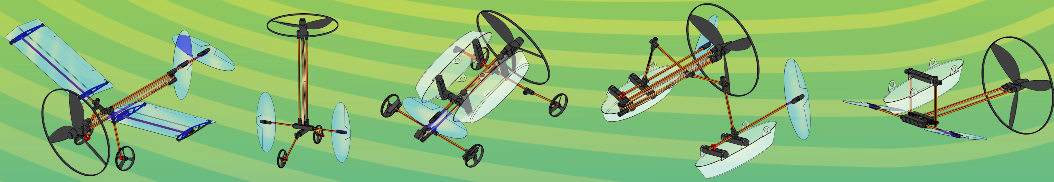
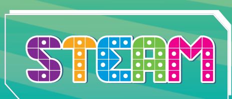
Rubber Band Racers





8+ AGES

71 PIECES

5 MODELS

Page Order

Product features

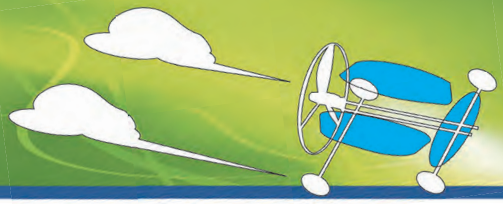
- Premium bamboo has been selected to craft the parts of this product; Gigo has conducted hundreds of tests to find the strongest and lightest material that allows planes to fly with stability.
- The blades of the propeller are specially designed to help the models to move faster and with more stability.

Learning

- The 22-page color instruction book details the assembly of five models; as well as detailed assembly instructions, it also explains principles and applications.
- The Gigo elastic kinetic models revolutionize the concepts of toy airplanes. Most rely on electric parts or air balance to fly and glide. Air balance is how paper airplanes glide through the air.
- Propellers allow children to play and learn the principles of aircraft throughout the process, along with the principles of other modes of transportation.
- Various types of innovation allow children to understand the principles of transportation tools: e.g. why boats do not sink?

Innovation

Gigo has created rotary propeller planes, helicopters, hydrofoils, and race cars using kinetic elasticity. Using our unique experience and thinking, we guide children towards their own ambitions and creative thinking so that they can have both fun and safety.



Suggestions to parents and Safety Guidelines

- With this science experiment set, your child can learn the concepts of physics such as lift and elasticity through play. Each stage in the assembly allows children to develop their thinking ability and to enter the field of natural kinetic force.

- Please read the safety instructions within the instruction manual carefully. We suggest that you follow the steps in the manual for the assembly of models. Soon, you will understand how to assemble the various parts and learn how to construct various models as you wish.

- This set is a toy appropriate for children above eight years of age. It can help children explore and learn through the assembly of models.

- This product is inappropriate for children under the age of three as they may eat or accidentally swallow smaller parts, leading to danger of suffocation.

- Take care not to throw assembled models at other people or animals and ensure that people or animals are beyond the range of the model.

- All outdoor experiments should be conducted under the supervision of parents or other adults.

- The box and instruction manual contain vital information and should be stored appropriately.

- When using this product, we suggest a clear area of at least 30 meters by 30 meters to allow airplane fly; also, bathtubs or kiddie pools can be used as safe enviroments for playing with boats.

Warning

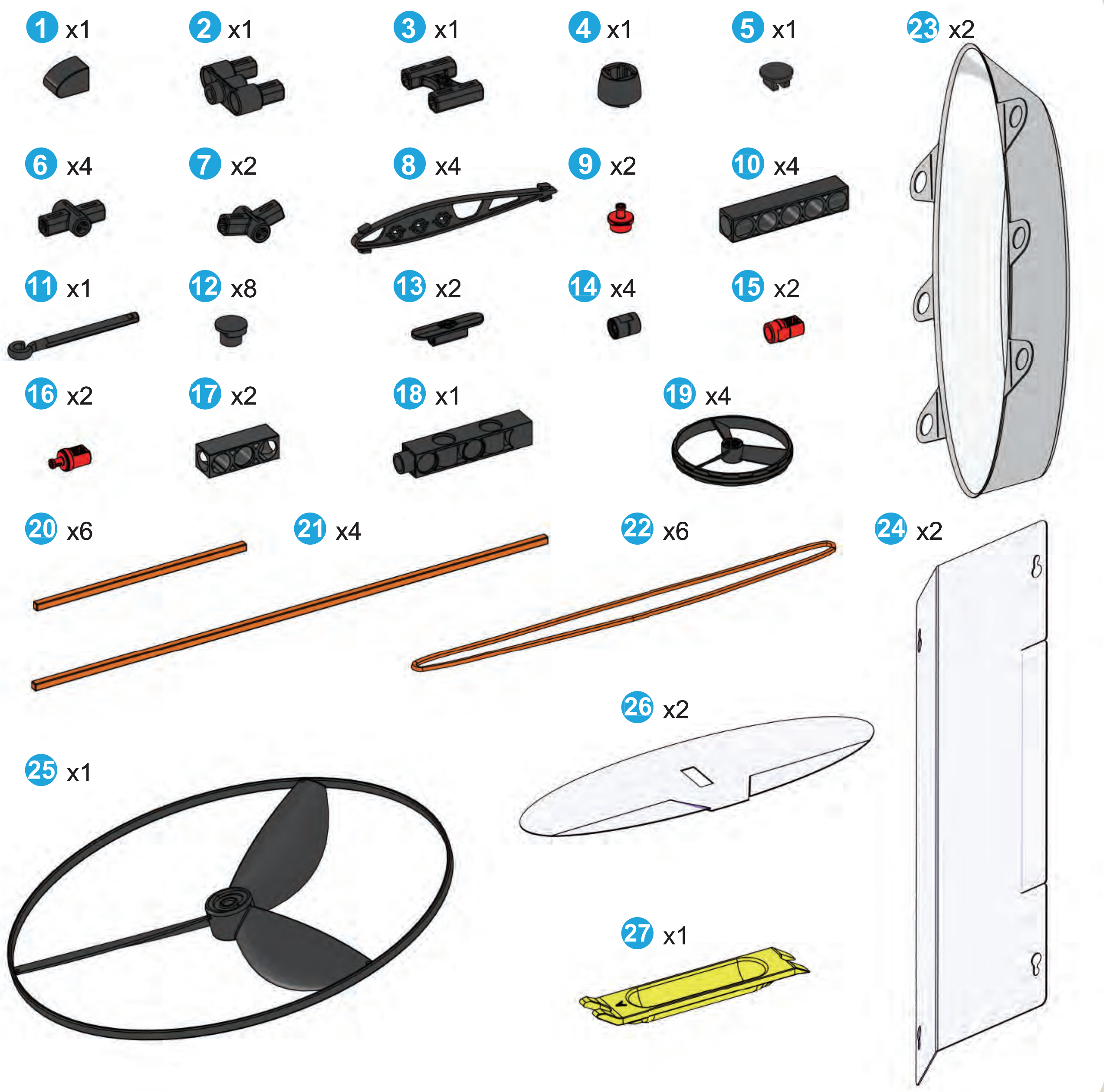
- Do not let children shoot the rubber band at objects or other people to avoid the risk of injury or damage.

- Take extra caution when inserting bamboo joints into parts as excessive force may cause them to split, crack, or break; this may lead to injury.

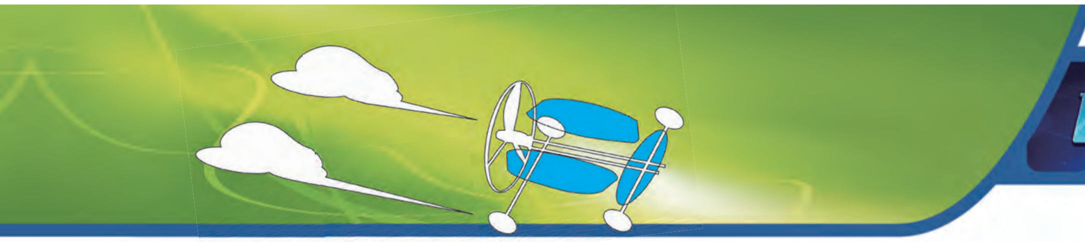
Caution

This toy set is not appropriate for children under the age of three as it includes small parts that may be swallowed. Please place the toy out of reach of small children.

EXPERIMENTS

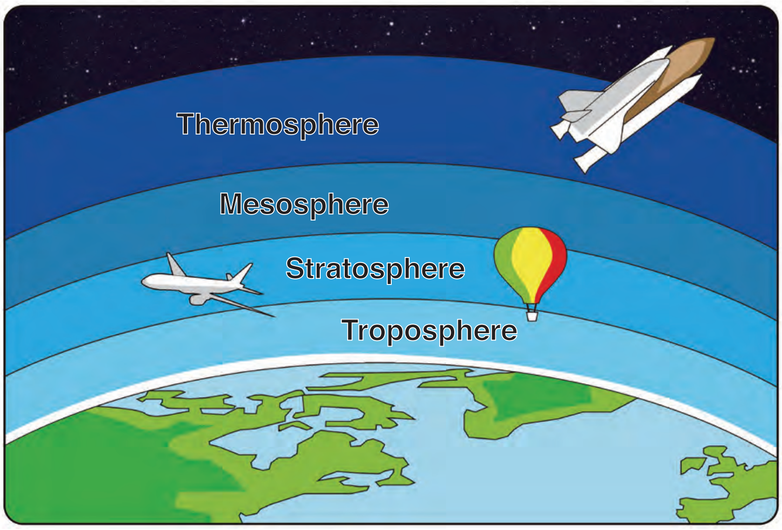


(1) Nose cone	(2) Hook fixture	(3) H shape connector	(4) Propeller clutch	(5) Propeller clutch cap
(6) Connector	(7) Angle connector 150 degree	(8) Airfoil rib	(9) Axis of rotation	(10) 5-hole rod (side 2-hole)
(11) Hook	(12) Button fixer	(13) Tail fixture	(14) Bamboo fixer peg	(15) Carbon fiber star switch
(16) Carbon fiber axis connector	(17) 3-hole rod	(18) Dual rod	(19) Carbon fiber wheel	(20) Bamboo square bar (90mm)
(21) Bamboo square bar (220mm)	(22) Rubber band	(23) Pontoon	(24) Wing surface plastic film	(25) 170 Propeller
(26) Vertical stabilizer film	(27) Peg / Axle remover			



The earth's atmosphere

The atmosphere is composed of gases that comprise 78% helium, 21% oxygen, and 1% of other gases; this ratio will not change.
The earth's atmosphere is 600km thick. This sounds very thick, but if you draw the earth as a circle with a radius of 64cm, the atmosphere's thickness is a mere 6cm. The flight altitude of planes is only 1 or 2mm from the earth's surface.(diagram 1)



(diagram 1)

The stratosphere at 11,000 to 20,000m is the most suitable altitude for planes to fly at as the turbulence in the troposphere causes unstable flight and many climatic phenomena (such as rainfall). The temperature of the stratosphere is controlled and in comparison very stable. Only during summer do high temperatures cause clouds to appear in higher positions and cause many instances where planes must fly under the clouds.

