

# What's on technology



8+

15 models to build

165 pieces 

#7323

# WATER POWER

water power





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## RECOMMENDATIONS

Please read these instructions, follow the safety rules and keep them for reference. We recommend that you make the models in the order that is given. You will then be able to understand assembly of parts and soon many more different models you wish.



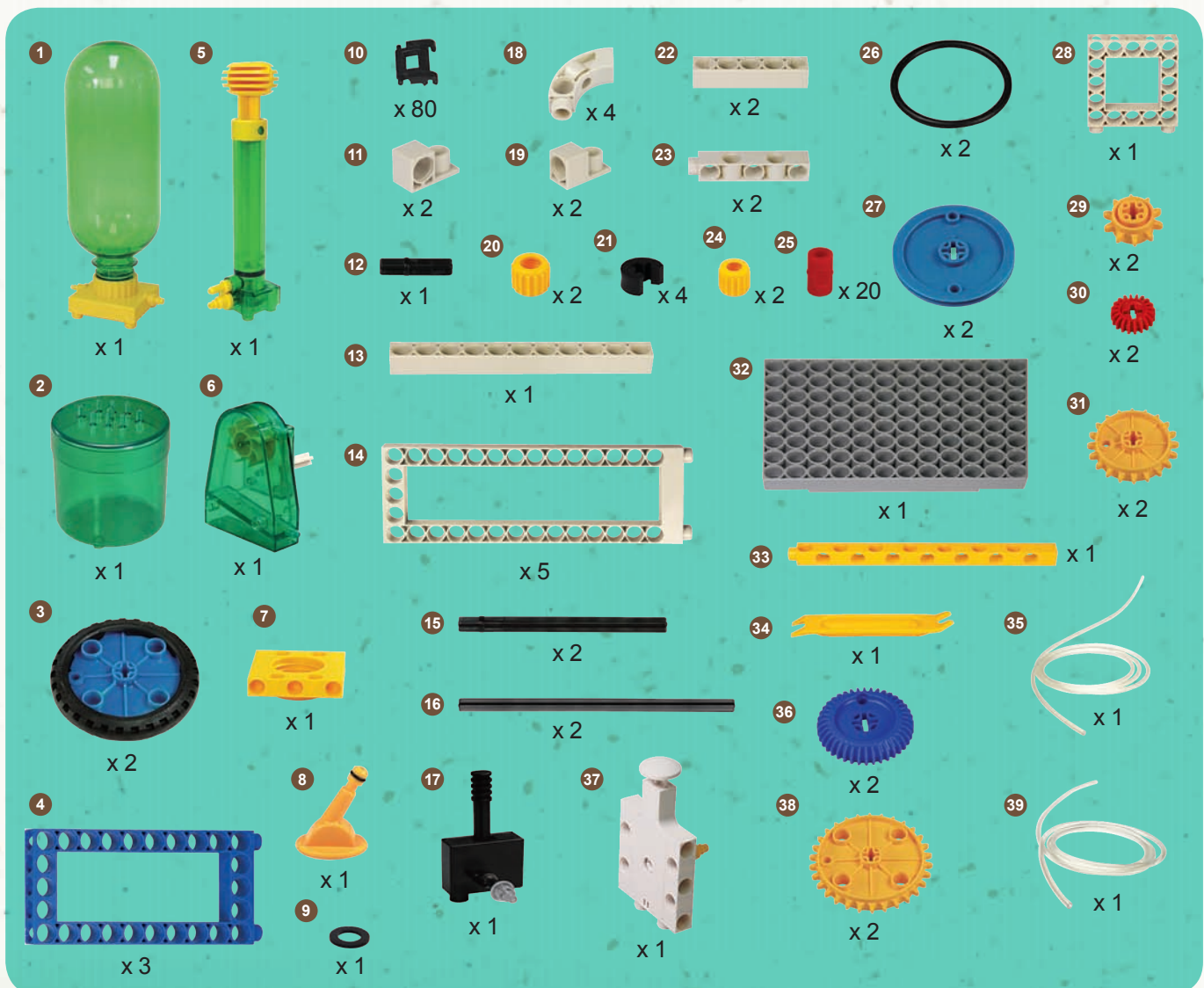
### WARNING TO PARENTS

- This is a toy that has been designed for children over 8 years of age. It is not suitable for children under 3 years of age. It contains small parts that a child could swallow. It must be kept out of the reach of very young children.
- Discuss the safety warnings and possible risks involved with the children before allowing them to build these models.

# Parts List | WATER POWER



No	PARTS NAMES	PCS	No	PARTS NAMES	PCS	No	PARTS NAMES	PCS
1	SECURED AIR-WATER STORAGE	1	14	LONG FRAME	5	27	L PULLEY	2
2	RECYCLED WATER STORAGE	1	15	L DR. AXLE	2	28	SQUARE FRAME	1
3	RACING TIRE	2	16	XL DR. AXLE	2	29	S CHAIN GEAR	2
4	SHORT FRAME	3	17	SECURED ONE-WAY SWITCH	1	30	S GEAR	2
5	SECURED PUMP	1	18	BENDED ROD	4	31	M CHAIN GEAR	2
6	AIR-WATER POWER PACK	1	19	90 DEGREE CONVERTER - R	2	32	DOUBLE-SIDED BASE GRID	1
7	STORAGE CAP	1	20	L SECURITY NUT	2	33	LONG ROD	1
8	NOZZLE	1	21	GEAR FIXING	4	34	PEG /AXLE REMOVER	1
9	WASHER	1	22	5-HOLE ROD	2	35	TUBE - B 120CM	1
10	UNIT CHAIN	80	23	DUAL ROD	2	36	M GEAR	2
11	90 DEGREE CONVERTER - L	2	24	S SECURITY NUT	2	37	CAR LAUNCHER	1
12	S DR. AXLE	1	25	PEG	20	38	L CHAIN GEAR	2
13	ROD	1	26	O RING L	2	39	TUBE - A 200CM	1
							TOTAL	165





Every transmission system (gear train) contains gears. A gear is a useful and important transmission component, as it is a transmission method that applies to two shafts, or between a wheel and a shaft.

You can observe the transmission of meshing gears inside old toys or old clocks. There is a gearbox within the transmission system of cars, which combines meshing gears of different sizes. In this way, to change among different speeds becomes easy.

Do you know how gears work? Please carefully read the descriptions below. You will learn the secrets of gear trains from the world patent GIGO GEARS. The design of GIGO scientific educational building blocks ( that is GIGO SCIENCE-TOOL KIT ) is based on the number of 10 and its multiples; whether on the size of the components, the distance between the holes, or the unique GIGO gear tooth number. Therefore your child will be able to not only correctly assemble the gears, but also conveniently calculate the gear ratio or change the rotary speed. Different from other gear designs adopting the number of 8 or 7 as their fundamental number, GIGO gears are created with perfect designs for the use of scientific teaching, and express the care on children and passion for scientific education.

We suggest a gradual learning with GIGO gears which starts from the basic structures to understand the combinations of each component. Once you finish your practice following the examples in this instruction, and possess the fundamental concepts of gear trains, you can put your unlimited creativity into action and create various vehicles or airplanes on your own. Let's enjoy the pleasure of creativity!

The wheel which has many tooth-shaped objects sticking out of the rim with the same size is called a "gear". Two gears can mesh with each other with the teeth on the rims. When a gear rotates, the other one will be driven to rotate as well. The intermeshing teeth of the two gears transmit rotation and torque.

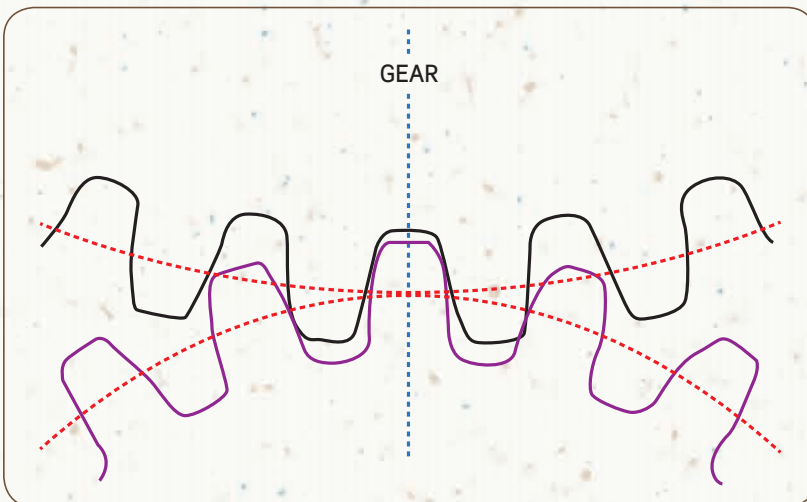


Fig. A  
The intermeshing of gears can effectively transmit rotation. The red circle represents the actual diameters of the transmission, which is called the pitch diameter. The fitting shape of the teeth assures the intermeshing and transmits power along the pitch.

A simple gear train uses two gears with the same or different sizes. If one of these gears is attached to a motor or a crank, it takes the role as the driver gear. The gear that is turned by the driver gear is called the driven gear. Gears are used to increase or decrease the speed or the power of rotary motion. The mechanism of changing the speed or power is called the gear ratio (speed ratio).

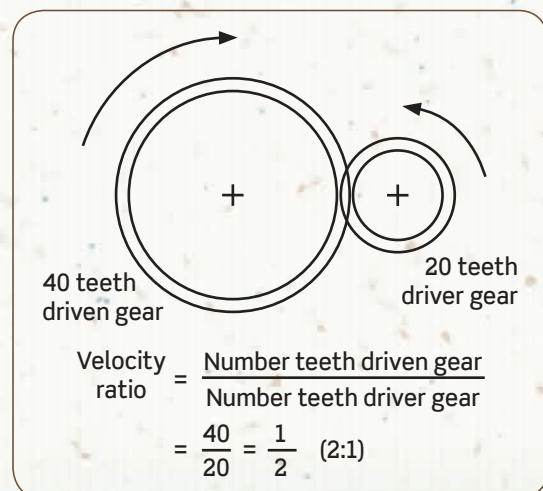


Fig. B  
Illustration of gear ratio calculation



The number of teeth between the big gear and small gear is different. Despite the teeth number or size of the gears, the teeth of the gears in the same gear set should have the same size. In simple gear trains, the driver and driven gears will rotate in opposite directions. When a third gear is inserted between the driver gear and driven gear, and makes them rotate in the same direction, it is called an idler gear.

The world patent gears designed by GIGO come in 5 different types: 20T, 40T, 60T, 80T, and 160T, the extra large gear.

Each of GIGO gear sets contains both spur and bevel gears. Gears of **HYDRO-PNEUMATIC** contain "Spur Gears" (gear wheel to gear wheel) meshing in the same plane and regulating speed or direction of turning of the shafts and "Bevel Gears" (the rounded off sections on one edge of your gears in the set) meshed together to change direction at right angles to the initial turning plane of the gears and shafts (axles).

The tooth shape of GIGO gears shares the same specification of module pitches=1. Namely, the pitch diameter of the 20T gears is 20mm while the pitch diameter of the 40T gears is 40mm. The pitch diameters refer to the imaginary circles between the meshed gear teeth as shown in Figure E.

The secret of GIGO designs for gears is to place the distance between each hole based on 10 or the multiples. In Fig. E, the distance between the centers of the two gears is

$$R1+R2 = \frac{20\text{mm}}{2} + \frac{40\text{mm}}{2} = 30\text{mm}$$

and therefore the two gears can be smoothly assembled or transmitted. Other sizes of GIGO gears are also designed with the same perfect concept, and their holes and gears can be greatly meshed and operated with each other!

\* According to the instruction above, can you figure out how many holes there are between a 40T and a 60T gear when they are meshed?

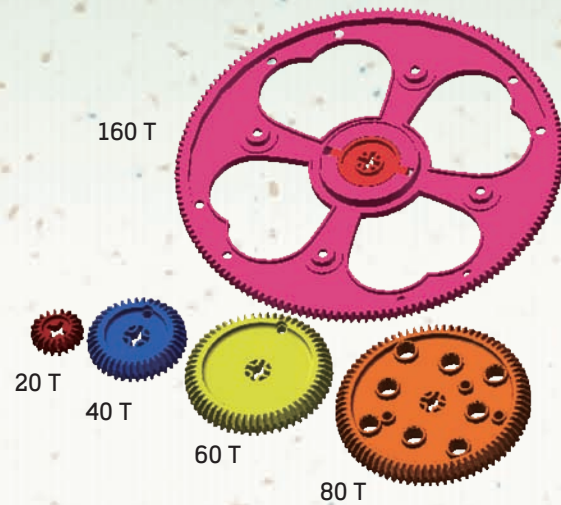


Fig. C GIGO Gears

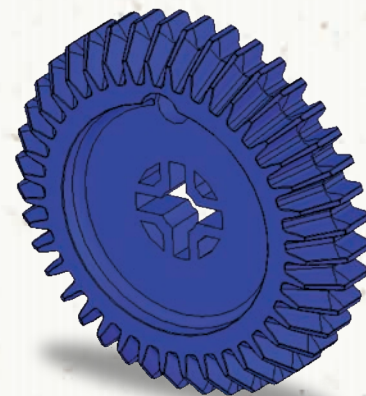


Fig. D Characteristics of GIGO gear teeth

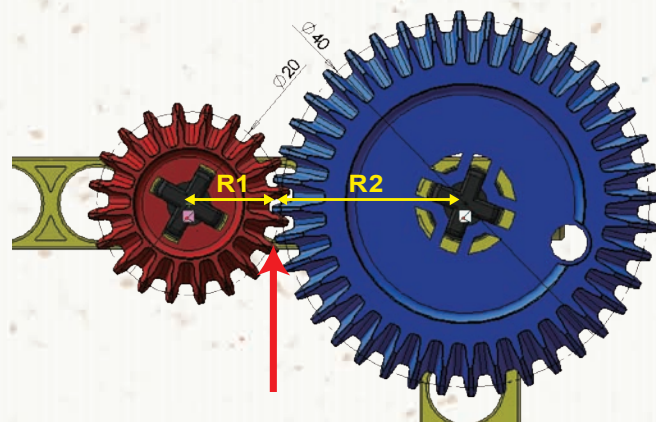
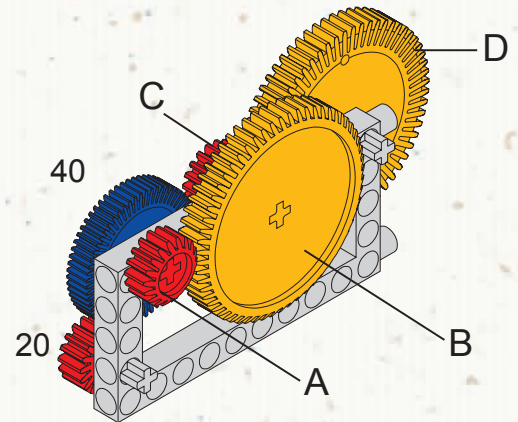
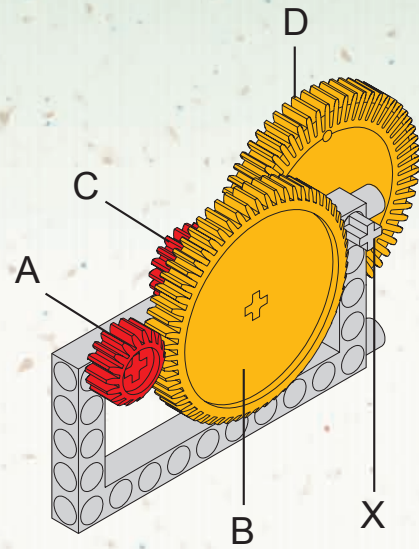


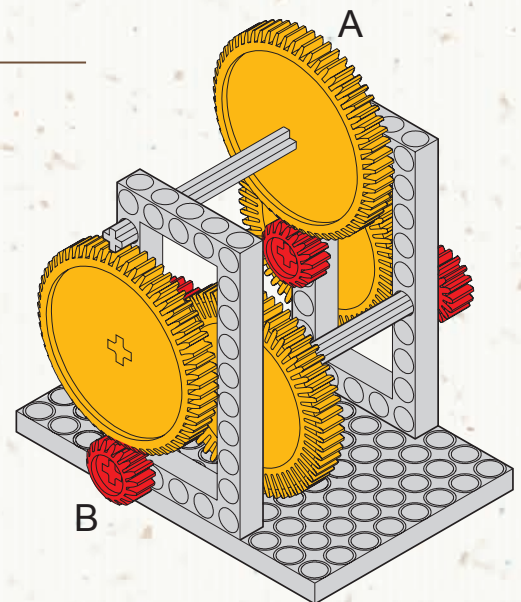
Fig. E The transmission between the pitches during the intermesh of two gears



1. Use two red 20-tooth gears and two yellow 60-tooth gears to make this system.
2. How many times do you have to turn the small gear A in order to make the second large gear D turn once?  
 The small gear A turning the large gear B gives a 3 to 1 ratio as you found out on the table.  
 The second small gear C is directly driven by the arrangement and produces another 3 to 1 ratio with the second large gear D.  
 Did you find out that you had to turn the small gear A 9 times to turn the second large gear D once?  
 The overall gear ratio of the system is 9 to 1. ( A gear ratio of 3 to 1 multiplied by another 3 to 1 = 9 to 1).
3. Add a third red 20-tooth gear to the short drive axle at (x). Why does it lock?
4. Add a blue 40-tooth and a red 20-tooth gear to the system. Can you work out mathematically what the gear ratio of system would be?  
 Count the number of turns. Were you right?

