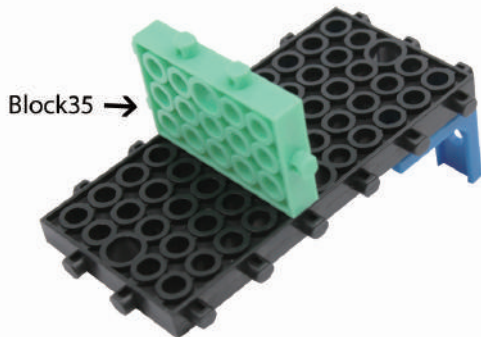


28



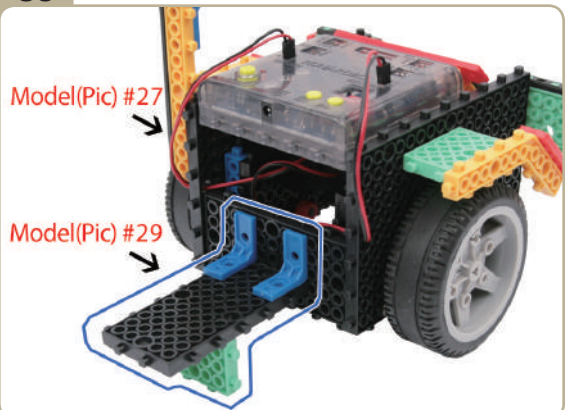
Attach two 'L' adapters to 'block511'. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

29 (Bottom of model(pic)#28)



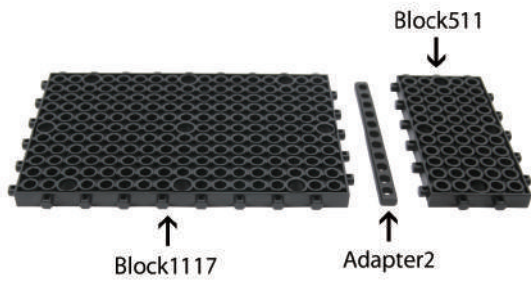
Turn model(pic)#28 upside down, attach a 'block35'.

30

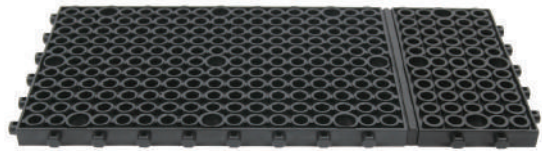


Turn model(pic)#29 upside down, then connect it to the back of model(pic)#27.

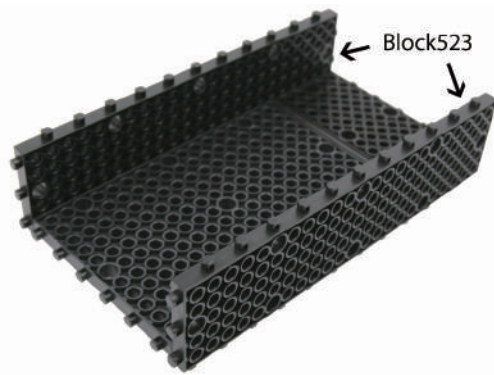
31



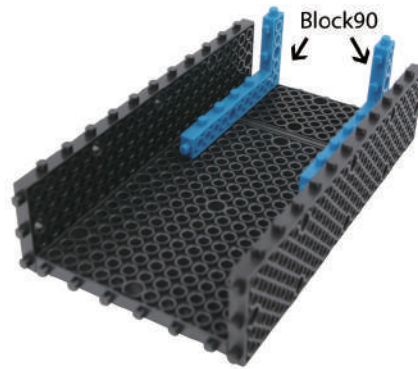
32



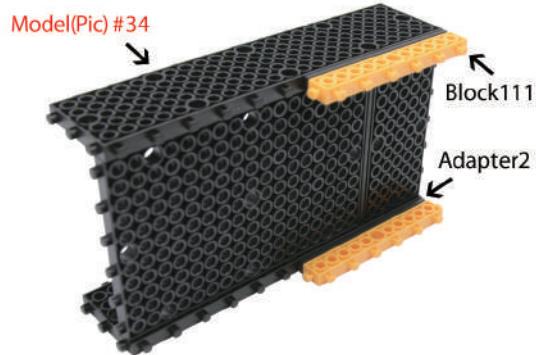
33



34

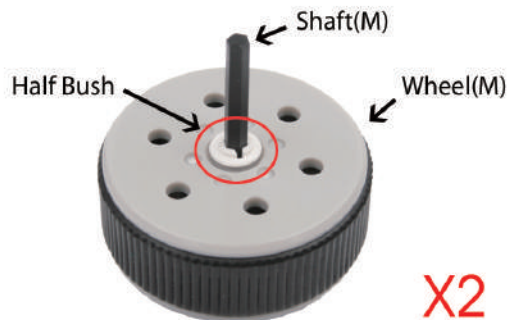


35 (Bottom of model(pic)#34)



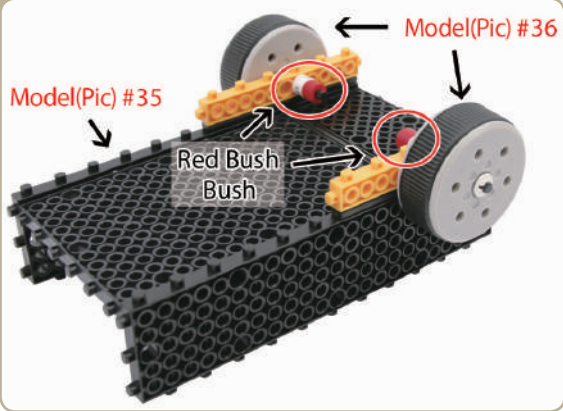
Turn model(pic)#34 upside down, attach two 「block111」s and two 「adapter2」s.

36



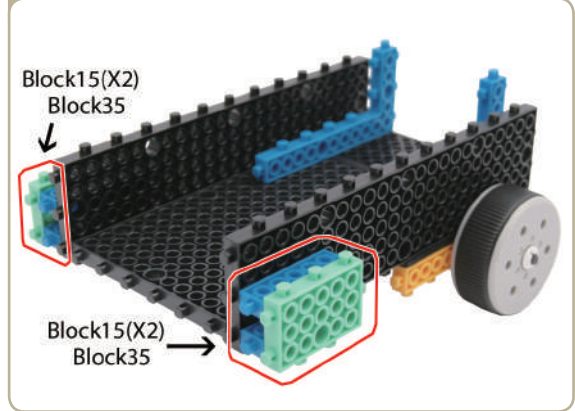
Insert a medium shaft and a half bush to medium wheel. (Assemble two identical models.)

37



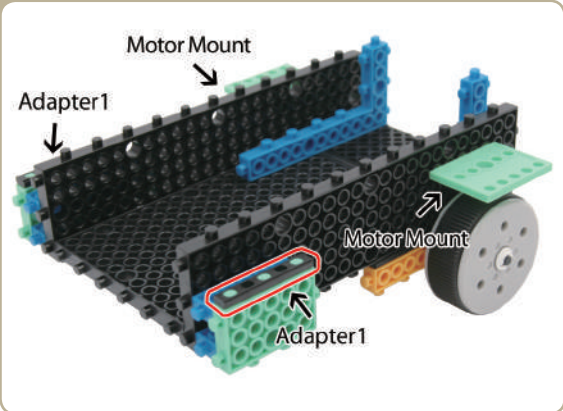
Connect two previously constructed parts of model(pic)#36 to mode(pic)#35 with red bushes and bushes.

38



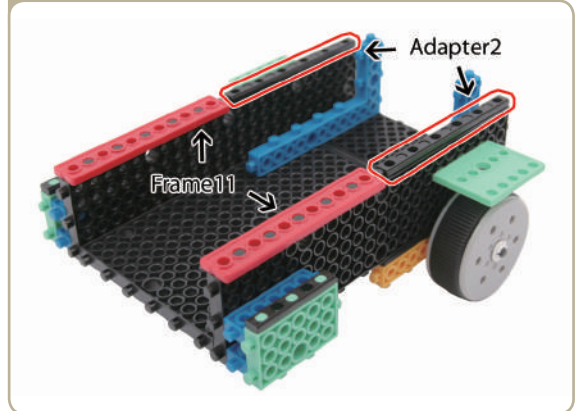
Turn model(pic)#37 upside down, attach four 「block15」s and two 「block35」s.

39



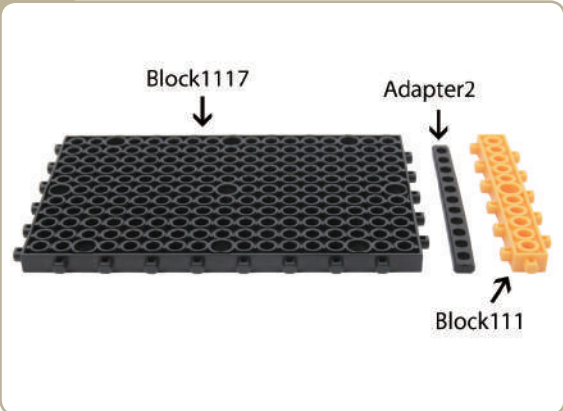
Attach two motor mounts and two 「adapter1」s to model(pic)#38.

40



Attach two 「frame11」s and two 「adapter2」s to model(pic)#39.

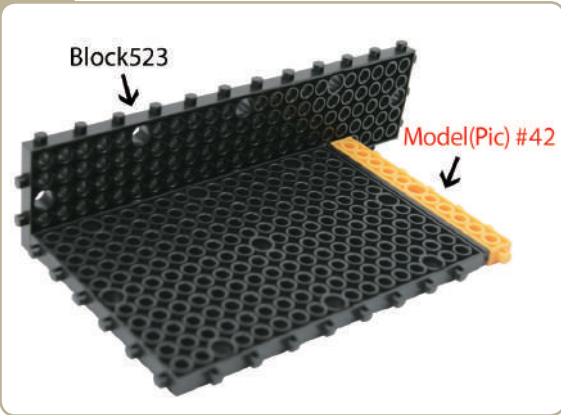
41



42

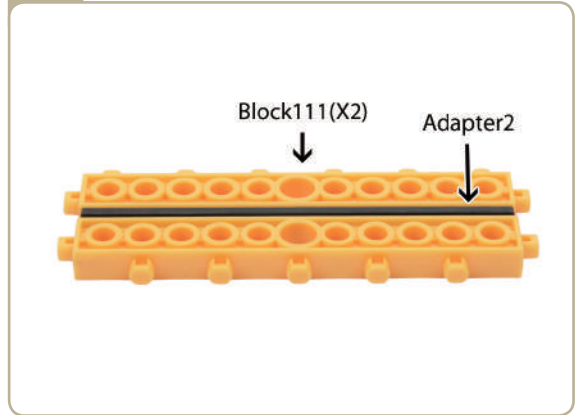


43



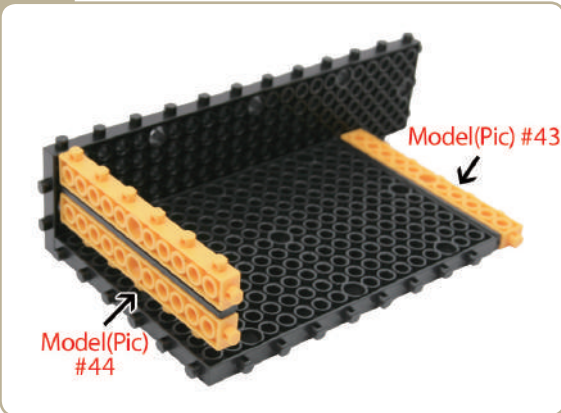
Attach a 「block523」s to model(pic)#42.

44



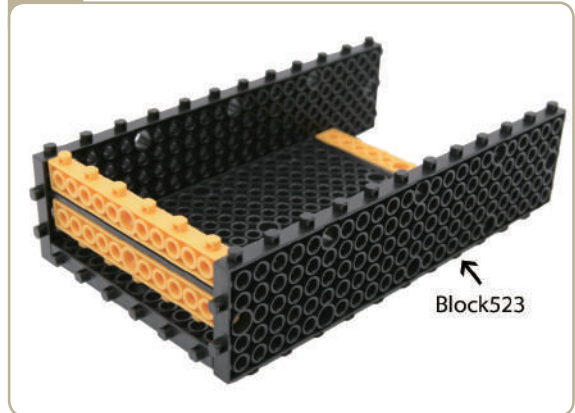
Two 「block111」s are combined with a 「adapter2」.

45

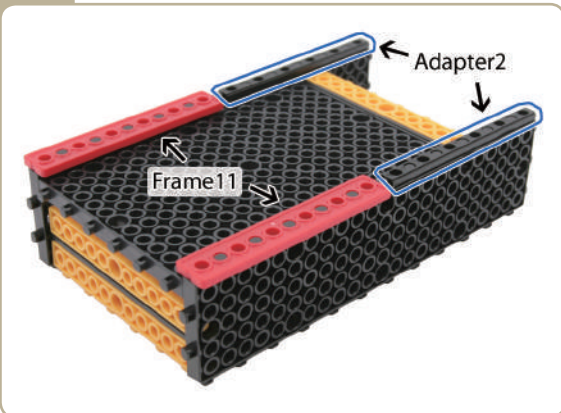


Combine model(pic)#44 to model(pic)#43.

46

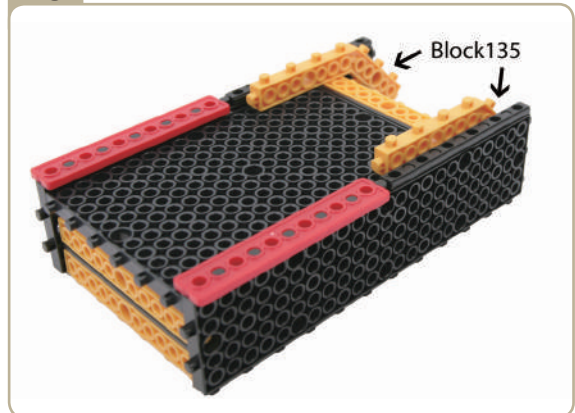


47



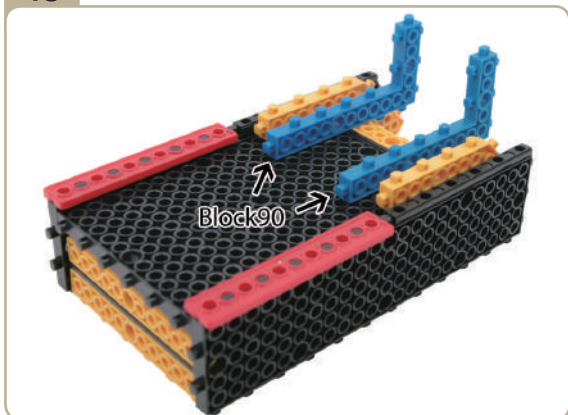
Turn model(pic)#46 upside down, attach two 「frame11」s and two 「adapter2」s.

48



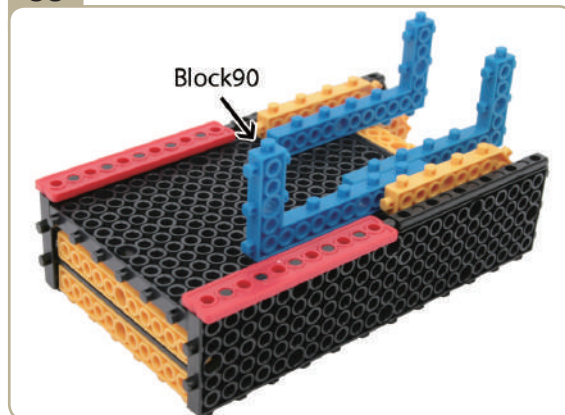
Attach two 「block135」s to model(pic)#47.

49



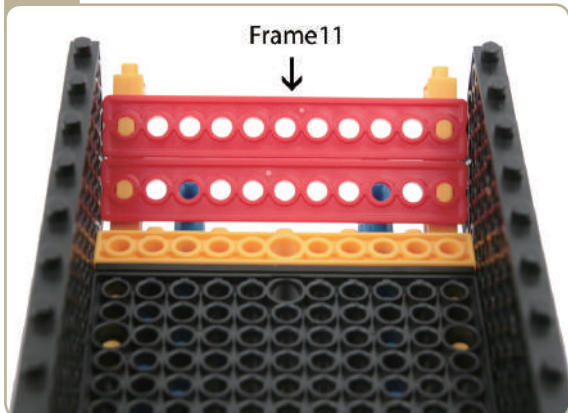
Attach two 「block90」s to model(pic)#48.

50



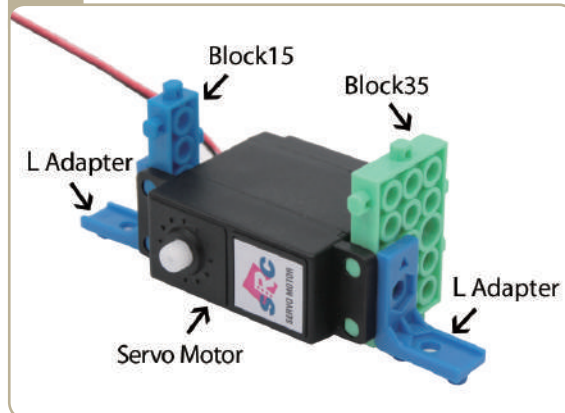
Attach a 「block90」 to model(pic)#49.

51



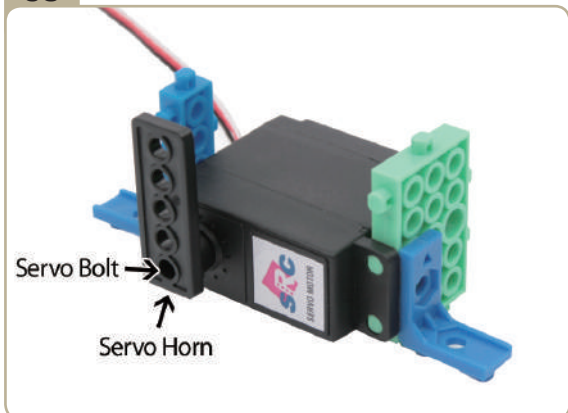
Turn model(pic)#50 upside down again, attach two 「frame11」s.

52



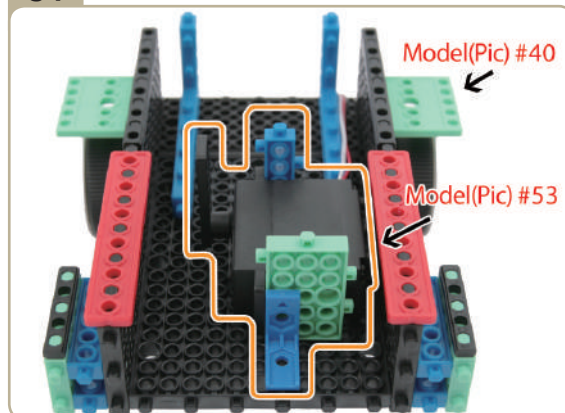
Attach a 「block35」 and a 「block15」 to servo motor, then attach two 'L' adapters.

53



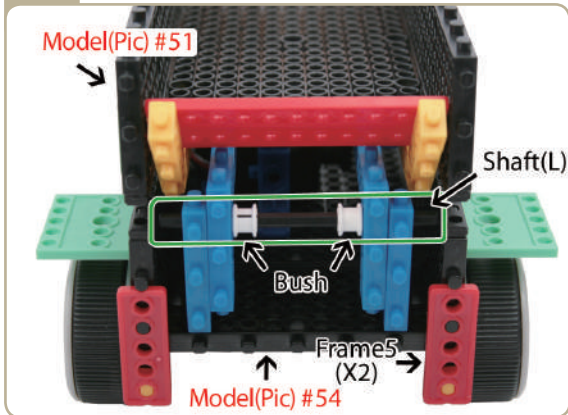
After adjusting zero point of servo motor, fix servo horn with a small servo bolt.

54



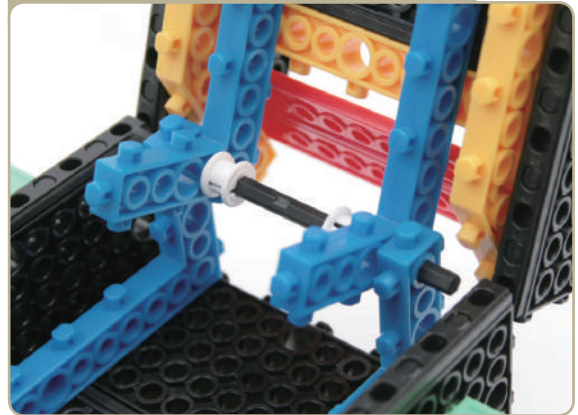
Combine model(pic)#53 with model(pic)#40.

55

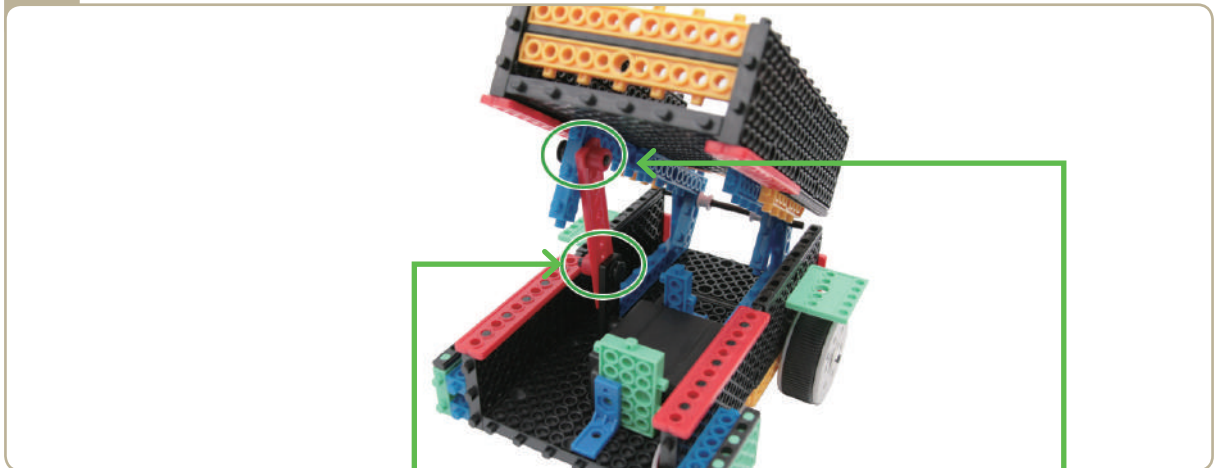


Connect model(pic)#51 to the back of model(pic)#54 with a long shaft and two bushes, then attach two 「frame5」s.

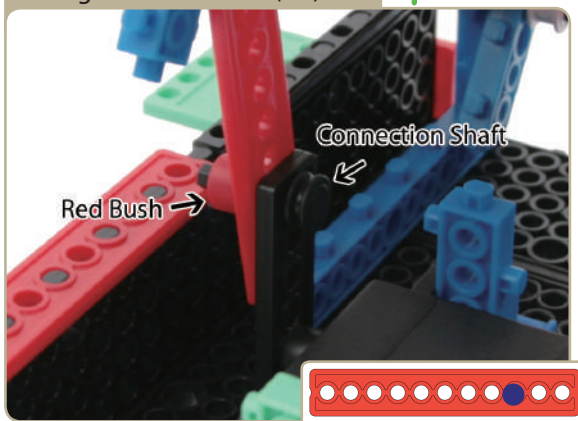
56 (Enlargement of model(Pic)#55)



57

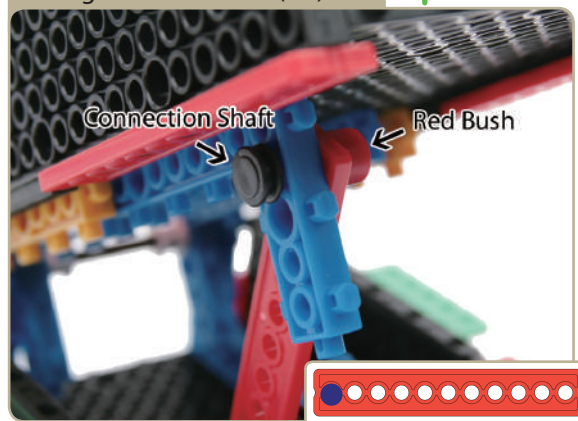


Enlargement of model(Pic)#57



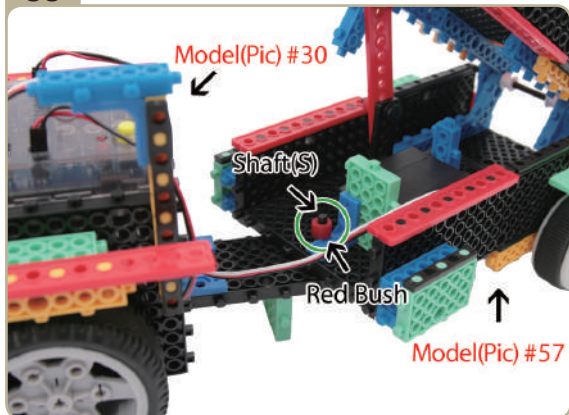
Connect servo horn's first hole and 「frame11」's third hole with a connection shaft and a red bush.

Enlargement of model(Pic)#57



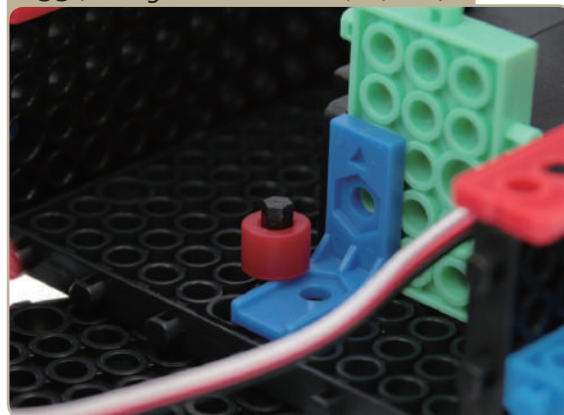
Connect 「block90」's second hole and 「frame11」's first hole with a connection shaft and a red bush.

58

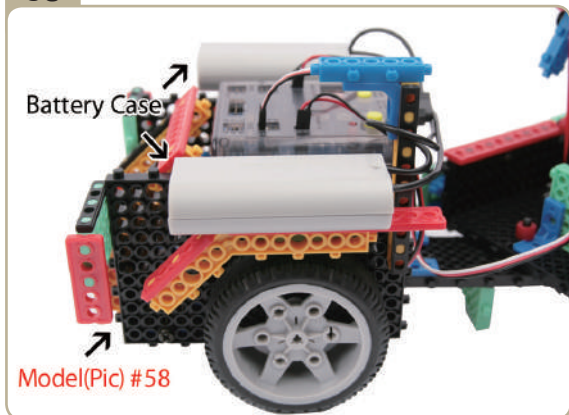


Connect the truck and the dump trail with a short shaft and a bush. (The back side fastens with a red bush.)

59 (Enlargement of model(Pic)#58)

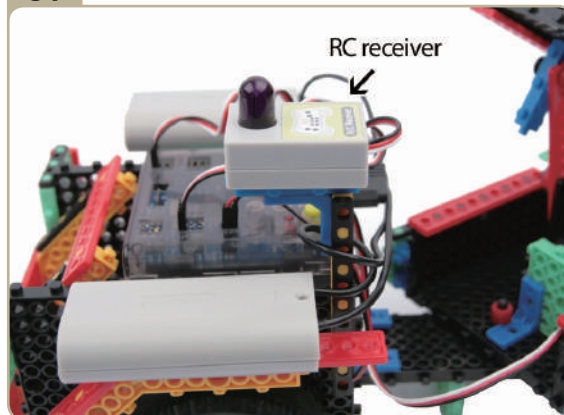


60



Connect battery cases to model(pic)#58.

61



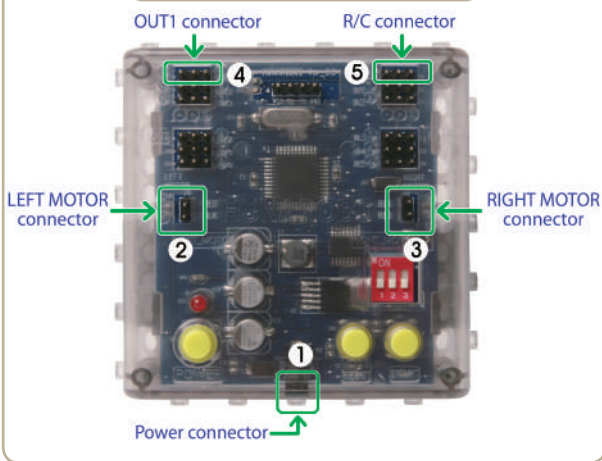
Attach RC receiver board to model(pic)#60.

Completed



How to operate the Dump Truck

Connecting the mainboard



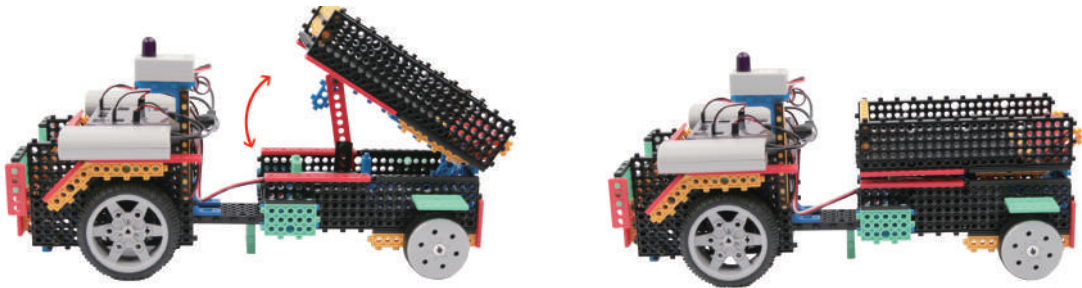
Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program



























- Using the motion patterns as reference, let's write the program.

Program Download

1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on. (Power OFF \rightarrow Power ON)

Program Example

Action	No
 Program Start	0
 Remocon : [Up] {	1
 DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	2
END }	3
 Remocon : [Down] {	4
 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	5
END }	6
 Remocon : [Right] {	7
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	8
 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	9
END }	10
 Remocon : [Left] {	11
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	12
 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	13
END }	14
 Remocon : [Up + Right] {	15
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	16
 DC motor 1 : [R-MOTOR1]=[Stop]	17
END }	18
 Remocon : [Up + Left] {	19
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	20
 DC motor 1 : [L-MOTOR1]=[Stop]	21
END }	22
 Remocon : [KEY OFF] {	23
 DC motor 1 : [Both MOTOR1]=[Stop]	24
END }	25
 Remocon : [F1] {	26
 Servo : [OUT1]=[50]	27
END }	28
 Remocon : [F2] {	29
 Servo : [OUT1]=[0]	30
END }	31
 Program End	32



Fossil Fuels, they are ancient!

Panel 1: Peter asks HUNA what he is reading about. HUNA replies it's about fossil fuels created millions of years ago. Peter says he'll tell him all about it.

Panel 2: HUNA asks if Peter can get started right now. Peter explains the process of coal formation: plants buried under soil for millions of years, where pressure and heat change them into a flammable stone.

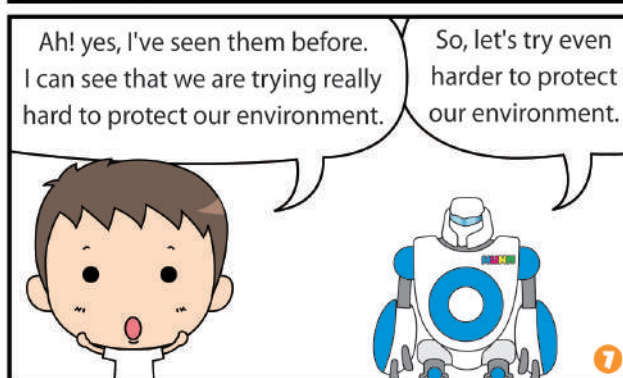
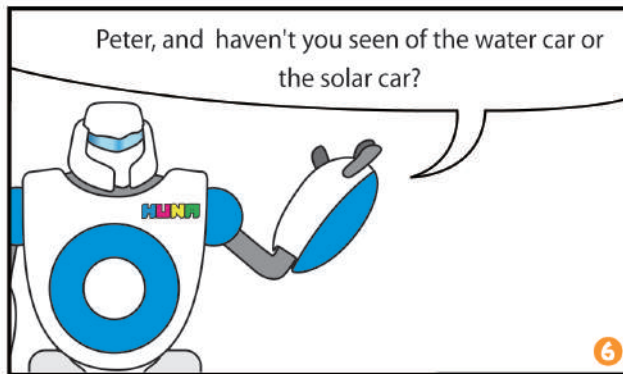
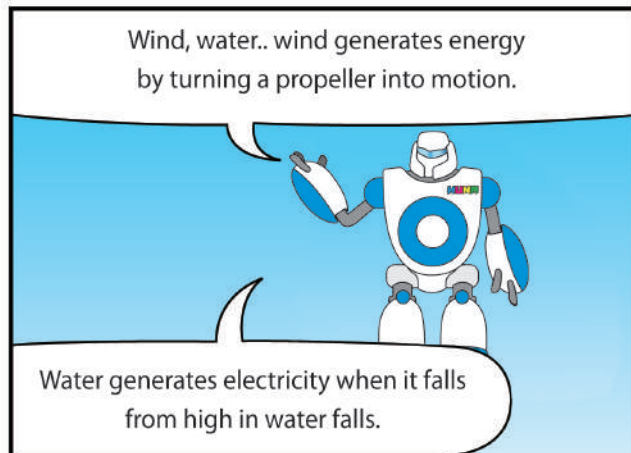
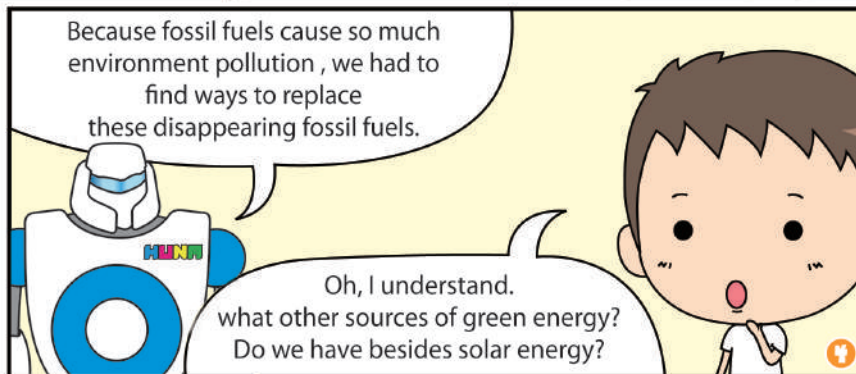
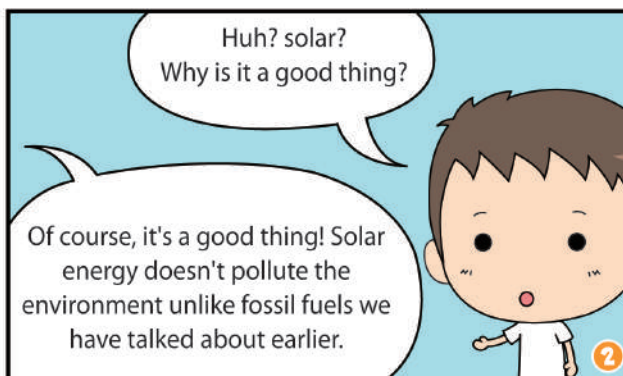
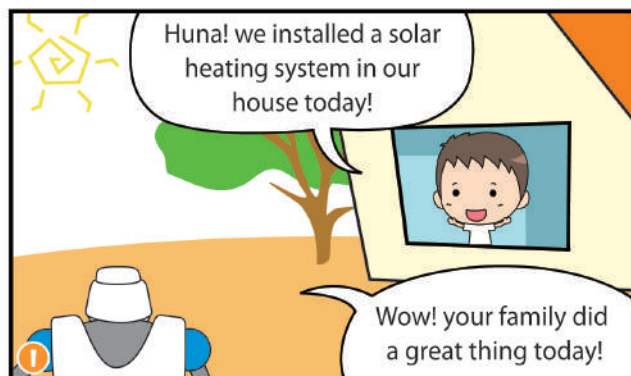
Panel 3: Peter asks about the next thing, petroleum. HUNA explains it's the oil of animal bodies buried and decaying underground for a long time.

