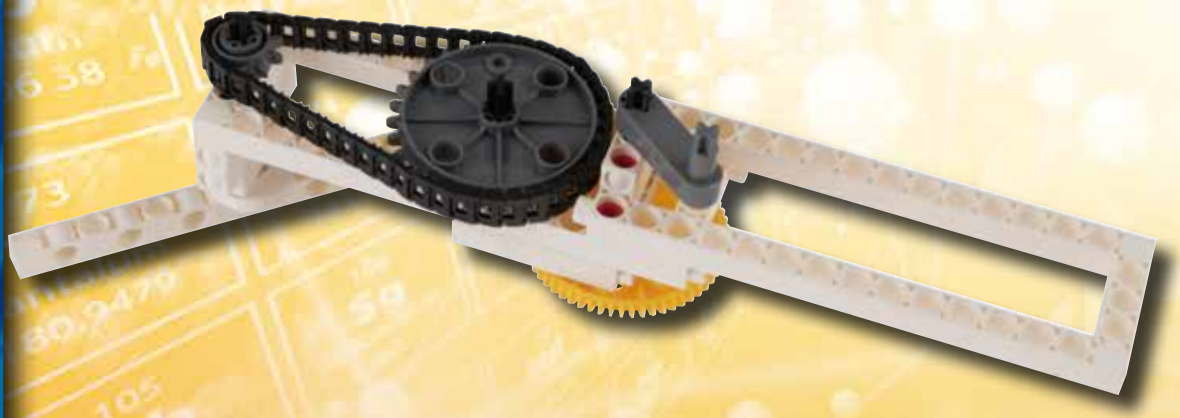
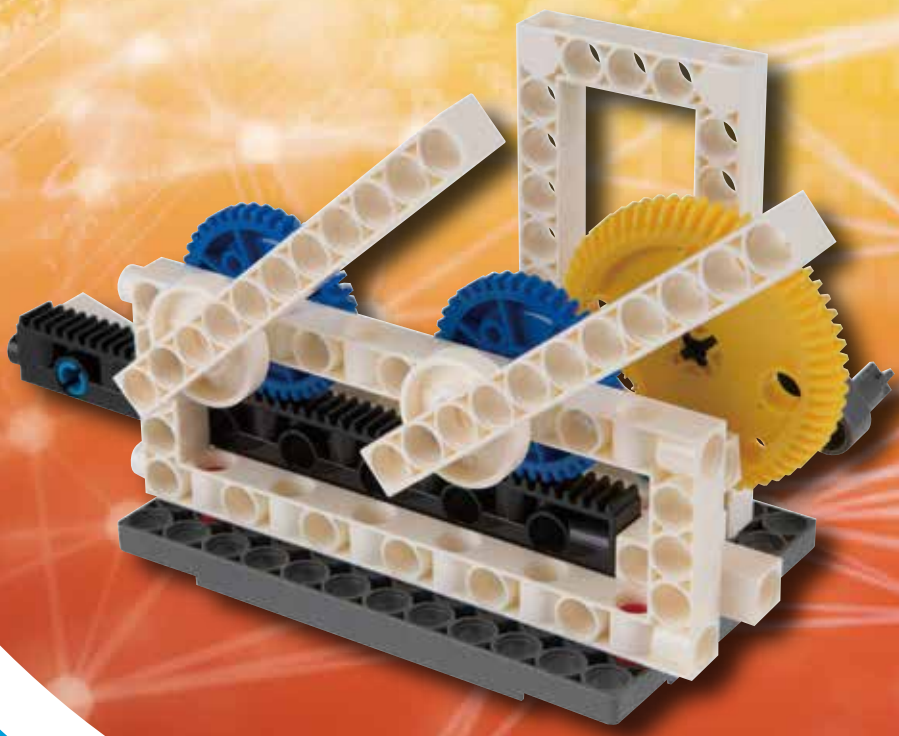
MOTION AND MECHANISM

LEARNING LAB





#1235R

325 PCS

7+

INVENTING CAN BE LEARNED

20 EXPERIMENTS INCLUDED

INVENTING CAN BE LEARNED

Gigo Learning Lab's complete series includes individual packages and school sets. The special features of Gigo's Learning Lab are as follows:

1. Using Gigo's "building block" construction-based curriculum, every class has a ready-toassemble model, and includes time designed to promote individual creativity.

2. Promotes thinking outside-the-box of the traditional educational framework by learning innovation through play!

3. We are all innately good at something, so we should take into account both individual development and the ability to work as part of a team effort.

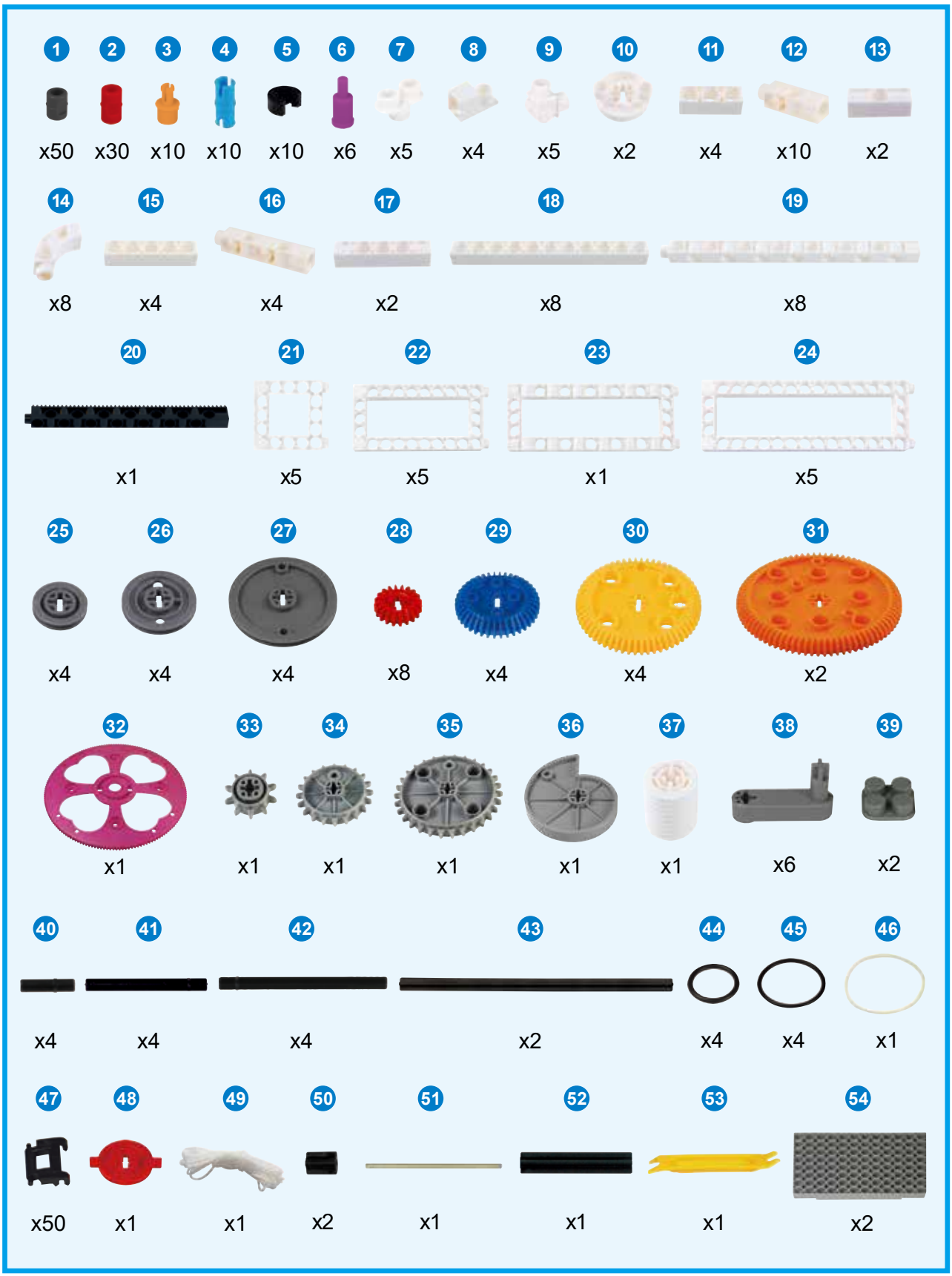
4. Course levels are designed from elementary to difficult, combining a life sciences-based curriculum with applications from daily life.

5. Experiment using Gigo's "building blocks", which can be used over and over again, saving both time and effort.

We hope that kids can enthusiastically learn scientific knowledge through fun hands-on experience, developing their problem-solving abilities, as well as a positive attitude towards science. Our mission is to help children apply their newfound knowledge to daily life, furthering their innovational skills and abilities.

Index

Parts List


1 x50
2 x30
3 x10
4 x10
5 x10
6 x6
7 x5
8 x4
9 x5
10 x2
11 x4
12 x10
13 x2
14 x8
15 x4
16 x4
17 x2
18 x8
19 x8
20 x1
21 x5
22 x5
23 x1
24 x5
25 x4
26 x4
27 x4
28 x8
29 x4
30 x4
31 x2
32 x1
33 x1
34 x1
35 x1
36 x1
37 x1
38 x6
39 x2
40 x4
41 x4
42 x4
43 x2
44 x4
45 x4
46 x1
47 x50
48 x1
49 x1
50 x2
51 x1
52 x1
53 x1
54 x2

Parts List:

No.	Description	Item No.	Qty.
1	B–SHORT PEG	7344-W10-C2D	50
2	C–LONG PEG	7061-W10-C1R	30
3	C–AXLE	7026-W10-H1O	10
4	C–20mm AXLE CONNECTOR	7413-W10-T1B	10
5	C–AXLE FIXING	3620-W10-A1D	10
6	C–CAM CONNECTOR	7413-W10-S1P	6
7	C–TWO–IN–ONE CONVERTER	7061-W10-G1W	5
8	C–FRONT CONVERTER	7061-W10-Y1W	4
9	C–HINGE	7061-W85-F1W	5
10	C–ROD CONNECTOR	7026-W10-L2W	2
11	C–3 HOLE ROD	7026-W10-Q2W	4
12	C–3 HOLE DUAL ROD	7413-W10-Y1W	10
13	C–3 HOLE ROD FRONT CLOSED	7026-W10-X1W	2
14	C–BENDED ROD	7061-W10-V1W	8
15	C–5 HOLE ROD	7413-W10-K2W	4
16	C–5 HOLE DUAL ROD	7413-W10-X1W	4
17	C–5 HOLE ROD FRONT CLOSED	7413-W10-R1W	2
18	C–11 HOLE ROD	7413-W10-P1W	8
19	C–15 HOLE DUAL ROD	7413-W10-Z1W	8
20	C–150mm RACK	7061-W10-T2D	1
21	C–5X5 FRAME	7413-W10-Q1W	5
22	C–5X10 FRAME	7413-W10-I1W	5
23	C–5x13 DUAL FRAME	7061-W10-U1W	1
24	C–5X15 FRAME	7413-W10-J1W	5
25	C–OD23mm PULLEY	7344-W10-N3S1	4
26	C–OD33mm PULLEY	7344-W10-N2S1	4
27	C–OD53mm PULLEY	7344-W10-N1S1	4

No.	Description	Item No.	Qty.
28	C–20T GEAR	7026-W10-D2R	8
29	C–40T GEAR	7346-W10-C1B	4
30	C–60T GEAR	7026-W10-W5Y	4
31	C–80T GEAR	7328-W10-G2O	2
32	C–160T GEAR	7026-W10-G1P	1
33	C–10T CHAIN GEAR	3569-W10-D2S1	1
34	C–20T CHAIN GEAR	3569-W10-D1S1	1
35	C–30T CHAIN GEAR	3569-W10-C1S1	1
36	C–SNAIL CAM	7063-W10-A2S1	1
37	C–WORM GEAR	7344-W10-A1W	1
38	C–CRANK	7063-W10-B3S1	6
39	C–BASE GRID CONNECTOR	7026-W10-I1SK	2
40	C–30mm AXLE II	7413-W10-N1D	4
41	C–70mm AXLE II	7061-W10-Q1D	4
42	C–100mm AXLE II	7413-W10-L2D	4
43	C–150mm AXLE I	7026-W10-P1D	2
44	C–OD36 O–RING	R12-07S	4
45	C–OD56 O–RING	R12-09S	4
46	C–70mm RUBBER BAND	R10-02	1
47	C–CHAIN	3569-W10-B1D	50
48	C–160T GEAR ADAPTER	7026-W10-J1R	1
49	C–2000mm STRING	R39-W85-200	1
50	C–DUAL AXLE END	7061-W10-S2D	2
51	C–DUAL AXLE CORE	M10#7061	1
52	C–DUAL AXLE BODY	7061-W10-S3D	1
53	B–PEG REMOVER	7061-W10-B1Y	1
54	C–BASE GRID	7125-W10-A1SK	2

TIPS AND TRICKS:

Here are a few tips for assembling and using the models.
Read them carefully before starting.

For more assembly tips, please refer to

NG!(without space) OK!(with space)

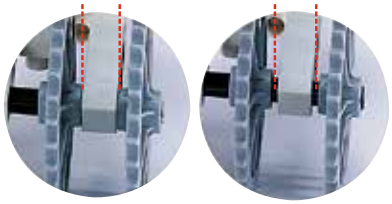


Fig.1 Fig.2

A. Pay attention to the hole:

When fixing gears onto the frame with drive axle be sure to keep a proper space (about 1mm) between the gear and the frames (Fig. 2). And try to turn the gear to ensure every gear in the gear train turning smoothly so that the least friction will be created and most efficient power transmission can be expected.

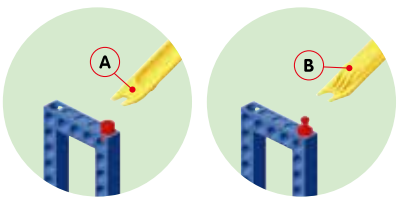
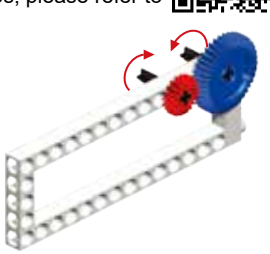


Fig.3 Fig.4

B. B-Peg remover:

Using peg remover to pull peg off as Fig.3 shows.
Using peg remover to pull axle off as fig.4 shows.



C. Gear wheels:

The models will often have several gear wheels installed in a row, or gear train. In order for the models to work well, thesae gears will have to mesh well. Otherwise, the force from one gear wheel won't be properly transferred to the next.

1 Track Car

Scientific Application

Newton's First Law Of Motion

Gigi's father is a fan of railways and trains; his study has a large collection of models. Gigi curiously touched a car as her father discussed his collection with her. Suddenly the railcar started to move forward and then derailed, but it was still running.

Gigi asked, "Why does the railcar keep going after running off the track?" Her Dad replied, "If it is not moving and there is no external force, it will remain still; but if it is moving and there is no external force, it will continue moving at the same speed."

An object stays in its state of rest or in uniform motion as long as no external force is added or removed. This is Newton's first law of motion, which we call inertia. Why would the car either stop, or move? Think about it and let me know!

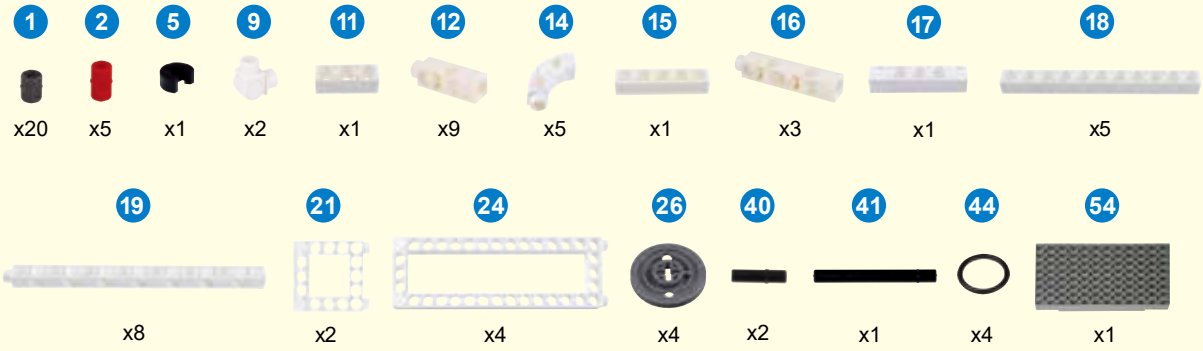
Daily Application

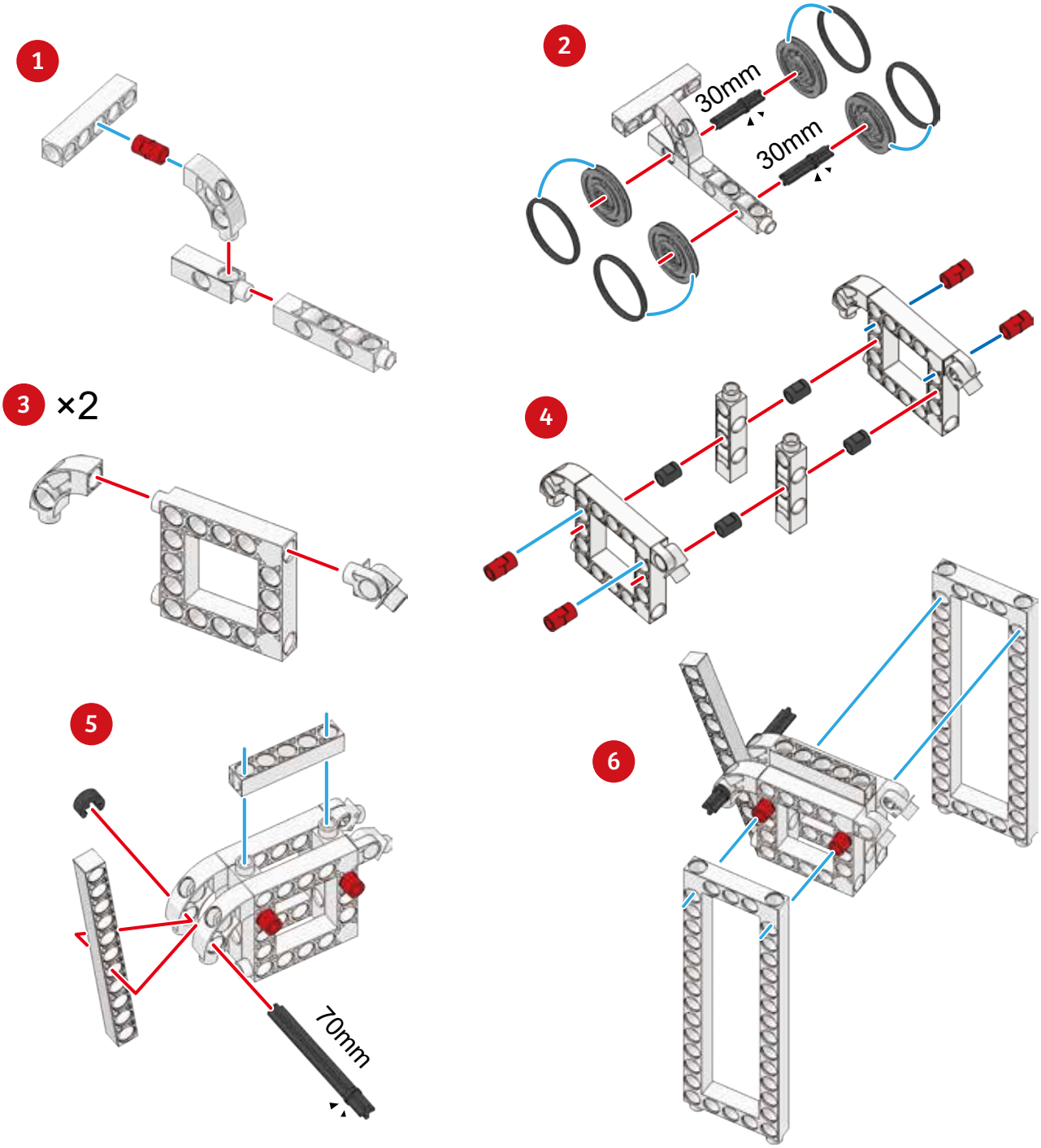
Newton's first law of motion is also commonly referred to as the law of inertia. An object continues to do whatever it is currently doing unless a forces is exerted upon it. If it is at rest, it continues to remain in a state of rest; if it is moving, it will continue to keep moving. For example, if a moving car has to suddenly stop, the people inside the car will lean forward as they will maintain the same force, direction, and speed. That's why we wear seatbelts! In addition, inertia increases as mass increases. Therefore, the heavier you are, the more forward force you feel if the car suddenly stops.

Brainstorming

If a moving car stopped abruptly, what would happen to the passengers inside it?

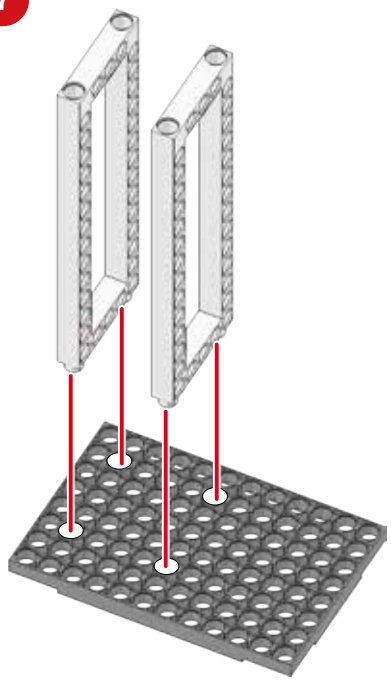
Parts List


1
2
5
9
11
12
14
15
16
17
18
x20
x5
x1
x2
x1
x9
x5
x1
x3
x1
x5
19
21
24
26
40
41
44
54
x8
x2
x4
x4
x2
x1
x4
x1