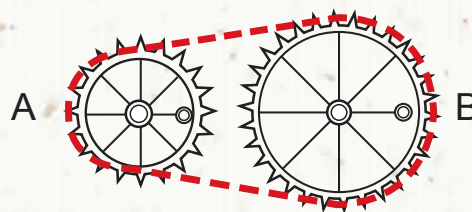
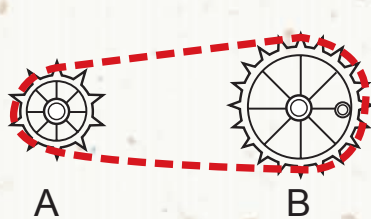
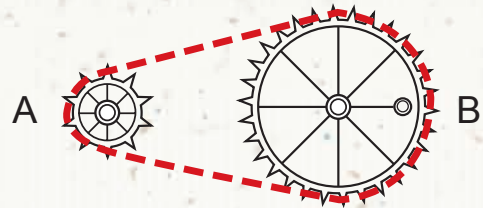


- 
1. This gear box uses a combination of red 20-tooth gears and yellow 60-tooth gears.  
 There are four pairs of red 20 and yellow 60-tooth gears. Each pair produces a gear ratio of 3 to 1.  
 The overall gear ratio would then be  $3 \times 3 \times 3 \times 3 = 81$ .  
 If gear B is turned 81 times then gear A would turn once.
  2. If gear A could be turned once then gear B would turn 81 times! Could you add another pair of gears to make a ratio of 243 to 1?

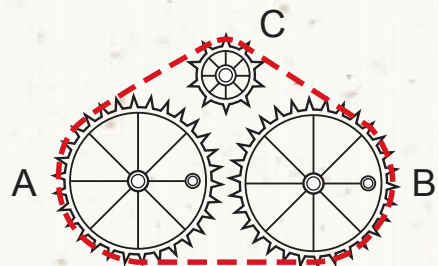




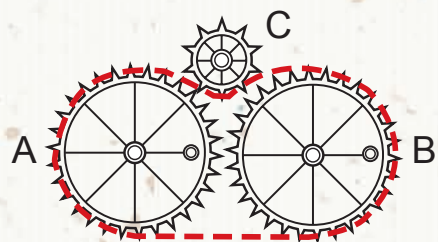
- The power transmission of chain gears depends on chains instead of meshing each other. The teeth of chain gears must go with chains. The “working” diameters of the chain gears are about 10mm (10-tooth), 20mm (20-tooth) and 30mm (30-tooth). Try to ensure that when connecting drive chains they are neither too tight nor too loose so that the motion of one is transmitted efficiently to the other. If the lengths can not exactly fit the distance a little looser will work better than a little tighter, only that the drive chains come off the chain gears. This system can be found in normal bikes or escalators.
- Connect a 10-tooth chain gear to a 30-tooth chain gear as shown.
- Use a pencil point, or something similar, to turn B.  
Which way does A turn?  
Would this be the same if A and B were two gears in mesh?  
How many times would you have to turn A for B to rotate once?  
The gear ratio of these two chain gears would be \_ to \_ ?
- Repeat the experiment for the two other arrangements and make a table of your results for all three.



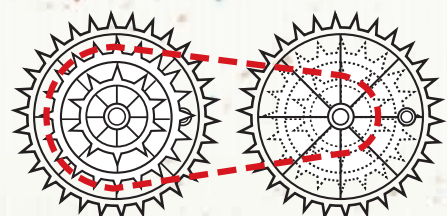
- Try chaining a 10-tooth chain gear and two 30-tooth chain gears together. Turn A clockwise.  
What happens to B and C?  
Do they turn in the same direction? Do they turn at the same speed?



- Try to chain the 10-tooth chain gear C as shown. Turn A clockwise. What happens to B and C?  
Do they turn in the same direction?  
Do they turn at the same speed?



- By connecting two sets of chain gears together three speeds can be obtained. This system is widely used in transmission bikes by adding a gear shift in between.



## FIXING BASE GRID, RODS AND FRAMES

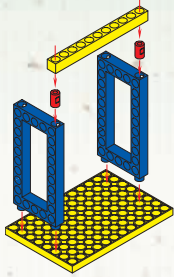


Fig. 1

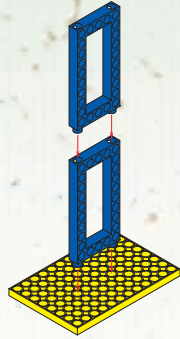


Fig. 2

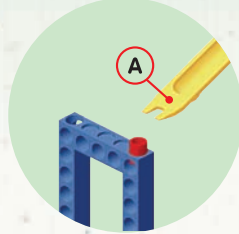


Fig. 3

1. The peg can be used to join rods and frames (Fig. 1).
2. Frames can be connected directly to each other end to end (Fig. 2).
3. Using the end "A" of the peg/axle remover to pull a peg off as Fig. 3 shows.

## FIXING GEARS

### Fixing gears to the frame

When fixing gears onto the frame with a drive axle, be sure to keep a proper space (about 1mm) between the gears and the frames. Try to turn the gear and confirm if every gear in the gear train can turn smoothly so that the least friction will be created and then the most efficient power transmission can be expected (Fig. 4 & 5).



**NG!** (without a space)  
Fig. 4



**OK!** (with a space)  
Fig. 5

### Gear fixing

Gear fixings are designed to prevent a pulley or gear from moving along the axle, or slipping. They are easy to be installed without removing any wheel or axle (Fig. 6).



Fig. 6

### Lengthening drive axes

Use a chain gear to connect two drive axes to lengthen when necessary (Fig. 7).



Fig. 7

### Arranging gear wheels in symmetry

When you use a power pack to drive a wheeled vehicle, the gear wheels should be arranged in symmetry (the holes on the two opposite chain gear wheels must be kept in a horizontal line) and be kept at the same driven speed, or the motor will stall and the vehicle won't move (Fig. 8).

**TIP!** These two holes must be kept in a horizontal line.

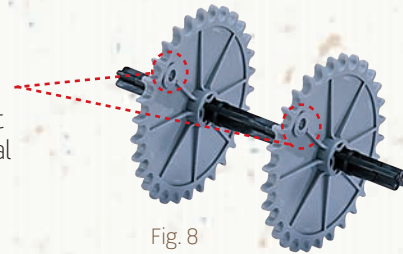


Fig. 8

### Meshing gears at 90°

When the two red gears mesh with each other at 90° the one on the drive axle must be assembled as close as possible to the outer end of the axle so that the mesh can be ensured (Fig. 9).



Fig. 9

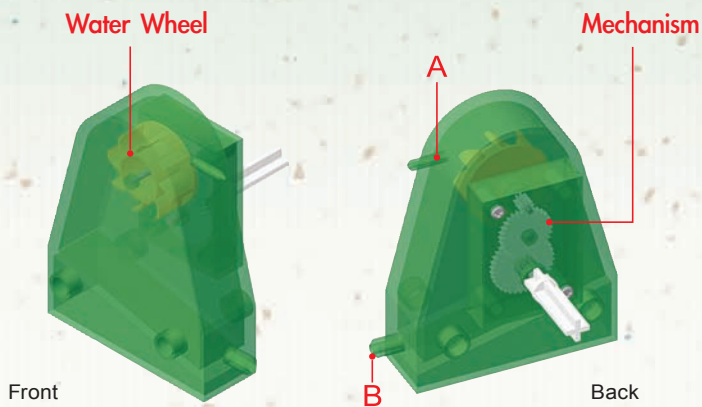
### Connecting unit chains

Ensure to get the face of each unit chain when connecting them to one another as a drive chain so that the transmission can be done efficiently and smoothly (Fig. 10).



Fig. 10

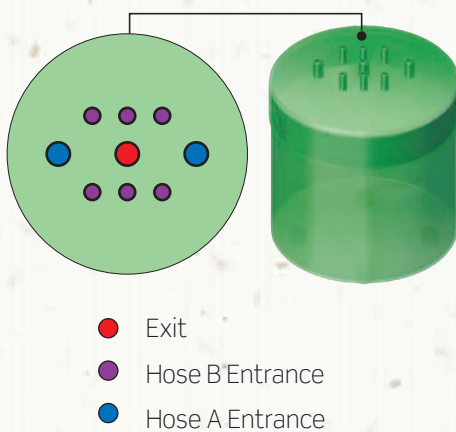




### Air-Water Power Pack

“A” is the entrance and “B” is the exit. Air and water enter the power pack through the entrance to strike the water wheel directly and drive the mechanism behind it. Then the water flows back to the Recycled Water Storage through the exit for repeated use.

### Recycled Water Storage



### Secured Pump

“A” is the entrance and “B” is the exit. The water in the Recycled Water Storage is driven by the Secured Pump to come into the Air-Water Storage. When the pump rod is pulled up, air and water will come into the Secured Pump through the entrance and then go out to the Air-Water Storage through the exit when the pump rod is pushed down.



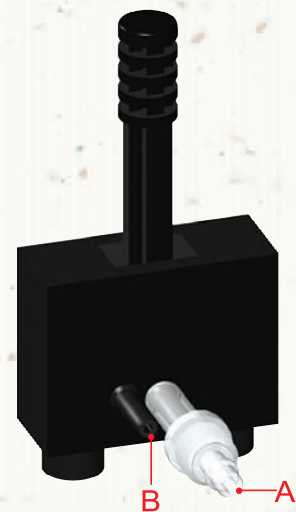
### Secured Air-Water Storage

“A” is the entrance and “B” is the exit. Air and water in the Secured Recycled Water Storage come into the Air-Water Storage through the entrance and go out through the exit.



### Secured One-Way Switch

“A” is the entrance and “B” is the exit. When the switch rod is in the middle, the exit is closed, and air and water come into One-Way Switch. When the switch rod is turned to the side of the entrance, the exit is opened and the air and water flow out.





### 1. NOTES FOR ASSEMBLY:

- Insert a 9.5cm long Tube A into the protrudent hole on the reverse side of the lid of the Recycled Water Storage, and cut its the other end on the bias (Fig. 11). To attach the bias-cut end to the inside bottom of the storage so that water will easily enter the hose when pumping.
- The lengths of hoses for the models given in this guide are for reference only. Be sure not to make the hoses too tight nor twisted or pressed (Fig. 12) in connection so that water can go through them smoothly.
- Put a Security Nut through a hose and screw it completely when connecting the hose to a secured basic part (Fig. 13 & 14).
- Use an L Security Nut for Tube A, and an S Security Nut for Tube B. The hoses might become stubborn and easily come off the connected part after repeated use. The solution is to cut off the stubborn end about 1-1.5cm long. Be sure to wipe the connected part dry with tissue paper before the refreshed hose is used again.
- The cut hoses can be repeatedly used for different models.

Fig. 11



Fig. 12



Fig. 13

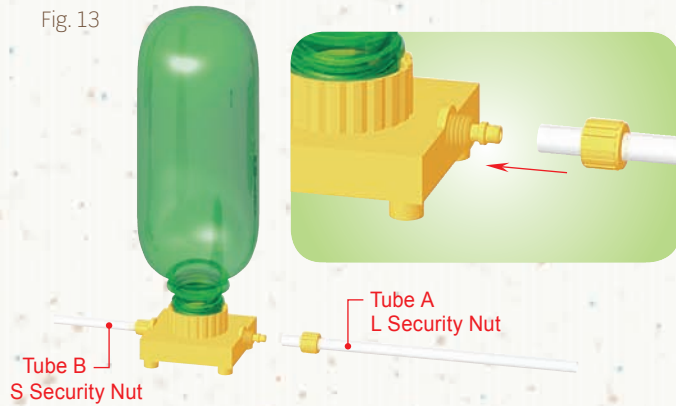
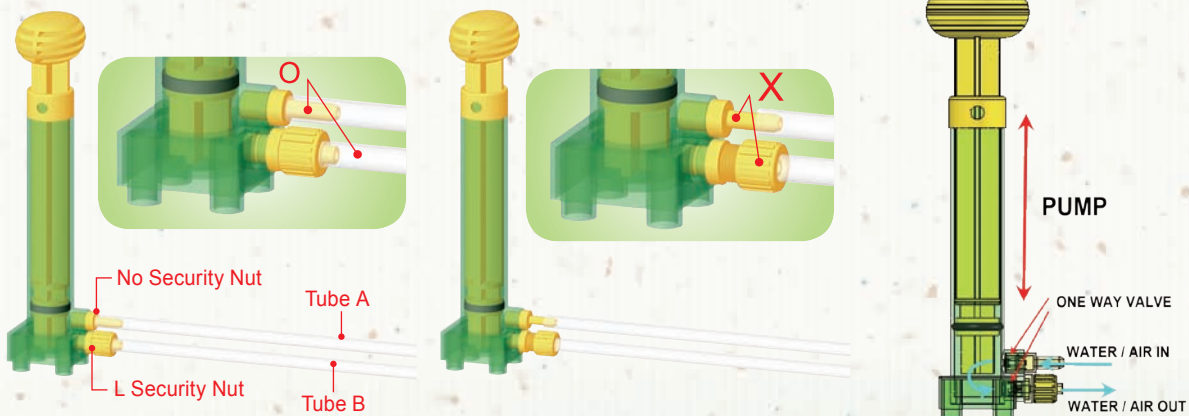


Fig. 14





## 2. NOTES FOR OPERATION:

- Check if all the hoses are fixed to the right positions before pumping.
- Check if all Switch Rods are put in the middle of the Switches (i.e. in a closed condition as Fig. 16 shows) before pumping so that the pumped air/water won't escape.
- The Switch Rod should be fixed a little tight so that air/ water leaking can be avoided. Don't hesitate if it needs some strength to move it.
- Check if the Air/Water Storage is screwed to the end (Fig. 15).
- Move the Pump from the model to the tabletop whenever you pump it, and put it back after you finish pumping (Fig. 17).
- The first 10 pumping is for pushing the water from the Recycled Water Storage to the Secured Air-Water Storage. Try to hold the pump rod up for 2-3 seconds before you push it down so that the most water can be driven into the pump cylinder in each pumping (Fig. 18).
- Pump no more or less than 50 times. If pumping over 50 times, the basic parts might be under too much pressure and become damaged. On the contrary, if pumping less than 50 times, the power might be too weak to lead to a smooth operation. The more the air is pumped into the basic part, the bigger the air pressure and the air power are caused ( $PV=nRT$ ).
- Don't pull off any hose either during the operation or before all the water gets back to the Recycled Water Storage. Otherwise, the water stream will spurt from the hose and might hurt you or spoil the surroundings.
- Once if hoses come off during the operation, please turn off the switch by shifting the switch rod back to the middle to stop the spurt of the water, and wipe the hose opening dry before refixing it on.
- Use the secured One-Way Switch to release the air/ water left in the Air-Water Storage before you put the models away.

Fig. 15

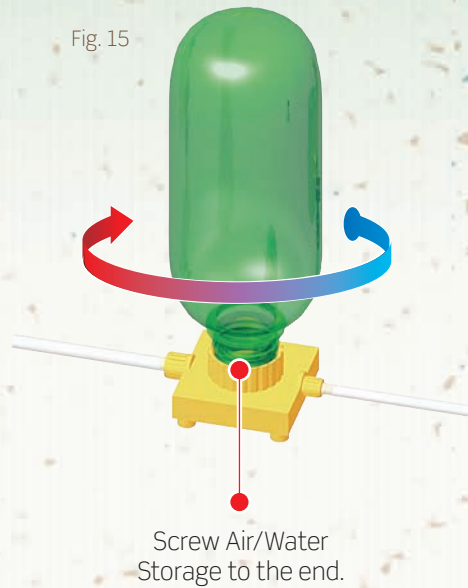


Fig. 16

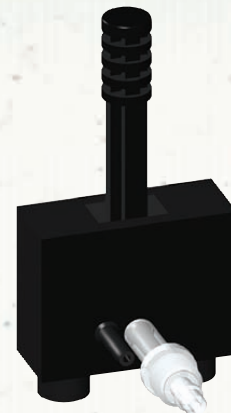


Fig. 17

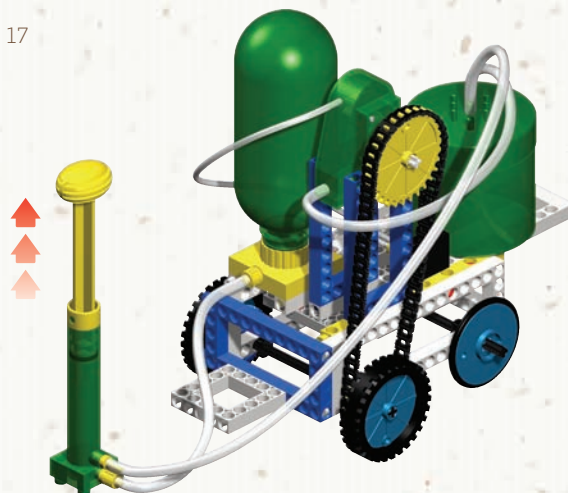


Fig. 18





### PRINCIPLES :

Each time as the Secured Pump drives the water from the Recycled Water Storage into the Secured Air-Water Storage, the water shall squeeze upward the entire air inside the Secured Air-Water Storage. Air is a compressible fluid, in other words, the volume of air can be reduced by compressing, whereas water cannot. When more and more water is added into the Secured Air-Water Storage, the water shall occupy more and more capacity. Since the space within the Secured Air-Water Storage is limited, the water which eventually occupies more and more space compresses the air inside the Secured Air-Water Storage. As a result the pressure inside is exceedingly higher than the air outside the Secured Air-Water Storage. This high-pressurized air pushes the entire water within the Secured Air-Water Storage, where the water shoves the lateral sides of the storage and attempt to escape to recover pressure equilibrium.

After the air pump draws water into the Secured Air-Water Storage and is then pumped for another 40 times, more air is pumped into the remaining fixed space occupied by water, and thus the inside air pressure is even higher.

These phenomena include many physical principles:

1. Water is incompressible, whereas air is compressible.
2. Boyle's law:  
For a fixed amount of gas kept at a fixed temperature, the product of the volume and pressure is constant.  
 $(P_1 \cdot V_1 = P_2 \cdot V_2)$   $(P_1 : P_2 = V_2 : V_1)$   
As more air is pressed inside the fixed volume, the air pressure shall rise.
3. Pascal's principle, also called Pascal's Law, is a term in fluid (gas or liquid) mechanics. It indicates pressure variation occurred with a part of the static fluid within the closed container, and transfers to every part of the fluid and to a part of the container wall without any loss.

How much energy is stored within the Secured Air-Water Storage?

According to the experiment, when the Secured Pump draws water into the Secured Air-Water Storage and is then pumped for another 40 times, the value is approximately 3.5kg/cm<sup>2</sup>

### EXPERIMENT



1. Use a pressure gauge not included in this set for inspection.
2. At initial state the value of the pressure gauge is zero.