Panel 4: Peter asks about natural gas. HUNA explains it's found underground as an energy source because it comes from underground and is called natural gas.

Panel 5: Peter asks HUNA what he thinks of his hard work. HUNA replies that he did well because Peter taught him a lot of new things today.

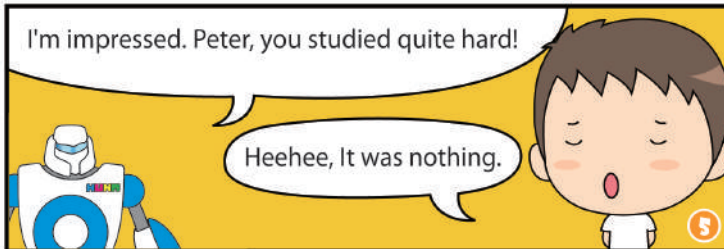
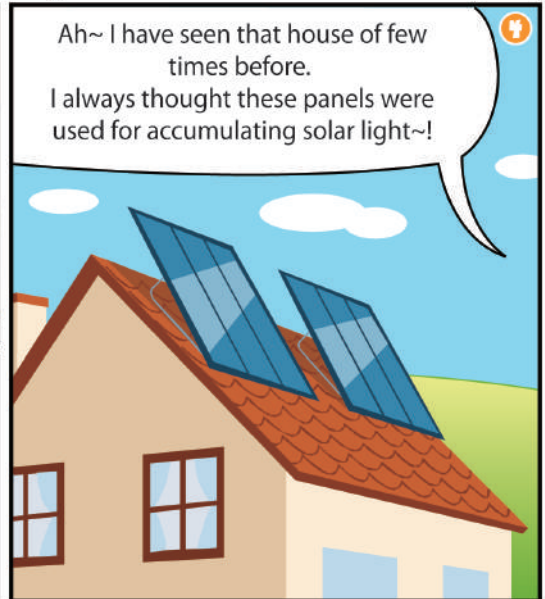
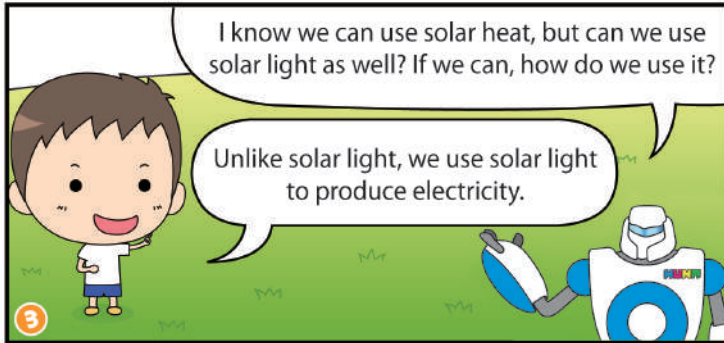
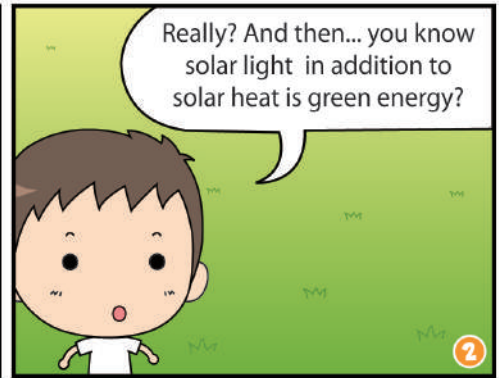
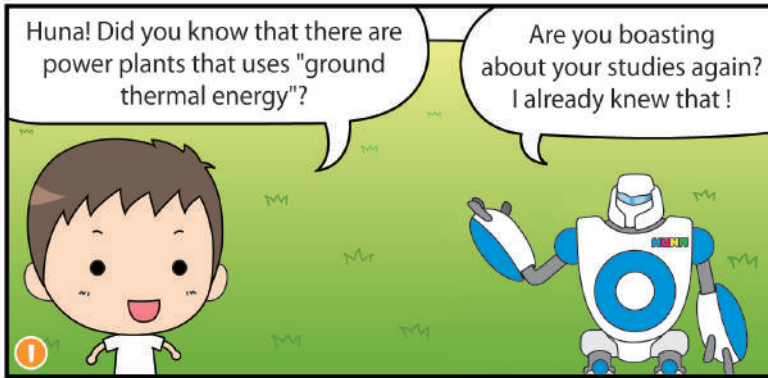
Robot story 1

Protecting the environment and creating sustainable energy sources - Green Energy





There is green energy everywhere around us!

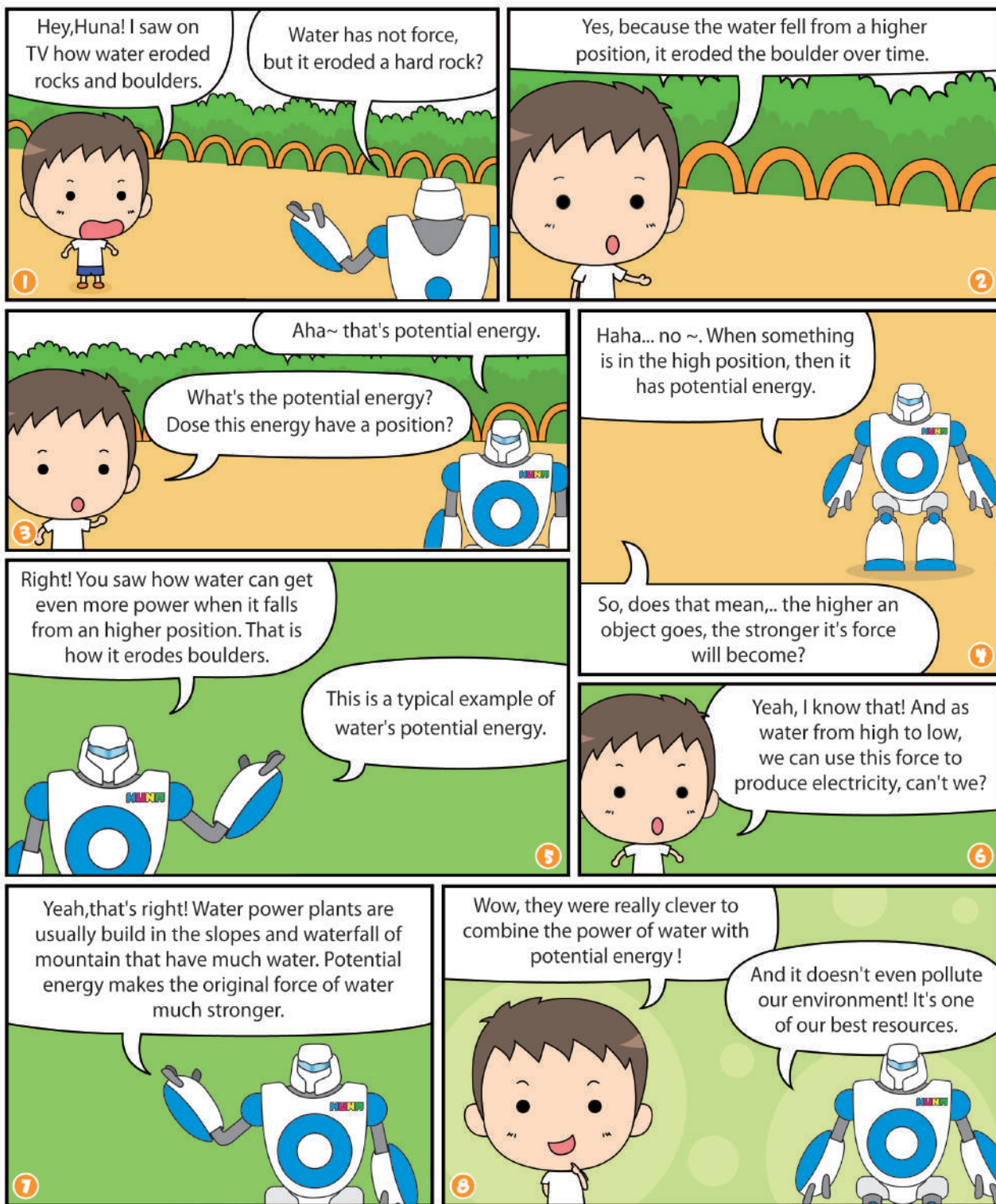


Let's see what other things we can find that uses green energy as a energy sources.

Spiral notebook area for writing notes.

Robot story 1

**The incredible power of thing in higher positions
- Potential Energy**



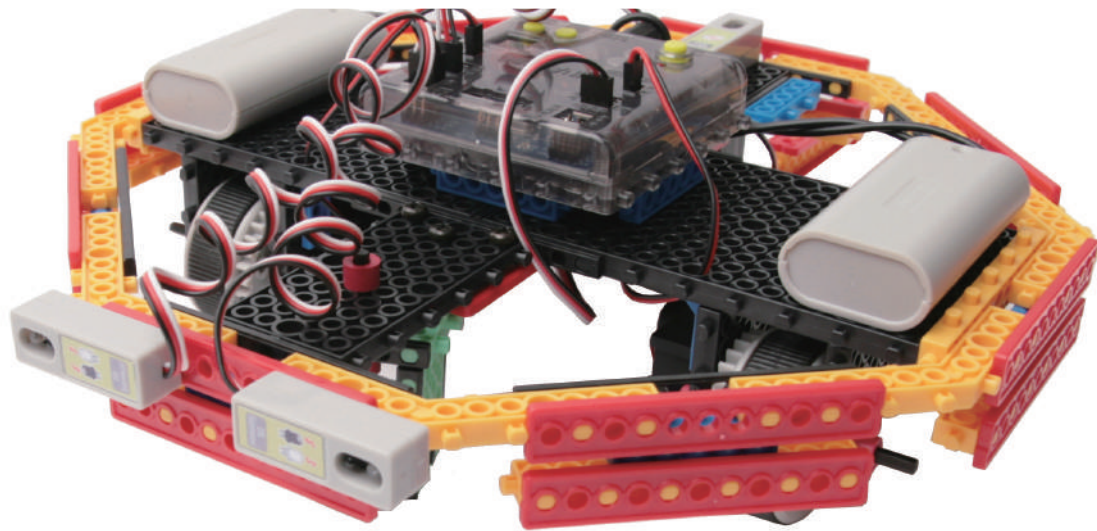
Let's Make it 1 *Creating a robot that utilizes several kinds of sensors*



Cleaner Bot



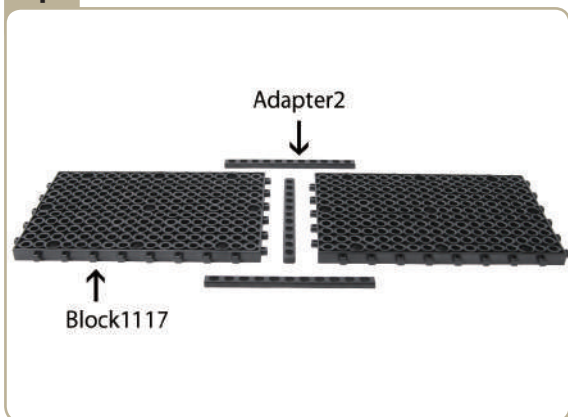
This robot is a replica of the cleaning robots we often see at home. This robot is driven by two DC motors. Servo motor performs the cleaning motion by collecting the waste in front of it. This robot uses an infrared sensor to avoid objects, and its operation is activated by CdS sensor.



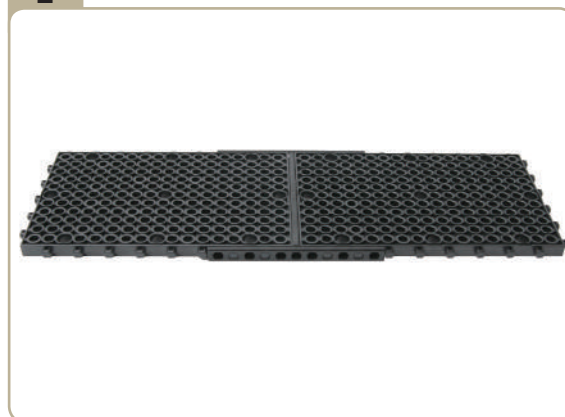
Prepare parts for assembly

	Block1117	×2		Frame21	×5	
				Frame11	×18	
				Adapter2	×9	
				Adapter1	×8	
	Block511	×6		L Adapter	×8	
	Block135	×8		Shaft(S)	×2	
	Block111	×11		Shaft(L)	×2	
	Block35	×3		Half Bush	×4	
	Block15	×14		Red Bush	×6	
	DC Motor	×2		Bolt(S) / Nut	×9	
	Servo Motor	×1		Gear(L)	×2	
	Wheel(M)	×2		Gear(S)	×2	
				Guide Wheel	×1	

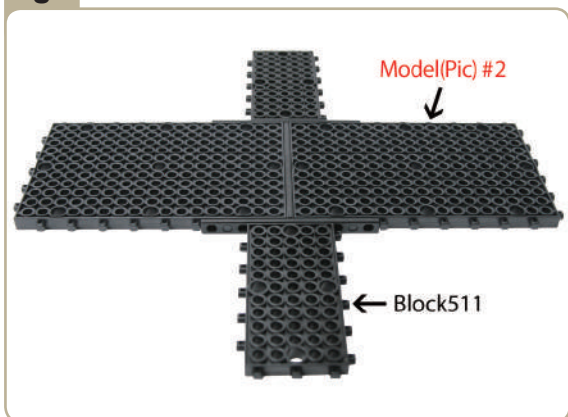
1



2

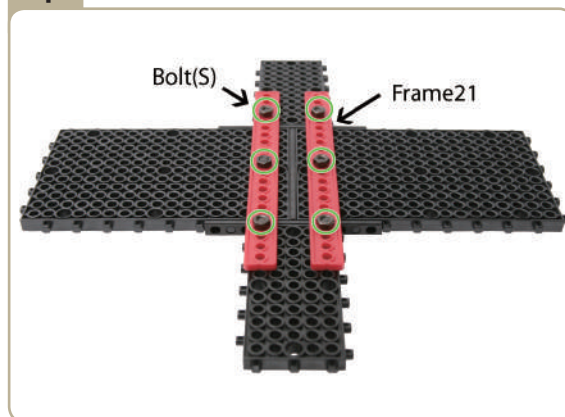


3



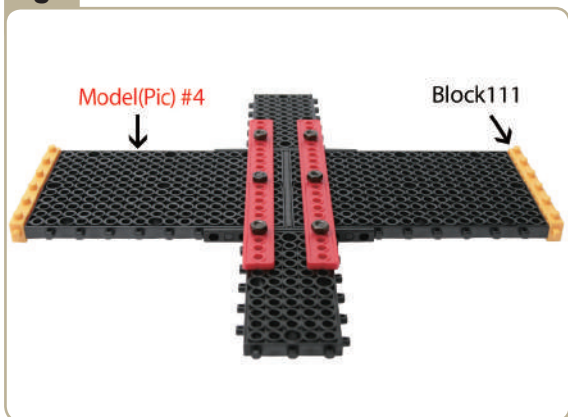
Connect two 「block511」s to model(pic)#2.

4



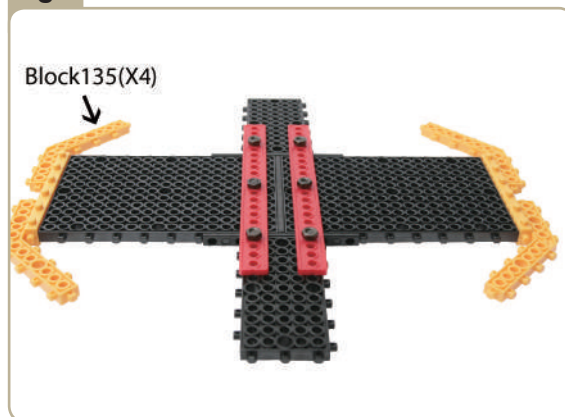
Fix two 「frame21」s to model(pic)#3 with short bolts and nuts.

5



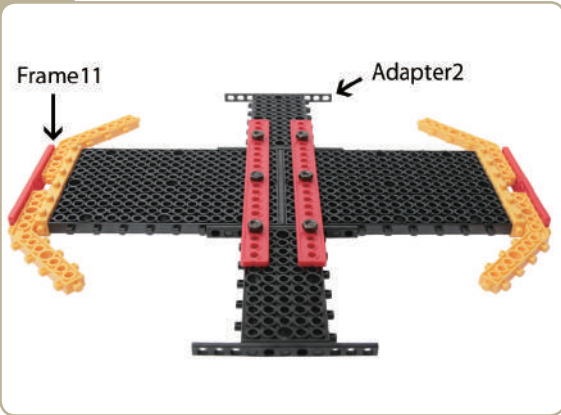
Attach two 「block111」s to model(pic)#4.

6



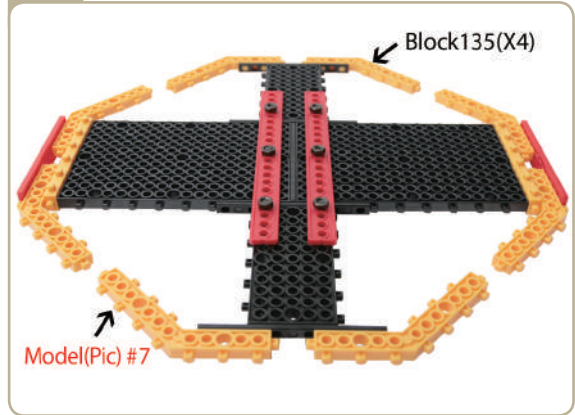
Attach four 「block135」s to model(pic)#5.

7



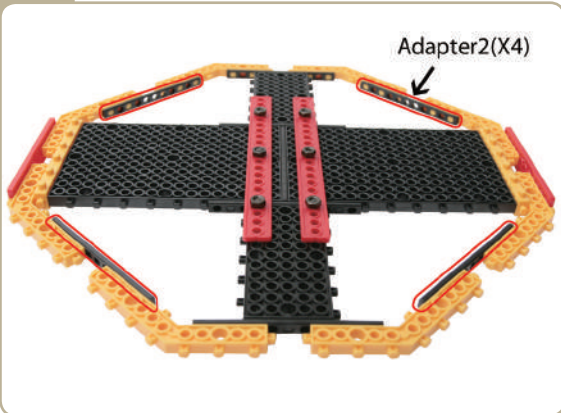
Attach two 「frame11」s and two 「adapter2」s to model(pic)#6.

8

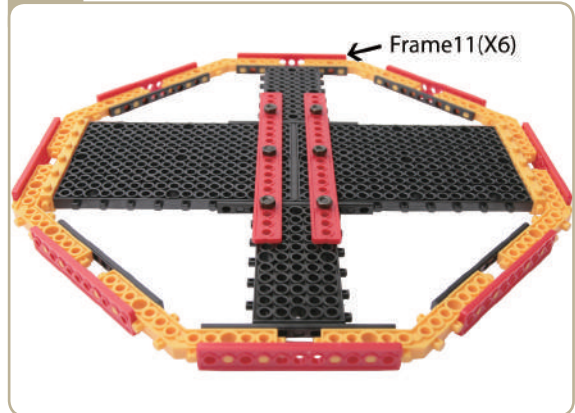


Attach four 「block135」s to model(pic)#7.

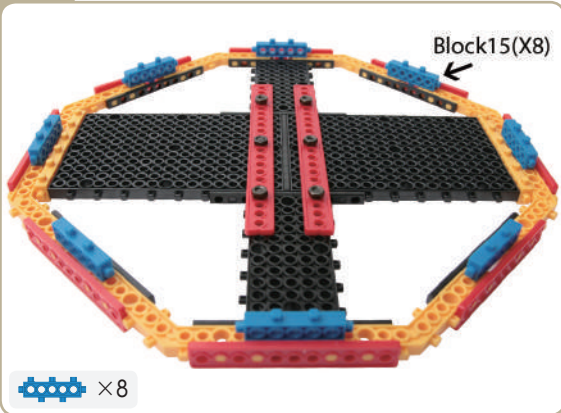
9



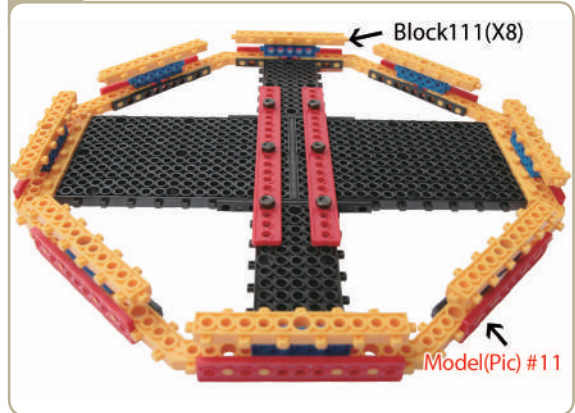
10



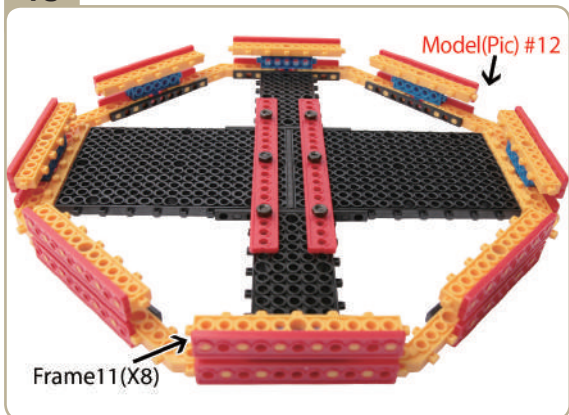
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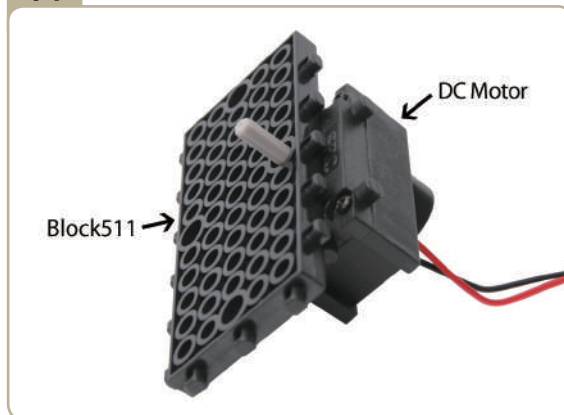
12



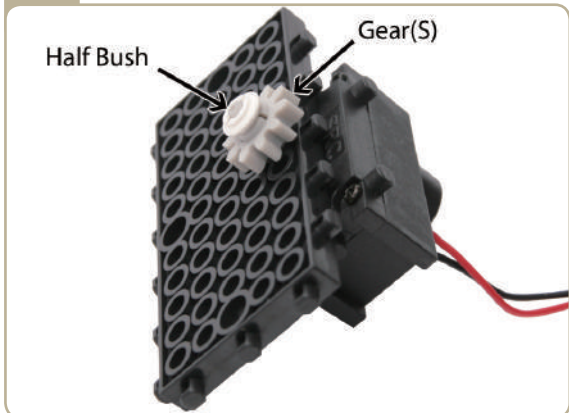
13



14

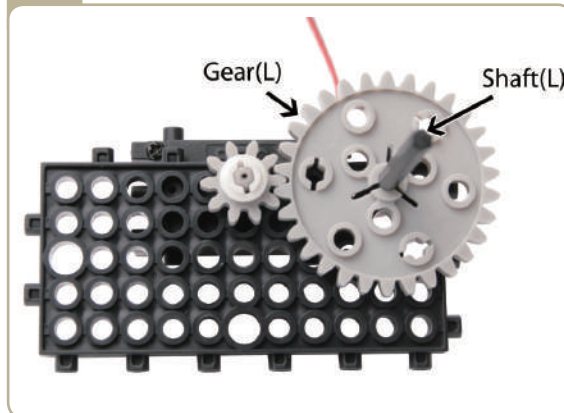


15



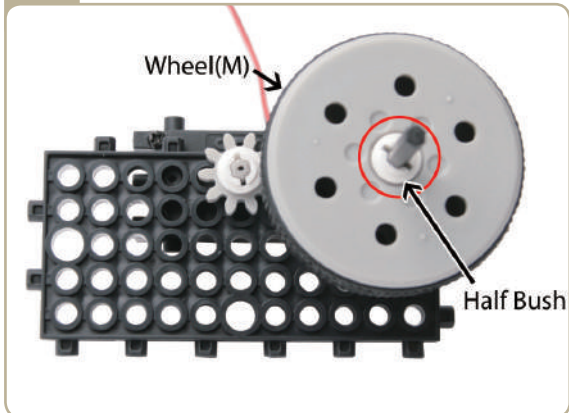
Insert a small gear and a half bush to the shaft of DC motor.

16



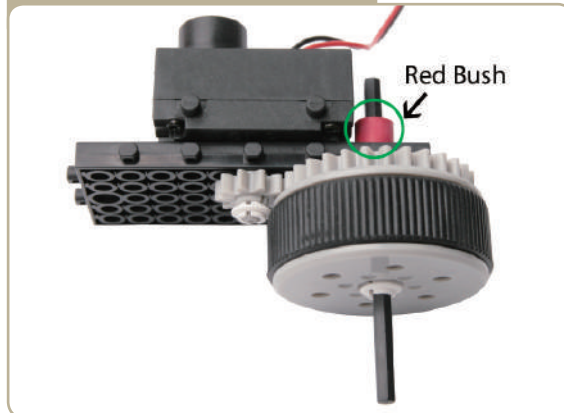
Connect a large gear and a long shaft to model(pic)#15. (The back side fastens with a red bush.)

17

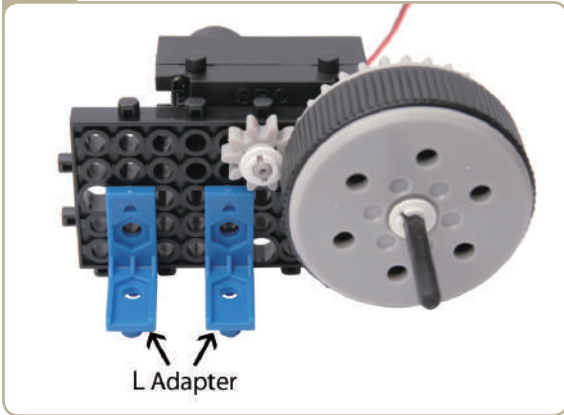


Insert a medium wheel to the long shaft of model(pic)#16, then fix it with a half bush.

18 (Back of model(Pic)#17)

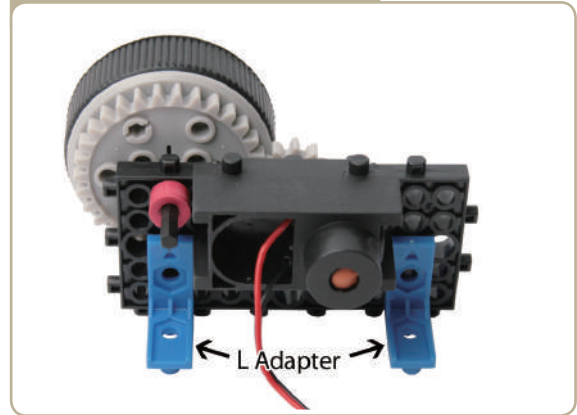


19



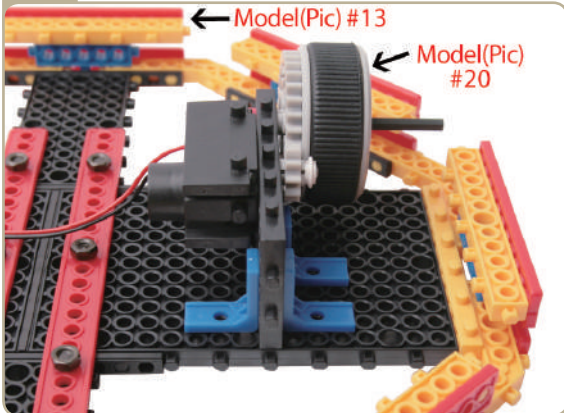
Attach two 'L' adapters to model(pic)#18. (Pay close attention to the arrows(▲) that indicates how the adapters should be attached).

20 (Back of model(Pic)#19)



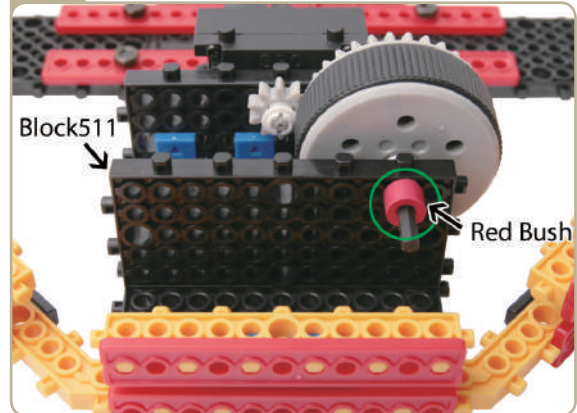
Attach two 'L' adapters to the back of model(pic)#19. (Pay close attention to the arrows(▲) that indicates how the adapters should be attached).

21



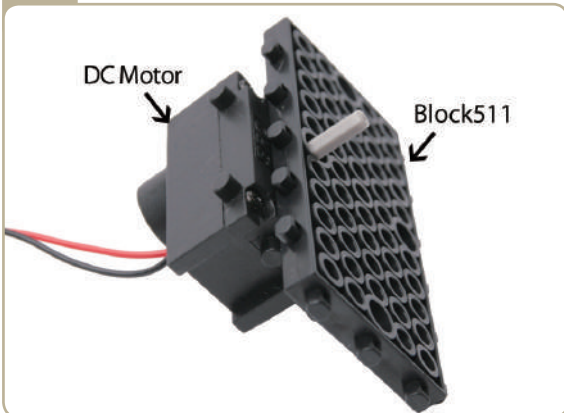
Combine model(pic)#20 with model(pic)#13.

22

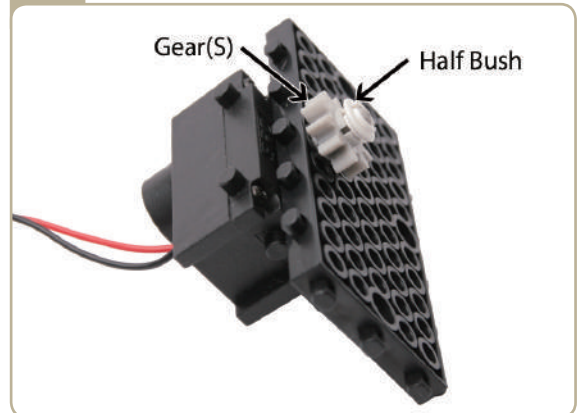


Insert a 'Block511' and a red bush to the long shaft of model(pic)#20.

23

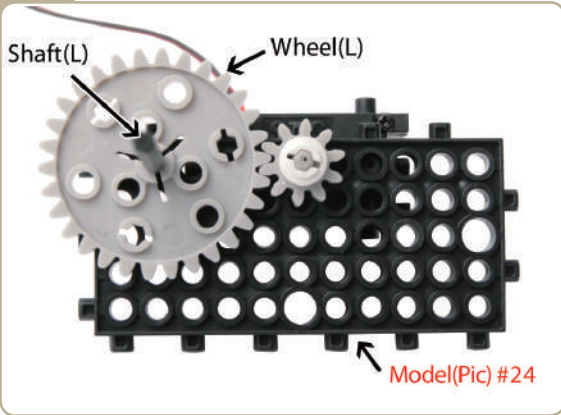


24



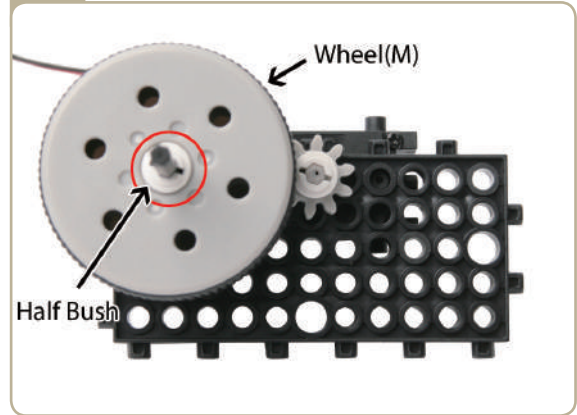
Insert a small gear and a half bush to the shaft of DC motor.

25



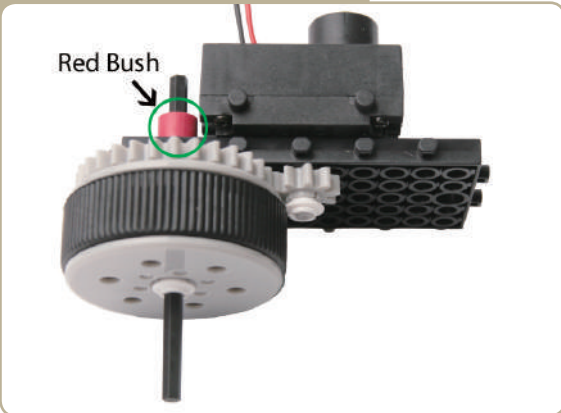
Connect a large gear and a long shaft to model(pic)#24. (The back side fastens with a red bush.)

26

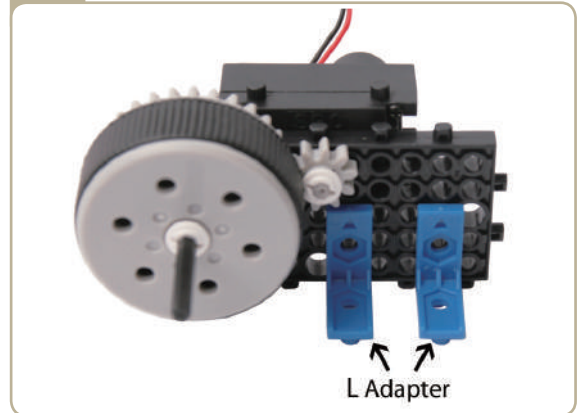


Insert a medium wheel to the long shaft of model(pic)#25, then fix it with a half bush.

27 (Upside of model(Pic)#26)

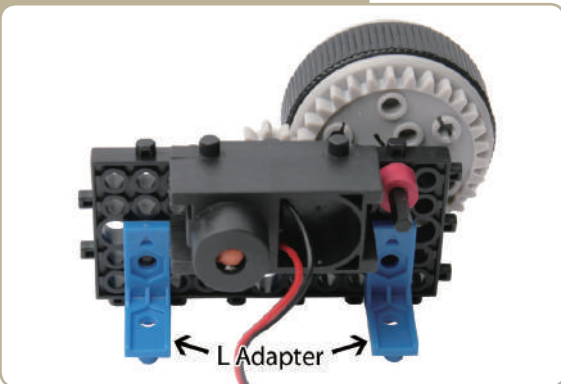


28



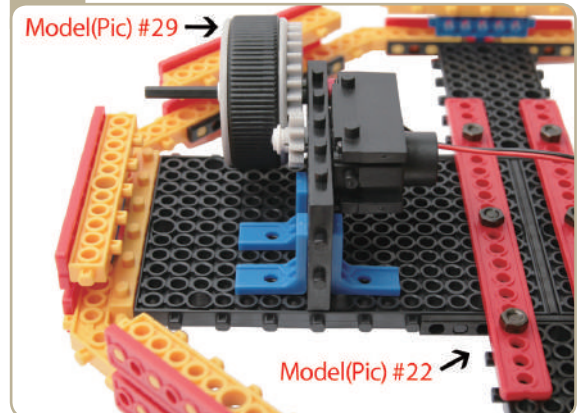
Attach two 'L' adapters to model(pic)#27. (Pay close attention to the arrows(▲) that indicates how the adapters should be attached).

29 (Back of model(Pic)#28)



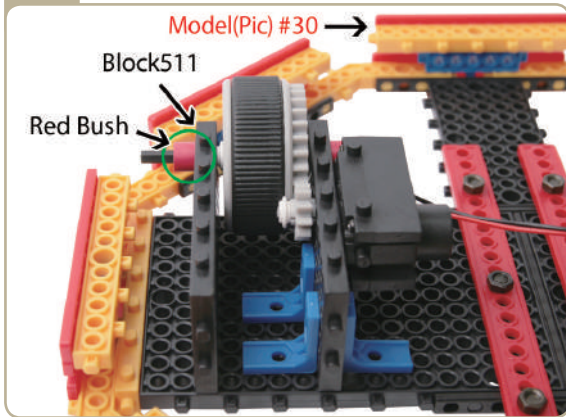
Attach two 'L' adapters to the back of model(pic)#28. (Pay close attention to the arrows(▲) that indicates how the adapters should be attached).

