EXPERIMENT MANUAL

AIR-STREAM MACHINES

HOVERCRAFT & AIR-DRIVEN MODELS

Renewable Energy

THAMES & KOSMOS

Safety Information

WARNING! Not appropriate for use by children under 3 years of age. There is a danger of choking due to the possibility of swallowing or inhaling small parts. There is a danger of strangulation if the long cables are placed around the neck. Store this kit and built models out of reach of young children.

WARNING! Only suitable for children at least 8 years old. Instructions for parents or other responsible persons are attached and must be followed. Keep packaging and instructions as they contain important information.

Individual parts in this kit may have sharp edges or corners. Do not injure yourself!

For the models using the propeller: Do not put the propeller near the face or long hair.

For experiments with water: Warning! Use only the models recommended for use in the water and make sure they are properly assembled according to the instructions. Use models in the bathtub under adult supervision only. After experimenting, dry all components and return them to the box for storage.

Safety for Experiments with Batteries

››› Never experiment with wall outlets or the household power supply. Never insert wires or other parts into wall outlets! Household voltage can be deadly.
››› You will need six 1.5-volt AA batteries for the experiments. Due to their limited shelf life, these are not included in the kit.
››› Avoid short-circuiting the batteries while experimenting; they could explode!
››› Different types of batteries (e.g., rechargeable and standard batteries), or new and used batteries should not be used together.
››› Do not mix old and new batteries.
››› Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
››› Only install batteries in the correct polarity direction. Press them gently into the battery compartment.
››› Never recharge non-rechargeable batteries. They could explode!
››› Rechargeable batteries must only be charged under adult supervision.
››› Rechargeable batteries are to be removed from the toy before being charged
››› Remove dead batteries from the kit.
››› Dispose of used batteries in accordance with environmental regulations.
››› Make absolutely sure that metallic objects such as coins or key chains are not left in contact with battery terminals.
››› Do not bend, warp, or otherwise deform batteries.
››› In all experiments with batteries, an adult should check the assembly to make sure it is set up correctly.
››› After experimenting, disconnect all circuits and remove the batteries from the battery compartment.

Notes on Environmental Protection

None of the electrical or electronic components in this kit should be disposed of in the regular household trash when you have finished using them. Instead, they must be delivered to a collection location for the recycling of electrical and electronic devices. The symbol on the product, instructions for use, or packaging indicates this.

The materials are reusable in accordance with their designation. By reusing or recycling used devices, you are making an important contribution to the protection of the environment. Please consult your local authorities for the appropriate disposal location.

Dear Parents!

Before experimenting, read the instructions together with your child and discuss safety with them. Check to make sure the models are properly assembled and guide your child through the experiments. We hope you and your child have a lot of fun with the experiments!

An experiment to help you hit the ground running

It all depends on the direction...
Give it a try and prepare to be surprised!

Can the wind blow backward?

WANT TO LEARN MORE?
Then come along and explore the exciting world of air...

YOU WILL NEED

- **Drive motor**
- **Propeller**
- **Battery box with switch**
- *3 x 1.5-volt batteries (type AA/LR6/penlight)*

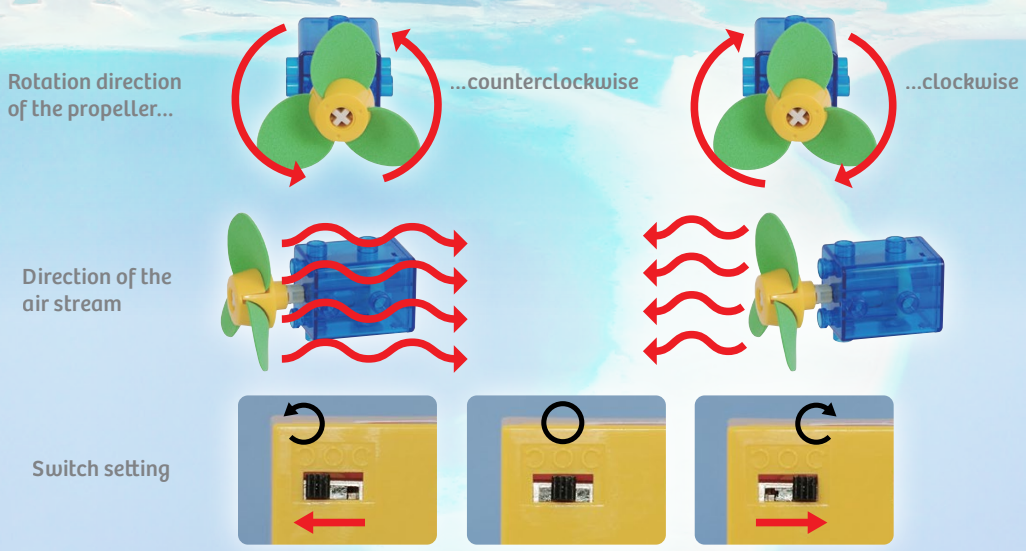
HERE'S HOW

1. Mount the propeller firmly onto the drive motor shaft.
2. Insert the three batteries into the battery box as indicated in the box.
3. Now connect the motor to the battery box with the wire.
4. Slide the battery box switch all the way to the right and then all the way to the left. Hold your hand in front of the propeller and feel what happens.

TIP !
The drive motor is always connected to the battery box with the switch. The switch lets you experiment with the air stream direction.

WHAT'S HAPPENING?

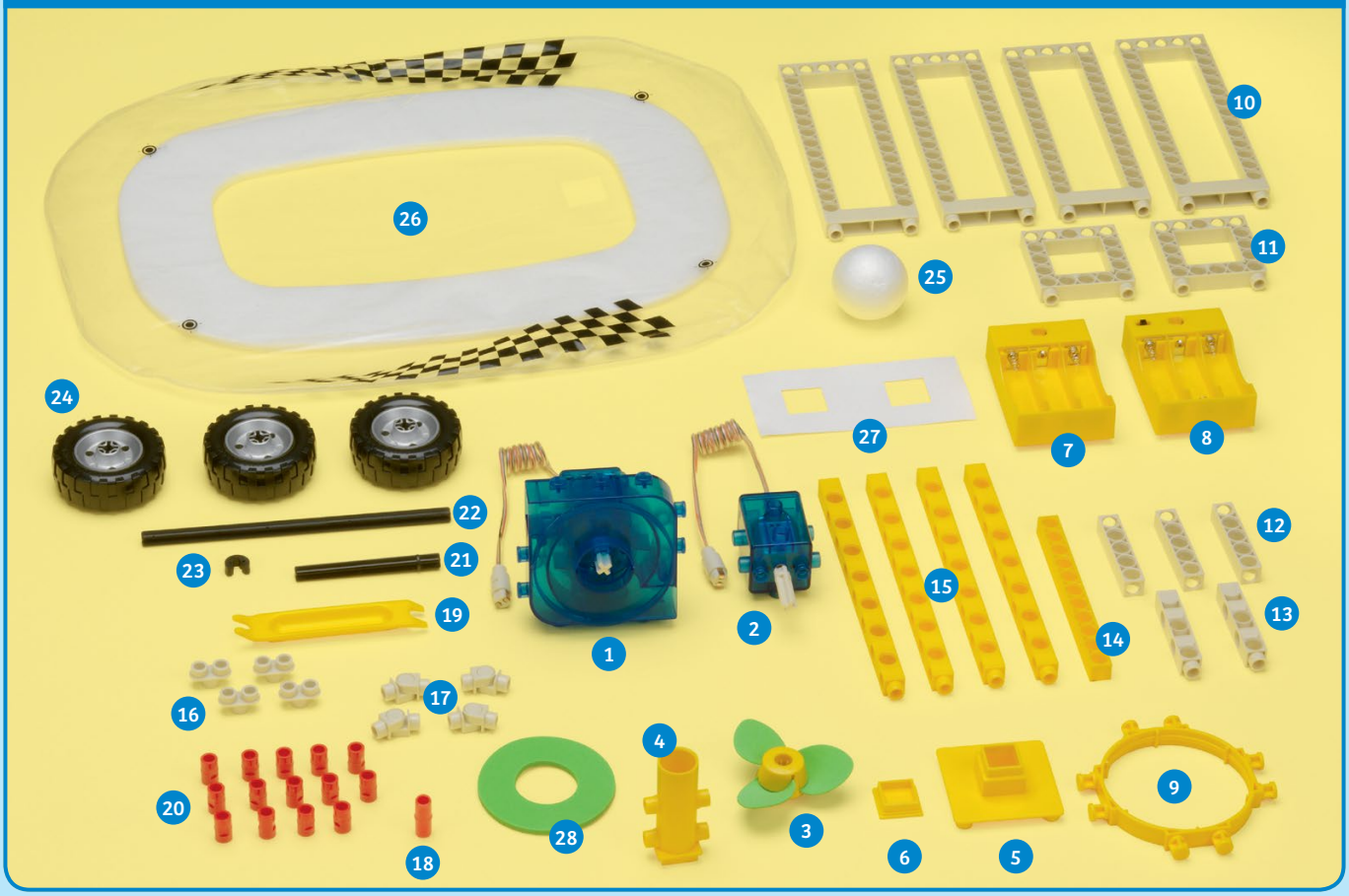
The propeller is driven by the motor and rotates at high speed. That creates a stream of air. You can change the direction of the propeller's rotation by using the battery box switch. That also changes the air stream direction. You will later be using the propeller to drive your models. Push the switch all the way to the right when you want your model to move forward.



GOOD TO KNOW! If you are missing any of the parts from the kit, call Thames & Kosmos customer service.

Any materials not included in the kit are indicated in *italic script* under the "You will need" heading.

What's Inside Your Experiment Kit:



Checklist: Find – Inspect – Check off

✔	No..	Description	Qty.	Item No.
❍	1	Air motor	1	713 636
❍	2	Drive motor	1	713 639
❍	3	Propeller	1	713 638
❍	4	Fan tube	1	713 640
❍	5	Mounting bracket	1	713 641
❍	6	Cover	1	713 642
❍	7	Battery Box	1	713 647
❍	8	Battery Box with switch	1	713 646
❍	9	Ring	1	712 982
❍	10	Long frame	4	703 239
❍	11	Square frame	2	705 016
❍	12	5-hole rod	3	704 063
❍	13	5-hole dual rod	2	705 012
❍	14	11-hole rod	1	712 986

✔	No..	Description	Qty.	Item No.
❍	15	Long rod	4	707 046
❍	16	Two-to-one converter	4	705 010
❍	17	Hinge	4	705 011
❍	18	Joint pin	1	702 524
❍	19	Part separator tool	1	702 590
❍	20	Anchor pin	14	702 527
❍	21	Axle	1	713 490
❍	22	XL axle	1	703 518
❍	23	Axle lock	1	702 813
❍	24	Wheel	3	712 336
❍	25	Polystyrene ball	1	713 645
❍	26	Air cushion	1	713 637
❍	27	Double-sided stickers	1	713 643
❍	28	Green foam rubber	1	713 644

You will also need: 6 x 1.5-volt batteries (type AA/LR6/penlight), paper, scissors, pen, tape, kitchen scale, thin books, board (about 70 x 30 cm)

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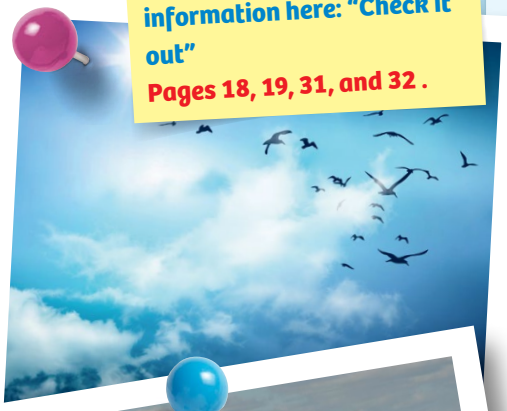
TIP !
You will find additional information here: "Check it out"
Pages 18, 19, 31, and 32 .



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Wow, air sure is strong! Here's where you'll learn about all the other things you can do with it. Lots of fun games and even a car are invited to the party.

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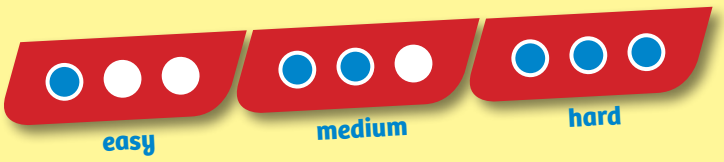
Publisher's information ..... inside back cover

TIP!

Above each model, you will find a red bar.

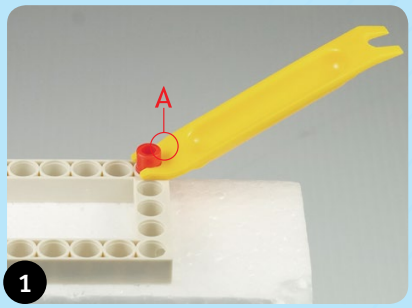
››› The bar shows you how hard the model is to assemble:

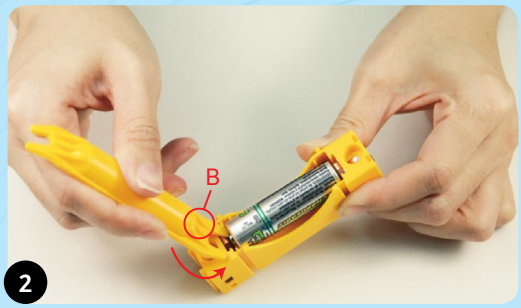


The part separator tool

In the box, you will find a small tool — the yellow part separator tool.