The amazing power of air

We can't see air so it's hard to imagine how powerful it is.
For instance, we often use suction cups on a daily basis to attach them to walls and hang objects on them. This is all thanks to air. Suction cups press down to force air out so that pressure is exerted on the external side of the cup, causing it to attach firmly to the wall.

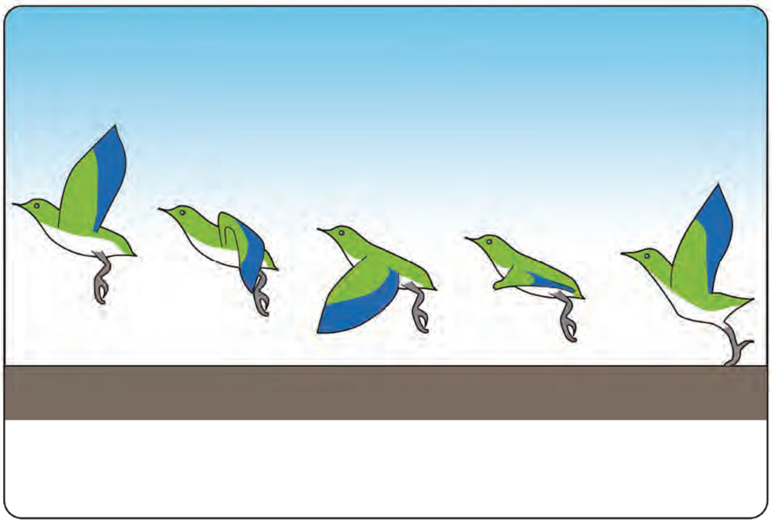
An atmospheric pressure of 1 cm^2 can withstand a force of 1 kg (1kg/cm^2) so if the surface of the suction cup is 15 cm^2 then we know that 15 cm^2 x 1 kg/cm^2 is 15 kg. This means that the atmospheric pressure of the suction cup is 15kg.

(diagram 2)

Think about it, how much weight can you put on (diagram 2) suction cup without it falling?

How do birds fly?

Since ancient times, humankind has wanted to fly through the sky. We envied the birds who fly so freely, and began to study the principles of flight through birds. Now we too can fly.
Birds fly in more than one way. Finches must flap their wings nonstop and eagles glide through the sky. When observed through magnified slow motion birds not only flap their wings up and down but rely on arm motions similar to the butterfly swimming stroke; they extend outwards when striking downwards and retract inwards when striking upwards. (diagram 3)

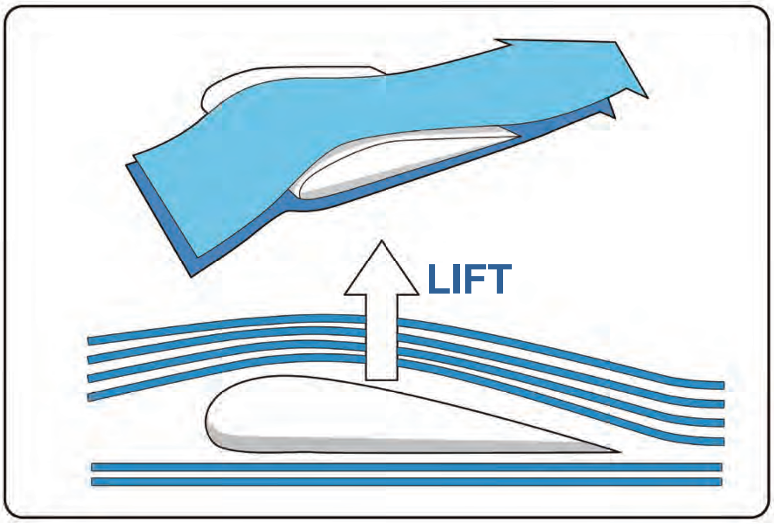


(diagram 3)

The method that birds use to flap their wings allows them to feel the force of air and use it to carry their wings upwards; they push air behind them to accept a larger force. This force is known as lift.

The principles of lift

Resistance is the force that pulls an object when it is moving forward; lift is the atmospheric force that lifts it vertically, but where does it come from? It is dependent on the density, speed, viscosity, and compression of air. Airflow passes through an object's surface and shape, and the angle between the object and airflow. Their relationship is highly complicated but was later defined by Bernoulli's law. (diagram 4)

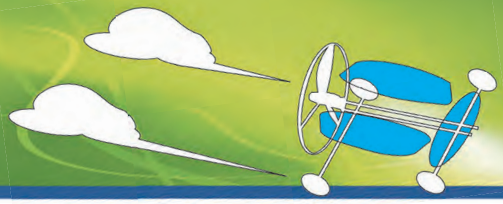


(diagram 4)

Bernoulli's law

The law was proposed by Daniel Bernoulli in 1738 in a paper titled <Hydrodynamica>. Simply put, the theory states that "when flow speed increases, pressure decreases". Bernoulli utilized Newton's study of kinematics and the theory of energy conservation (i.e. energy+potential energy=constant) to deduce his law: energy+pressure=constant. In other words, when an object's flow speed increases pressure will decrease because of the law of energy conservation.

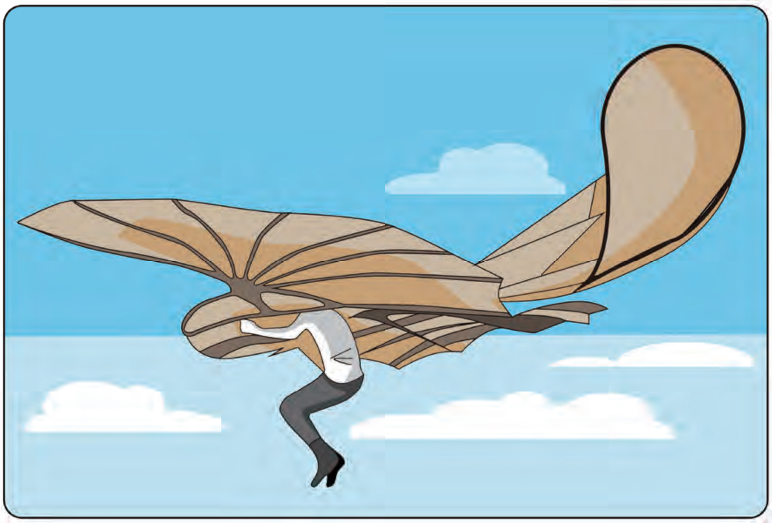
Airplanes depend on this theory to fly in the sky. "When an object's flow speed differs from those around them, the object with faster flow speed will have lower pressure causing pressure around the object to pressure the object with faster flow speed". If an object can move, it is usually affected by this type of force and moves towards the direction of force. The backs of planes are designed to be curved and their bottoms are designed to be flat to allow airflow on the back to travel faster and utilize the higher pressure on the bottom to support the plane's weight in the air.



Can humans fly?

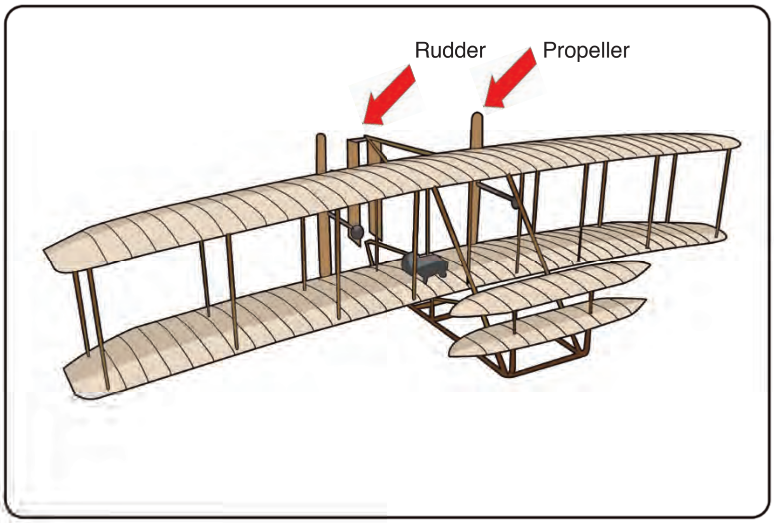
Leonardo Da Vinci (1452-1519) conducted many studies on birds and attempted to invent flying contraptions. He drew blueprints for an ornithopter to imitate the feather structure of birds but after lengthy research concluded that it was impossible for humankind to fly nimbly like birds.

At the end of the 19th century, people began to ponder the possibility that forward and upward forces were two separate forces; this replaced the idea that flapping wings like birds was the way to move upward and forward.



(diagram 5)

The first glider flight was that in 1891 by a German named Otto Lilienthal. He conducted many studies and experiments on flight and birds and successfully built a hang glider. (diagram 5)



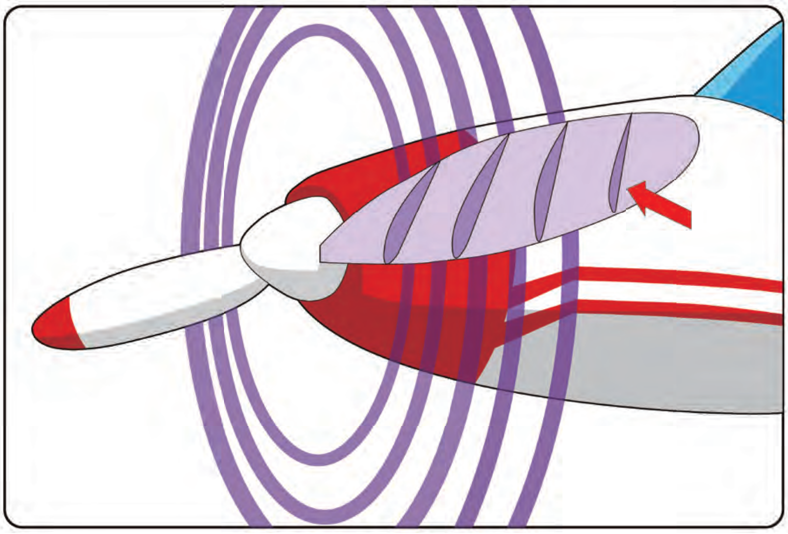
(diagram 6)

The Wright brothers were greatly inspired by Otto Lilienthal but in the end they abandoned Otto's method and used their own invented technology.