30



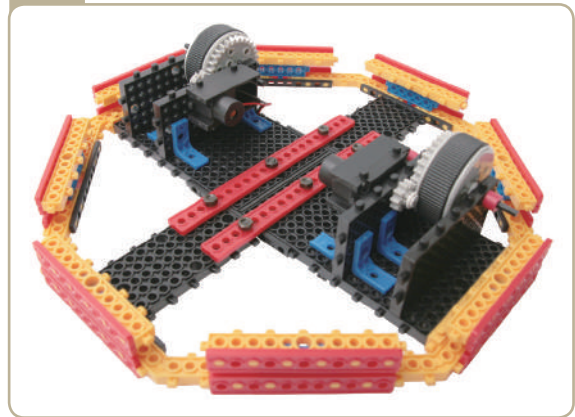
Combine model(pic)#29 with model(pic)#22.

31



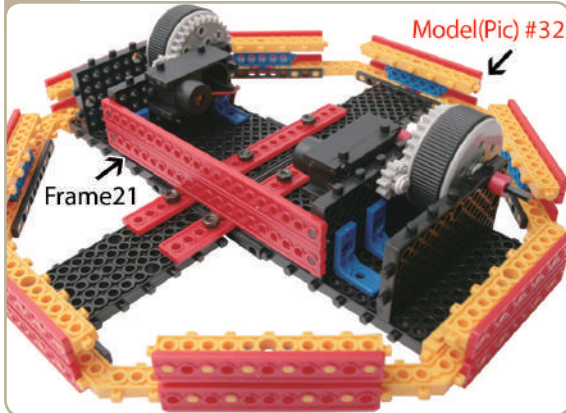
Insert a 「block511」 and a red bush to the long shaft of model(pic)#20.

32



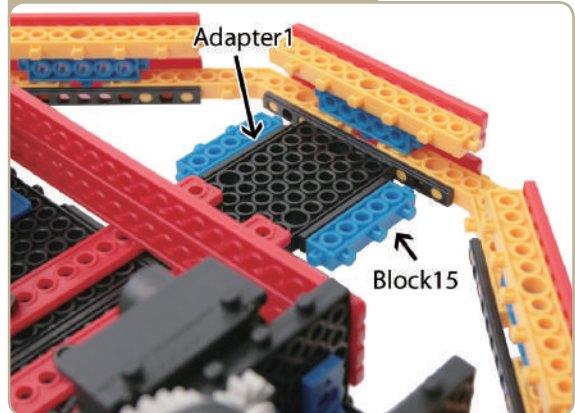
* An illustration of assembled wheels.

33



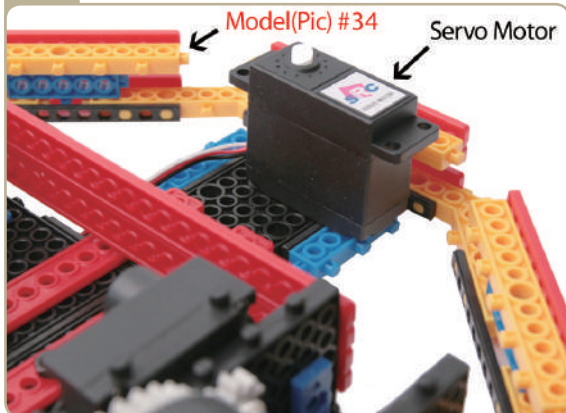
Attach two 「frame21」s to model(pic)#32.

34 (Back of model(Pic)#33)



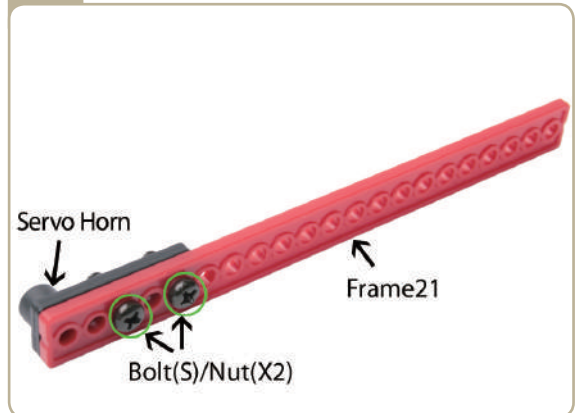
Turn model(pic)#33 by 180 degrees, then attach two 「block15」s with 「adapter1」s as illustrated in the picture.

35



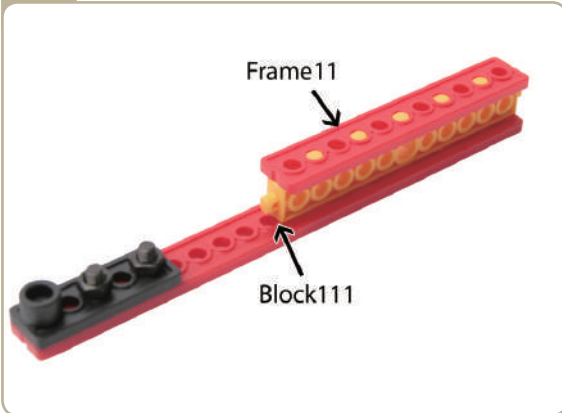
Connect servo motor to model(pic)#34.

36

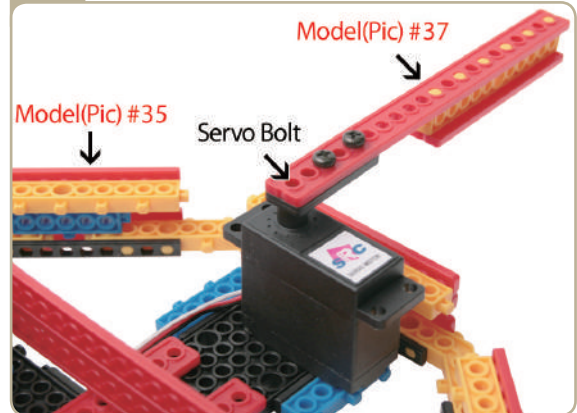


Fix servo horn to 「frame21」 with short bolts and nuts.

37

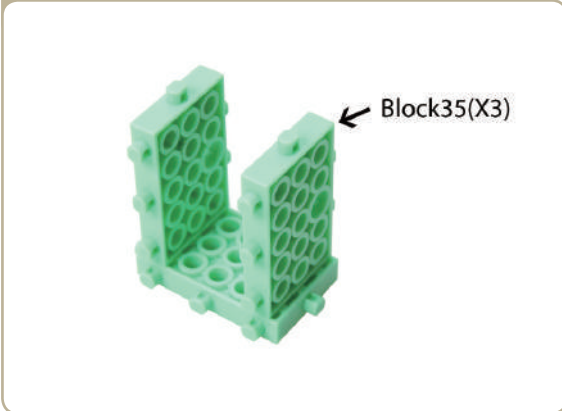


38

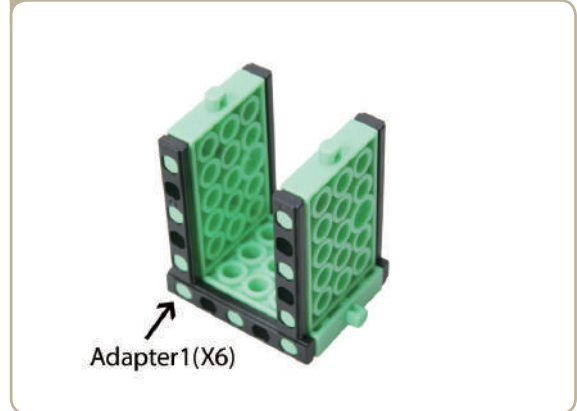


After adjusting zero point of servo motor, then fix model(pic)#37 with a small servo bolt.

39

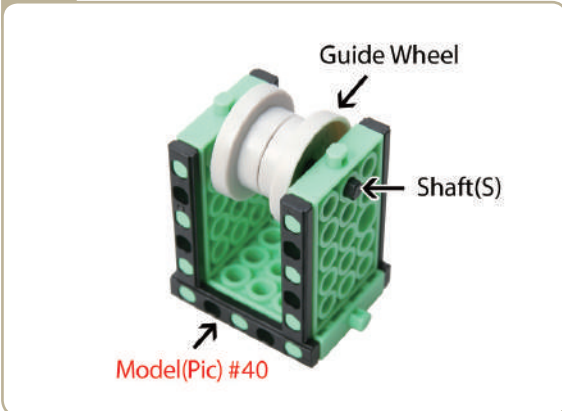


40



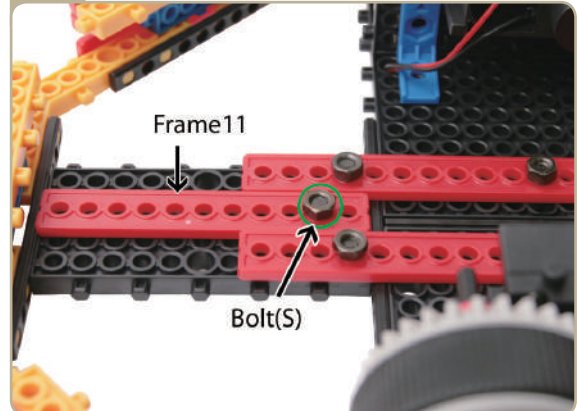
Attach six 「adapter1」s to model(pic)#39.

41



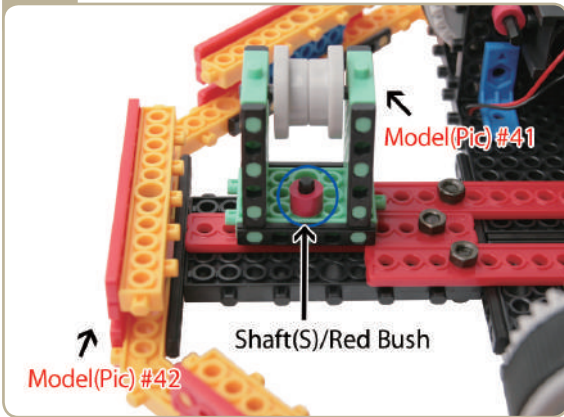
Connect a guide wheel to model(pic)#40 with a short shaft.

42



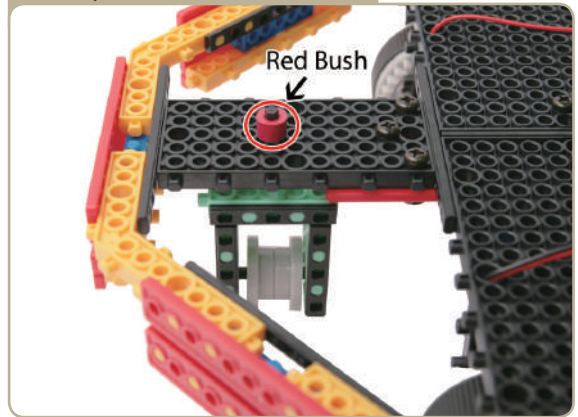
On model(pic)#38, fix a 「frame11」 to opposite side of servo motor with short bolt and a nut.

43



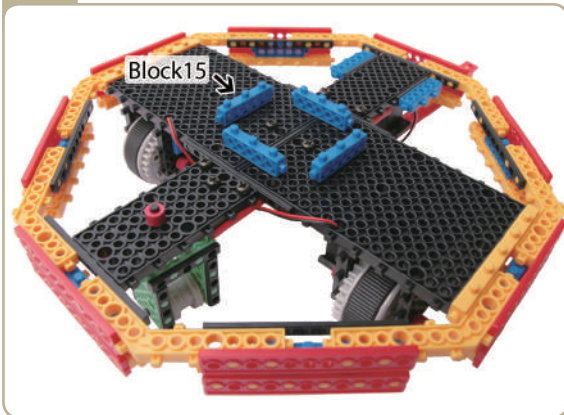
Connect model(pic)#41 to model(pic)#42 with a short shaft and a red bush.

44 (Upside of model(Pic)#43)



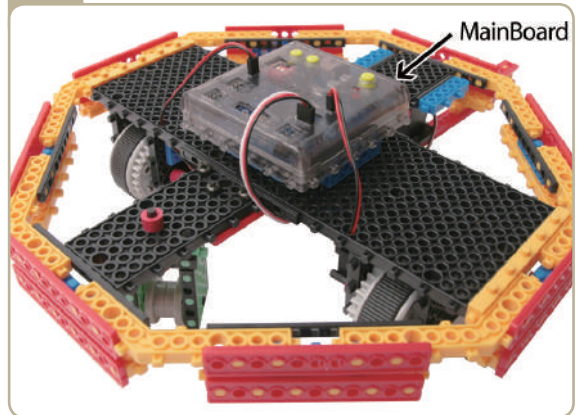
Turn model(pic)#43 upside down, then fix a short shaft with a red bush.

45



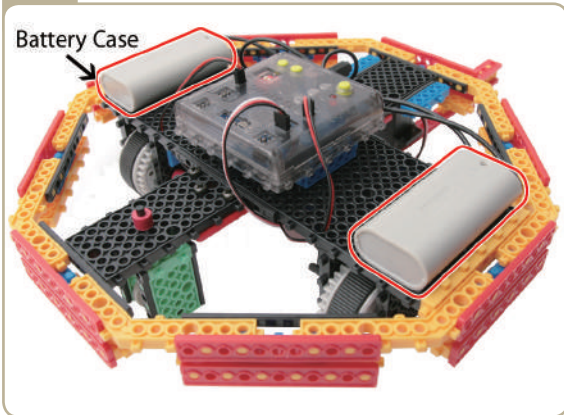
Attach four 'block15's to model(pic)#44.

46



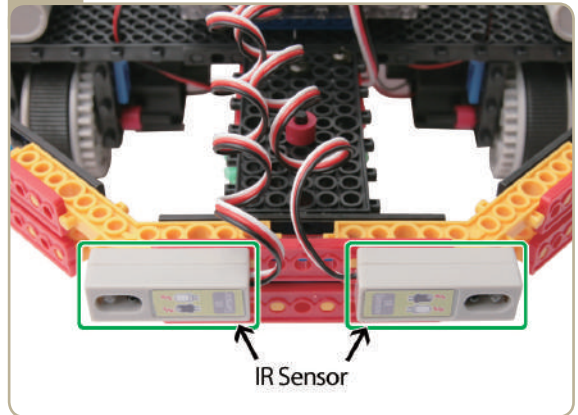
Connect Mainboard to model(pic)#45.

47



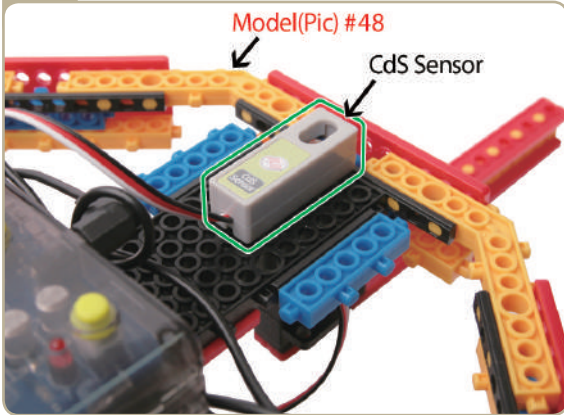
Connect battery cases to model(pic)#46.

48



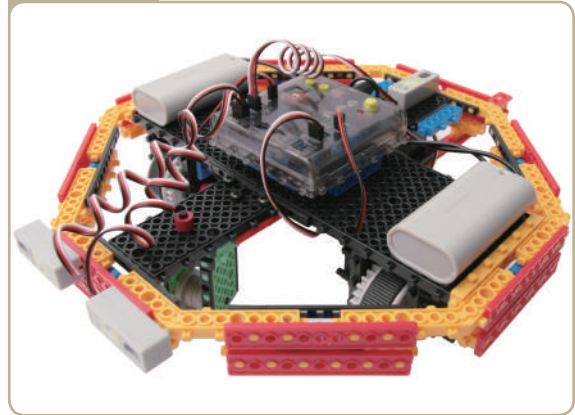
Attach two IR sensors to the front of model(pic)#47.

49



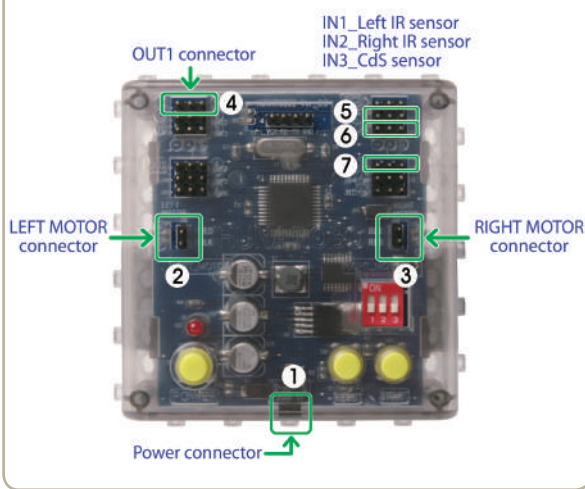
Attach CdS sensor to the back of model(pic)#48.

Completed



How to operate the Cleaner Bot

Connecting the mainboard

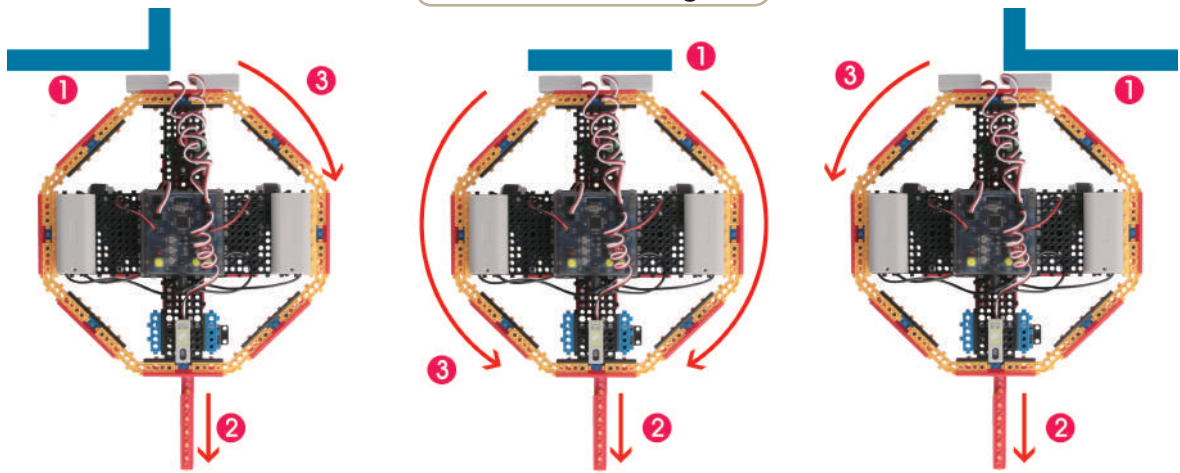


Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect Left IR sensor to IN1 of INPUT connector.
6. Connect Right IR sensor to IN2 of INPUT connector.
7. Connect CdS sensor to IN3 of INPUT connector.

- The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .
- Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program



- Using the motion patterns as reference, let's write the program.

Program Download

1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on. (Power OFF \rightarrow Power ON)

Program Example

Action	No
Program Start	0
CdS : [IN3]=[Dark] {	1
1 DC motor 1 : [Both MOTOR1]=[Stop]	2
Delay : [2 sec]	3
1 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=8]	4
Delay : [2 sec]	5
1 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=8]	6
1 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=8]	7
Delay : [1 sec]	8
END }	9
IR : [IN1]=[None], [IN2]=[None] {	10
1 DC motor 1 : [Both MOTOR1]=[Backward],[Speed=8]	11
Servo : [OUT1]=[0]	12
END }	13
IR : [IN1]=[Sense], [IN2]=[None] {	14
1 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=8]	15
Servo : [OUT1]=[-50]	16
Delay : [0.5 sec]	17
Servo : [OUT1]=[50]	18
Delay : [0.5 sec]	19
Servo : [OUT1]=[-50]	20
Delay : [0.5 sec]	21
Servo : [OUT1]=[50]	22
1 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=8]	23
1 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=8]	24
Delay : [0.5 sec]	25
END }	26
IR : [IN1]=[None], [IN2]=[Sense] {	27
1 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=8]	28
Servo : [OUT1]=[-50]	29
Delay : [0.5 sec]	30
Servo : [OUT1]=[50]	31
Delay : [0.5 sec]	32
Servo : [OUT1]=[-50]	33
Delay : [0.5 sec]	34
Servo : [OUT1]=[50]	35
1 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=8]	36
1 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=8]	37
Delay : [0.5 sec]	38
END }	39
Program End	40



Where can we see potential energy?

1 Peter, Do you know where we can find potential energy besides in water power?

2 Well, I haven't thought about it yet. Have you heard of treadmills? Our ancestors used treadmills as a farming tool to grind various grains in the past?

3 I know! I went to a museum and saw it. They also make use of potential energy. Right~

4 After pressing the tool with your feet, it will raise up to a higher position. Now, if you would remove your feet from the tool, it will have potential energy because it's falling down from a higher position. Does water mills work in the same manner?

5 Water mill also works by using the power of water, it grinds grains in the same way as treadmill.

6 Wow! Our ancestors were really wise!



Let's have a look and see what things we can find that uses potential energy?

Spiral notebook graphic with a large blank area for writing.



It's only in moving objects, nothing else! - Kinetic energy

1 Huna~, I accidentally got hurt when a child ran into me?

Are you ok, Peter? Did you get a bandage?

2 He was a little boy, so I thought I wouldn't get hurt. Ahh, it hurts so much..

3 Well, he had a lot of kinetic energy, so it probably made him stronger.

Kinetic energy? Is that the energy that moving objects possess?

Right~ It's the force that the moving objects have..

4 Wow, energy also occurs when we are moving! So that means there is more energy while we are running than when we are walking.

OK! The faster an object moves, the higher amount of power it creates. It's the same as potential energy, where the height of the object influences the amount of energy.

5 Aha~. So what thing has kinetic energy?

An electronic fan converts electronic energy into kinetic energy. This kinetic energy can be seen as the wings of the fan turns.

Look around you, there are many things that uses kinetic and potential energy.

6 Wow, I am quite impressed with these little things that have so much energy. Because of this energy, the little boy got stronger.

Sure, so don't feel relaxed just because someone is small and weak. Be careful from now on!

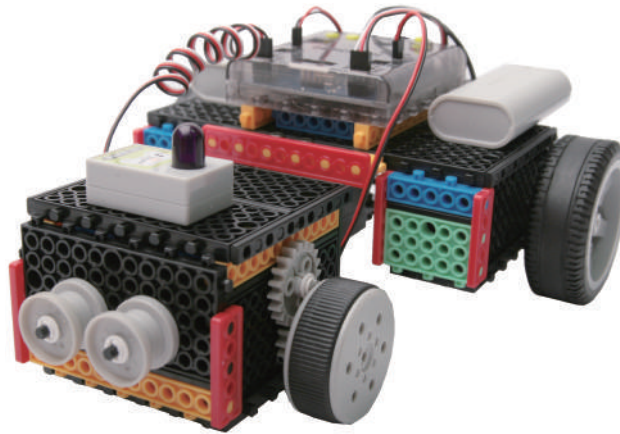


Making four wheels-drive-robot with DC motor and servo motor

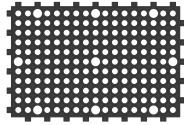


























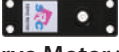








The little car 'Bumboo'

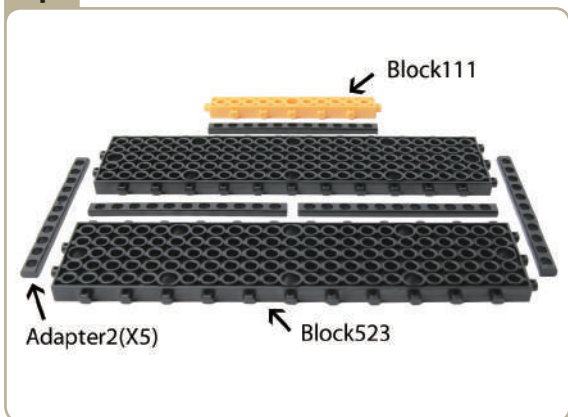
Our little car 'Bumboo' is a model that resembles the famous 1980's animation character. The model make use of freely driven front and back wheels. Both the front and back wheels are driven by a DC motor, and can change direction with on servo motor. The model is controlled by a remote control. But we are going to do something different, like installing different sensors, and so on.



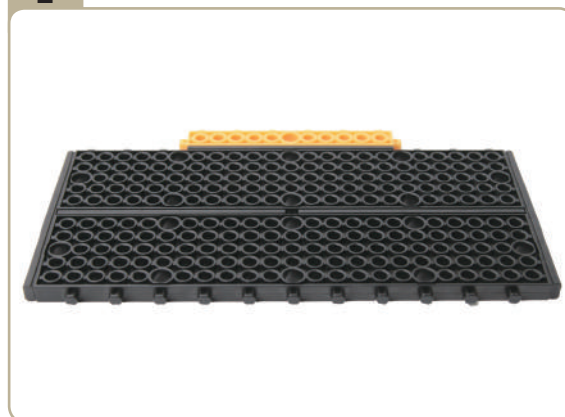
Prepare parts for assembly

	Block1117	x1		Frame11	x1	
				Frame5	x6	
				Adapter2	x11	
	Block523	x3		Adapter1	x4	
	Block511	x9		L Adapter	x10	
				Shaft(S)	x2	
				Shaft(M)	x2	
	Block135	x2		Shaft(L)	x4	
	Block111	x6		Half Bush	x7	
	Block15	x4		Bush	x2	
	Block35	x2		Red Bush	x6	
	Guide Wheel	x2		Coupling	x3	
	Wheel(M)	x2		Bolt(S)	x10	
				Bolt(M)	x2	
				Nut	x12	
	Wheel(L)	x2		Gear(S)	x1	
				Gear(M)	x2	
				Gear(L)	x1	

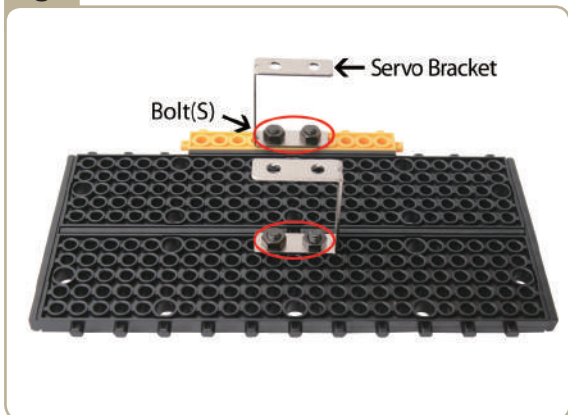
1



2

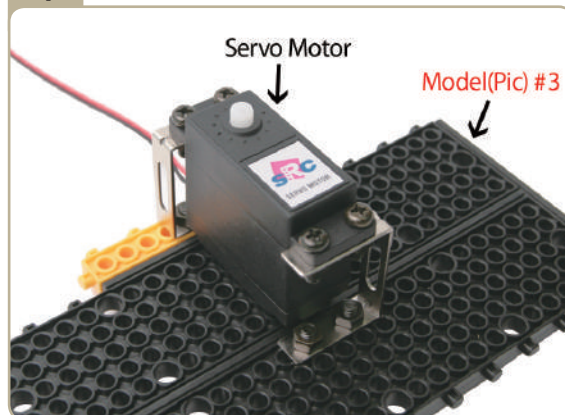


3



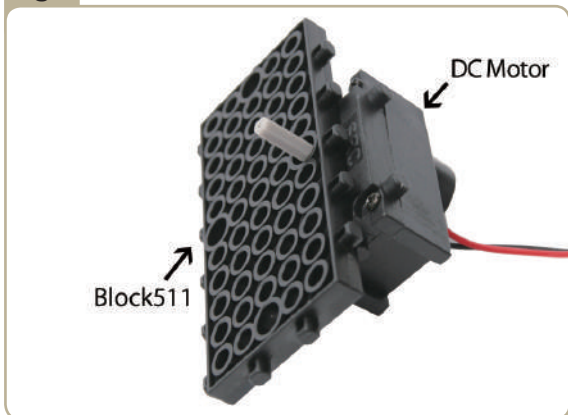
Fix two servo brackets to model(pic)#2 with short bolts and nuts.

4

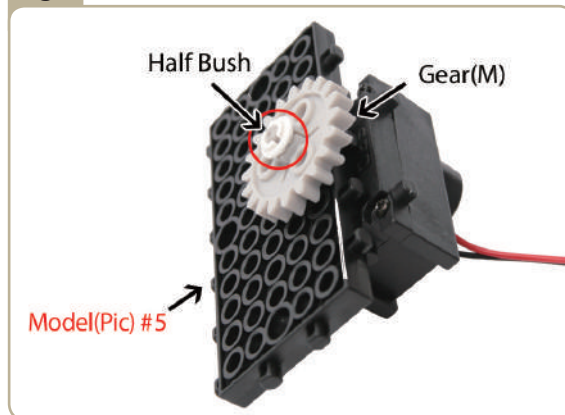


On model(pic)#3, fix servo motor to servo bracket with short bolt and nuts.

5

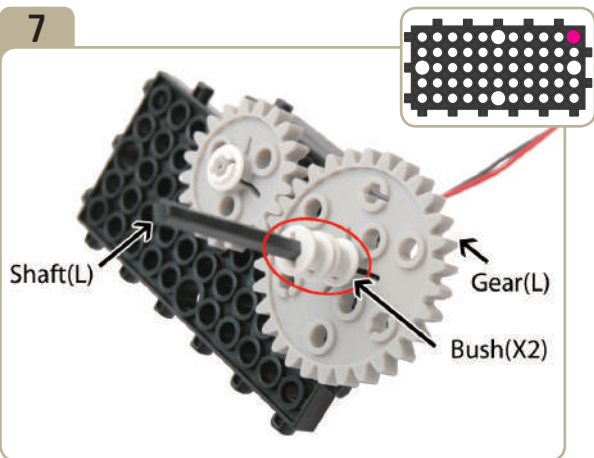


6



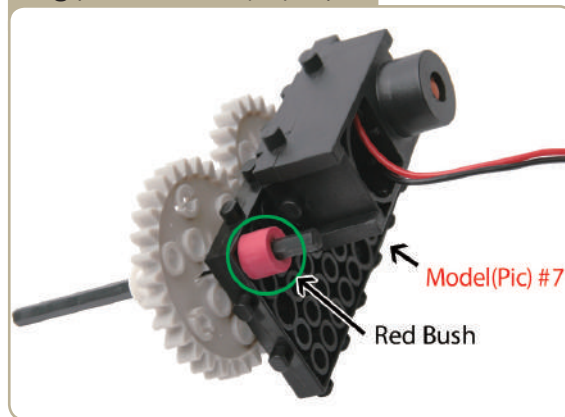
Insert a medium gear and a half bush to the shaft of DC motor.

7



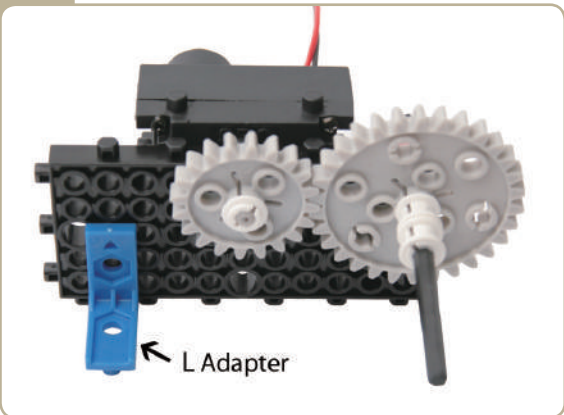
Connect parts in the following order; A long shaft → A large gear → Two bushes to model(pic)#6. (The back side fastens with a red bush.)

8 (Back of model(Pic)#7)



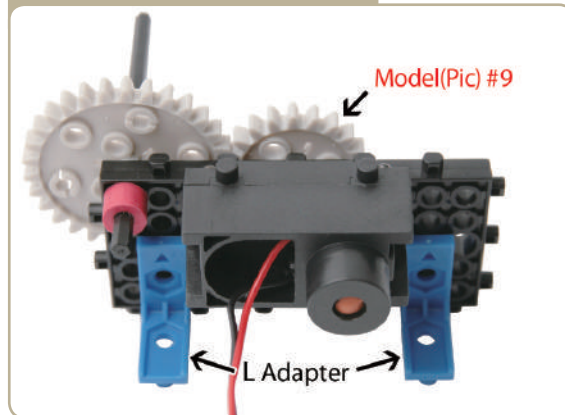
Insert a red bush to long shaft on the back of model(pic)#7.

9



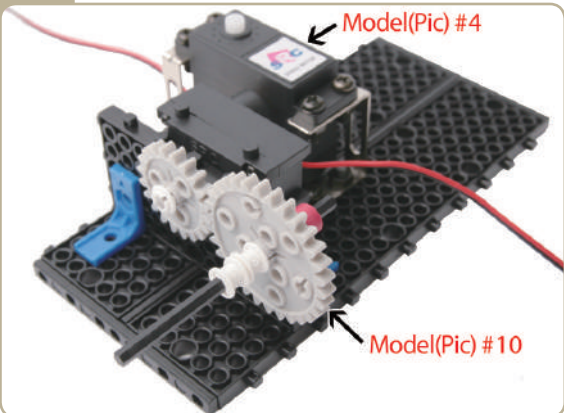
Attach a 'L' adapter to model(pic)#8. (Pay close attention to the arrows(▲) that indicate how the adapter should be attached.)

10 (Back of model(Pic)#9)



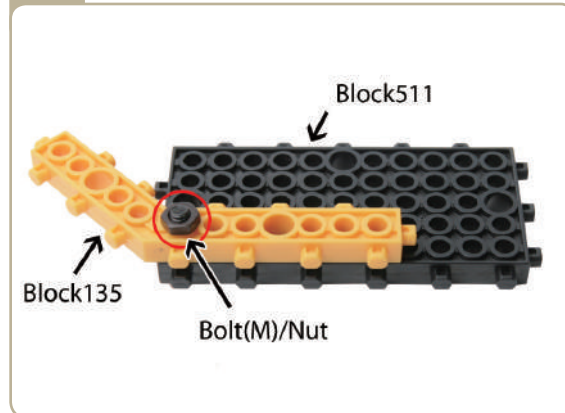
Attach two 'L' adapters to the back of model(pic)#9. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

11



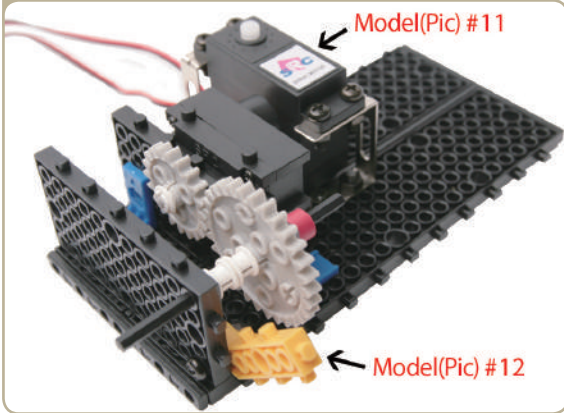
Combine model(pic)#4 with model(pic)#10.

12



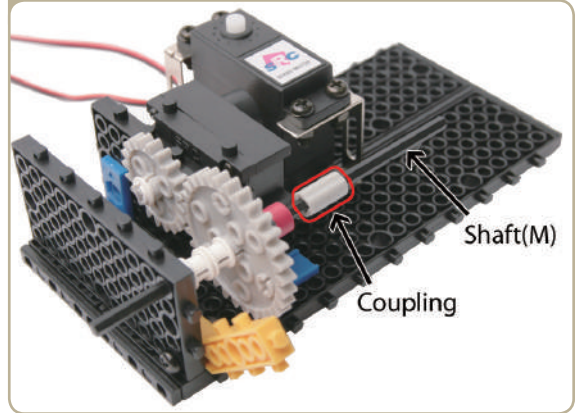
Fix a 'block135' to 'block511' with a medium bolt and nut.