3. Pump the water from the Recycled Water Storage into the Secured Air-Water Storage. By evenly pressing the Secured Pump for about 10 times.
4. At this point, the pressure is approximately 0.9kg/cm<sup>2</sup>.
5. Each time as the Secured Pump drives the water from the Recycled Water Storage into the Secured Air-Water Storage, the water shall squeeze upward the entire air inside the Secured Air-Water Storage. Air is a compressible fluid, in other words, the volume of air can be reduced by compressing, whereas water cannot. When more and more water is added into the Secured Air-Water Storage, the water shall occupy more and more capacity. Since the space within the Secured Air-Water Storage is limited, the water which eventually occupies more and more space compresses the air inside the Secured Air-Water Storage. As a result the pressure inside is exceedingly higher than the air outside the Secured Air-Water Storage.



6. Pump the Secured Pump another 40 times.
7. Pumping steadily to perform a completed stroke as possible as you can, the value is approximately 3.5kg/cm<sup>2</sup>.
8. When more air is pumped into the remaining fixed space, the air pressure inside is even higher.



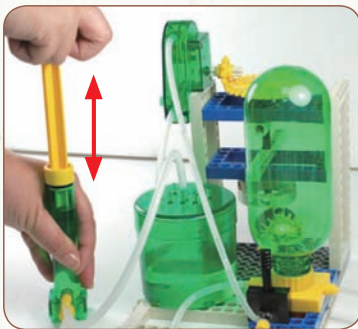
1 atmospheric pressure (atm)  
 = 76 cm-Hg  
 = 76\*13.6 (density of mercury)  
 = 1033.6 cm-Hg = 10.336 m-Hg

3.5kg/cm<sup>2</sup> compressed air is equal to 3.4 atm. If it is compared to potential energy, 1 atmospheric pressure (atm) = 10.336m-Hg, 3.5kg/cm<sup>2</sup> = 35 m height of water column pressure (it can be compared to the height of a 10-story building). Therefore the created energy via air pumping and stored within the pressure storage tank, can push and run your various unique assembled models.



## HOW TO OPERATE

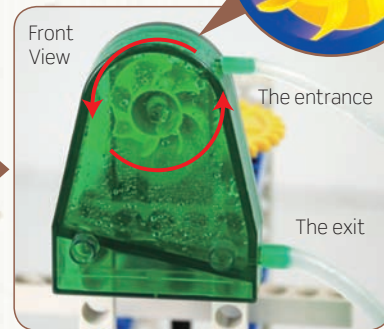
1. Pump the Secured Pump about 10 times to get all water from Water-Recycled Storage to Secured Air-Water Storage and keep pumping another 40 times to compress the air in the Secured Air-Water Storage.
2. Then turn the rod of the Secured One-Way Switch to open it.
3. The released water will jet out to strike the blades of the water wheel to activate the Air-Water Power Pack and drive the mechanism behind it, and then flows back through the exit to the Recycled Water Storage for repeated use.



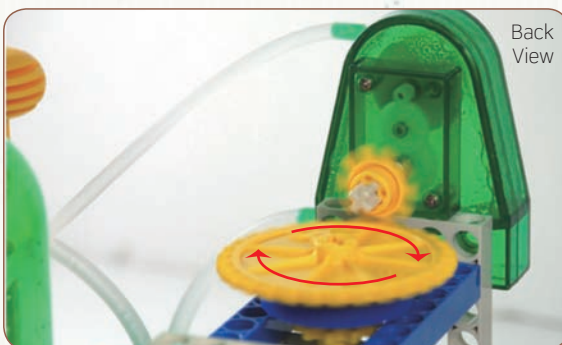
**Step 1** Pump 50 times.



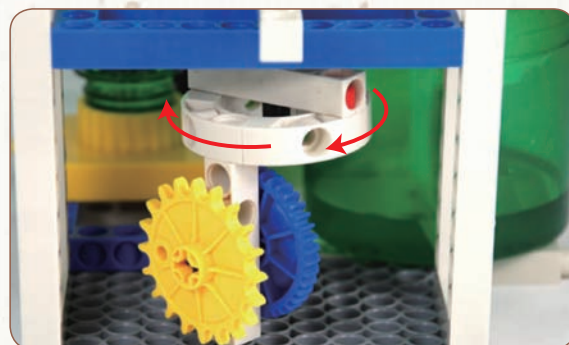
**Step 2** Turn on the switch.



**Step 3** To activate the Air-Water Power Pack.



To drive the mechanism behind it.



The model works!

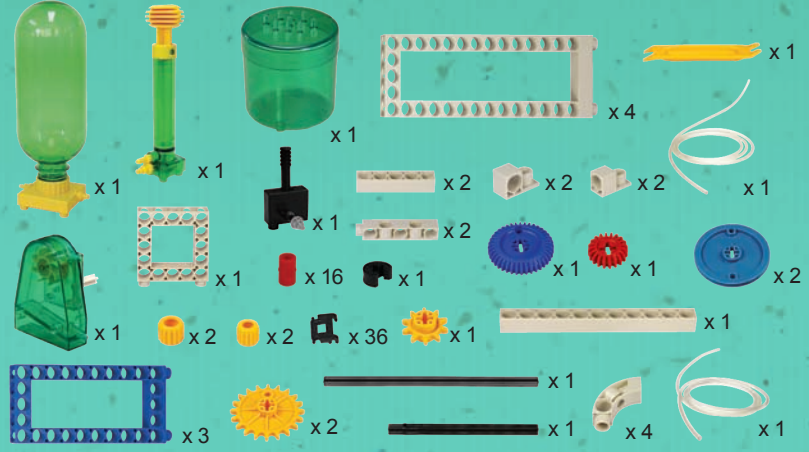


# WATER POWER | MODEL 1 Cutting Machine

## Cutting Machine



### Parts Needed

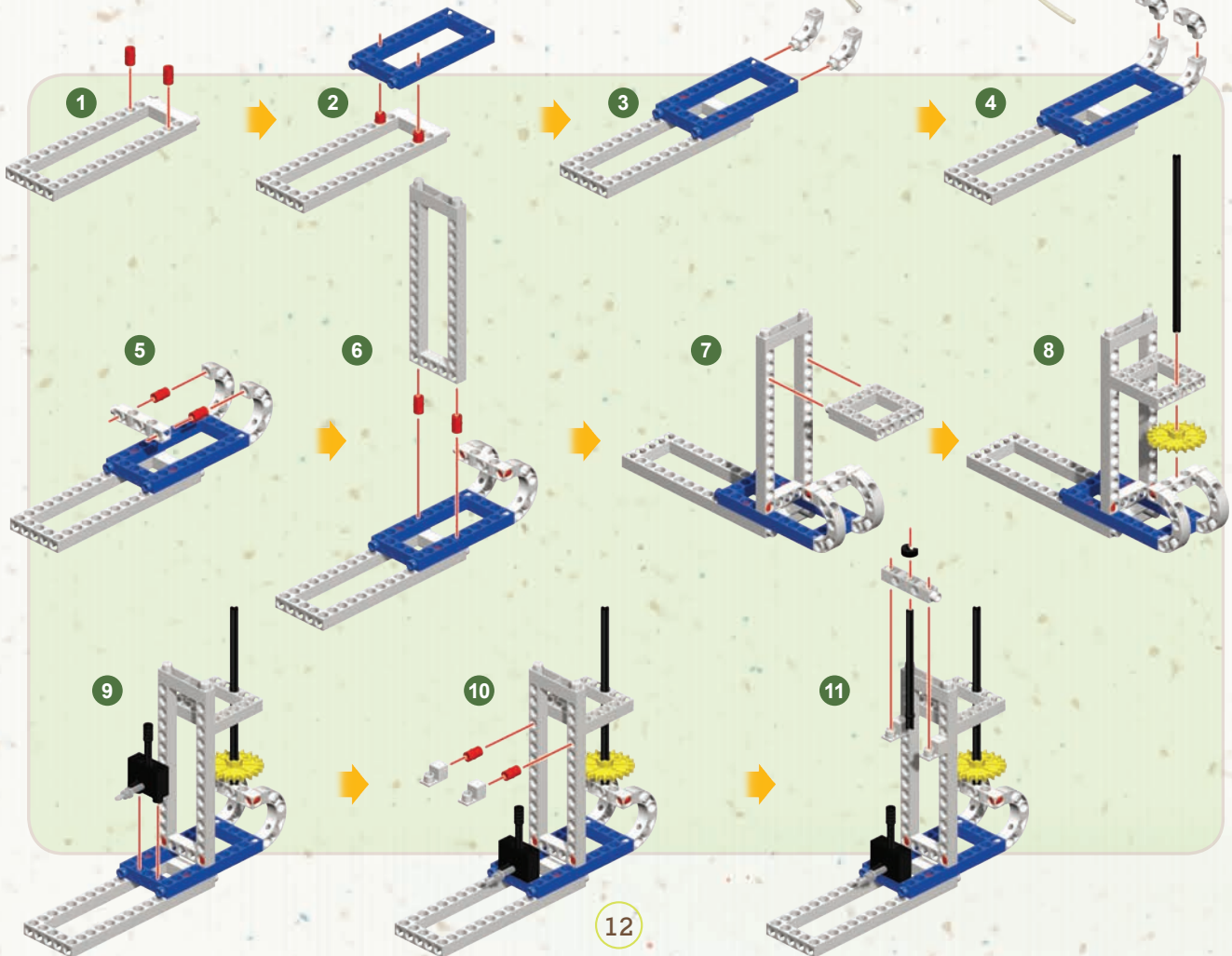
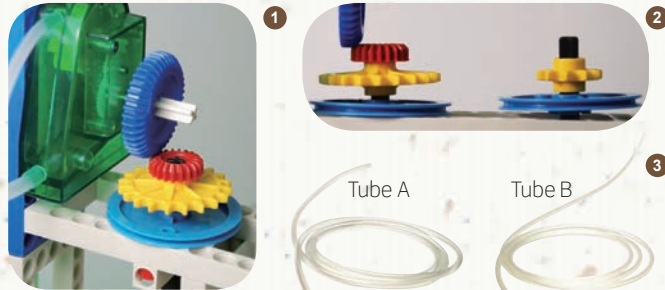


### Notes for Assembly

1. The gears should be meshed with each other well in order to operate smoothly.
2. Note that the chain gears are to be aligned in order for the chain to operate smoothly.
3. Cut Tube A and Tube B to get the tubes in following lengths for this model.

**Tube A:** 9.5cm x1, 30cm x1, 37cm x1, 44cm x1

**Tube B:** 25cm x1, 35cm x1



# MODEL 1 Cutting Machine | WATER POWER



12 13 14 15 16 17 18 19

20 21 22 23 24

25 26 27 28

29 30 31 32

cut on the bias  
Tube A : 9.5cm

Tube A : 30cm

Tube B : 25cm

Connecting the Security Nut

S SECURITY NUT X 2

Tube B : 35cm

Tube A : 37cm

L SECURITY NUT X 2

Tube A : 44cm

Completed

13





# MODEL 2 Grinder | WATER POWER



**14** **15** **16** **17** **18**

**19** **20** **21** **22**

**23** **24** **25**

**26** **27**

**28** **29**

**15** **Completed**

cut on the bias  
Tube A : 9.5cm

Tube A : 30cm

Tube B : 35cm

Tube B : 25cm

Connecting the Security Nut

S SECURITY NUT X 2

Tube A : 37cm

L SECURITY NUT X 2

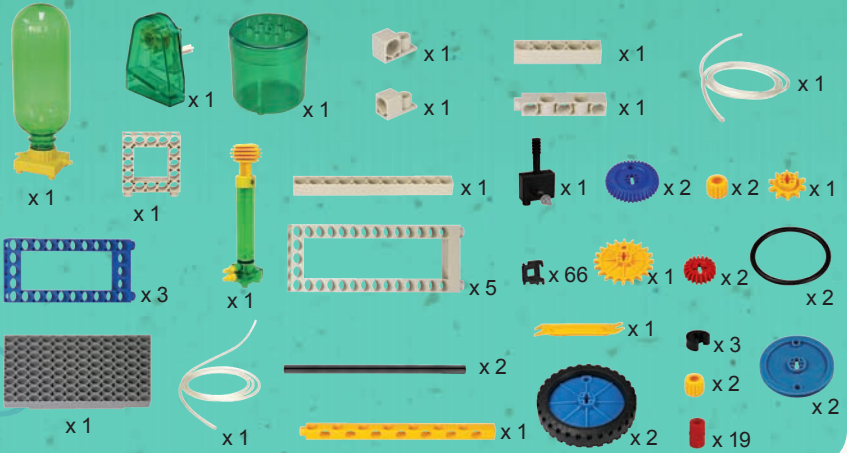
Tube A : 44cm



Truck



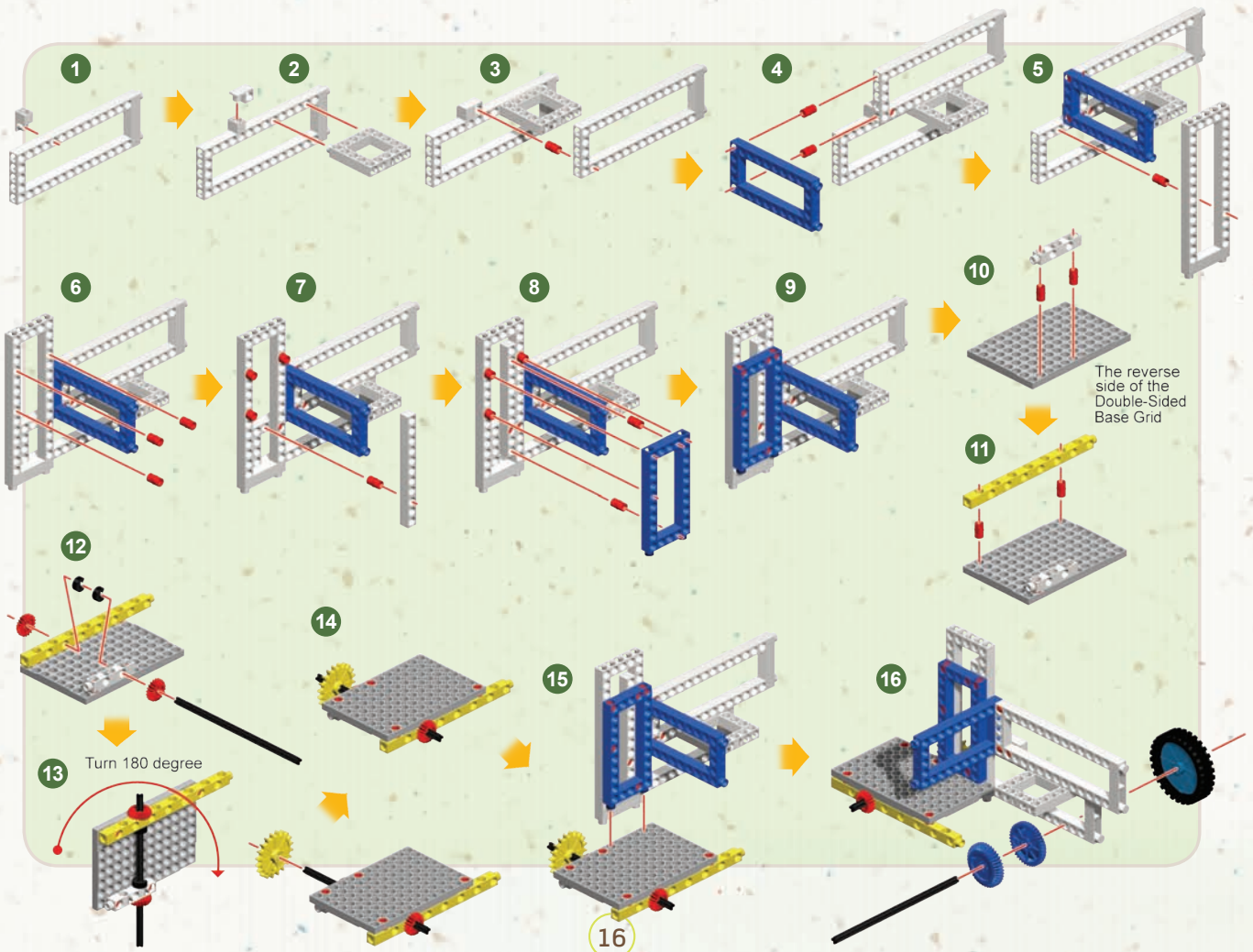
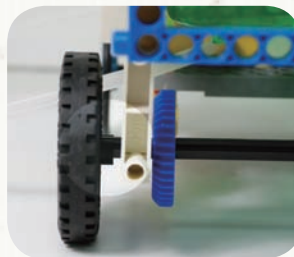
Parts Needed



Notes for Assembly

1. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
2. Cut Tube A and Tube B to get the tubes in following lengths for this model.

Tube A: 9.5cm x1, 30cm x1, 37cm x1, 44cm x1  
 Tube B: 25cm x1, 35cm x1



# MODEL 3 Truck | WATER POWER



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cut on the bias  
Tube A : 9.5cm

23

24

25

26

27

L SECURITY NUT X 1

28

29

x 66

Tube A : 30cm

30

31

Tube B : 35cm

32

Connecting the Security Nut

Tube B : 25cm

S SECURITY NUT X 2

33

Tube A : 37cm

34

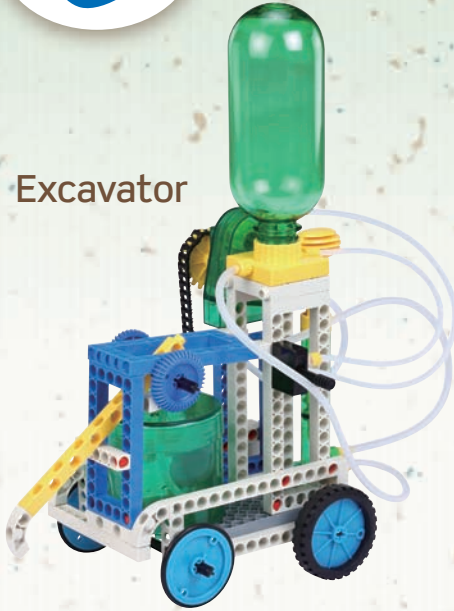
Tube A : 44cm

L SECURITY NUT X 1

Completed



Excavator



### Parts Needed

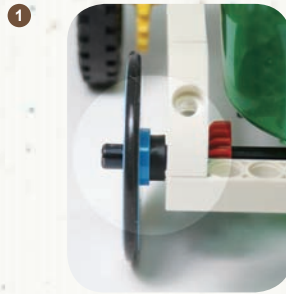
				x 2				x 2	
	x 1		x 1		x 2		x 1		x 1
	x 1		x 2		x 1		x 2		x 2
	x 3		x 17		x 4		x 2		x 1
	x 1		x 1		x 4		x 73		x 4
			x 1		x 1		x 1		x 2
			x 2		x 2		x 3		x 1
			x 1		x 1		x 2		x 2

Notes for Assembly

1. Note that the chain wheel is to be aligned in order for the chain to operate smoothly.
2. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
3. Cut Tube A and Tube B to get the tubes in following lengths for this model.