Finally, in 1903 they invented the first flying machine. They used propellers to propel the machine forward and produce lift.

They also created a rudder that could adjust the plane's movement in four directions. This was the first time that humans could break free of the wind's restrictions and create a plane that allowed the control of flight. (diagram 6)

Propeller principle



(diagram 7)

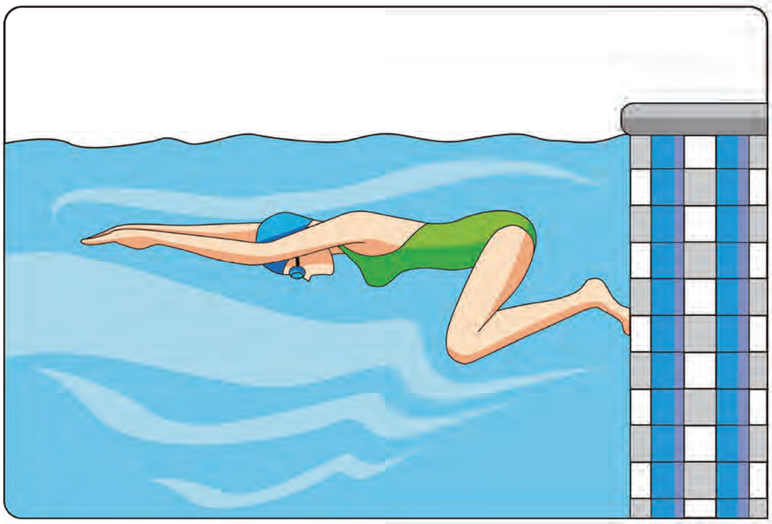
Before we can understand how planes use propellers to fly, we must first understand two principles: Bernoulli's law and force and reaction.The first governs the flight of planes designed in the shape of a blade to create a difference in pressure and air speed to achieve a forward force.

When a propeller spins, its blades continue to push massive amounts of air backwards to create a reactionary force that pushes forward; this is what is commonly known as propulsion.The principle that allows a propeller to push a plane forward is completely different from that underpinning rockets, jets, and other flying machines.

If you look at a segment of a propeller blade, it looks just like the wings of a plane (see the arrow in diagram 7). So during the process of rotation lift is produced according to Bernoulli's law. However, the direction of this lift is forward so it is called propulsion and moves the plane forward.

There are many types of propellers such as single blade, double blade, triple blade, and more. They are also categorized by the direction of propulsion such as roller propellers (also known as positive propellers), thrust propellers, and more.

Force and reaction



(diagram 8)

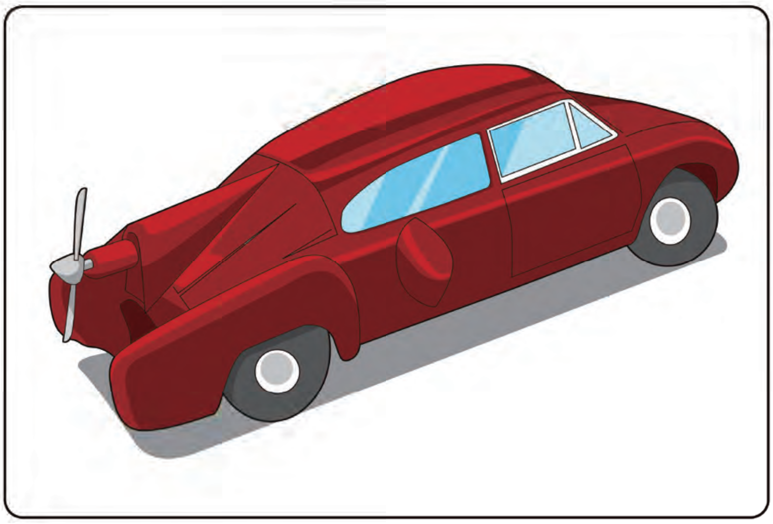
Newton's third law states that for every action, there is an equal and opposite reaction. This means that in every interaction, there is a pair of forces acting on the two interacting objects. The size of the forces on the first object equals the size of the force on the second object.

For example: when you push hard against a wall, it will exert a reactionary force onto you. The harder you push, the stronger the reactionary force.
Another example: when you are swimming and push off the walls of the pool, the harder you push the further you will glide. This is an example of force and reactionary force. (diagram 8)

Force and reactionary force are a normal part of our lives and we use them every day.

Cars

The relationship of force with airplanes is similar to that with cars. Assume that a car maintains a speed of 80km while driving on a flat road. The driver must use the same force to step on the accelerator to keep the accelerator in a fixed position. This is because friction is created between the tyres and road while air resistance obstructs the car as it is moving forward; in other words, the car moves forward because of resistance. A car in motion must continuously exert a force identical to resistance in order to maintain a speed of 80km on the road. If the accelerator is stepped on with more force and a force stronger than the resistance is created, the car will speed up. On the other hand, if resistance is greater, the car will slow down.



(diagram 9)

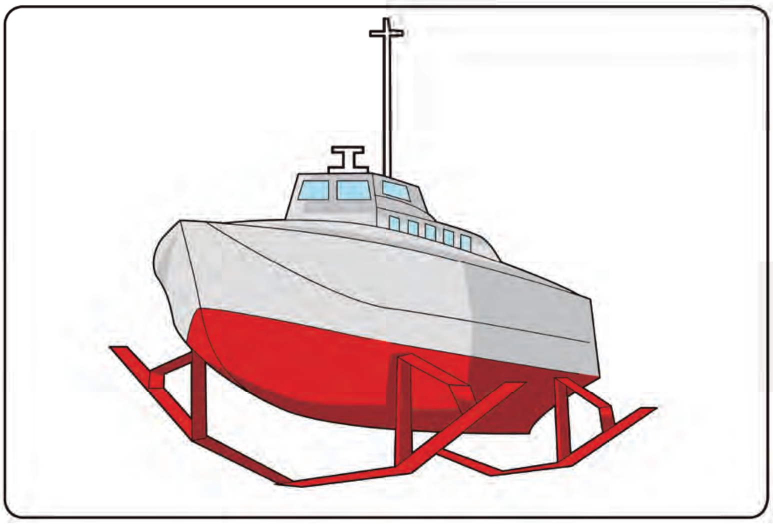
Early cars used propellers as propulsion. From 1912 to 1936, the French relied heavily on cars that utilized propellers. The "Flying Argentinian" equipped with a Chevron engine was planned for mass production in California during 1955. Eventually, because of the great windspeeds created by the propeller such equipment was abandoned in cars for safety reasons. (diagram 9)

Boats

Boats can float on water thanks to buoyancy. Archimedes' principle states that the buoyancy of objects in liquid = the same weight in liquid equal to the object. In other words, if the object's weight is greater than the weight of an equal amount of liquid (object density greater than liquid density), then the object's buoyancy will be less than the weight of the object and it will sink; if the object's weight is less than the weight of an equal amount of liquid (object density less than liquid density) then the object's buoyancy will be greater than the object's weight and it will float.

Hydrofoils

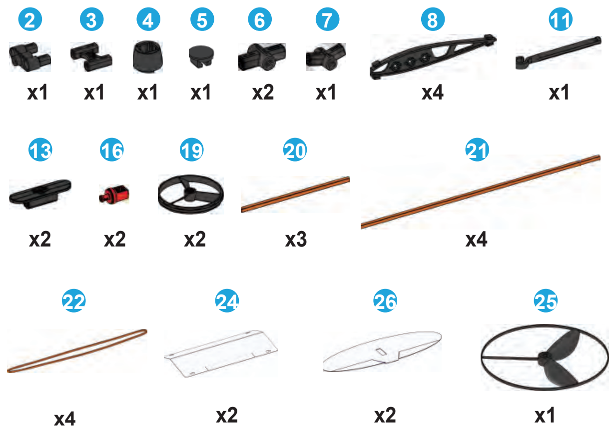
Hydrofoils are a type of high-speed boat. There is a support structure on the bottom of the boat equipped with a hydrofoil. When the boat's speed increases, the buoyancy provided by the hydrofoil lifts the boat from the surface of the water to decrease water resistance and increase cruising speed. (diagram 10)

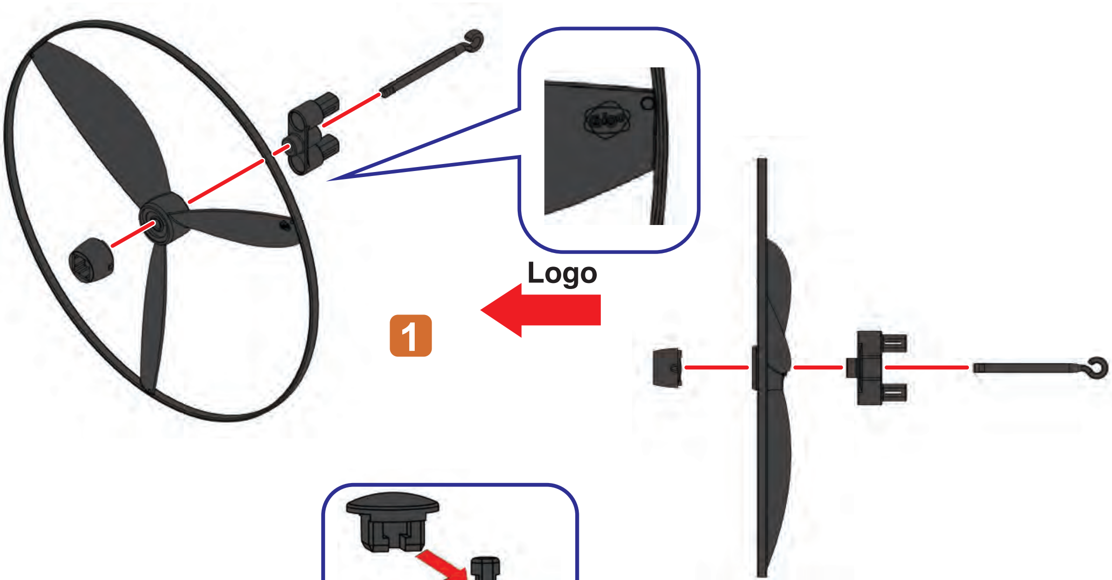


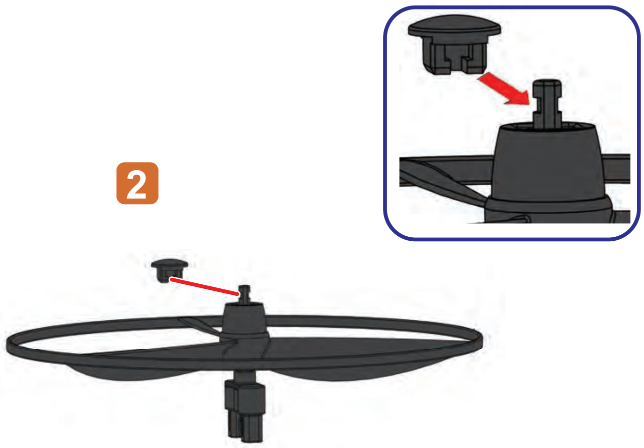
(diagram 10)