1. With end A of the tool, you can easily remove anchor pins.

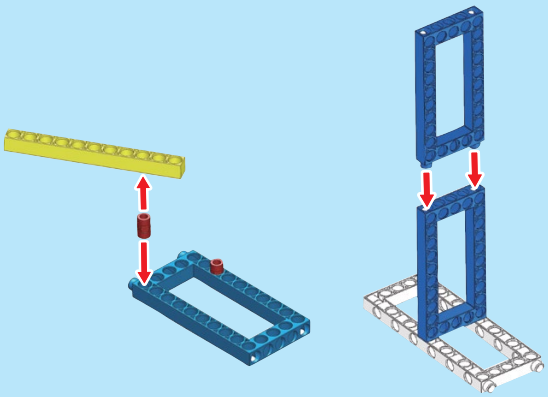




2. Use the B end of the tool to lift batteries out of the battery box.

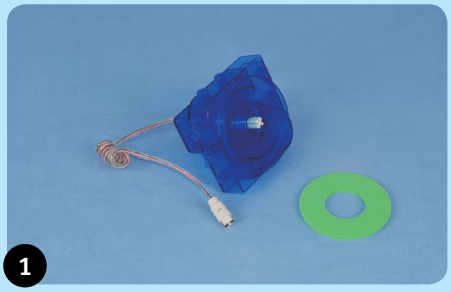
Assembling bars and frames

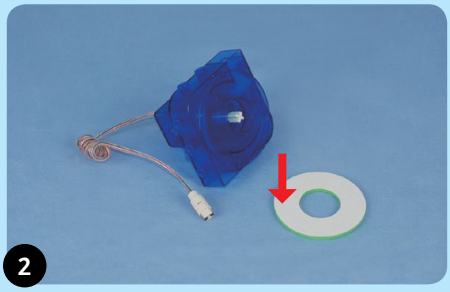
Use the anchor pins to connect bars and frames together.
Some components can also be connected without anchor pins.

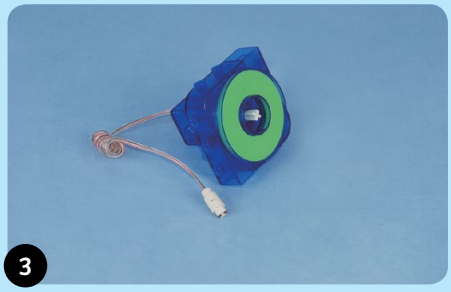


The green foam rubber

1. Find the air motor and the foam rubber in the box.
2. Remove the protective film from the rear side of the foam rubber.
3. Then stick the green foam rubber on the inside of the air motor as decoration.

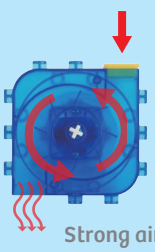




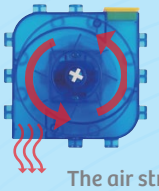


The air motor

For some of the experiments, you will need to use the cover to seal the opening at the top of the air motor.

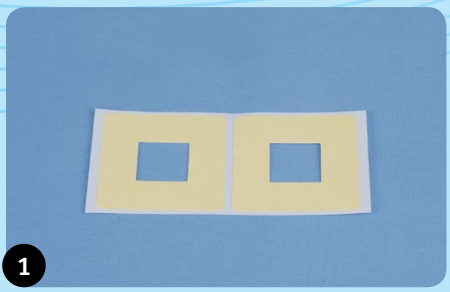


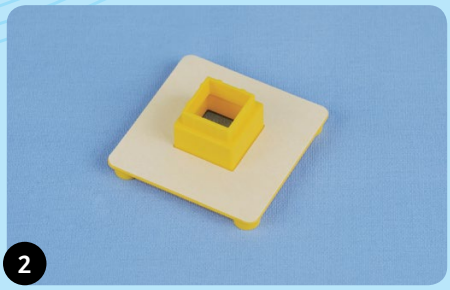
Strong air stream

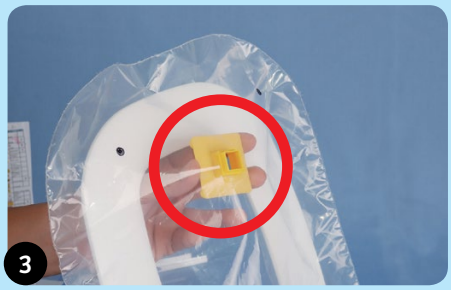


The air stream is now so strong that it makes the hovercraft levitate.

Preparing the air cushion for the hovercraft



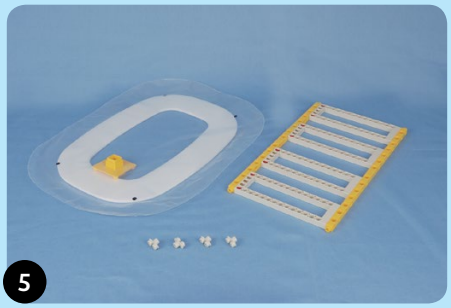


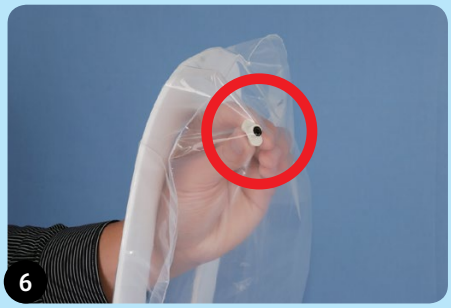


1. Find the double-sided stickers in the box and remove one of the stickers from its film backing.

2. Stick it onto the mounting bracket. Then remove the top layer of protective film.

3. Insert the bracket from underneath through the opening in the air cushion and into the square hole.



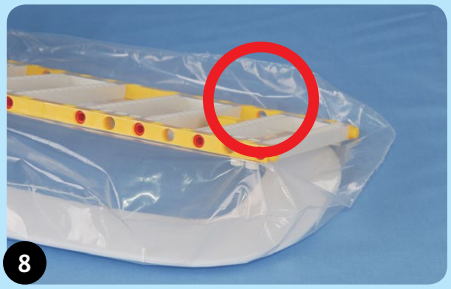


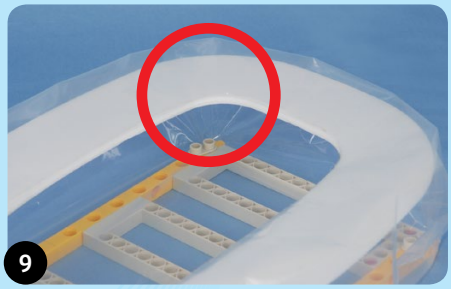
4. The bracket base is now stuck to the air cushion from the inside.

You can now move on to constructing the hovercraft, models 1 through 6, on the following pages. Return to these instructions when it is time to attach the air cushion to the frame.

5. Once you have built your hovercraft frame (see page 7), find the four two-to-one connector pieces.

6. Take one two-to-one connector piece and guide it through the opening in the air cushion. The head of the two-to-one connector should now lie on the black dot.



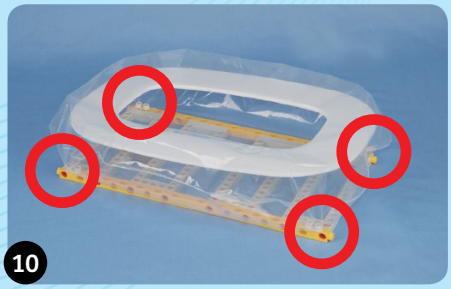


7. Connect the frame to the air cushion by pushing the head of the two-to-one connector piece and the film with the black dot into the hole in the frame. The assembly instructions for models 1 to 6 will tell you which one is the right hole.

8. This is how the connection looks from the outside...

9. ...and this is how it looks from the inside.

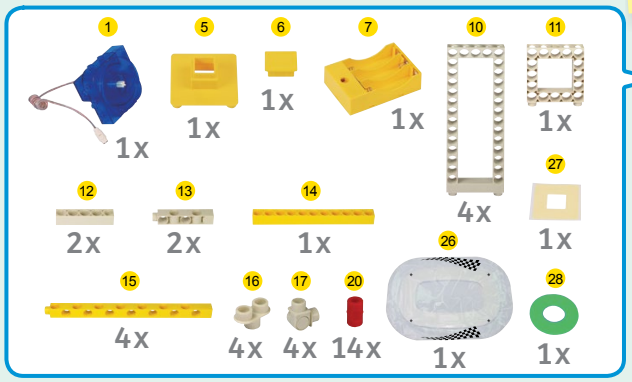
10. Proceed exactly the same way with the other three two-to-one connector pieces. Now attach the frame to the air cushion at all four corners.



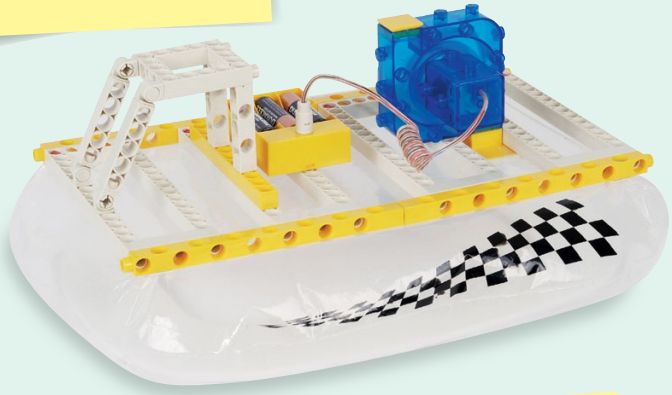
Hovercraft

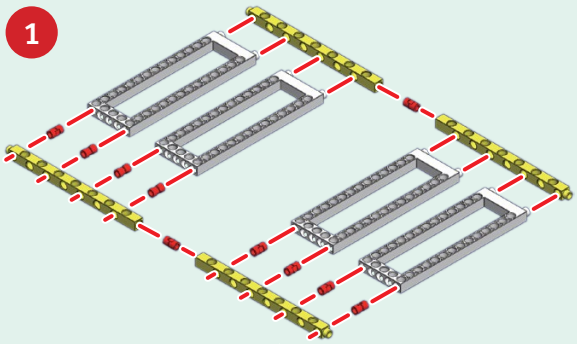
What would it be like to float gently on nothing but air? Over land, ice, or even water? You will be building a model that works just like a full-sized hovercraft — also known as an amphibious vehicle. Like an amphibian such as a frog or salamander, this kind of craft can travel on land as well as in water. In this chapter, you will learn how a hovercraft works.

HOVERCRAFT

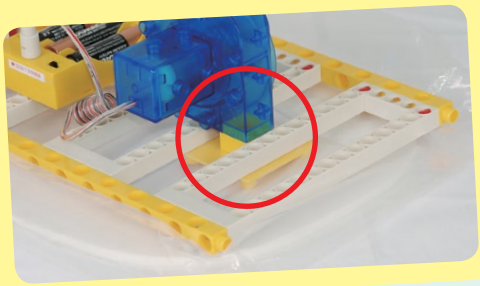


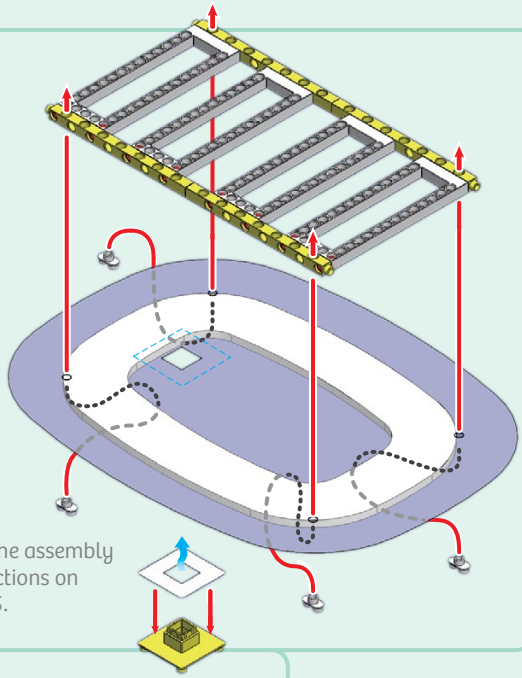
TIP !
You can drive it on land or in the bathtub!



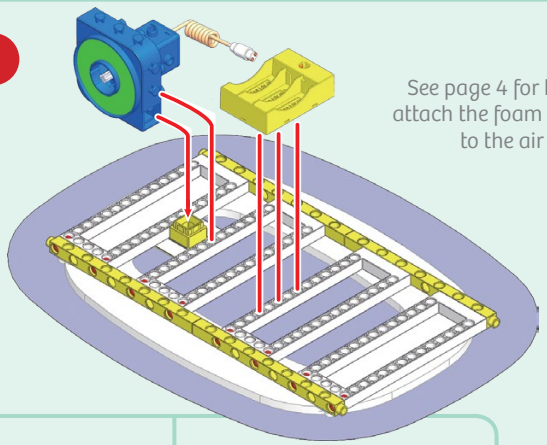


TIP !
Be sure that the parts are firmly connected at this location, so no air escapes and the hovercraft can float.