**Tube A:** 9.5cm x1, 30cm x1, 37cm x1, 44cm x1

**Tube B:** 25cm x1, 35cm x1



1. Attach a grey Technic beam 1x10 to a grey Technic plate 4x4.

2. Attach a grey Technic beam 1x10 to the top of the frame.

3. Attach a grey Technic beam 1x10 to the side of the frame.

4. Attach a black Technic axle pin to the side of the frame.

5. Attach a blue Technic frame 1x3 to the top of the frame.

6. Attach a grey Technic bush to the side of the frame.

7. Attach a grey Technic bush to the side of the frame.

8. Attach a blue Technic frame 1x3 to the side of the frame.

9. Attach a grey Technic bush to the side of the frame.

10. Attach a grey Technic bush to the side of the frame.

cut on the bias  
Tube A : 9.5cm

# MODEL 4 Excavator | WATER POWER



**11** → **12** → **13** → **14** → **15** → **16** → **17**

**18** → **19** → **20** → **21**

**22** → **23** → **24** → **25** → **26**

**27** → **28** → **29** → **30**

**31** → **32** → **19** → **Completed**

For L SECURITY NUT

For S SECURITY NUT

Tube A : 30cm

Tube B : 35cm

Connecting the Security Nut

Tube B : 25cm

S SECURITY NUT X 2

Tube A : 37cm

L SECURITY NUT X 2

Connecting the Security Nut

Tube A : 44cm



Detective Car



**Parts Needed**

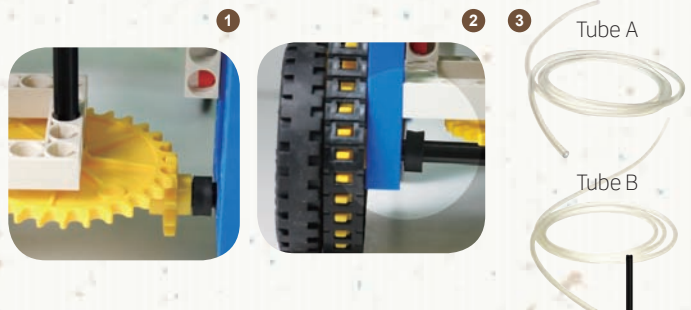
	x1		x1		x1		x1		x2		x2		x20		x2		x2		x1
	x1		x1		x1		x1		x1		x1		x2		x2		x2		x1
	x1		x2		x2		x1		x2		x2		x2		x2		x2		x1

Notes for Assembly

1. The gears should be meshed with each other well in order to operate smoothly.
2. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
3. Cut Tube A and Tube B to get the tubes in following lengths for this model.

Tube A : 9.5cm x1, 30cm x1, 37cm x1, 44cm x1

Tube B : 25cm x1, 35cm x1



The reverse side of the Double-Sided Base Grid should be assembled upwards.

# MODEL 5 Detective Car | WATER POWER



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34

35

Completed

cut on the bias  
Tube A : 9.5cm

Tube A : 30cm

Tube B : 35cm

Connecting the Security Nut

Tube B : 25cm

S SECURITY NUT X 2

Tube A : 37cm

L SECURITY NUT X 2

Tube A : 44cm



Tank



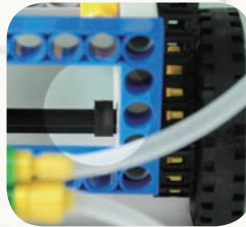
**Parts Needed**

x1	x1	x2	x2	x2	x2	x2
x1	x1	x1	x2	x18	x4	x2
x1	x1	x1	x2	x2	x2	x2
x1	x1	x3	x1	x1	x1	x1
x1	x1	x1	x1	x1	x1	x1
x3	x1	x2	x2	x1	x1	

Notes for Assembly

1. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
2. Cut Tube A and Tube B to get the tubes in following lengths for this model.

**Tube A:** 9.5cm x1, 30cm x1, 37cm x1, 44cm x1  
**Tube B:** 25cm x1, 35cm x1



1

2



1. Attach red pins to the grey base plate.
2. Attach grey Technic beams to the pins.
3. Attach yellow Technic beams to the grey beams.
4. Attach red pins to the yellow beams.
5. Attach black axles to the red pins.
6. Attach black axles to the red pins.
7. Attach black axles to the red pins.
8. Attach blue wheels to the black axles.
9. Attach blue wheels to the black axles.
10. Attach blue wheels to the black axles.
11. Attach blue wheels to the black axles.
12. Attach blue wheels to the black axles.



# MODEL 6 Tank | WATER POWER



**13** **14** **15** **16**

**17** **18** **19** **20**

**21** **22** **23** **24** Tube A : 30cm

**25** Tube B : 35cm **26** Tube B : 25cm Connecting the Security Nut S SECURITY NUT x 2

**27** Tube A : 37cm **28** Tube A : 44cm L SECURITY NUT x 2

**23** Completed

cut on the bias  
Tube A : 9.5cm

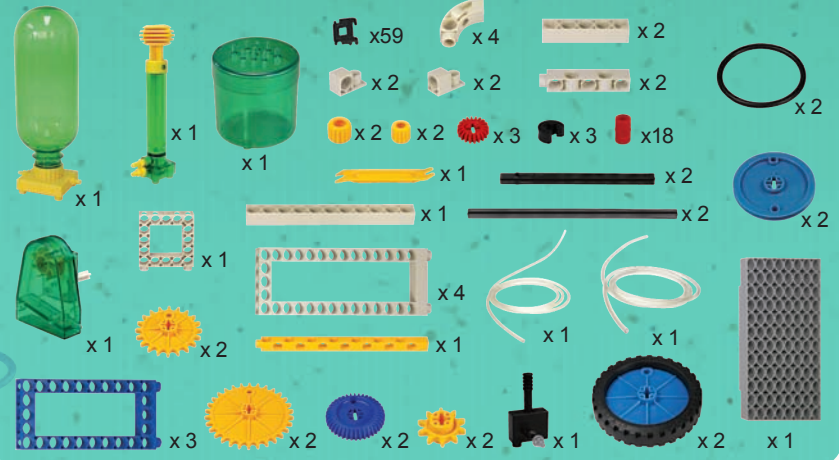
x75



### Antique Car



#### Parts Needed

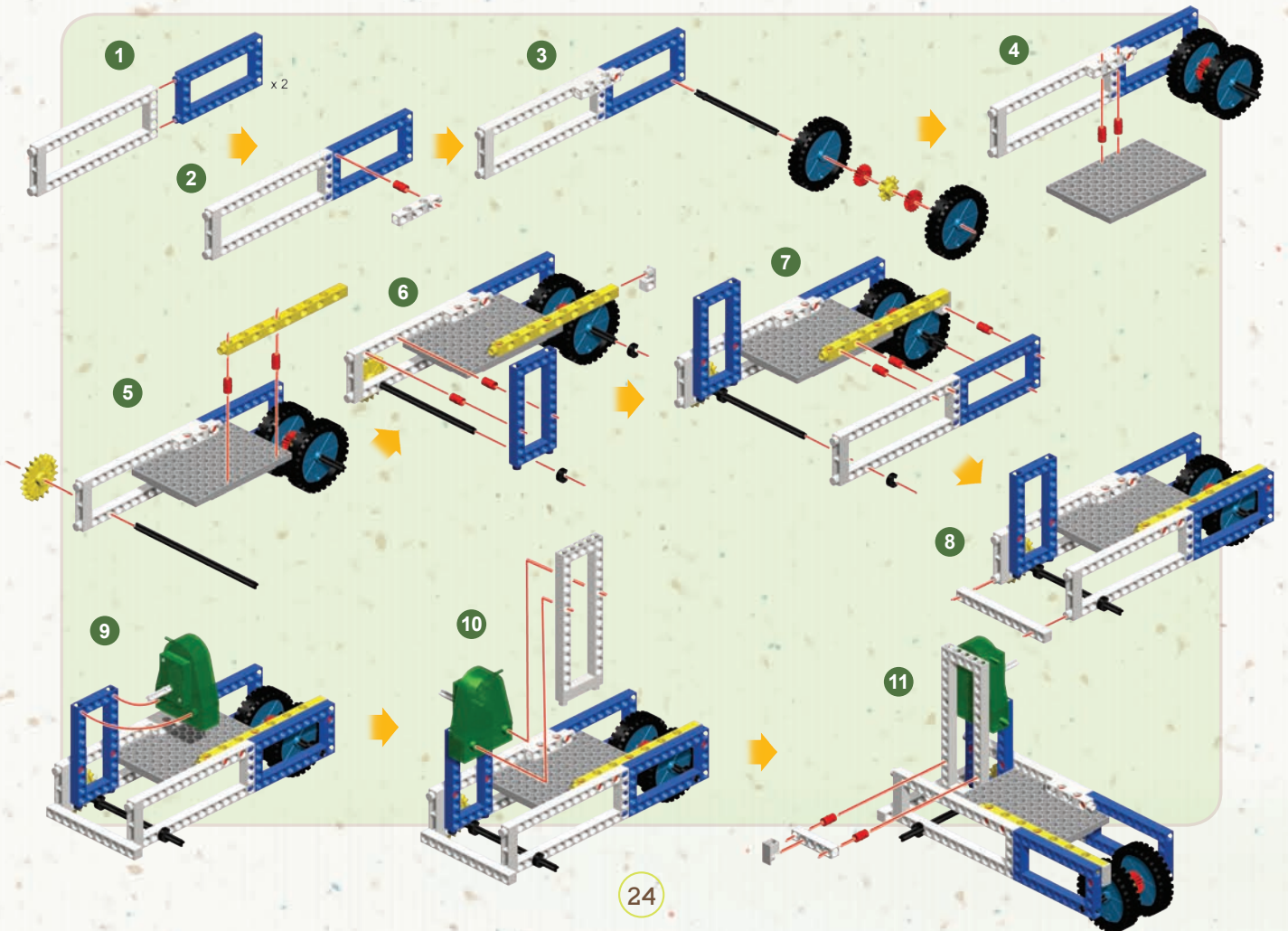
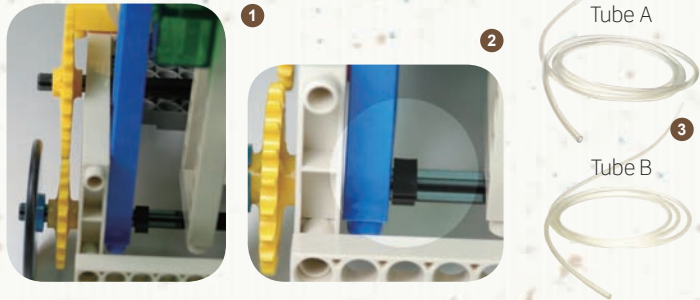


#### Notes for Assembly

1. Note that the chain wheel is to be aligned in order for the chain to operate smoothly.
2. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
3. Cut Tube A and Tube B to get the tubes in following lengths for this model.

Tube A: 9.5cm x 1, 30cm x 1, 37cm x 1, 44cm x 1

Tube B: 25cm x 1, 35cm x 1



# MODEL 7 Antique Car | WATER POWER



**12** **13** **14** **15** **16** **17** **18** **19** **20** **21** **22** **23** **24** **25** **26** **27** **28** **29** **30** **31** **32**

cut on the bias  
Tube A : 9.5cm

Tube A : 30cm

Tube B : 35cm

Tube A : 37cm

L SECURITY NUT x 2

Tube B : 25cm

Connecting the Security Nut

S SECURITY NUT X 2

Tube A : 44cm

Completed

**25**



## WATER-JET VEHICLES

Water-Jet Vehicles are included in HYDRO-PNEUMO MODELS without water recycling system, which consist of two separate parts - the vehicle itself and the launcher, different from HYDRO-PNEUMO MODELS with water recycling system, of which all parts are built in a complete unit.

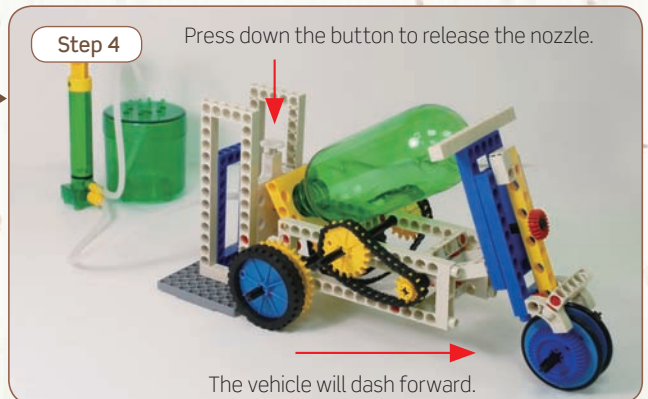
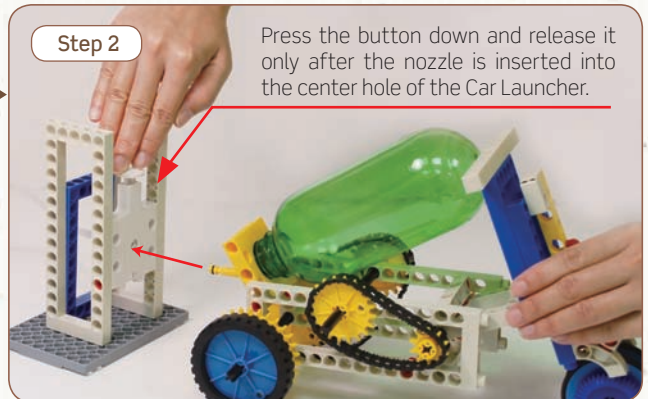
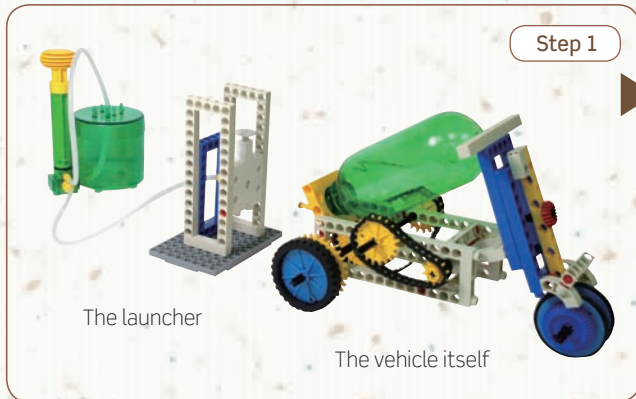
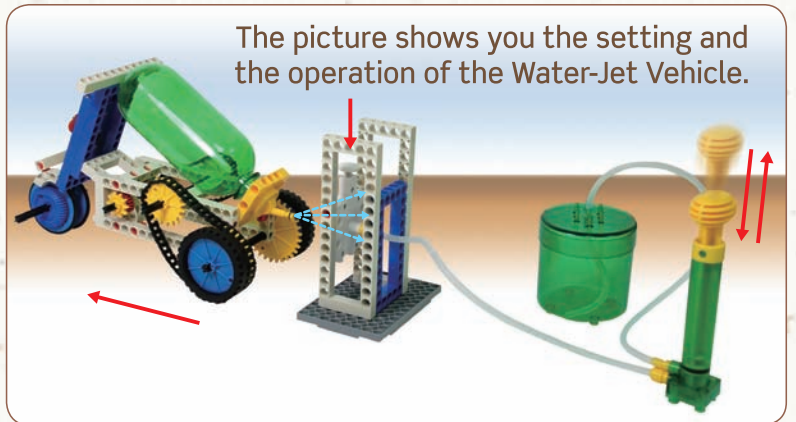
## PRINCIPLE

Newton's Third Law of Motion: When two objects interact, the force from each acts on the other with the same intensity but in opposite directions. This law is also known as the "Law of action and reaction."

## HOW TO OPERATE

Please follow the following steps to operate.

1. Build up a model of Water-Jet Vehicles according to the illustration given in this instruction manual.
2. Pressing down the button on the Car Launcher on the launcher part and insert the nozzle of the Secured Air/Water Storage on the vehicle part into the center hole of the Car Launcher and then release the button so that the vehicle itself and the launcher are joined well together.
3. Pump the Secured Pump about 50 times until all the water comes from the Recycled Water Storage to the Secured Air/Water Storage and the air in it is properly compressed.
4. Press down the button on the Car Launcher to release the nozzle, the vehicle will instantly jet out the highly pressurized water column from the nozzle and dash forward.





## EXPERIMENT:

Adding water into the Water Recycled Storage

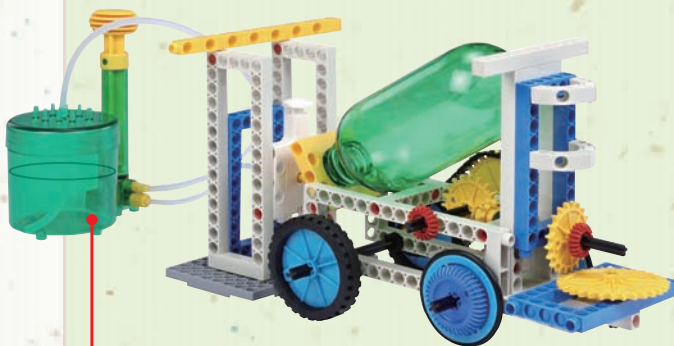
With the same volume, the mass of water is much greater than that of air and thus will enhance the reaction force according to Conservation of Momentum (Newton's Third Law of Motion). However, too much water added will reduce the space for the air and diminish the generation of kinetic energy. Then, what is the best amount of water? This is an issue worth experimenting.