Airplane Model 1

Kit Contents







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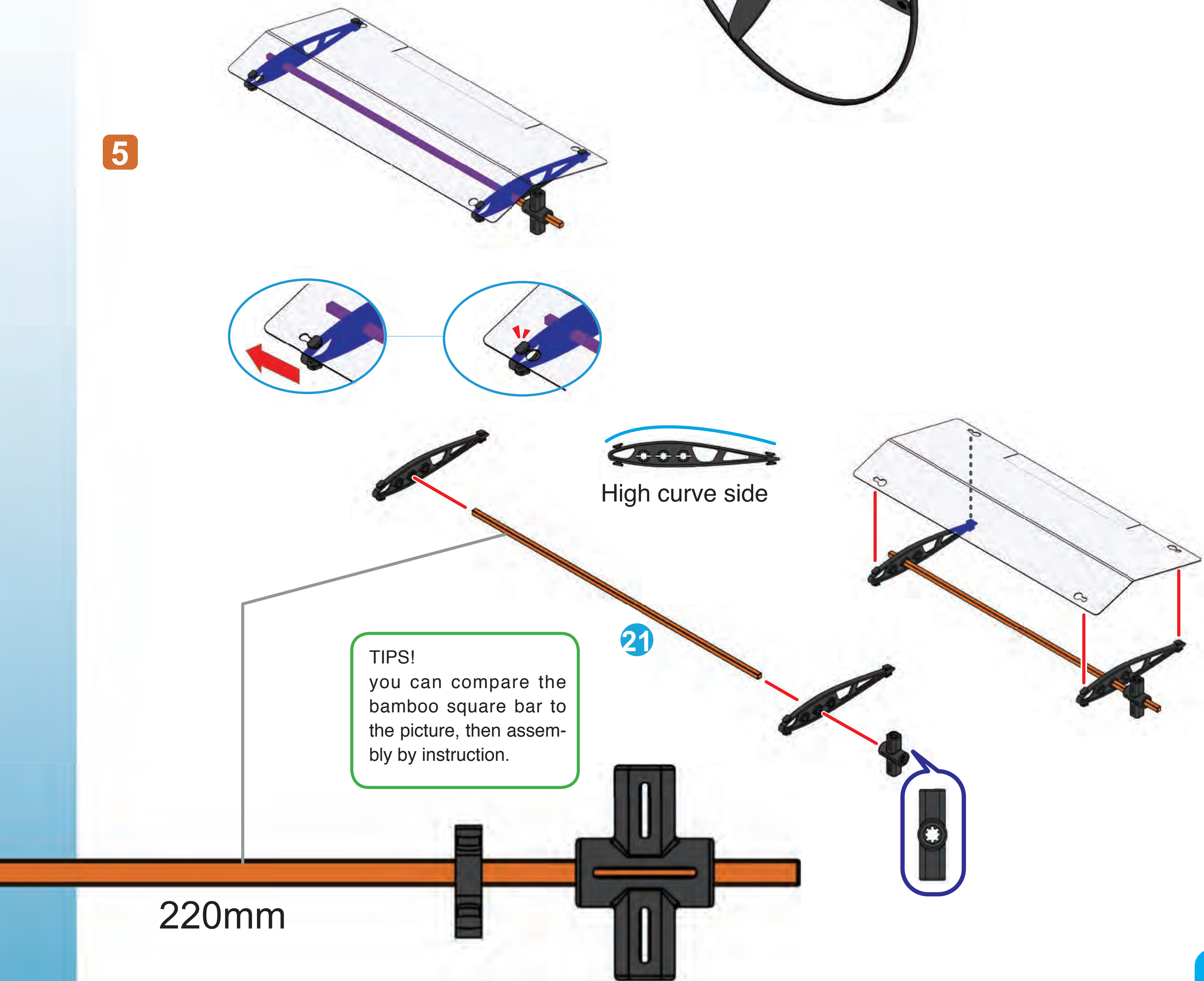
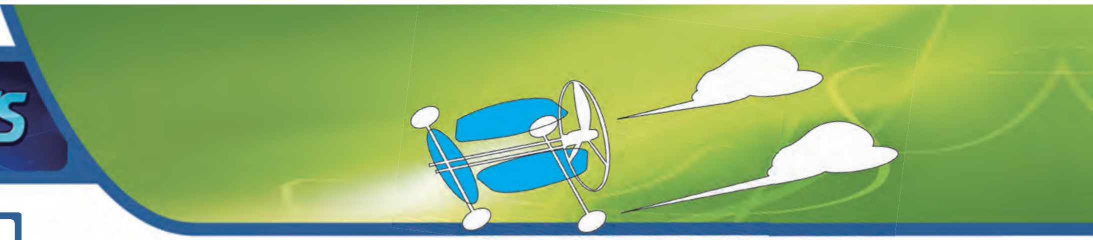


TIPS!
you can compare the bamboo square bar to the picture, then assembly by instruction.



Airplane Model 1

TIPS!
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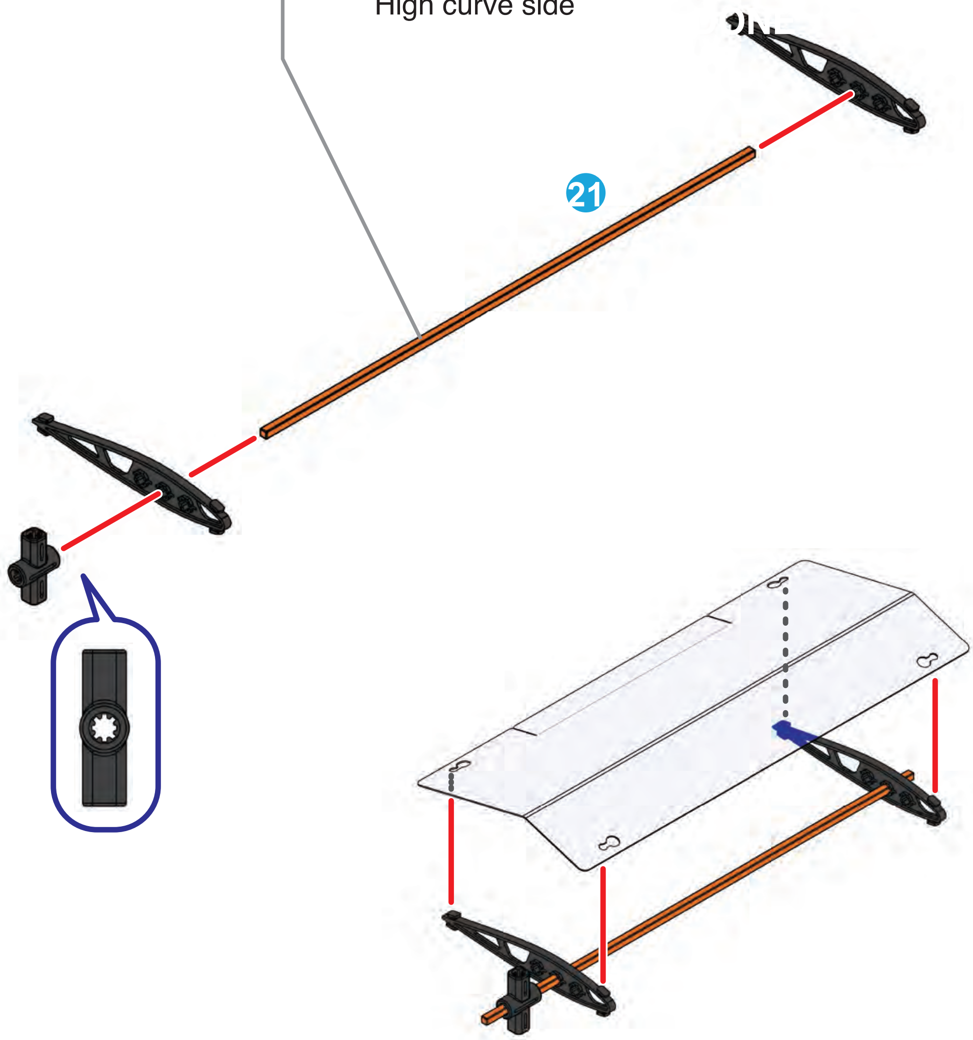