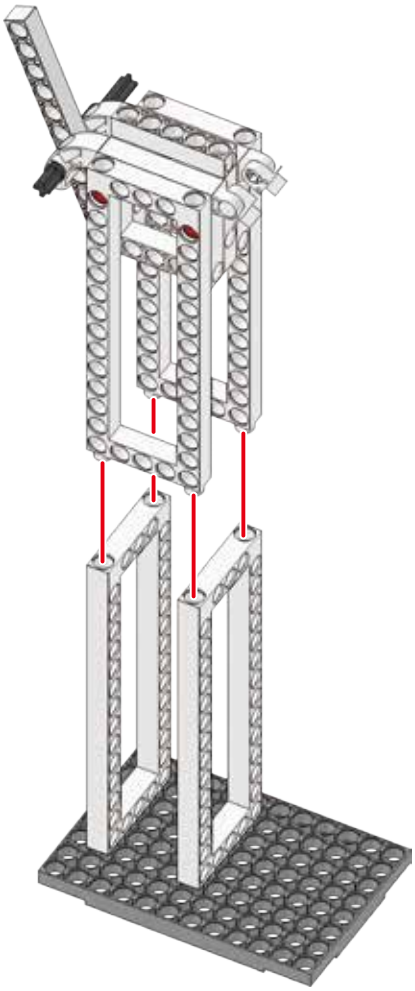

1
2
30mm
30mm
3 ×2
4
5
70mm
6

1 Track Car

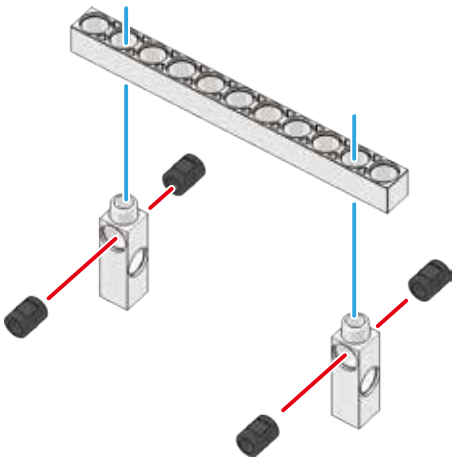
7



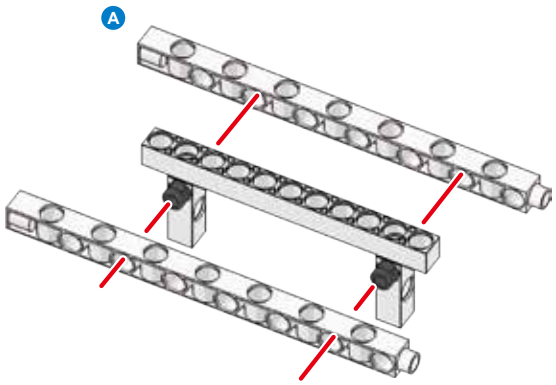
8



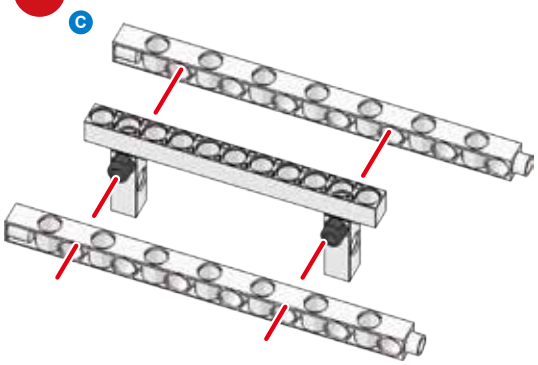
9 ×2



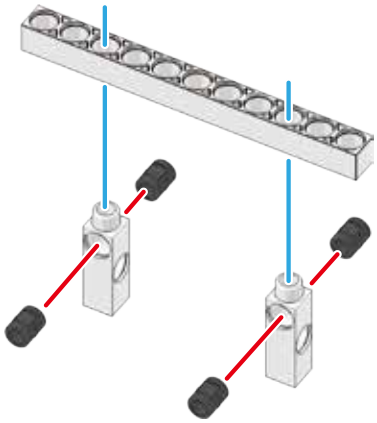
10



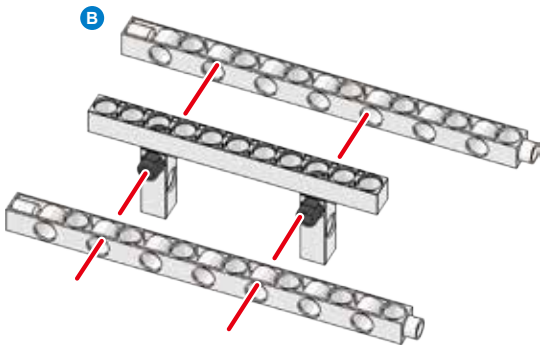
11



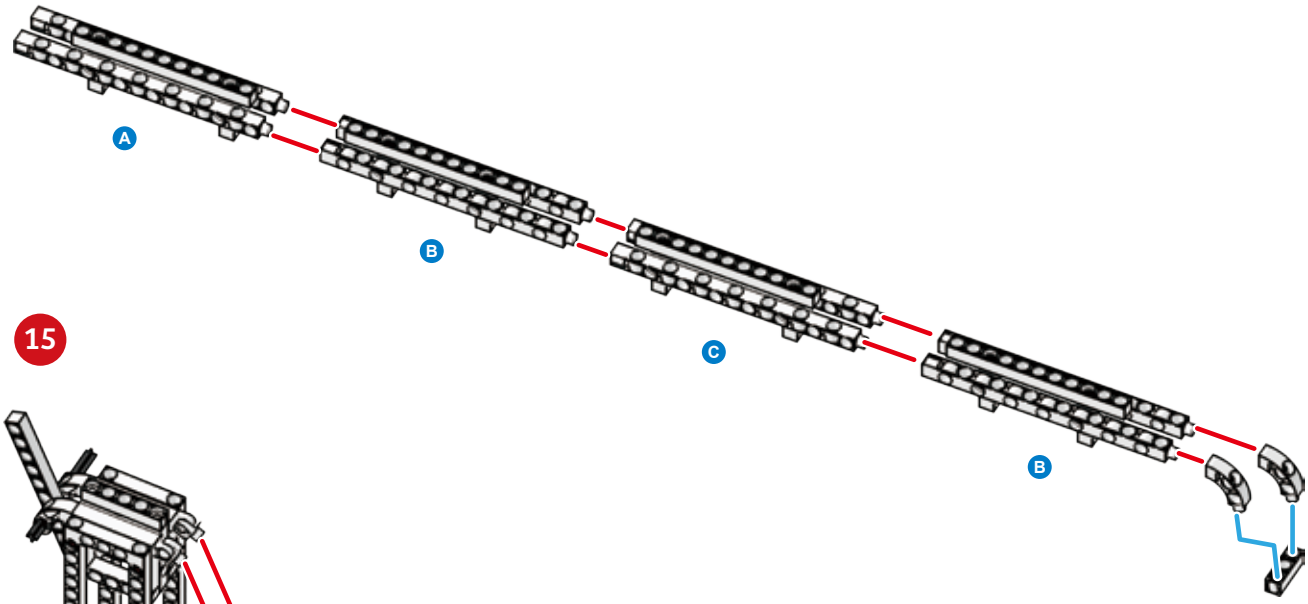
12 ×2



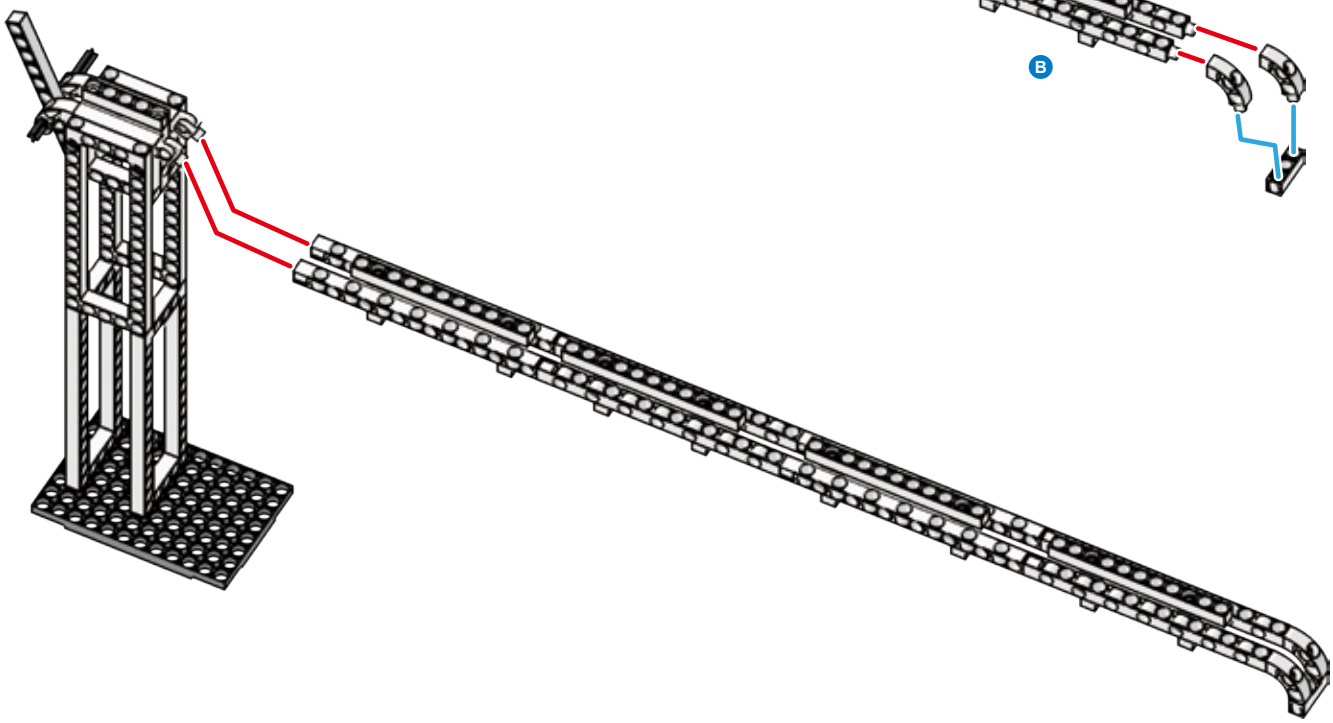
13 ×2



14

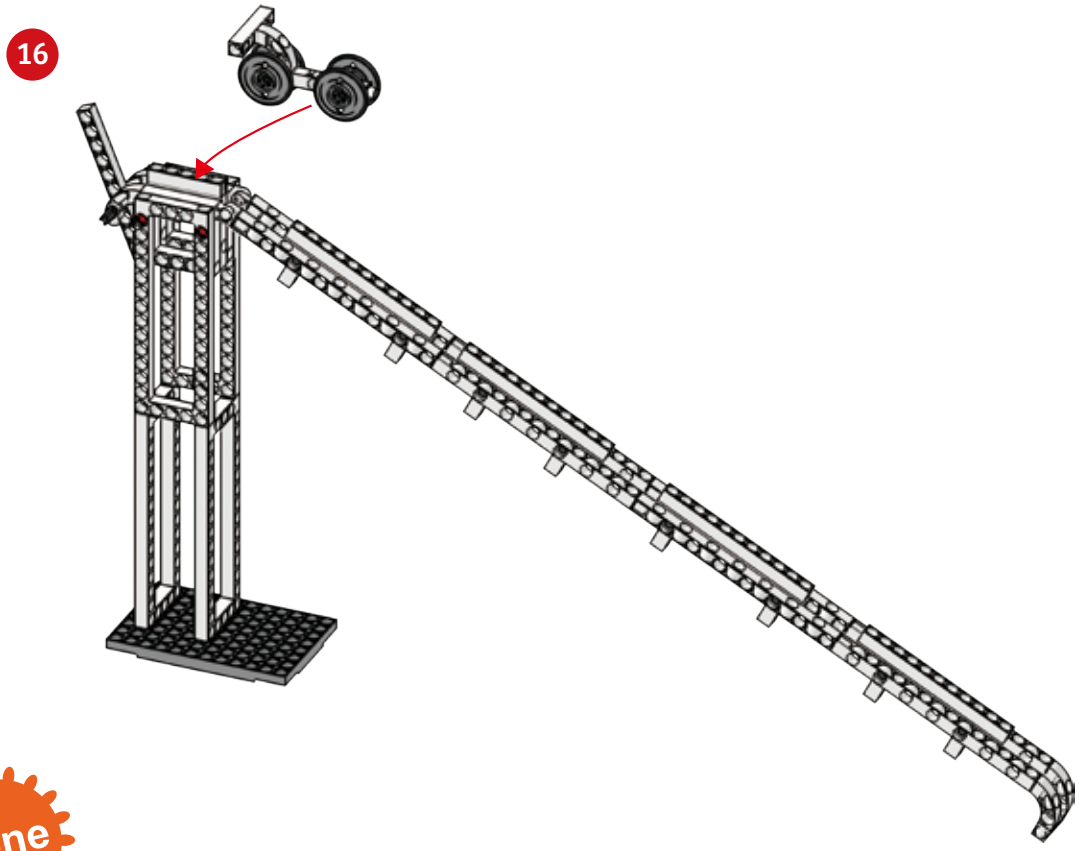


15

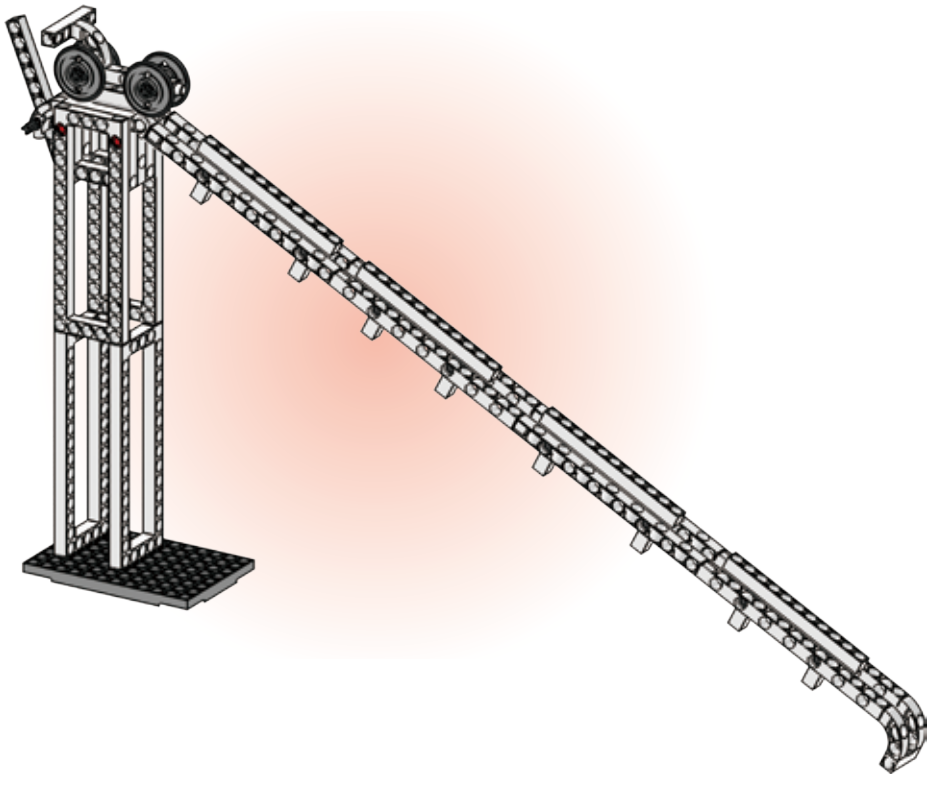


1 Track Car

16



Done



Model Operation Video

Hands-on Experiment

Try adjusting the car, then the track. See which factors affect the glide distance.

Hands-on Creativity

Try remodeling your car and doing things like putting a marble on it. Also, you can put a book at the end of the track and see what happens when the car glides to the end of the track.

Evaluation

Smart Manual
Web Service

1 Model Assembled

2 Experiment Complete

3 Model Creation

2 Rickshaw

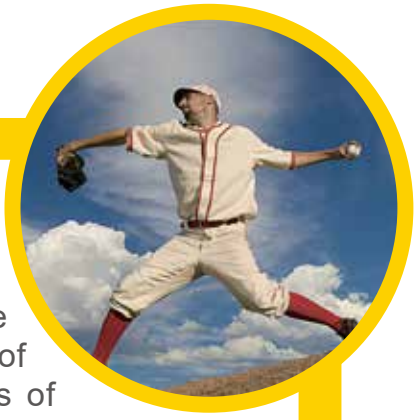
Scientific Application: Newton's Second Law of Motion

For the school's tenth anniversary there would be a fair with a variety of snack stalls, as well as all kinds of games. Everyone was looking forward to the event and would remember it for a long time afterward!

Gogo was happily skipping from stall to stall. He thought the toy car game was the most fun! The game required the players simply to push the car to a designated spot to win the game.

On the first go, Gogo did not use enough force. The car did not go far enough. The second attempt, he pushed too hard and the car went past it's mark. Feeling a bit upset, he decided to give it one last try. After a careful survey of the track distance, and with a deep breath, Gogo gave it a very careful shove, not too much, not too little. The car glided into the right spot and he cheered! He even won a prize!

Daily Application

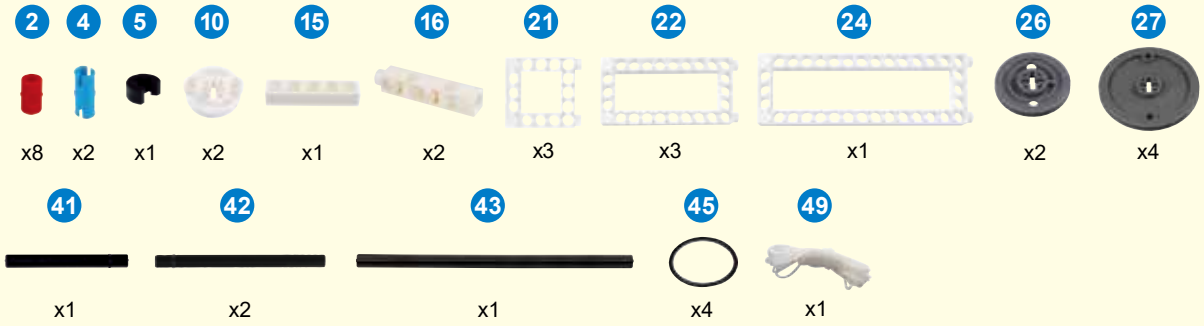


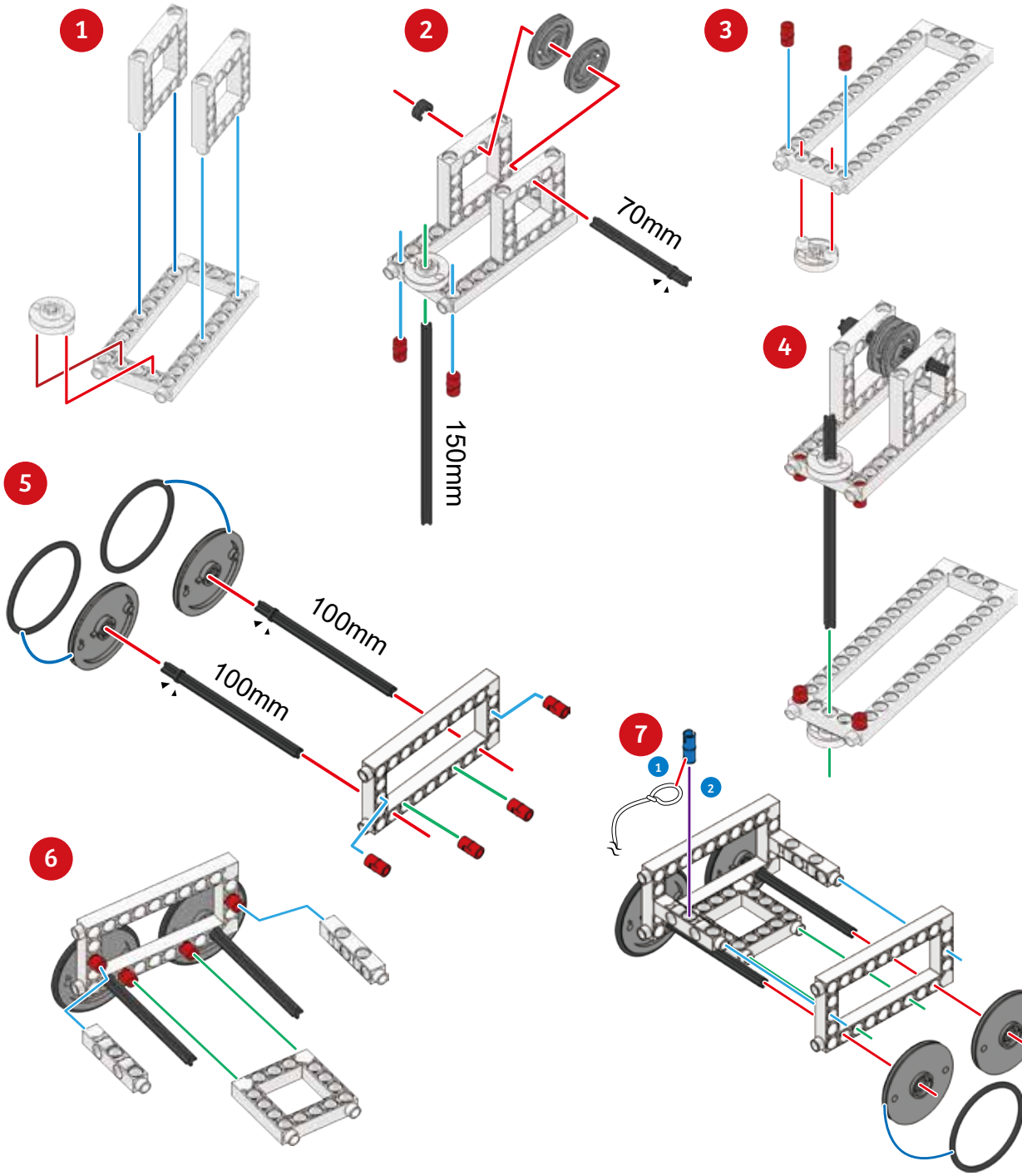
Newton's second law of motion is also known as the law of acceleration. If an object is affected by an external force, it will move in the same direction of the applied force. The rate of acceleration is directly proportionate to the amount of force applied, and inversely proportionate to the mass of the object. Using the example of throwing two balls made from different materials (one baseball and one shot-put), we can see this in action. When you throw a baseball, you probably find it easy to throw it pretty far. What if you were you to try and throw a shot-put with the same force? You'd find that the shot-put didn't travel nearly as far as the baseball. Comparing the two, we'd find that the baseball accelerated faster, and that the shot-put decelerated faster, due to its larger mass.

Brainstorming

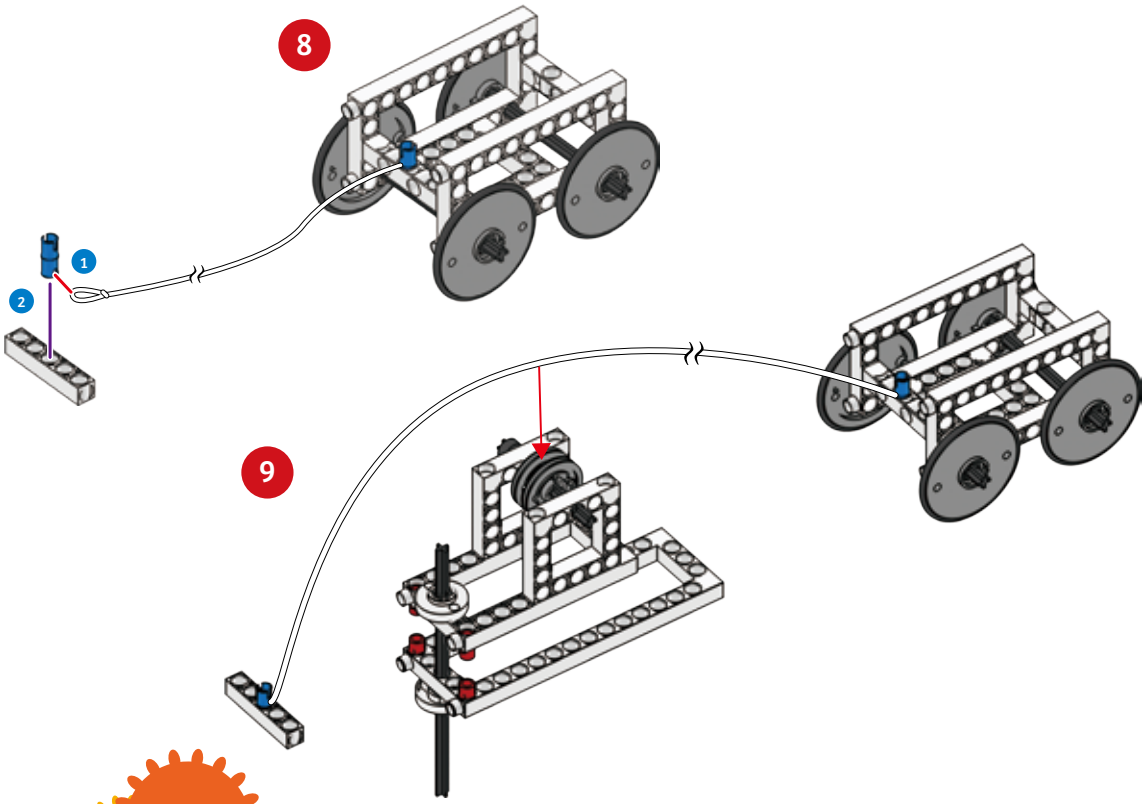
What phenomena in daily life can we apply Newton's second law of motion to?

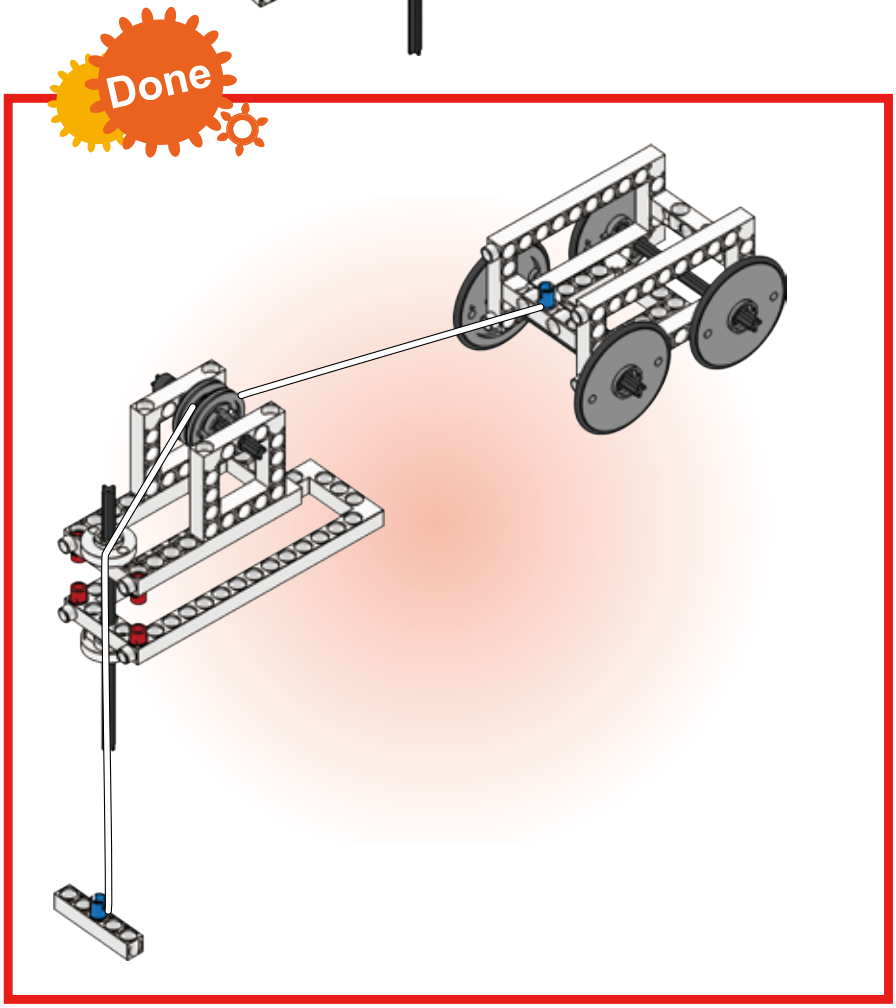
Parts List


2
4
5
10
15
16
21
22
24
26
27
x8
x2
x1
x2
x1
x2
x3
x3
x1
x2
x4
41
42
43
45
49
x1
x2
x1
x4
x1


1
2
70mm
150mm
3
4
5
100mm
100mm
6
7
1
2

2 Rickshaw





Model Operation Video

Hands-on Experiment

Try the Rickshaw and see whether its speed goes from slow to fast.

Hands-on Creativity

Observe how the speed of the car changes when it carries either one or two rubber wheels.

Evaluation

Smart Manual
Web Service

1 Model Assembled

2 Experiment Complete

3 Model Creation

3 Balloon Car

Scientific Application
Newton's Third Law of Motion

One day, when up blowing a balloon, Gigi wasn't holding on to it properly. It slipped out of her fingers and whizzed all around the room! The air released from the balloon also blew on Gigi's face, which felt refreshing.

Gigi noticed a force as the air escaped from the balloon. It was like a rocket launch in movies where the hot exhaust from the propulsion nozzle at the bottom produces thrust. This thrust works to oppose the force of gravity acting on the mass of the rocket, and sends the rocket into space.

Gigi wondered if she could control the whizzing balloon and use it to produce force in a direction she wanted, then she could make a "rocket-powered" balloon car.

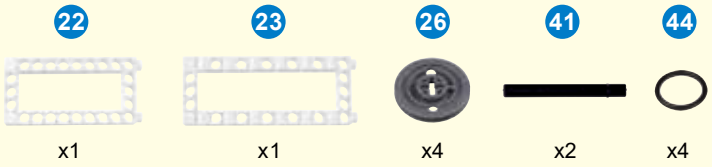
Daily Application

Newton's third law of motion states that every action has an equal and opposite reaction. This means that in every interaction, there is a pair of forces acting an object. These two forces are equal, and they will move in diametrically in opposition to each other. Because the two opposing forces act upon different objects, they cannot cancel each other out. As the two forces are created at the same time, they will also disappear at the same time too. We commonly see this during a rocket launch. A rocket is able to blast into space because when it blasts hot air and gas out and down, the rocket is pushed up by an equal and opposite (directionally) force. This is the law of opposite forces.

Brainstorming

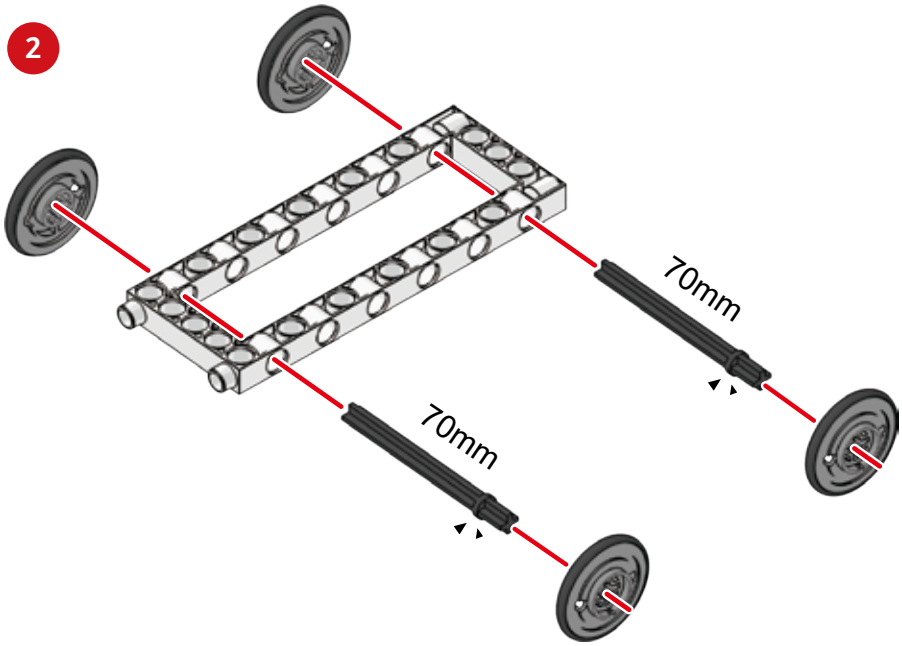
What phenomena in daily life can we apply Newton's third law of motion to?

Parts List

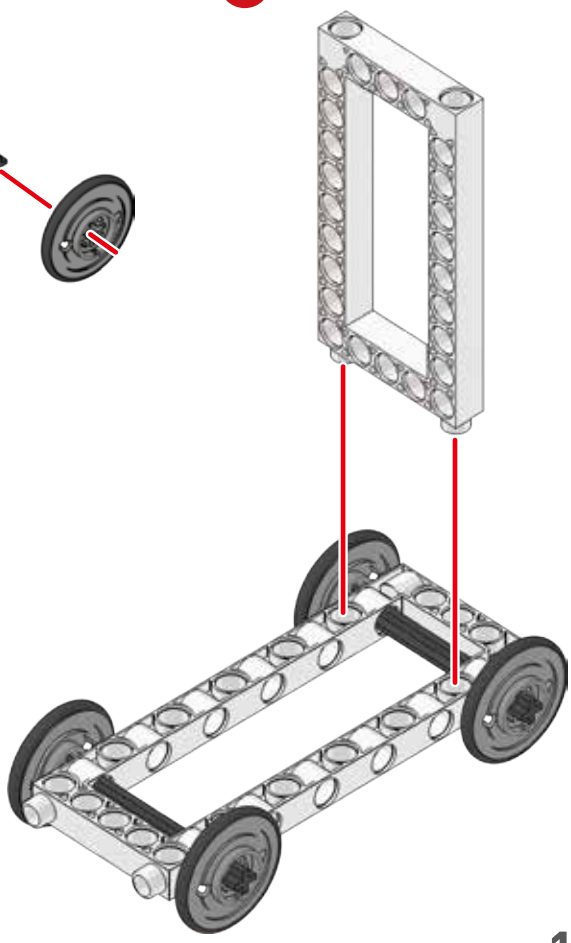


1 ×4

2

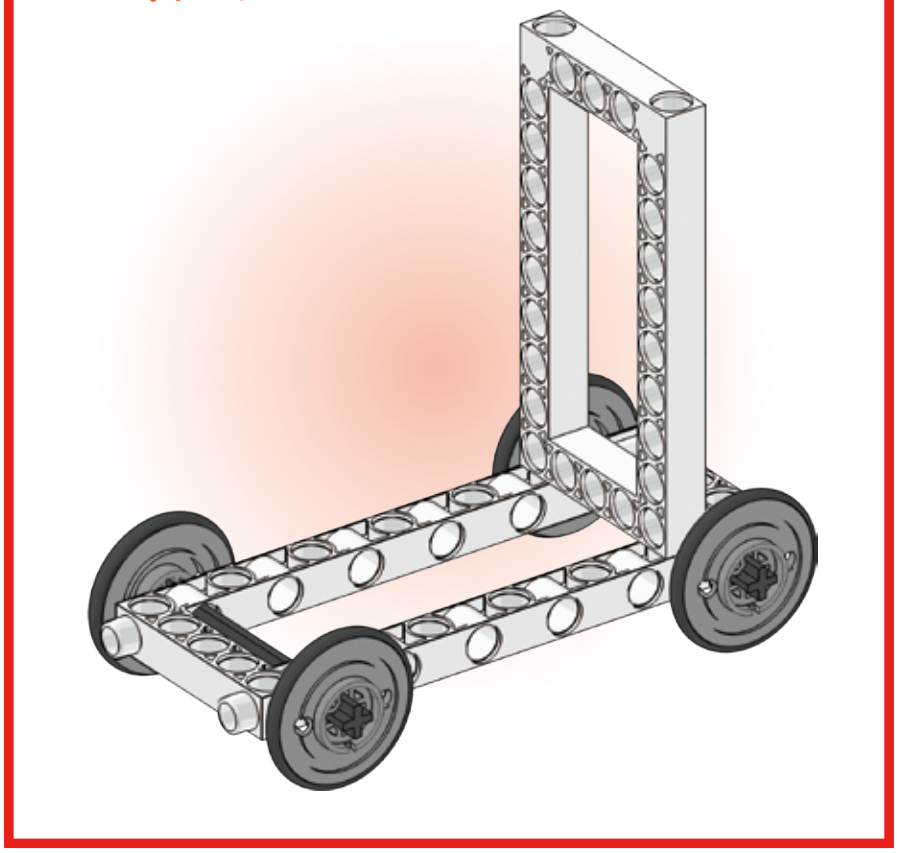


3



3 Balloon Car

Done



Model Operation Video

Hands-on Experiment

Now try this: Insert a flat balloon in the upper hole of the 5X10 FRAME and inflate it. Write down the car speed while testing the balloon under different levels of pressure.

Hands-on Creativity

Try another experiment. Insert straws with different diameters into the balloon and seal them tightly with tape. Observe the changes in car speed with different size straws.

※ Required Materials: balloons, straws, and tapes.

Evaluation

Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

4 Roulette Wheel

Scientific Application

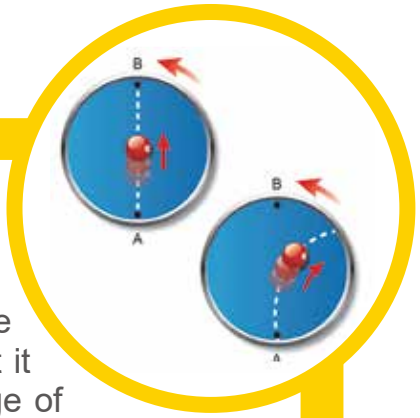
The Coriolis Effect

Gogo went to the Taipei Astronomical Museum for a tour. The museum display was all about cosmic exploration and introduced the planets of our solar system. There was a popular cosmic theater for both children and parents, where the audience could experience sitting under a star lit sky.

In the interactive section, Gogo found a very interesting model of a flat version of planet earth. It was rotating and there was a space for players to throw balls on to it. It was a kind of game and players had to throw a ball into a hole in the middle. Gogo was very confident he could do it, but when he threw the ball, to his surprise, the ball veered off to one side!

The member of staff nearby explained that if the Earth didn't rotate on its own axis, it would travel in a straight line, not around the Sun! However, the Earth does rotate causes an effect we call the Coriolis effect, which keeps the Earth's journey around the Sun in a stable elliptical path.

Daily Application

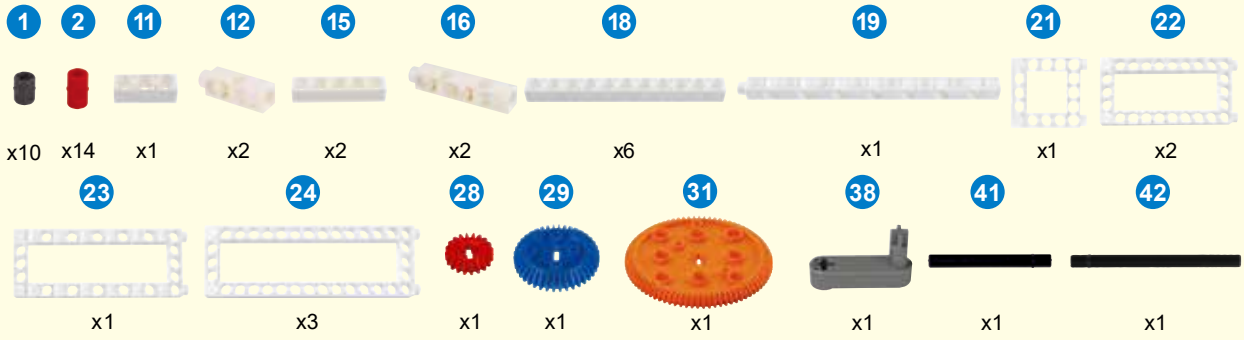


The Coriolis effect is created by the turning of a disk. The force is generated by clockwise or counterclockwise rotation. For example, if we were to place a ball on a stable disk, and push the ball from the edge of the disk's surface (Point A) so that it traveled at a constant velocity towards the opposite edge of the disk (Point B), it would travel in a straight line. However, you would notice that from the viewpoint of someone observing from Point B, the trajectory of the ball would no longer be a straight line, but rather it will begin to automatically curve towards the right. In fact, the ball is still traveling linearly, but we have added an illusory Coriolis effect.