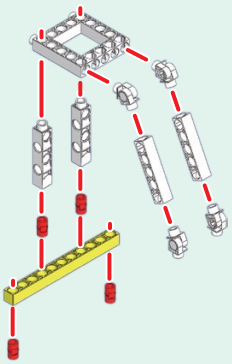


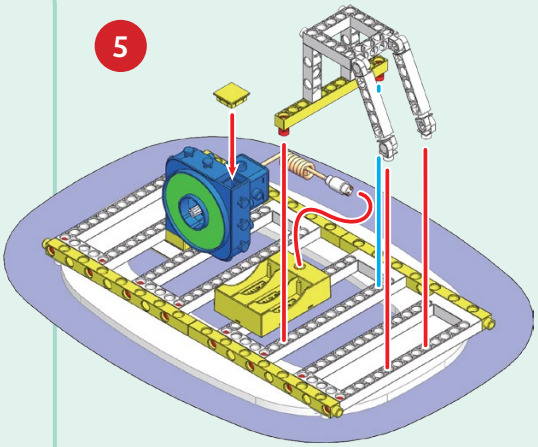


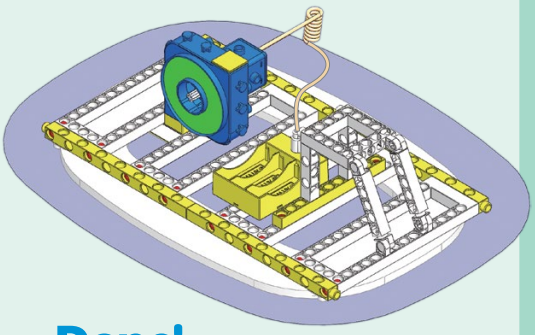
Note the assembly instructions on page 5.



See page 4 for how to attach the foam rubber to the air motor.







Done!

EXPERIMENT 1

How does a hovercraft work?

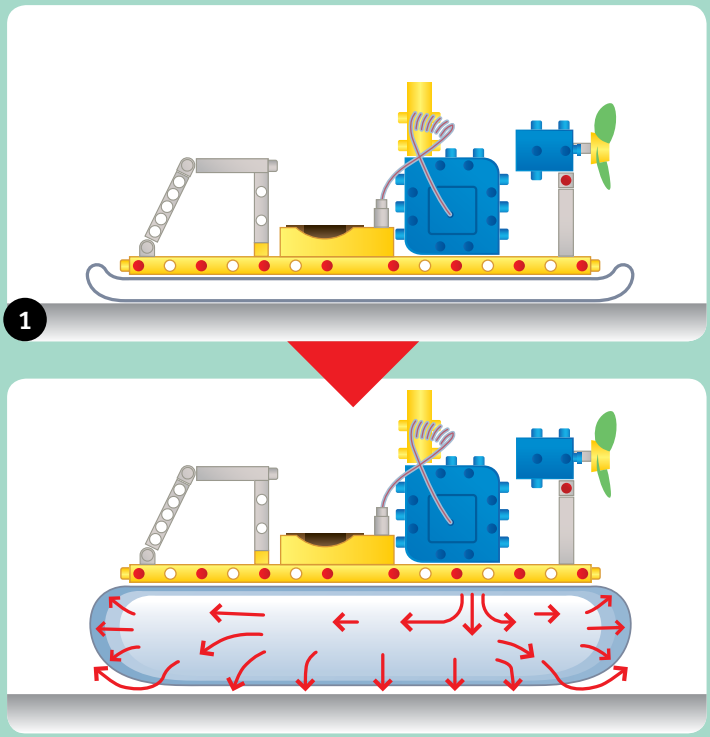
YOU WILL NEED

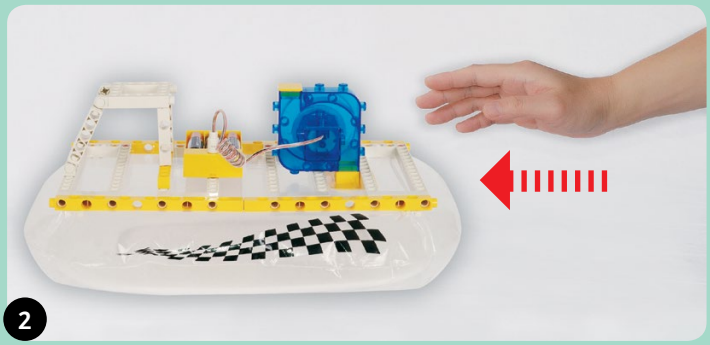
› **The assembled hovercraft**
› *3 x 1.5-volt batteries (type AA/LR6/penlight)*

HERE'S HOW

1. When you insert the batteries into the battery box, the motor will pump air under the boat. The air cushion (plastic skirt) then fills with air, and the craft rises up. Since the air can escape from all sides equally, the entire craft floats across the ground on a thin layer of air.

2. You can gently nudge the craft to make it hover off in whatever direction you want. On smooth ground, such as hardwood floor, the craft works particularly well. If you try it over a carpet, you will notice that the motor's power isn't quite enough to make the craft hover very effectively.





DID YOU KNOW...

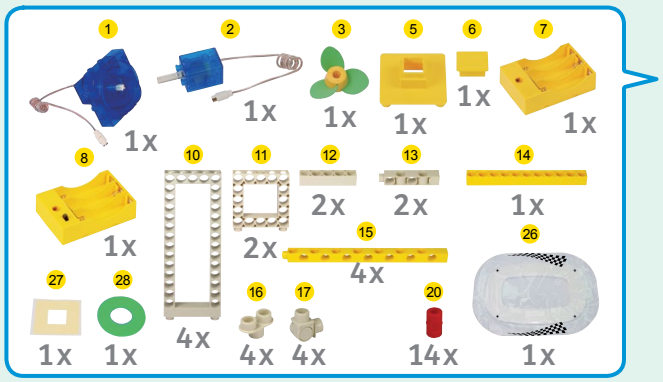
This kind of craft is also known as an air-cushion vehicle, since it floats on a cushion of air.

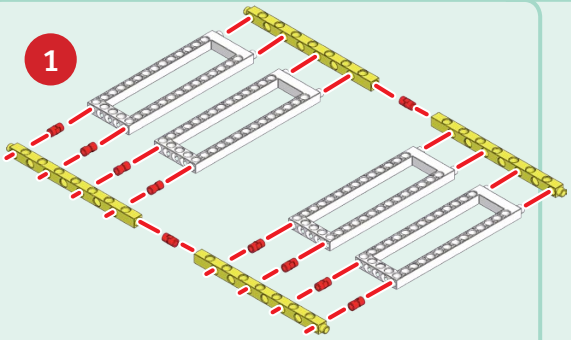
WHAT'S HAPPENING?

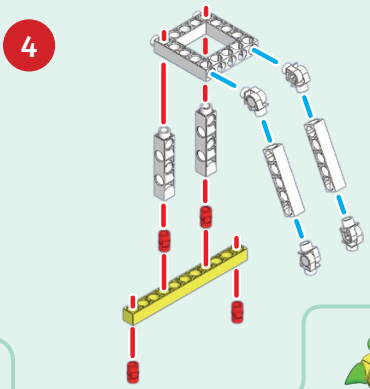
As long as the air can escape equally on all sides from beneath the hovercraft, it keeps hovering. But if you lift up on some part of the craft, more air suddenly escapes from that area. That disrupts the film of air and the plastic skirt drops directly onto the ground. Then the air escapes out from the plastic skirt as well, and the craft sinks. When you let go, everything fills with air again and the craft resumes its hovering.

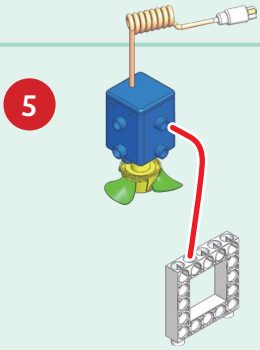
PROPELLER-HOVERCRAFT

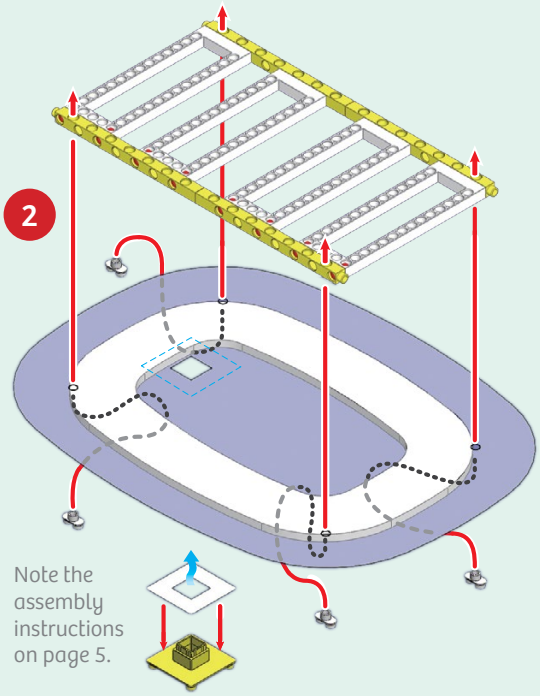
TIP!
Drive it on land or in the bathtub!











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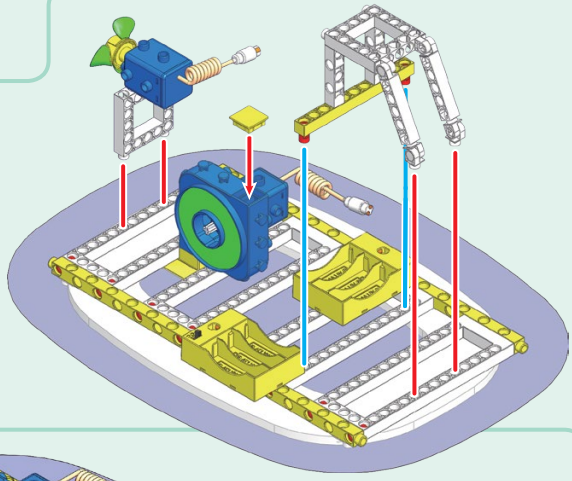

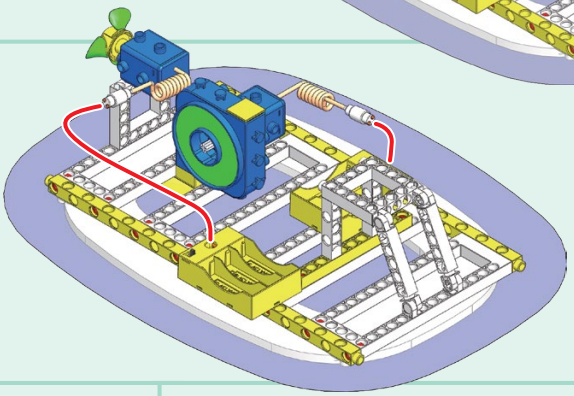

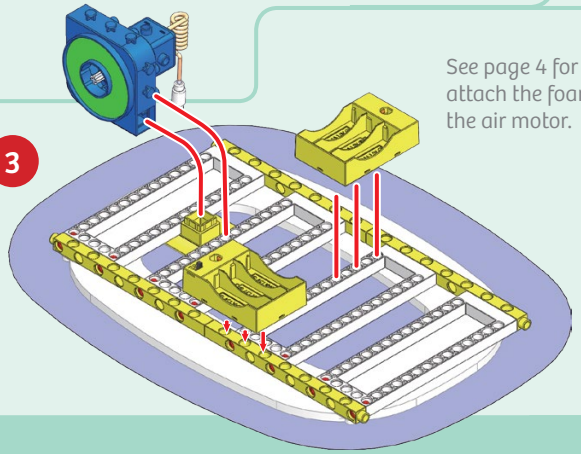

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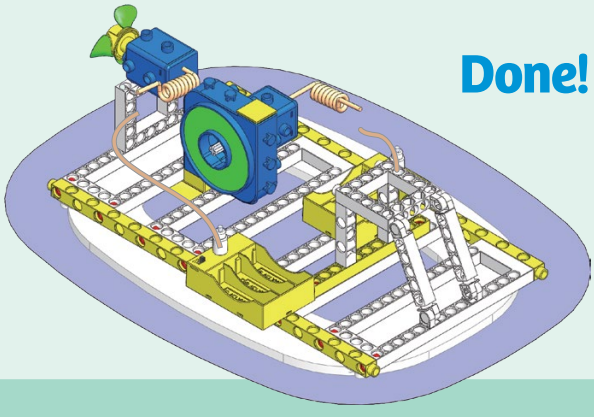


Done!