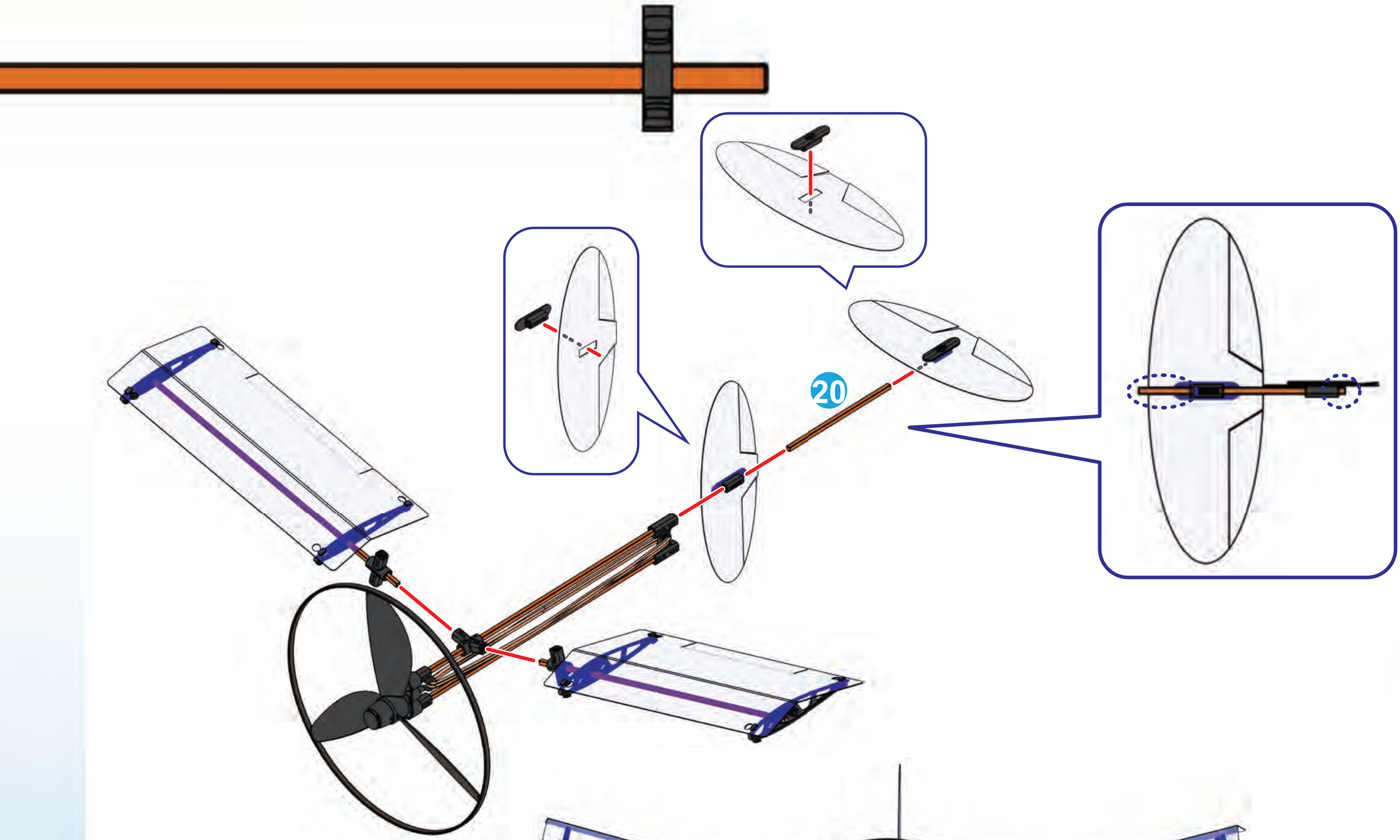

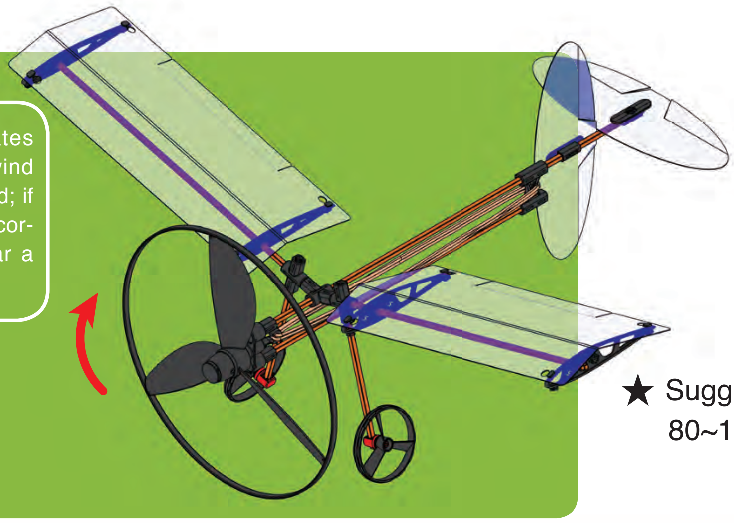

The arrow indicates the direction to wind up the rubber band; if the direction is incorrect, you will hear a "clicking" sound.

DONE

★ Suggestion: please wind up 80~100 turns

Propeller car Model 2

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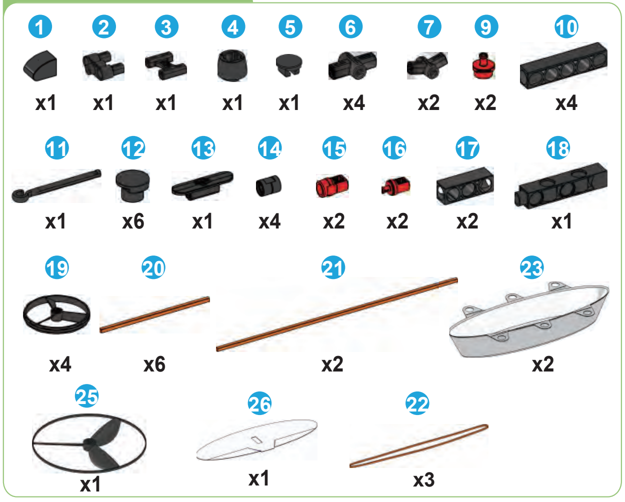

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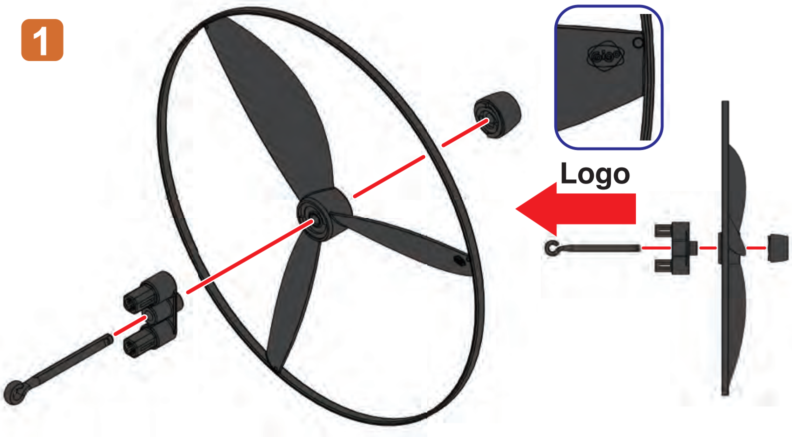

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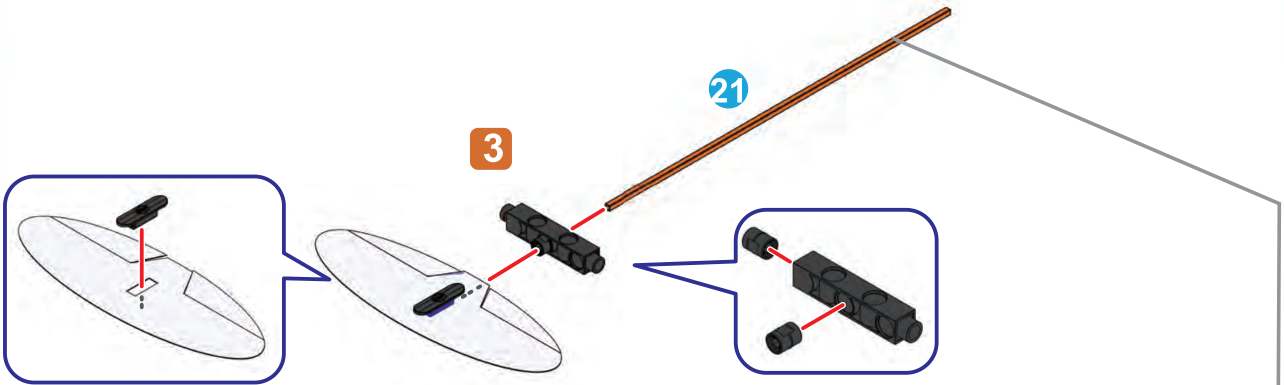
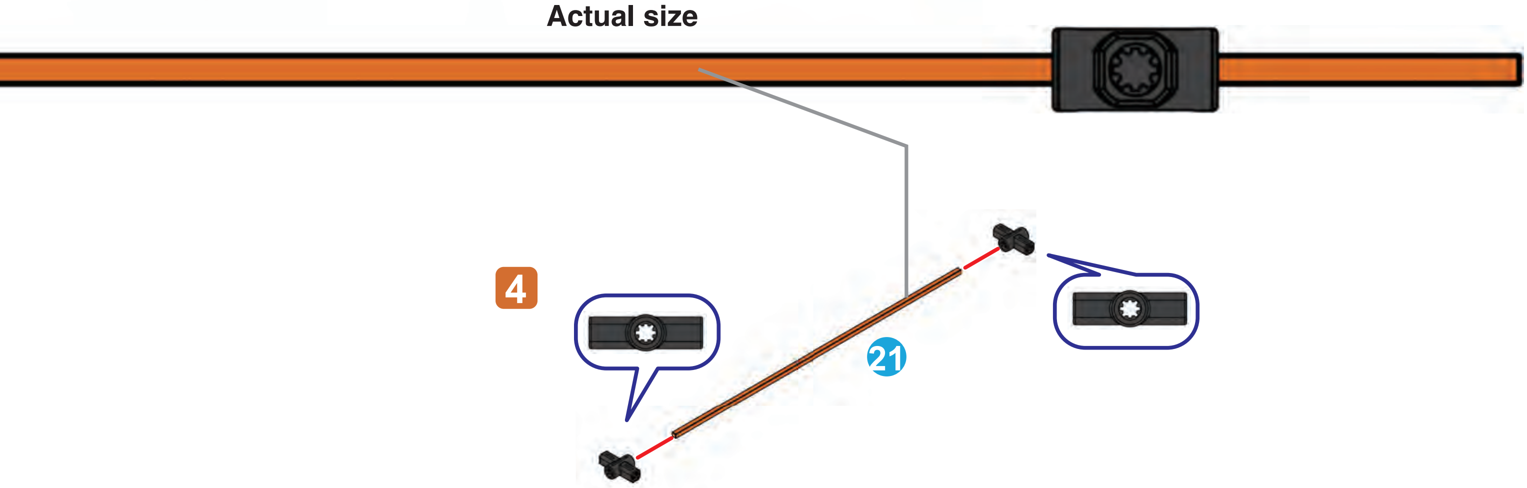
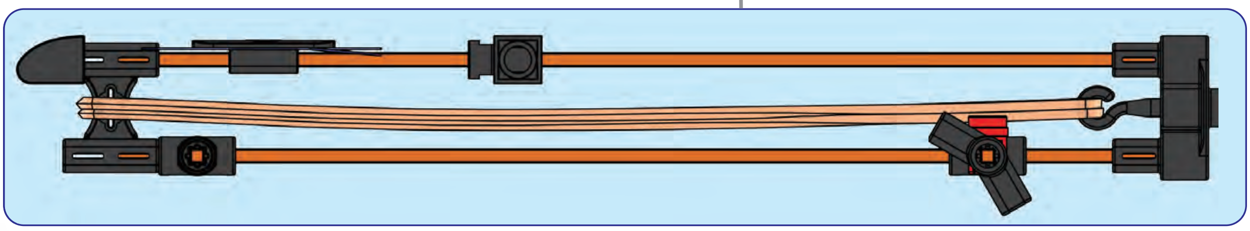