Without water to be pumped

### (1) No water is added

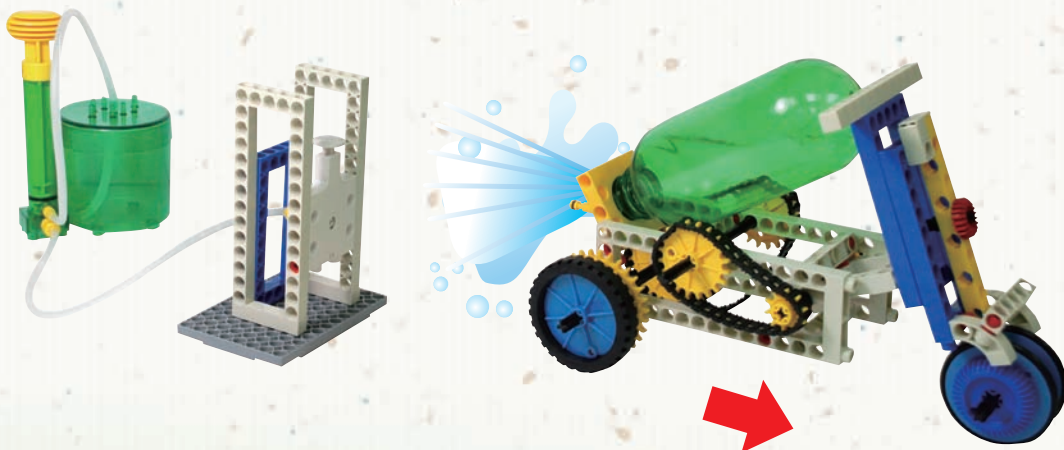
If no water is added, no water will enter the Secured Air-Water Storage, the limited air in the storage will dash out as soon as the nozzle is opened, which leads to a minor change on momentum for the Water-Jet Vehicle. As a result, the Water-Jet Vehicle moves forward at a low speed within a shorter distance.



With water halfway full

### (2) Adding water until halfway full

Adding water into the Recycled Water Storage about half of the way full. Then, using the Secured Pump to draw water into the Secured Air-Water Storage, and pumping air into the storage as well. At this time, since the volume of the Secured Air-Water Storage remains the same, the air density in the storage increases with more and more air molecules pumped into. These air molecules keep moving and colliding with each other even when the pumping is stopped, and they generate a constant total momentum, which always equals to the sum of the momentum of each molecule, verifying Conservation of Momentum. As shown in the Momentum formula: Momentum (Force) = Mass (M) × Velocity (V) and the Pascal's Principle: P (Pressure) = F (Force) / A (Area), it can be figured out that when the area is fixed, force will increase if pressure enhances. Therefore, using the identical Secured Air-Water Storage (to fix the area), a greater force to run the Water-Jet Vehicle farther can be derived by adding greater pressure.





## Rocket Car

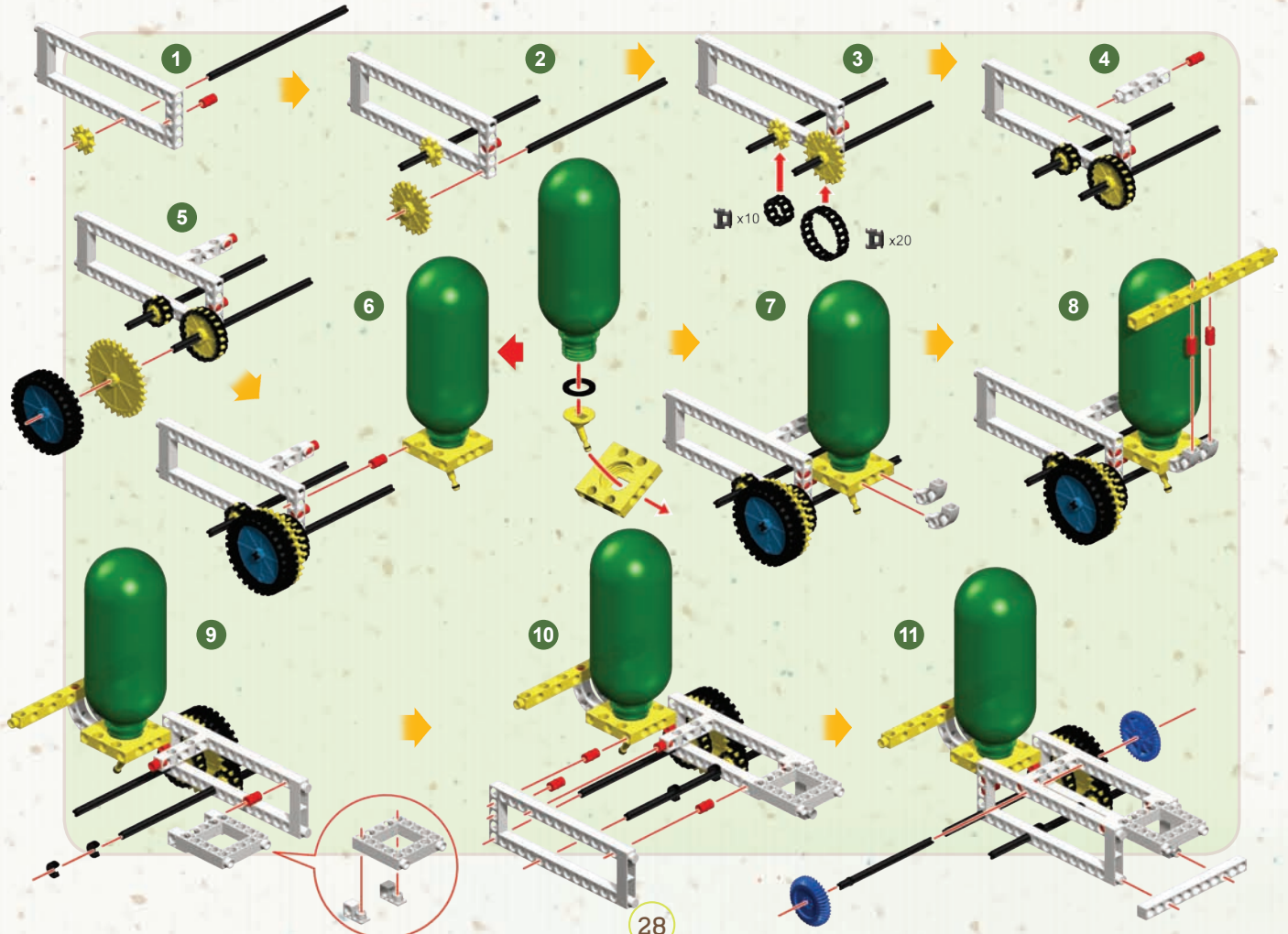


**Parts Needed**

x1	x1	x1	x60	x4	x2	x2
x1	x1	x1	x2	x2	x2	x2
x1	x1	x1	x2	x2	x3	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20
x1	x1	x1	x1	x1	x2	x20

## Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. Leave a 1mm gap between the gear and the long frame in order for the wheel to turn smoothly.
3. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1



# MODEL 8 Rocket Car | WATER POWER



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Rocket Car Completed

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Tube A : 21cm

Connecting the Security Nut

L SECURITY NUT x 2

Tube A : 40cm

cut on the bias

Tube A : 9.5cm

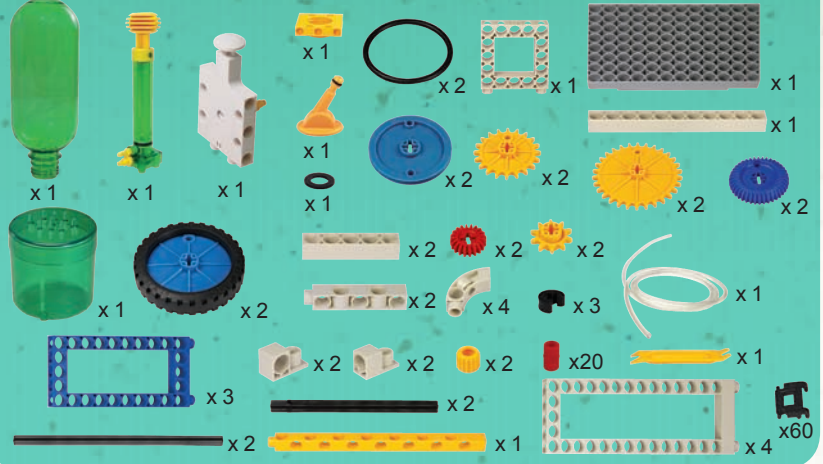
Launcher Completed



Excavator

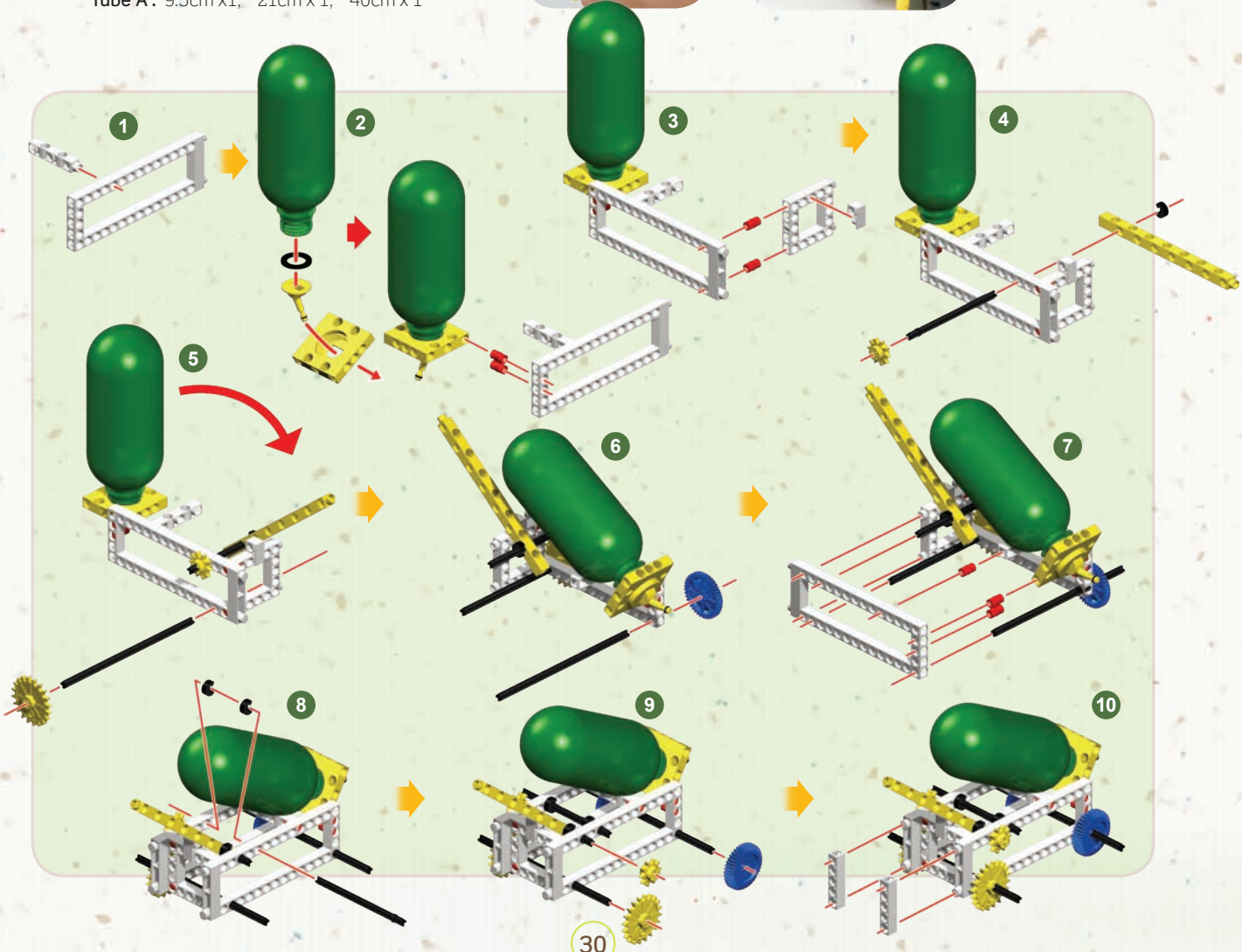
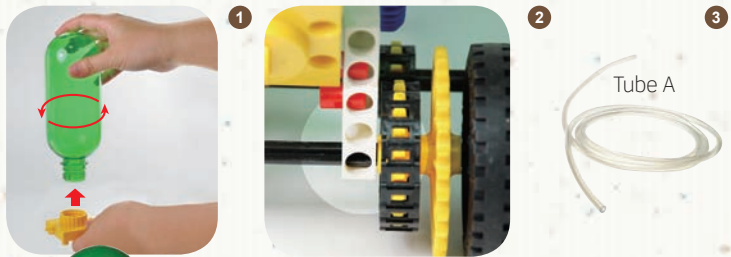


Parts Needed



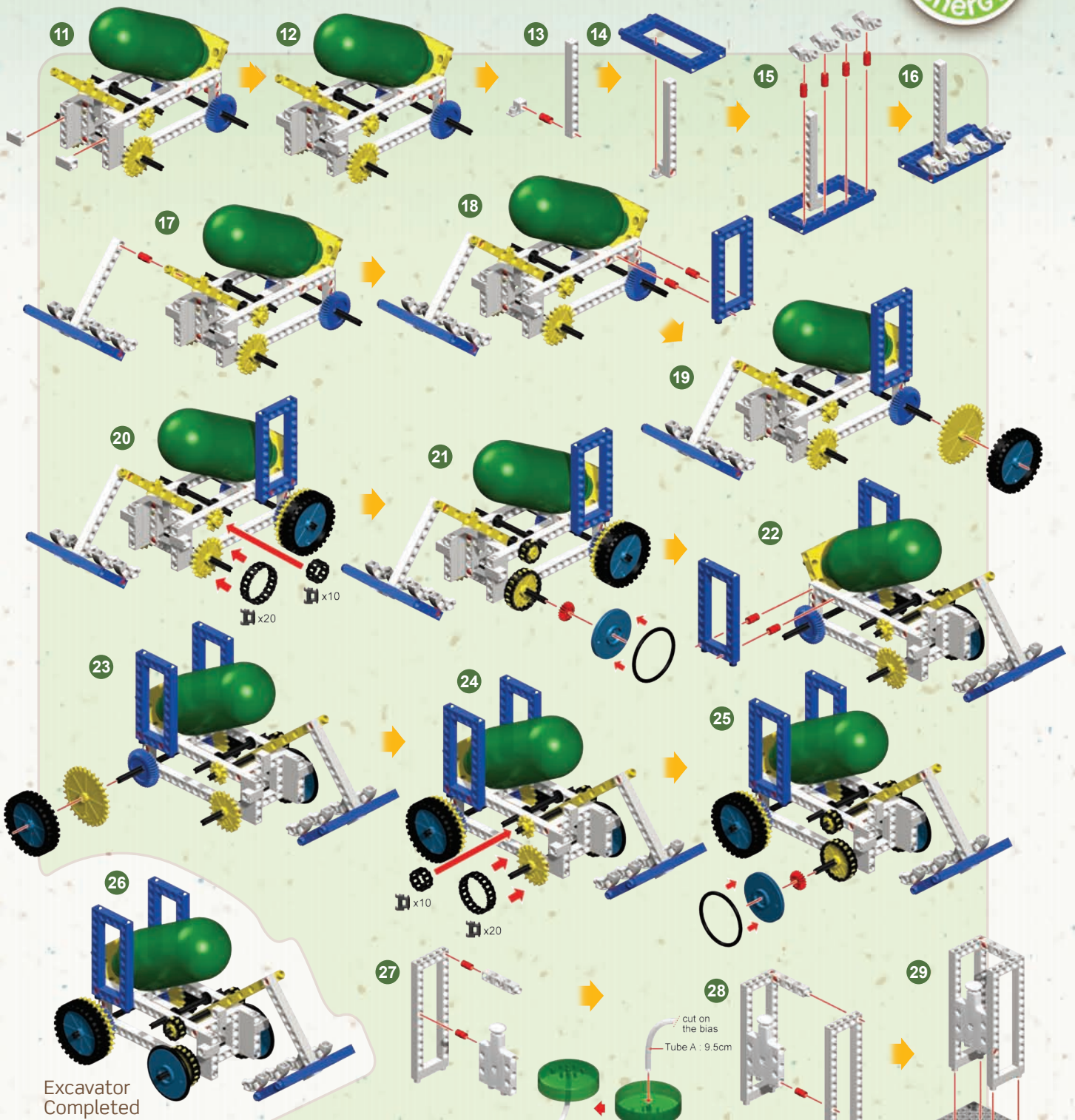
Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. Leave a 1mm gap between the gear and the long frame in order for the wheel to turn smoothly.
3. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1