13



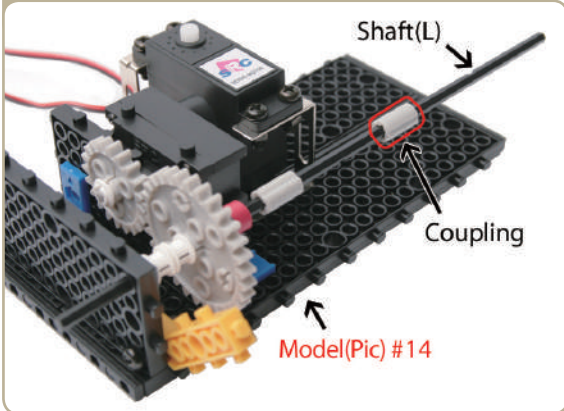
Combine model(pic)#12 to the long shaft of model(pic)#11.

14



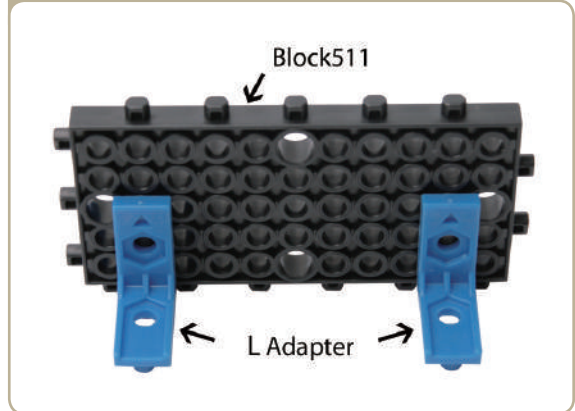
Insert a coupling to the long shaft of model(pic)#13, then connect a medium shaft.

15



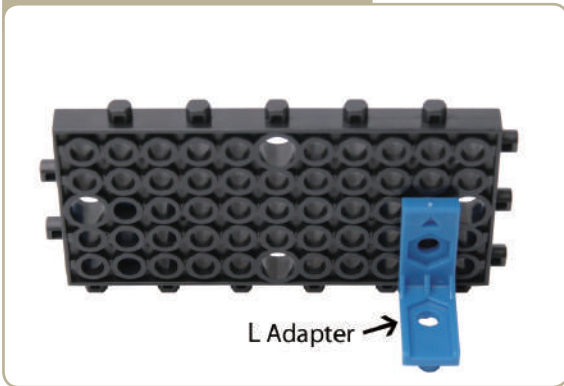
Insert a coupling to the medium shaft of model(pic)#14, then connect a long shaft.

16



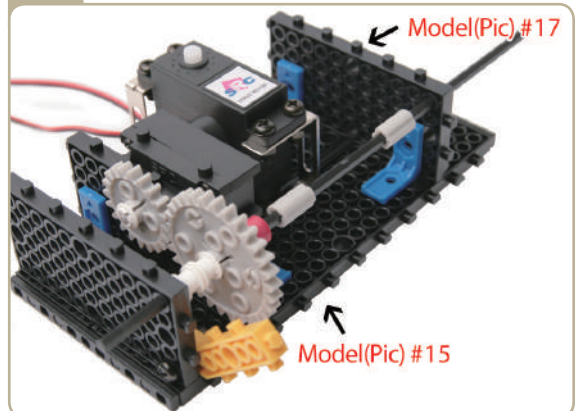
Attach two 'L' adapters to 'Block511'. (Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)

17 (Back of model(Pic)#16)



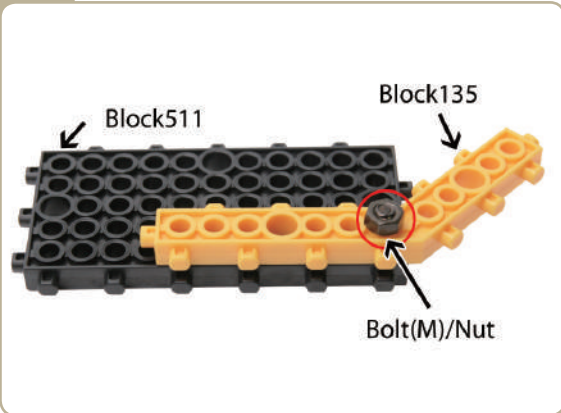
Attach a 'L' adapters to the back of model(pic)#16. (Pay close attention to the arrows (▲) that indicate how the adapter should be attached.)

18



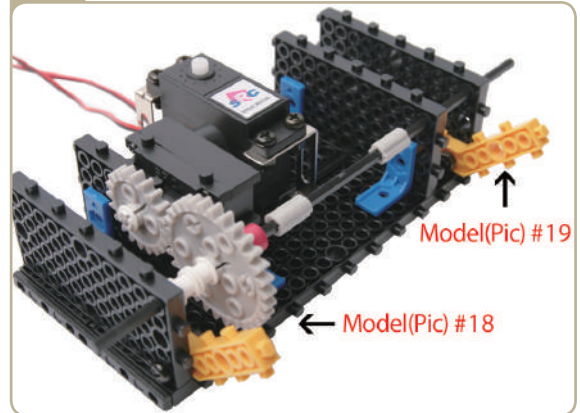
Combine model(pic)#15 with model(pic)#17.

19



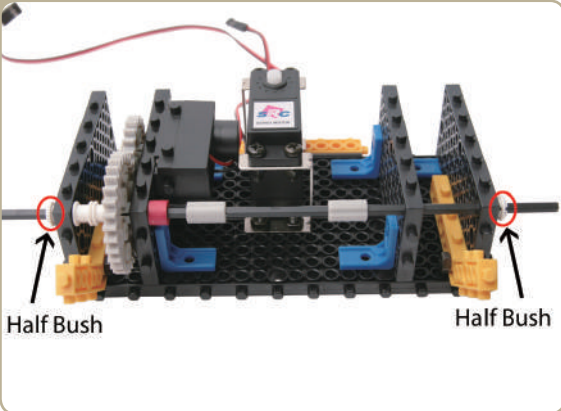
Fix a 「block135」 to 「block511」 with a medium bolt and nut.

20



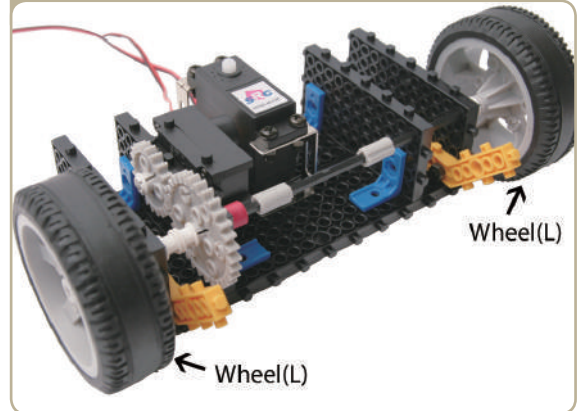
Combine model(pic)#18 with model(pic)#19.

21



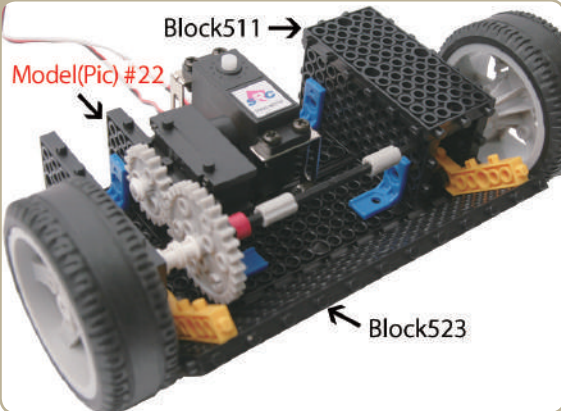
Insert two half bushes to the shaft on both side of model(pic)#20.

22



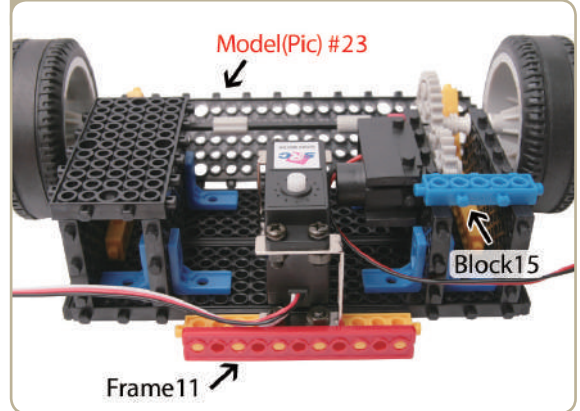
Connect two large wheels to the long shaft of model(pic)#21.

23



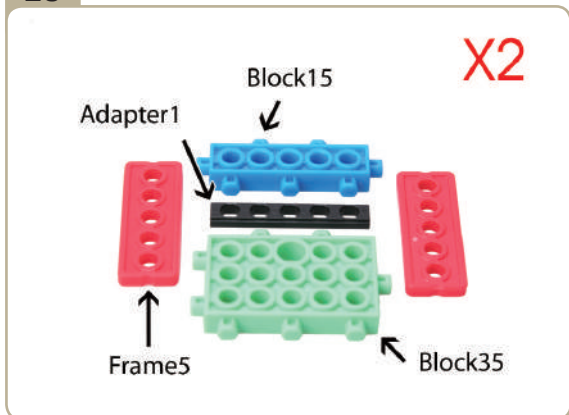
Attach a 「block523」 and a 「block511」 to model(pic)#22.

24 (Back of model(Pic)#23)



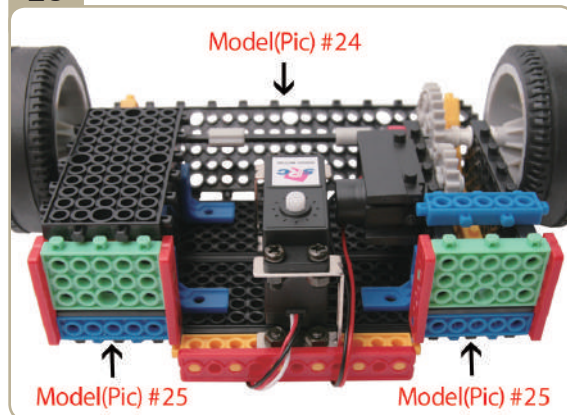
Attach a 「frame11」 and a 「block15」 to model(pic)#23.

25



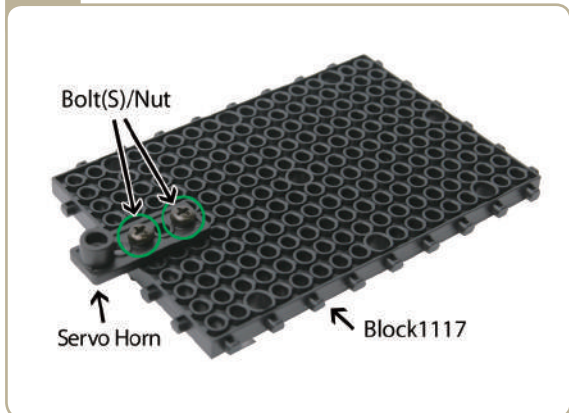
Connect a 「block35」 and a 「block15」 with a 「adapter1」, then attach two 「frame5」s.(Assemble two identical models.)

26



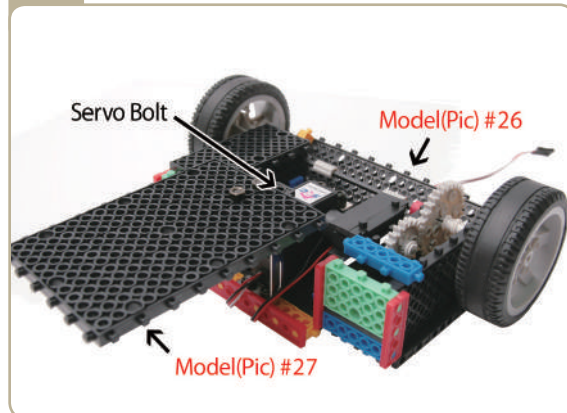
Combine model(pic)#24 with two previously constructed parts of model(pic)#25.

27



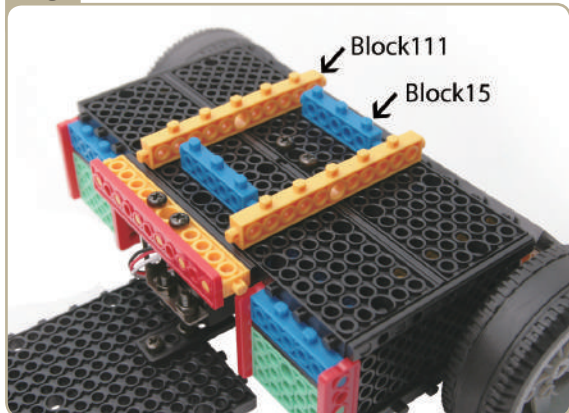
Fix a servo horn to 「block1117」 with short bolts and nuts.

28



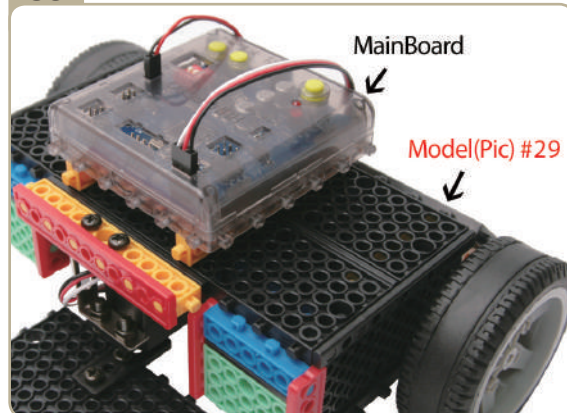
After adjusting zero point of servo motor, then fix model(pic)#27 to model(pic)#26 with a small servo bolt.

29



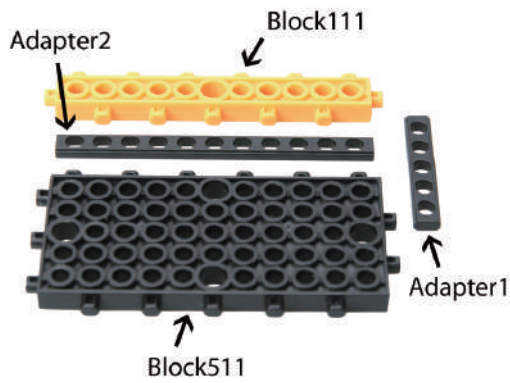
Turn model(pic)#28 upside down, then attach two 「block111」s and two 「block15」s.

30

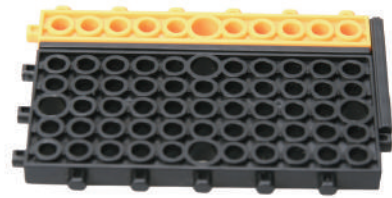


Connect mainboard to model(pic)#29.

31



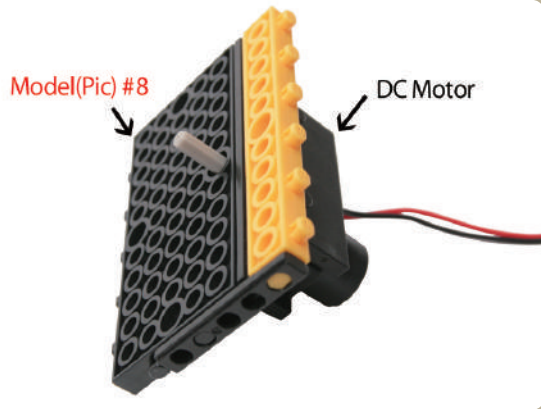
32



X2

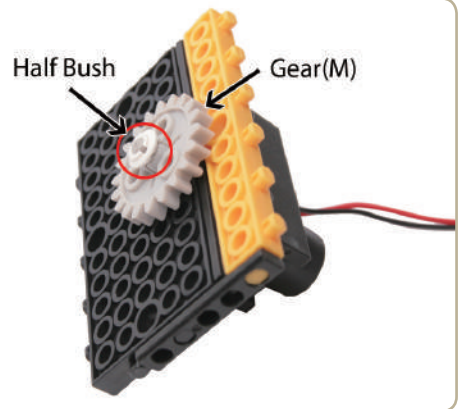
Assemble two identical models.

33



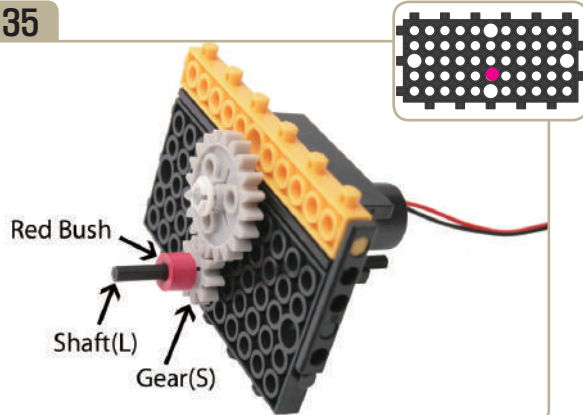
Connect a DC motor to model(pic)#32.

34



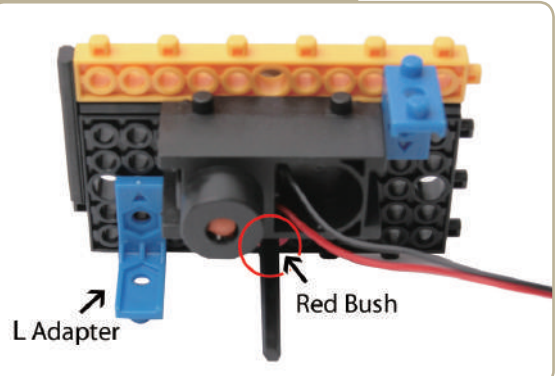
Insert a medium gear and a half bush to the shaft of DC motor.

35



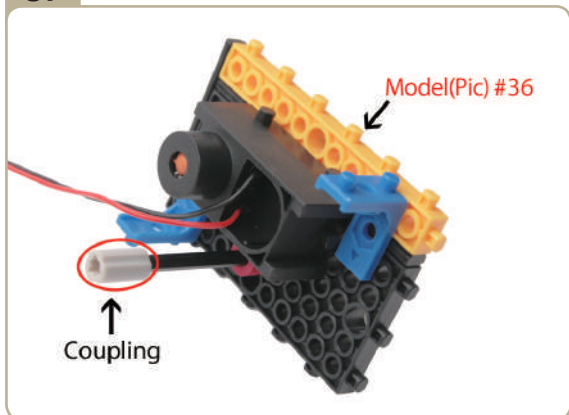
Align the small gear and medium gear as illustrated. Use a long shaft to connect model(pic)#34. (The back side fastens with a red bush.)

36 (Back of model(Pic)#35)



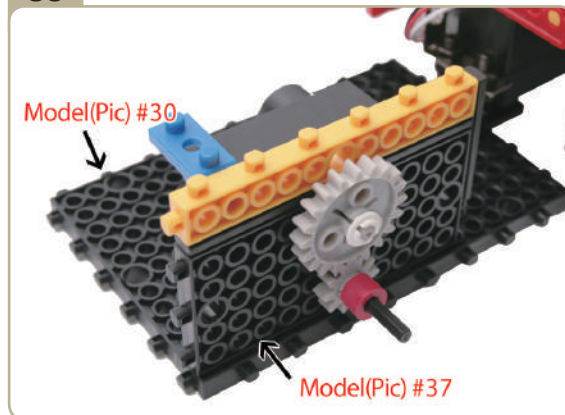
Attach two 'L' adapters to the back of model(pic)#35. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

37



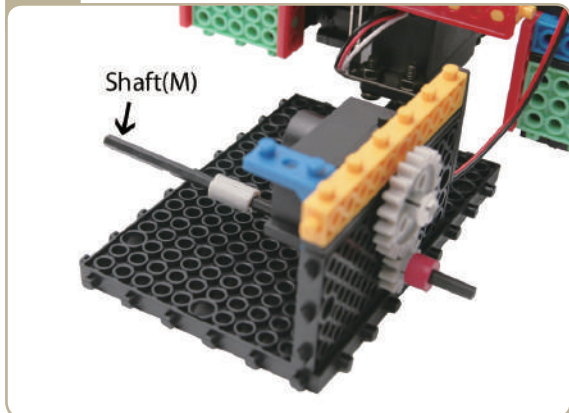
Insert a coupling to the long shaft of model(pic)#36.

38



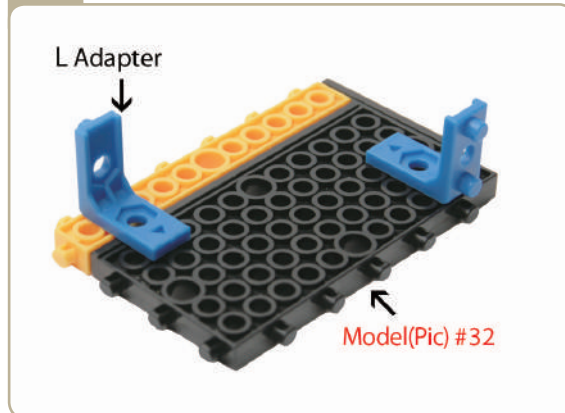
Combine model(pic)#30 with model(pic)#37.

39



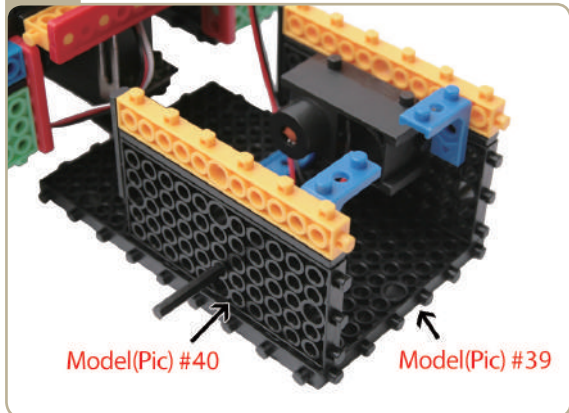
Connect a medium shaft to the coupling of model(pic)#38.

40



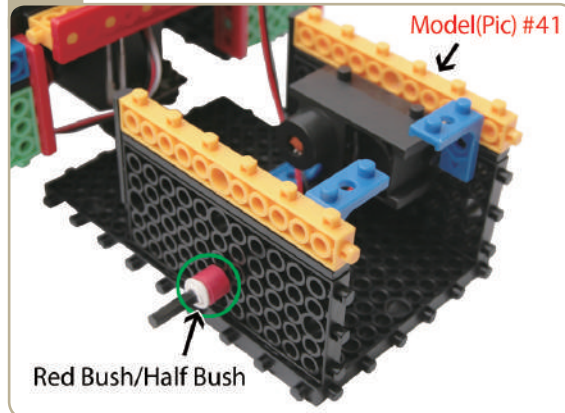
Attach two 'L' adapters to model(pic)#32.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

41



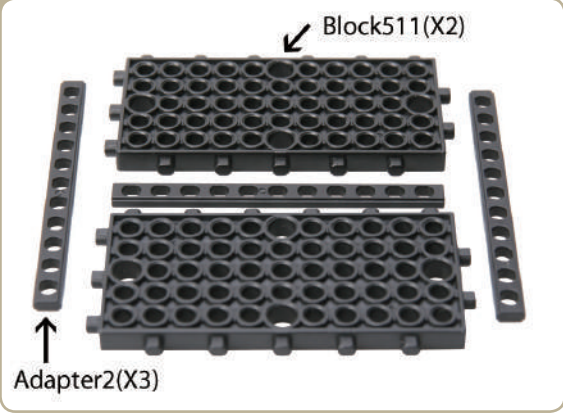
Combine model(pic)#39 with model(pic)#40.

42



Insert a red bush and a half bush to the shaft of model(pic)#41.

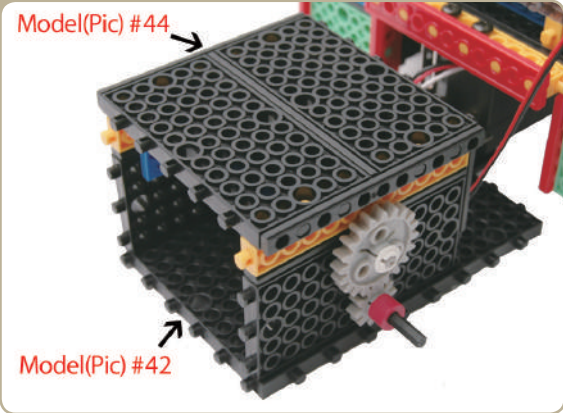
43



44

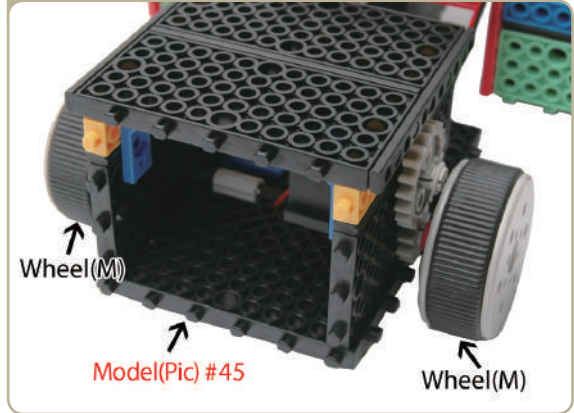


45



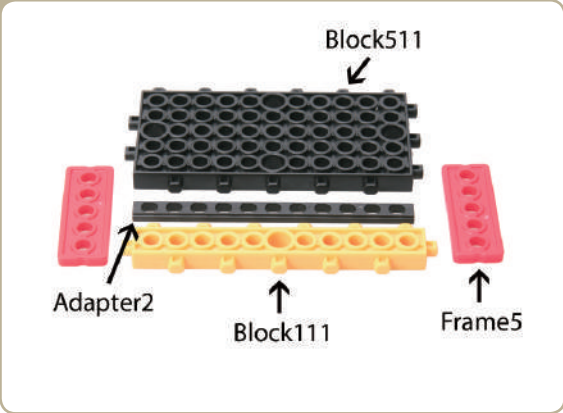
Combine model(pic)#42 with model(pic)#44.

46



Connect two medium wheels to the both side shaft of model(pic)#45.

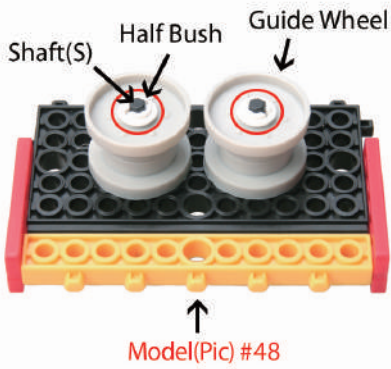
47



48

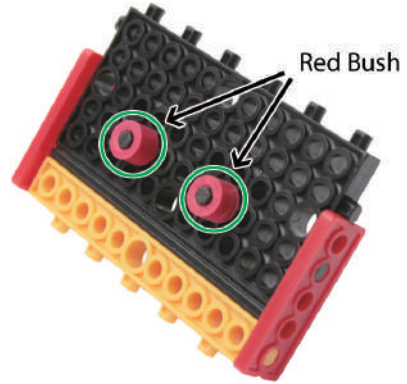


49

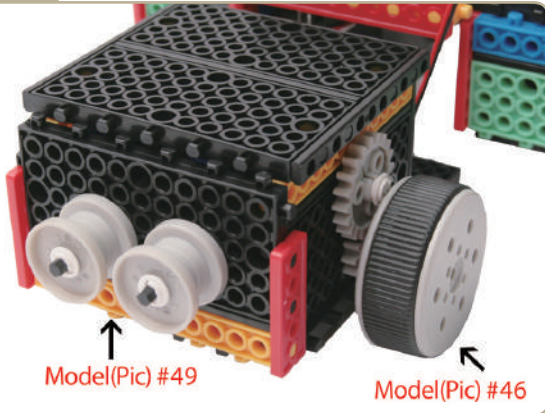


Connect short shafts and guide wheels to model(pic)#48 with half bushes. (The back side fastens with red bushes.)

50 (Back of model(Pic)#49)

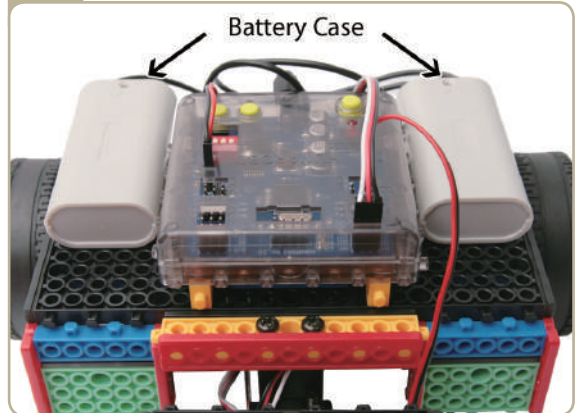


51



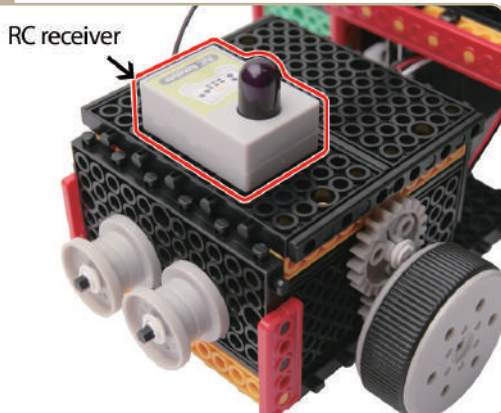
Combine model(pic)#46 with model(pic)#49.

52



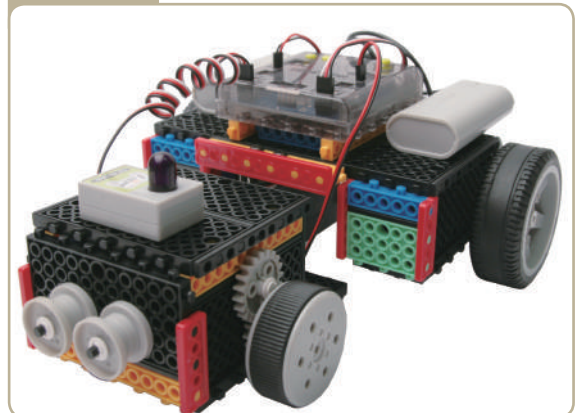
Connect battery cases to model(pic)#51.

53



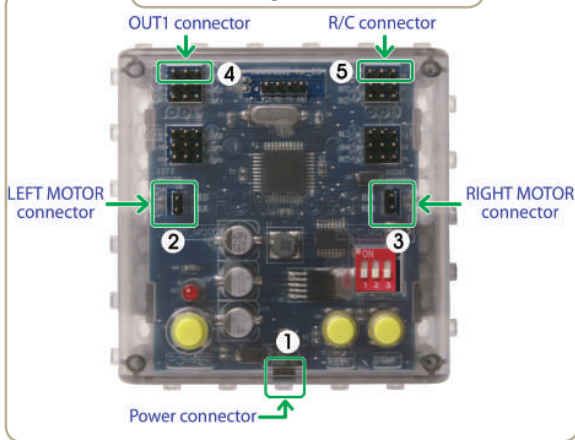
Connect RC receiver to model(pic)#51.

Completed



How to operate the little car 'Bumboo'

Connecting the mainboard



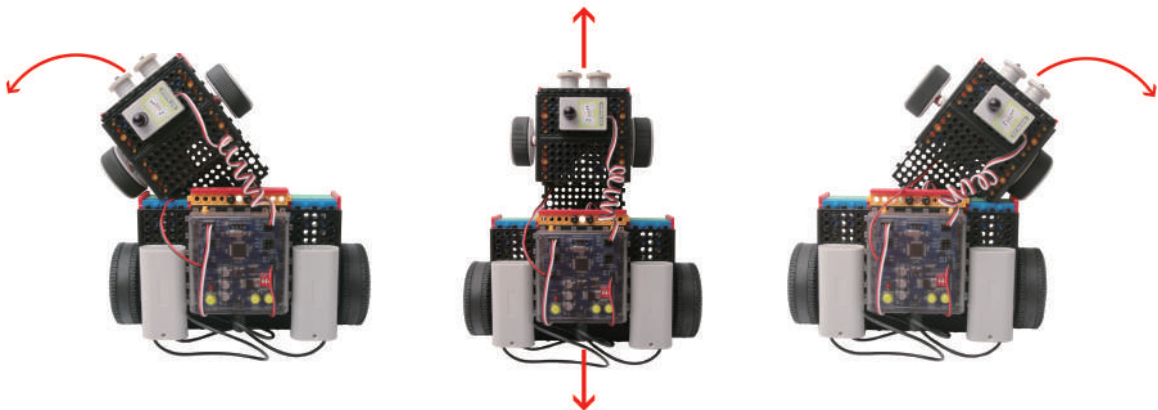
Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program



- Using the motion patterns as reference, let's write the program.






















Program Download

1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on. (Power OFF \rightarrow Power ON)

Q Is your robot functioning correctly? Is your robot turning the wrong direction? What is the exact problem? Let's discuss it. Brainstorm with your friends and teacher. Correct robot.

Hint. The center of gravity(Let's change position of battery!)


Program Example

	Action	No
	Program Start	0
	Remocon : [Up] {	1
	Servo : [OUT1]=[0]	2
	DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	3
	END }	4
	Remocon : [Down] {	5
	Servo : [OUT1]=[0]	6
	DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	7
	END }	8
	Remocon : [Up + Right] {	9
	Servo : [OUT1]=[-20]	10
	DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	11
	END }	12
	Remocon : [Up + Left] {	13
	Servo : [OUT1]=[20]	14
	DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	15
	END }	16
	Remocon : [Down + Left] {	17
	Servo : [OUT1]=[20]	18
	DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	19
	END }	20
	Remocon : [Down + Right] {	21
	Servo : [OUT1]=[-20]	22
	DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	23
	END }	24
	Remocon : [KEY OFF] {	25
	DC motor 1 : [Both MOTOR1]=[Stop]	26
	END }	27
	Program End	28



How energy goes back and forth! - Roller coaster

Peter, look at this picture.



Wow! it's a roller coaster! That looks really exciting! Let's go to the amusement park!

No, let's go to the amusement park a little bit later~ Do you know why I showed you the picture of the roller coaster?

Do you want to ride the roller coaster?

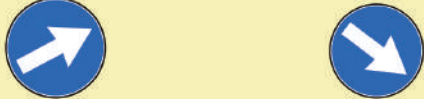
I'll tell you about it later~ I showed you the picture of the roller coaster so that you can see a roller coaster uses both kinetic and potential energy.

That may be why a roller coaster is so strong~

Ha ha ha! But it can only produce one kind of energy at a time, because it changes one kind of energy to another kind of energy.

What? It is not strong? How do roller coasters change energy?

When roller coaster is rising up, does it go up slowly? Because it's speed decreases as it goes up the kinetic energy gradually changes into potential energy.



Kinetic energy → Potential energy Kinetic energy → Potential energy

Wow, a lot of things happen in a roller coaster!