Actual size

Actual size





Propeller car Model 2

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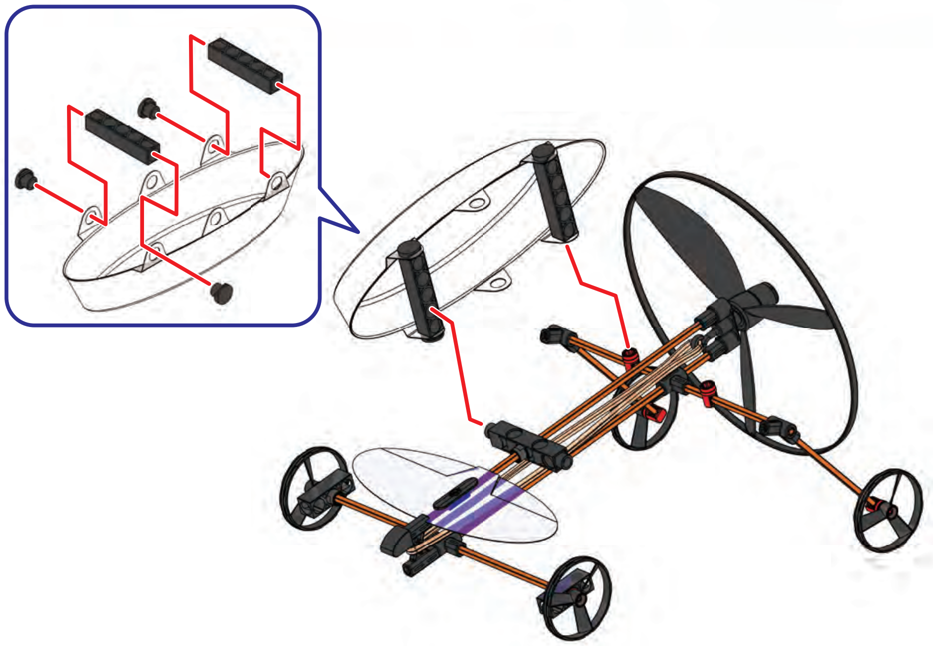

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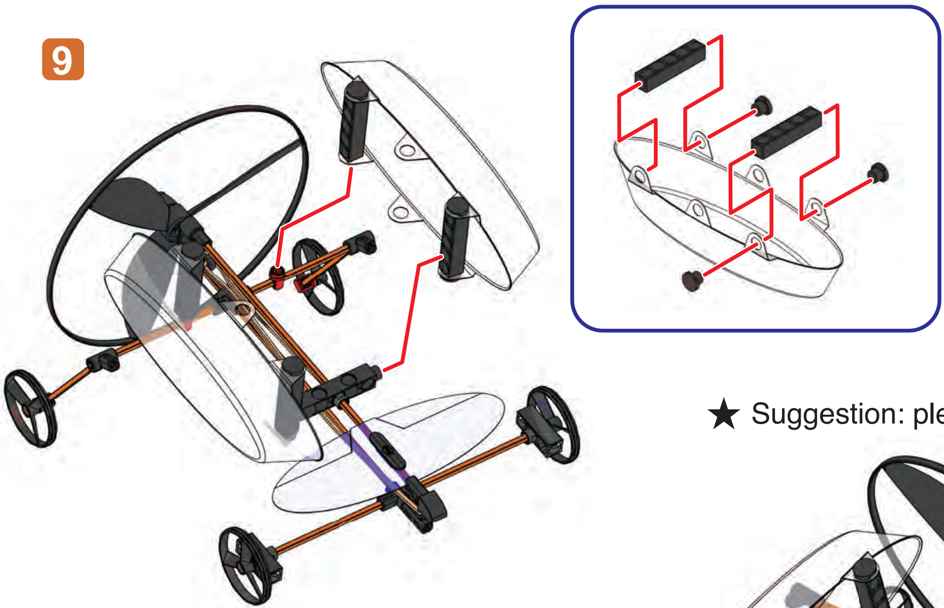
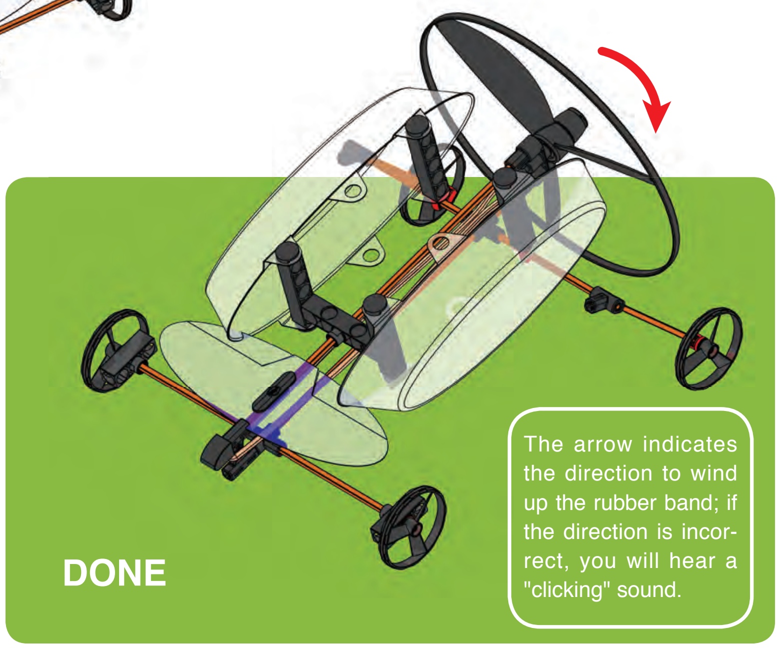
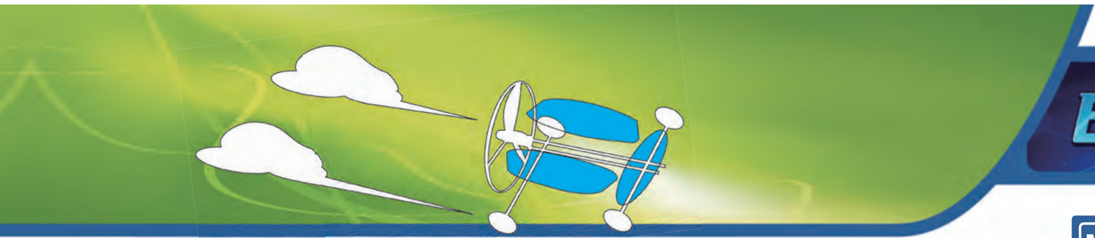


★ Suggestion: please wind up 60~80 turns





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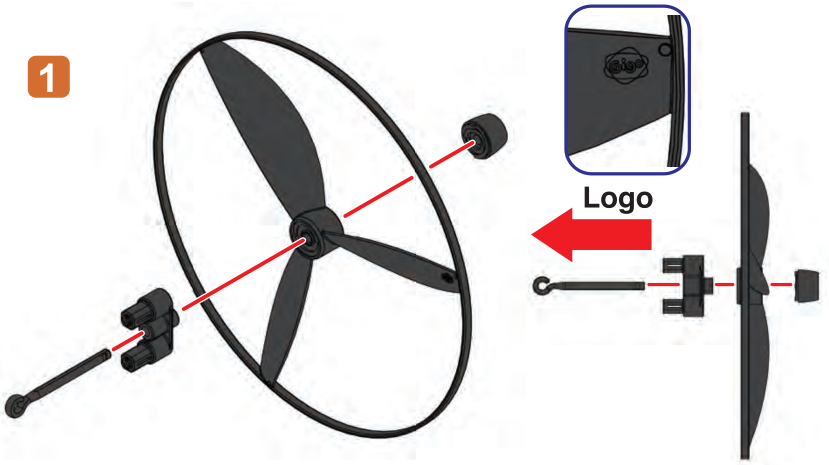

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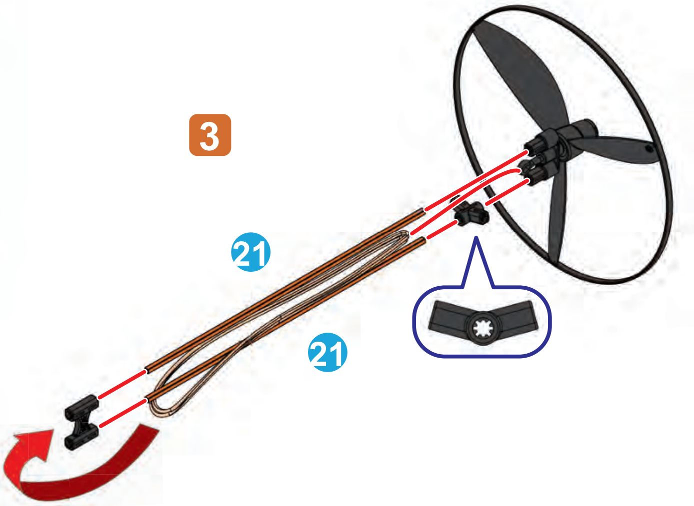