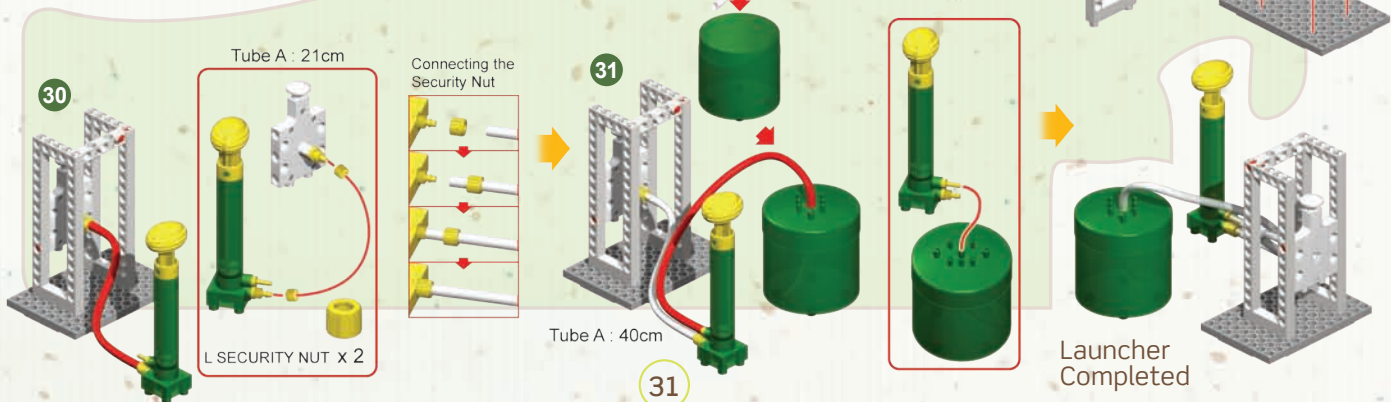




# MODEL 9 Excavator | WATER POWER



Excavator Completed



Tube A : 21cm

Connecting the Security Nut

L SECURITY NUT X 2

Tube A : 40cm

Launcher Completed



# MODEL 10 Heavy Motorbike | WATER POWER



**15** **16** **17** **18** **19** **20** **21** **22** **23** **24** **25** **26** **27** **28** **29** **30** **33**

**Heavy Motorbike Completed**

**Launcher Completed**

Tube A : 21cm

Connecting the Security Nut

L SECURITY NUT X 2

Tube A : 40cm

Tube A : 9.5cm

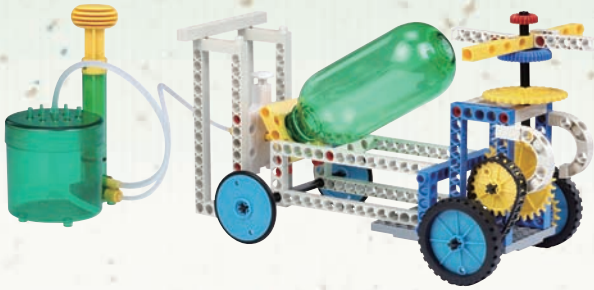
cut on the bias

x47

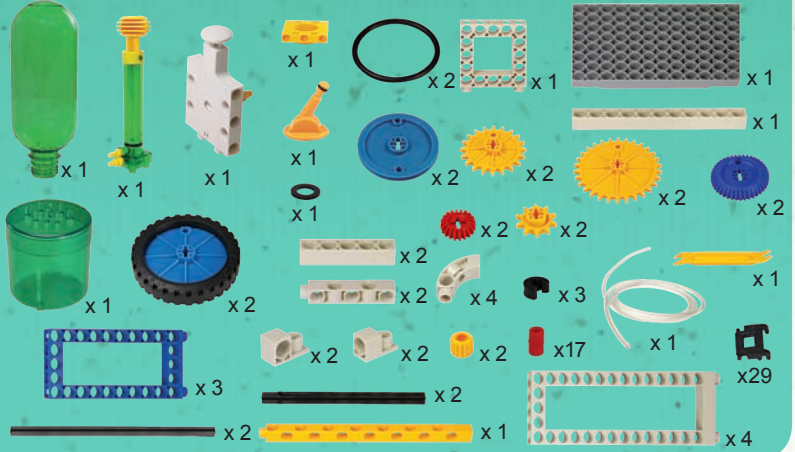
x32



### Helicopter

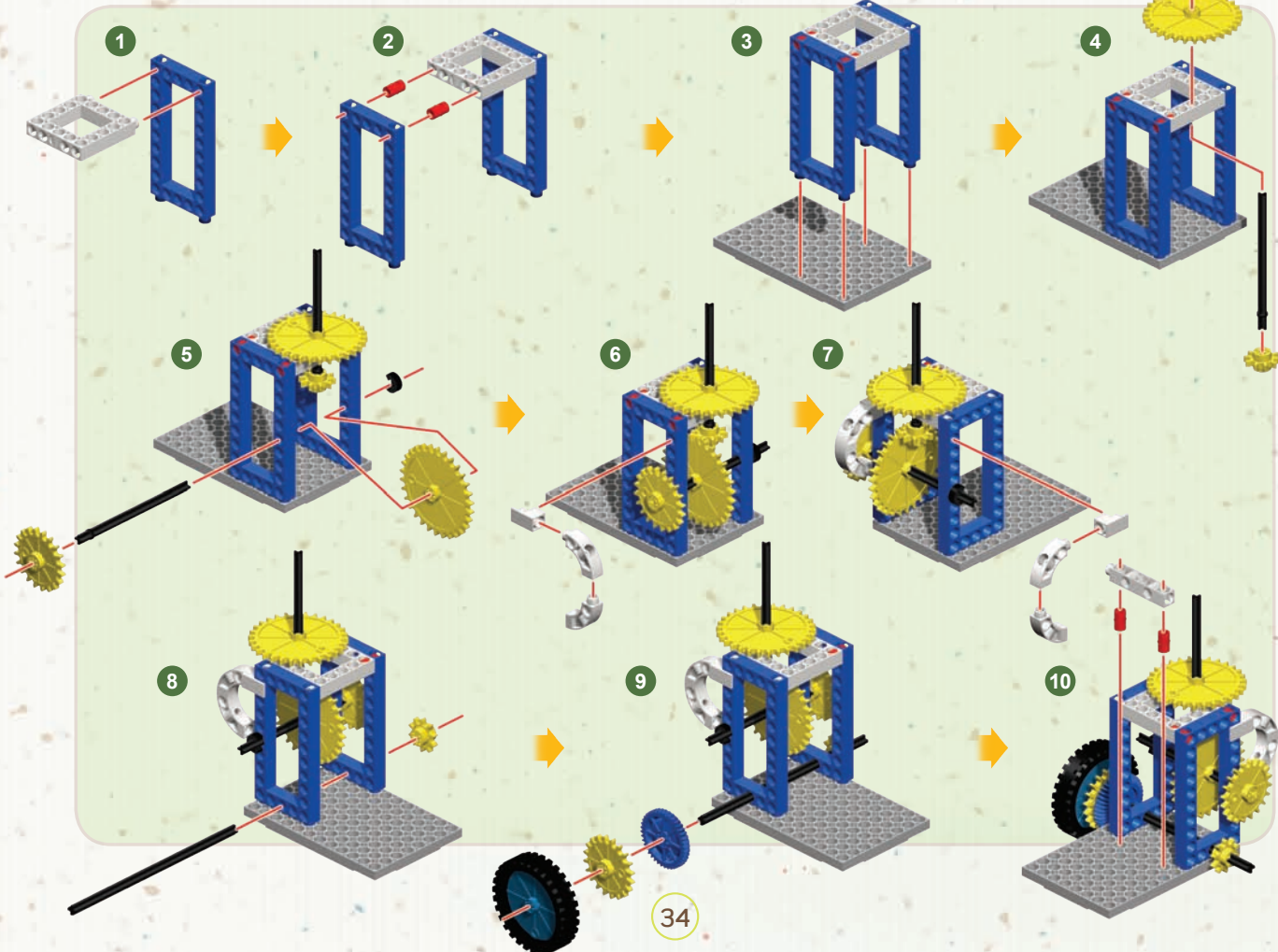
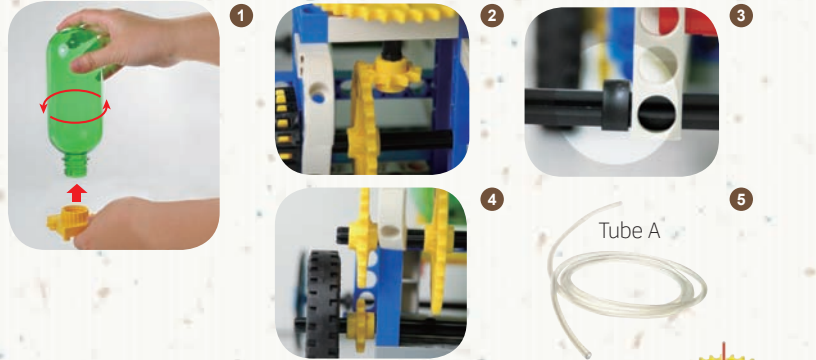


### Parts Needed



### Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. The gears should be meshed with each other well in order to operate smoothly.
3. Leave a 1mm gap between the gear and the long frame in order for the wheel to turn smoothly
4. Note that the chain gears are to be aligned in order for the chain to operate smoothly.
5. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1



# MODEL 11 Helicopter | WATER POWER



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Helicopter Completed

Launcher Completed

Tube A : 21cm

Connecting the Security Nut

L SECURITY NUT X 2

Tube A : 40cm

Tube A : 9.5cm

cut on the bias



Detective Car

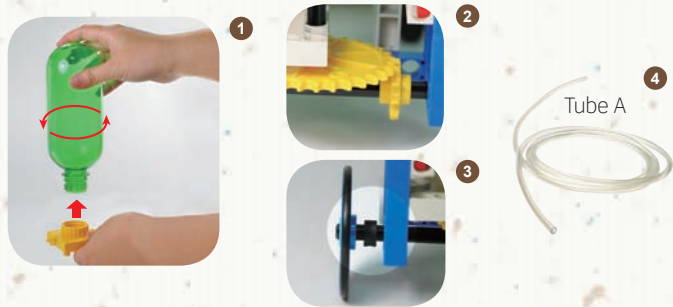


**Parts Needed**

- Green bottle cap x1
- Green bottle x1
- White connector x1
- Yellow Technic pin x1
- Black O-ring x2
- White square frame x1
- Grey Technic plate x1
- Yellow Technic axle x1
- Blue Technic axle x2
- Yellow gear x2
- Yellow gear x2
- Yellow gear x1
- Blue gear x2
- Yellow gear x1
- Yellow gear x2
- Yellow gear x2
- White Technic axle x2
- White Technic axle x2
- White Technic axle x4
- Black Technic axle x4
- Black Technic axle x1
- Yellow Technic axle x2
- Red Technic axle x18
- White Technic axle x2
- White Technic axle x4
- White Technic axle x20
- Black Technic axle x2
- Yellow Technic axle x1
- White Technic axle x4
- White Technic axle x20
- White Technic axle x1
- White Technic axle x20

Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. The gears should be meshed with each other well in order to operate smoothly.
3. Leave a 1mm gap between the gear and the long frame in order for the wheel to turn smoothly
4. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1



1. Attach the white Technic axle to the blue Technic frame.

2. Add the white square frame to the axle.

3. Insert the white Technic axle through the white square frame.

4. Attach the yellow gear to the axle.

5. Add the black Technic axle to the frame.

6. Mesh the yellow gear with the black gear.

7. Add the yellow gear to the black axle.

8. Attach the grey Technic plate to the top of the frame.

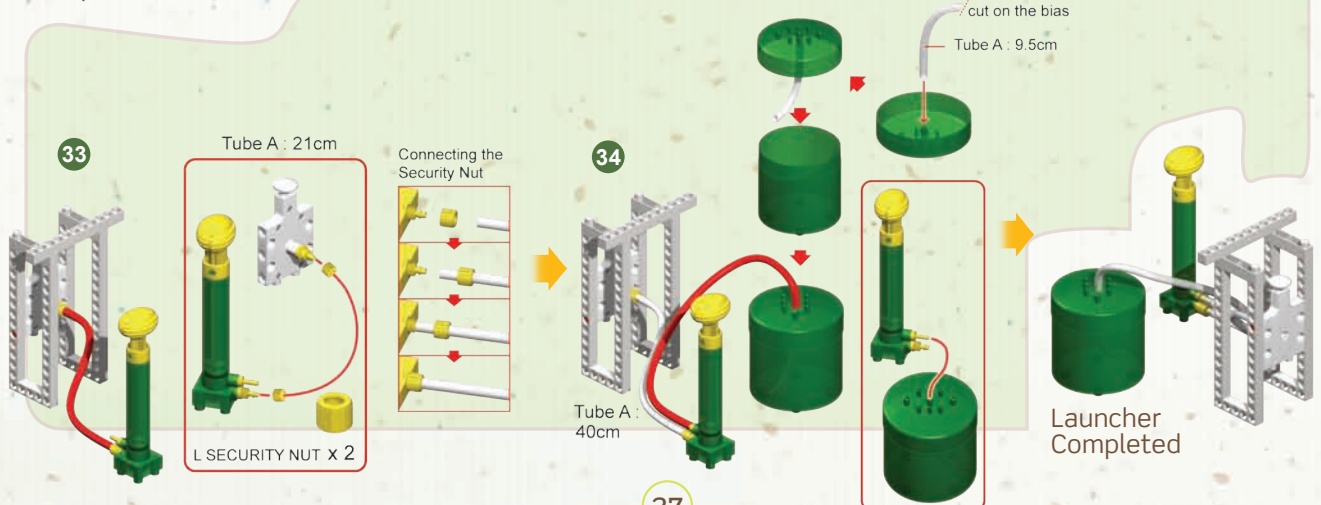
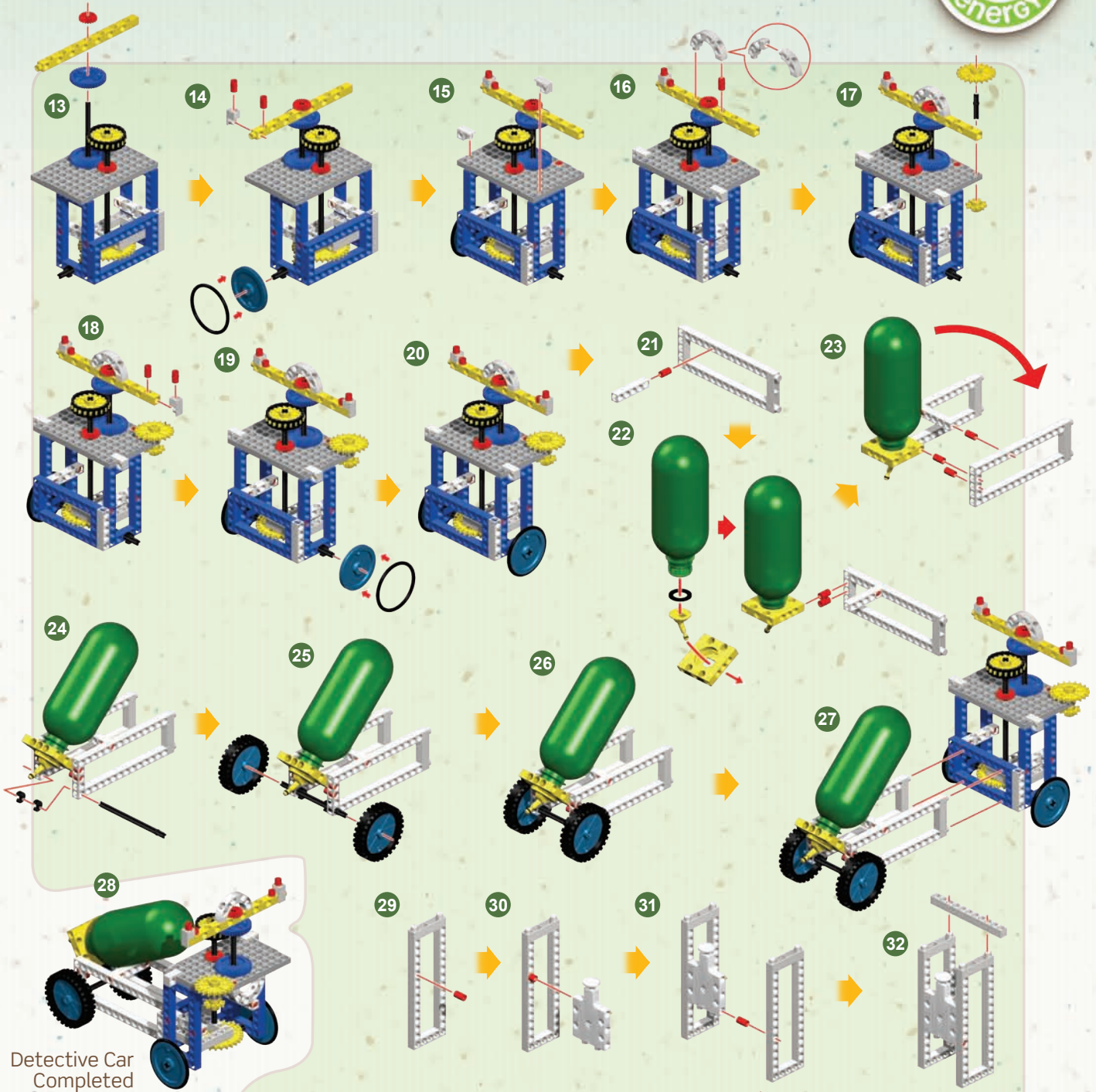
9. Add the red Technic axle to the grey plate.

10. Mesh the red gear with the yellow gear.

11. Add the blue gear to the red axle.

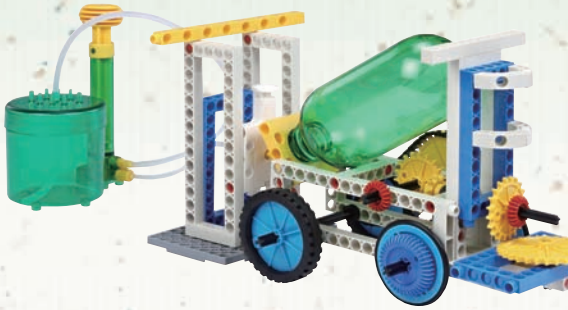
12. Attach the black Technic axle to the blue gear.