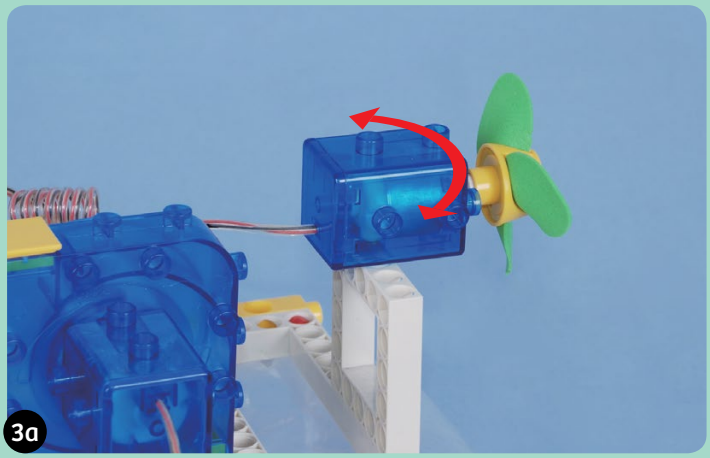
Driving with the propeller

YOU WILL NEED

› **The assembled hovercraft**
› *6 x 1.5-volt batteries (type AA/LR6/penlight)*

HERE'S HOW

1. Insert the batteries into the battery boxes.
2. Once the air motor has lifted up the hovercraft, switch on the drive motor at the second battery box. Starting from the "off" center position, move the switch first to one side and then to the other. You will see how the craft moves forward on one setting and backward on the other.
3. If you try turning the propeller to the left or the right relative to its straight starting position, the craft will turn in a circle to the right or the left. It will still move forward or backward depending on the switch setting.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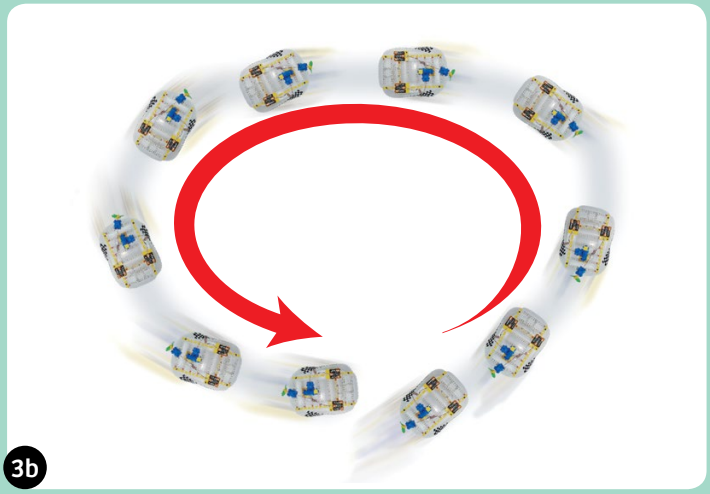
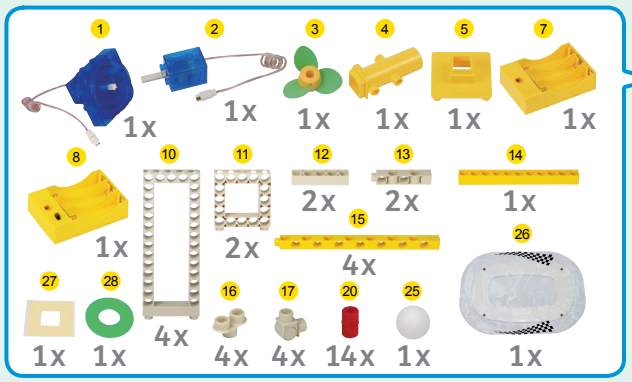

3b

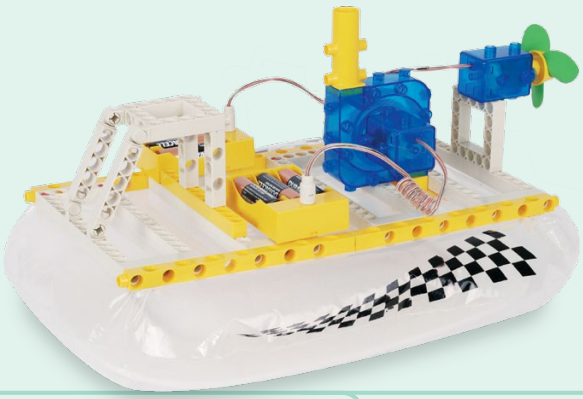
WHAT'S HAPPENING?

Instead of pushing the craft with your finger (as in Experiment 1), you can let the work be done by the drive motor and its propeller. In principle, this is exactly the same way that a big hovercraft works. Depending on the switch setting, the propeller turns clockwise or counterclockwise. That results in the air either getting sucked in (reverse direction) or pushed away (forward direction).

FLOATING BALL

TIP!
Operate it on land!





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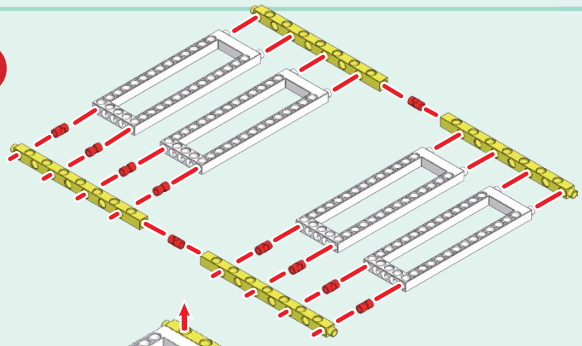

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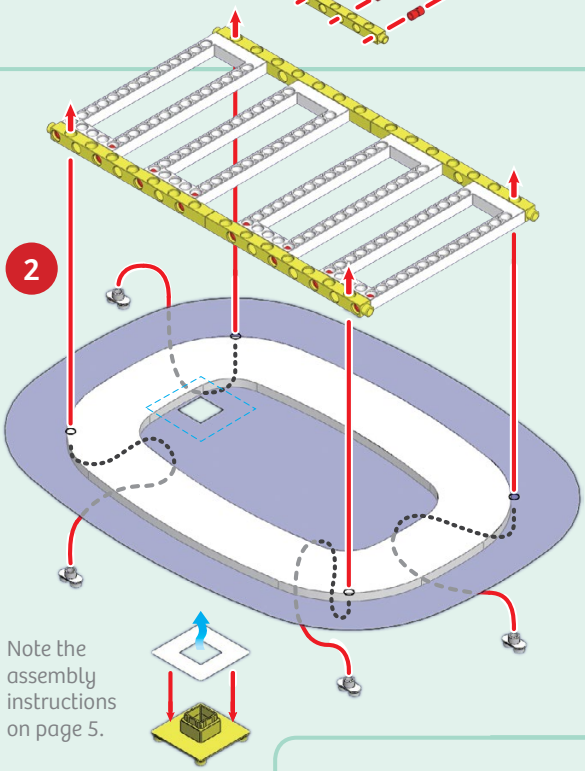
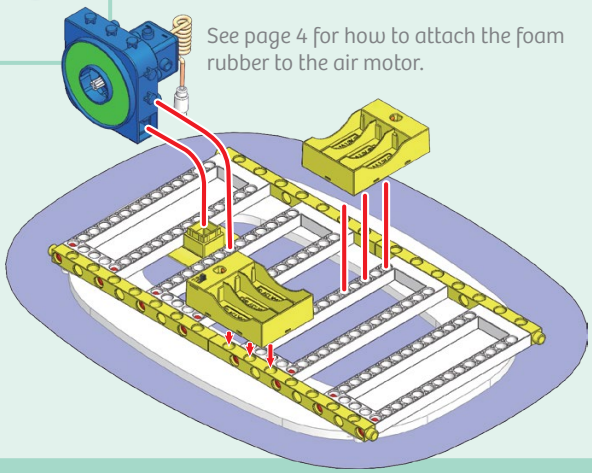


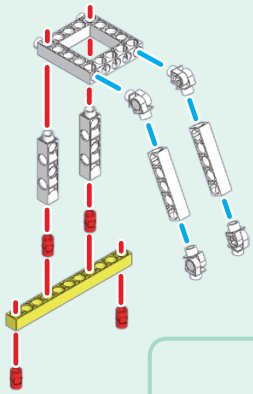
Note the assembly instructions on page 5.

3



See page 4 for how to attach the foam rubber to the air motor.

4



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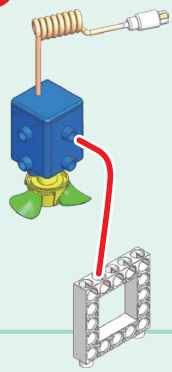

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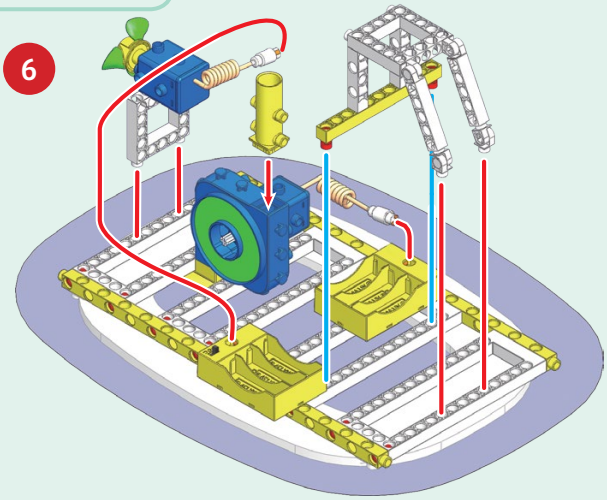

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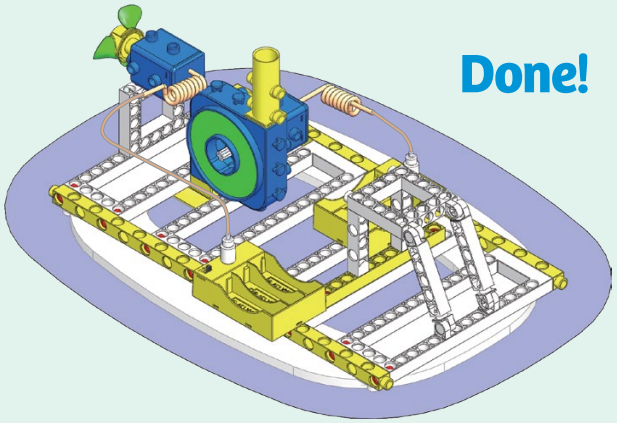


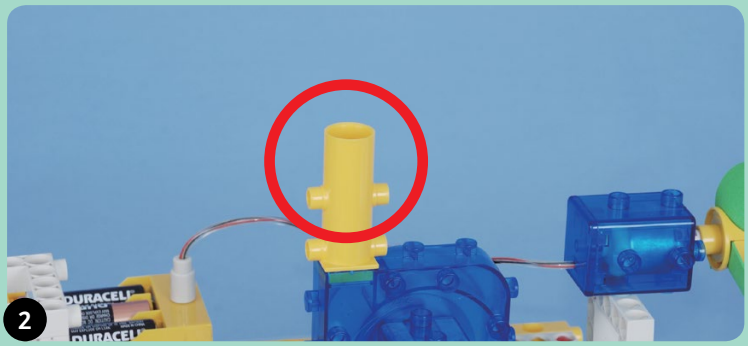
Magic ball on a stream of air

YOU WILL NEED

› **The assembled hovercraft**
› *6 x 1.5-volt batteries (type AA/LR6/penlight)*
› *1 board for a ramp (about 30 cm wide and 60 – 80 cm long)*

HERE'S HOW

1. Insert the batteries into the battery boxes.
2. Once the air motor has lifted up the hovercraft, place the white polystyrene ball on the stream of air. The air from the air motor will lift up the hovercraft and keep the ball levitated at the same time.
3. Now place the board with one end on the hovercraft kit box and the other end on the floor. This will act as a ramp. Set the craft at the top of the ramp and place the ball on the air stream. Let the craft glide down the ramp.



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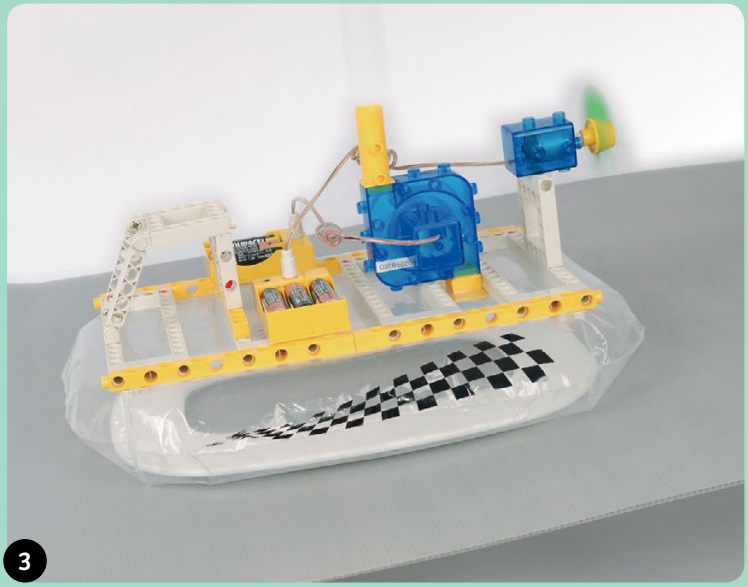
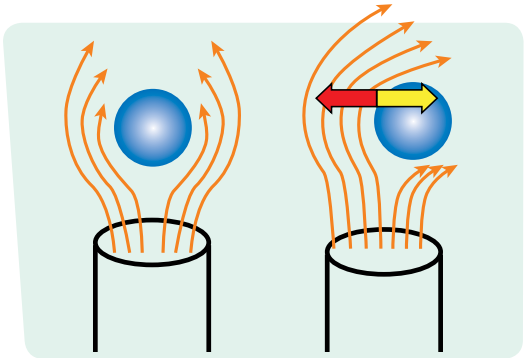

3

WHAT'S HAPPENING?

The air flows around the ball and holds it aloft, as if by invisible hands. The ball will float and sometimes dance around a little. If it does that too much, it might fall. If that happens, simply place it back on the air stream. Even when the craft glides down the ramp, the ball remains caught in the air stream.