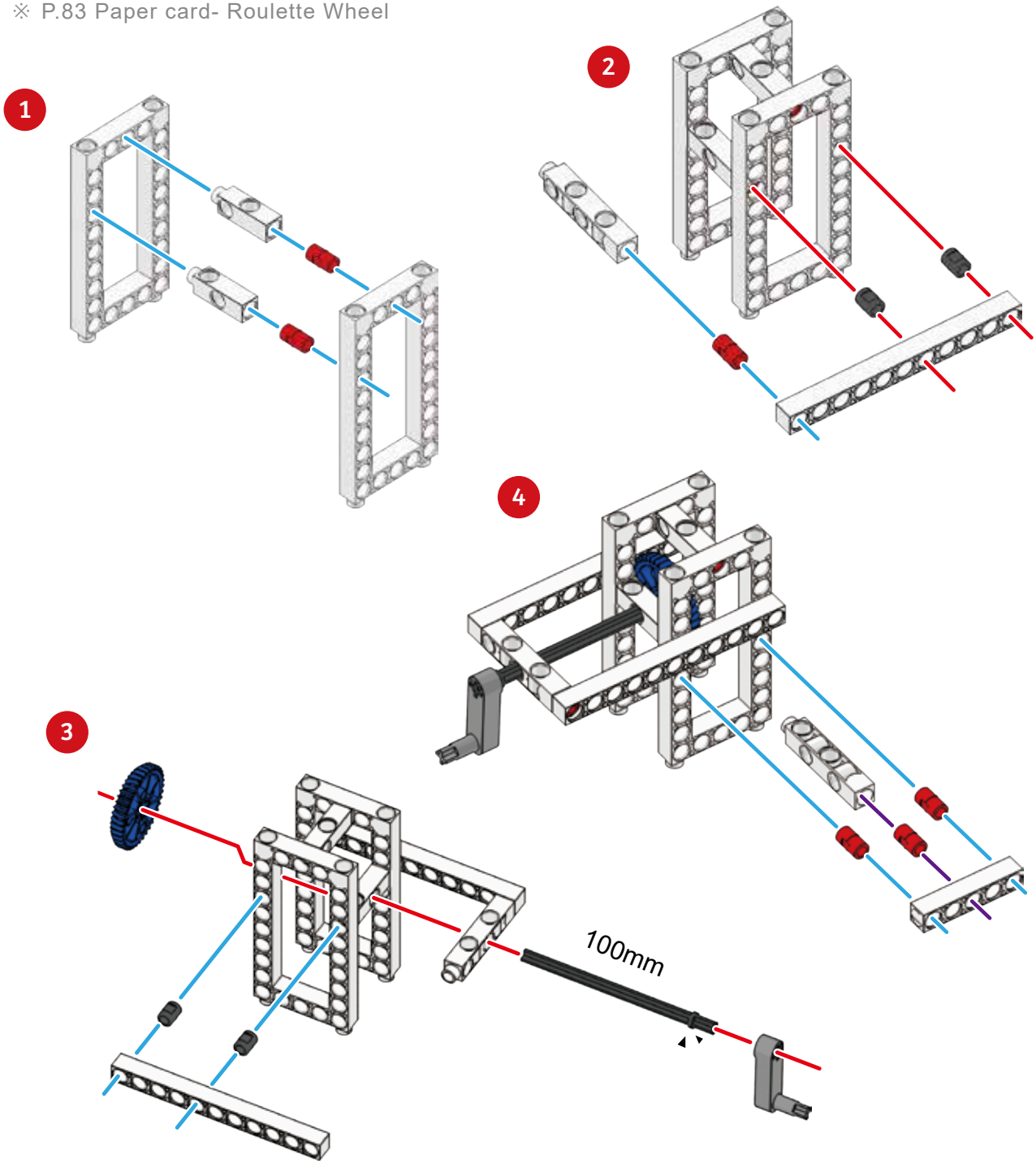
Brainstorming

Do you know which surface phenomena are affected by the Coriolis force?

Parts List

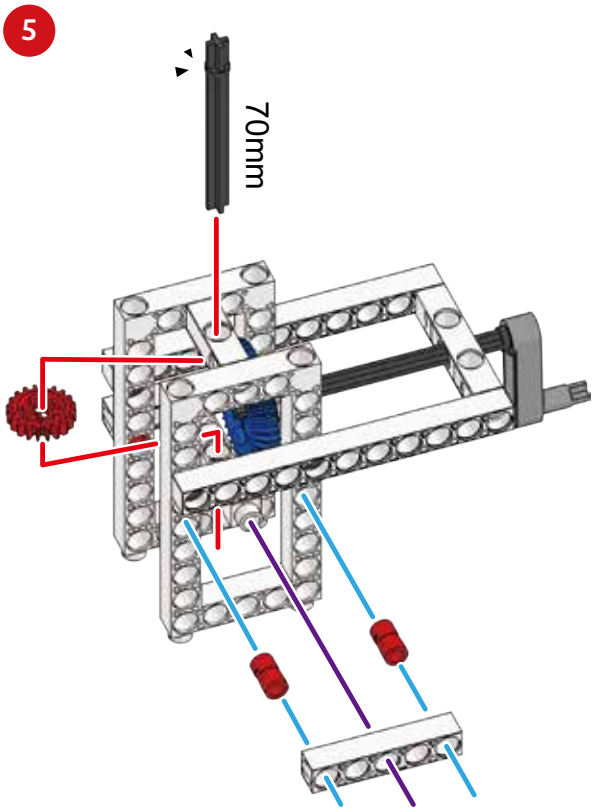


※ P.83 Paper card- Roulette Wheel

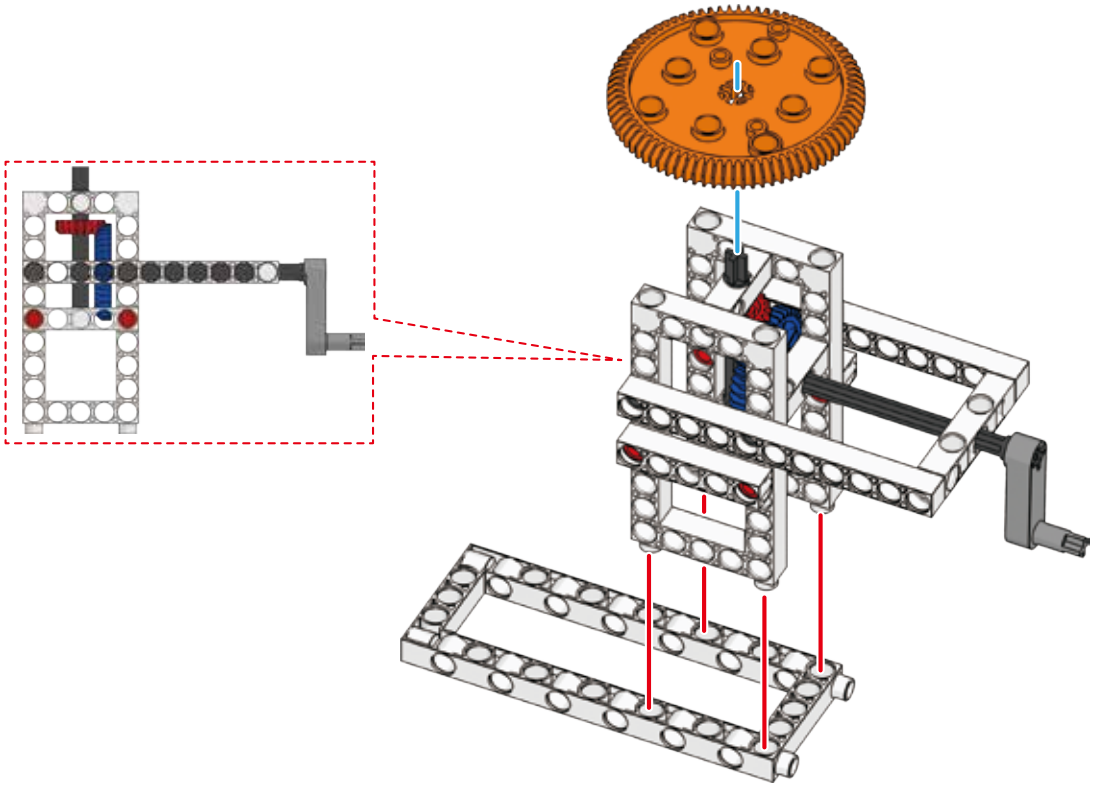


4 Roulette Wheel

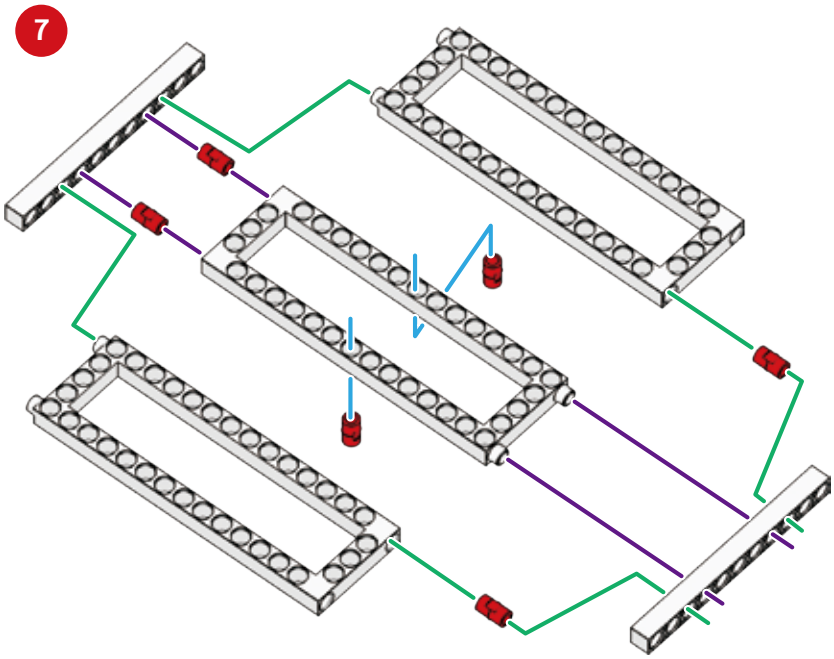
5



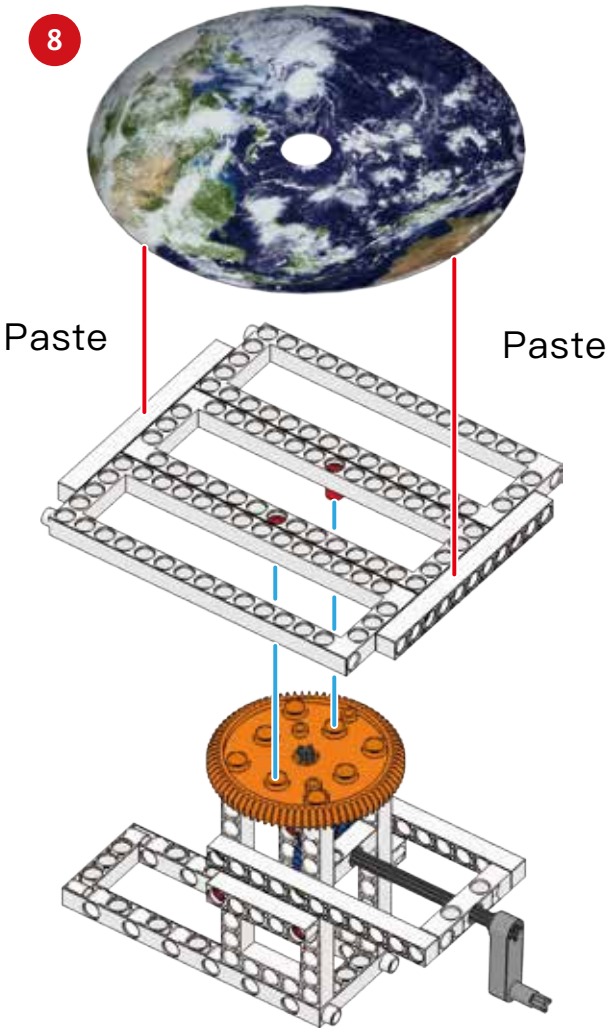
6



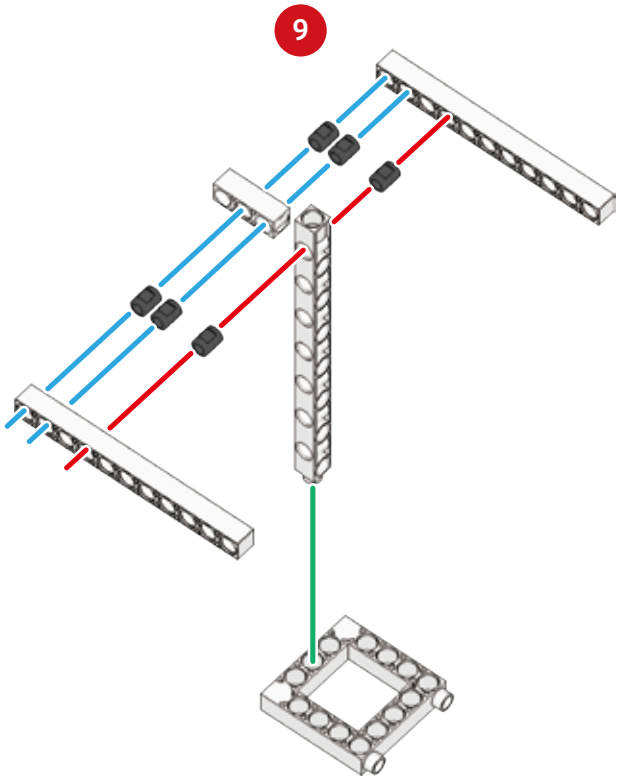
7



8

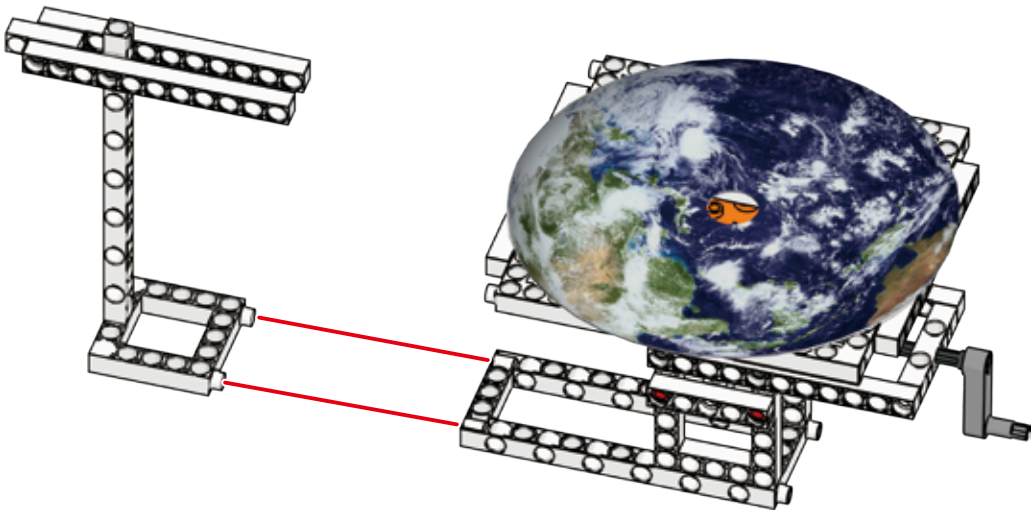


9

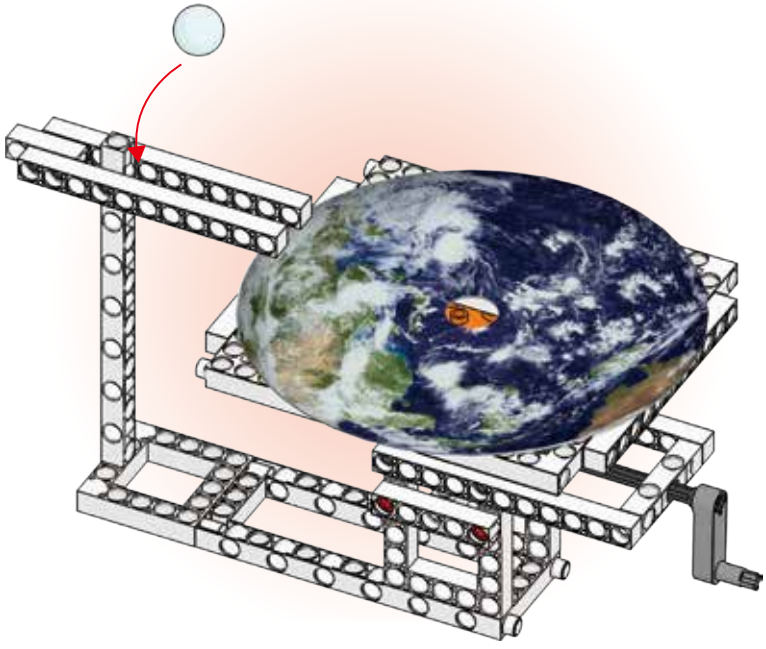


4 Roulette Wheel

10



Done



Model Operation Video

Hands-on Experiment

Now try this: One person aims the ball at the hole in the center of the Earth while the other spins the turntable. Put some ink on the marble so that it will leave a trace of the journey as it travels across the disc.

Hands-on Creativity

Try something different: Rotate the model in both clockwise and counterclockwise directions. Observe any differences in the journey of the marble.

Evaluation

Smart Manual
Web Service

1 Model Assembled

2 Experiment Complete

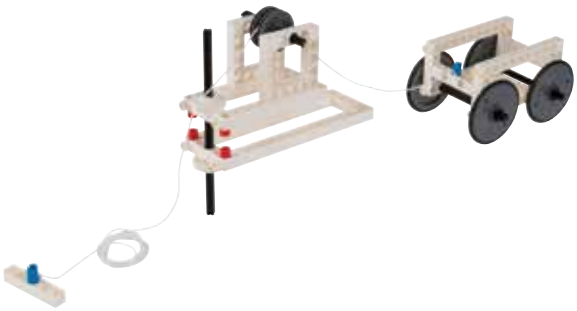
3 Model Creation

5 Monograph 1

Show us what you're learned so far. Make a rubber band powered vehicle that you can pull back & let go. Use it to compete against other students.

Model Review

1. Track Car



2. Rickshaw

3. Balloon Car

4. Roulette Wheel

Design Concept

My Artwork

Evaluation

1 ★ Model Design

2 ★ Model Creation

3 ★ Winner!

6 Mechanical clock

Scientific Application: Gears

Gigi's Grandpa has a mechanical clock, something rarely seen these days. Every time Gigi went to Grandpa's house, she would see him wind it. "So that's it!", Gigi thought. The traditional mechanical clock is powered by a wound spring. Therefore, it needs regular tightening so that the mechanism continues to function correctly.

Grandpa often tells Gigi clocks have been virtually indispensable since their invention. Whether old-fashioned, or modern and stylish, mechanical time keepers are an outstanding symbol of human and also industrial civilization.

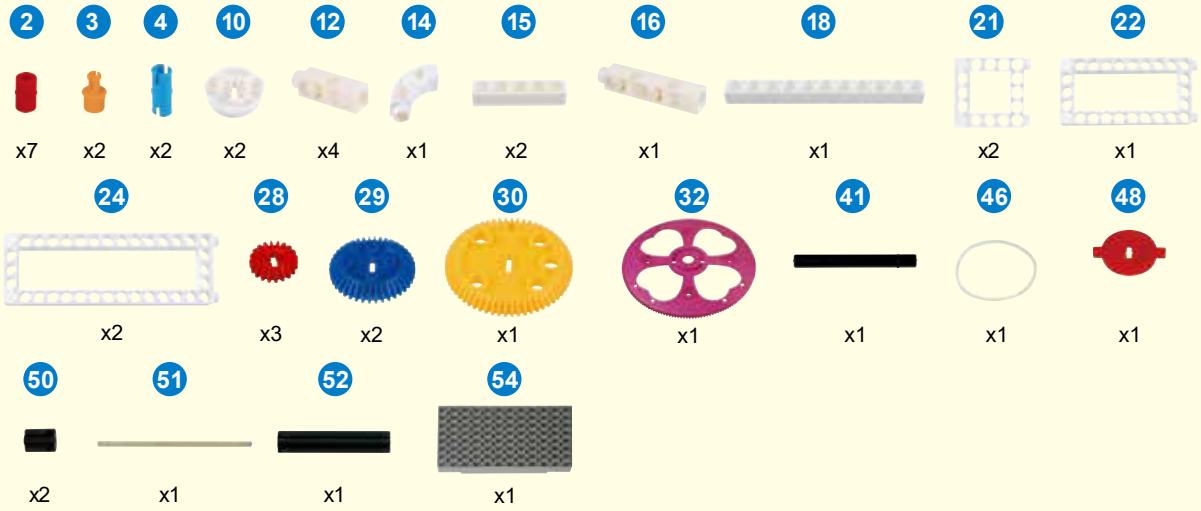
Daily Application

A traditional clock relies on the slackening of the internal spring to drive the clock hands. It is the precise mechanical gear meshing that keeps time. When the spring releases its power, the main gear is triggered and drives the meshed smaller gears to govern the motion of the minute and second hands.

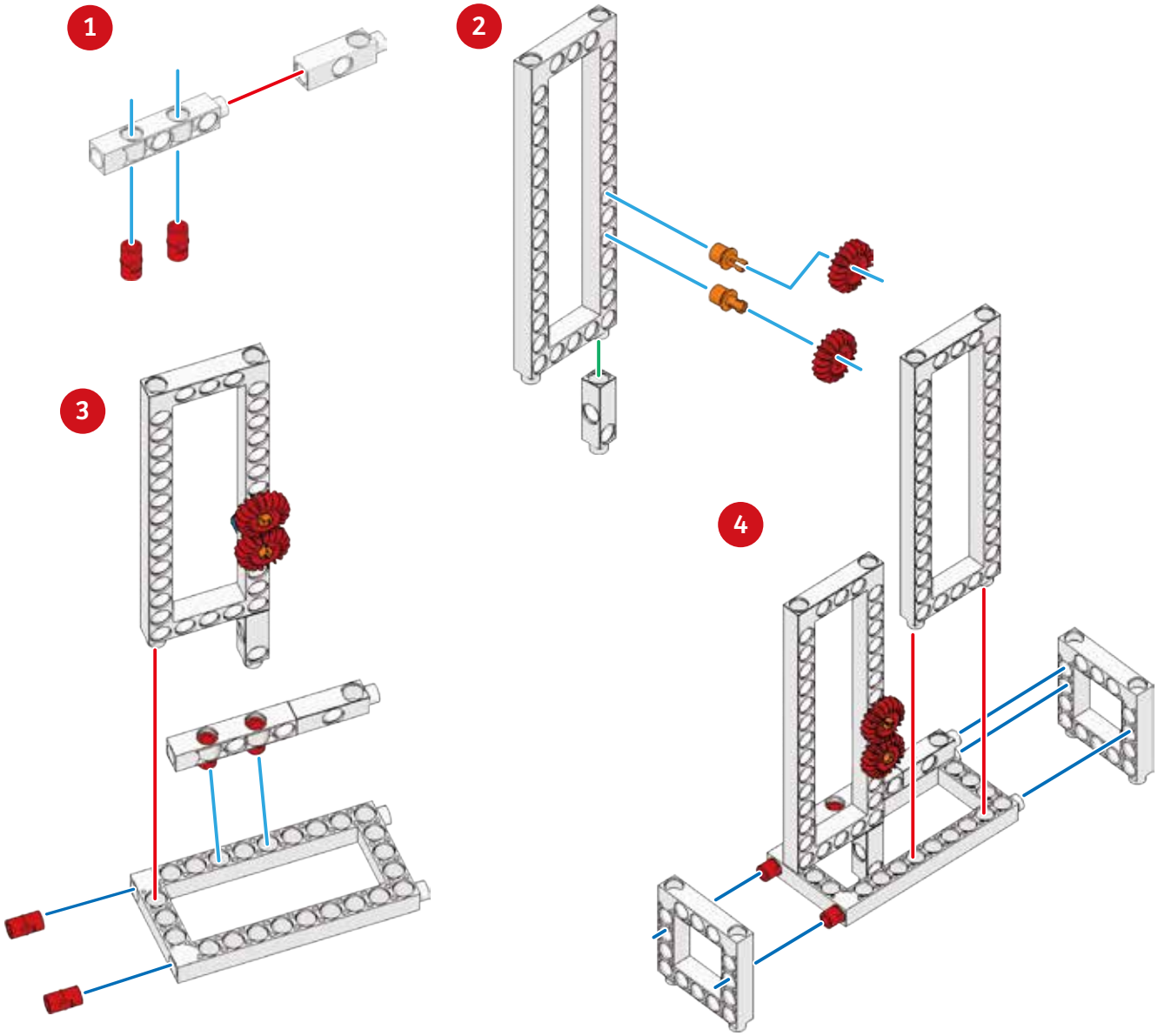
Brainstorming

Do you know the difference between a traditional mechanical clock and a modern electronic watch?