MODEL 12 Detective Car | WATER POWER





Lift

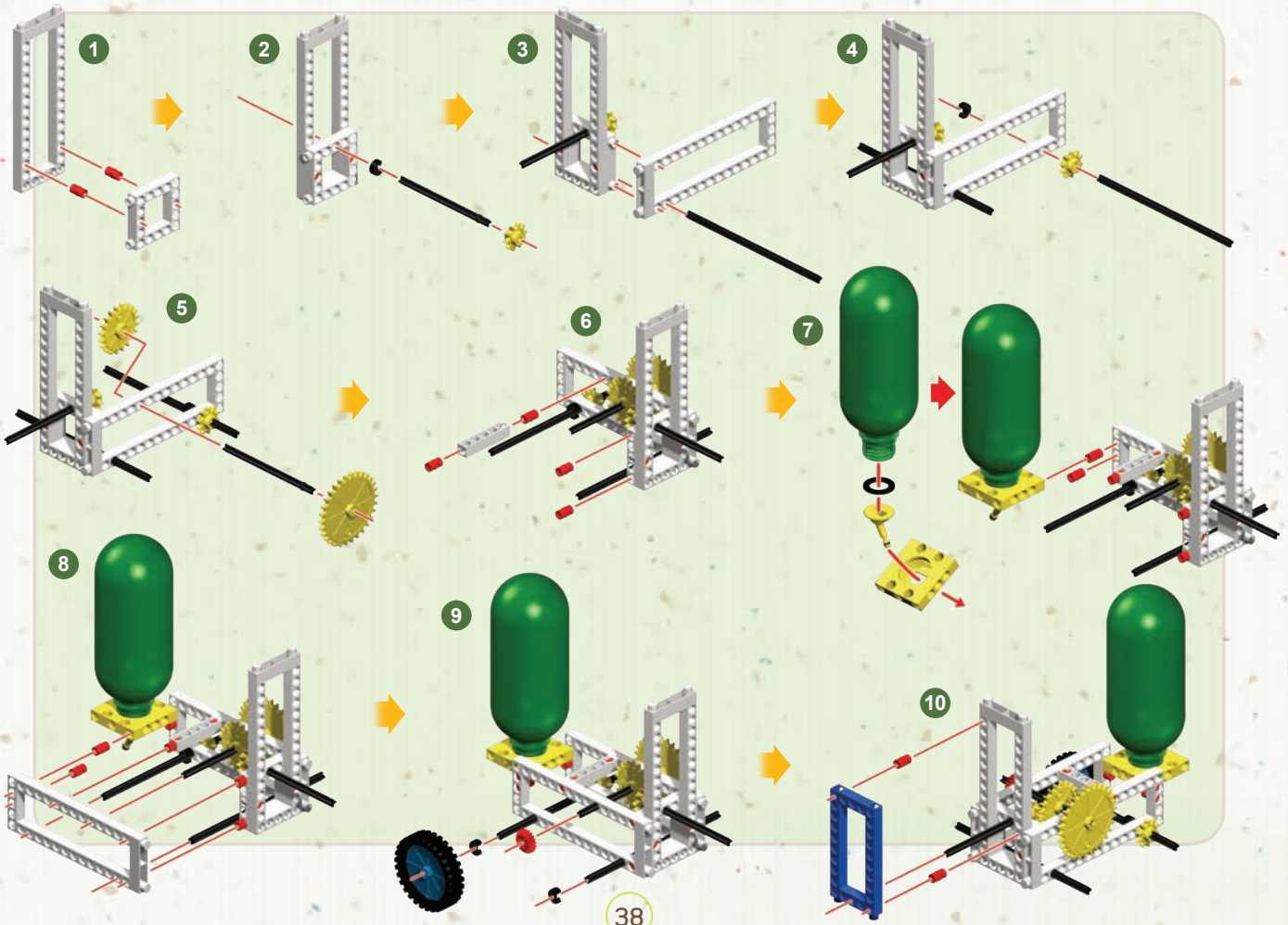
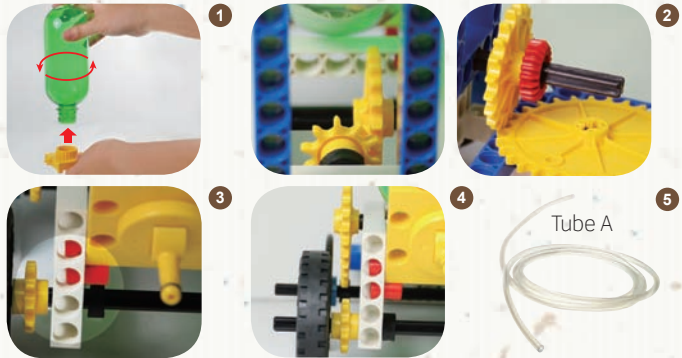


### Parts Needed

x1	x1	x1	x1	x2	x1	x1
x1	x1	x1	x1	x2	x2	x1
x1	x2	x2	x2	x2	x2	x2
x3	x1	x2	x2	x4	x4	x2
x2	x1	x20	x2	x1	x1	x1
x2	x1	x2	x1			
						x45

Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. The gears should be meshed with each other well in order to operate smoothly.
3. Leave a 1mm gap between the gear and the long frame in order for the wheel to turn smoothly
4. Note that the chain gears are to be aligned in order for the chain to operate smoothly.
5. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1





# MODEL 13 Lift | WATER POWER



x45

**11** **12** **13** **14** **15** **16** **17** **18** **19** **20** **21** **22** **23** **24** **25** **26** **27** **28** **29** **30** **39**

**Lift Completed**

**Launcher Completed**

Tube A : 21cm  
L SECURITY NUT X 2

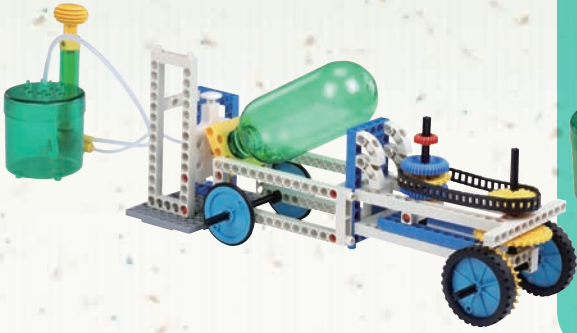
cut on the bias  
Tube A : 9.5cm

Tube A : 40cm

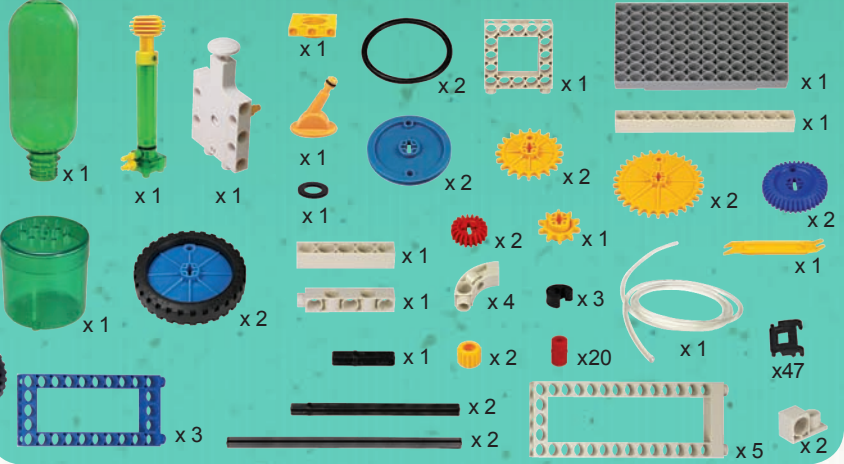
Connecting the Security Nut.



### Antique Car



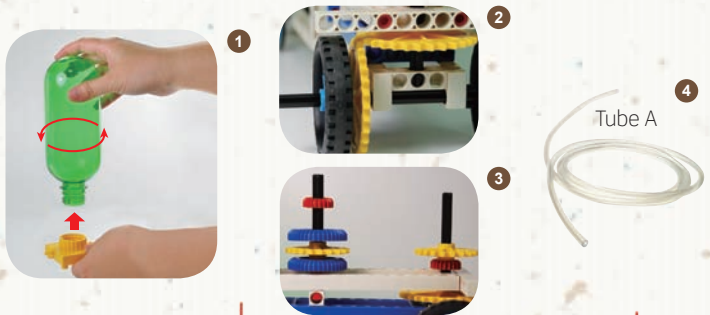
### Parts Needed

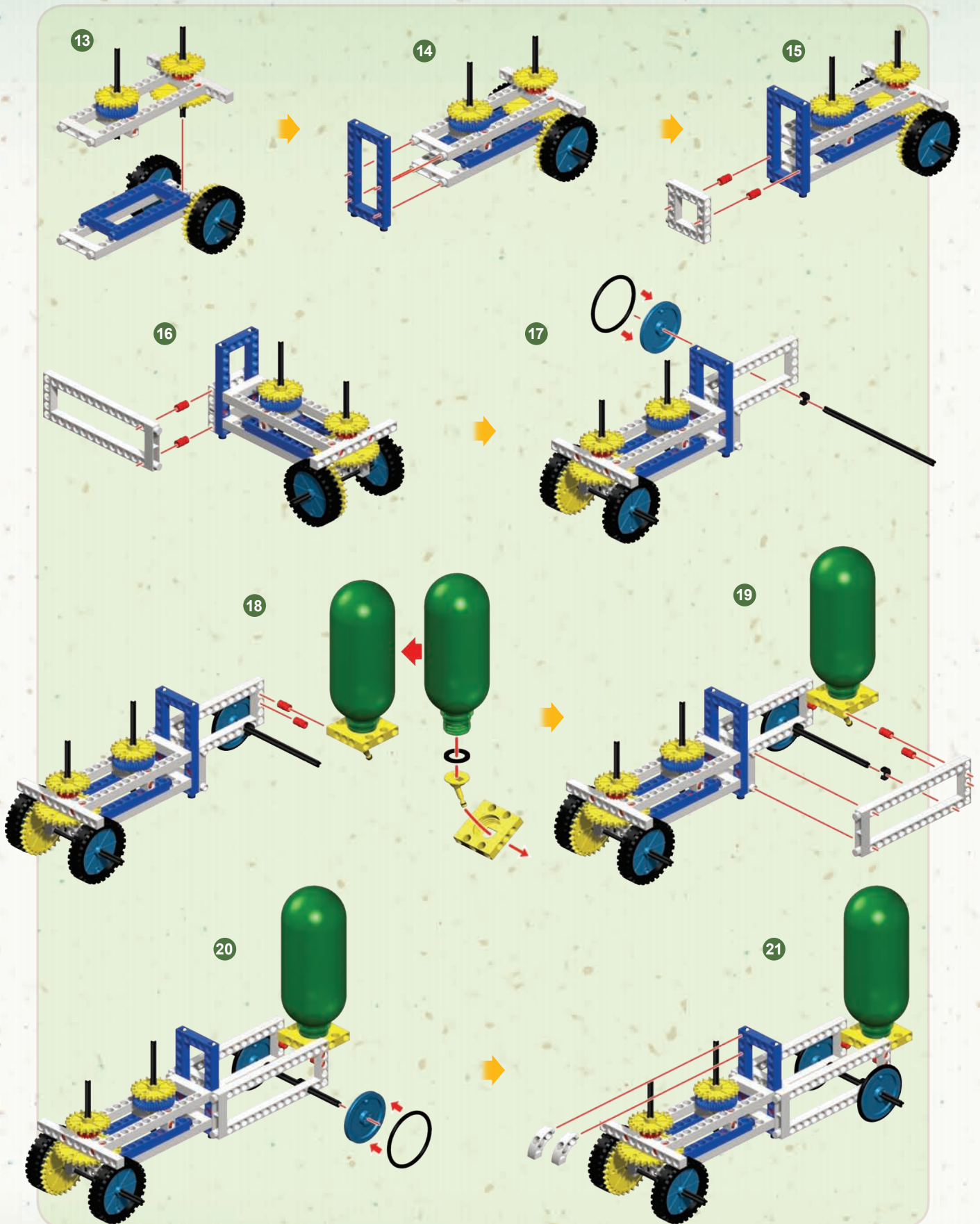


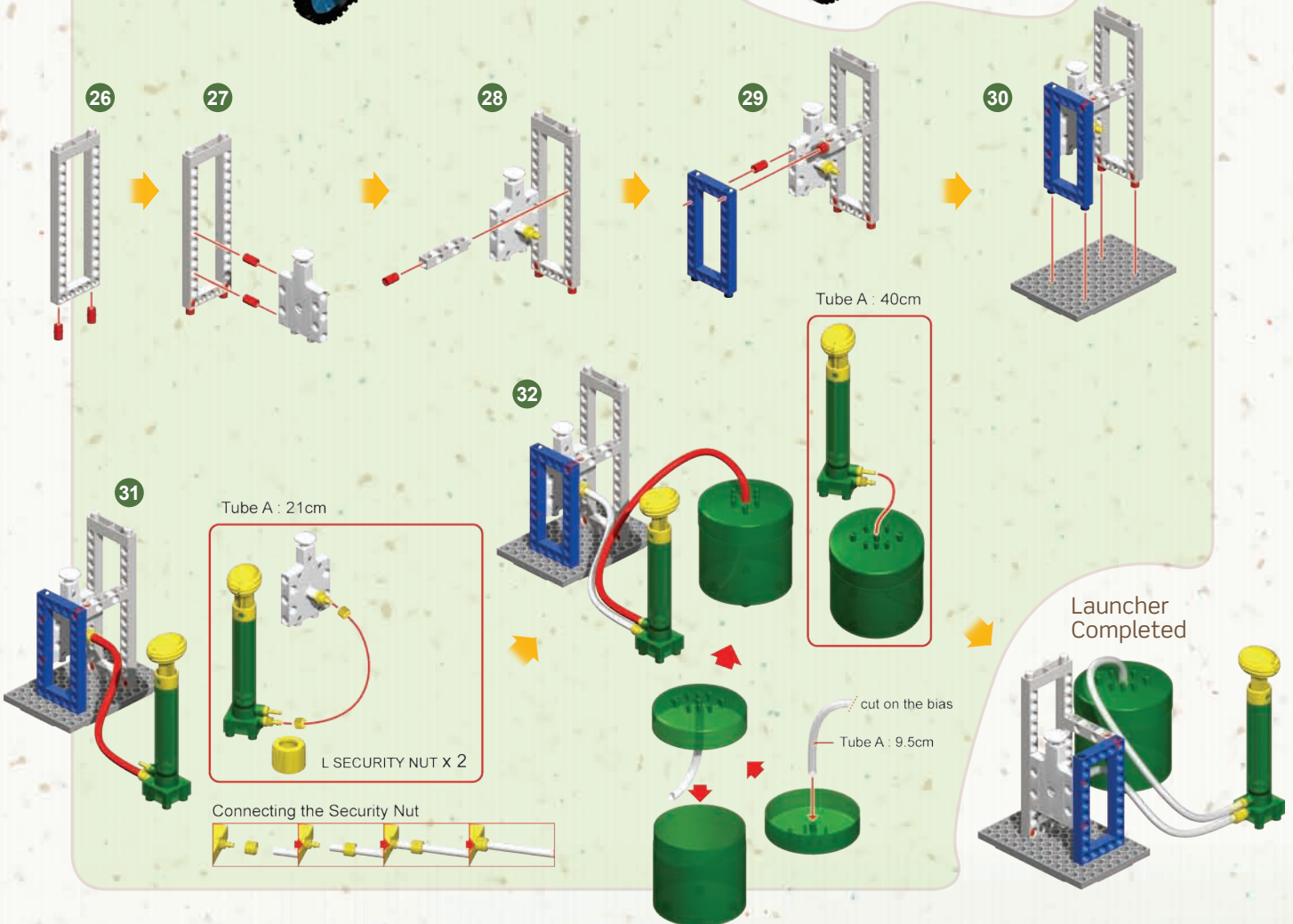
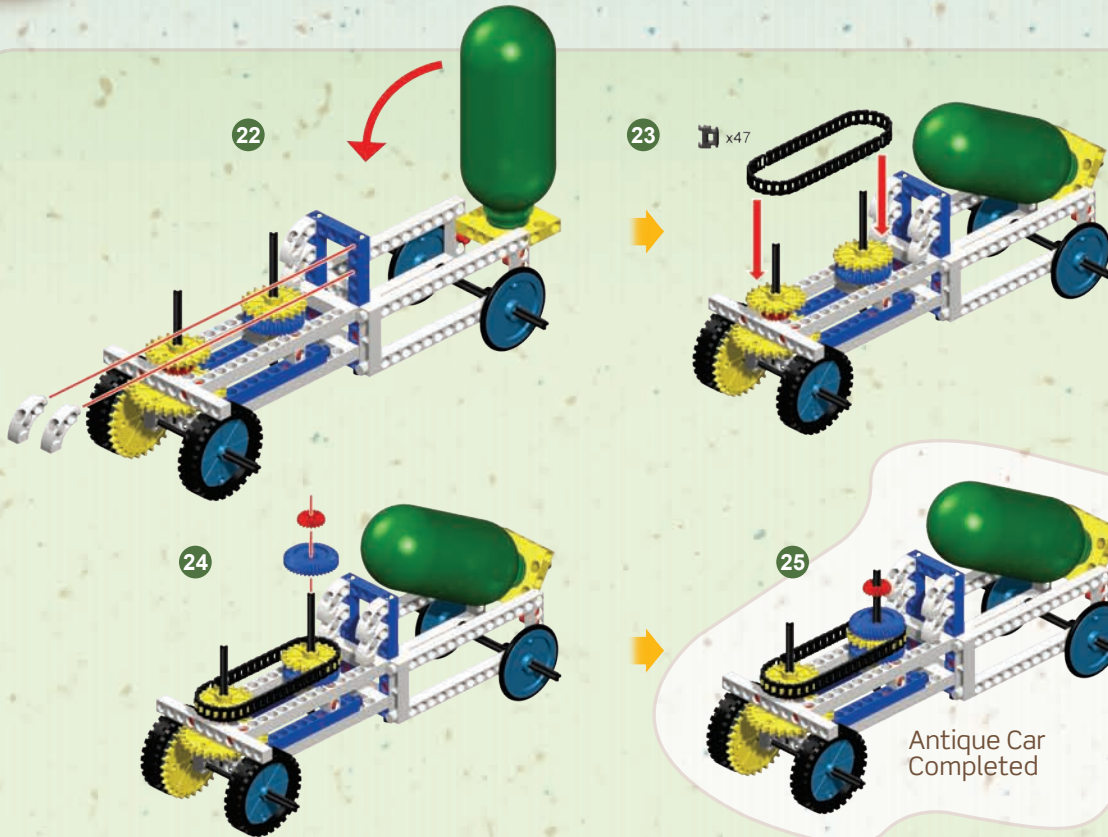
### Notes for Assembly

- 1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
- 2. The gears should be meshed with each other well in order for the chain to operate smoothly.
- 3. Note that the chain gears are to be aligned in order for the chain to operate smoothly.
- 4. Cut Tube A to get the tubes in following lengths for this model.