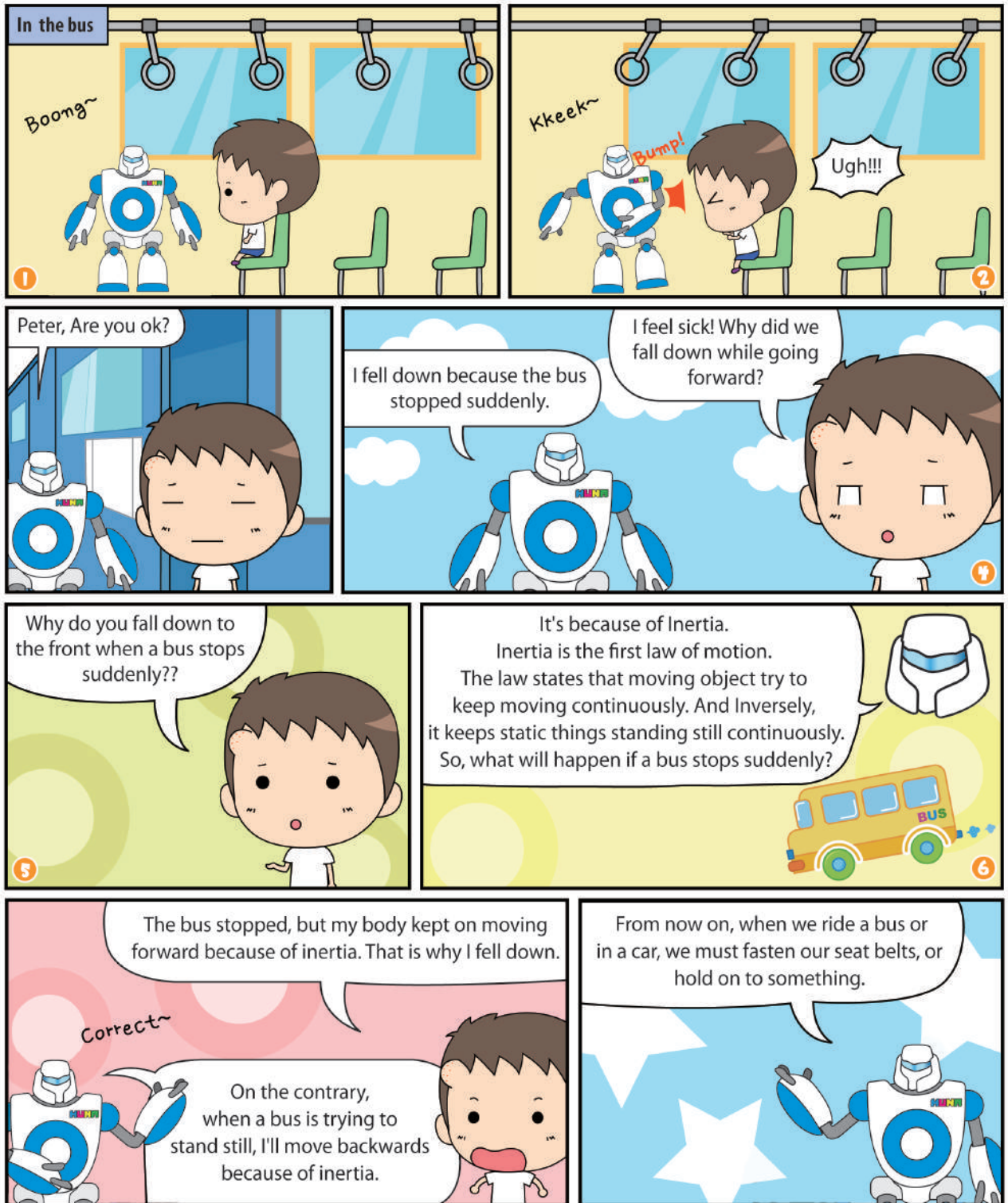
Now, let's go to the amusement park.

The opposite is also true when the roller coaster is coming down, it's speed increases, and it's height decreases. That is why potential energy changes into kinetic energy.

OK! Let's go ahead and feel how energy changes to other kinds of energy.

Robot story 1

The first law of motion - Inertia

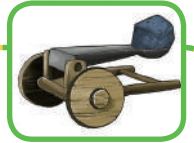




Making a catapult that uses the law of inertia



Catapult



Catapults are ancient military weapons that were primarily used to launch big stones into air to destroy enemy targets, such as castles and bridges.

It utilizes the first law of motion, Inertia, and the third law of motion, Action and Reaction to launch objects. This robot employs the elasticity of a rubber string and the action of the servo motor to launch and throw objects.

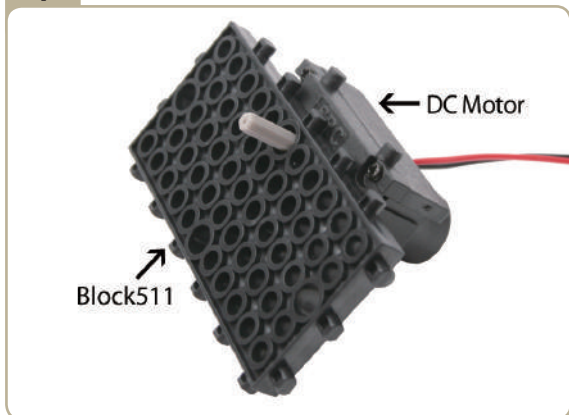


* Prepare rubber bands separately.

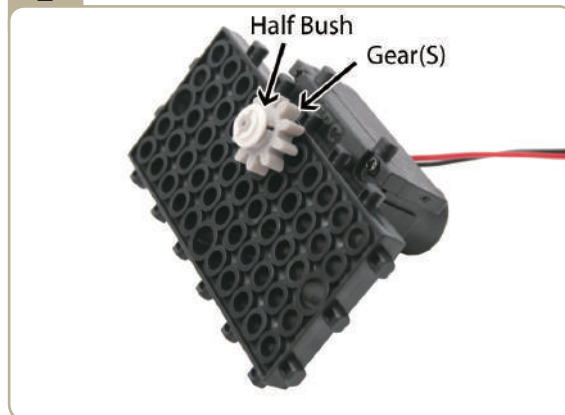
Prepare parts for assembly

	Block1117	×1		Frame21	×3		
				Frame5	×5		
				Adapter1	×1		
	Block523	×4		L Adapter	×10		
				Connection Shaft	×1		
	Block511	×8		Shaft(S)	×2		
				Shaft(M)	×3		
	Block135	×2		Half Bush	×5		
				Bush	×2		
	Block111	×8		Red Bush	×6		
	Block15	×16		Bolt(S) / Nut	×6		
	Block35	×1		Gear(S)	×2		
	Wheel(M)	×2		Gear(L)	×2		
	Wheel(L)	×2		DC Motor	×2		
				Servo Motor	×1		

1

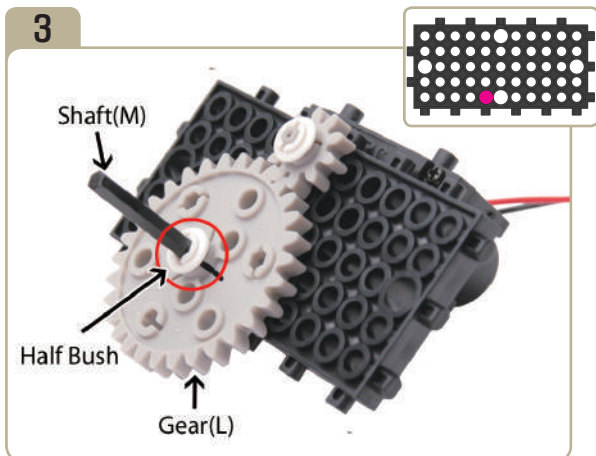


2



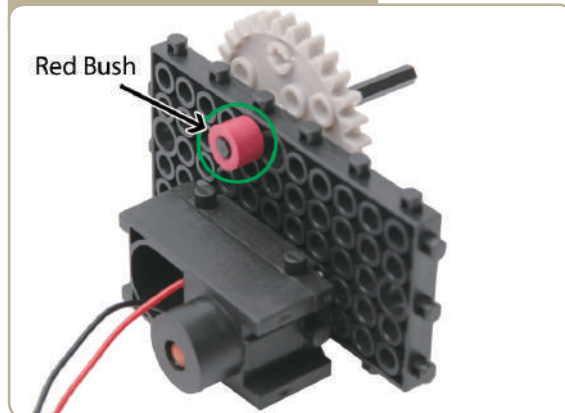
Insert a small gear and a half bush to the shaft of DC motor.

3

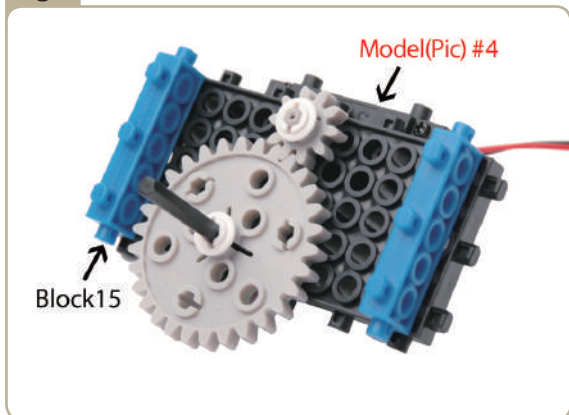


Align the small gear and large gear as illustrated. Use a medium shaft to connect model(pic)#2. (The back side fastens with a red bush.)

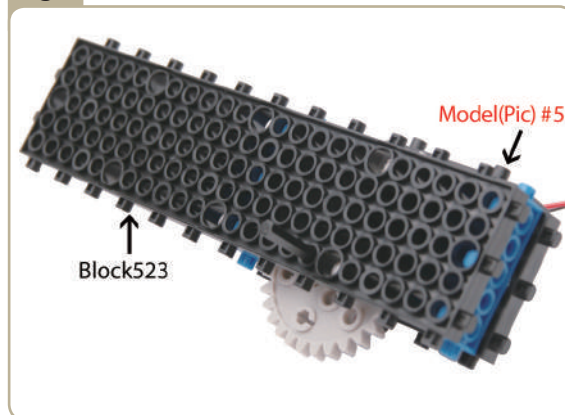
4 (Back of model(Pic)#3)



5

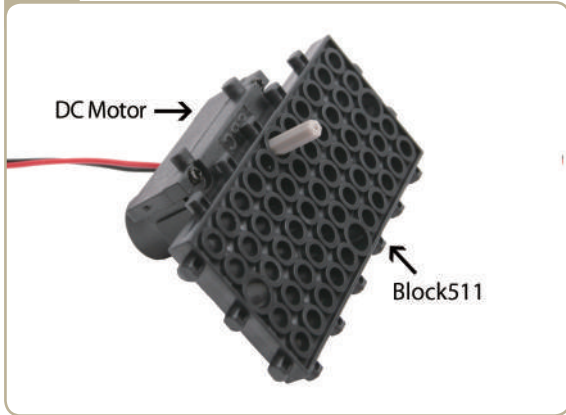


6



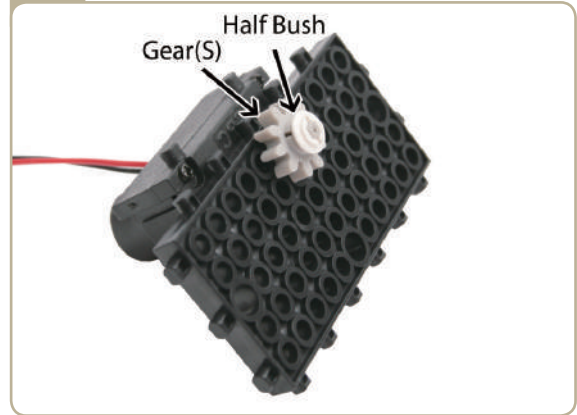
Attach a 「block523」 to model(pic)#5.

7



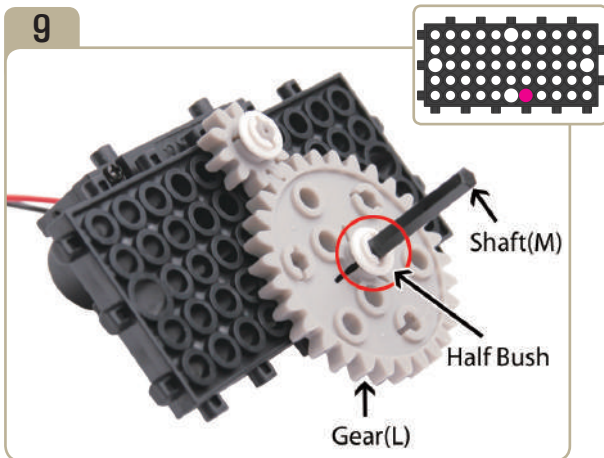
Connect a 「block511」 to DC motor.

8



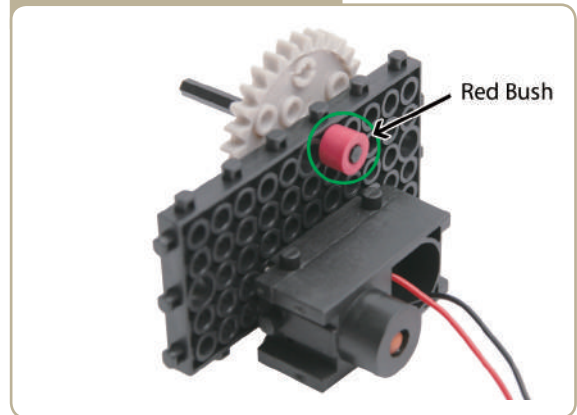
Insert a small gear and a half bush to the shaft of DC motor.

9

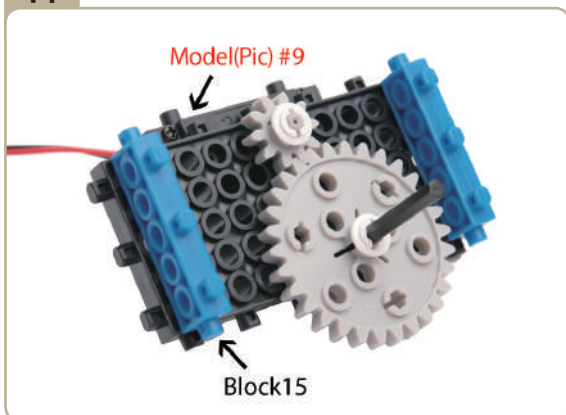


Align the small gear and medium gear as illustrated. Use a medium shaft to connect model(pic)#8. (The back side fasten with a bush.)

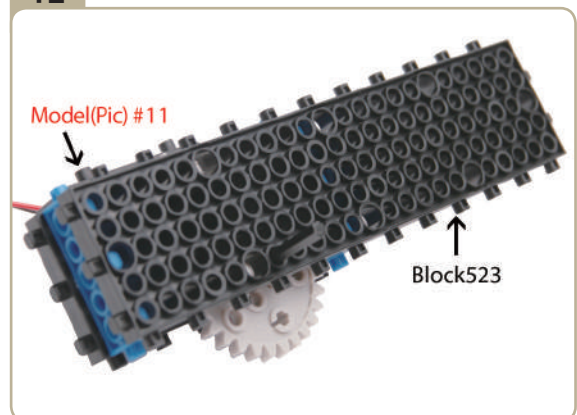
10 (Back of model(pic)#9)



11

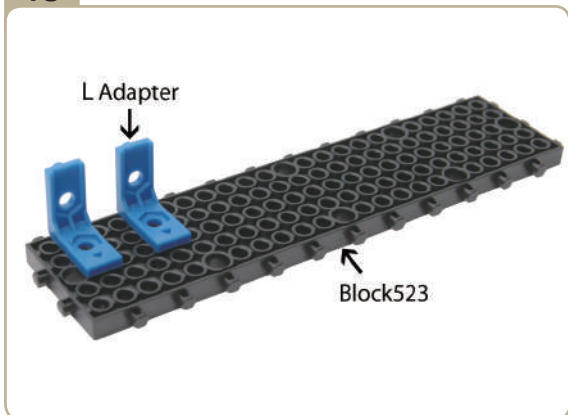


12



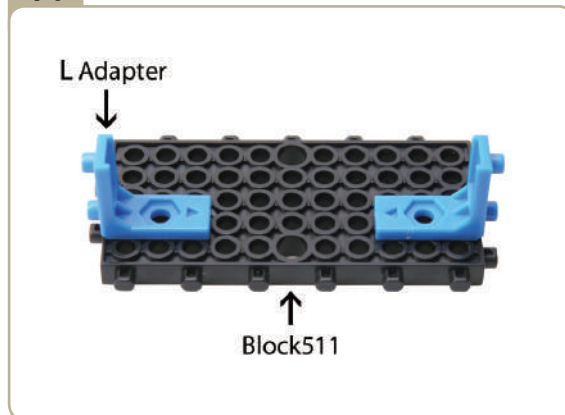
Attach a 「block523」 to model(pic)#11.

13



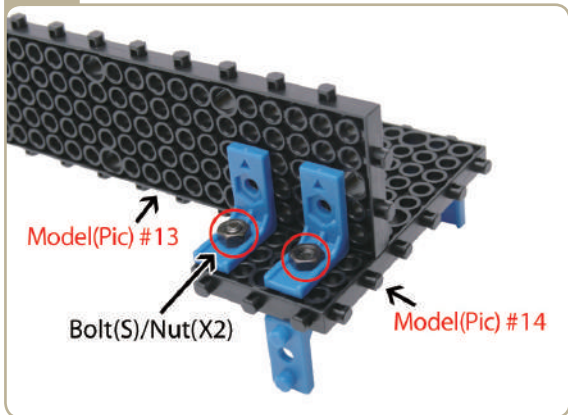
Attach two 'L' adapters to 'Block523'.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

14



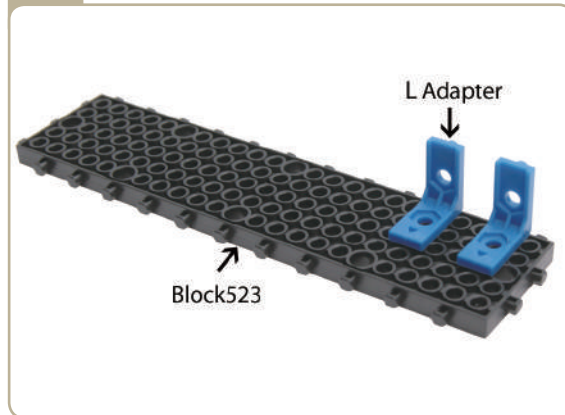
Attach two 'L' adapters to 'Block511'.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

15



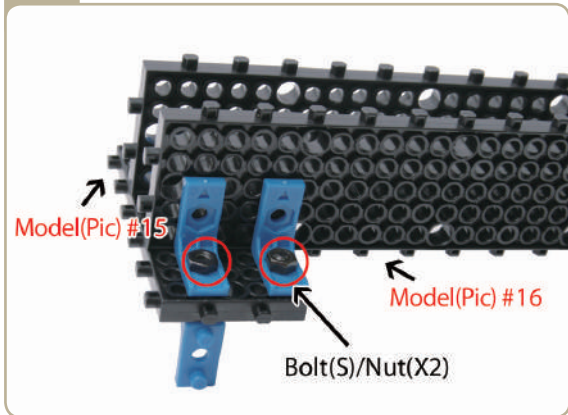
Fix model(pic)#14 to model(pic)#13 with short bolts and nuts.

16



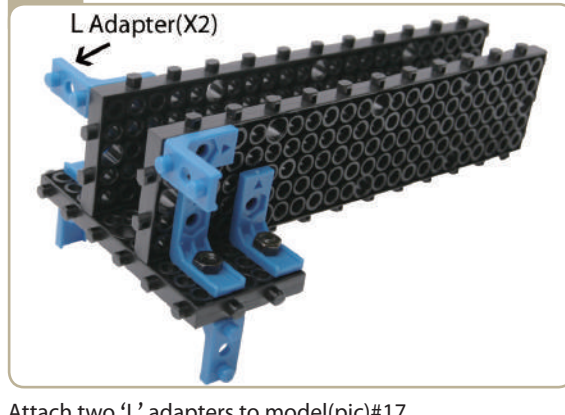
Attach two 'L' adapters to 'Block523'.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

17



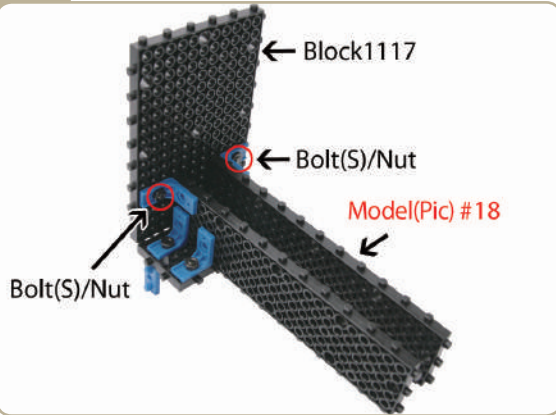
Fix model(pic)#16 to model(pic)#15 with short bolts and nuts.

18



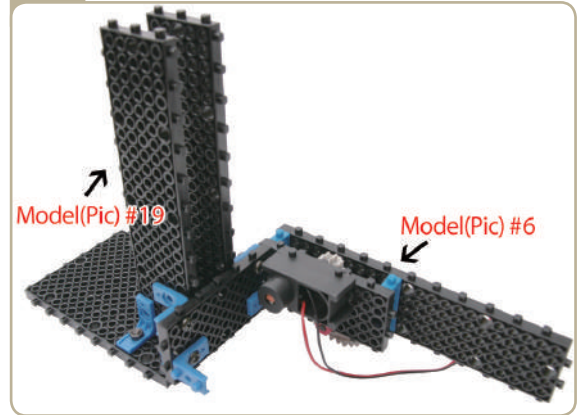
Attach two 'L' adapters to model(pic)#17.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

19



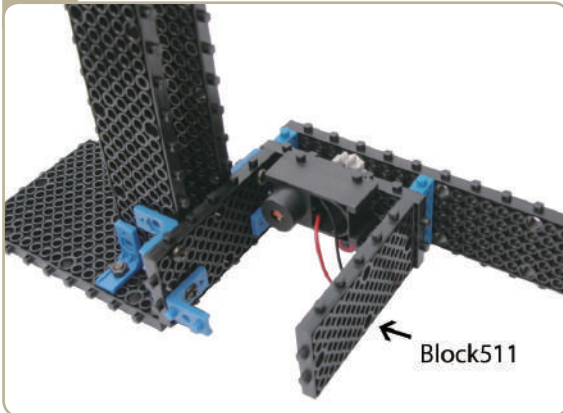
Fix a 「block1117」 to model(pic)#18 with short bolts and nuts. (Pay close attention to the direction of block.)

20



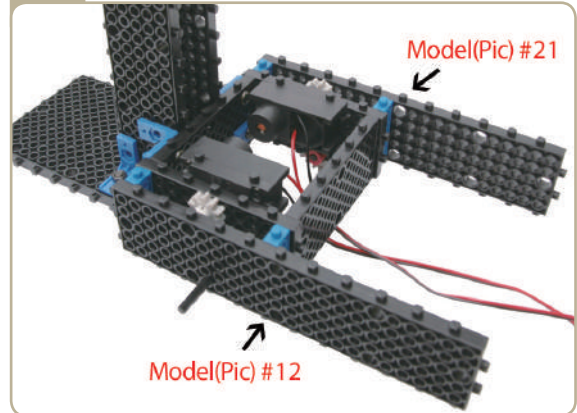
Combine model(pic)#6 to model(pic)#19.

21



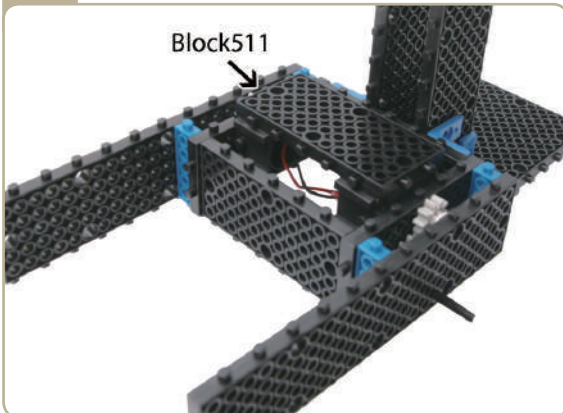
Attach a 「block511」 to model(pic)#20.

22



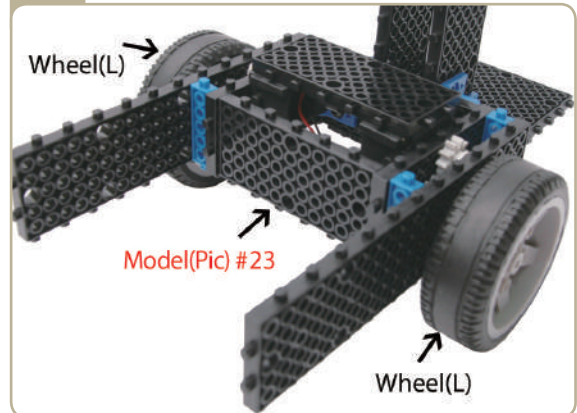
Combine model(pic)#12 to model(pic)#21.

23



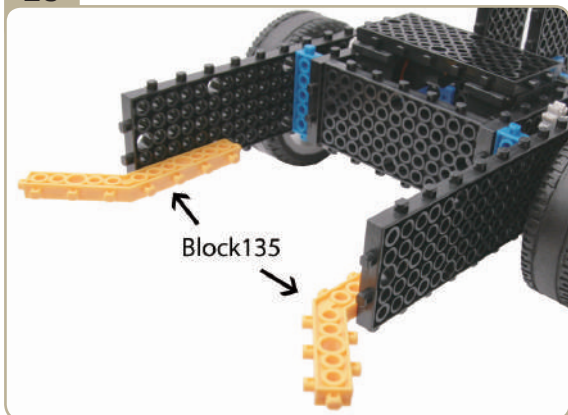
Attach a 「block511」 to model(pic)#22.

24

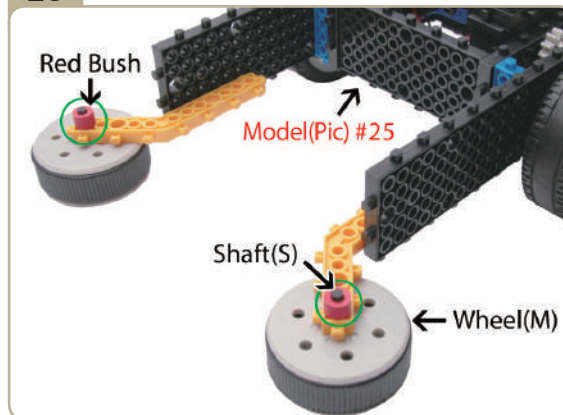


Connect two large wheels to the medium shaft of model(pic)#23.

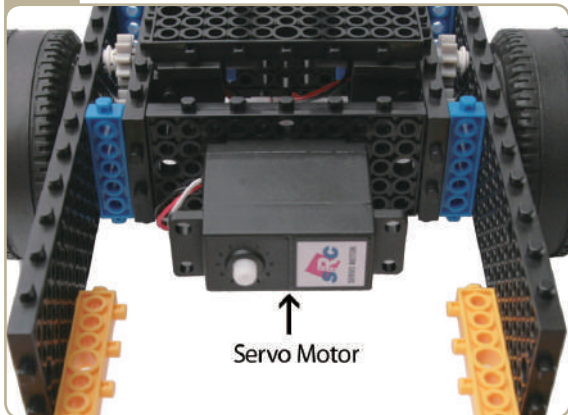
25



26

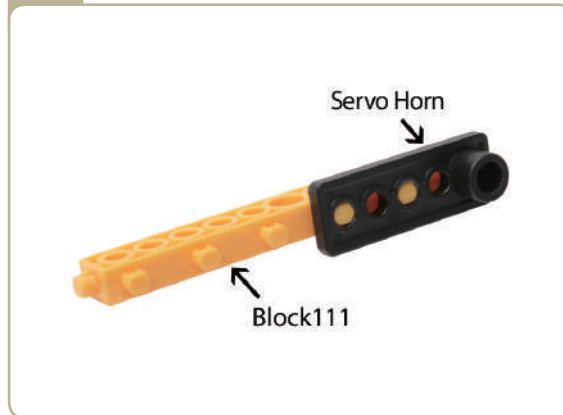


27



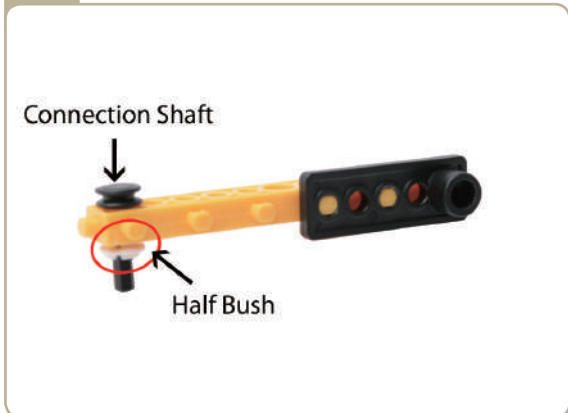
Connect servo motor to model(pic)#26.

28



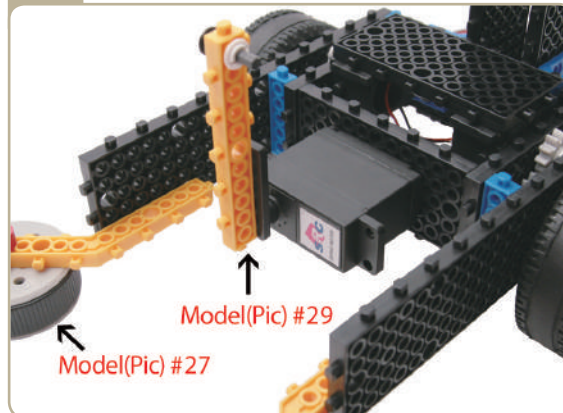
Attach servo horn to 「block111」.

29



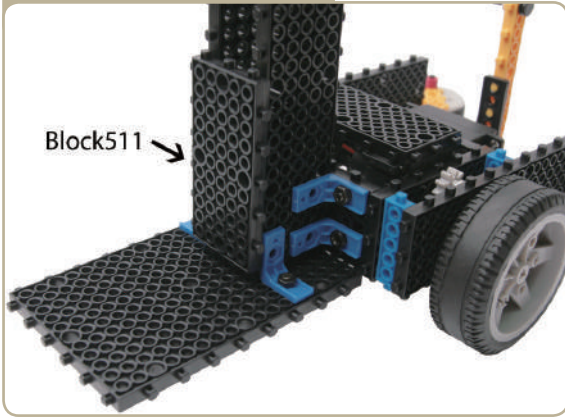
Connect a connection shaft and a half bush to model(pic)#28.

30



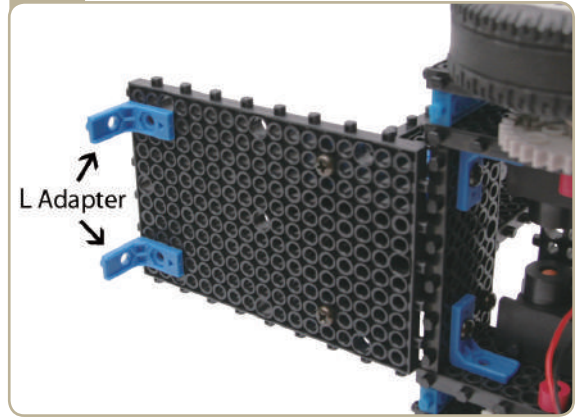
After adjusting zero point of servo motor, connect model(pic)#29 to servo motor.

31 (Back of model(Pic)#30)



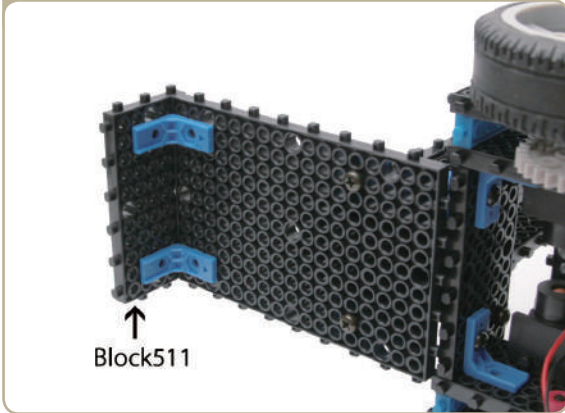
Attach a 「block511」 to the back of model(pic)#30.

32



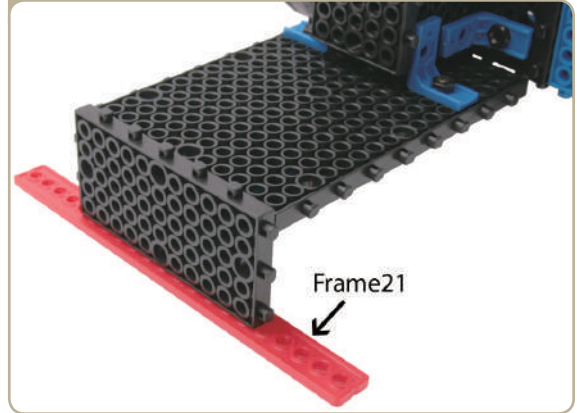
Attach two 'L' adapters to the bottom of model(pic)#31. (Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

33



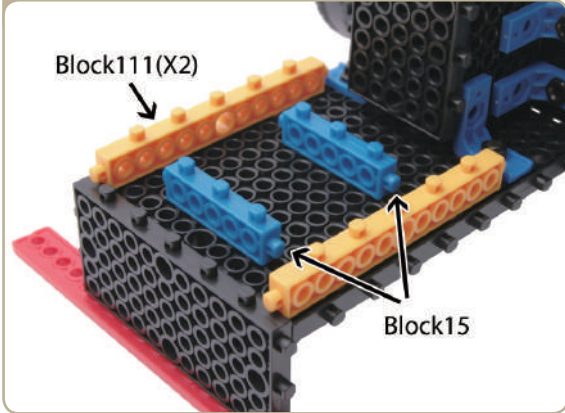
Attach a 「block511」 to model(pic)#32.

34



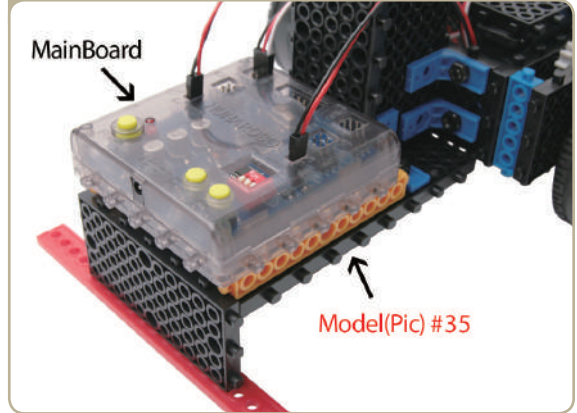
Attach a 「Frame21」 to model(pic)#34.

35



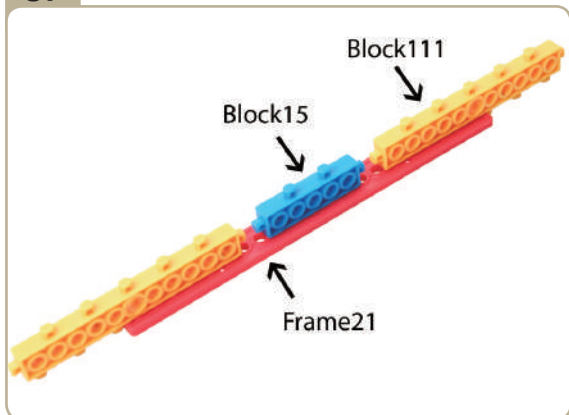
Attach a 「Block111(X2)」 and 「Block15」 to model(pic)#35.

36

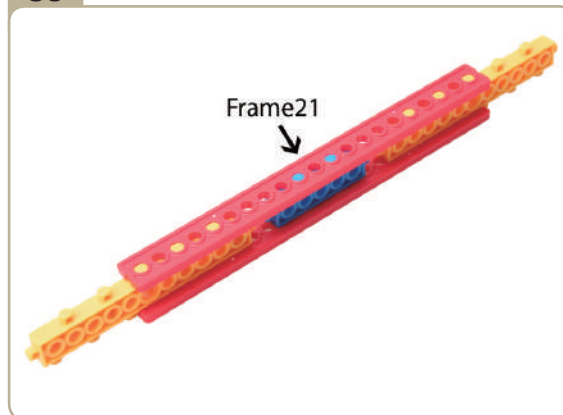


Connect mainboard to model(pic)#35.

37



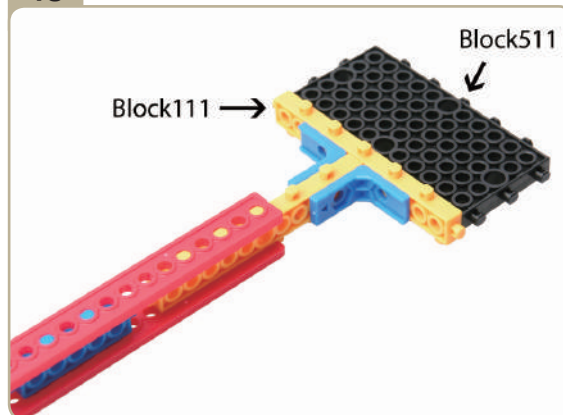
38



39

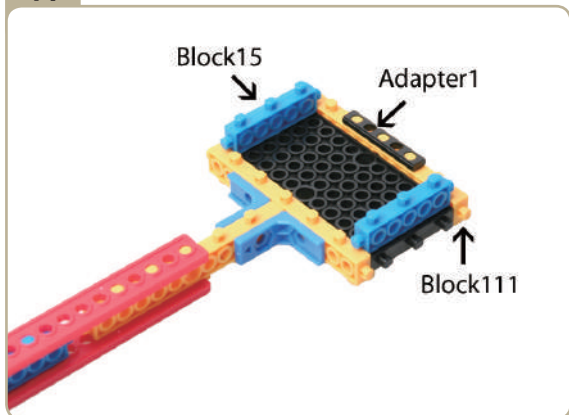


40

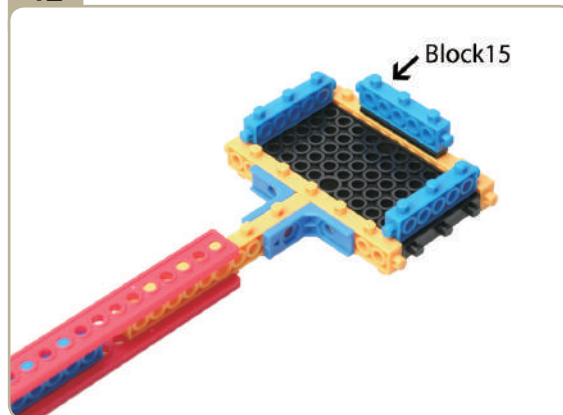


Attach two 'L' adapters to model(pic)#38.
(Pay close attention to the arrows(▲) that indicate how the adapters should be attached.)