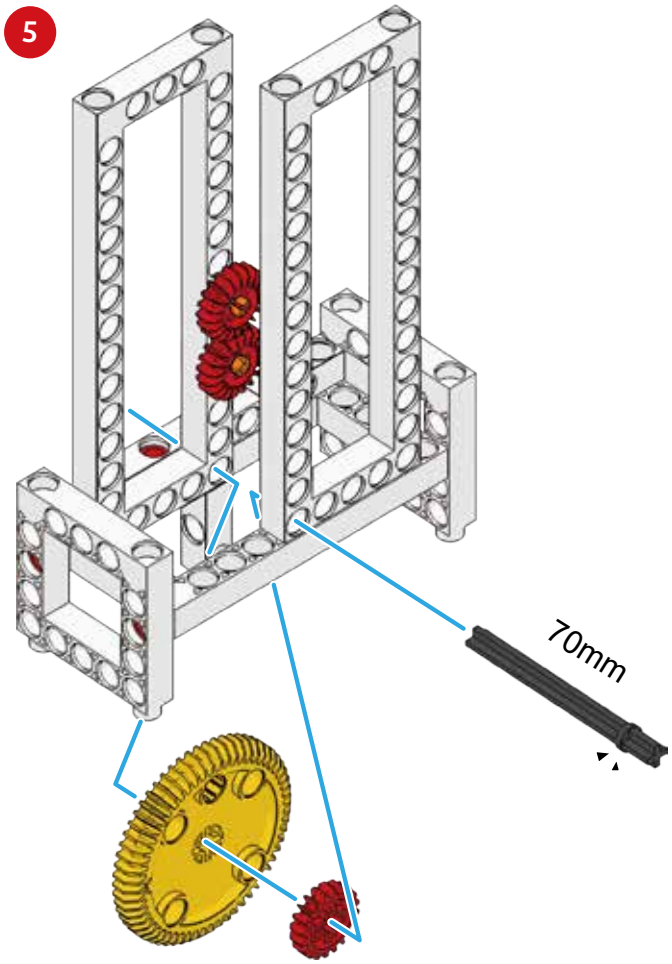
Parts List

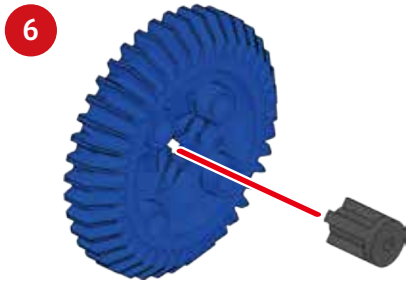


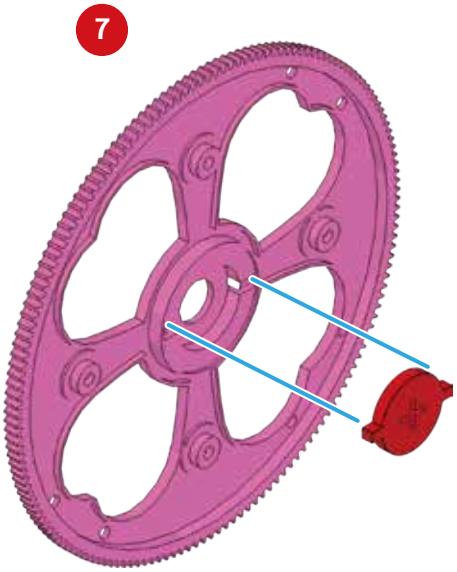
※ P.84 Paper card- Mechanical clock

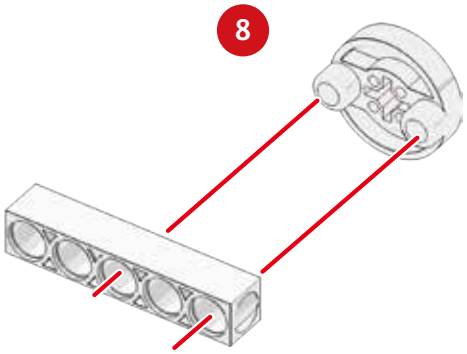


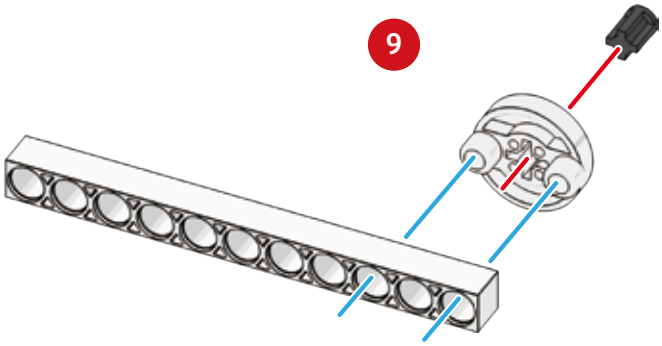
6 Mechanical clock



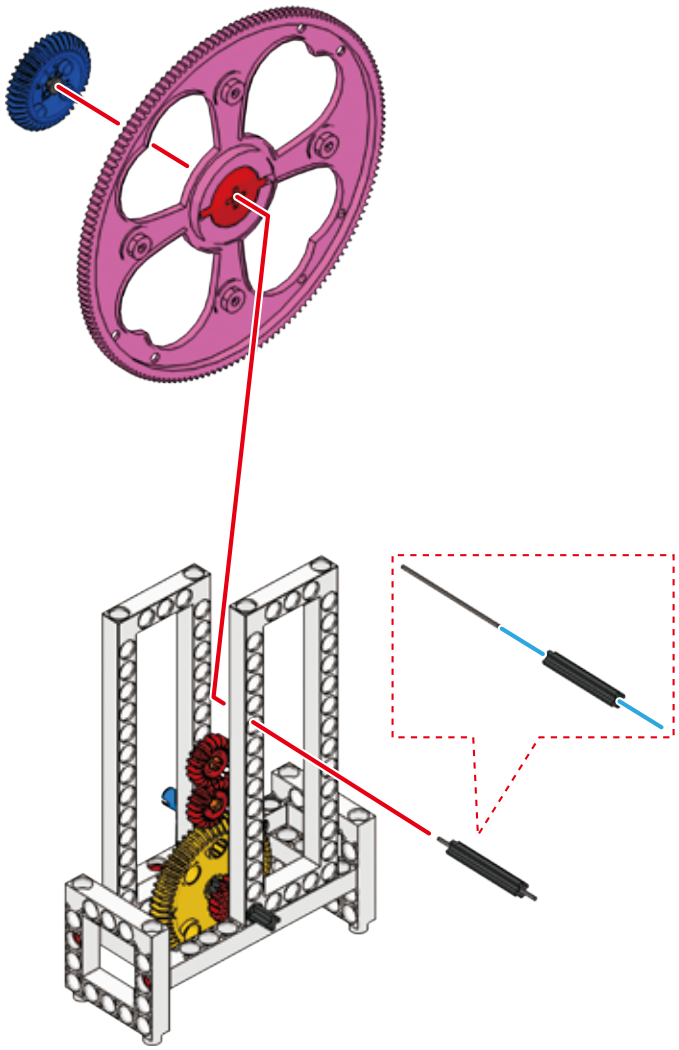




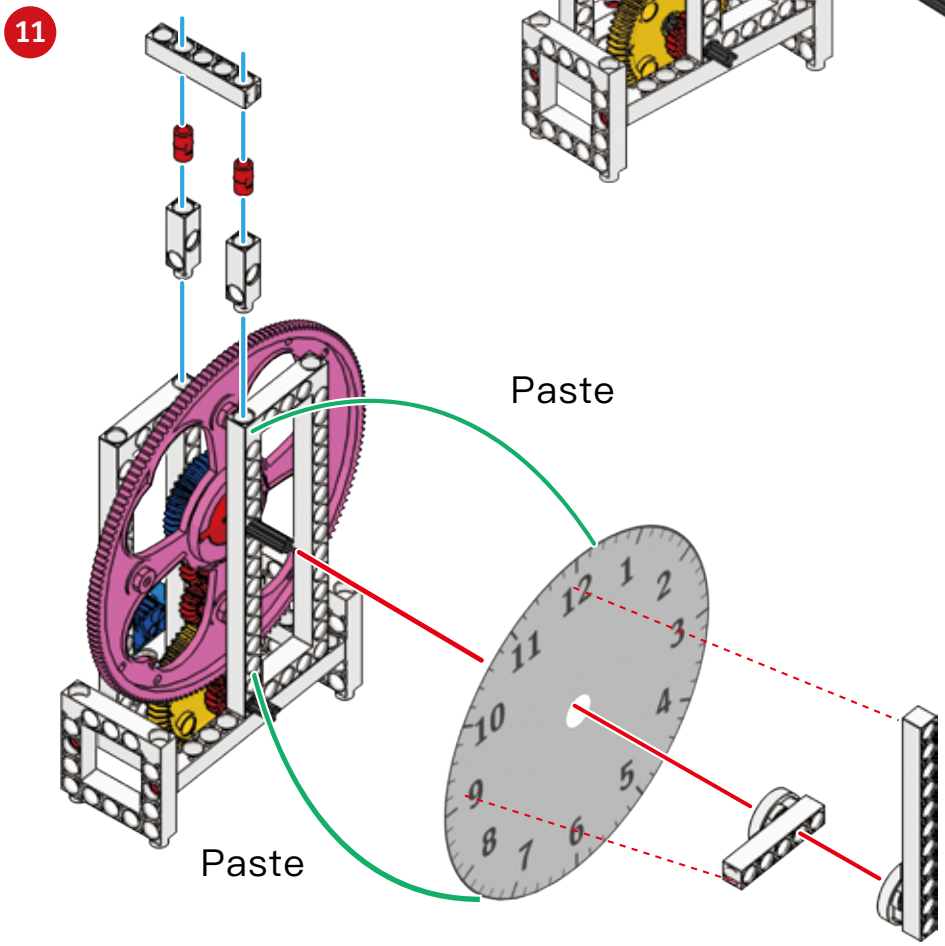




10

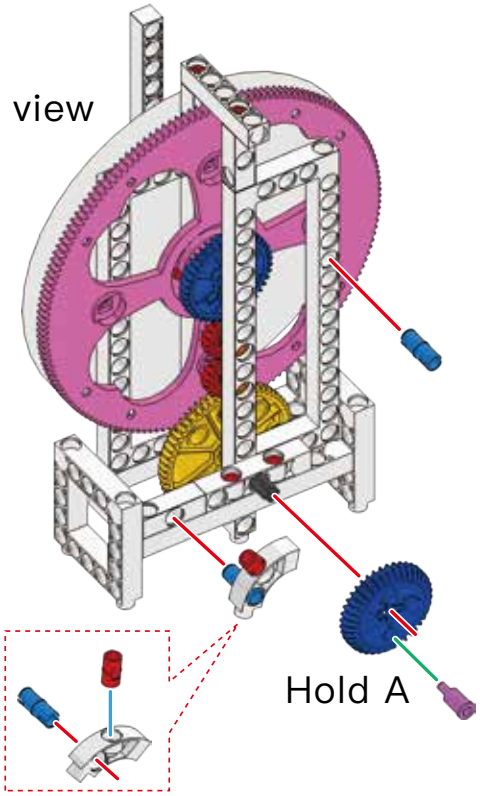


11

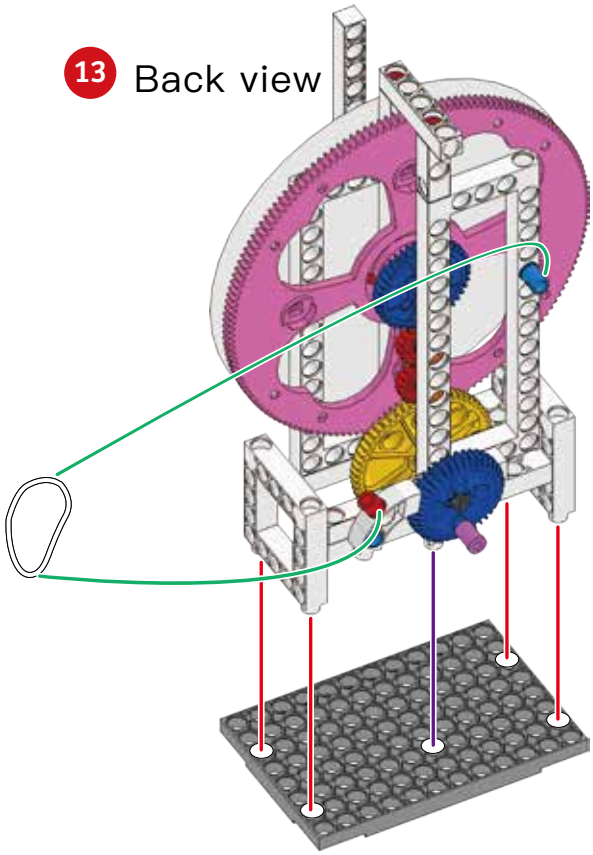


6 Mechanical clock

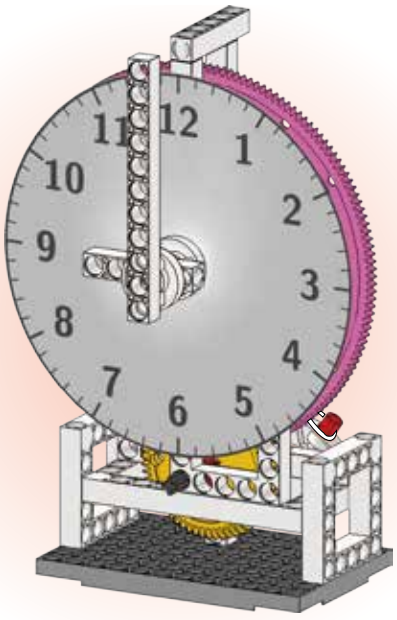
12 Back view



13 Back view



Done



Model Operation Video

Hands-on Experiment

Adjust the gear ratio to change the speed of the clock hands, and then observe how they are affected by the adjustment.

Hands-on Creativity

Try to redesign the outside of the Mechanical Clock so it looks like Big Ben in England.

Evaluation

Smart Manual
Web Service

1 Model Assembled

2 Experiment Complete

3 Model Creation

7 Angle Measuring Instrument

Scientific Application: Worm Gear

Gogo wanted to build a secret base camp using a paper box. With a lot of pens, gauges and pieces of paper at the ready, Gogo started drawing away like an architect, making sure to revise his plans so they were the best.

To design a special roof with angular features, Gogo was holding the angle gauge in his right hand, and the pen in his left hand, all while still trying to fix the paper box. He had run out of hands!

Was there a good way to solve Gogo's problem? He came up with the idea of break the limitation of worm unable to be driven in opposite direction. So, he fixed the angle gauge on a desired angle, and used only one hand to do the gauging, while the other could easily mark the coordinates and angles.

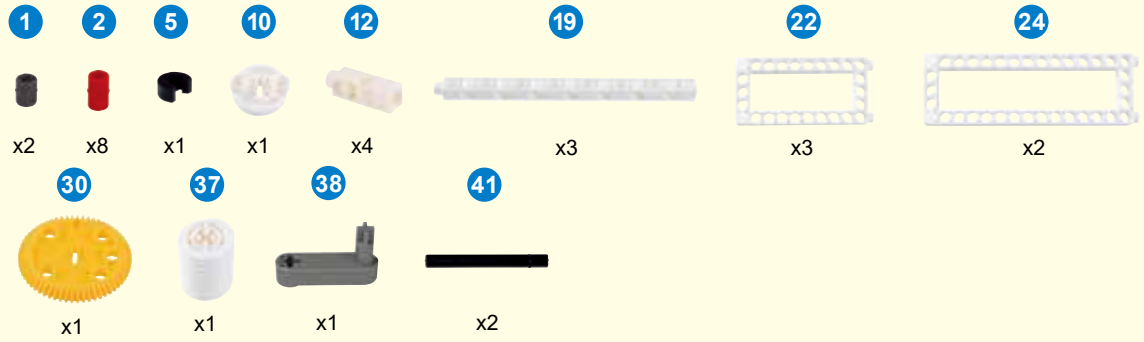
Daily Application

In a small mechanism, the easiest way to achieve deceleration, high torque, and a change in transmitted direction is to use a Worm Drive (Worm Gear and Worm Screw). The theory behind the worm drive is simple. From its appearance, it is easy to relate it to most mechanisms that have an up/down function. The special feature of the worm drive is its ability to amplify force. This results in a substantial reduction in speed, but gives an increase in torque. Therefore, you can use a smaller motor on a lift, and it will still be able to generate a huge amount of torque capable of lifting heavy things. Another very important feature is that the worm screw cannot work in reverse, so if there is an emergency situation, such as a sudden loss of power, the worm gear will immediately lock itself in place, remaining safe and stable.

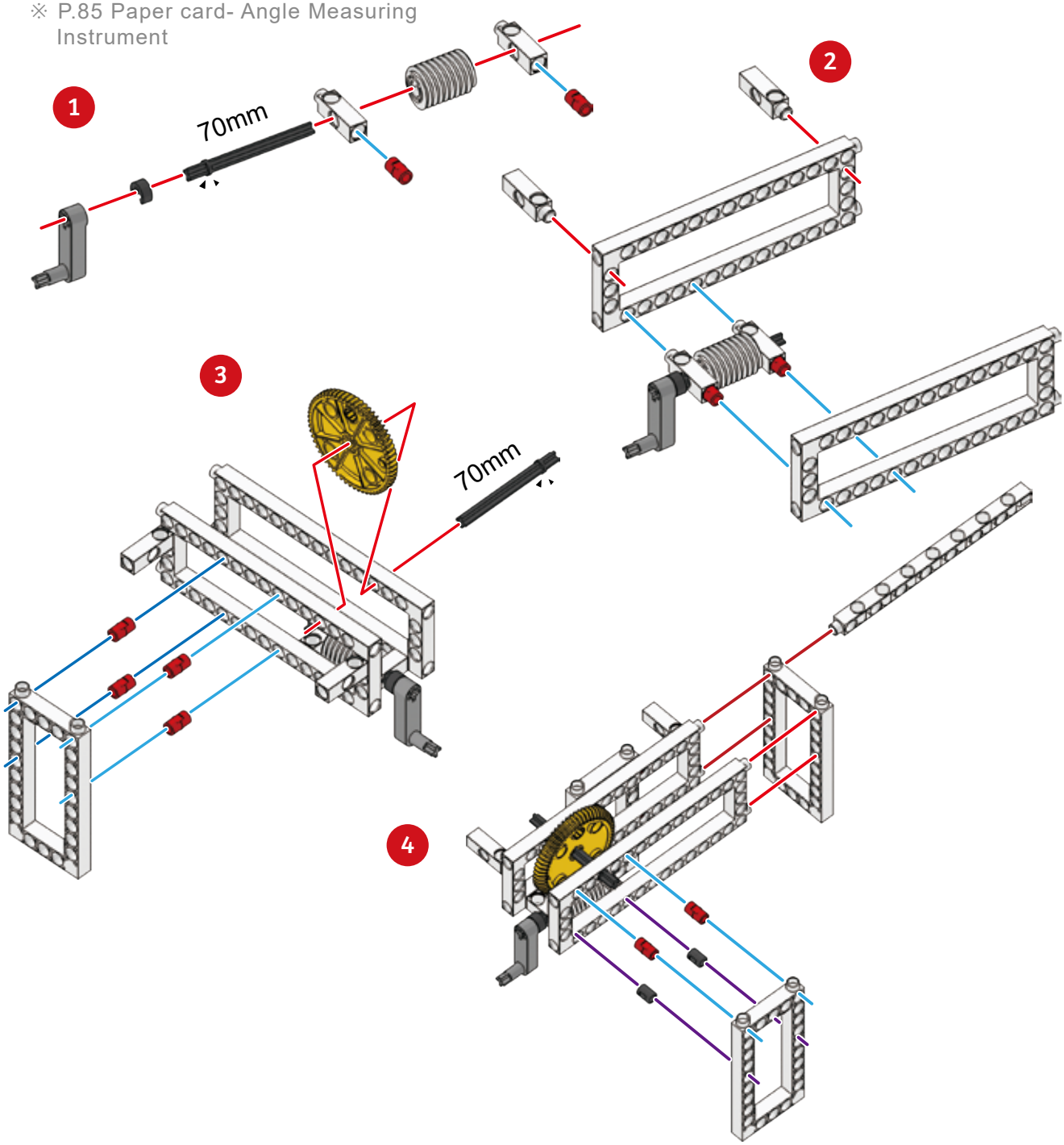
Brainstorming

How are worm gears and gear wheels different from each other?

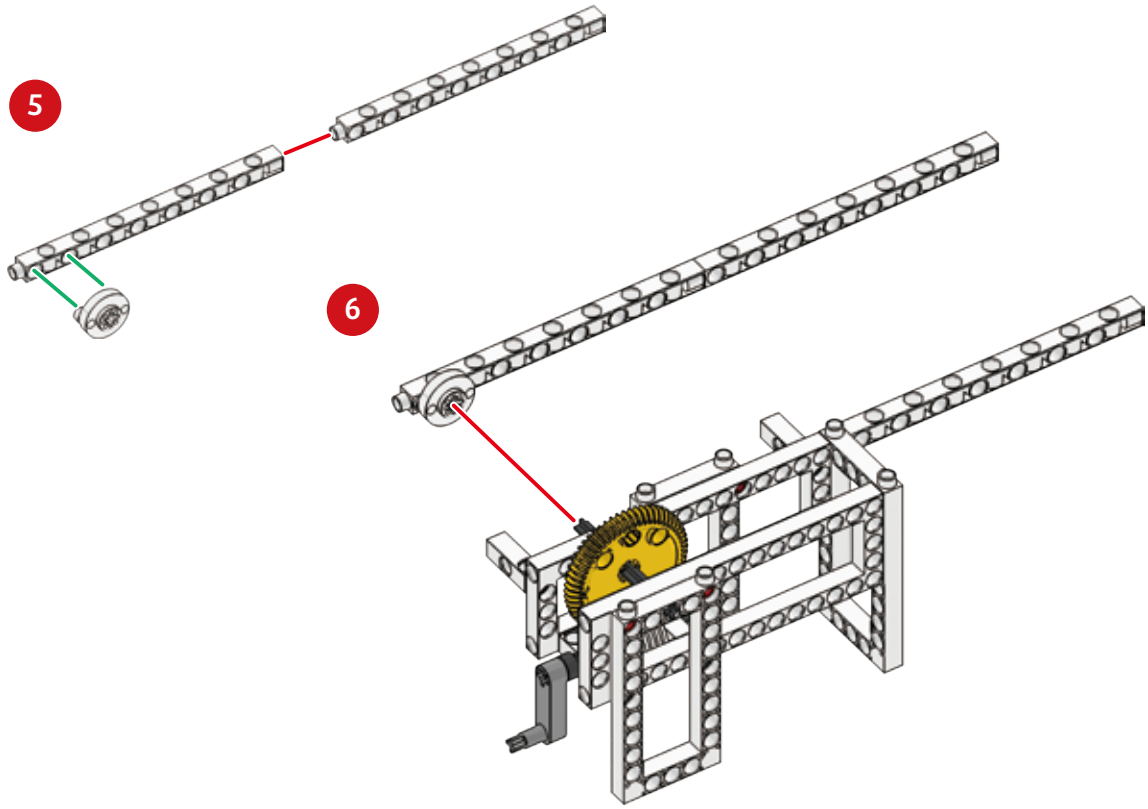
Parts List



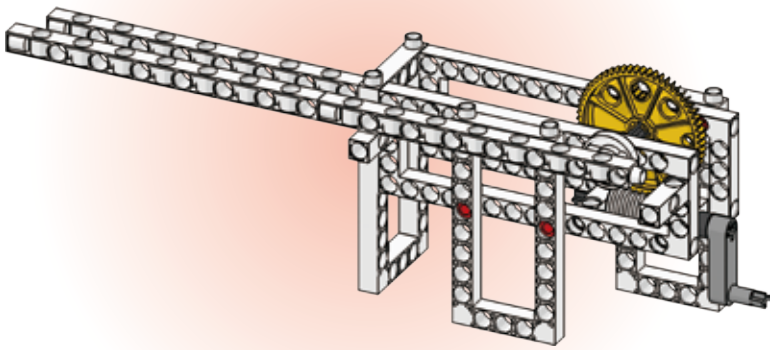
※ P.85 Paper card- Angle Measuring Instrument



7 Angle Measuring Instrument



Done



Model Operation Video

Hands-on Experiment

Use an Angle Measuring Instrument to mark 30 and 60-degree angle increments on the blackboard.

Hands-on Creativity

With the same worm gear, try to change the model into a fence machine.

Evaluation

Smart Manual
Web Service

1 Model Assembled

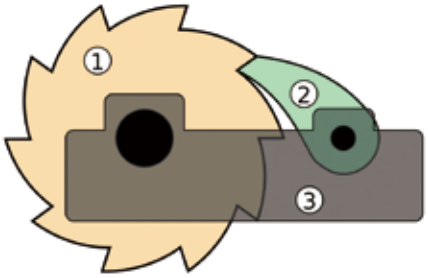
2 Experiment Complete

3 Model Creation

8 Revolving Door

Scientific Application: Ratchet

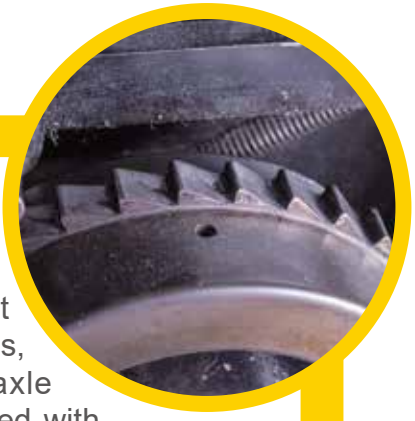
On his way home, Gigi passed by a supermarket where some repairmen were doing some maintenance on the revolving doors. He watched them working and found that only one person at a time was allowed to enter through the door. What impressed him the most was that the door could spin only in one direction, no opposite direction was allowed.



Gigi asked a worker why the door spun in one direction only. The worker explained to him, “The revolving door uses a ratchet and pawl mechanism to ensure a single-direction motion. If the ratchet tries go the other way, it gets stuck on the pawl and cannot move. ”

When the maintenance was done, Gigi went closer to the door for another look, but a repairman reminded him not to play by the door for safety reasons.

Daily Application

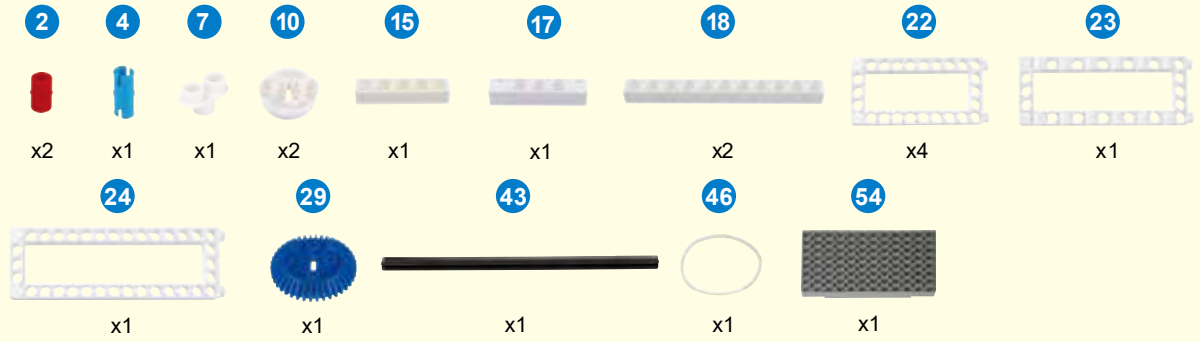


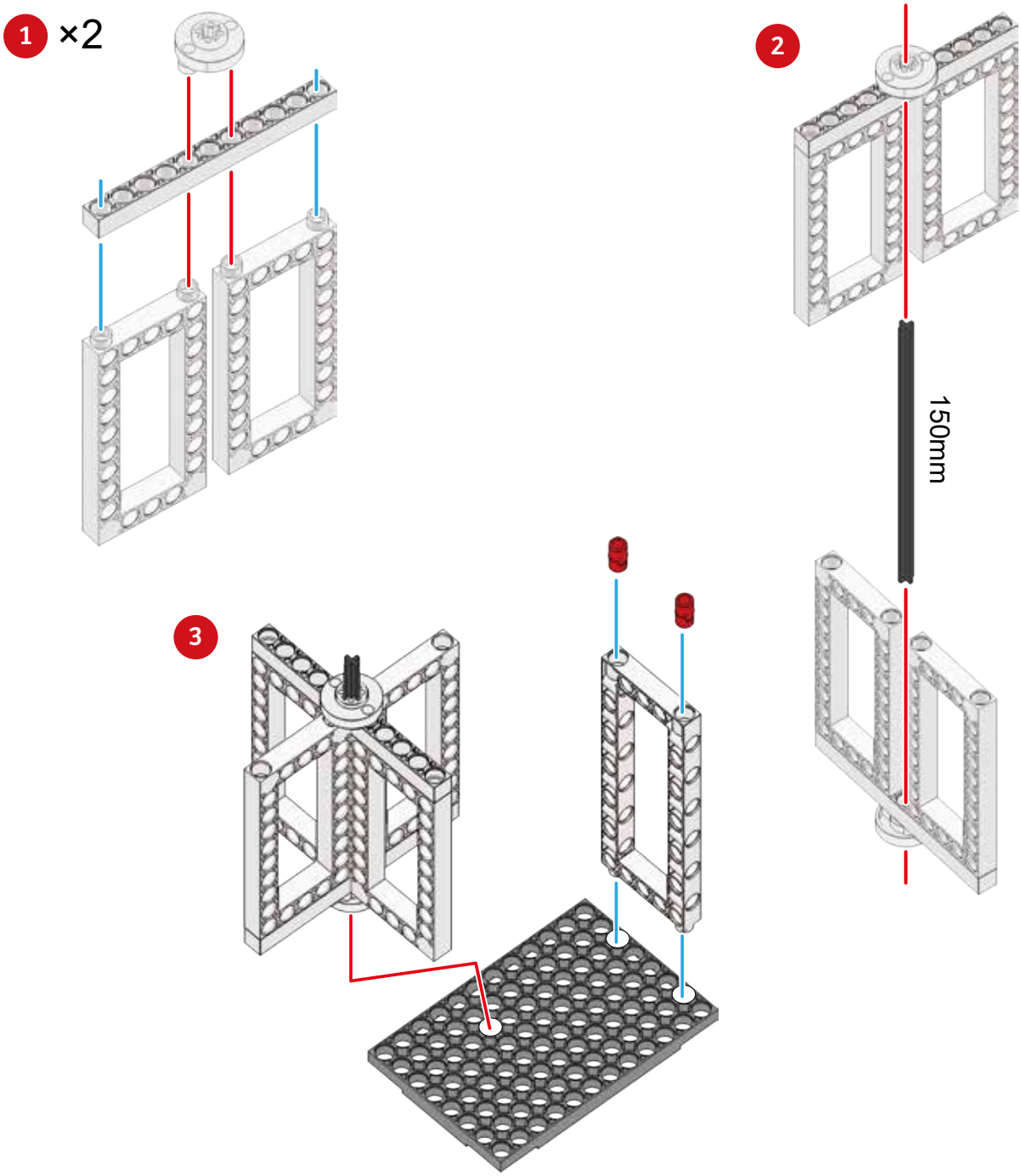
Axles are usually used to connect several rotating mechanical parts. For example, an axle is fixed onto a gear, so that the gear will rotate around the axle. When the axle is not long enough, an output shaft is used to connect the axle to another axle. Sometimes, the output shaft is used to change the direction of the axle center. As for the ratchet mechanism, the ratchet is combined with a small spring-loaded device known as a pawl. The teeth of the ratchet must be curved on one side, and steep on the other to function. As the ratchet moves forward, the pawl easily slides over the curved portion of the ratchet’s teeth. If the ratchet wheel rotates in the opposite direction, the pawl will “catch” on the steep portion of the ratchet’s wheel, and the wheel cannot rotate; therefore, the ratchet mechanism can only move in a singular direction.

Brainstorming

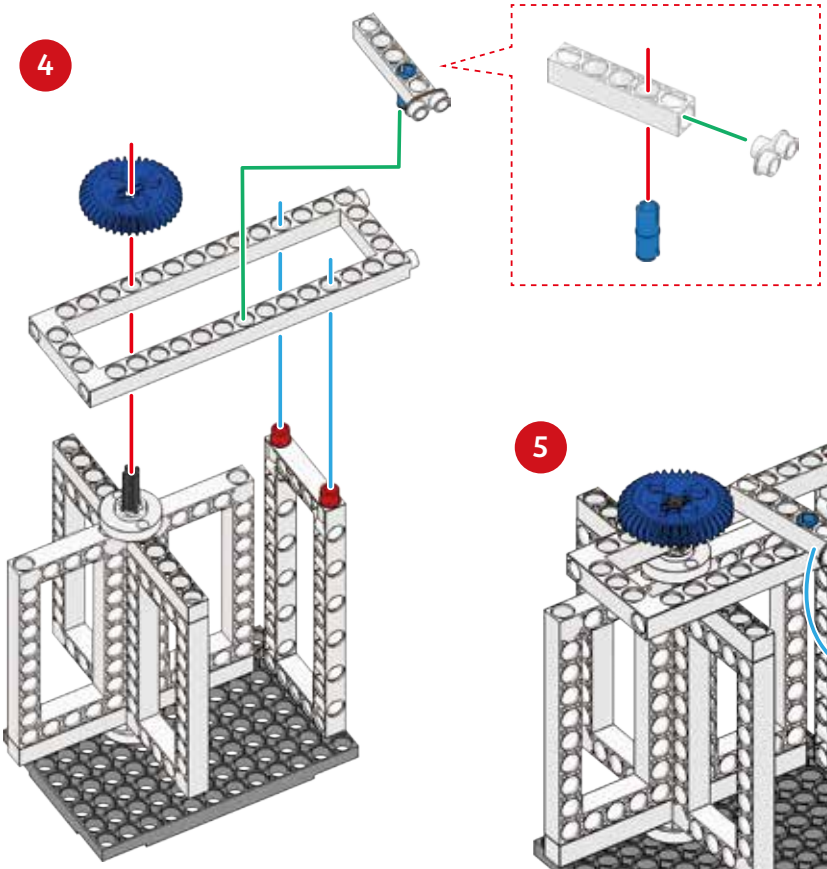
What applications of the ratchet and pawl mechanism can be seen in everyday life?

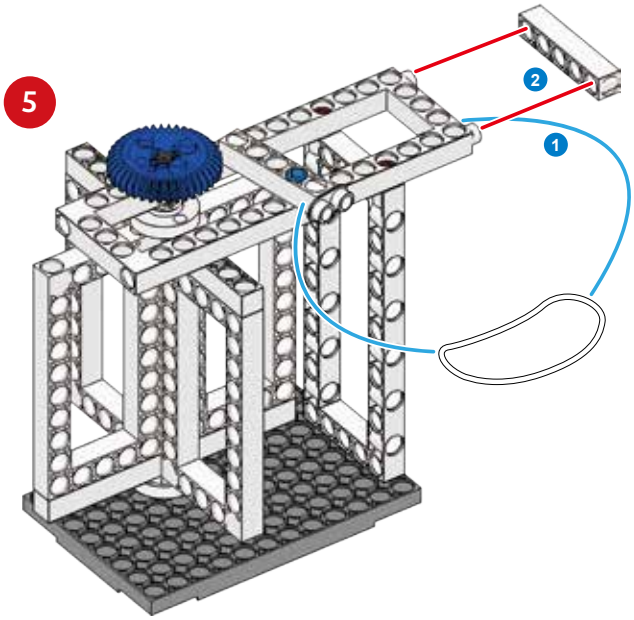
Parts List


2
4
7
10
15
17
18
22
23
x2
x1
x1
x2
x1
x1
x2
x4
x1
24
29
43
46
54
x1
x1
x1
x1
x1

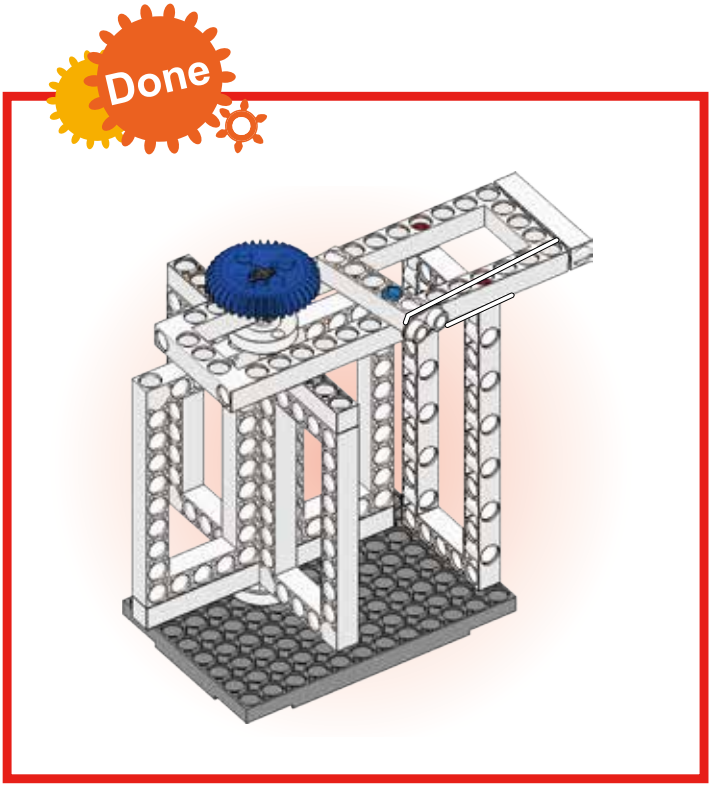

1 ×2
2
150mm
3

8 Revolving Door





Done



Model Operation Video

Hands-on Experiment

Try to spin a Revolving Door in clockwise and counterclockwise direction. See for yourself if the door can spin in one direction only.