Tube A: 9.5cm x1, 21cm x1, 40cm x1







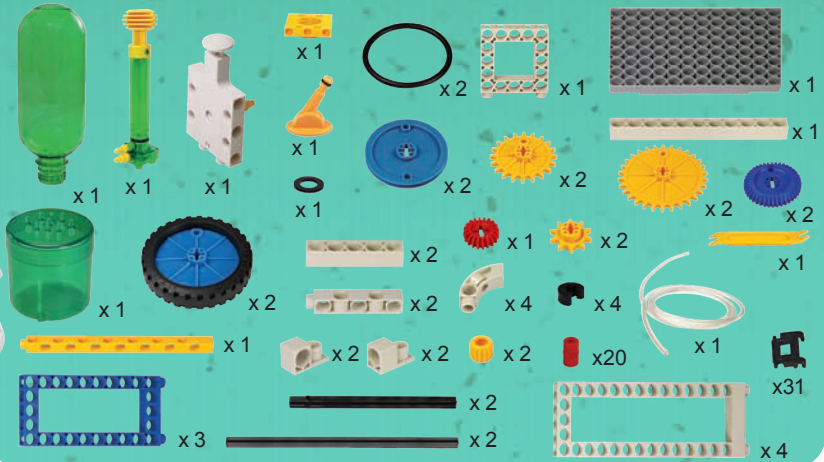
# MODEL 15 Propeller Aircraft | WATER POWER



## Propeller Aircraft

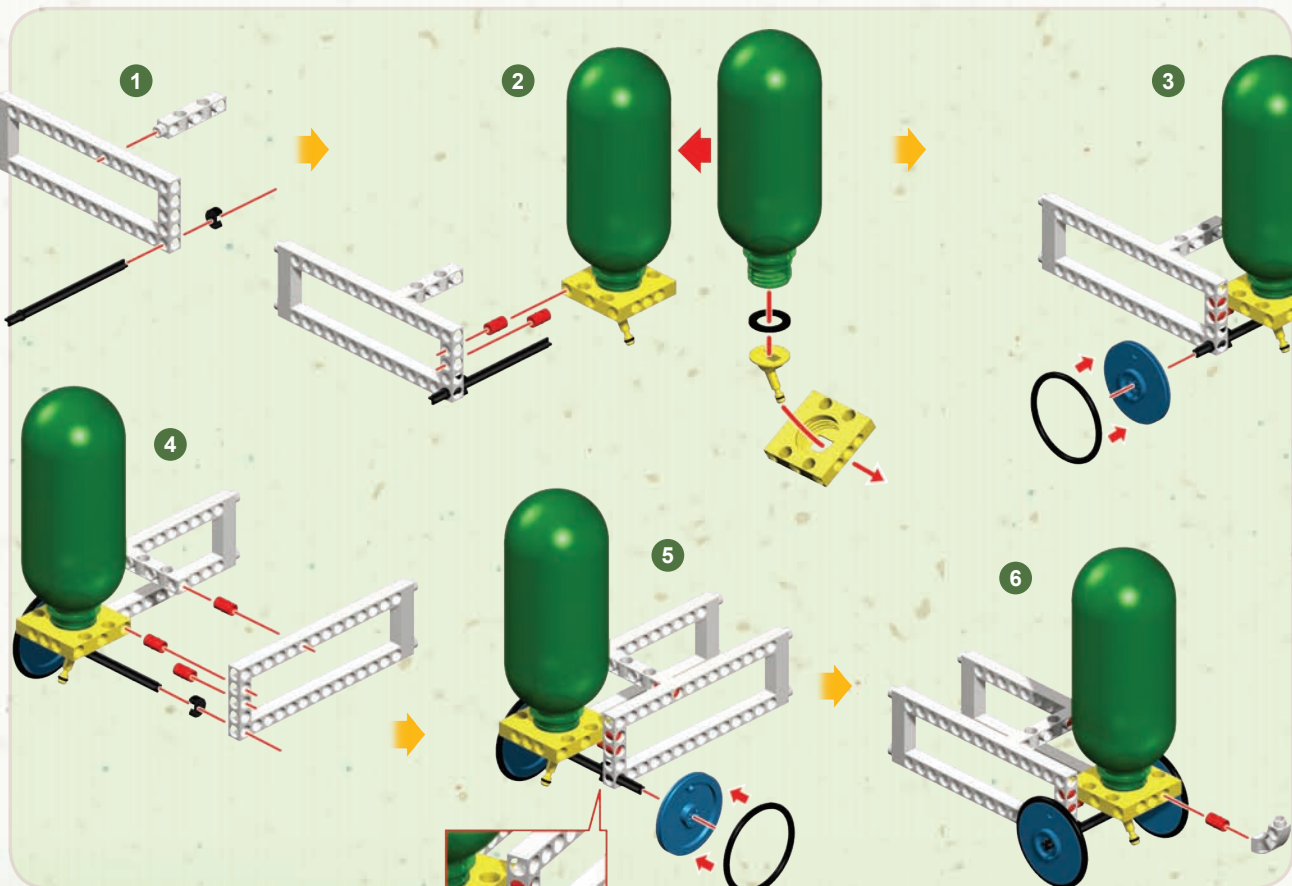
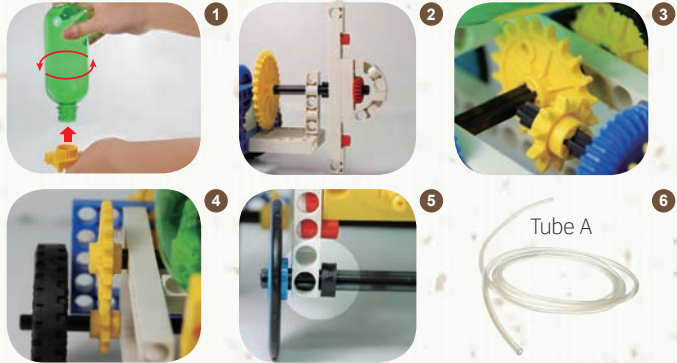


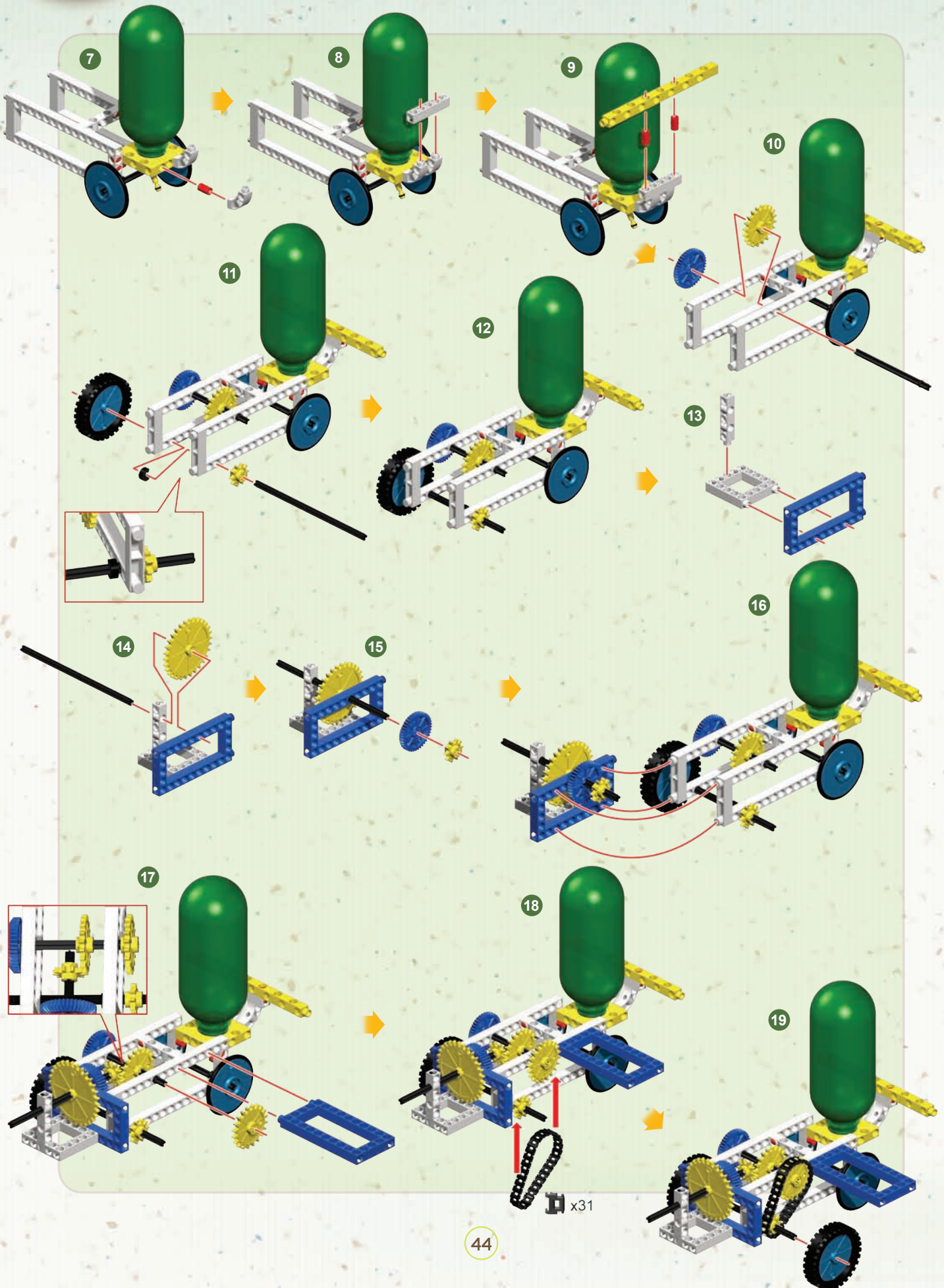
### Parts Needed



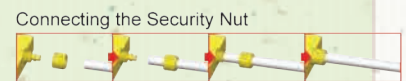
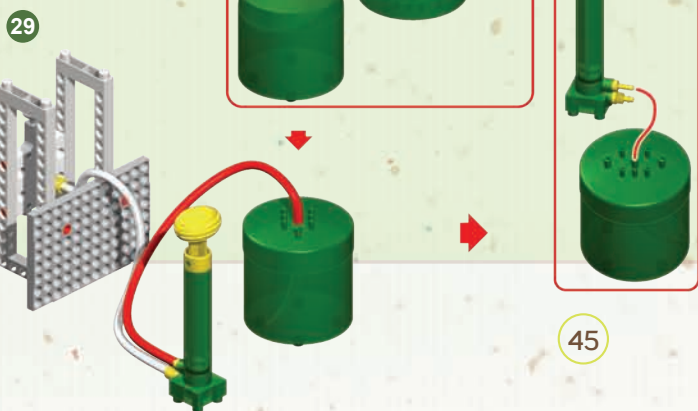
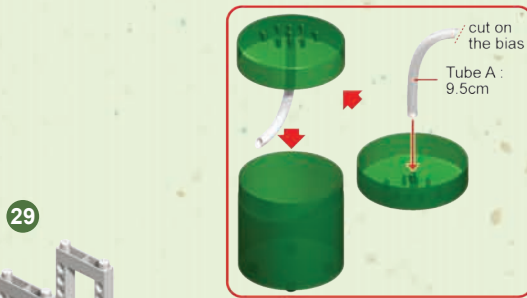
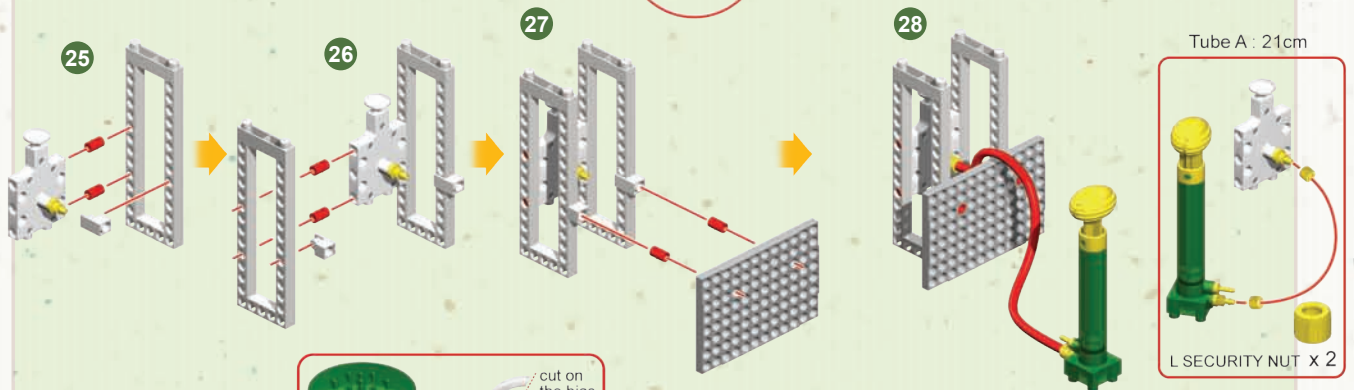
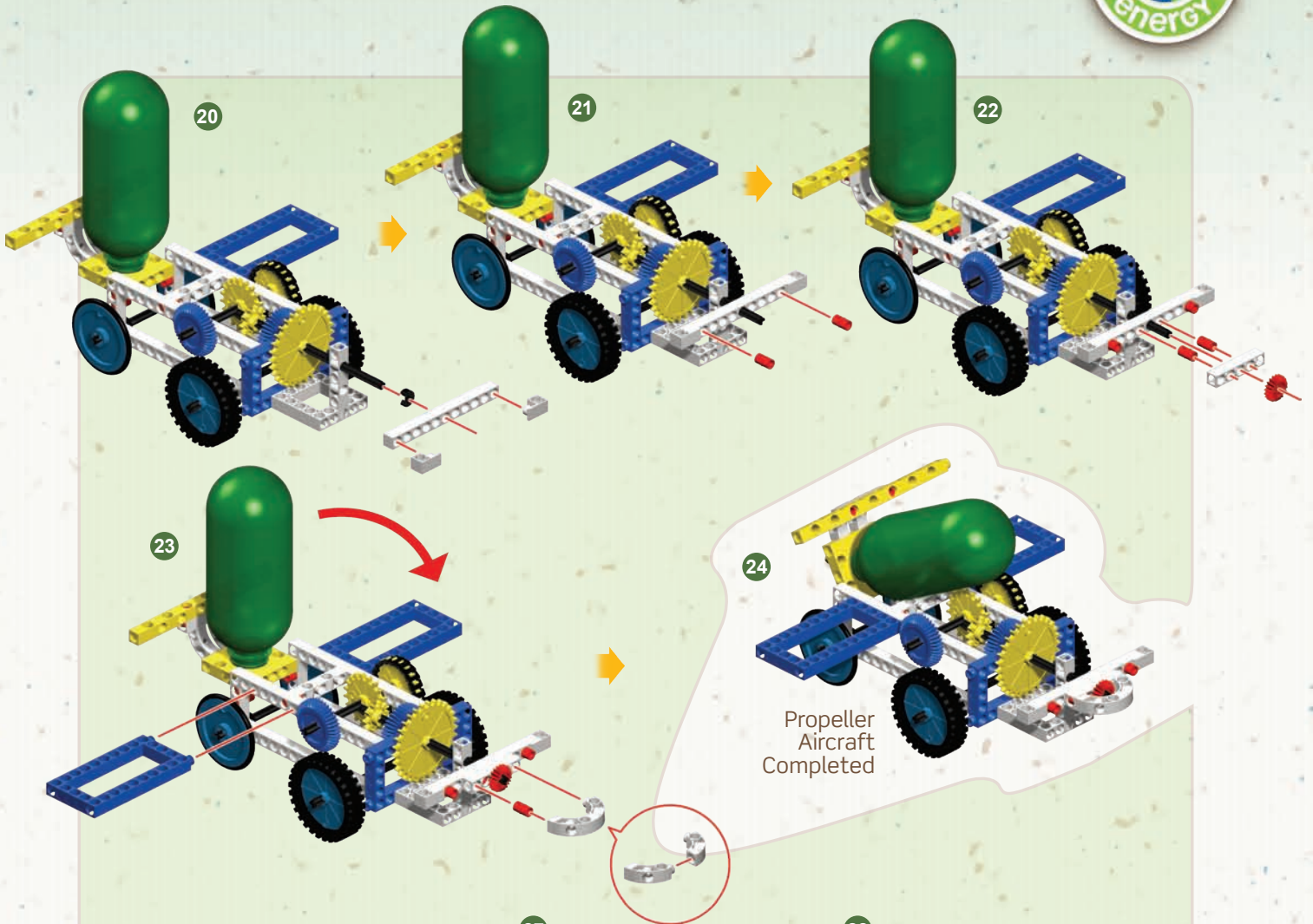
### Notes for Assembly

1. Screw off the original cap of the Secured Air-Water Storage before the model assembly starts. The original cap will not be used in this model.
2. The parts shown here on the model are to be tightly fixed together so that the propeller can rotate.
3. The gears should be meshed with each other well in order for the chain to operate smoothly.
4. Note that the chain gears are to be aligned in order for the chain to operate smoothly.
5. Leave a 1mm gap between the gear fixing and the long frame in order for the wheel to turn smoothly.
6. Cut Tube A to get the tubes in following lengths for this model.  
**Tube A:** 9.5cm x1, 21cm x1, 40cm x1





# MODEL 15 Propeller Aircraft | WATER POWER





#7323 Water Power 15 models 165 pcs



#7324 Wind Power 8 models 133 pcs



#7326 Electric Vehicles 11 models 122 pcs



#7328 Remote-controlled robots 10 models 182 pcs



#7329 Elasticity Power 11 models and experiments 170 pcs



#7349 Solar Power 6 models 177 pcs



#7345R Senior Solar 22 models 265 pcs

Parts are interchangeable with other GIGO Green Energy models

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