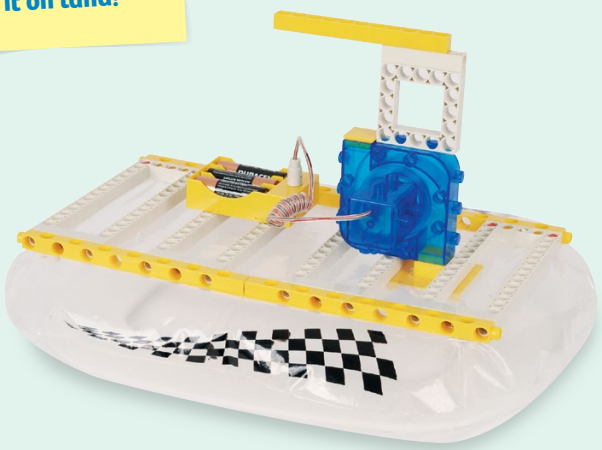


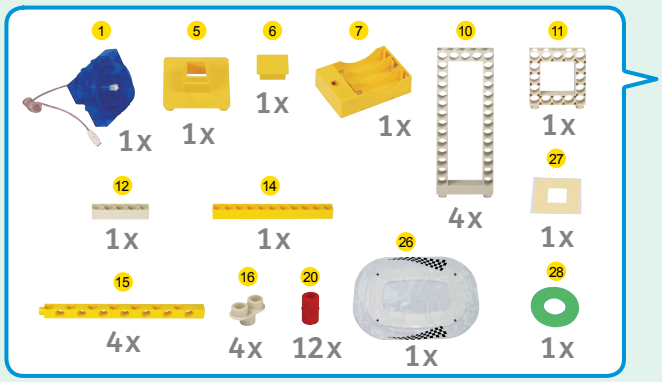
DID YOU KNOW...

The ball is held aloft by the air that flows tightly around it. This is known as the Coandă effect.

CURLING STONE

TIP!
Operate it on Land!





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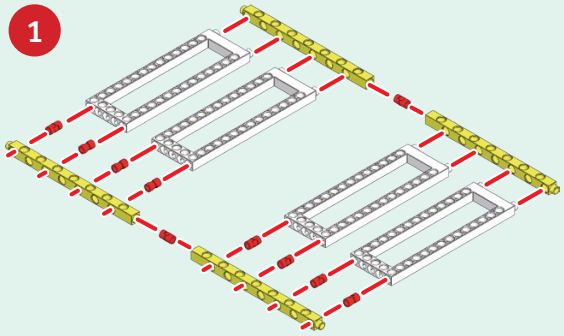

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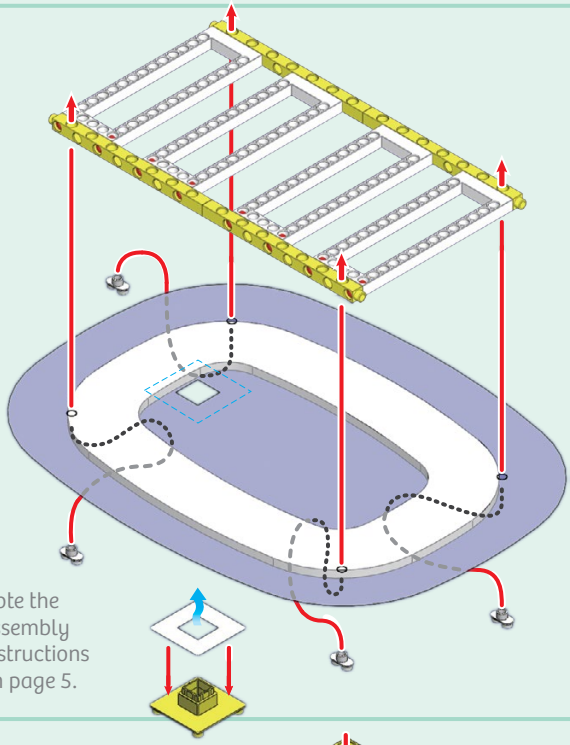
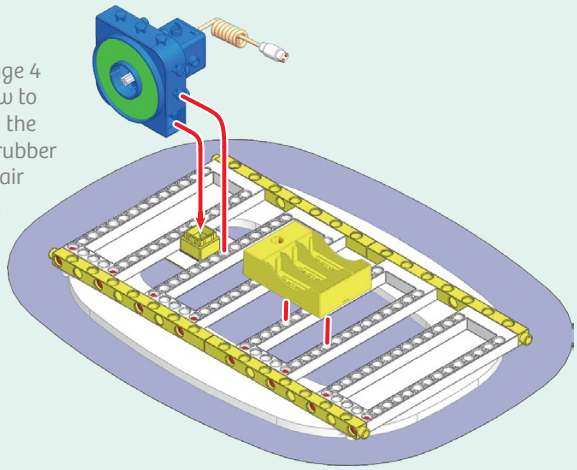


Note the assembly instructions on page 5.

See page 4 for how to attach the foam rubber to the air motor.

3



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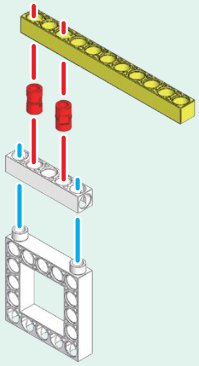

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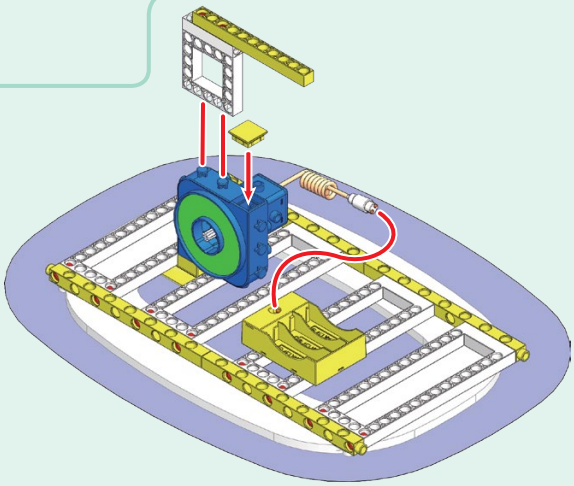
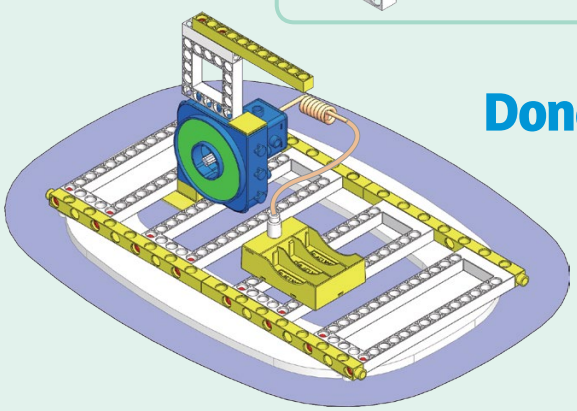
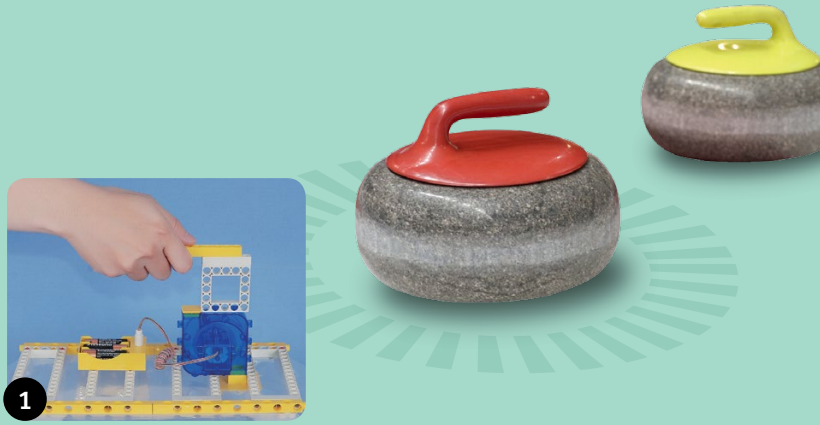




Done!

EXPERIMENT 4

Curling with the hovercraft

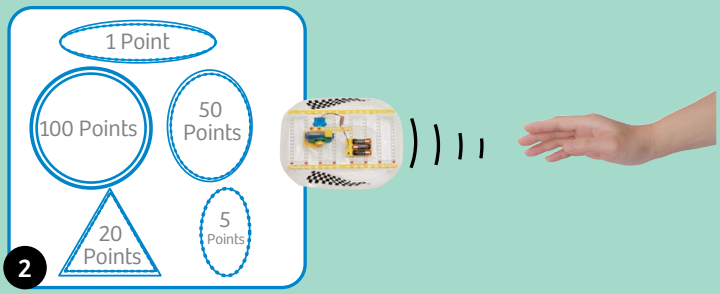


YOU WILL NEED

› **The assembled curling stone**
› *3 x 1.5-volt batteries (type AA/LR6/penlight)*
› *Paper*
› *Tape, pen, scissors*

HERE'S HOW

1. Prepare 5 panels of paper with point allocations from 1 to 100, and tape them to a smooth floor. Start up your curling stone and try to nudge it so it stops on a paper panel with the highest possible point total.



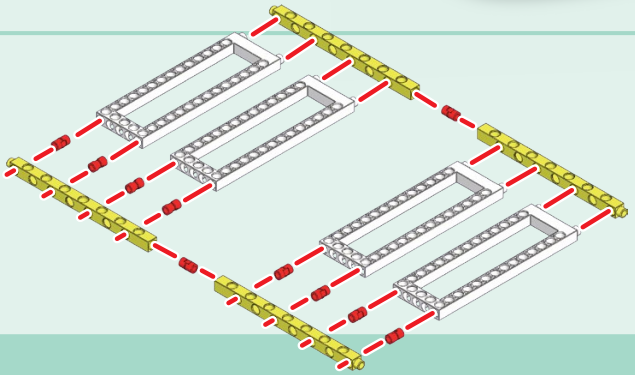
2. You will find that it is not so easy. The farther apart the paper panels lie, the easier it is to hit the one you're aiming for. Of course, it's more fun with several players. Who can get the most points?

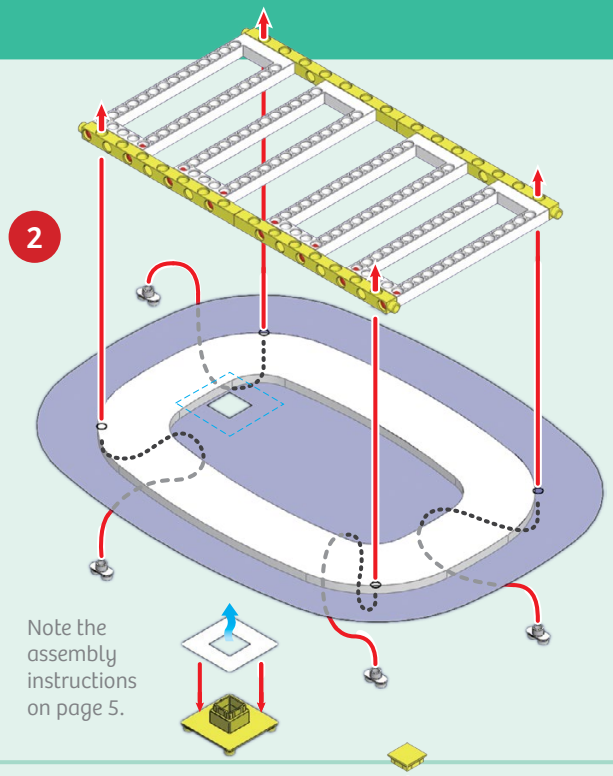
WHAT'S HAPPENING ?

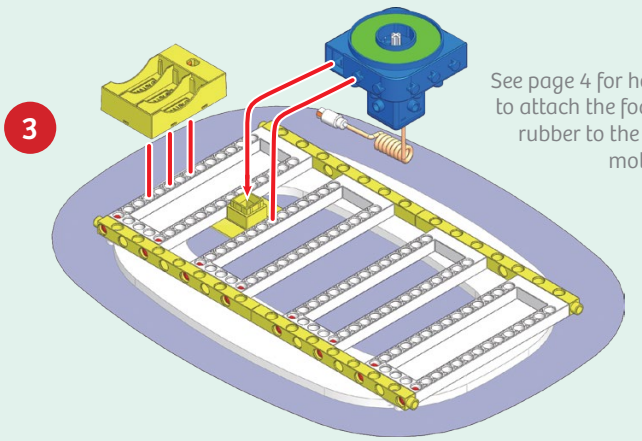
As you know, the hovercraft floats on a film of air. Just like a real curling stone on ice, your curling stone receives little resistance from the ground and can easily glide along for quite a distance. Where it comes to a stop is mostly determined by the force and direction of your push.