Boat Model 3

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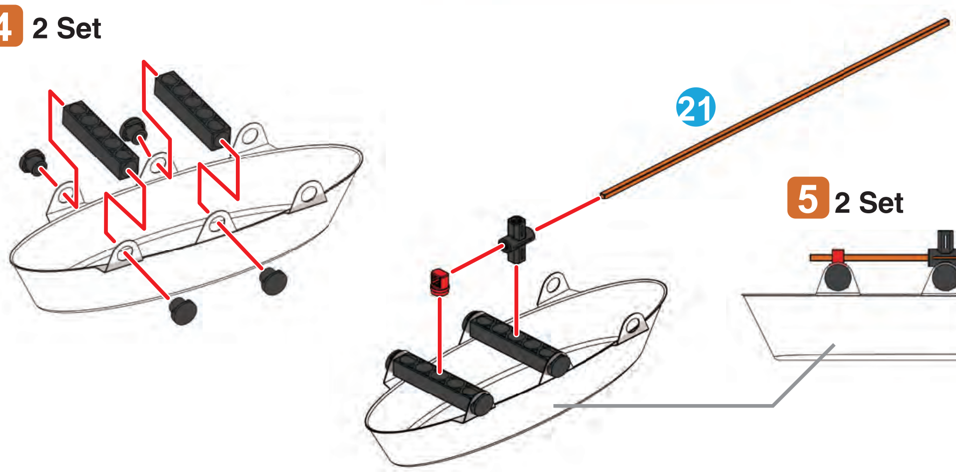
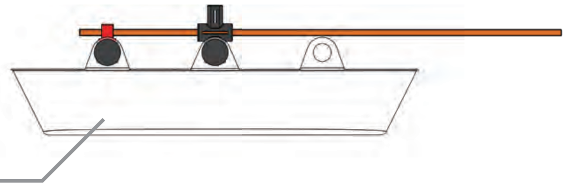


5 2 Set



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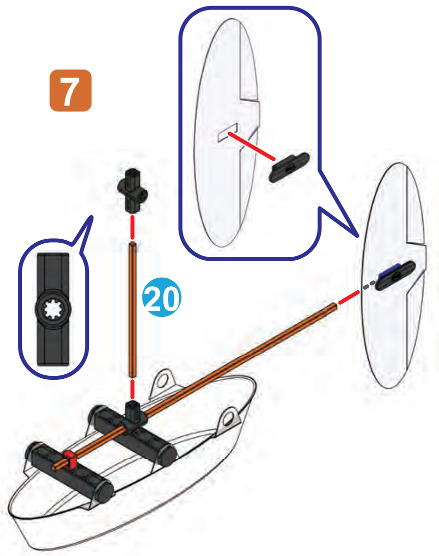

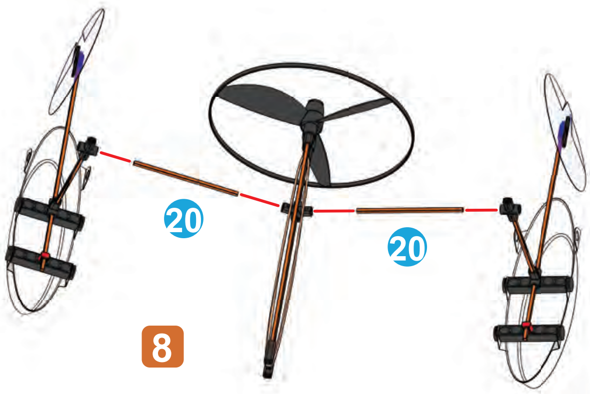

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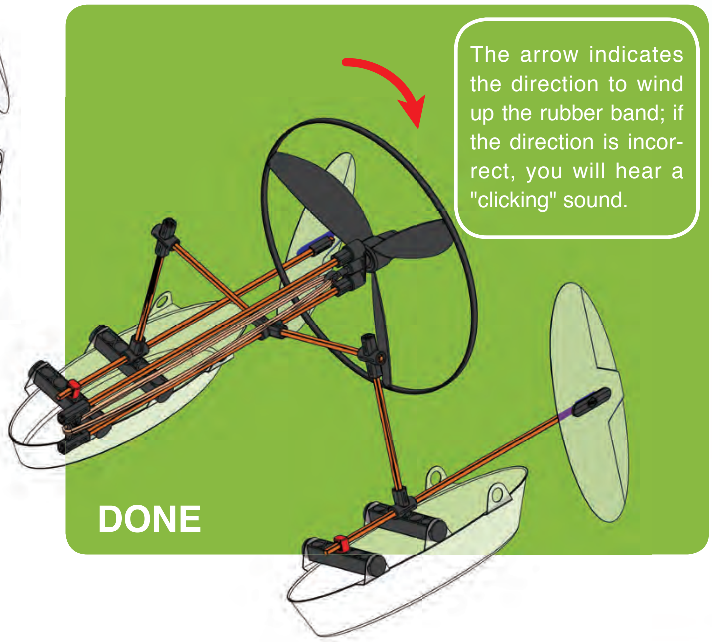
★ Suggestion: please wind up 60~80 turns



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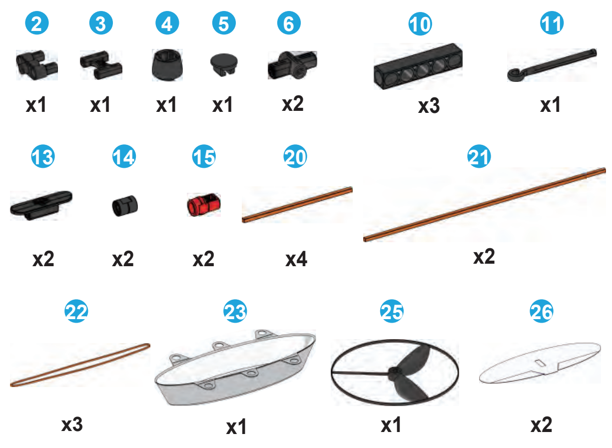

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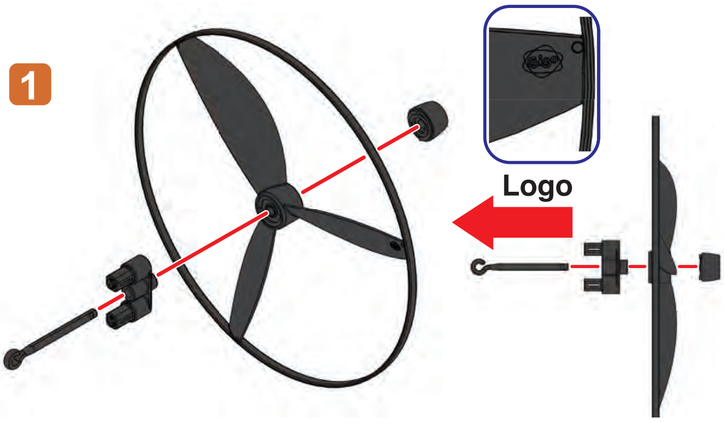

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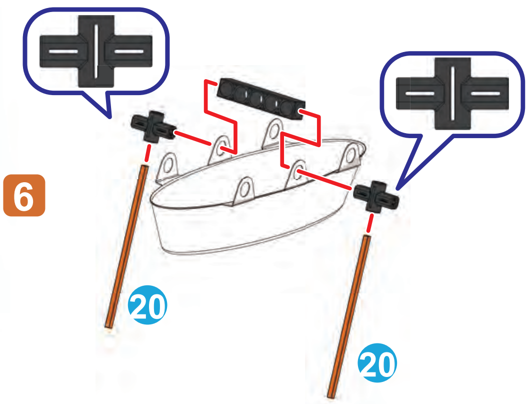

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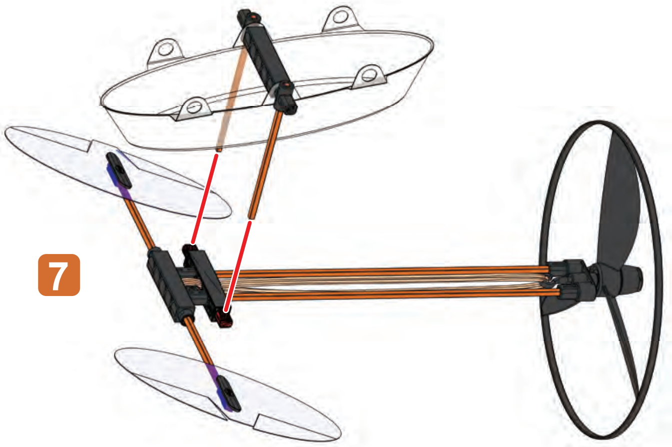
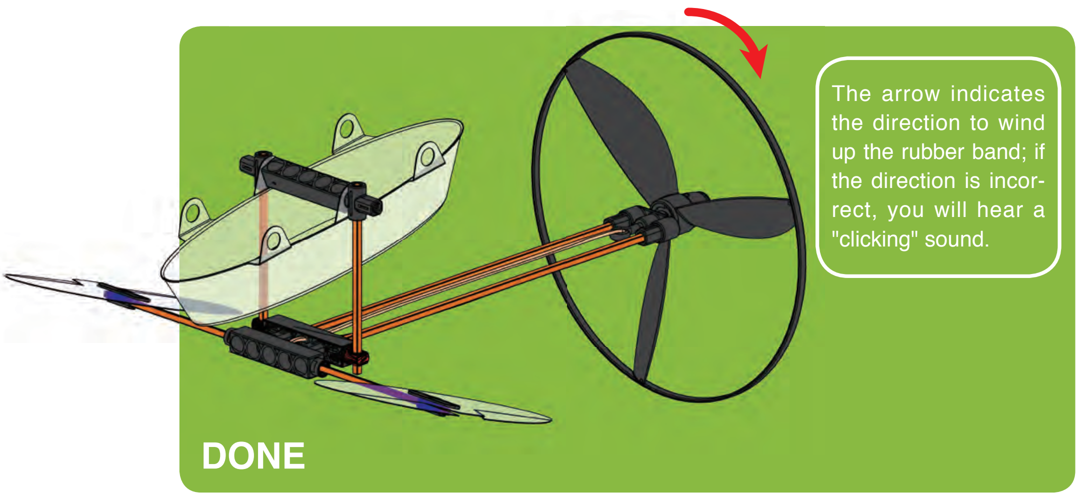
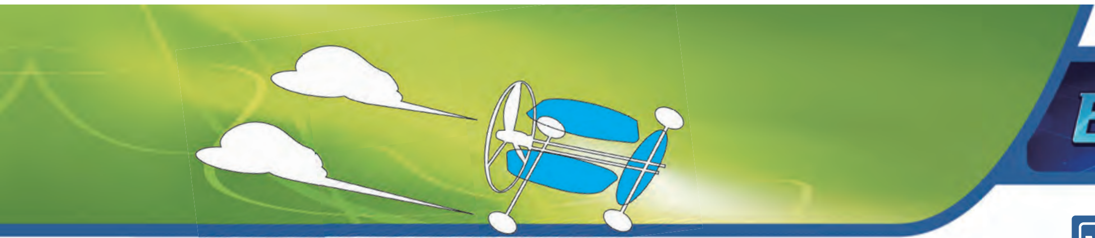