Hands-on Creativity

Use toy blocks to create a building, then add a Revolving Door to it for aesthetics and practicality.

Evaluation

Smart Manual Web Service

1 ★ Model Assembled

2 ★ Experiment Complete

3 ★ Model Creation

9 Push Game

Scientific Application: Crankshaft

In the class, the teacher showed a crankshaft to the students and asked them if they had seen something like this before.

The teacher explained, “Car engines use a crankshaft. When they are equipped with a linkage lever and pistons, a crankshaft will constitute the main power transmission mechanism inside the engine. ”

To help the students further understand the crankshaft motion, the teacher asked the students to make push game with their own hands and take it to compete against one another for fun! Everyone in the class was really serious in the gaming, and at the same time found that the momentum of the spinning crankshaft could drive the linkage lever into a kinetic force for repetitive movement.

Daily Application

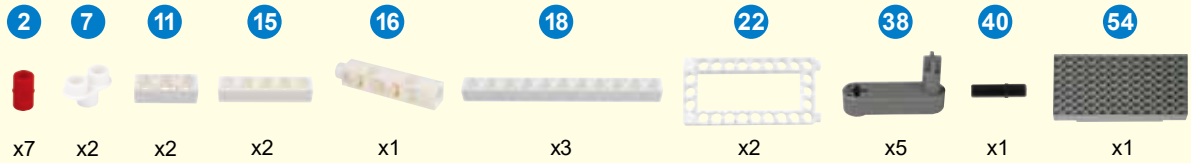
The main component of the crankshaft is a long rotating axle rod. The two corners of the axle rod are turned into cranks; which, when connected together, form a complete crankshaft.

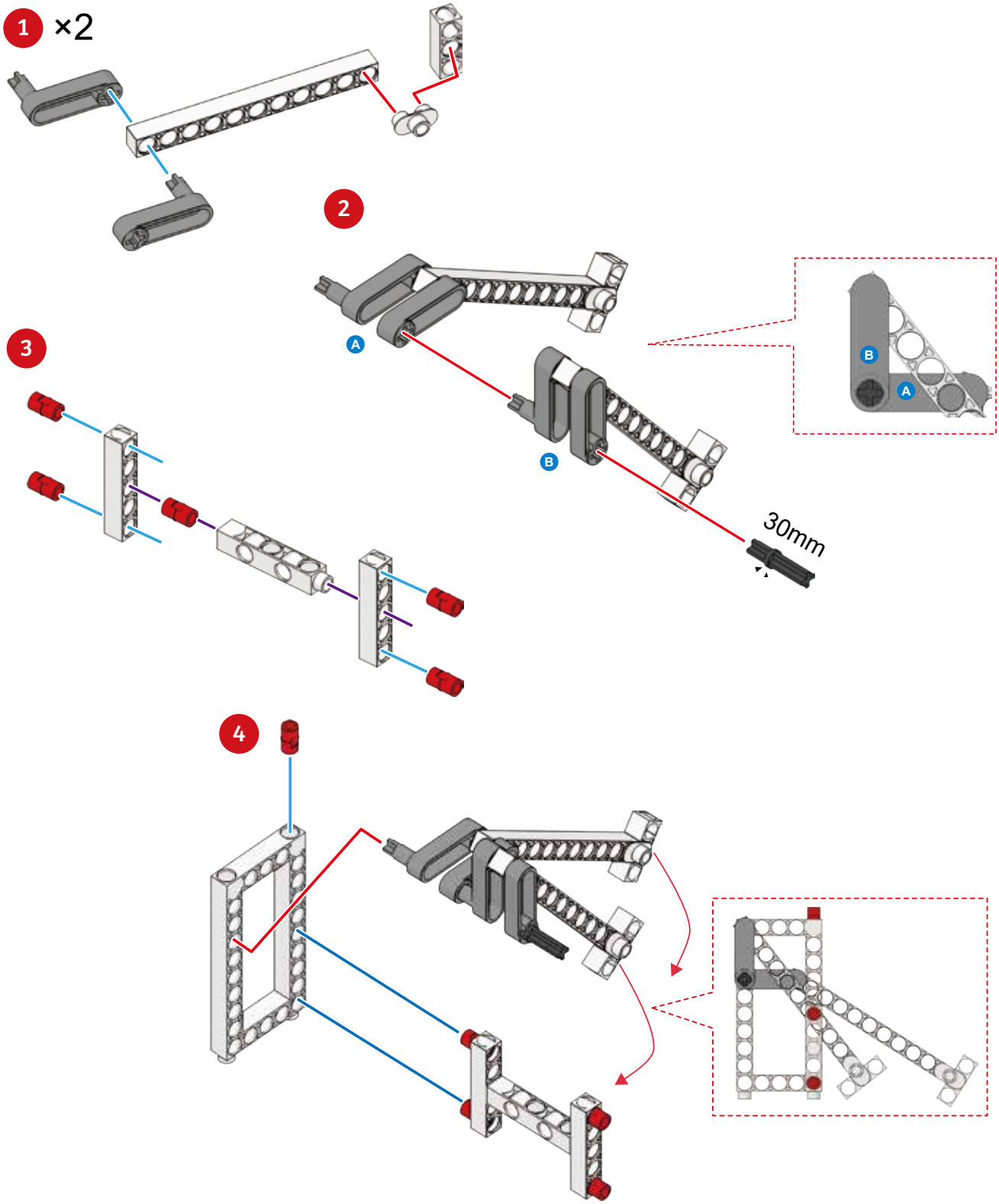
You can see this in an old car engine. If a crankshaft is installed on a connecting rod with pistons, it will become the main component in the transmission of a car. In a reciprocating engine, the crankshaft translates the linear motion of the pistons moving up and down, into a rotary motion. If a gear is attached to the crankshaft, the translated rotating motion will cause the gear to rotate as well. In order to transform the repeating motion of the pistons into a rotary motion, the crankshaft has a crank arm, or several crank pins, whose axis is offset from that of the main axle rod.

Brainstorming

How is the crankshaft rotation in a duplex piston engine translated into a kinetic force?

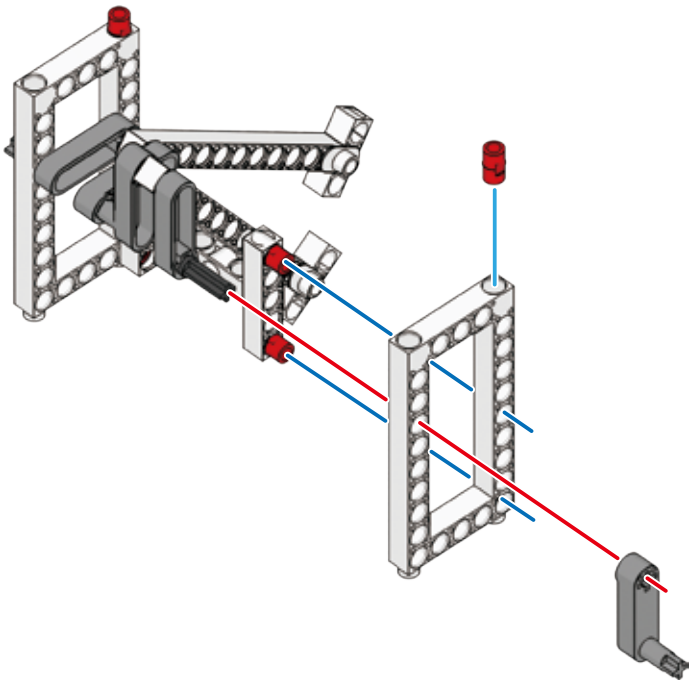
Parts List


2
7
11
15
16
18
22
38
40
54
x7
x2
x2
x2
x1
x3
x2
x5
x1
x1

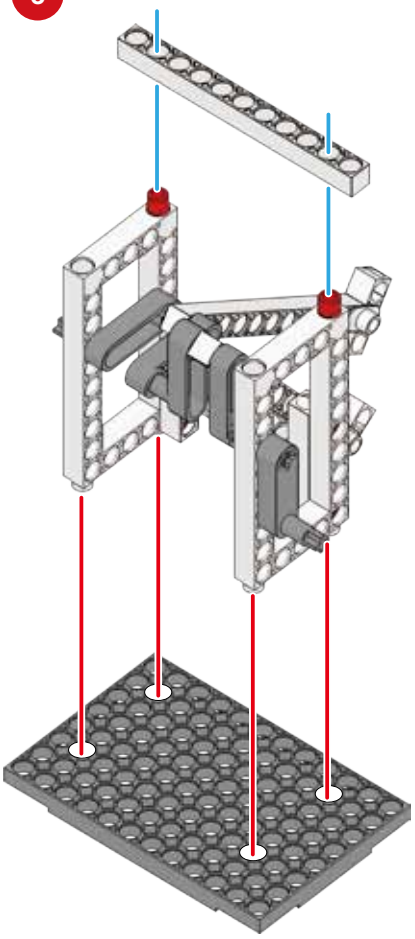

1 ×2
2
A
B
B
A
3
30mm
4

9 Push Game

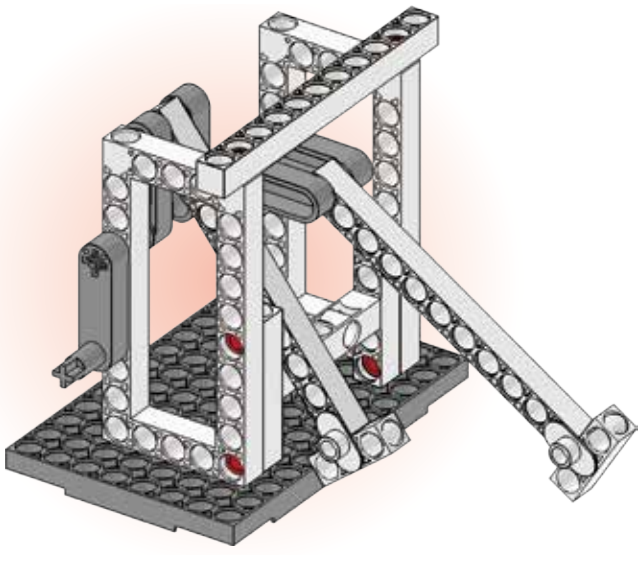
5



6



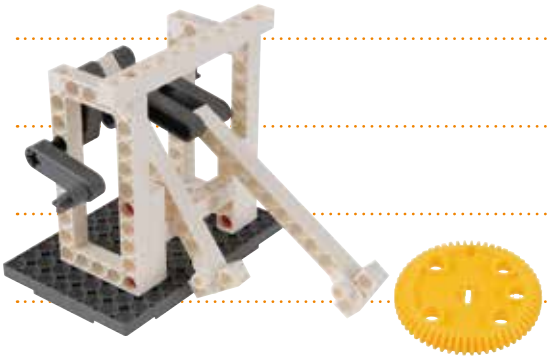
Done



Model Operation Video

Hands-on Experiment

Now try this: Put a 60T GEAR in front of a model Push Game, and then try to push it forward.



Hands-on Creativity

Try to build a back-kneading massage machine with a crankshaft.

Evaluation

Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

10 Monograph 2

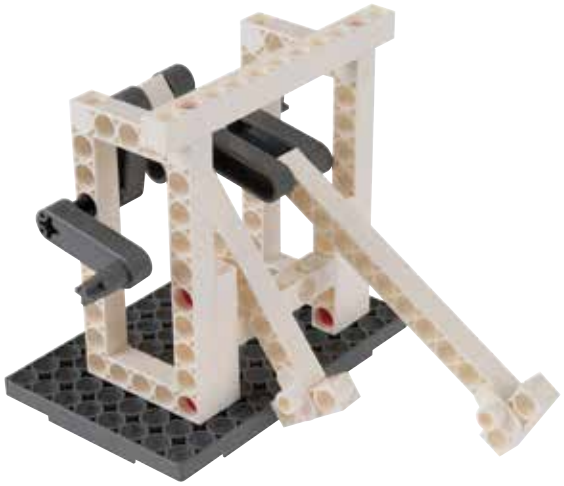
To summarize what have been learned so far, try to build a model animal (e.g. worm gear application on giraffes), and get it move. Of course, we can also use cardboard to decorate the model!

Model Review

6. Machine Clock

7.Angle Measuring Instrument

8. Revolving Door



9. Push Game

Design Concept

My Artwork

Evaluation

1
Model Design

2
Model Creation

3
Winner!

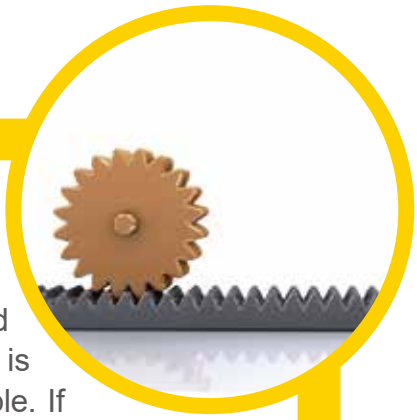
11 Wiper

Scientific Application: Gear & Rack

In class, the teacher told a story about the invention of windshield wipers. It was 1902, and a lady called Mary Anderson was travelling to New York. It was a rainy day and the driver had to stop the car frequently to wipe snow and rain from the windshield by hand. This made her realize that a machine could be designed to do the same thing. Later, her idea became the first windshield wiper system the world had ever seen.

After hearing this story, Gogo decided to design a windshield wiper for his little toy car. He rummaged in his tool box and found a couple of long strips for the wiper blades; then, along with some gears, racks and long rods he assembled everything. The rotating gear drove the rack in a left and right radial movement, just like the wiper blades going from left to right!

Daily Application

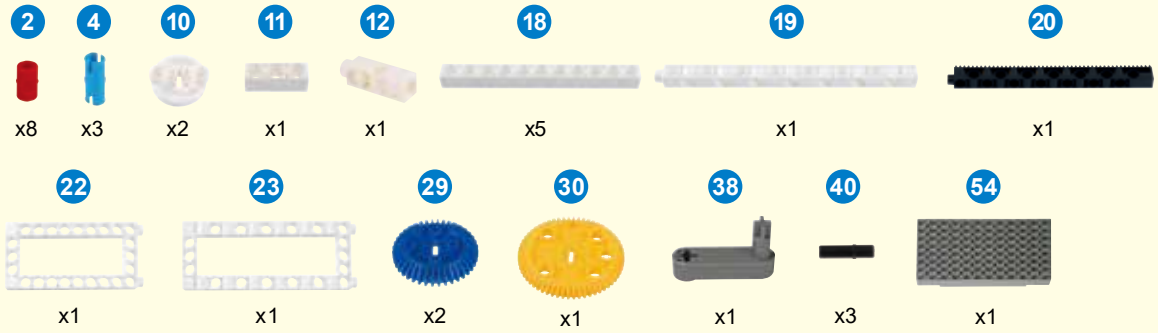


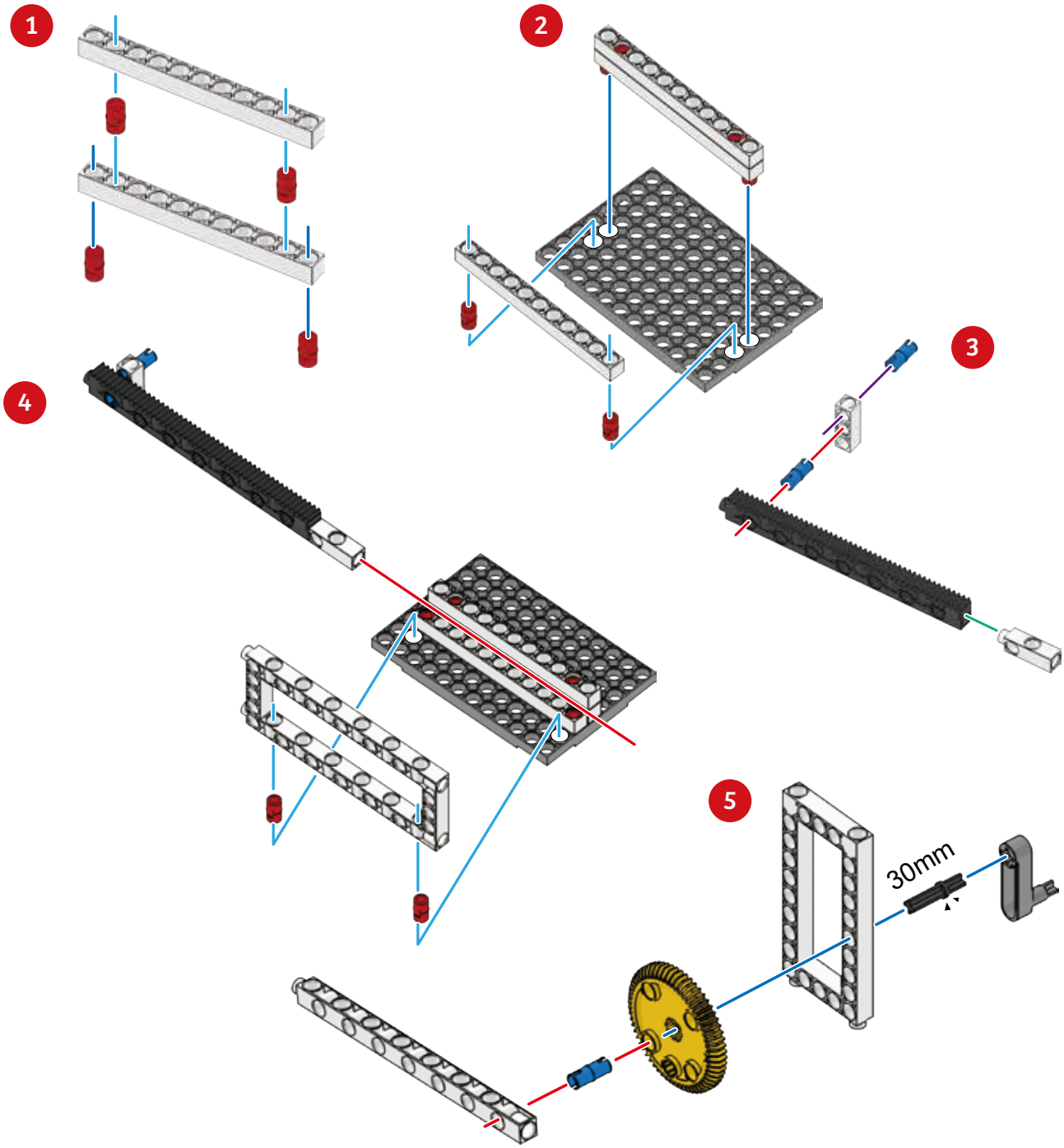
The rack and pinion system can transform the rotational movement of the steering wheel, into a linear movement for the wheels. It's very easy to recognize the pinion and rack from its outward appearance. The round gear is the pinion; the straight gear is the rack. The theory behind the rack and pinion is quite simple. If the rack is fixed in place, the pinion moves along its surface as it rotates. There are two possible kinds of movement: back and forth; and left and right. Either way, the center of the pinion moves linearly. Alternatively, if we fix the pinion in place, then the rack will move along the surface of the pinion, either up and down, or left and right. The previously mentioned steering wheel of a car is designed with this mechanism.

Brainstorming

What applications in our daily lives use gear and rack?

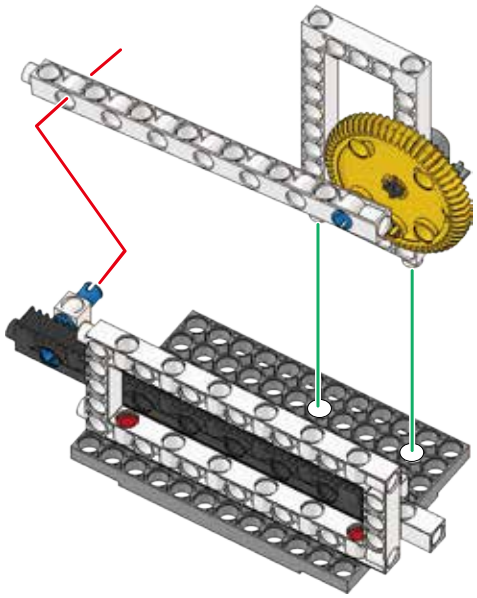
Parts List


2
4
10
11
12
18
19
20
x8
x3
x2
x1
x1
x5
x1
x1
22
23
29
30
38
40
54
x1
x1
x2
x1
x1
x3
x1

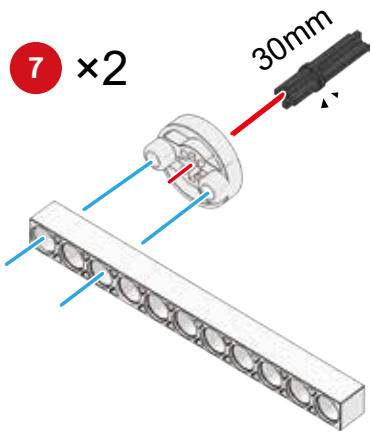

1
2
3
4
5
30mm

11 Wiper

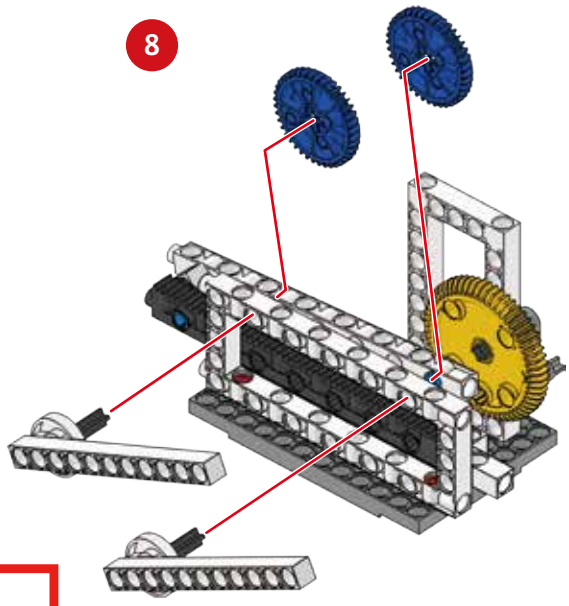
6



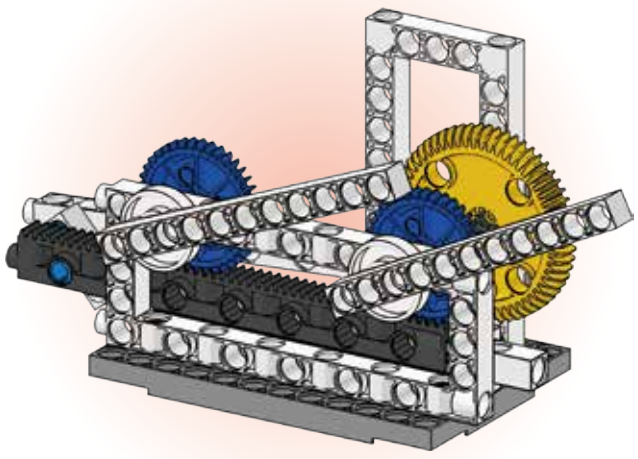
7 ×2



8



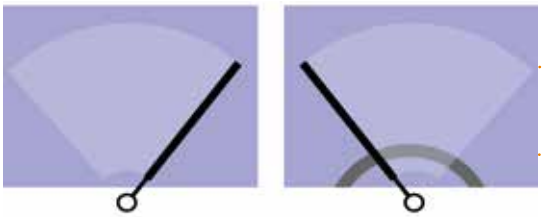
Done



Model Operation Video

Hands-on Experiment

Try to change the Wiper blades' movement from a radial, pivot movement, into a sequential/ pantograph (face-to-face) sweeping movement.



Hands-on Creativity

Find different ways to speed up the Wiper movement.

Evaluation

Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

12 Train

Scientific Application: Linkage

For long trips people often prefer to take the train. It affordable, easy, and a pleasant experience allowing the passenger to enjoy any beautiful landscape along the way. One day, Gigi was on a train platform, waiting for a train. There were lots of passengers waiting for the train to come. Gigi was very excited as it was her first trip by train.

The platform speaker loudly announced that the train was coming. When the train entered the station, Gigi noticed that there was a rod connecting the wheels of the locomotive. The rod, which is known as a linkage lever, transmits mechanical momentum evenly to stabilize the train. It makes the ride much more comfortable.

Gigi grabbed her bags and got ready for her adventure on the train!

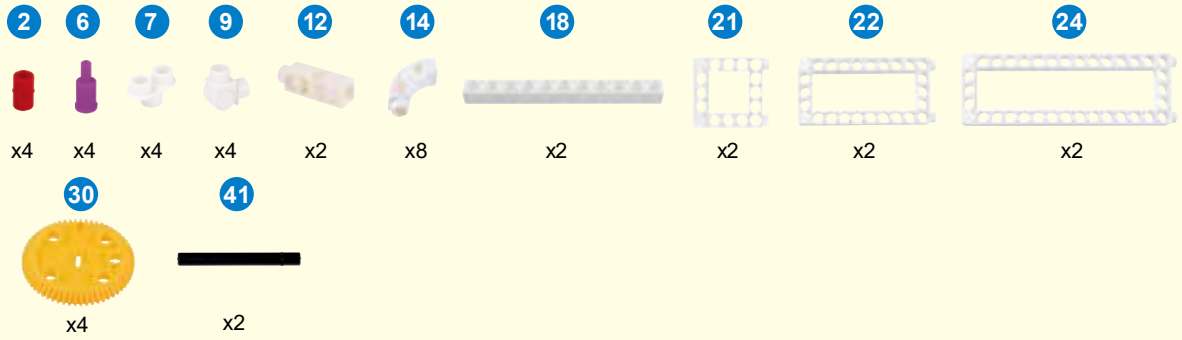
Daily Application

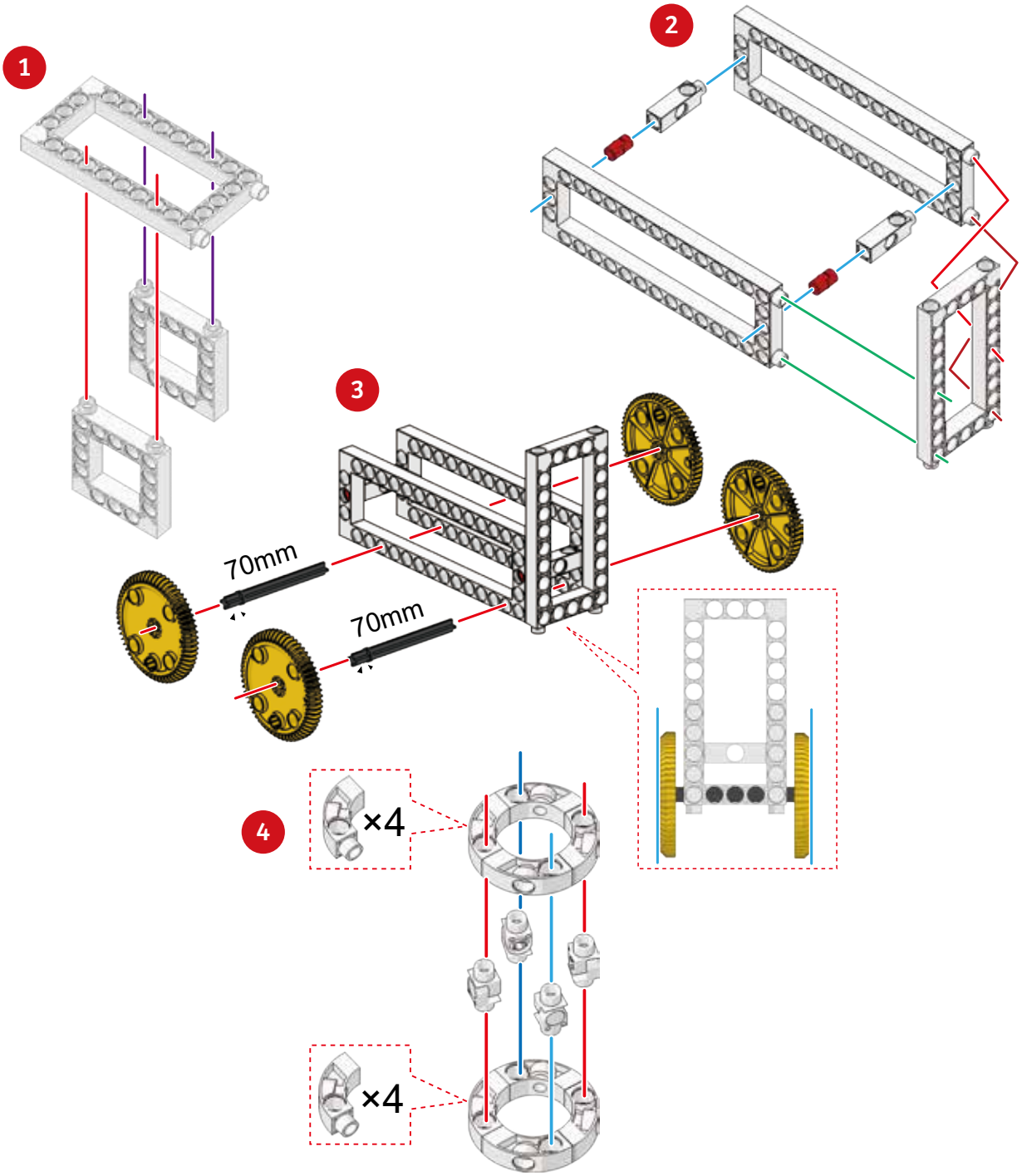
A lever has a fixed rotation point called the pivot and the two ends which are stressed are called the working point and resistance point, respectively. The vertical distances from the stress points to the pivot are called lever arm and resistance arm. When a lever is balanced, objects on both sides of the fulcrum remain stationary. A scale is a measuring tool based on the law of levers that is used to measure the mass of an object.