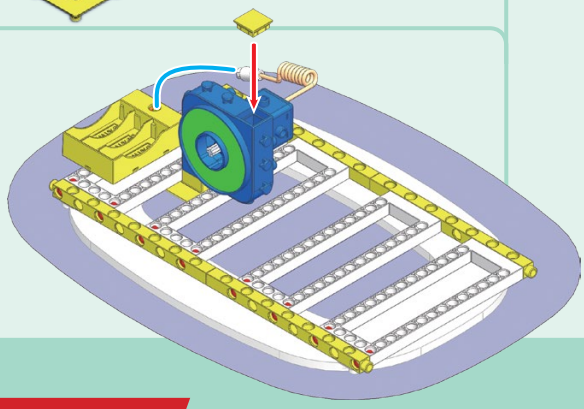
TRANSPORT HOVERCRAFT I

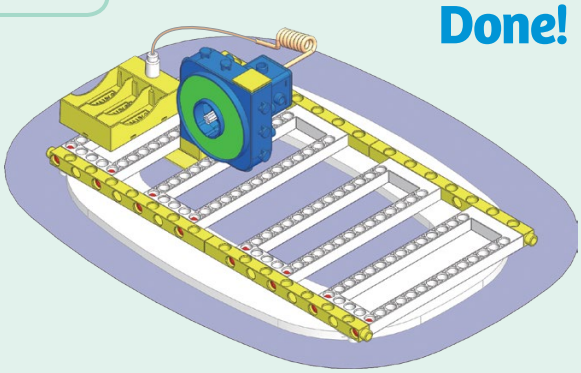
TIP !
Operate it on land!



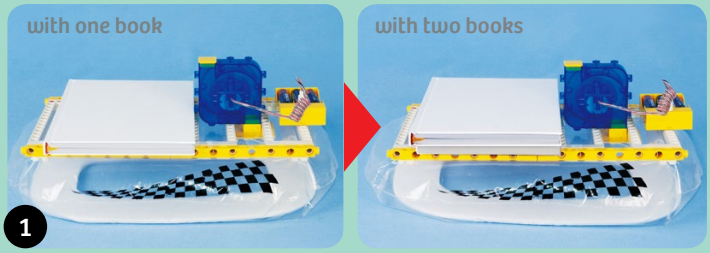








EXPERIMENT 5



How much weight can your hovercraft carry?

YOU WILL NEED

› The assembled hovercraft
› 3 x 1.5-volt batteries (type AA/LR6/penlight)
› Kitchen scale, slim books

HERE'S HOW

1. This transport hovercraft has a large surface left free for you to load your cargo. Start by inserting the batteries and load the craft with a slim book, and then with two slim books. You will notice that the more books you load, the closer to the ground it drops until it doesn't hover at all.

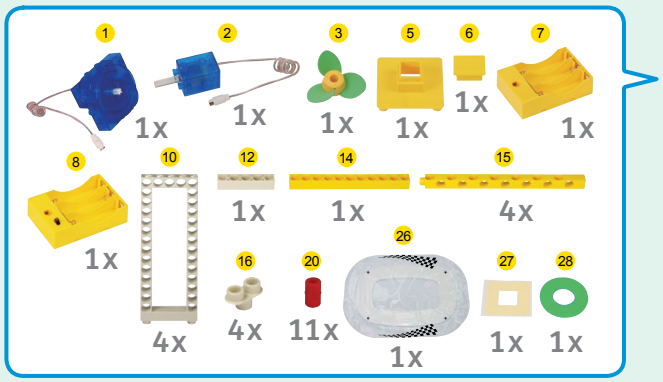
2. Your transport hovercraft isn't powerful enough for a heavier weight, like a fat dictionary. You can use your kitchen scale to determine the craft's total payload.

WHAT'S HAPPENING?

When you convert your hovercraft into a transport model, you will notice that its weight is no longer equally distributed, and the plastic skirt doesn't fill evenly with air. Then you load it with a book that is about as heavy as the air motor and batteries. That evens out the weight distribution, the air spreads out equally, and the transport hovercraft floats nicely again.

TRANSPORT HOVERCRAFT II

TIP !
Operate it on Land!



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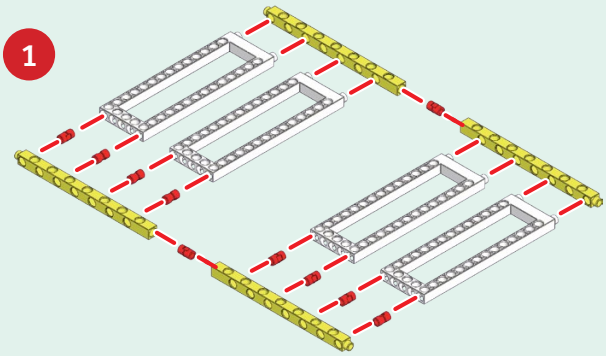

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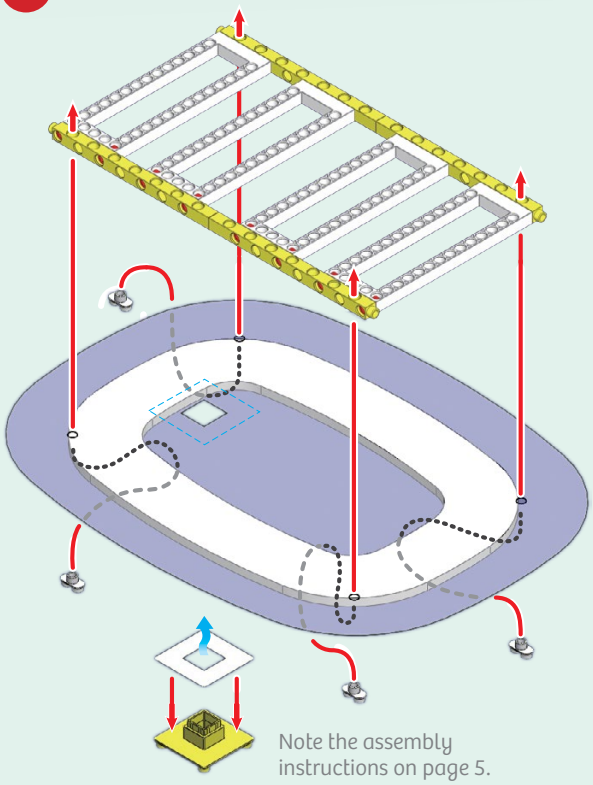
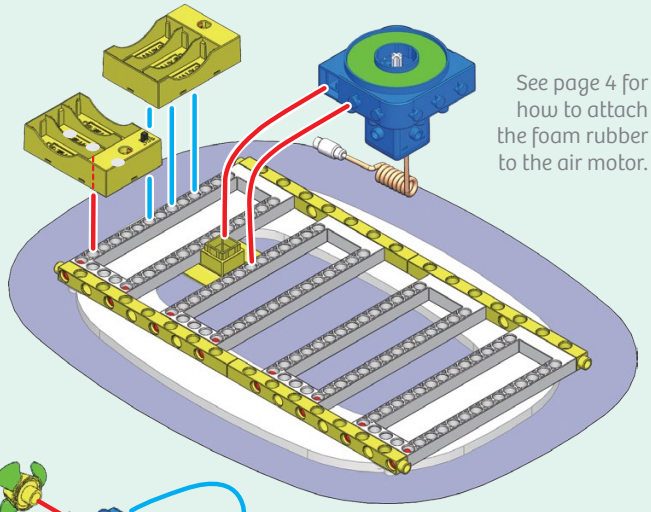


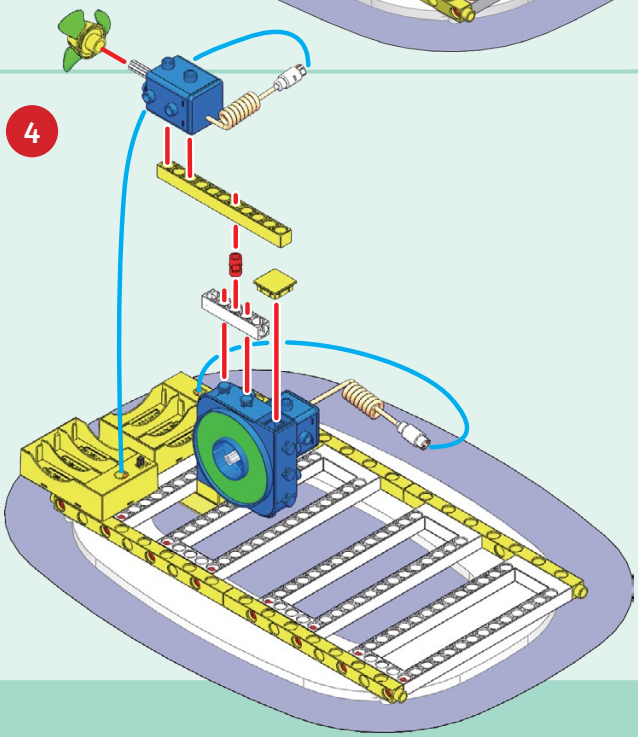
Note the assembly instructions on page 5.

3



See page 4 for how to attach the foam rubber to the air motor.

4



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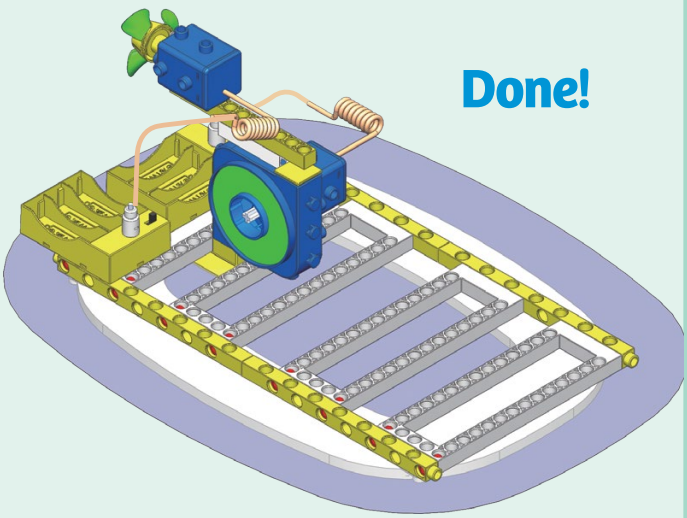
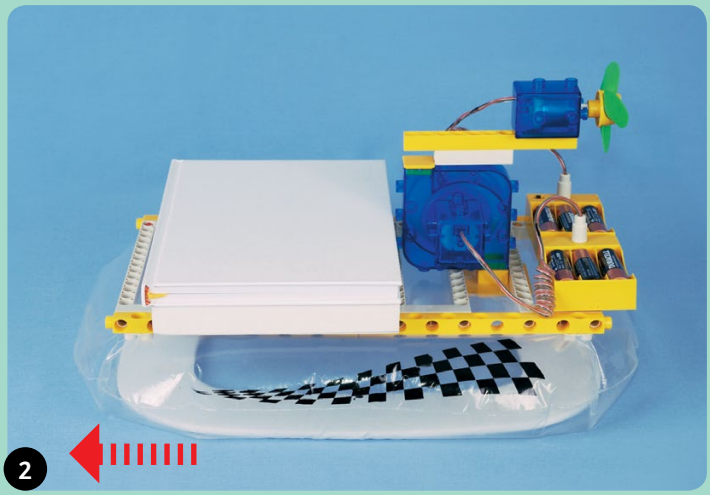


EXPERIMENT 6



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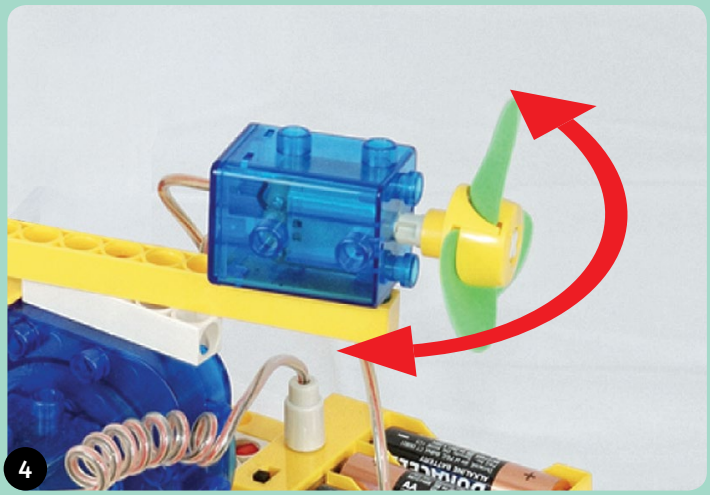


4

Transport hovercraft with propeller drive

YOU WILL NEED

› **The assembled transport hovercraft**
› *6 x 1.5-volt batteries (type AA/LR6/penlight)*
› *Kitchen scale*
› *Slim books*

HERE'S HOW

1. Insert the batteries in the battery boxes.
2. Once the air motor has lifted up the hovercraft, switch on the propeller at the second battery box. Be sure to use the right setting!
3. Hold onto the craft tightly and start by loading it with one thin book. Then load a second one. Can the propeller still move the loaded craft?
4. You can control the craft's direction by turning the motor.

WHAT'S HAPPENING?

As in Experiment 5, it is important to be sure that the payload weight is evenly distributed and is neither too great nor too small, which affects the craft's ability to hover. But the propeller's power has its limits, too. If you check the weight of the transported freight, then you will know the maximum payload that your craft can carry.

DID YOU KNOW...

The world's largest transport hovercraft can carry 330 tons of freight — equal to the weight of about 227 cars!

CHECK IT OUT

Hovercraft used as rescue vehicles

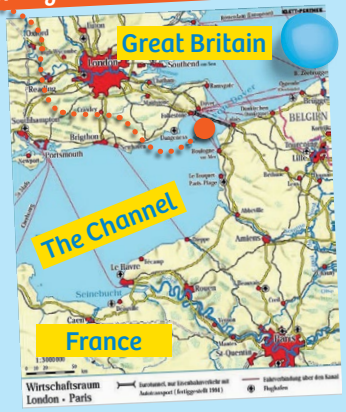
Hovercraft can cross difficult terrain, such as swamps, grassland, or ice, more easily than other vehicles and can move faster than ships on the water. Large transport hovercraft are often used to carry soldiers and armored vehicles. Smaller hovercraft are deployed as emergency rescue vehicles at sea. They are also useful for fighting fires in areas that are not easily reached from land.