★ Suggestion: please wind up 60~80 turns





Model 5 Helicopter

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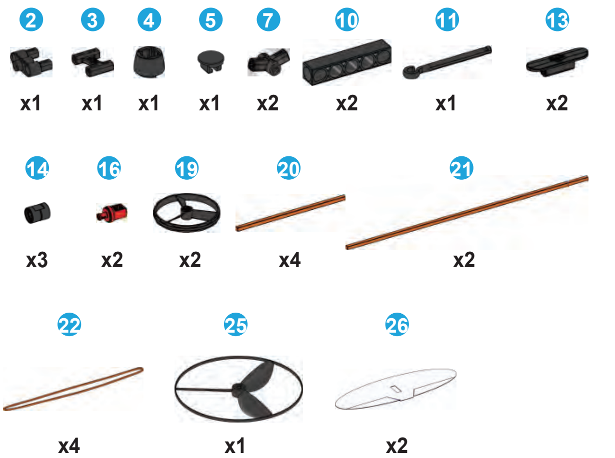

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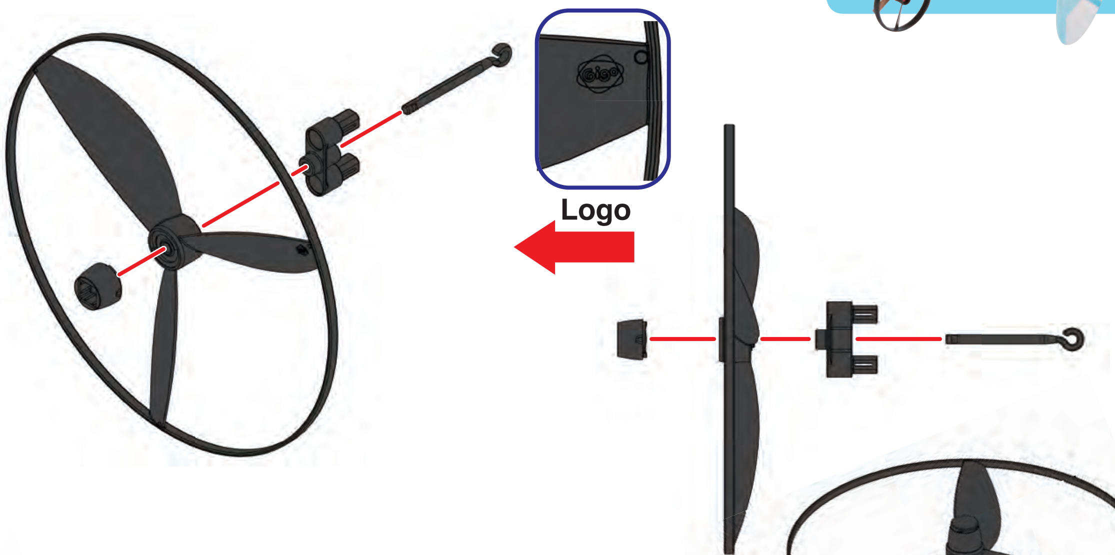

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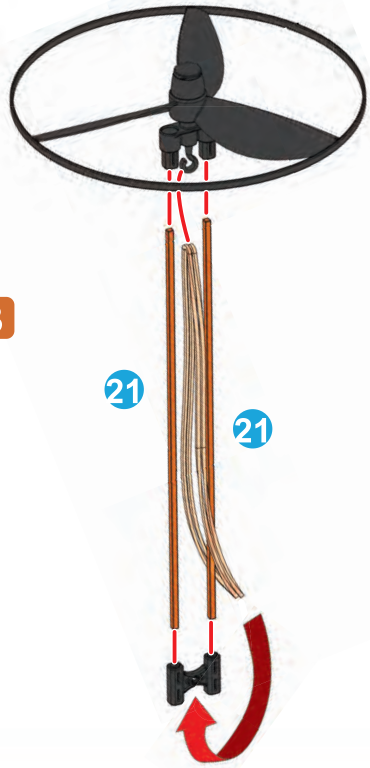
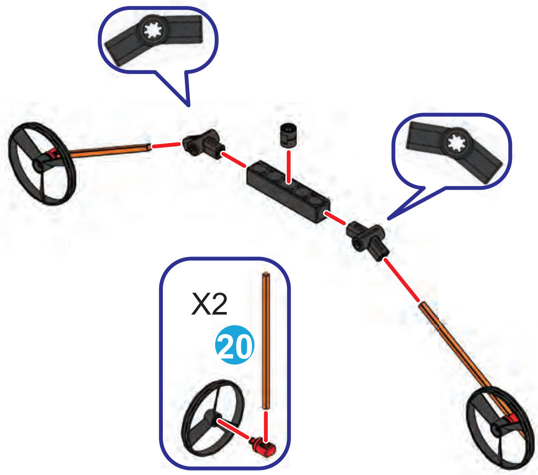


EXPERIMENTS

Helicopter Model 5

4

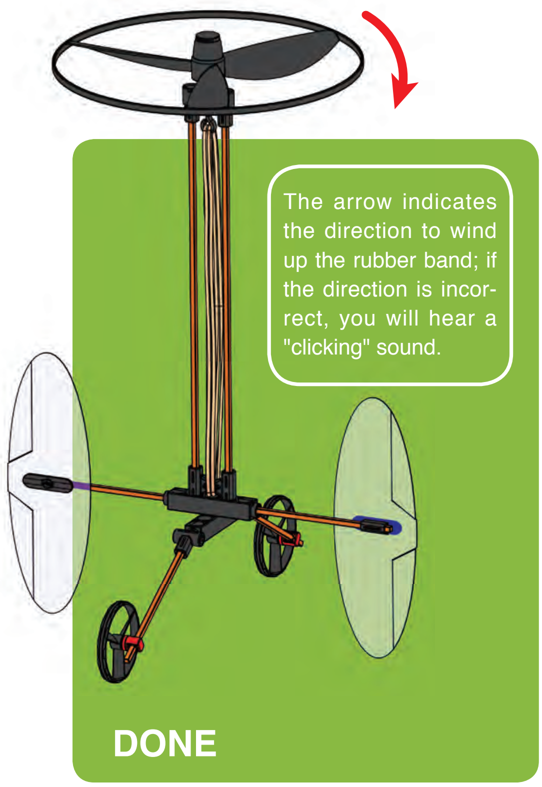
5



6

Stand
Remove the stand make the model fly higher!

★ Suggestion: please wind up 80~100 turns



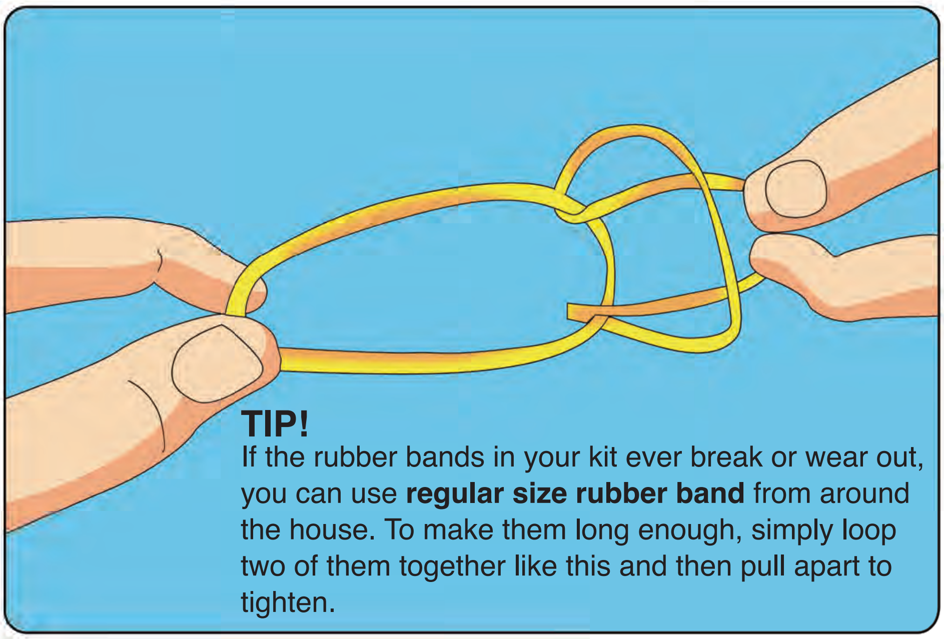
Understanding rubber

Rubber is a composite elastic material and it can be extracted from the juices of plants or be produced artificially. We use rubber in items such as tyres, rubber bands, and more.

Rubber bands were invented in 1845 by a rubber factory owner, Steven Perry. Today, bags of food are secured by rubber bands at the market and lunch boxes are secured with rubber bands so that the lids don't open. However, do you know why?

The primary reason we use rubber bands to secure things is because of their elasticity. Think about it. If you used a rope without elasticity to secure a lunchbox, what would happen?
Rubber bands are composed of isoprene polymers called polyisoprene (PI for short) and the isoprene monomer of the formula is C5H8.

Hooke's law is a basic theory of elasticity: it states that the force needed to extend or compress a spring by some distance is proportional to that distance. That is: where is a constant factor characteristic of the spring, its stiffness. So,
$F=kx$
F: the external force the spring withstands
k: elasticity constant
x: amount of extension (compression) of the spring
The law was proposed by the British physicist Robert Hooke (1635-1703) in 1678. Hooke belonged to the same generation as Newton and they were both outstanding physicists.



TIP!
If the rubber bands in your kit ever break or wear out, you can use **regular size rubber band** from around the house. To make them long enough, simply loop two of them together like this and then pull apart to tighten.

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