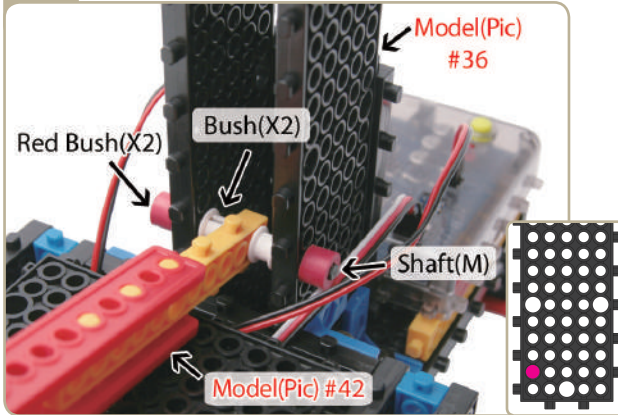
41



42

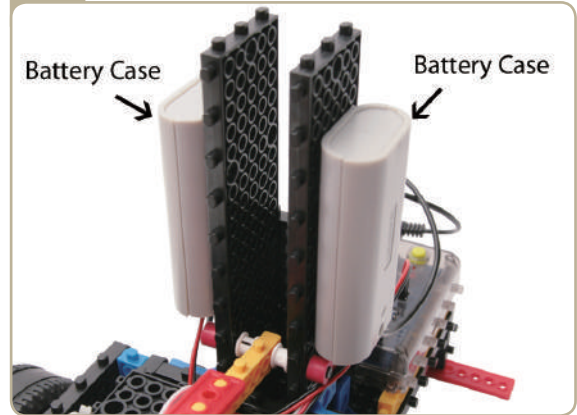


43



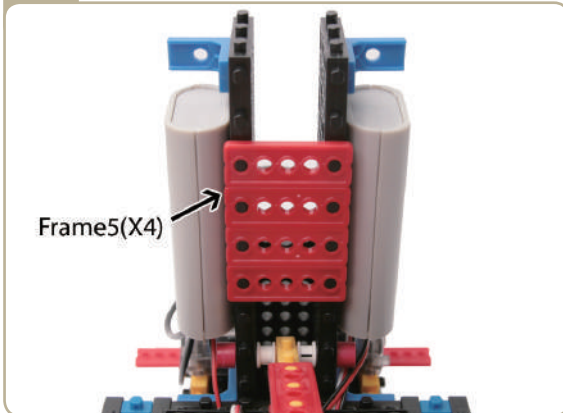
Connect model(pic)#42 with a medium shaft and two bushes and two red bushes to model(pic)#36.

44

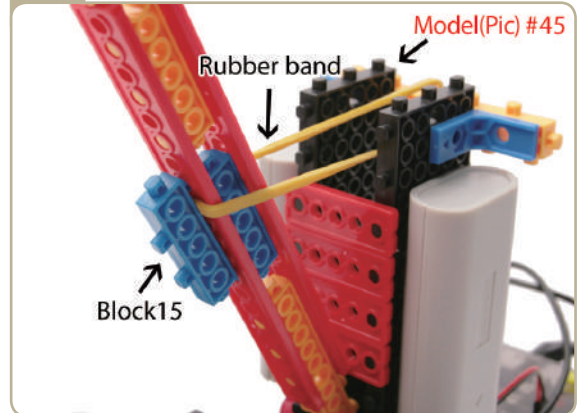


Connect battery cases to model(pic)#43.

45

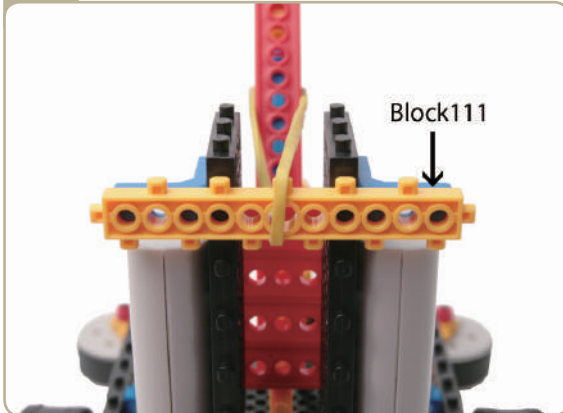


46

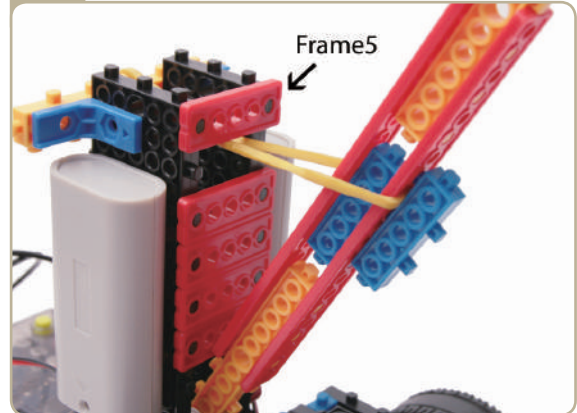


Install an rubber band with a 「block15」 and a 「block11」 to model(pic)#45.

47

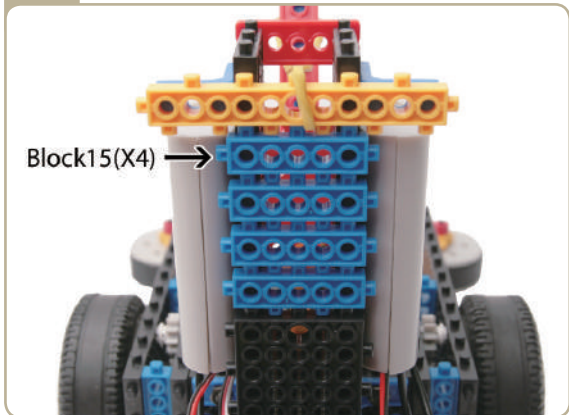


48

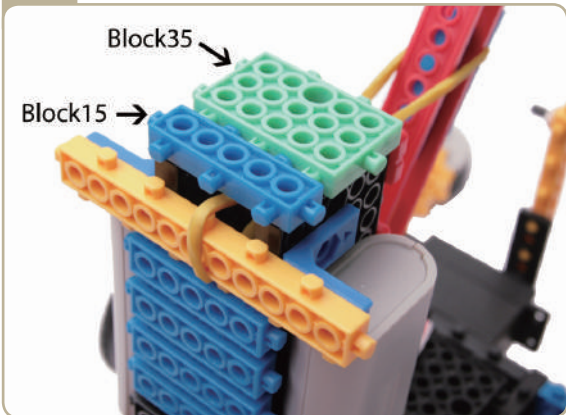


Attach a 「frame5」 to model(pic)#47.

49

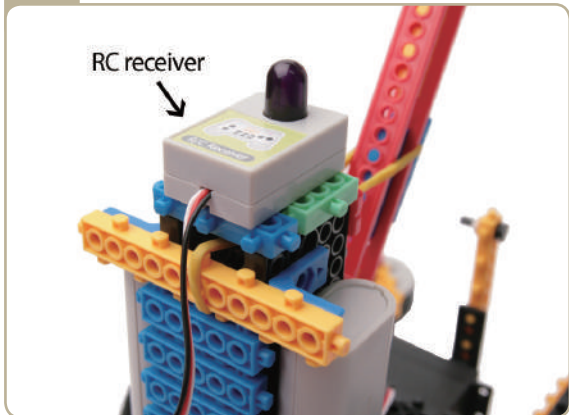


50



Attach a 「block15」 and a 「block35」 to model(pic)#49.

51



Connect RC receiver to model(pic)#50.

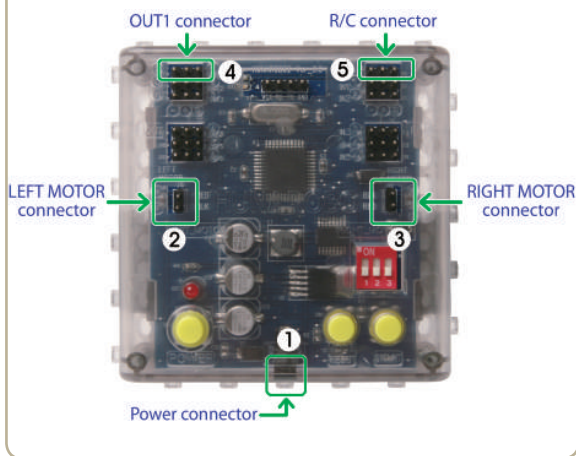
Completed





How to operate the Catapult

Connecting the mainboard



Connect in this order.

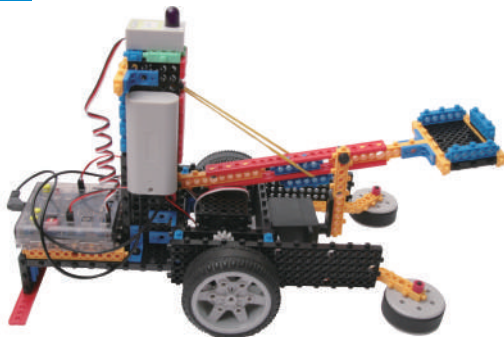
1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program

1



2




























1. Hang the catapult arm installation to the safety link that is connected to the servo motor.
2. When the remote control's **F1** Key is pressed, the catapult will launch itself.

- Using the motion patterns as reference, let's write the program.

Program Download

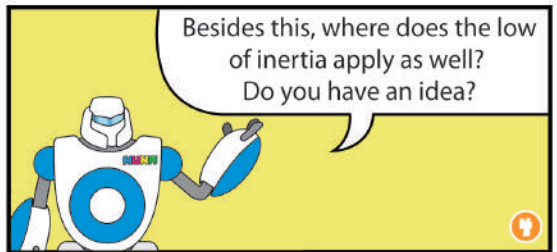
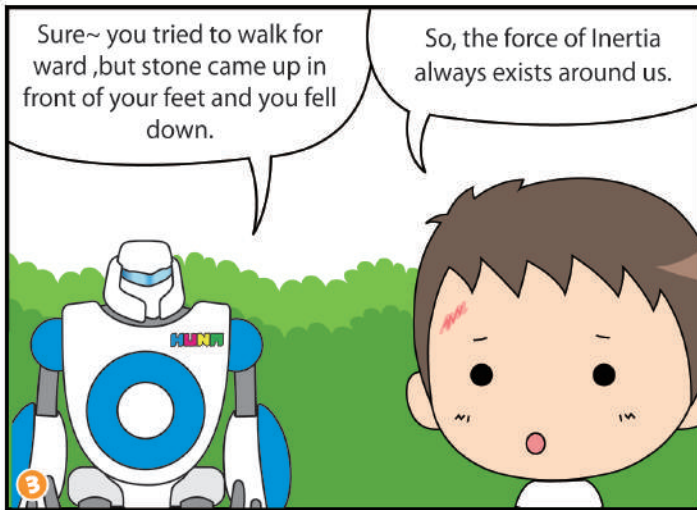
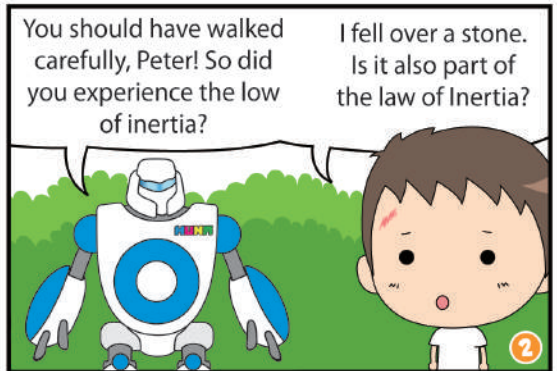
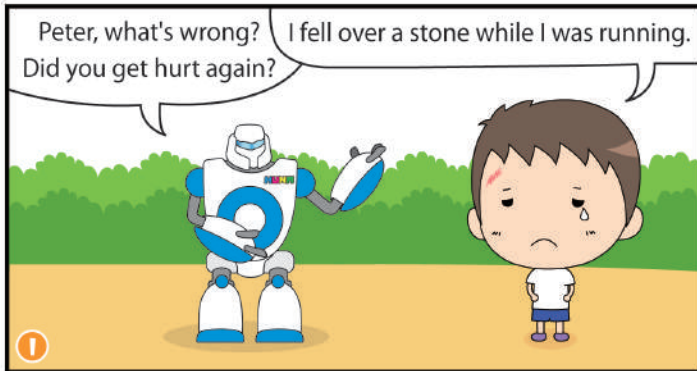
1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on.
(Power OFF \rightarrow Power ON)

Program Example

Action	No
 Program Start	0
 Remocon : [Up] {	1
 DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	2
END }	3
 Remocon : [Down] {	4
 DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	5
END }	6
 Remocon : [Right] {	7
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	8
 DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	9
END }	10
 Remocon : [Left] {	11
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	12
 DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	13
END }	14
 Remocon : [Up + Right] {	15
 DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	16
 DC motor 1 : [R-MOTOR1]=[Stop]	17
END }	18
 Remocon : [Up + Left] {	19
 DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	20
 DC motor 1 : [L-MOTOR1]=[Stop]	21
END }	22
 Remocon : [KEY OFF] {	23
 DC motor 1 : [Both MOTOR1]=[Stop]	24
END }	25
 Remocon : [F1] {	26
 Servo : [OUT1]=[-40]	27
 Delay : [1 sec]	28
 Servo : [OUT1]=[0]	29
END }	30
 Servo : [OUT1]=[0]	31
 Program End	32



The law of Inertia can be seen all around us!

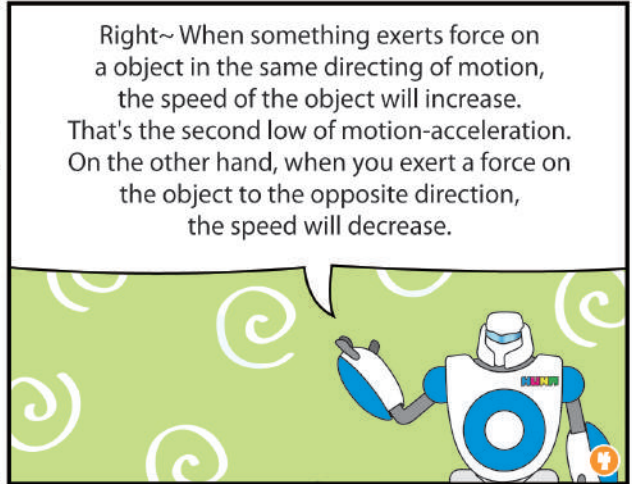
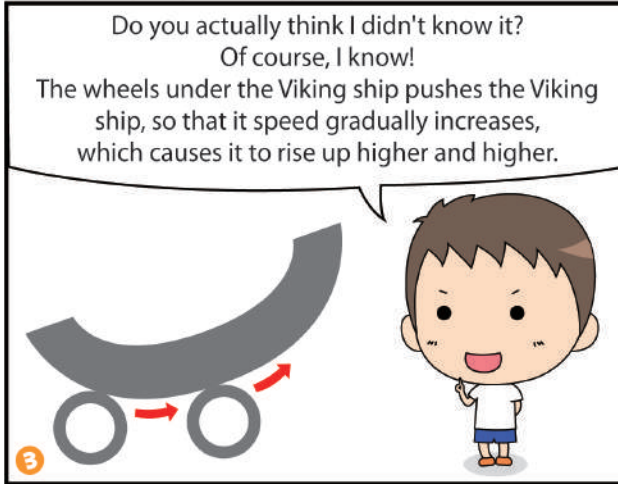
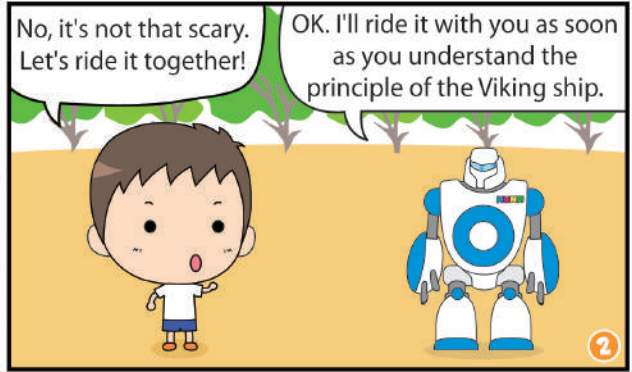


Think and write down all of things around you that is effected by the low of inertia!

Spiral notebook with lined writing area.



The second law of motion -Acceleration



Let's Make it 4 **Making a bug battle bot that moves with six legs**



Bug Battle Bot

This model was designed to resemble to appearance of an insect with 6 moving legs. These 6 legs are moved by a DC motor that uses the principles of rotation and levers. It makes directional changes with the connection between right and left DC motor. These motors are operated separately. It can move back and forth, right and left with a remote control.

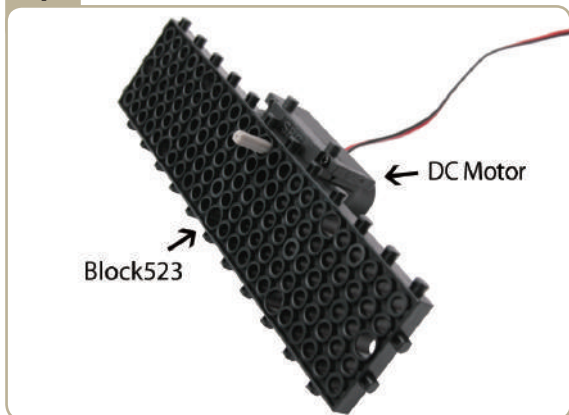
*** After assembly, you can play the pushing game or soccer game with the bug battle bot.**



Prepare parts for assembly

	Block1117	×1		Frame11	×15	
				Adapter2	×3	
				Connection Shaft	×6	
				Shaft(S)	×2	
	Block523	×2		Shaft(M)	×2	
				Shaft(L)	×6	
	Block511	×3		Half Bush	×6	
				Bush	×14	
	Block111	×4		Red Bush	×12	
	Block35	×2		Coupling	×3	
	Guide Wheel	×2		Gear(S)	×2	
				Gear(M)	×2	
				Gear(L)	×2	

1

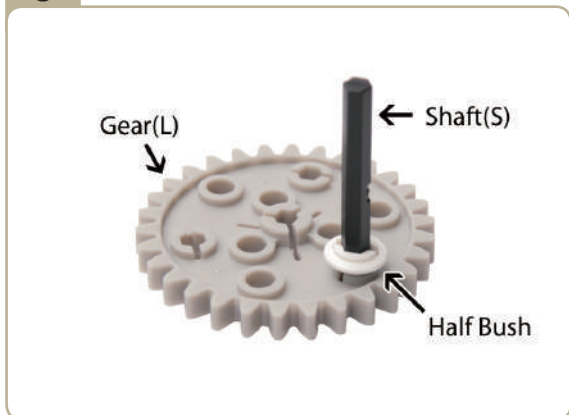


2



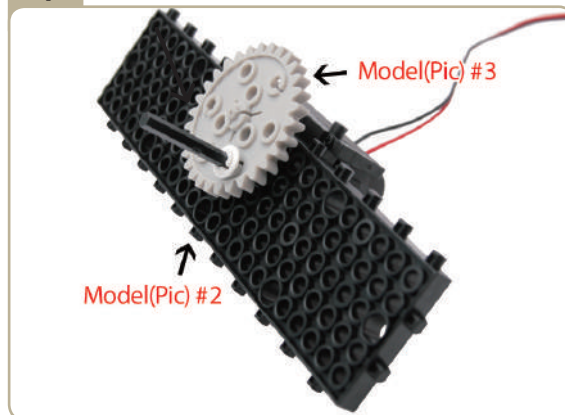
Insert a half bush to the shaft of DC motor.

3



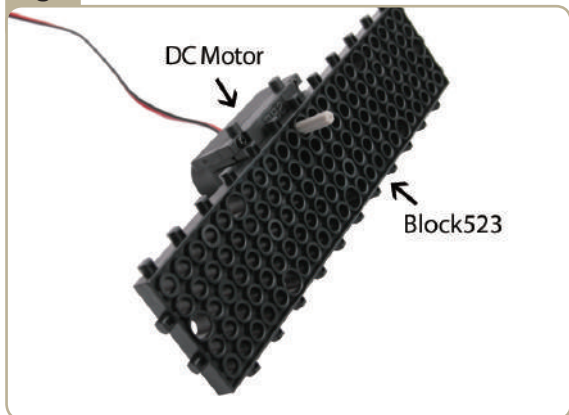
Connect a large gear and a short shaft, a half bush.

4



Connect model(pic)#3 to the shaft of DC motor.

5

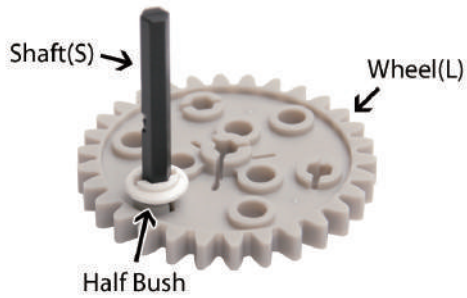


6



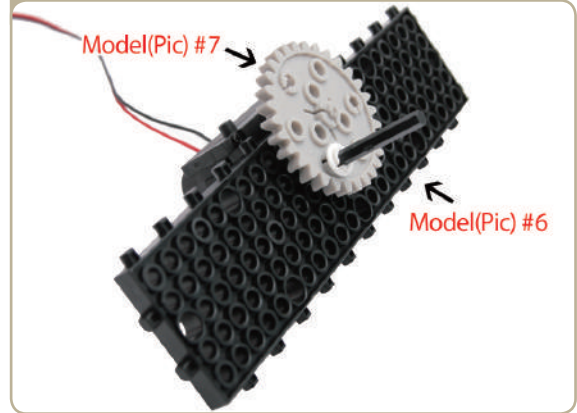
Insert a half bush to the shaft of DC motor.

7



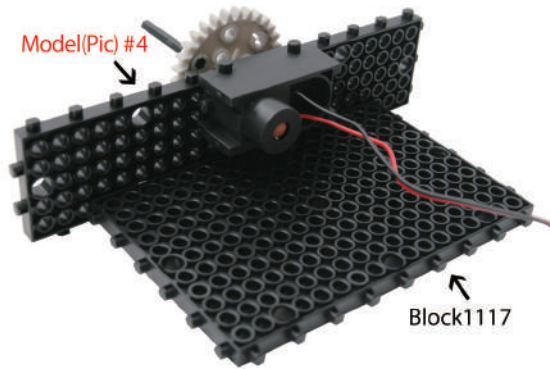
Connect a short shaft and a half bush to large gear.

8



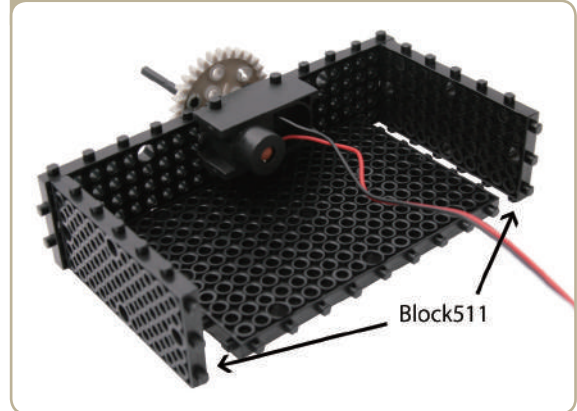
Connect model(pic)#7 to the shaft of DC motor.

9



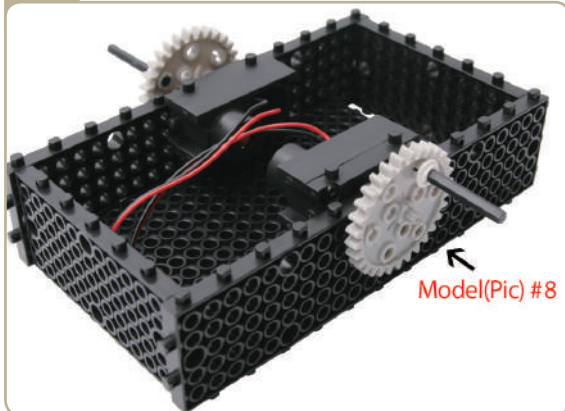
Attach a 「block1117」 to model(pic)#4.

10



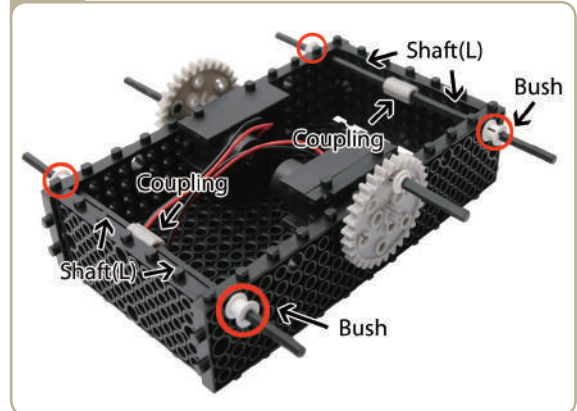
Attach two 「block511」s to model(pic)#9.

11



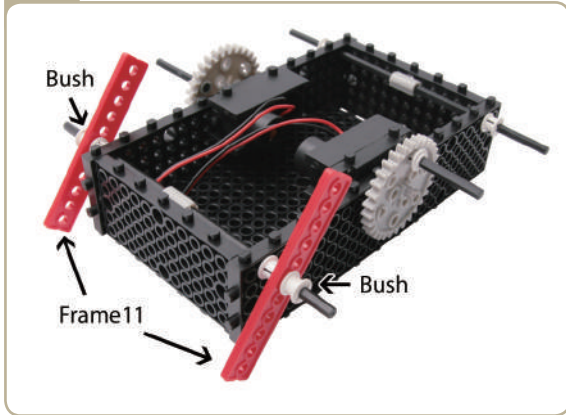
Combine model(pic)#10 with model(pic)#8.

12



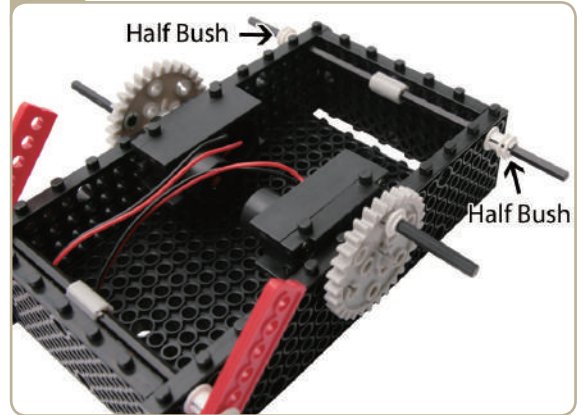
Connect long shafts and two couplings with four bushes to model(pic)#11.

13



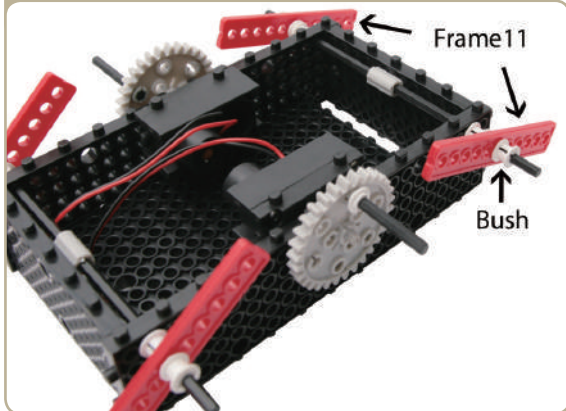
Insert a 「frame11」 and a bush to the long shaft of model(pic)#12 as illustrated in the picture.
(Assemble the other side identically.)

14



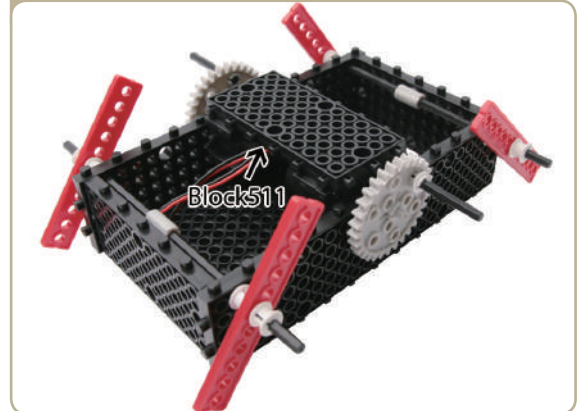
Insert a half bush to the long shaft of model(pic)#13 as illustrated in the picture.
(Assemble the other side identically.)

15



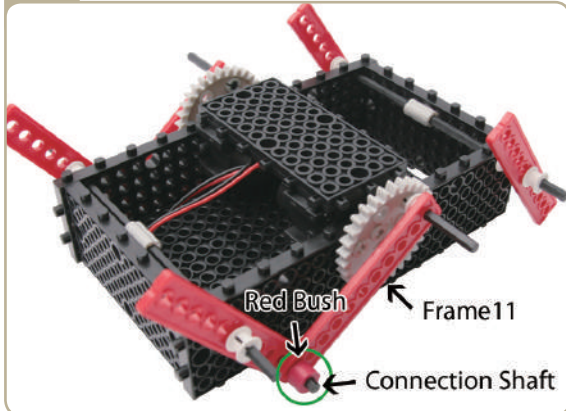
Insert a 「frame11」 and a bush to the long shaft of model(pic)#14 as illustrated in the picture.
(Assemble the other side identically.)

16



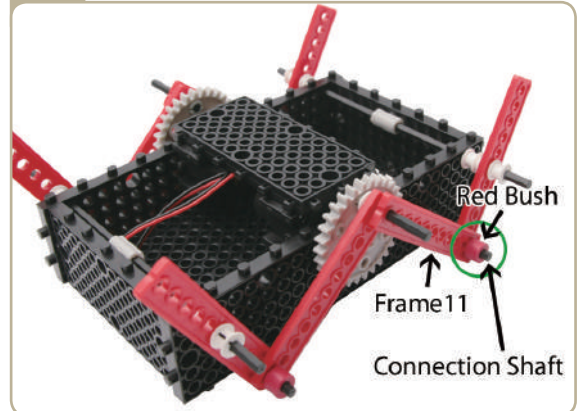
Attach a 「block511」 to model(pic)#15.

17



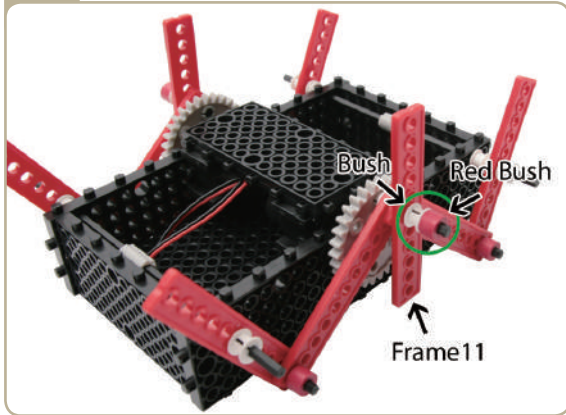
Connect a 「frame11」 and a red bush with a connection shaft to model(pic)#16. (Assemble the other side identically.)

18



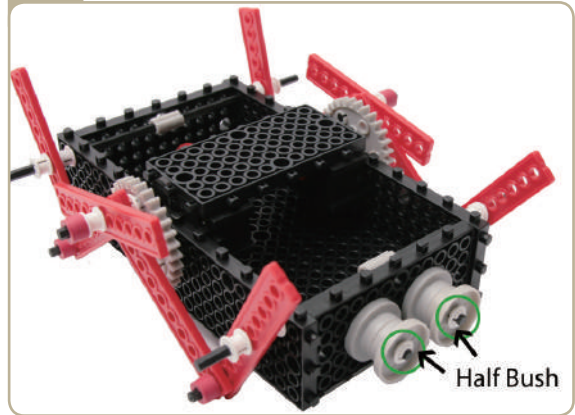
Connect a 「frame11」 and a red bush with a connection shaft to model(pic)#17. (Assemble the other side identically.)

19



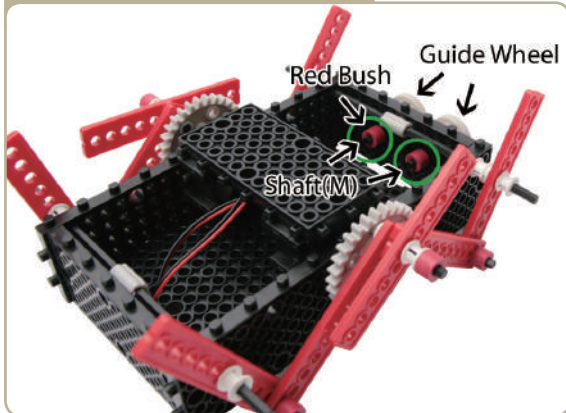
Connect a 「frame11」 and a red bush with a connection shaft to model(pic)#18. (Assemble the other side identically.)

20

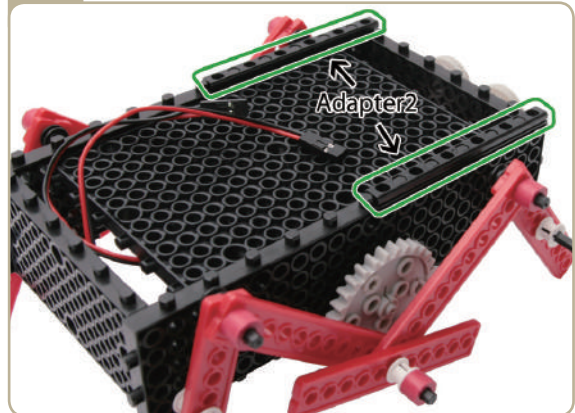


Connect a medium shaft with two guide wheels and two half bushes to model(pic)#19. (The back side fastens with a red bush.)

21 (Bottom of model(Pic)#20)

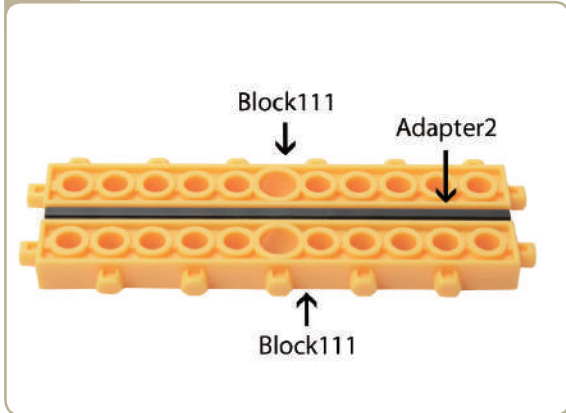


22

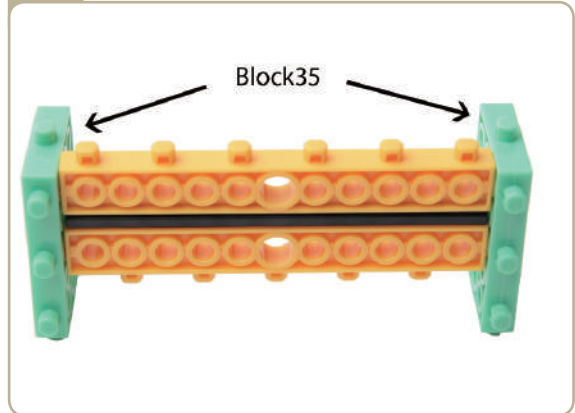


Turn model(pic)#21 upside down, then attach two 「adapter2」s.