CAN PEOPLE FLOAT IN THE AIR?

Of course! To do it, though, you need wind speeds of about 200 km/h, produced artificially in a wind tunnel. The stream of air comes from below and you can simply lie on top of it. This sport, known as body flying, is sometimes done as a training exercise by skydivers.

FAMOUS HOVERCRAFT

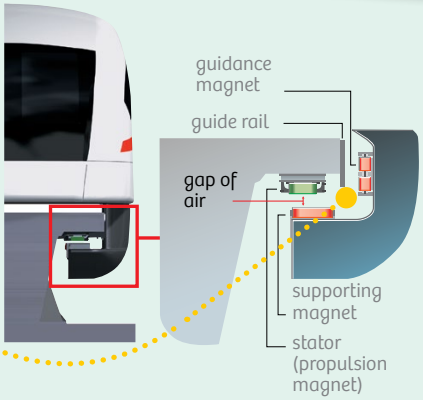
Some of the world's best-known hovercraft were the ones that provided a ferry service between Folkestone (Dover) in England and Calais in France. They were 2 to 3 times faster than ordinary ferries. Since 1994, however, there has been a train tunnel under the English Channel. The hovercraft just couldn't compete with this fast and convenient train connection, so they stopped service in the year 2000.



CHECK IT OUT

Levitating trains?

The first hovertrain to become really well known was the French Aérotrain, which was first tested in 1965. It never actually caught on though. Since then, magnetic levitation, or maglev, trains have been developed around the world. Many countries have maglev train test facilities, and Japan and China have maglev train systems actually serving the public. Of course, maglev trains are held aloft by powerful magnets rather than by a cushion of air.



AIR CUSHIONS IN CARS

Almost any car today comes with air cushions — airbags! The first airbag-equipped cars appeared on the market in the 1970s. An airbag contains a gas generator that is electrically ignited when a collision occurs. The gas generator then instantly produces large quantities of gas to fill up the airbag, which protects the passengers from hitting themselves against hard parts of the car's interior. Then the gas quickly escapes again.

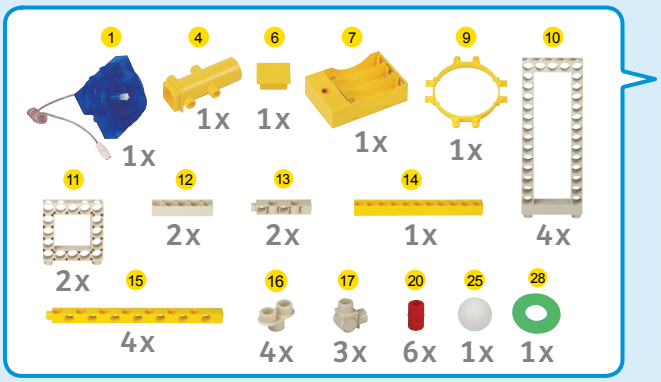
COANDĂ EFFECT WITH WATER

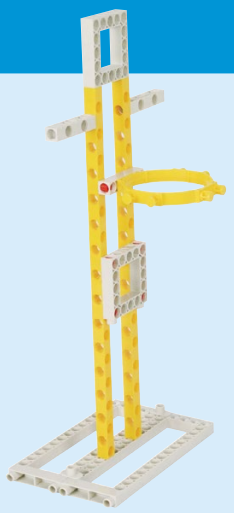
You were introduced to this effect in Experiment 3. It also works with water. Let some water run down the back side of a spoon. It sticks to the contour of the spoon instead of continuing in its initial direction of flow.

More Air-Stream Models

By now, you have gotten to know the hovercraft really well. In the next four experiments, you will be introduced to two ball machines, a carousel, and even an air-propelled race car. All of these models will teach you even more about air and how to use its powers to your advantage.

AIR BASKETBALL





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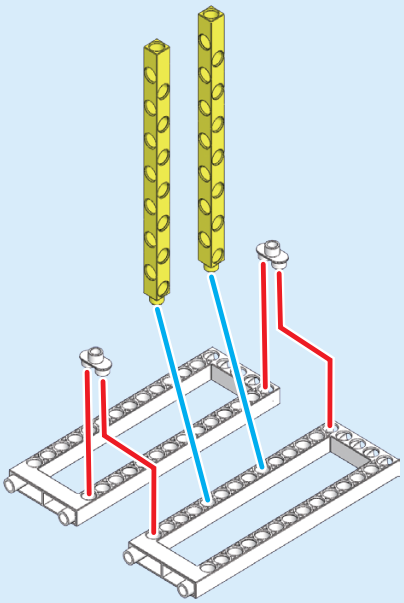

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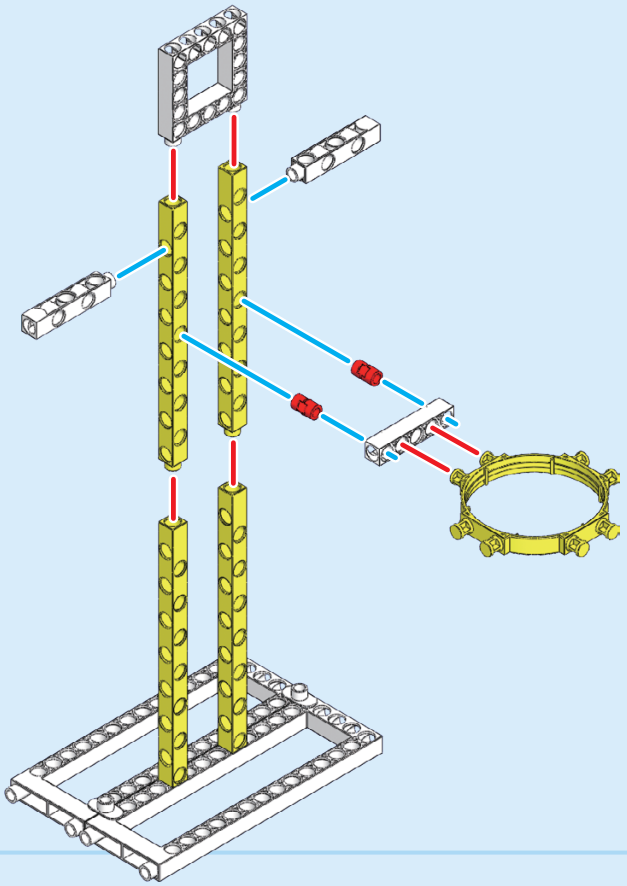

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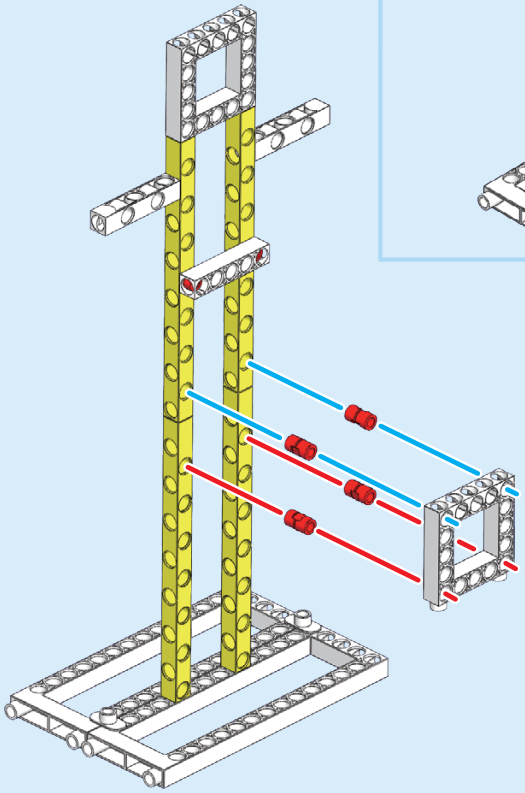

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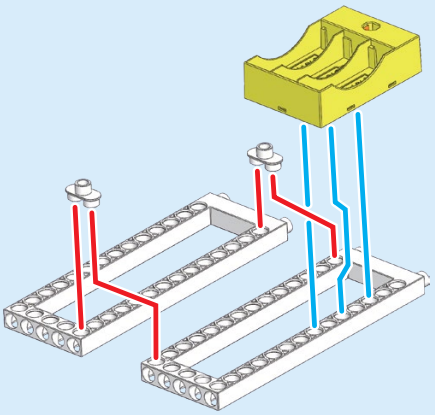

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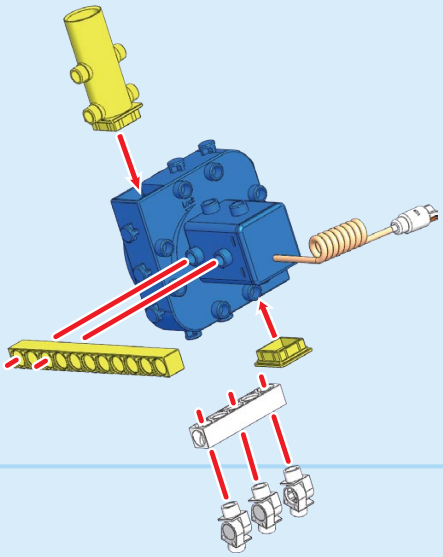

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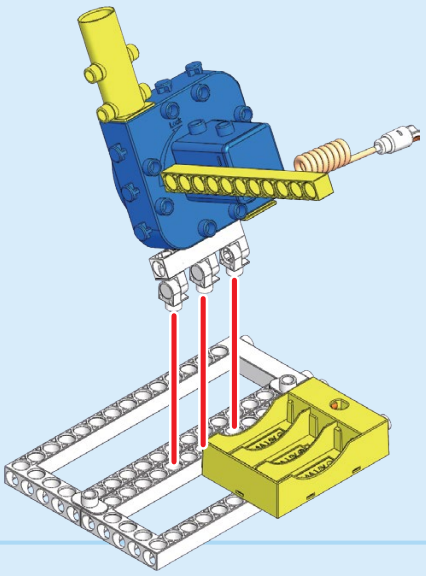

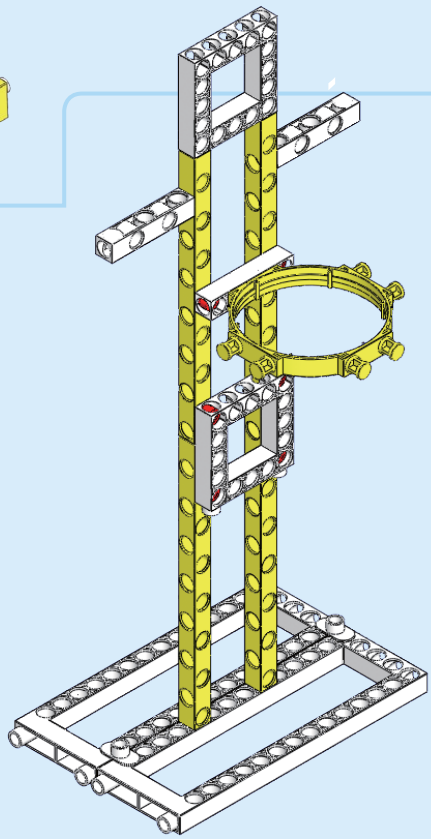

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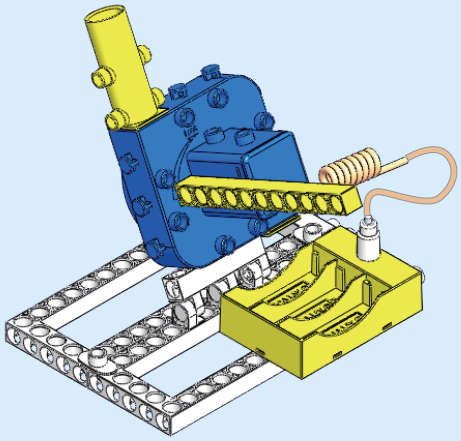
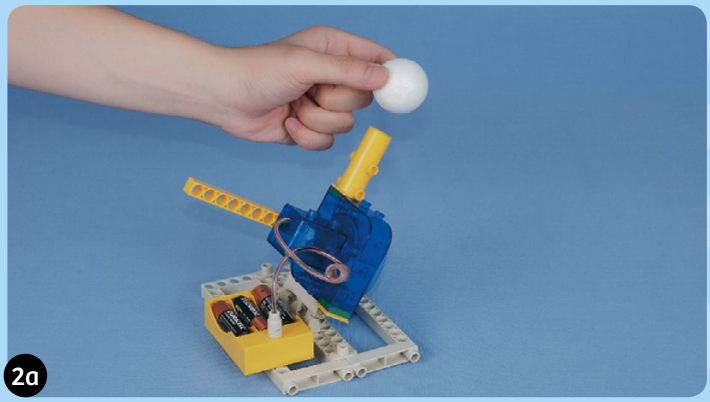