Brainstorming

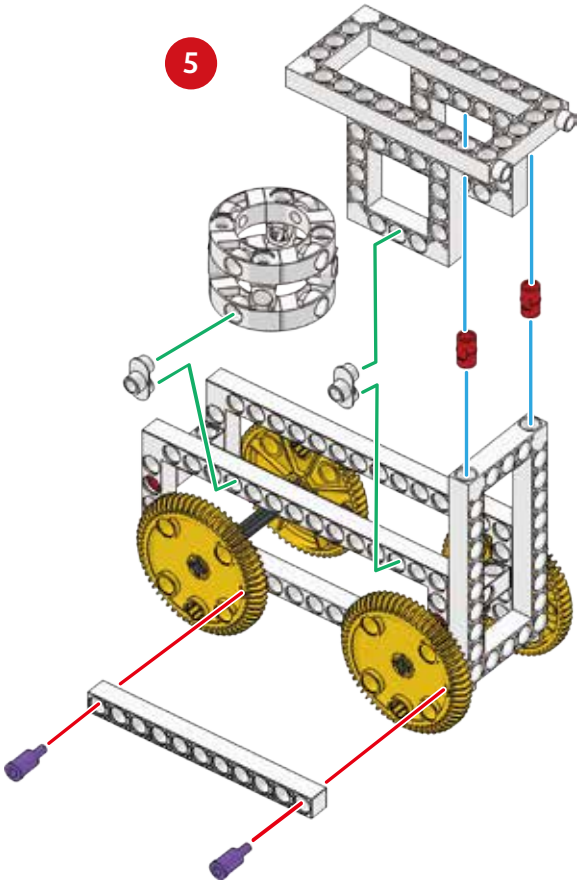
What applications in our daily does the linkage theory apply to?

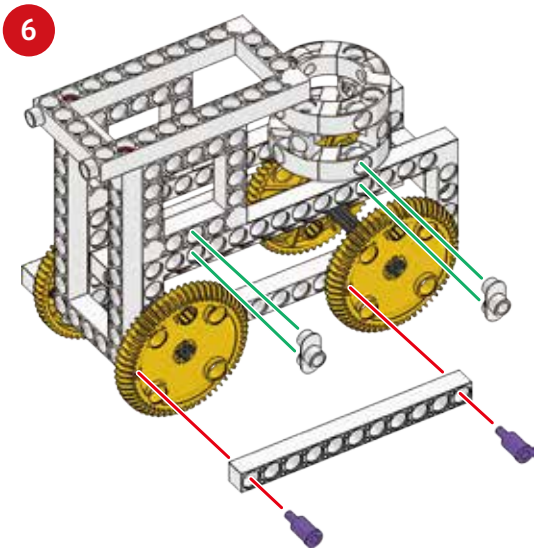
Parts List


2
6
7
9
12
14
18
21
22
24
x4
x4
x4
x4
x2
x8
x2
x2
x2
x2
30
41
x4
x2

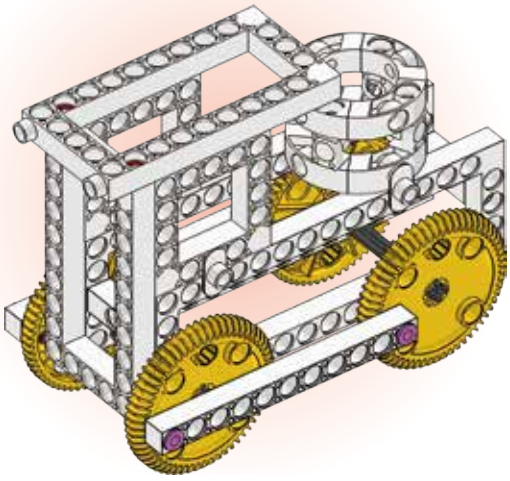

1
2
3
70mm
70mm
4
×4
×4

12 Train





Done



Model Operation Video

Hands-on Experiment

Change the planar-linkage to a triple-joint linkage mechanism and see if the Train can still run smoothly.

Hands-on Creativity

Use toy blocks to make a passenger carriage for your Train!

Evaluation

Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

13 Big Mouth

Scientific Application

Crank & Linkage

Gogo's sister was crying non-stop. To calm her down, Gogo came up with an idea. He wanted to make a big mouth puppet to cheer her up. On a piece of paper, Gogo drew the upper lip and low lip of a big mouth. But how could he make the lips move?

Gogo thought about it and then remembered that his teacher once taught them to assemble a crank and a connecting rod together to form a crank-linkage mechanism, which could transform the rotating motion into a repeating linear motion. So, Gogo invited his little sister to join him pasting the lips onto a model puppet and then he turned the crank.

When the little sister saw the big mouth open and close like funny talking creature she smiled a little bit, then she began laughing!

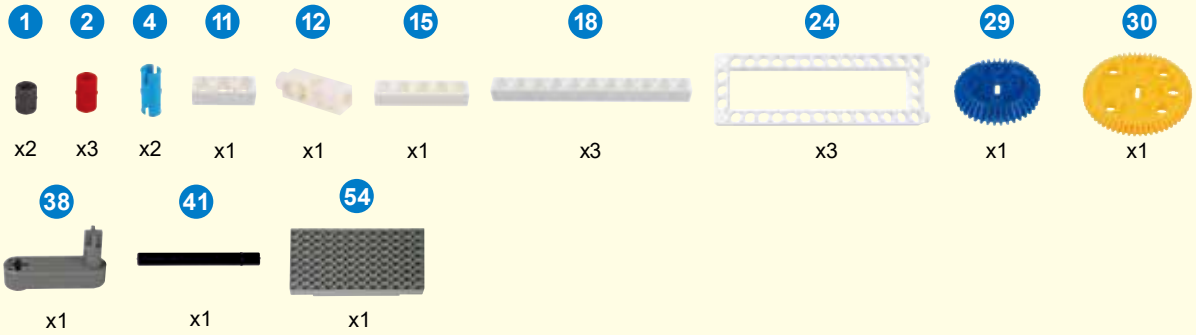
Daily Application

Connecting more than two levers creates a crank or pair of cranks. You can see this in the design of a bicycle pedal. The pedal is connected to a large gear disk, which function as a crank mechanism. If the crank and connecting rod are combined together, this will create a more complicated mechanism, which can change rotary motion into a repeating linear motion, and vice versa. The main function of the crank and connecting rod is to change the direction of motion and to transmit power.

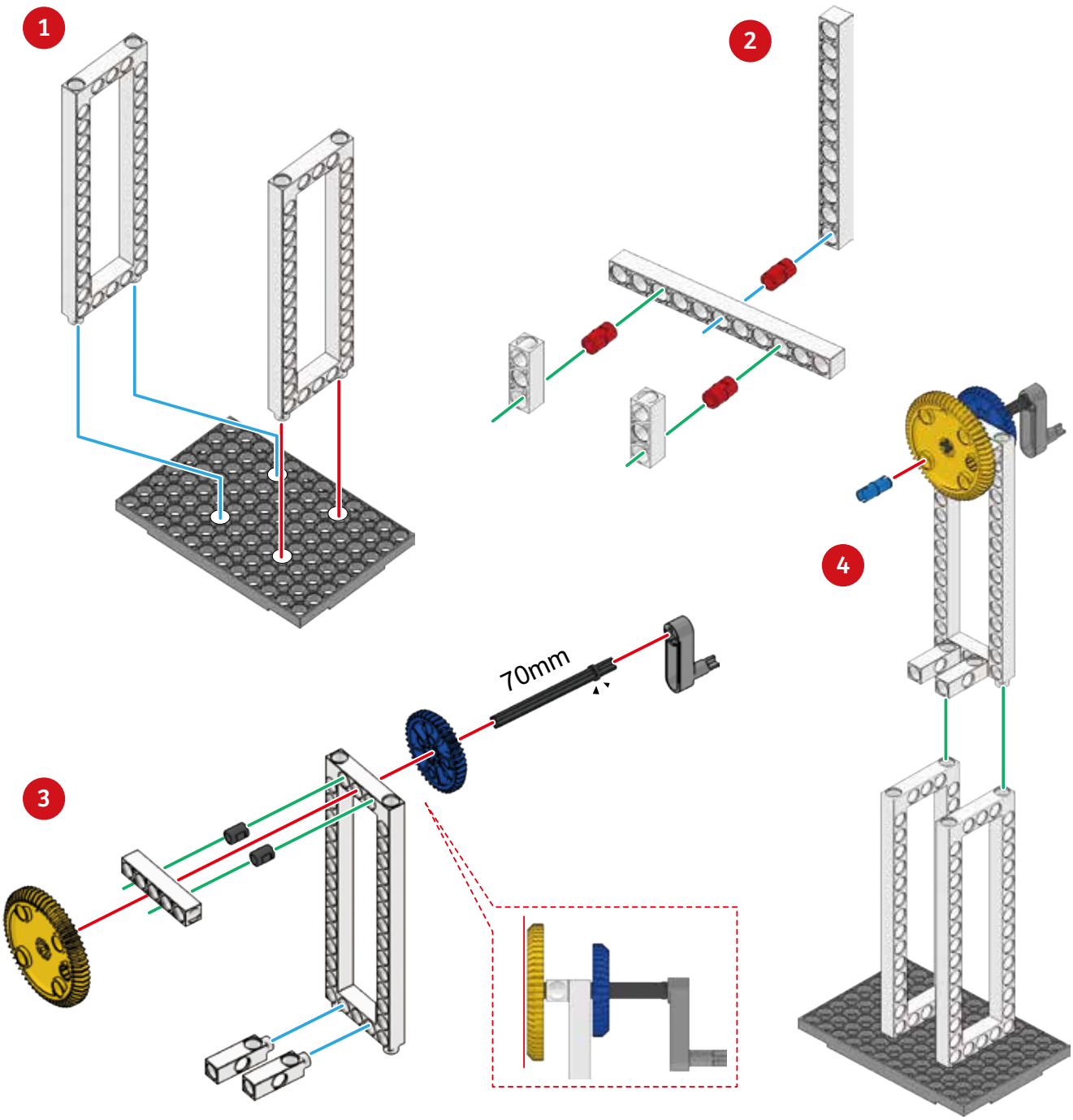
Brainstorming

What devices in daily life apply the crank and linkage mechanism?

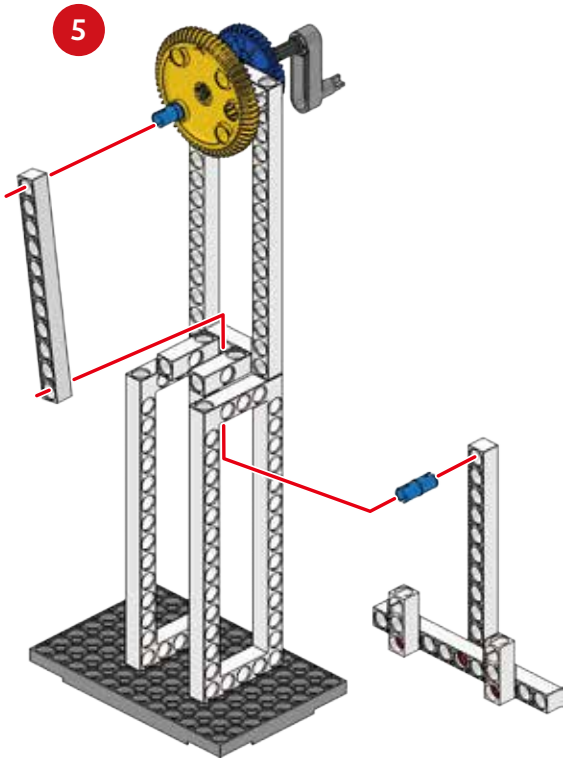
Parts List

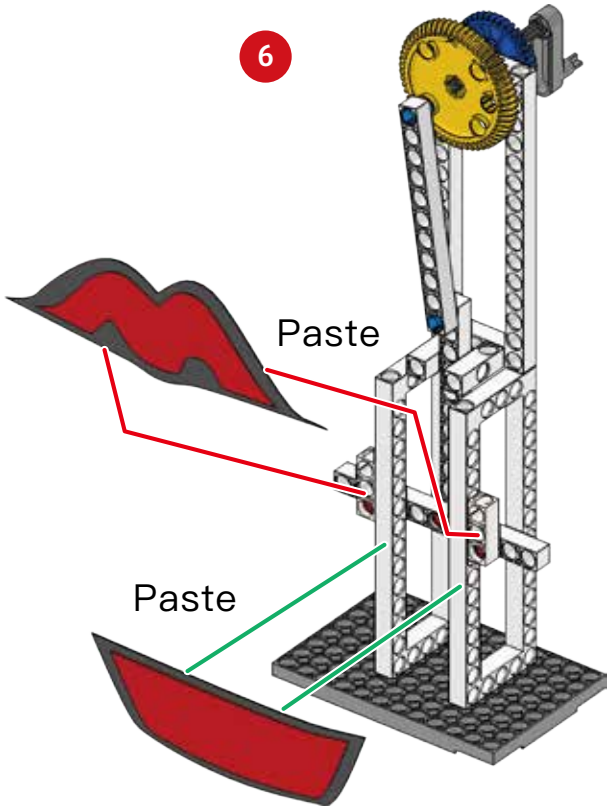


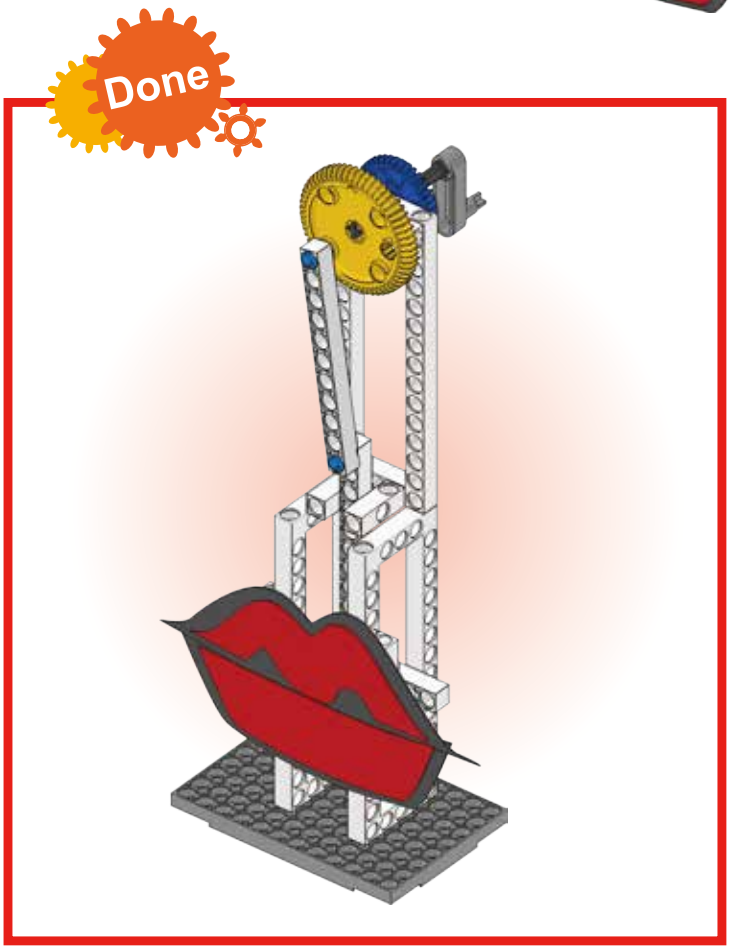
※ P.86 Paper card- Big Mouth



13 Big Mouth







Model Operation Video

Hands-on Experiment

Now let's do it. Make a copy of the upper and lower lip picture cards on the back cover of the instructions. Cut them off and paste them on a model puppet so the mouth can open and close.

Hands-on Creativity

Try to design your own picture cards for more fun!

Smart Manual
Web Service

Evaluation

1	2	3
Model Assembled	Experiment Complete	Model Creation

14 Lawn Mower

Scientific Application: Gears

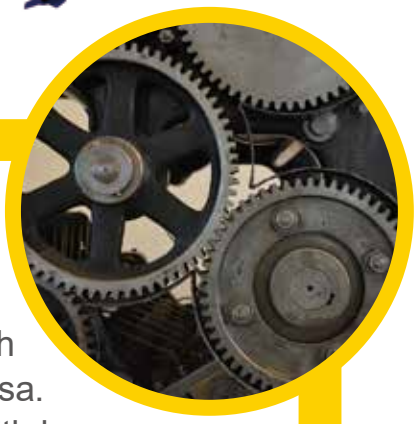
The cherry blossom trees in the yard were almost overwhelmed by weeds! One sunny day, Gigi's father wanted to get rid of the weeds and use them as compost.

Gigi was happy to be her Father's little assistant. She had a sturdy pair of gloves to pick up the weeds by hand and before long, under the burning sun, she was working up a sweat.

All of a sudden, Gigi heard a buzzing noise. It was her father using the monster-like mower to munch up the weeds in large chunks. Gigi wanted to try the power mower, but her Father said that the mower operated through a powerful gear system and that the fast rotation of the blades can be extremely dangerous, it was not suitable for her to operate.

Seeing Gigi's frustration, her Father promised her that they would use toy blocks to make a model mower, after the mowing was done.

Daily Application

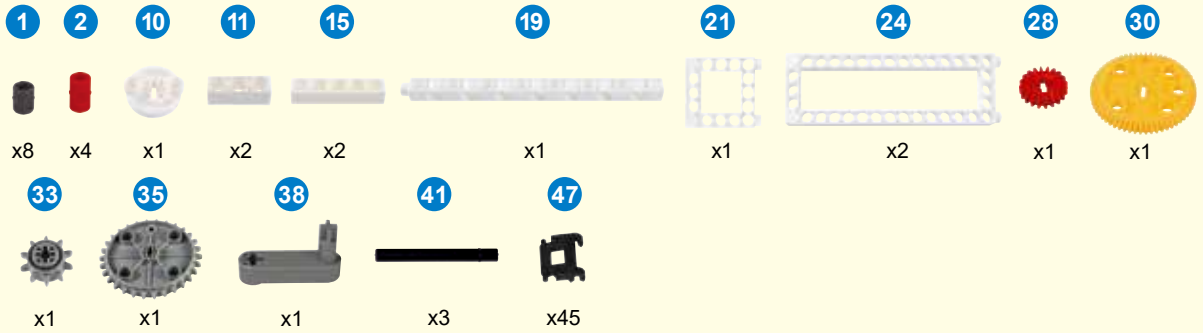


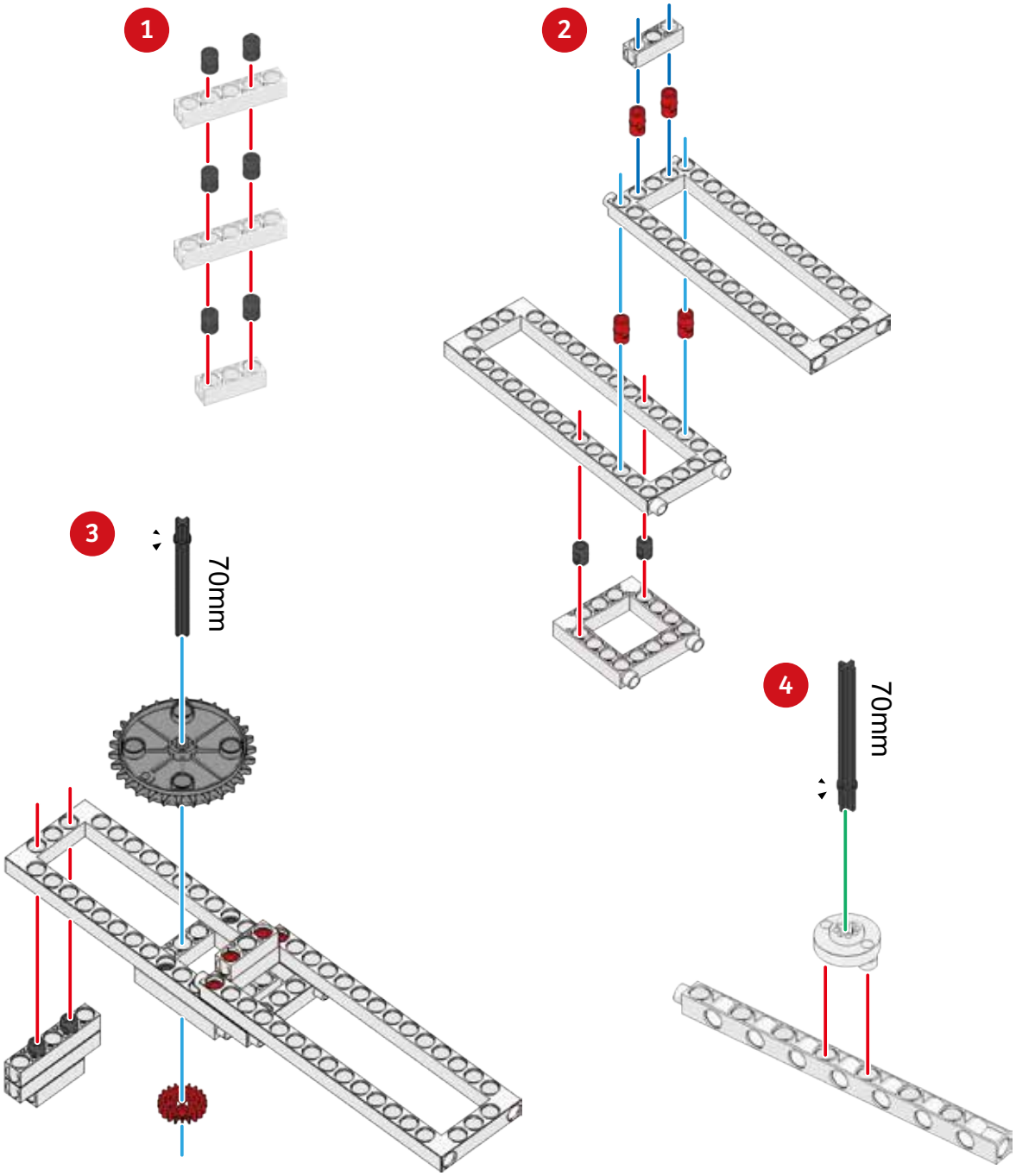
Through an interlocking series of several gears, power can be transferred. The greatest advantage of a series of gears is that they are capable of delivering force. Gears with more teeth can drive gears with less teeth, and vice versa. Being driven by a gear with more teeth causes gears with less teeth to rotate faster, at the expense of reducing torque. Allowing gears with less teeth to drive gears with more teeth transmits a greater amount of torque, but at the cost of speed.

Brainstorming

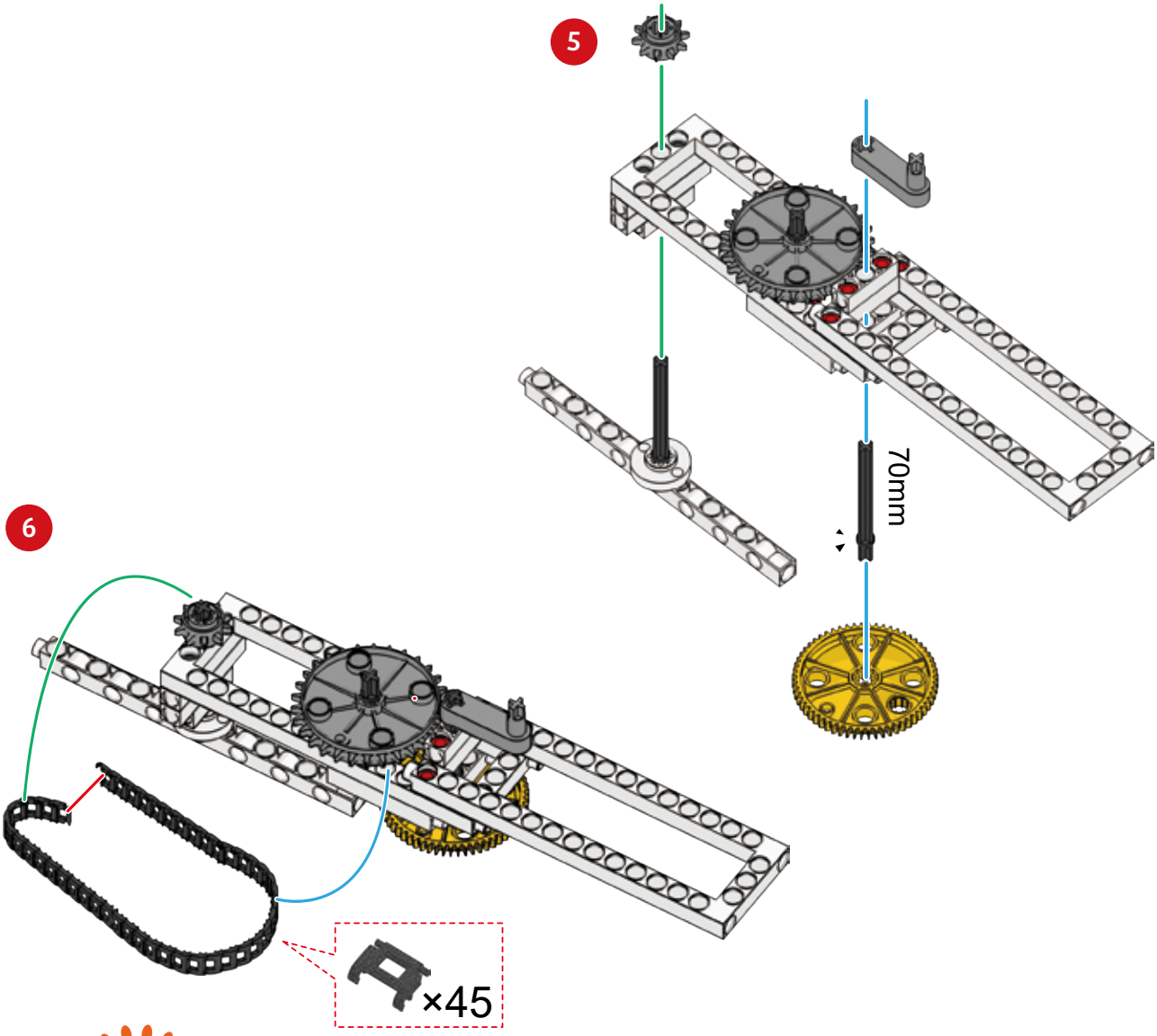
Where have you seen different gear combinations before? Why do people use such combinations?

Parts List

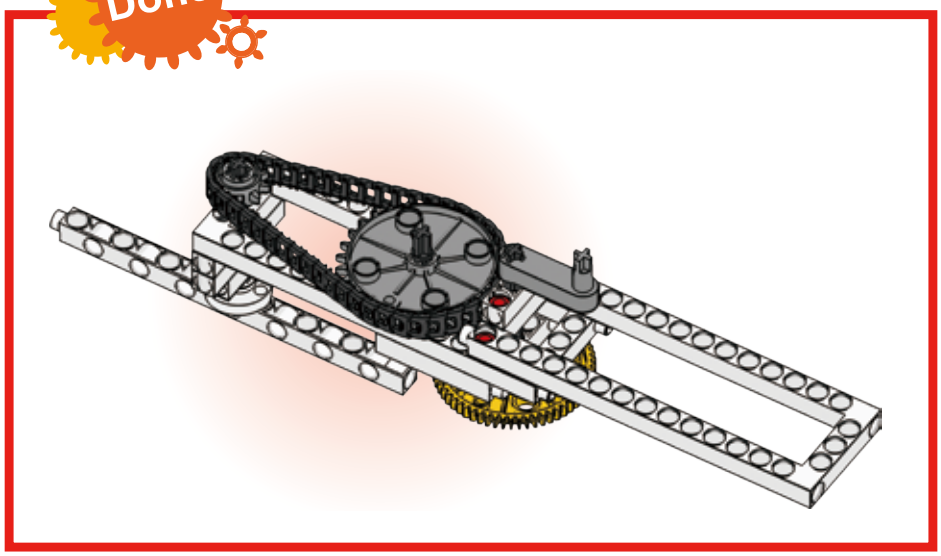

1
2
10
11
15
19
21
24
28
30
x8
x4
x1
x2
x2
x1
x1
x2
x1
x1
33
35
38
41
47
x1
x1
x1
x3
x45


1
2
3
70mm
4
70mm

14 Lawn Mower



Done



Model Operation Video

Hands-on Experiment

Now, let's make a model mower to see if it can actually work. Observe how the gear set transmits momentum.

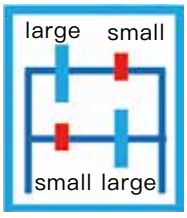
Caution:

1.When the model mower is operating, keep hands and long, slender, sharp objects away from it to avoid accidents.

2.Do not use the model on humans, animals, or dangerous objects. Do not use it on other people's property and always be mindful of safety.

Hands-on Creativity

Try to use it with other gear sets and make a transmission gearbox.



※Through front and rear pull deformation.

Evaluation

Smart Manual Web Service

1 Model Assembled

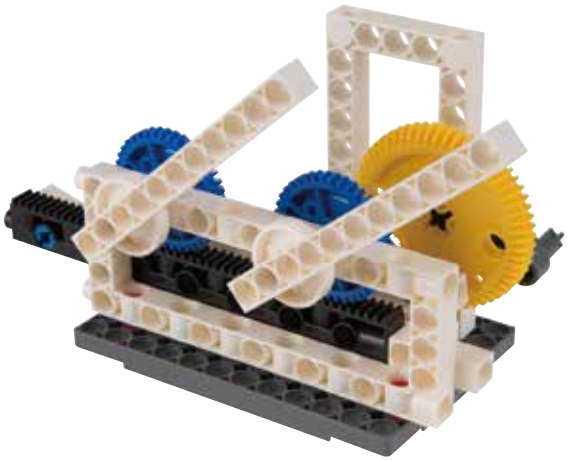
2 Experiment Complete

3 Model Creation

15 Monograph 3

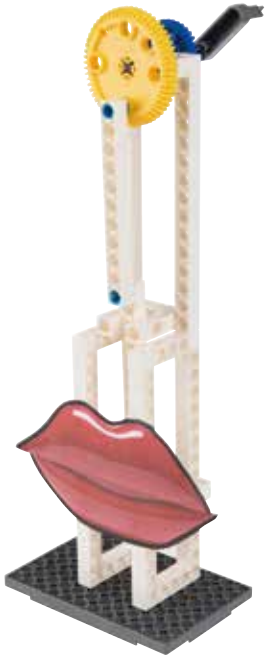
Based on the models and principles you have already learned, make a model face. If you get stuck, remember the applications of gears and racks.

Model Review



11. Wiper

12.Train



13. Big Mouth

14. Lawn Mower

Design Concept

My Artwork

Evaluation

1
Model Design

2
Model Creation

3
Winner!

16 Naughty Snake

Scientific Application

Periodic Motion

The long-awaited Motion and Mechanism exhibition finally came. The exhibition helped people understand the different manifestations of force and the impact that different mechanisms has had on human society. Early in the morning, Gogo went to the exhibition, hoping to observe and experience the displays in detail without being too bothered by the crowd.

The interactive section showed items related to periodic motion. Gogo was most interested in the naughty snake. He noticed that the naughty snake swung at a constant speed, that the start and end positions of the movement were fixed and it had a repetitive motion - just like a real snake.