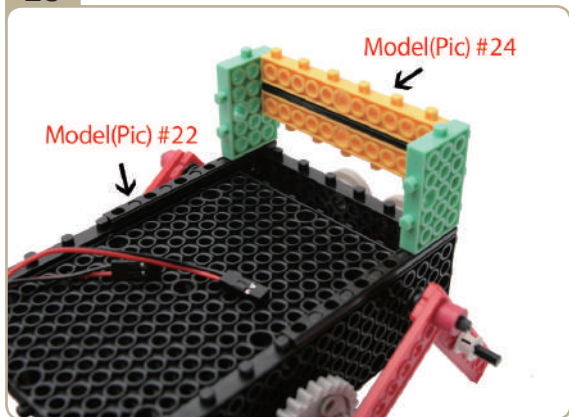
23



24

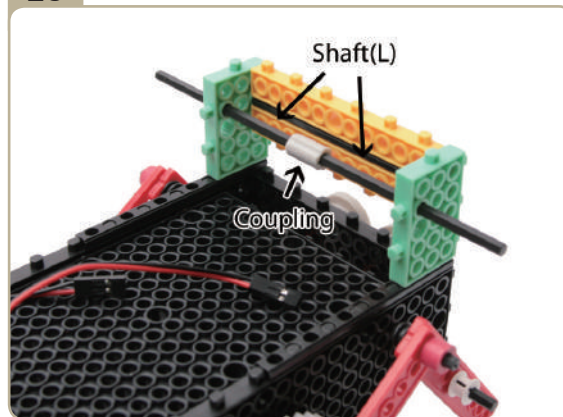


25



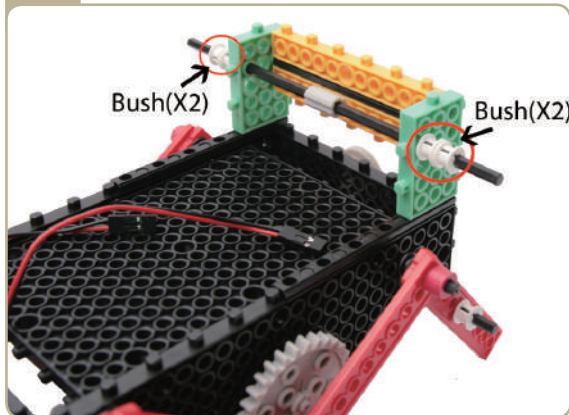
Combine model(pic)#22 with model(pic)#24.

26



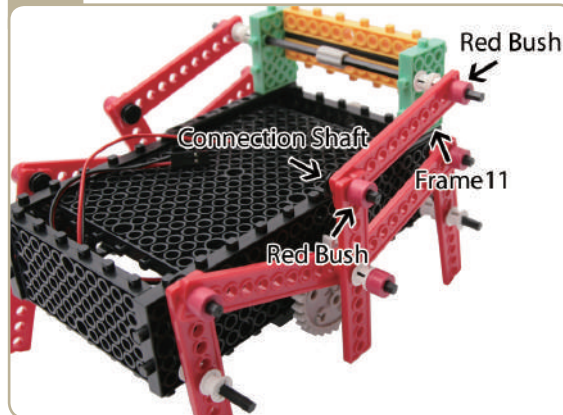
Connect two long shafts and a coupling.

27



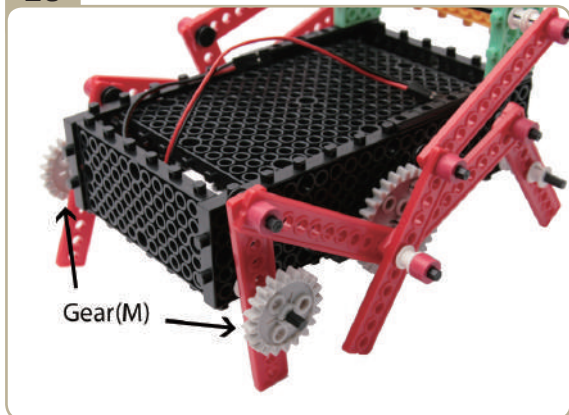
Insert 4 bushes to the shaft of model(pic)#26.

28



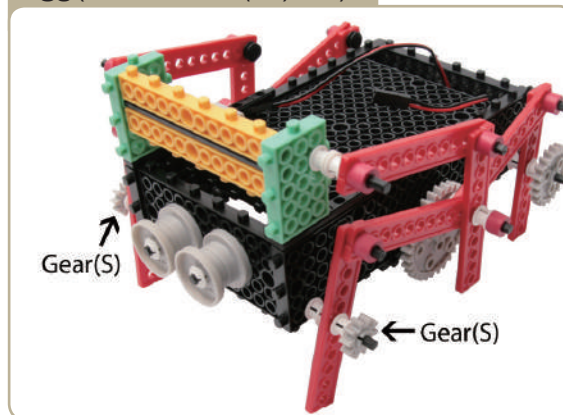
Connect a 「frame11」 and a red bush with a connection shaft to model(pic)#27. (Assemble the other side identically.)

29



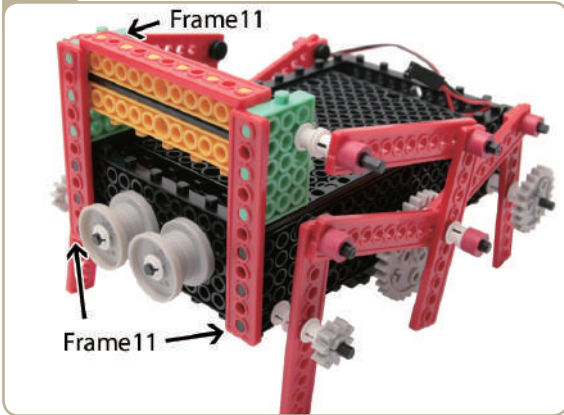
Insert a medium gear to the shaft of model(pic)#28 as illustrated in the picture. (Assemble the other side identically.)

30 (front of model(Pic)#29)



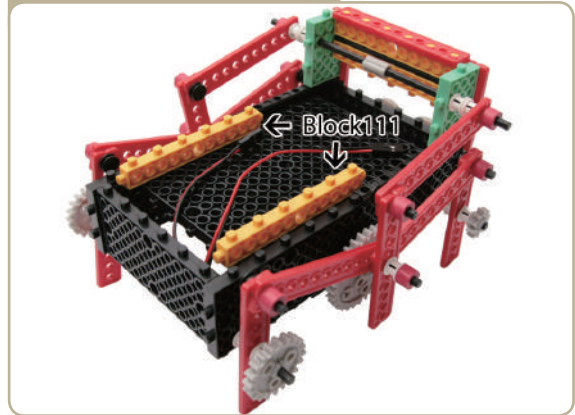
Take model(pic)#29 a round, insert a small gear to shaft as illustrated in the picture. (Assemble the other side identically.)

31



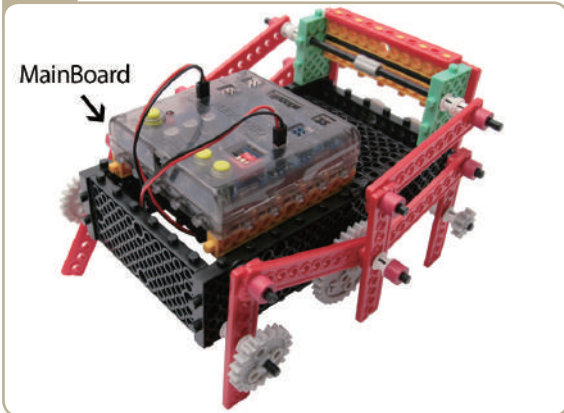
Attach three 「frame11」s to model(pic)#30.

32 (Back of model(Pic)#31)



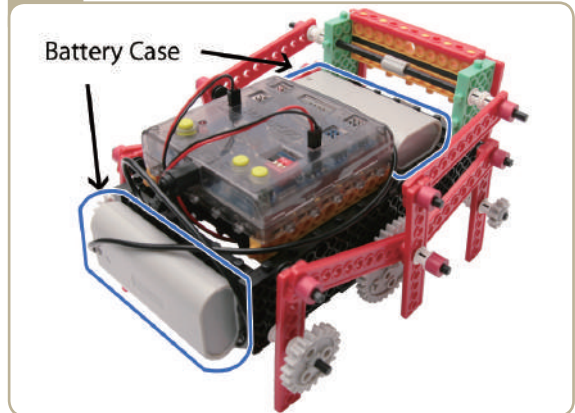
Attach two 「block111」s to model(pic)#31.

33



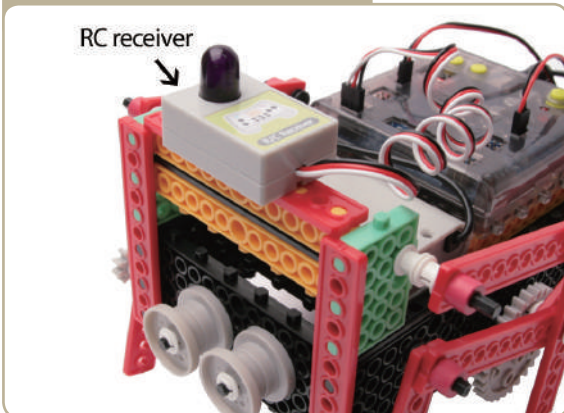
Connect mainboard to model(pic)#32.

34



Connect battery cases to model(pic)#33.

35 (frontof model(Pic)#34)



Connect RC receiver board to model(pic)#34.

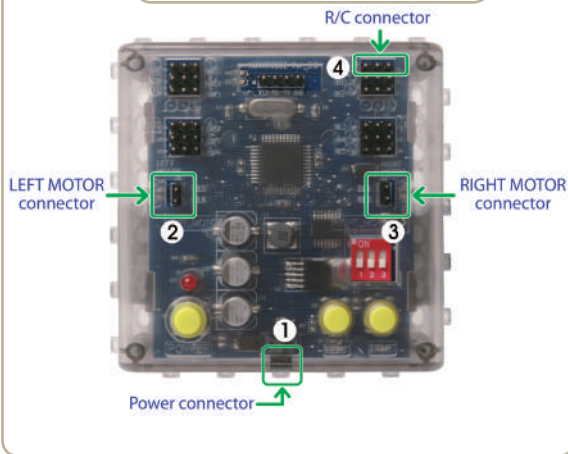
Completed





How to operate the Bug Battle Bot

Connecting the mainboard



Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect RC receiver board to R/C connector.

⊕ ———— The DC motor red wire must be connected to positive ⊕, the black wire to the negative ⊖.

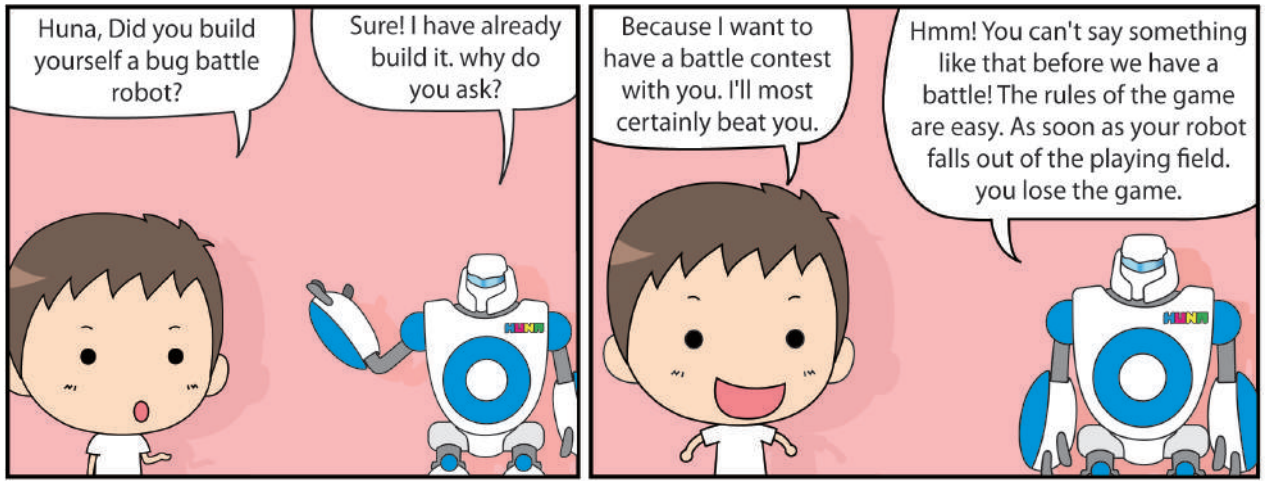
⊕ ———— Insert the black wire of 3P electric wire into the negative ⊖.

Program Example

Action	No
Program Start	0
Remocon : [Up] {	1
DC motor 1 : [Both MOTOR1]=[Forward],[Speed=10]	2
END }	3
Remocon : [Down] {	4
DC motor 1 : [Both MOTOR1]=[Backward],[Speed=10]	5
END }	6
Remocon : [Right] {	7
DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	8
DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	9
END }	10
Remocon : [Left] {	11
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	12
DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	13
END }	14
Remocon : [Up + Right] {	15
DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	16
DC motor 1 : [R-MOTOR1]=[Stop]	17
END }	18
Remocon : [Up + Left] {	19
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	20
DC motor 1 : [L-MOTOR1]=[Stop]	21
END }	22
Remocon : [KEY OFF] {	23
DC motor 1 : [Both MOTOR1]=[Stop]	24
END }	25
Program End	26



Having a bug battle bot contest with your friends

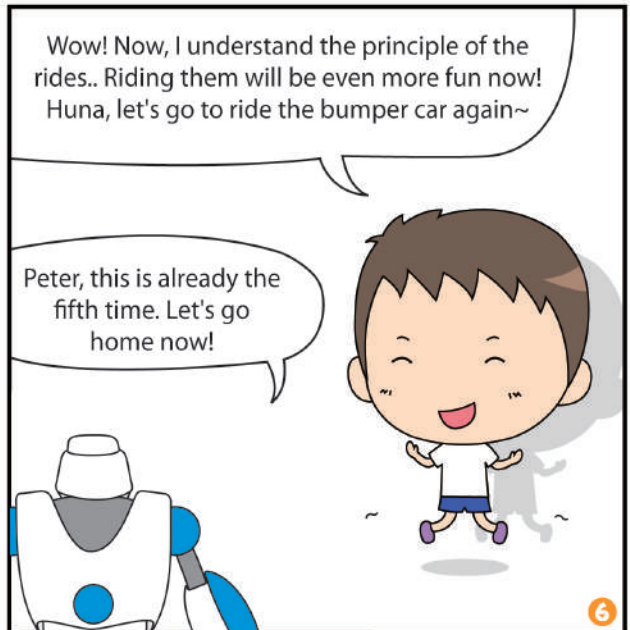
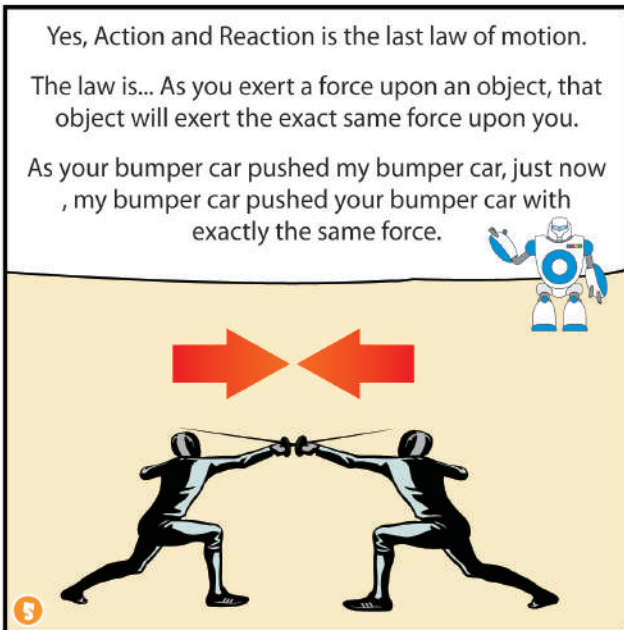
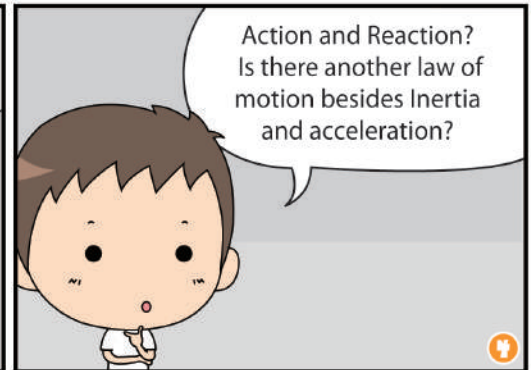
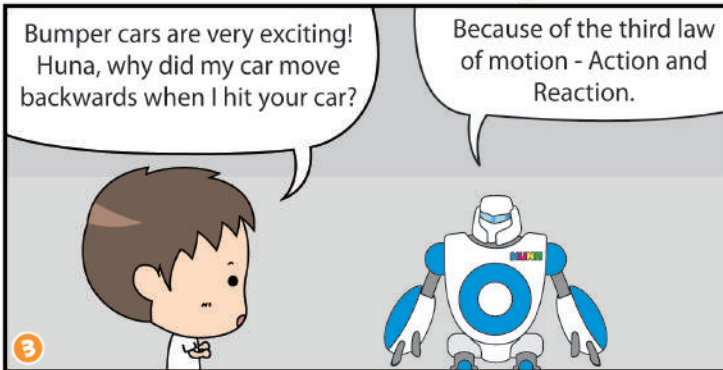
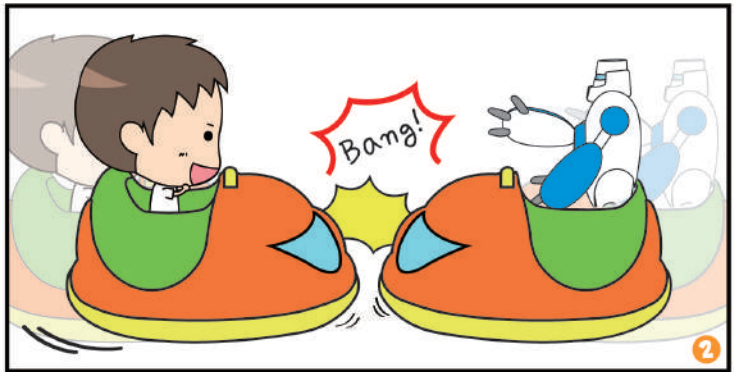


**Assemble a bug battle bot, then make a playing field.
When you are finished with that, play the game with your friends.**

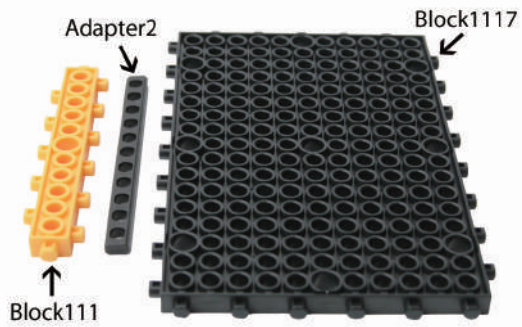
A large, blank page from a spiral notebook. The page is white with a light blue border on the right side. It has a silver spiral binding on the left edge. The page is ruled with horizontal lines, with a dashed line in the middle of each line pair, creating a notebook-style writing area.



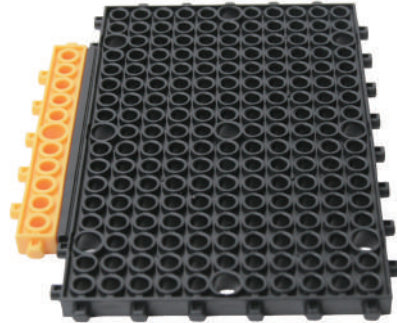
The third law of motion - Action and Reaction



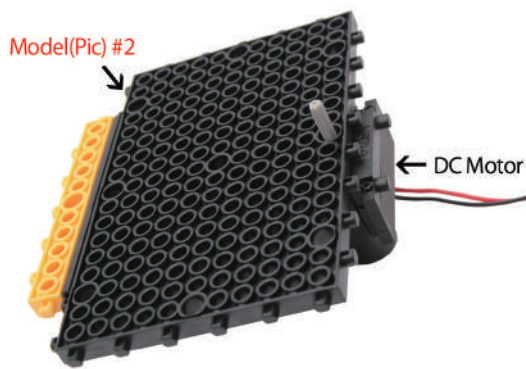
1



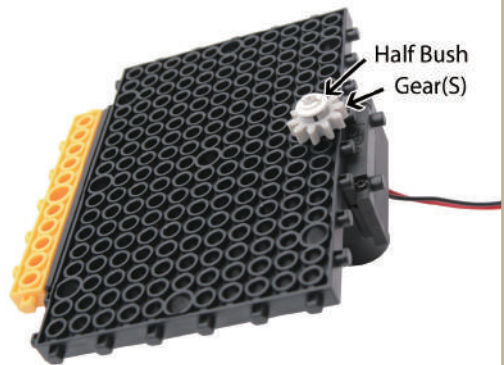
2



3

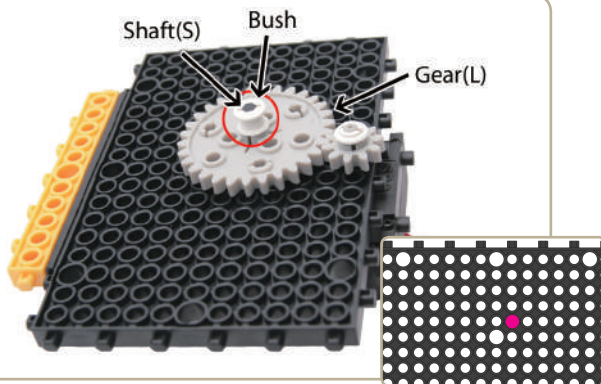


4



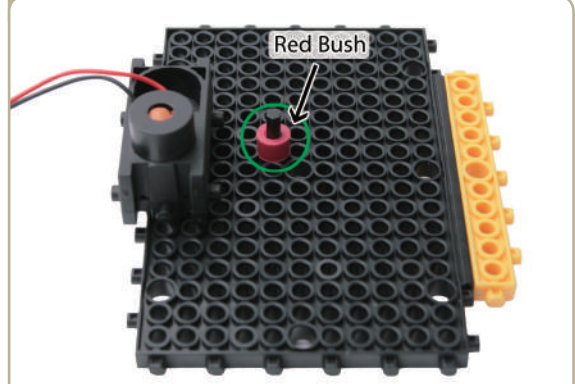
Insert a small gear and a half bush to the shaft of DC motor.

5

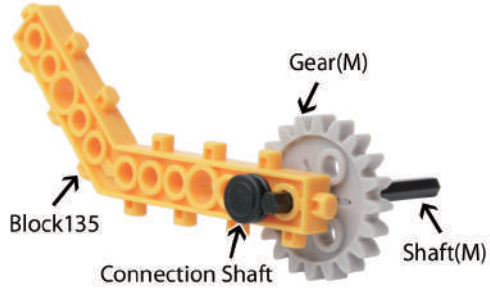


Align the small gear and large gear as illustrated. Use a short shaft to connect model(pic)#4. (The back side fasten with a red bush.)

6 (Bottom of model(Pic)#5)

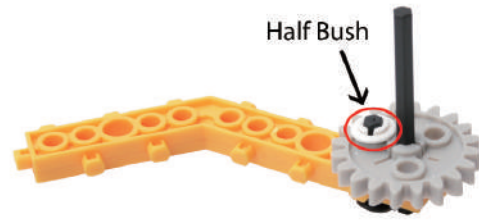


7



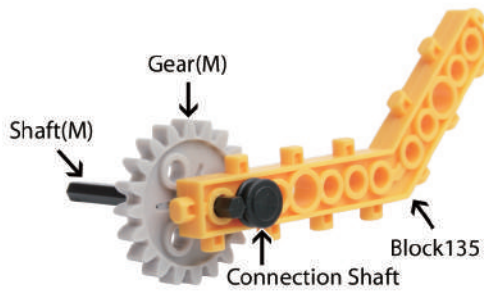
Connect a 「block135」 and a medium gear with a connection shaft, then connect a medium shaft.

8 (Opposite of model(Pic)#7)



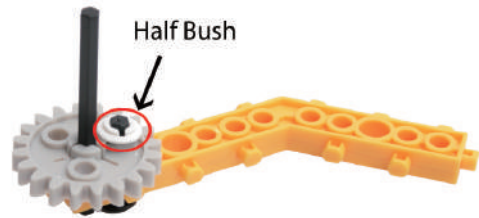
Fix connection shaft of model(pic)#7 with a half bush.

9



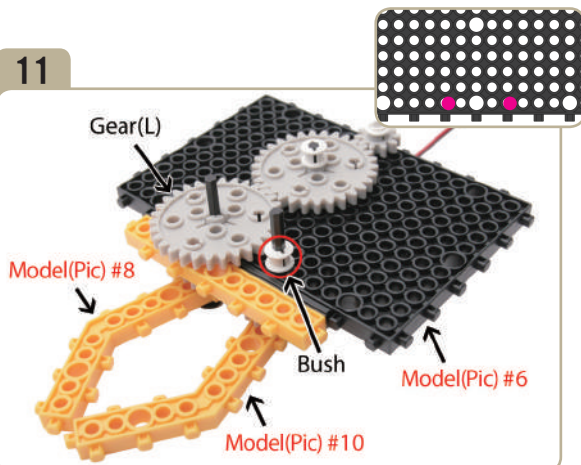
Connect a 「block135」 and a medium gear with a connection shaft , then connect a medium shaft.

10 (Opposite of model(Pic)#9)



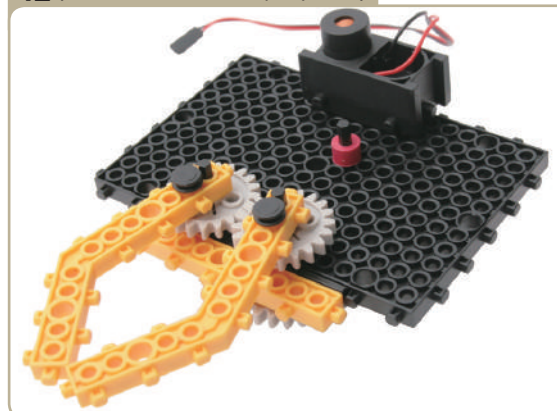
Fix connection shaft of model(pic)#9 with a half bush.

11

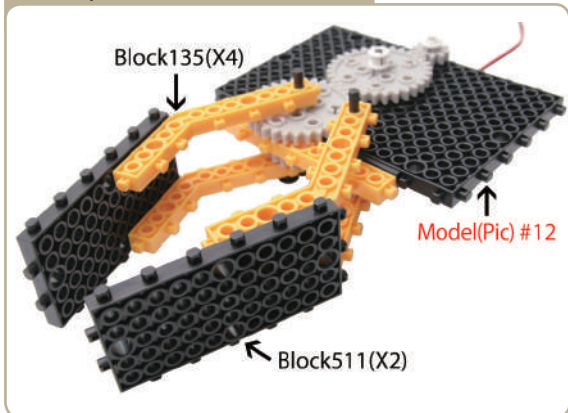


On model(pic)#6, engage the gear of model(pic)#8 and the gear of model(pic)#10, then engage another large gear and insert a bush to the remaining shaft.

12 (Bottom of model(Pic)#11)

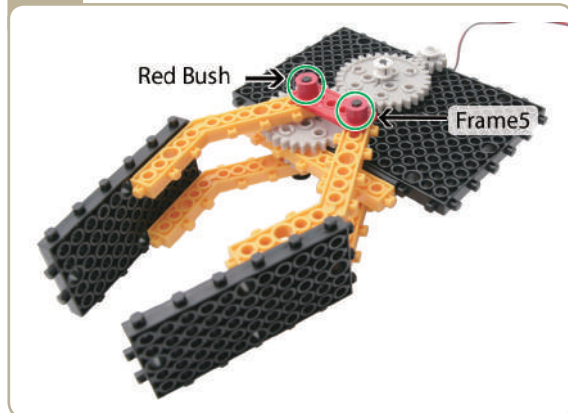


13 (Upside of model(Pic)#12)



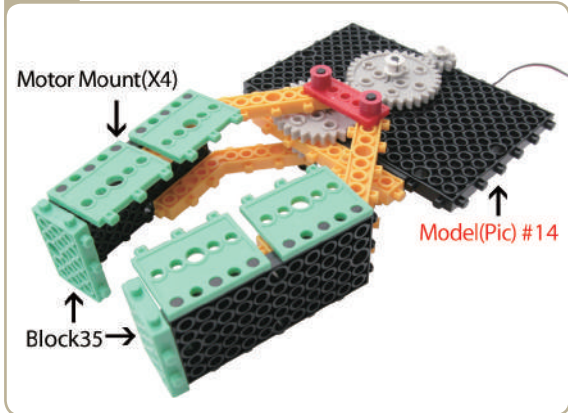
Connect two 「block135」s then attach 「block511」s to model(pic)#11.

14



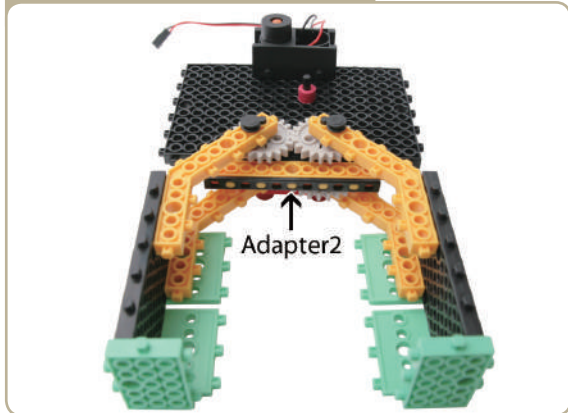
Fix a 「frame5」 with red bushes to model(pic)#13.

15



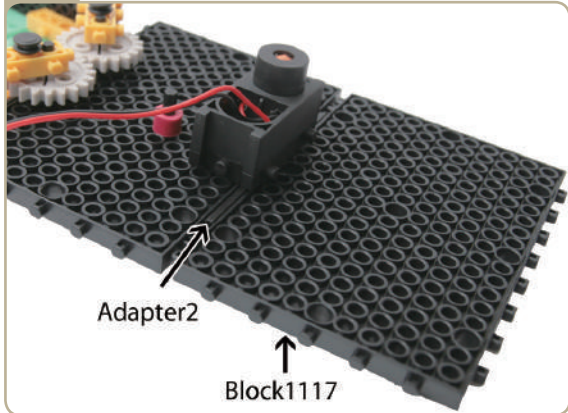
Attach four motor mounts and two 「block35」s to model(pic)#14.

16 (Bottom of model(Pic)#15)



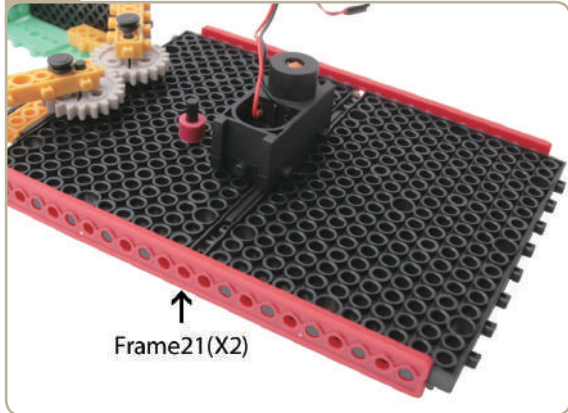
Attach a 「adapter2」 to model(pic)#15.

17



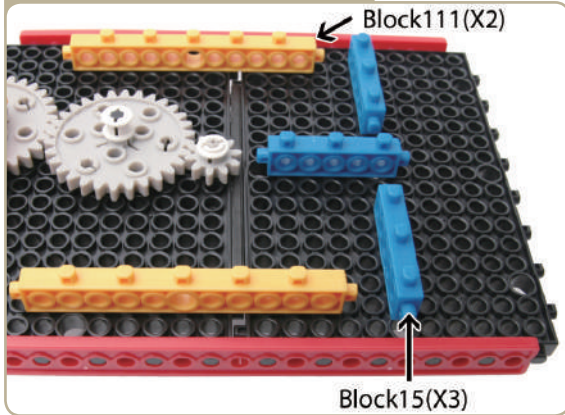
Attach a 「block1117」 to model(pic)#16 with a 「adapter2」.

18



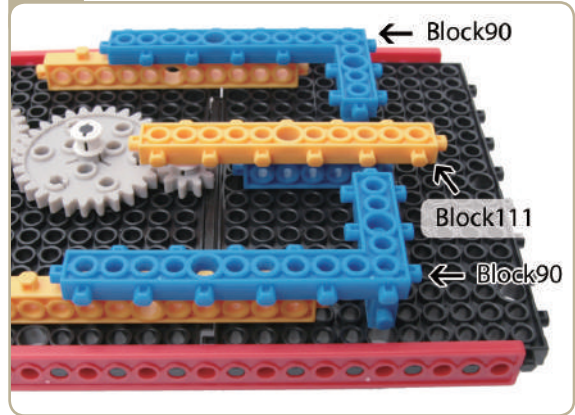
Attach two 「frame21」s to model(pic)#17.

19 (Bottom of model(Pic)#18)



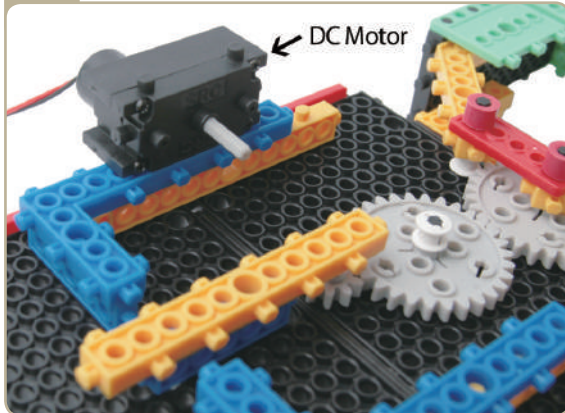
Turn model(pic)#18 upside down, then attach two 「block111」s and three 「block15」s.

20



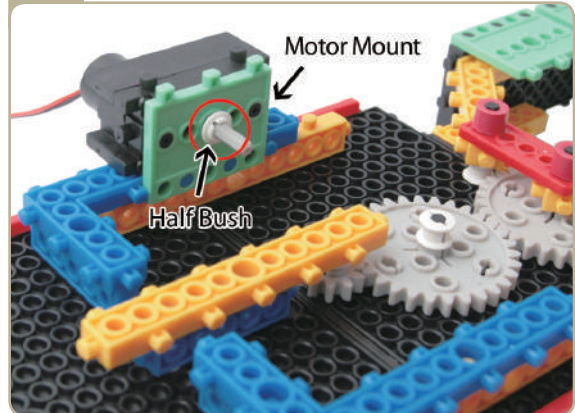
Attach two 「block90」s and a 「block111」 to model(pic)#19.

21



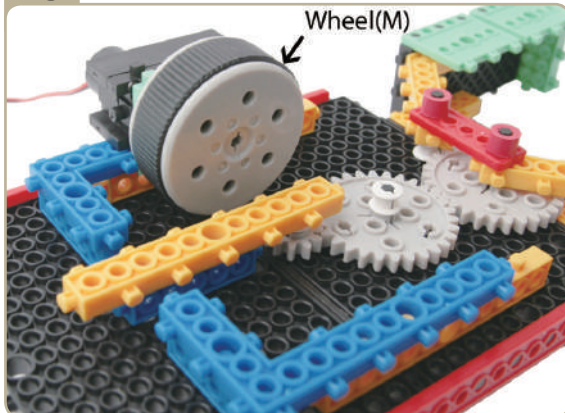
Connect a DC motor to model(pic)#20.

22



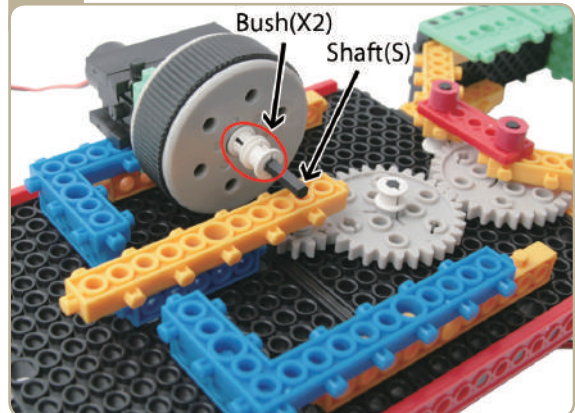
Insert a motor mount and a half bush to the shaft of DC motor.