In addition, Gogo also visited other items showing periodic motion, such as swings, Newton's Cradle and so on. He lingered around for a long time, reluctant to leave. There were many items displayed in the exhibition, with a variety of mechanical applications and principles taken from daily life!

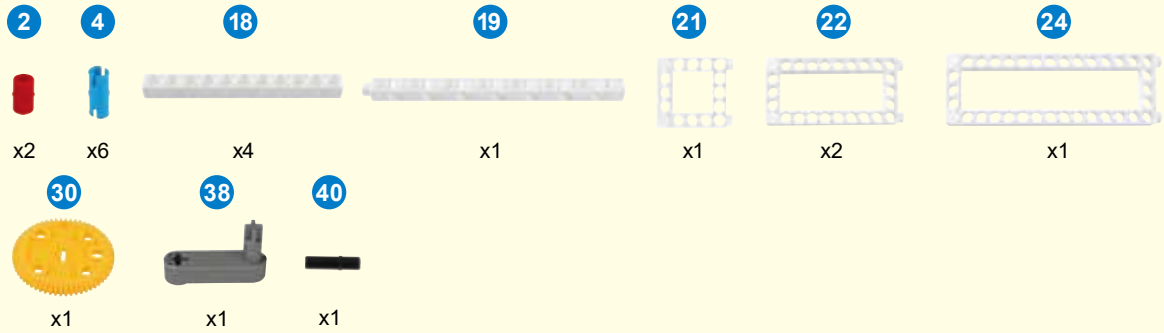
Daily Application

If a moving object swings back and forth, and velocity and acceleration are mostly or fully restored at the end of each movement, this is called a periodic motion. The time required for one full range of movement is called a cycle. One common example in our daily lives is the windshield wipers on our cars. We use them to clear rain and dust away from the windshield, improving driver visibility, and making driving safer. The principle behind the windshield wiper's movement is the conversion of the rotational action into linear action.

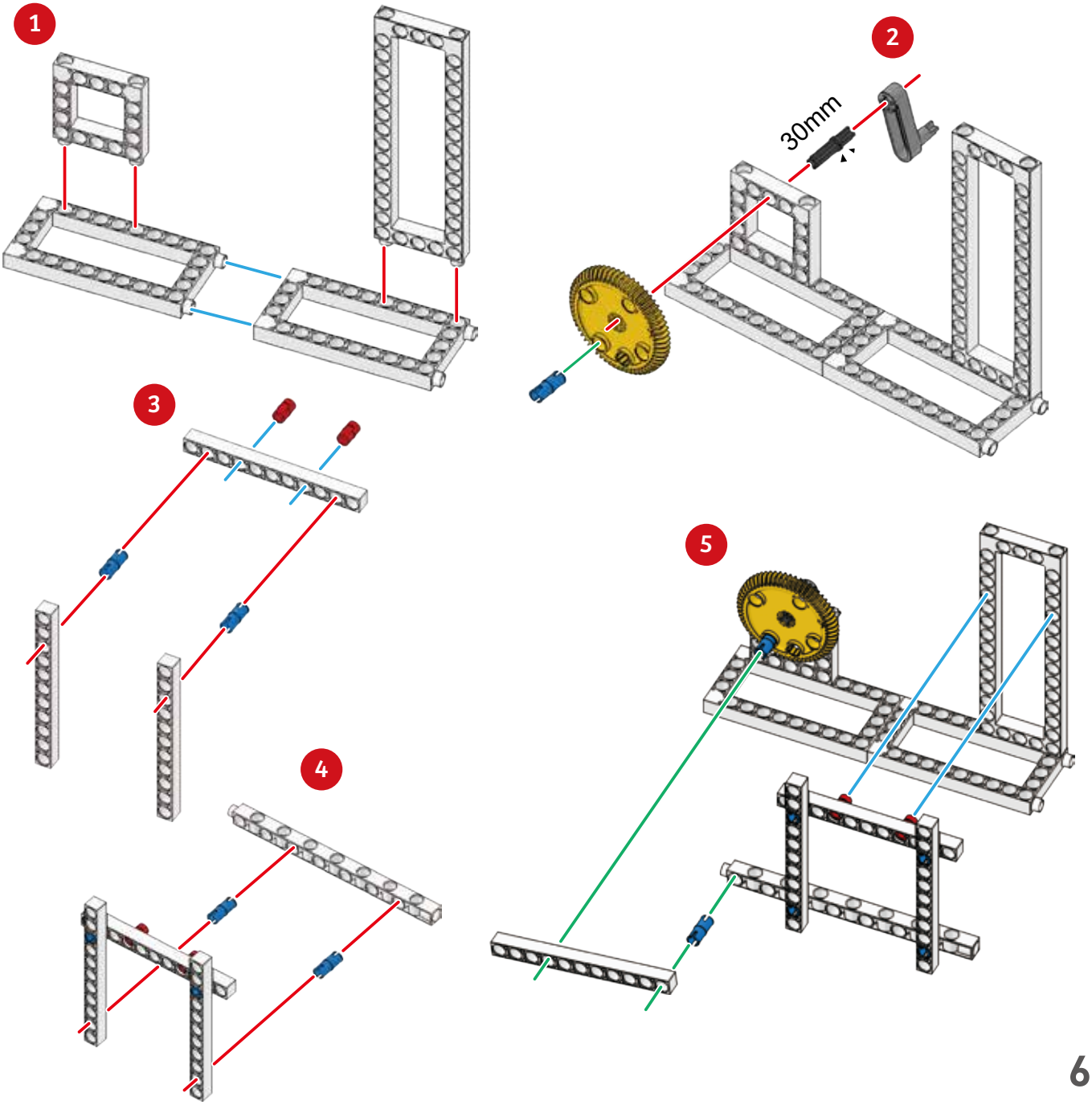
Brainstorming

What applications in our daily does the periodic motion apply to?

Parts List

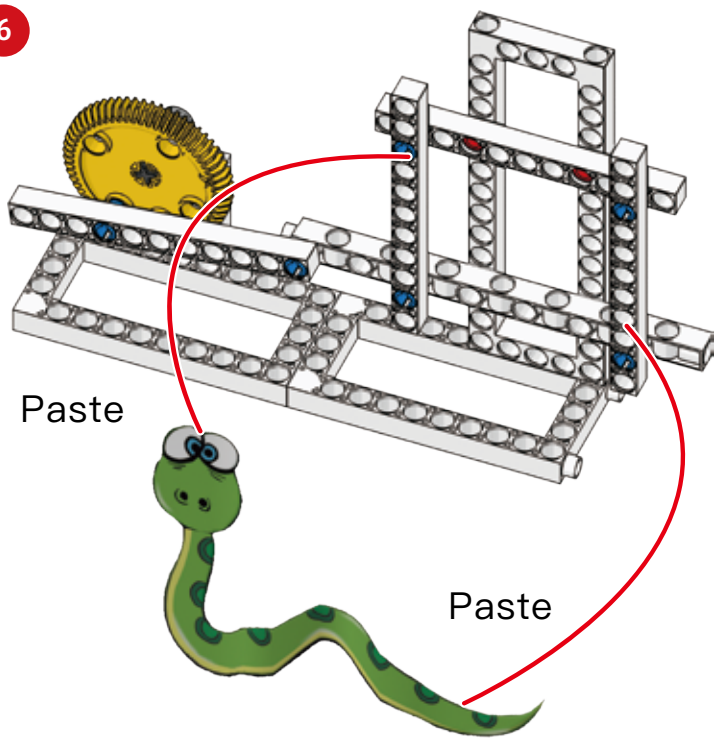


※ P.86 Paper card- Naughty Snake

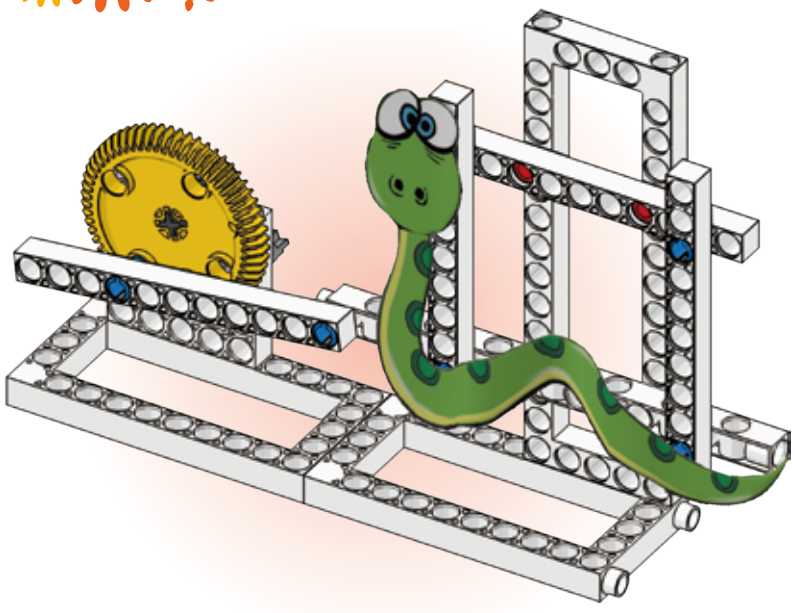


16 Naughty Snake

6



Done



Model Operation Video

Hands-on Experiment

Make a copy of the Naughty Snake picture card on page 79, then cut out the copied snake picture and paste it onto a model snake you have made. See if you can make it move like the Naughty Snake does.

Hands-on Creativity

Try to modify the model to make it a swing. See if the swinging motion is periodic.

Evaluation

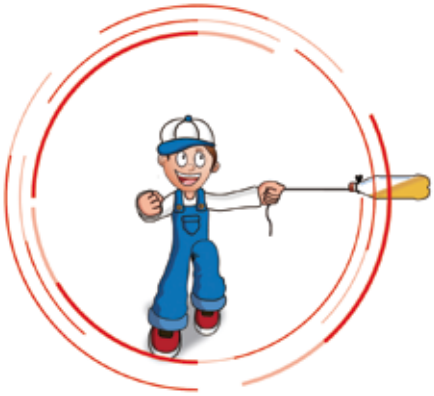
Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

17 Revolving Crane

Scientific Application

Circular Motion



At long last, Gogo came to the last stop of the exhibition – the souvenir shop, where miniature models were displayed for visitors to review what they had seen and purchase ones they liked. Gogo was keen to share this exhibition experience with his family.

As soon as he got home, Gogo showed-off his trophy from the exhibition – a souvenir of the revolving crane – for his little sister. His little sister was very happy to receive the gift, and Gogo told her that the model revolving crane used a circular motion.

The little spelled out “circular motion”, seemingly understanding the concept. Gogo explained to her that when an object's motion was circumferential, it was a circular motion. Then, his little sister said that the merry-go-round she liked also used a circular motion. Gogo was surprised by how clever she was and said, “I’m very proud of how smart you are!”

Daily Application

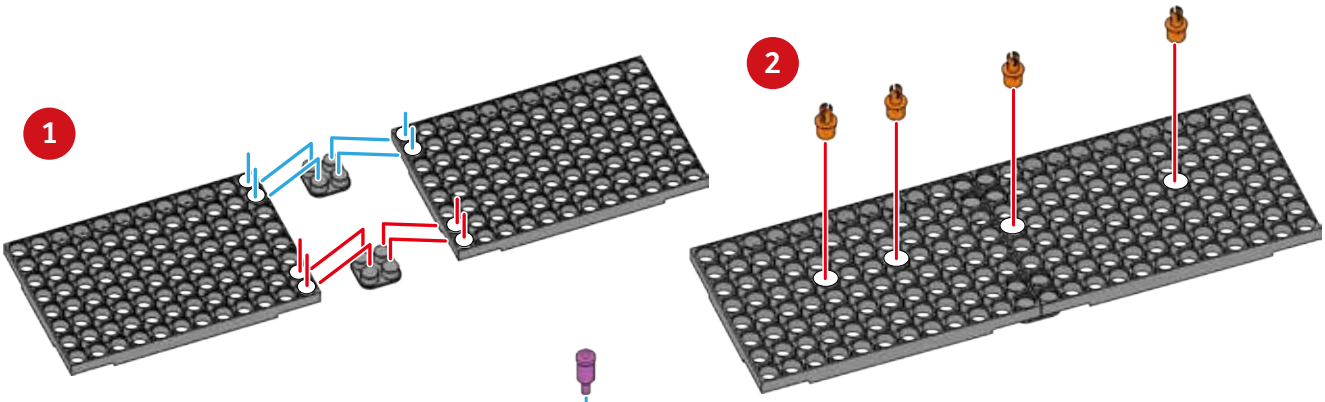
When the trajectory of a moving object follows the path of a circle, it is called “circular motion”. Common examples of circular motion are Ferris wheels, the hands of a clock, and carousels. The difference between circular and linear motion lies in their trajectory, this depends on the conditions that they emerge from. When a particle moves in a circular way, it’s momentum is provided by centripetal force, which gets its name from the fact that its center of power is a fixed point in the middle of a circle.

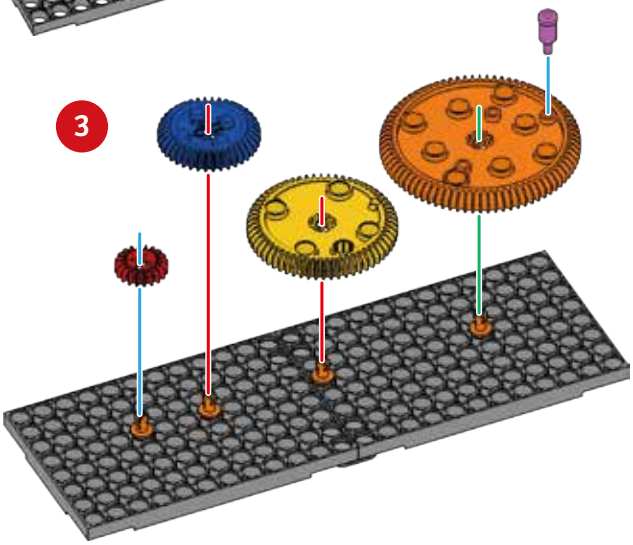
Brainstorming

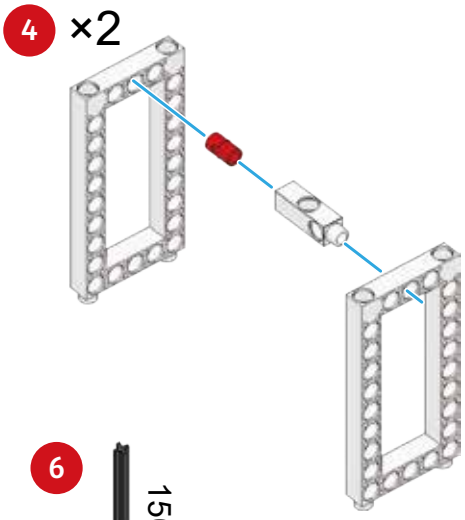
What applications in our daily does the circular motion apply to?

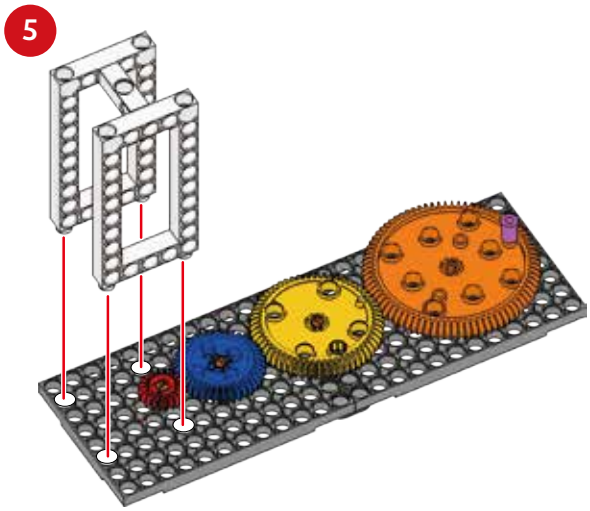
Parts List

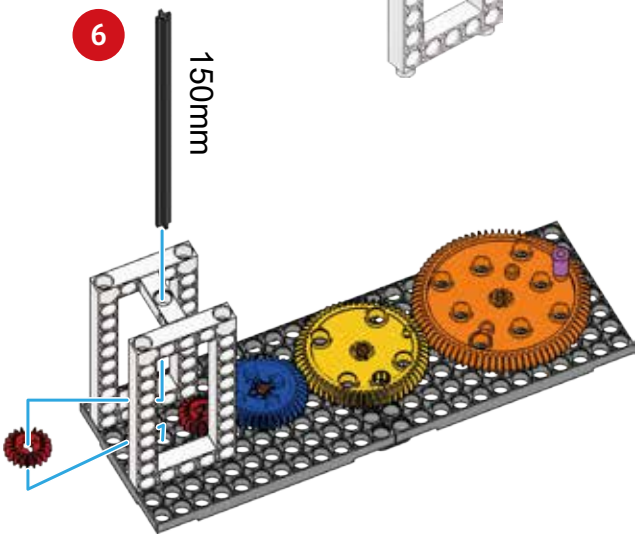

2
3
4
6
8
12
18
19
21
22
28
x6
x4
x4
x1
x2
x2
x2
x2
x4
x4
x2
29
30
31
33
39
41
43
54
x1
x1
x2
x1
x2
x1
x1
x2


1
2

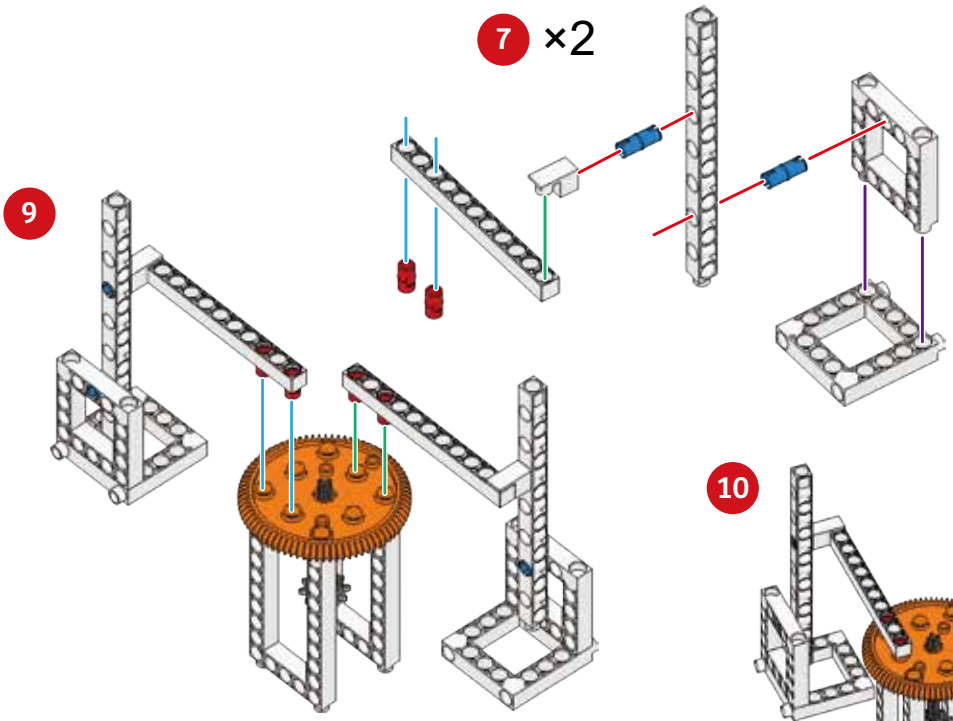

3

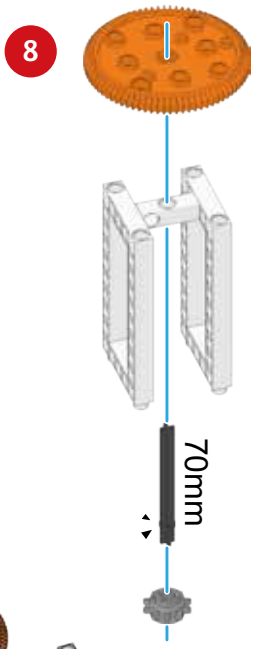

4
×2

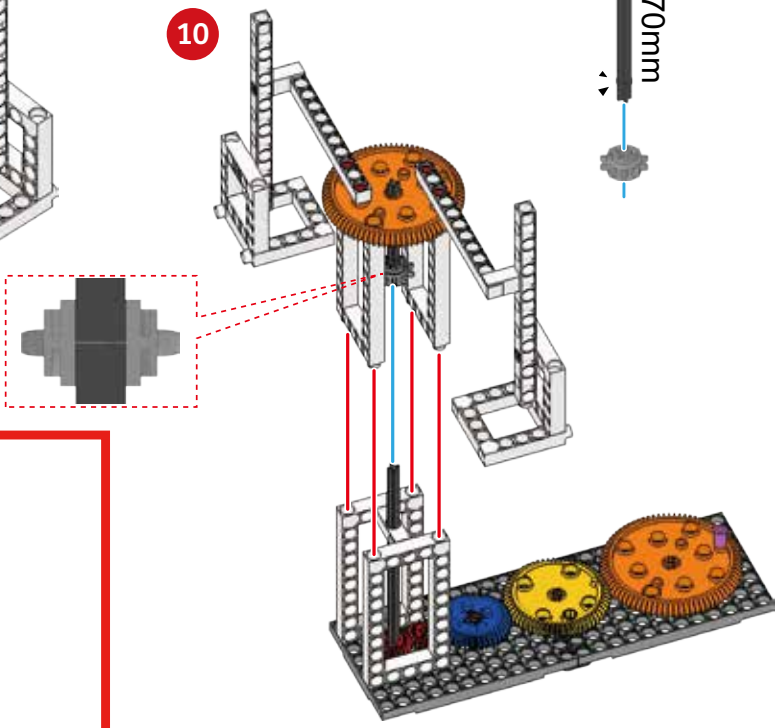

5

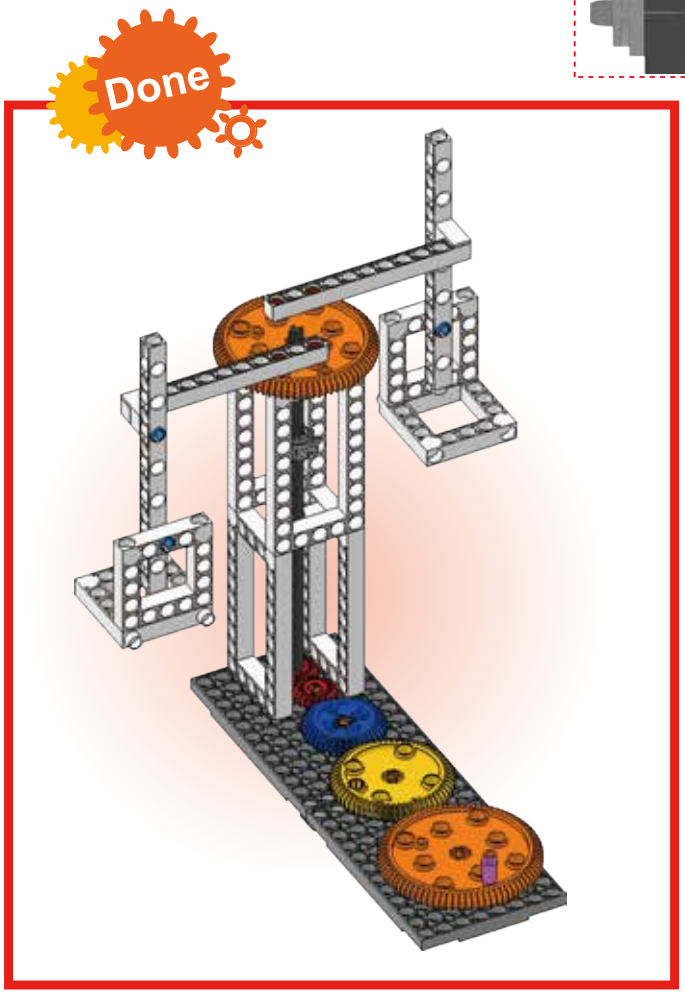

6
150mm

17 Revolving Crane









Model Operation Video

Hands-on Experiment

Try to redesign the model to make a spin dryer, and see whether its motion is circular.

Hands-on Creativity

Now let's do it. Put a ping-pong ball on a model seat, and when the seat's speed of rotation increases, see if the ball will fall off.

Evaluation

Smart Manual
Web Service

1	2	3
Model Assembled	Experiment Complete	Model Creation

18 Chicken Pecking Rice

Scientific Application: Intermittent Motion

Grandpa and Gigi went to a working farm for a fun day out called an Eco-Tour. This reminded Grandpa of his younger days. The ecology teacher led the group to explore interesting creatures in the park, including butterflies, dragonflies, blind spiders and all kinds of plants.

After the tour was over, Gigi and Grandpa joined in a fun DIY activity area where people were making mechanical “chicken pecking rice”. The mechanical chicken was very special. It could bow its head down like it was pecking rice and then swing its head up and down, in every few seconds. The teacher explained that it was an intermittent motion. The worm gear’s continuous rotation was transformed into a periodic motion then through another “intermittent mechanism”, which was all together was known as an “intermittent motion mechanism”.

Gigi and grandpa were very happy with the experience of the Eco Tour and the hands-on creative nature of the DIY program. What happy memories!

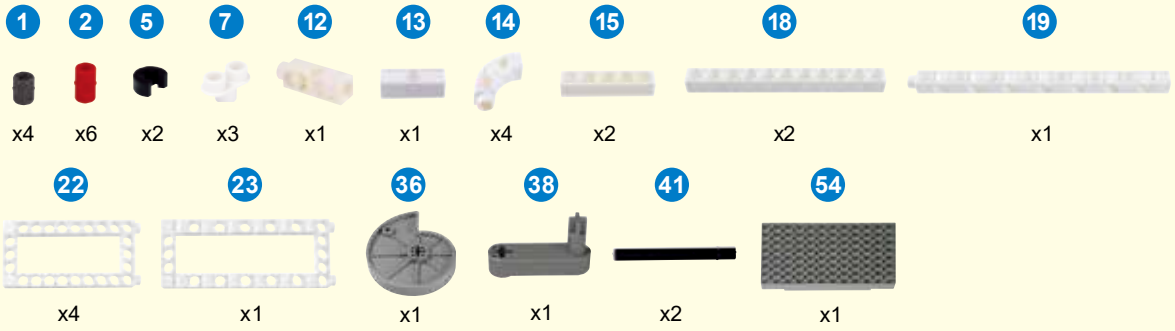
Daily Application

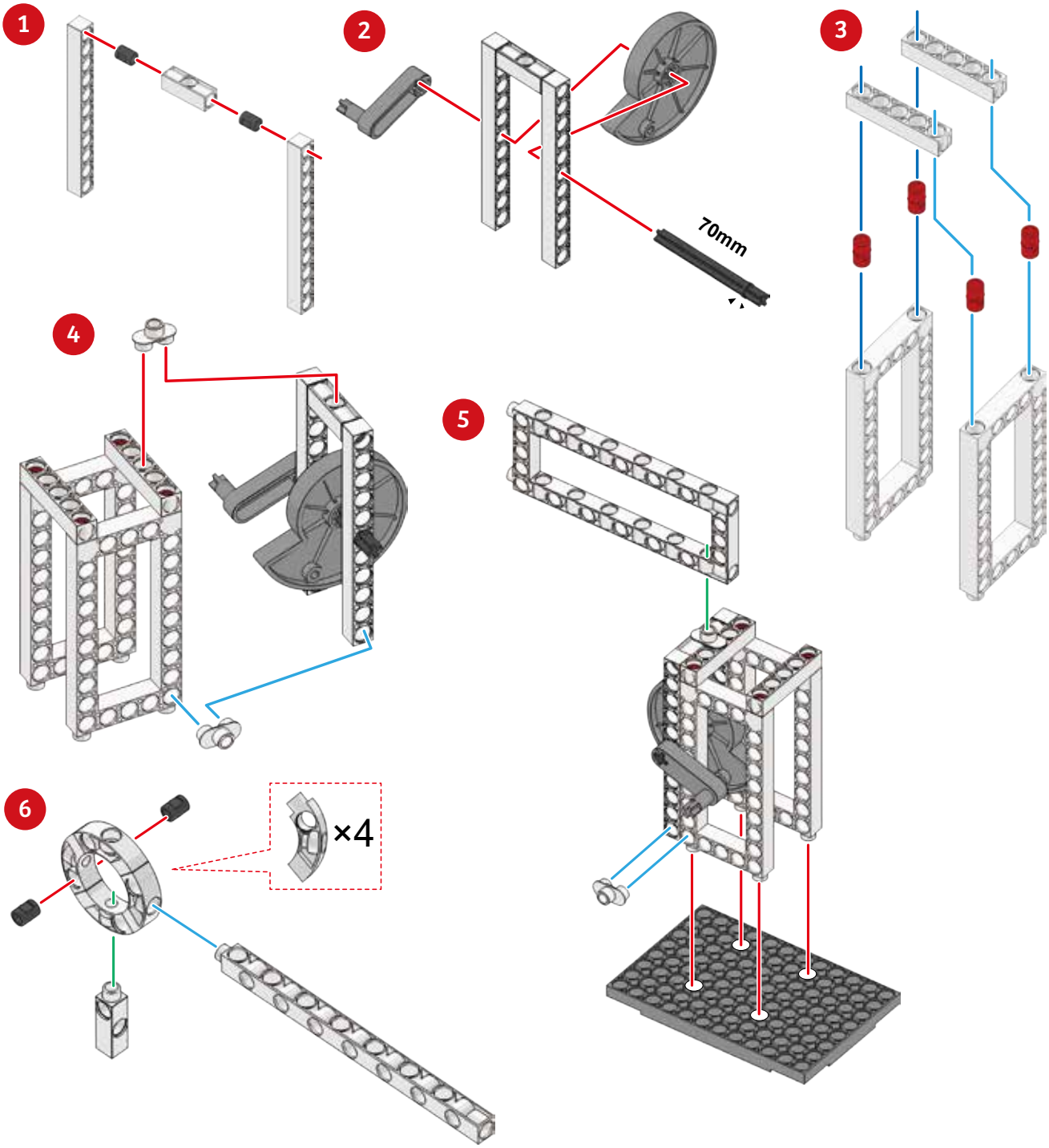
The important part of an intermittent motion mechanism is that there are two parts. One is continuously looping or rotating, while the other part may be still or in motion from time to time. There’s a type of intermittent transmission driven by rotation which was first designed by a Geneva watch factory, and is still known as the Geneva mechanism. It is composed of carrier rollers with radial transmission grooves, pins and drives, and it is often used as an indexing device in movie projectors and machine tools.