23



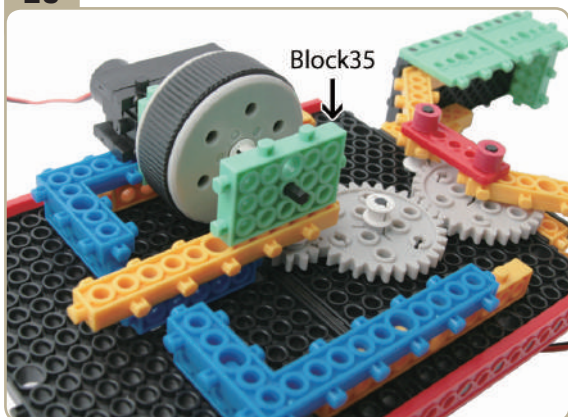
Connect a medium wheel to the shaft of DC motor.

24



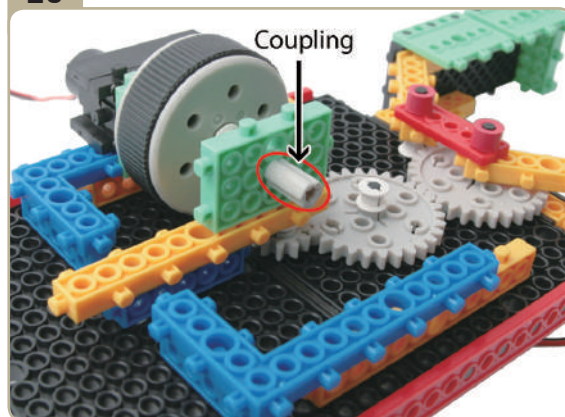
Connect a short shaft and two bushes to the medium wheel of model(pic)#23.

25



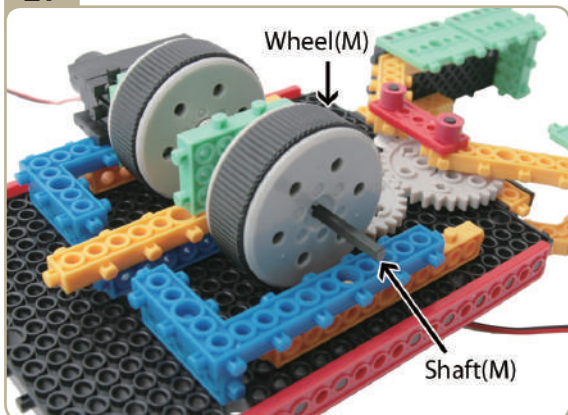
Insert a 「block35」 to the shaft of model(pic)#24.

26



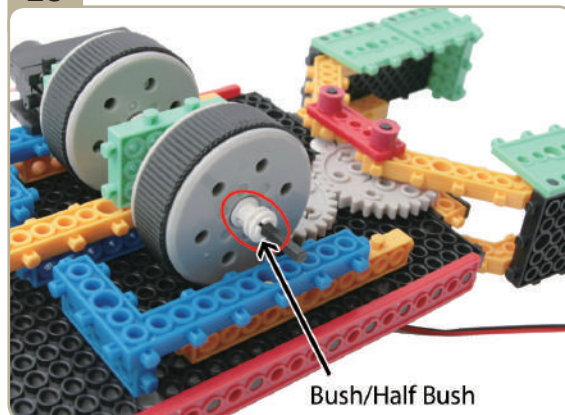
Insert a coupling to the shaft of model(pic)#25.

27



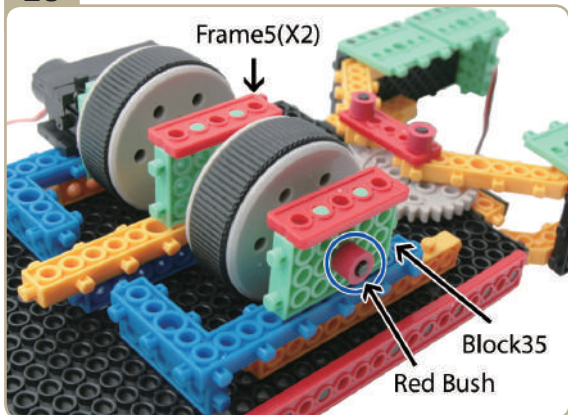
Connect a medium shaft to the coupling of model(pic)#26, then connect a medium wheel.

28



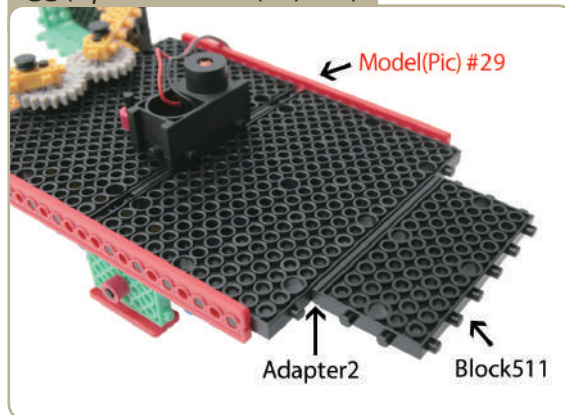
Insert a bush and a half bush to the medium shaft of model(pic)#27.

29

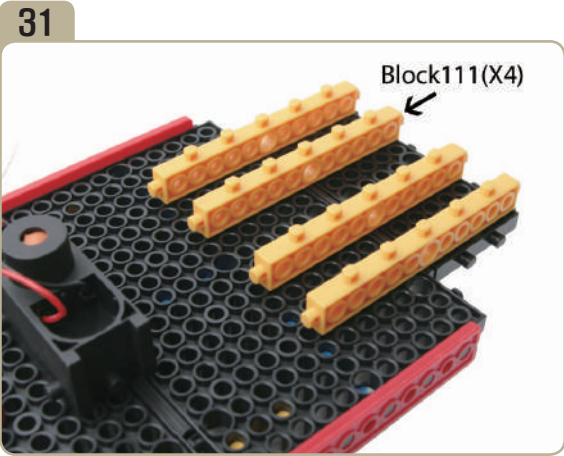


Connect a 「block35」 and a red bush to the model(pic)#28, then attach two 「frame5」s.

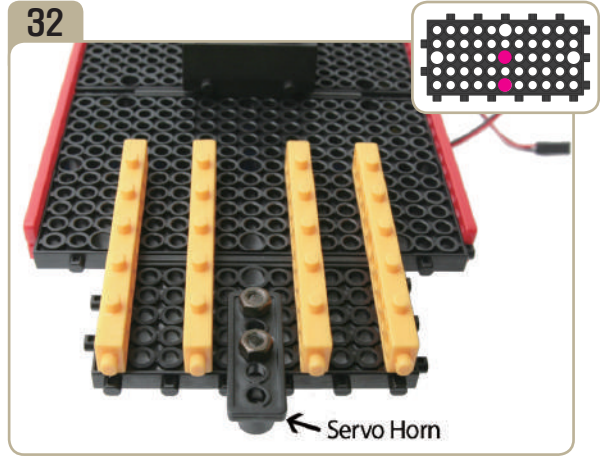
30 (upside of model(Pic)#29)



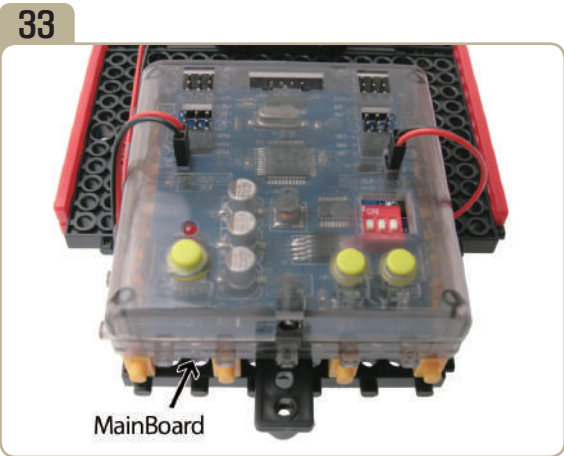
Turn model(pic)#29 upside down, then attach a 「adapter2」 and a 「block511」.



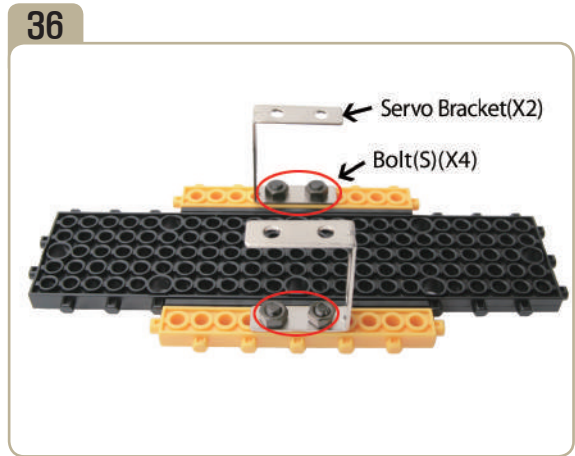
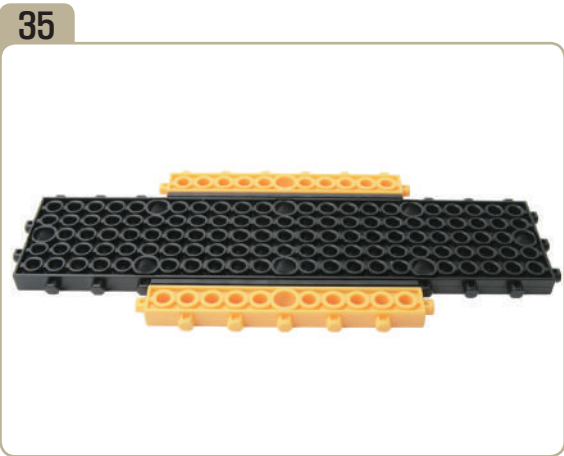
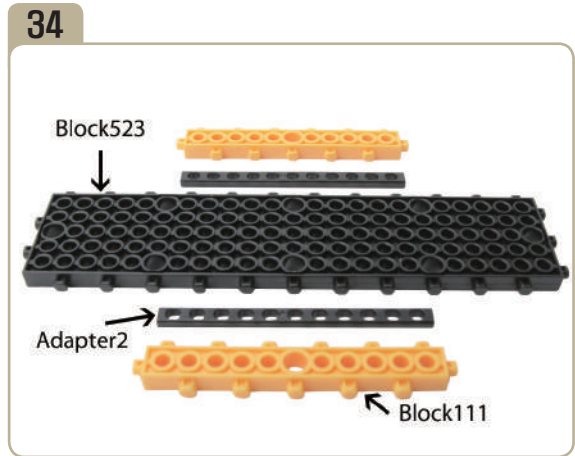
Attach four 「block111」s to model(pic)#30.



Fix servo horn with short bolts and nuts to model(pic)#31.

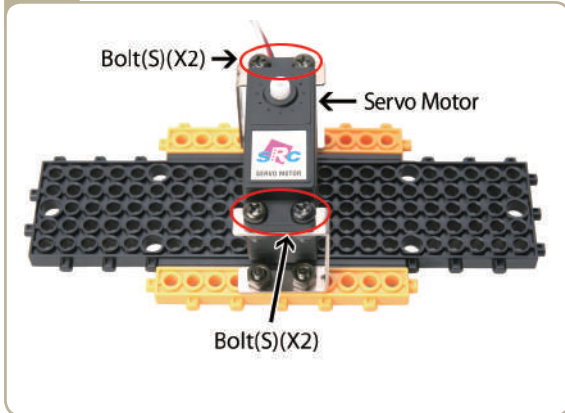


Connect mainboard to model(pic)#32.



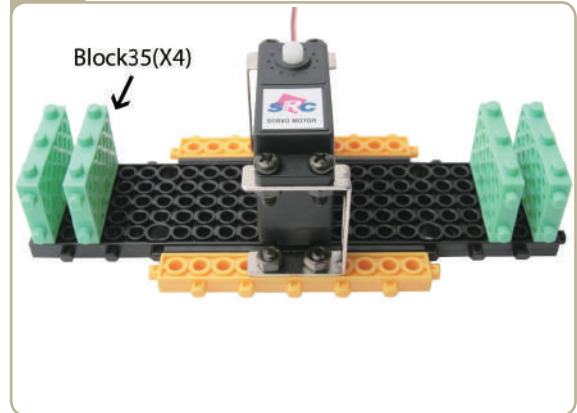
Fix servo brackets to model(pic)#35 with short bolts and nuts.

37



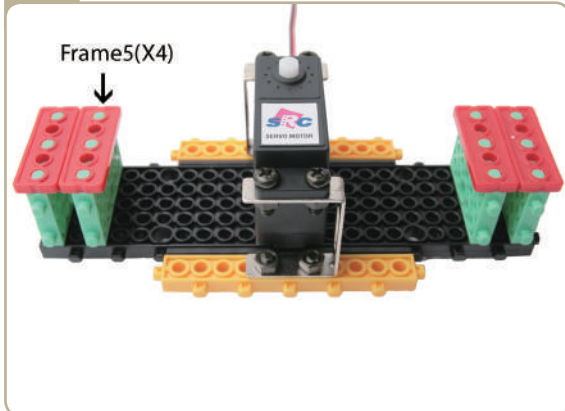
Fix servo motor to model(pic)#36 with short bolts and nuts.

38



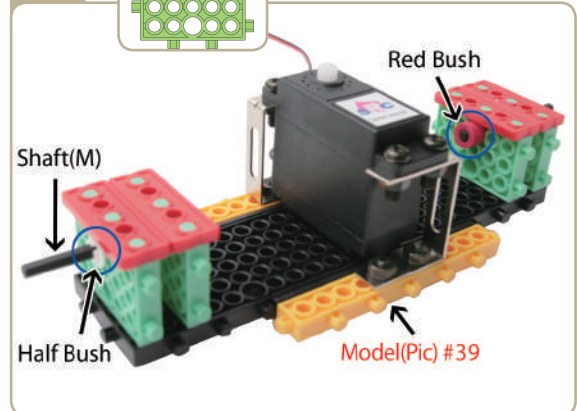
Attach four 「block35」s to model(pic)#37.

39



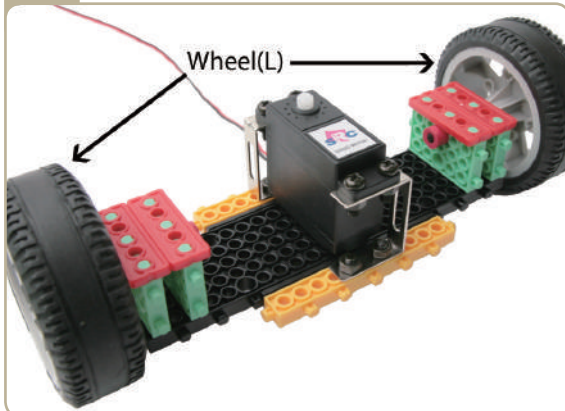
Attach four 「frame5」s to model(pic)#38.

40



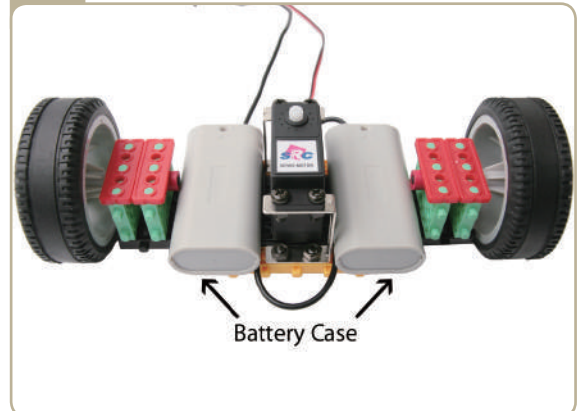
Connect medium shafts and half bushes, red bushes to model(pic)#39.

41



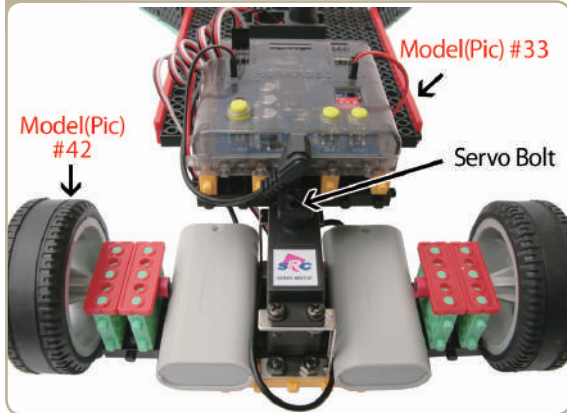
Connect two large wheels to the medium shaft of model(pic)#40.

42



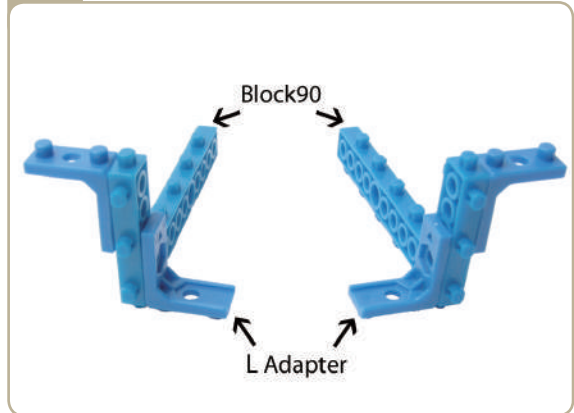
Connect battery cases to model(pic)#41.

43



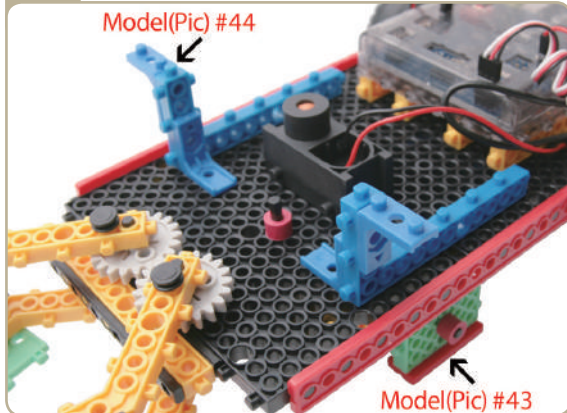
After adjusting zero point of servo motor, then fix model(pic)#33 to servo motor with a small servo bolt.

44



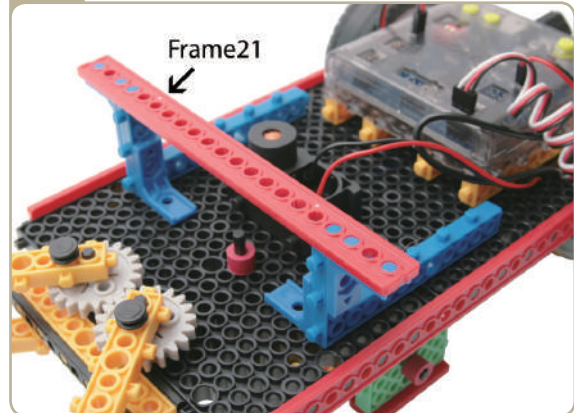
Attach four 'L' adapters to 「block90」. (Pay close attention to the arrows (▲) that indicate how the adapters should be attached.)

45



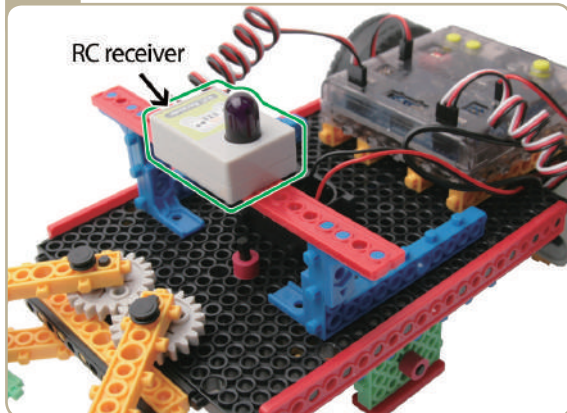
Combine model(pic)#44 to model(pic)#43.

46



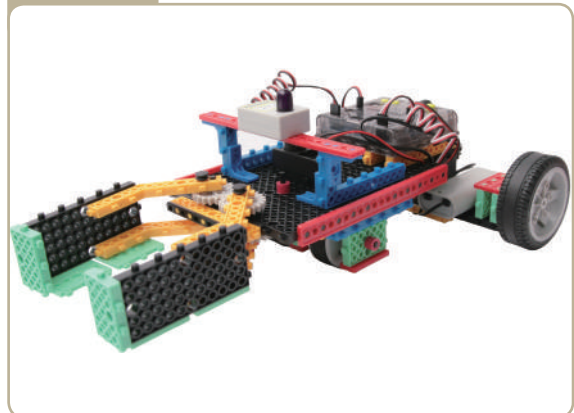
Attach a 「frame21」 to model(pic)#45.

47



Connect RC receiver board to model(pic)#46.

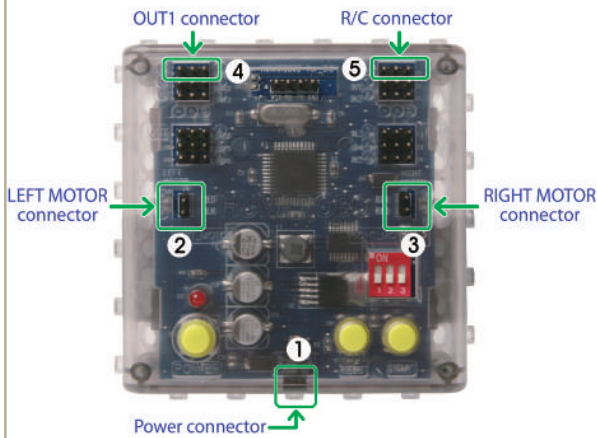
Completed





How to prepare the forceps robot for operation

Connecting the mainboard



Connect in this order.

1. Connect Battery cases to Power connector.
2. Connect Left DC motor to LEFT MOTOR connector.
3. Connect Right DC motor to RIGHT MOTOR connector.
4. Connect Servo motor to OUT1 of OUTPUT connector.
5. Connect RC receiver board to R/C connector.

The DC motor red wire must be connected to positive \oplus , the black wire to the negative \ominus .

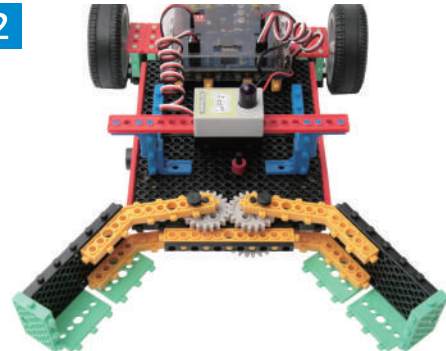
Insert the black wire of 3P electric wire into the negative \ominus .

Motion Pattern/Program

1



2



When you activate the forceps's DC motor with remote control, it bring them together or widens them.

- Using the motion patterns as reference, let's write the program.

Program Download

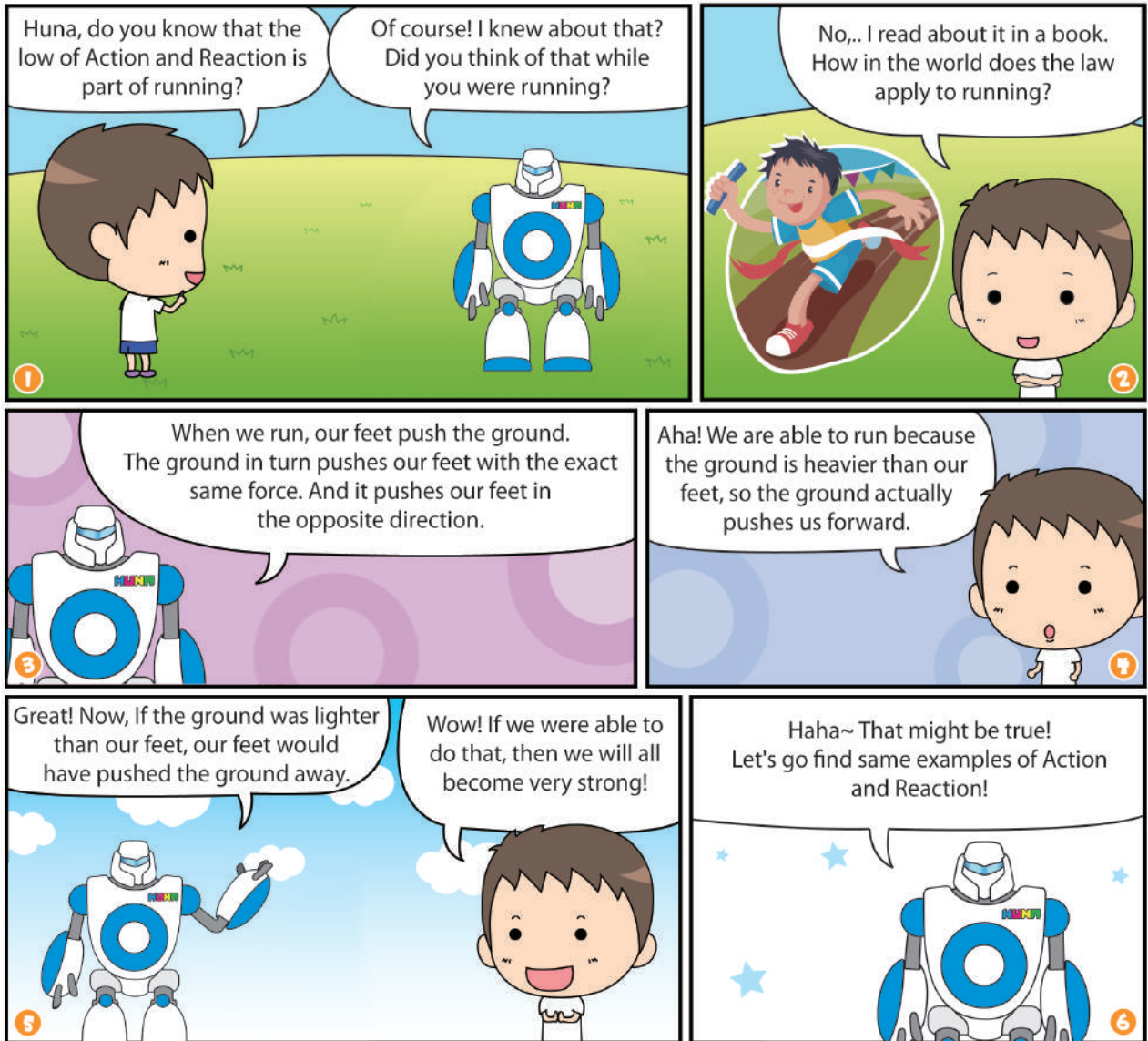
1. Write the program.
2. Make sure Power / DC Motor connector and sensor's connector are well connected.
3. Check the power OFF state, then insert the download cable.
4. 'SAVE' and click the 'DOWNLOAD' button on the program window.
5. Turn on the power when 'DOWNLOAD' window opens. (Power ON)
6. Once the download is completed, remove the download cable and then turn the power off and on.
(Power OFF \rightarrow Power ON)

Program Example

Action	No
Program Start	0
Remocon : [Up] {	1
Servo : [OUT1]=[0]	2
DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	3
END }	4
Remocon : [Down] {	5
Servo : [OUT1]=[0]	6
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	7
END }	8
Remocon : [Up + Right] {	9
Servo : [OUT1]=[20]	10
DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	11
END }	12
Remocon : [Up + Left] {	13
Servo : [OUT1]=[-20]	14
DC motor 1 : [R-MOTOR1]=[Backward],[Speed=10]	15
END }	16
Remocon : [Down + Right] {	17
Servo : [OUT1]=[20]	18
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	19
END }	20
Remocon : [Down + Left] {	21
Servo : [OUT1]=[-20]	22
DC motor 1 : [R-MOTOR1]=[Forward],[Speed=10]	23
END }	24
Remocon : [F1] {	25
DC motor 1 : [L-MOTOR1]=[Backward],[Speed=10]	26
Delay : [0.5 sec]	27
DC motor 1 : [L-MOTOR1]=[Stop]	28
END }	29
Remocon : [F2] {	30
DC motor 1 : [L-MOTOR1]=[Forward],[Speed=10]	31
Delay : [0.5 sec]	32
DC motor 1 : [L-MOTOR1]=[Stop]	33
END }	34
Remocon : [KEY OFF] {	35
DC motor 1 : [Both MOTOR1]=[Stop]	36
END }	37
Program End	38



Running, Action and Reaction, too!

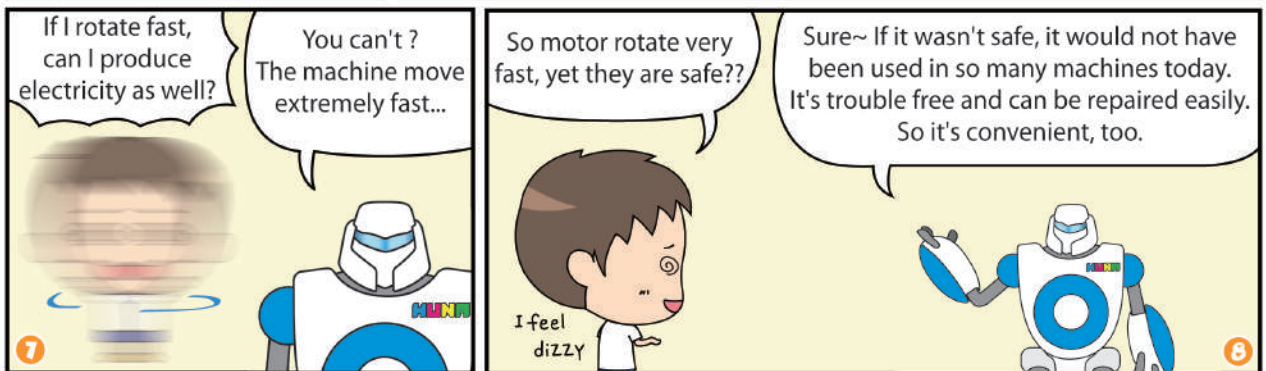
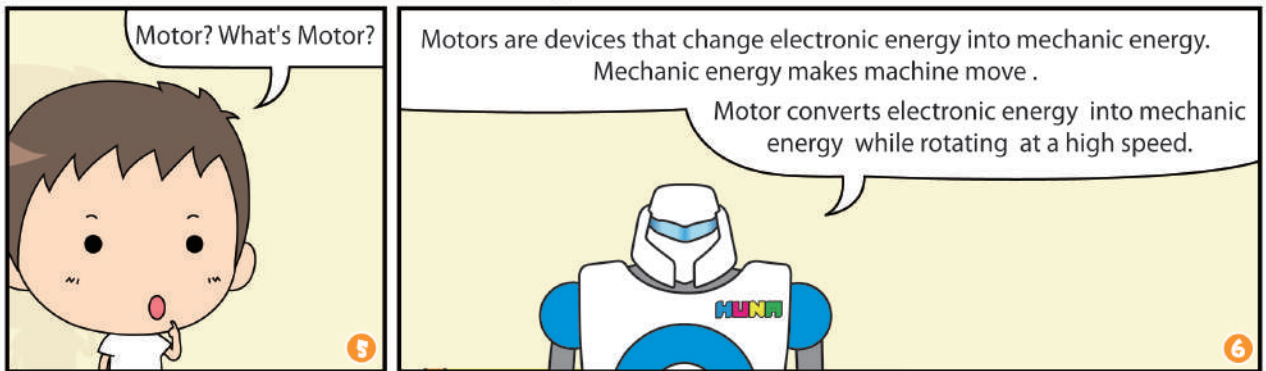
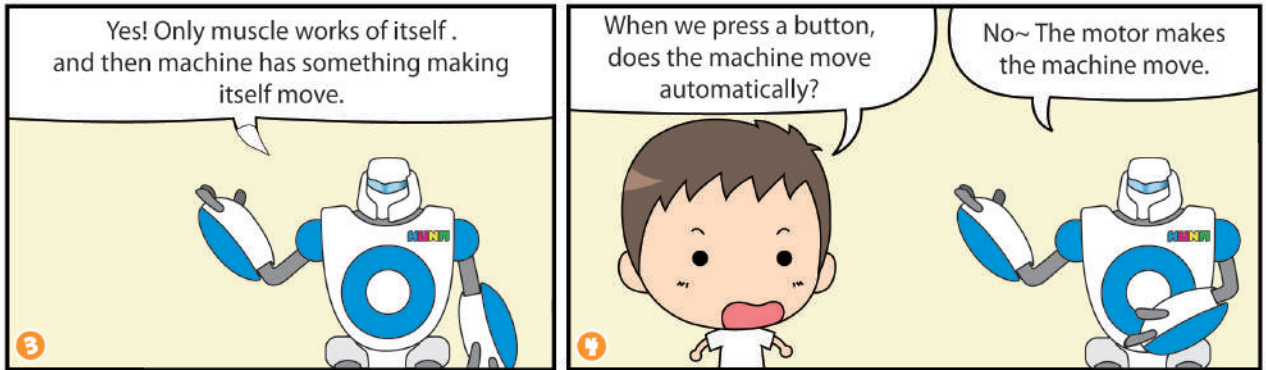
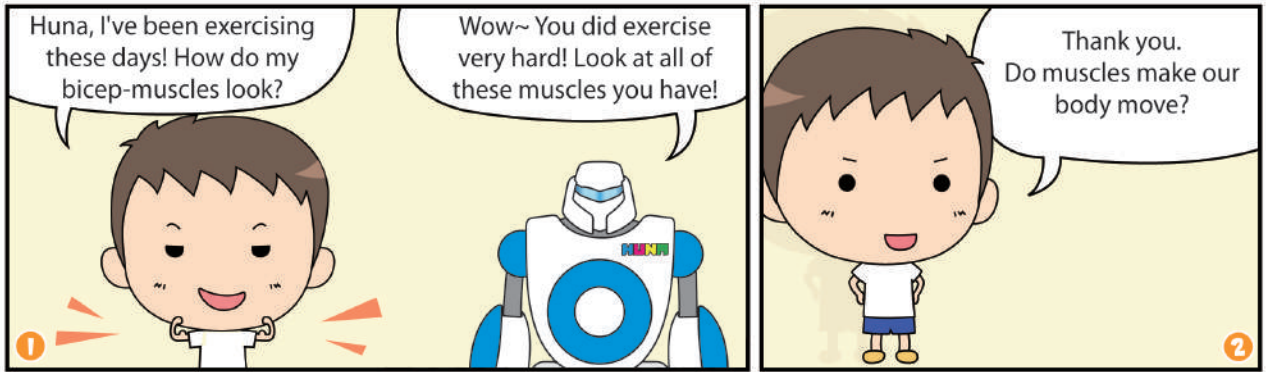


Let's find what's the example of Action and Reaction law applying around us!





How muscles make us move just like machines! - Motor 2



⚠ Caution

1. Fully understand the material before assembling.
2. Ensure that the assembling parts are handled properly.
3. Some parts can be dangerous for children and babies. Adult supervision may be required.
4. Some parts are sharp that may cause wounds for children. Please handle with care.
5. We reserve the right to change parts and products to improve quality and to meet international standards.
6. SRC is not responsible for consumer's incompetency. Please follow the instructions carefully.
7. HunaRobo SRC is a registered name.
8. No information here will be copied or reproduced without the express written consent of SRC Company.

⚠ USE OF BATTERY

1. Ensure + & - are inserted correctly. Upon removal of battery, push the battery a little and nudge outwards.
2. Don't mix old and new batteries, nor different quality batteries.
3. Adult supervision is required when charging batteries.
4. Do not use alkaline batteries for recharging.
5. Remove batteries and store in a safe location when robot not in use.
6. Don't throw batteries into an open flame. Explosions can occur.
7. Ensure that the batteries are inserted correctly otherwise the battery case can short out.



HUNAROBO 1 (Beginning Course)

Entrance level - learning basics using a variety of blocks, making hardware and using the in-house program



HUNAROBO 2 (Intermediate Course)

Mid-level - A step up from level 1, making hardware and using HunaRobo compiler. Learn how to make your own program.



HUNAROBO 3 (Advanced Course)

A addendum to Level 1 and 2. Using a variety of sensor modules to make a concrete and creative mode. Learn high level programming.



www.huna.asia Get more information by visiting our website.



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