Brainstorming

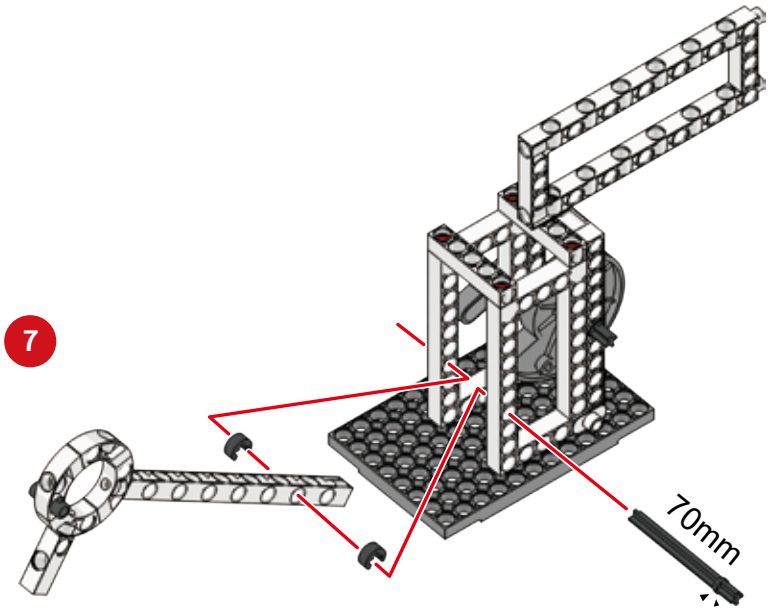
What applications in our daily does the intermittent motion apply to?

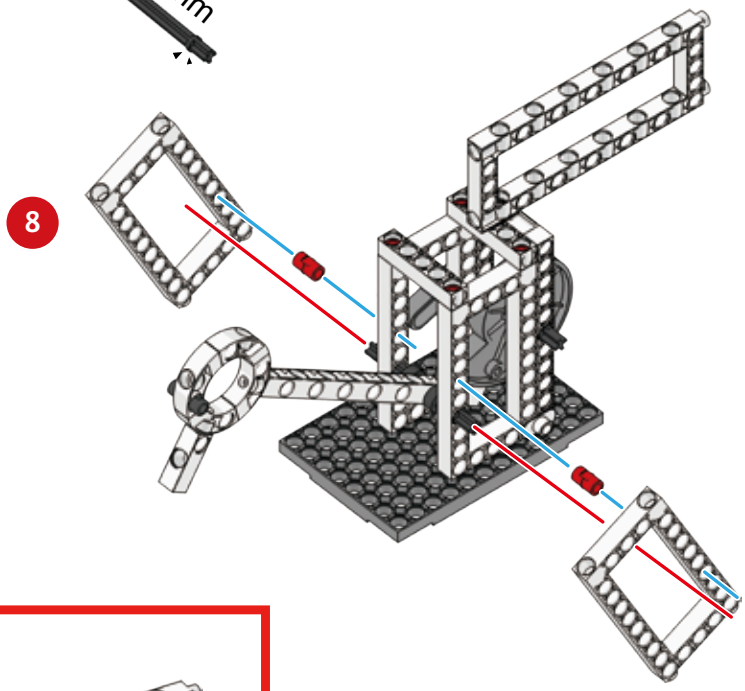
Parts List


1
2
5
7
12
13
14
15
18
19
x4
x6
x2
x3
x1
x1
x4
x2
x2
x1
22
23
36
38
41
54
x4
x1
x1
x1
x2
x1

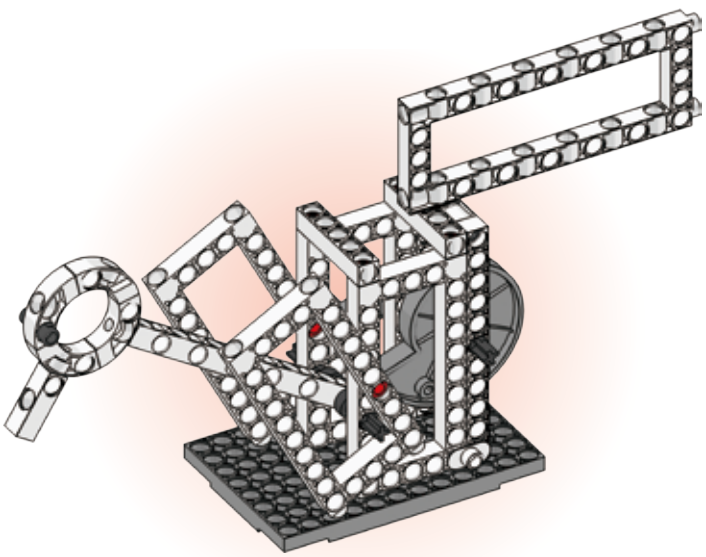

1
2
70mm
3
4
5
6
×4

18 Chicken Pecking Rice





Done



Model Operation Video

Hands-on Experiment

Now, let's rotate the chicken's head without stopping, and see if its motion is continuous or intermittent.

Hands-on Creativity

And now, let's change the SNAIL CAM in the model to a pulley, and rotate the handle again to observe the motion of the chicken's head.

Evaluation

Smart Manual
Web Service

1 ★ Model Assembled

2 ★ Experiment Complete

3 ★ Model Creation

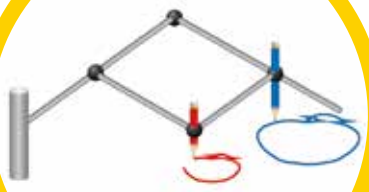
19 Drawing Pantograph

Scientific Application: Parallel linkage

A magnifying glass can be used to enlarge things like small writing, but it cannot give a full view of a pictures at just a glance. Gogo noticed this and said to his Grandma, “Take a photo so you can make an enlarged copy, Grandma. ” But Grandma’s eyes opened wide and she said, “Watch this, I’m going to make a diagraph.”

People would use linkages for diagraph frame, with four rod-shaped linkages connected in parallel. The fulcrum, drawing pen and trace pin were all adjusted by a specific enlargement ratio and aligned linearly, so that the draft could be zoomed in or out.

Daily Application

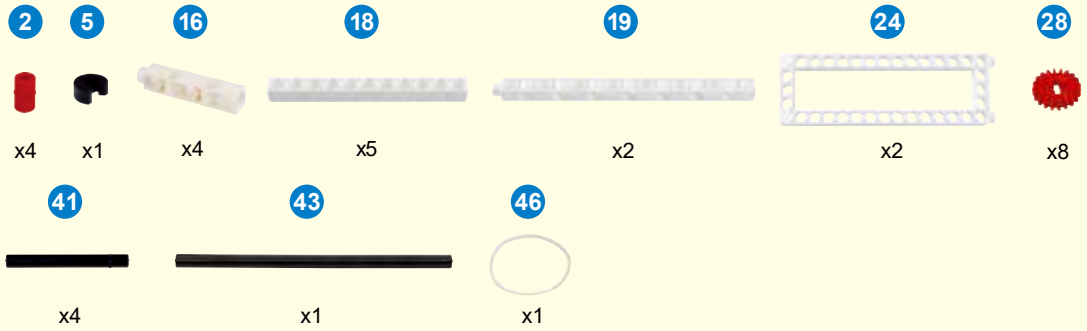


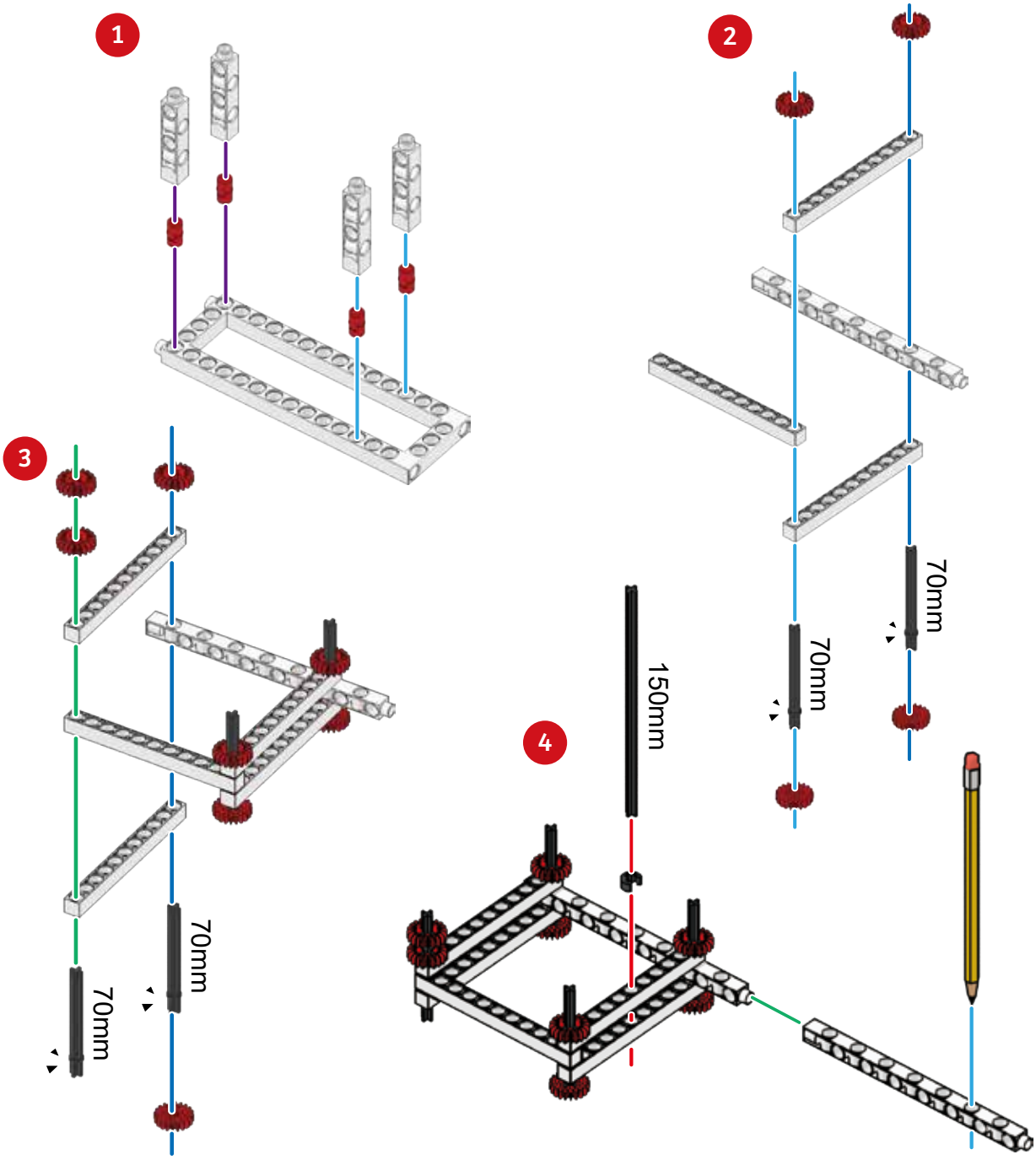
A drawing pantograph is a kind of machine, which can create a proportionally miniaturized or enlarged copy of the original picture. Its structure is made out of a series of four connecting rods in the shape of a parallelogram. The parallelogram’s shape helps prevent any of the four connecting rods from crossing over one another. In order to use a drawing pantograph, first adjust the pantograph to the scale at which you want to draw. Then place the pivot, or “stylus”, on the object you want to copy. Begin by tracing the image with the stylus. As you trace, the pencil follows your movements, recreating the image. If you place the pencil in the “inside” mount, it will create a miniature copy of the image. If place the stylus in the “outside” mount it will create a magnified image.

Brainstorming

What situations will you need to use a pantograph?

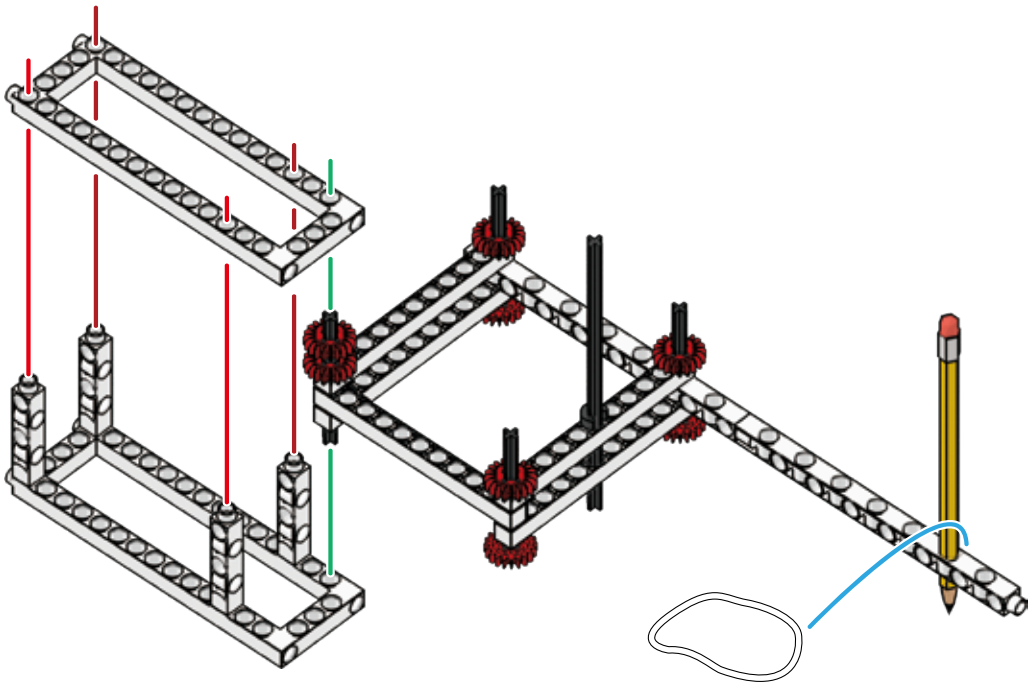
Parts List


2
5
16
18
19
24
28
x4
x1
x4
x5
x2
x2
x8
41
43
46
x4
x1
x1

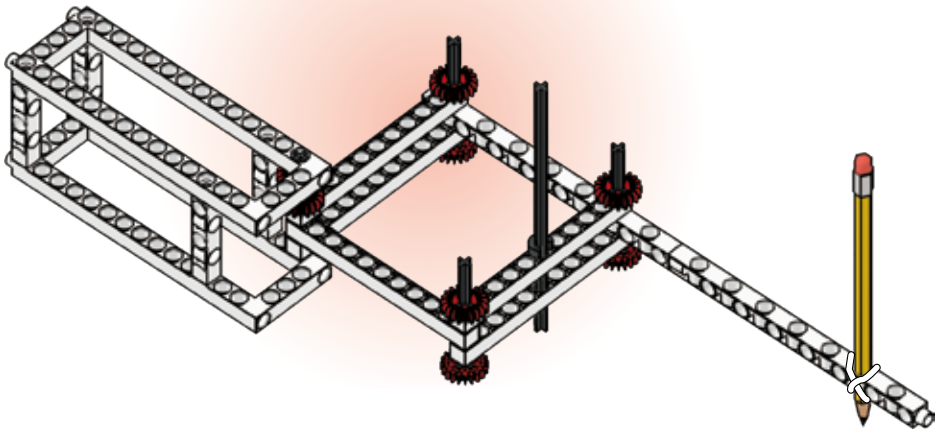

1
2
3
4
70mm
70mm
70mm
150mm

19 Drawing Pantograph

5



Done



Model Operation Video

Hands-on Experiment

Let's use a diagraph to draw two shapes of different sizes.

Hands-on Creativity

Now, swap the position of the 150mm AXLE I on the model with the position of the pencil. Compare the difference in the pictures you draw before and after the swap.

Evaluation

Smart Manual
Web Service

1 Model Assembled

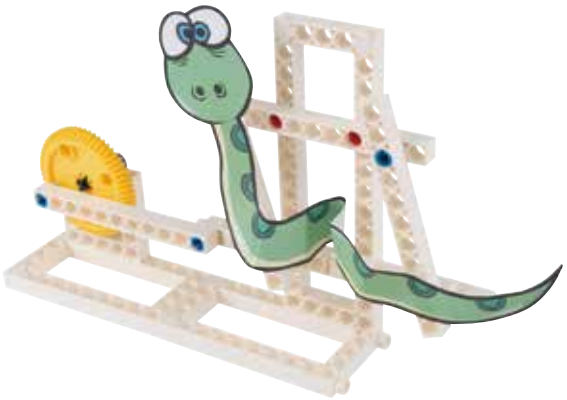
2 Experiment Complete

3 Model Creation

20 Monograph 4

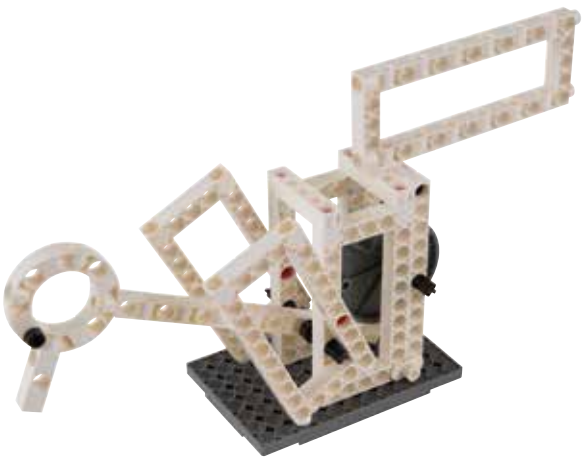
To summarize what you have learned so far, use the following models to make fitness equipment for parks (e.g. a space-walk machine).

Model Review



16. Naughty Snake

17.Revolving Crane



18.Chicken Pecking Rice

19. Drawing Pantograph

Design Concept

My Artwork

Evaluation

1
Model Design

2
Model Creation

3
Winner!

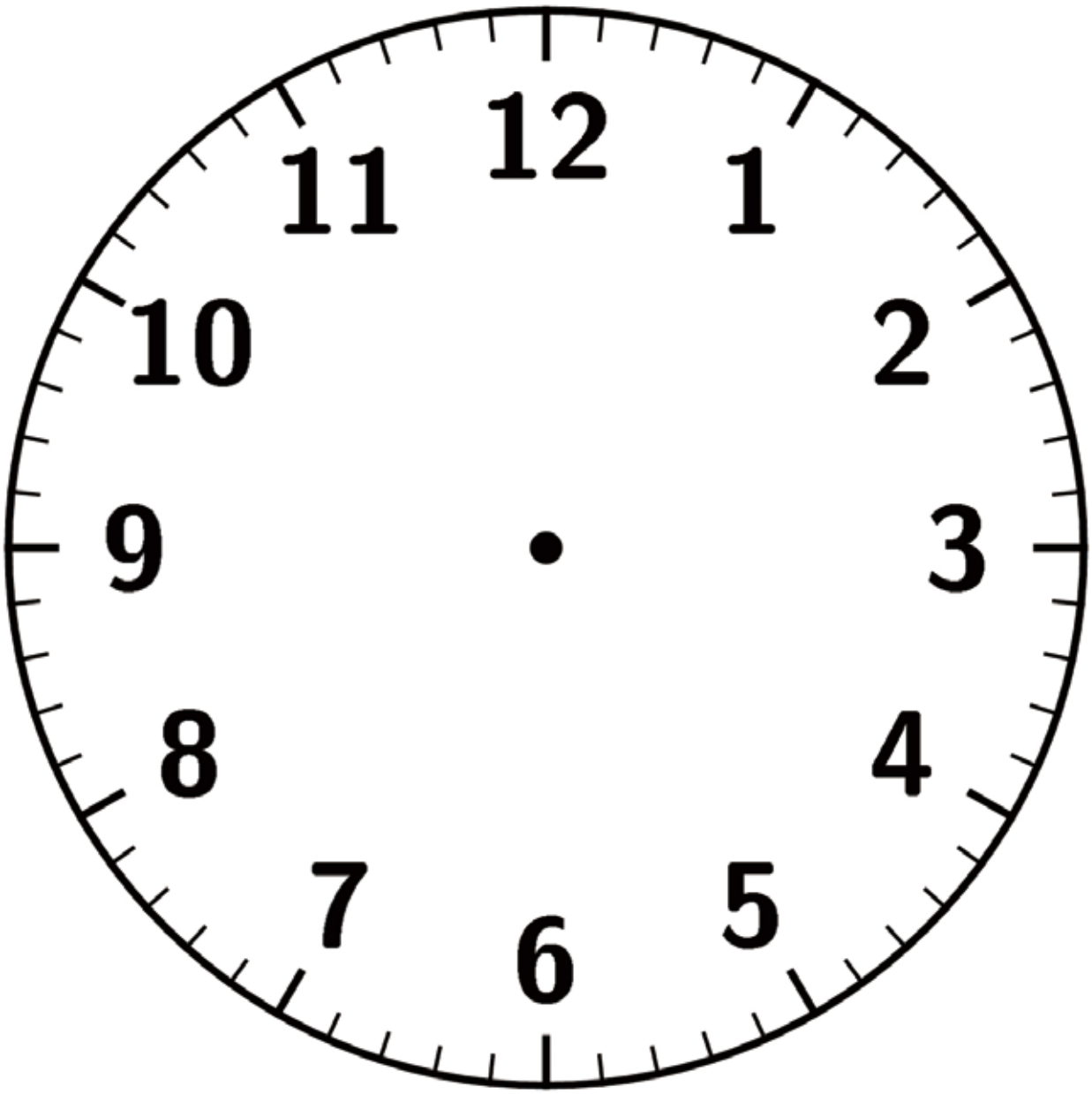
Appendix – Paper Card

Please copy for use.

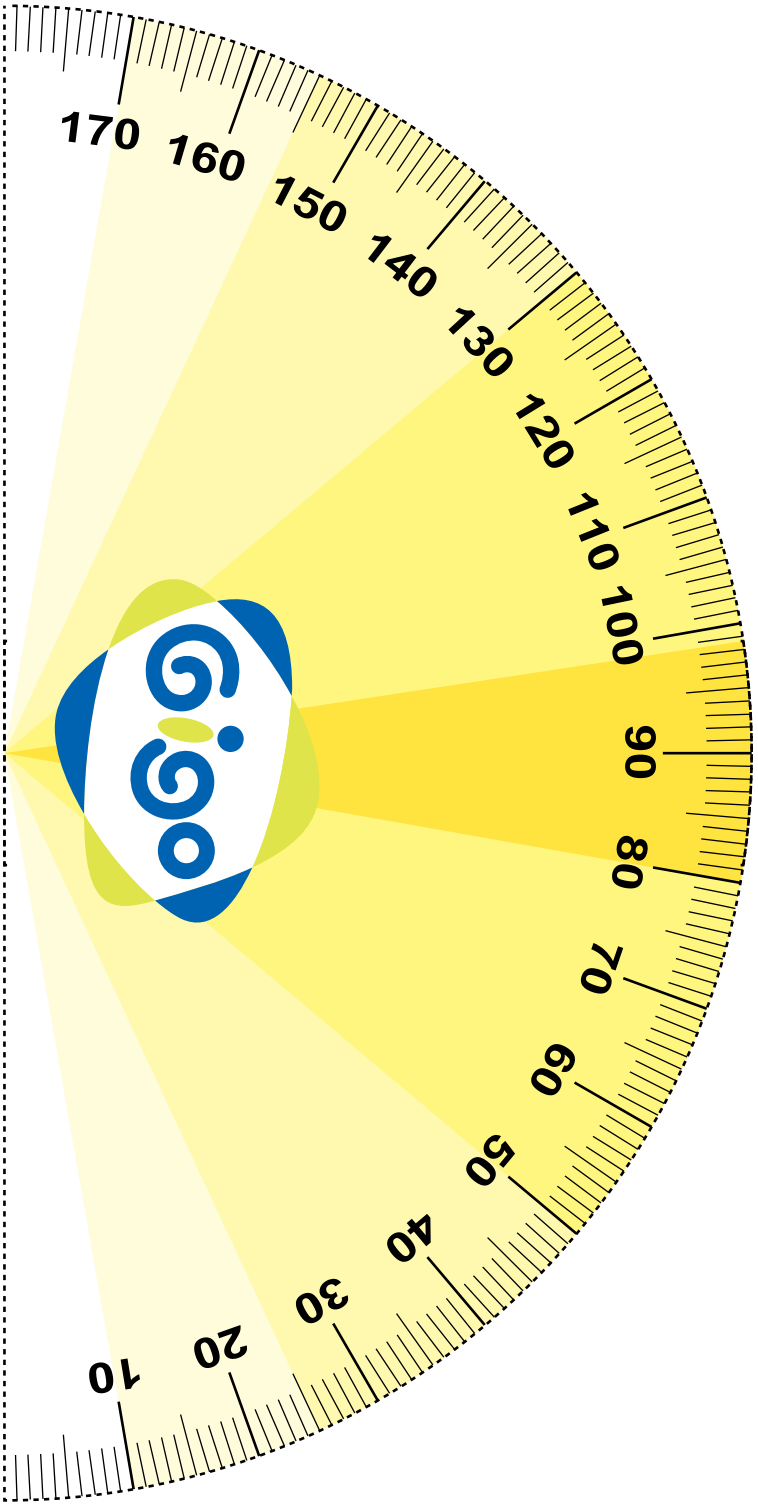
L4 Roulette Wheel

Paper card–Roulette Wheel
(Please copy for use.)

Paper card–Machine Clock
(Please copy for use.)

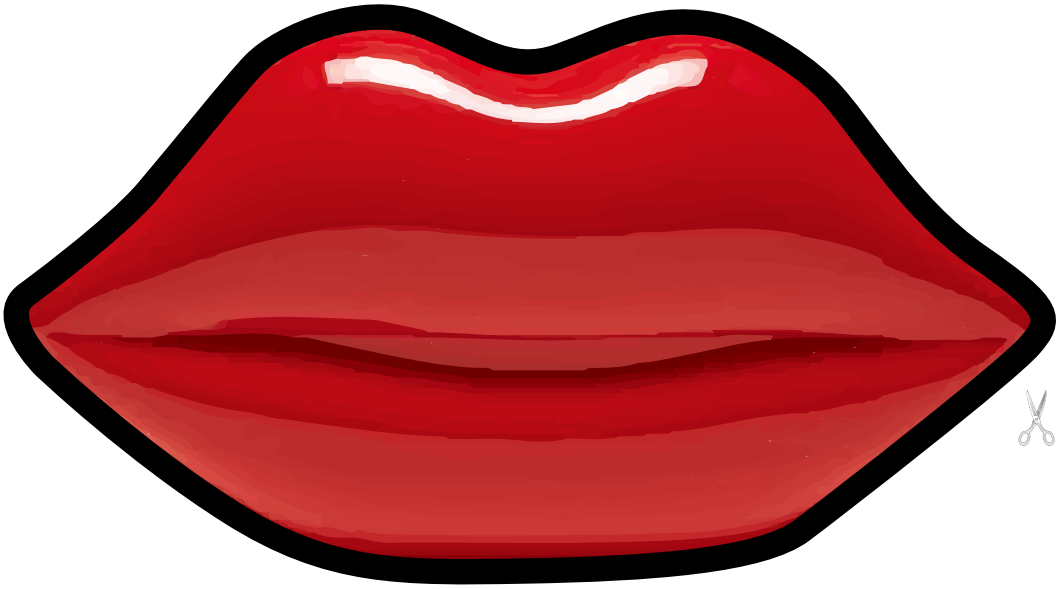


Paper card– Angle Measuring Instrument (Please copy for use.)



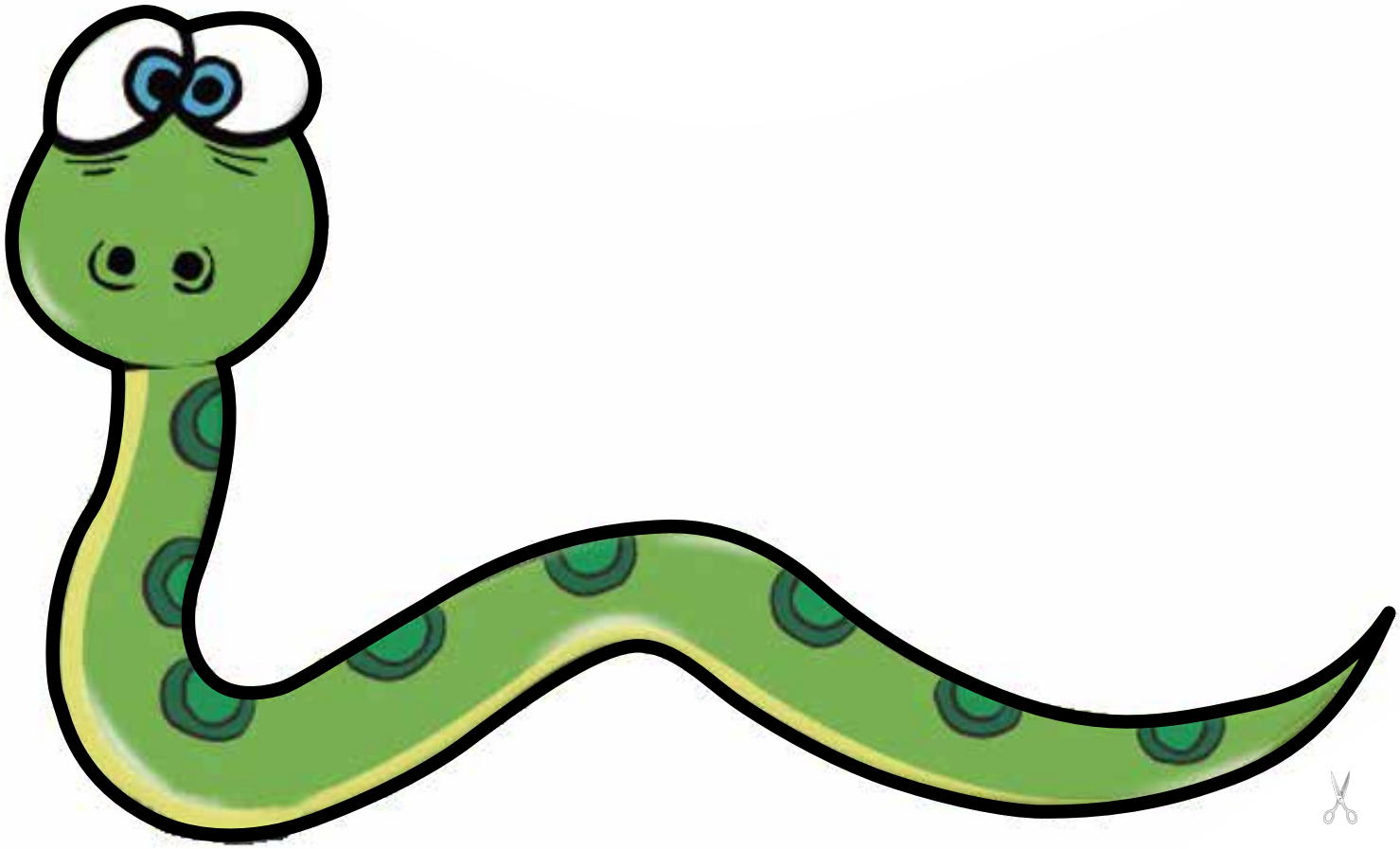
L13 Big Mouth

Paper card– Big Mouth
(Please copy for use.)



L16 Naughty Snake

Paper card– Naughty Snake
(Please copy for use.)



MADE IN TAIWAN

GENIUS TOY TAIWAN CO., LTD.

www.gigotoys.com

 R21#1235R-3