EXPERIMENT 7



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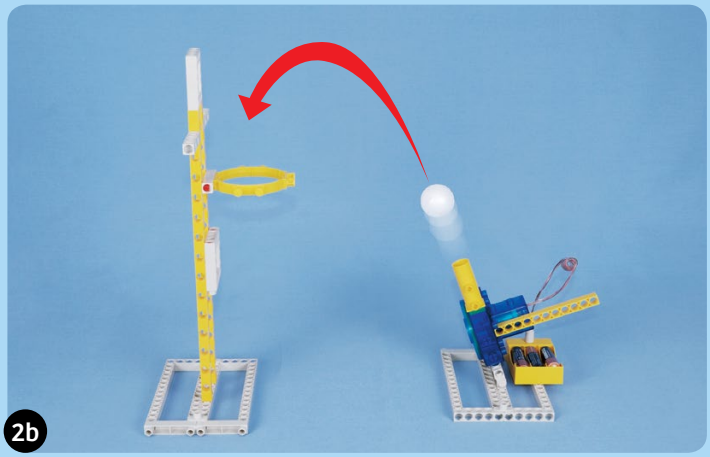

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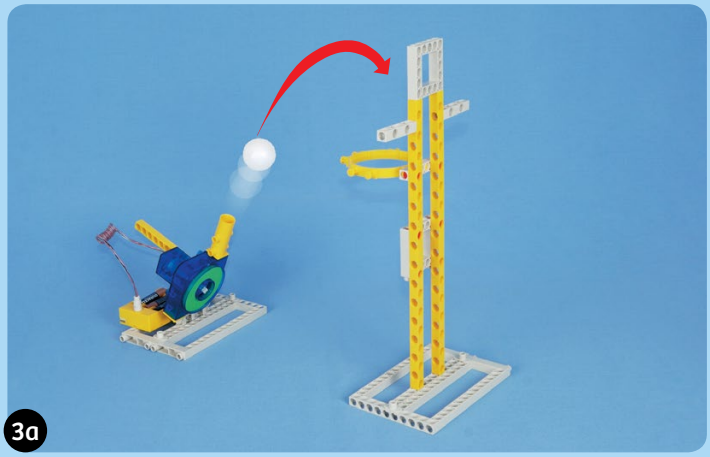

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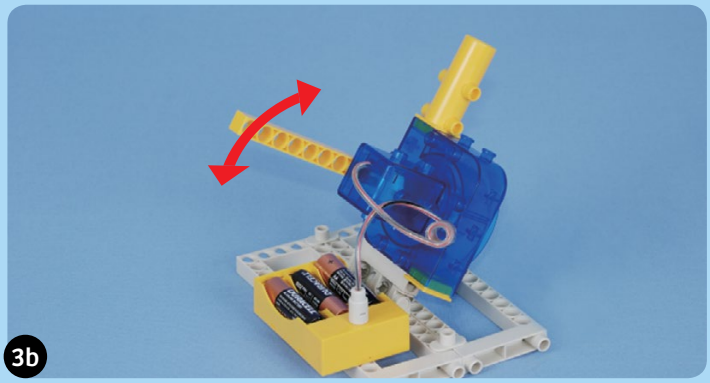


3b

Who can make the most baskets?

YOU WILL NEED

- **Ball-shooting machine and basketball basket**
- **Polystyrene ball**
- *3 x 1.5-volt batteries (type AA/LR6/penlight)*

HERE'S HOW

1. Insert the batteries as indicated in the battery box.
2. Now, hold the ball firmly between two fingers just above the opening of the air motor's fan tube. Then let it go and watch it fly — propelled by the stream of air — toward the basket.
3. You will get better at making baskets by adjusting the distance between the basket and the machine. If that still doesn't work well enough, try adjusting the angle of the air motor.

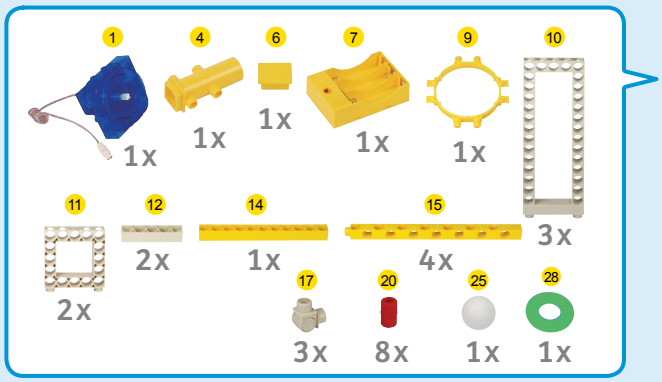
WHAT'S HAPPENING ?

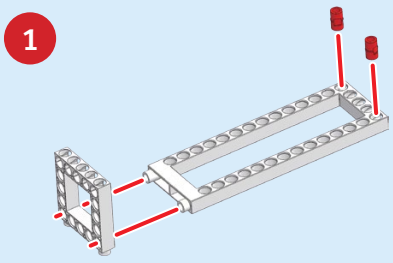
Due to the angled position of the air motor, the ball doesn't just stay captured in the stream of air as it did in Experiment 3. Instead, it breaks through the surrounding air stream and flies in a curved arc (due to Earth's gravity) back down again. If you have adjusted the ball-shooting machine at the right angle and distance from the basket, it will fly accurately through the yellow ring and you'll score two points.

DID YOU KNOW...

... that you can also refer to gravity as gravitational force or force of gravity?

BATTING MACHINE





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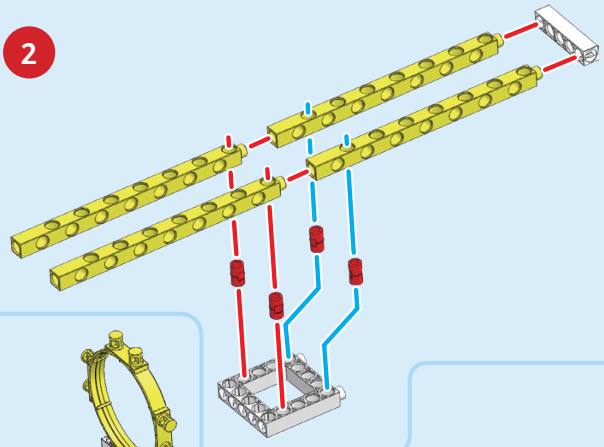

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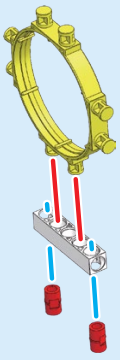

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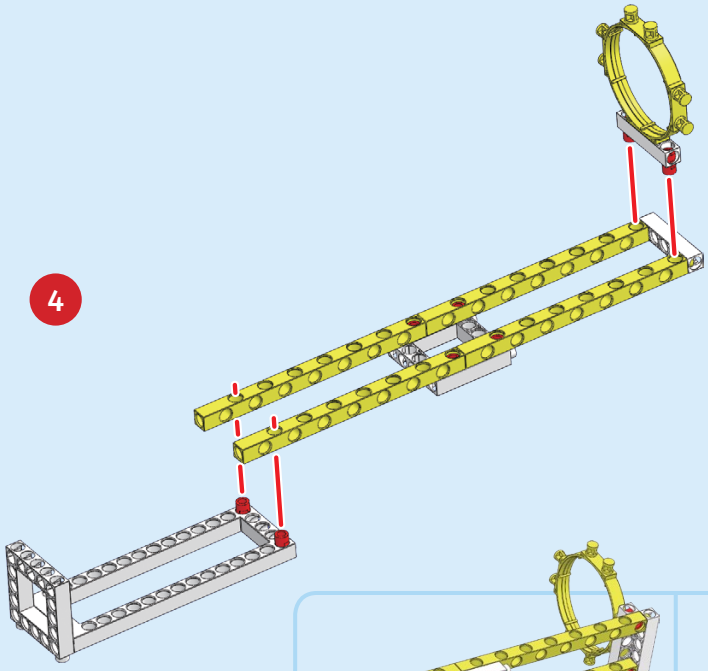

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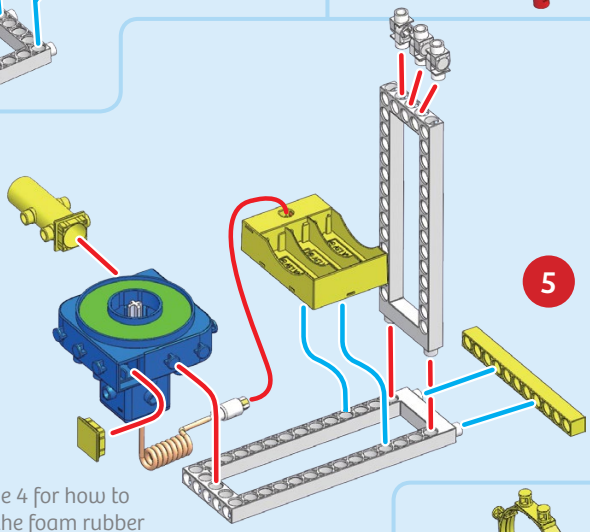

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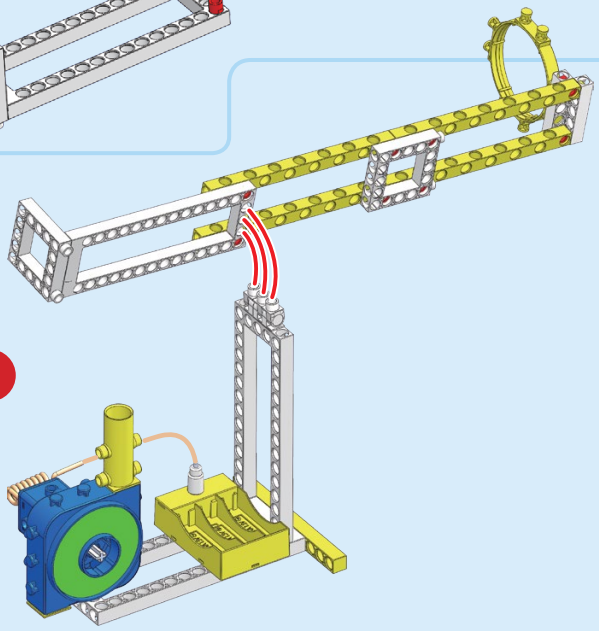
See page 4 for how to attach the foam rubber to the air motor.



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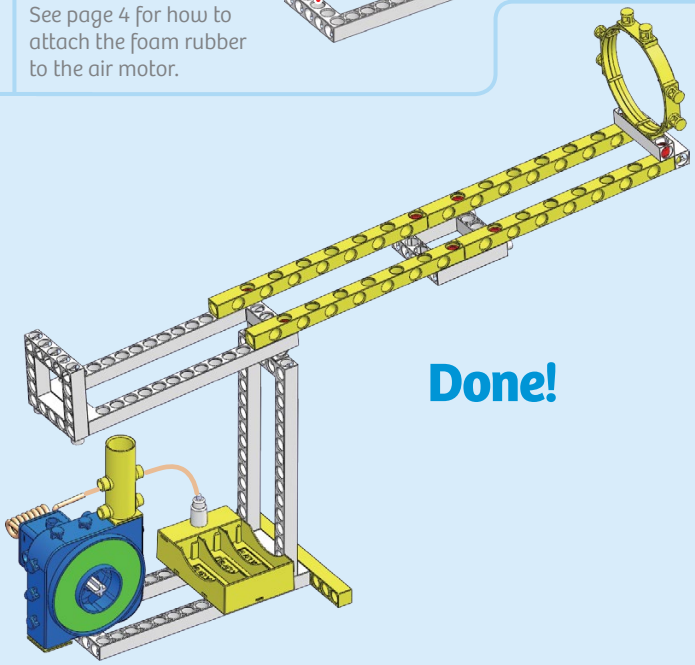

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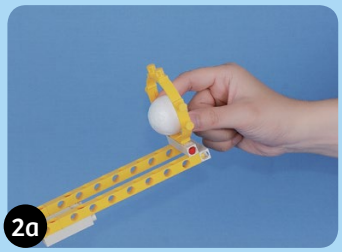
EXPERIMENT 8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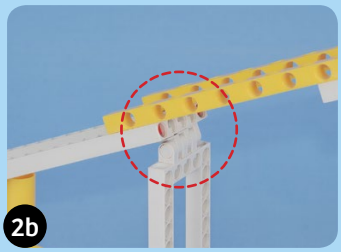
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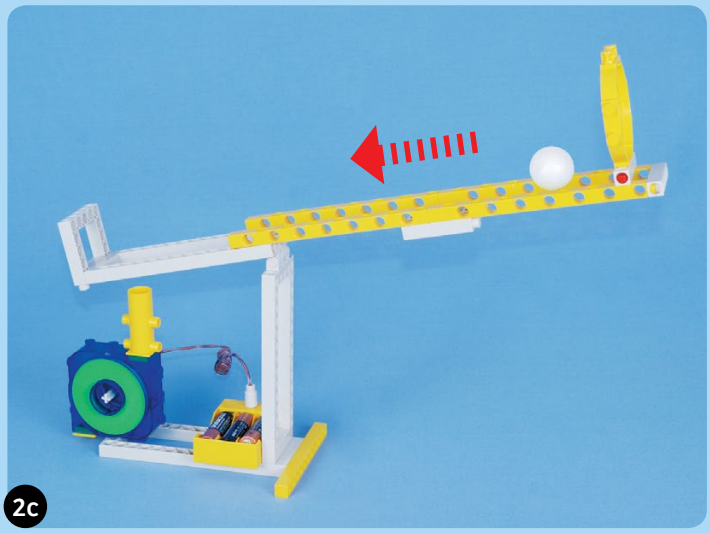
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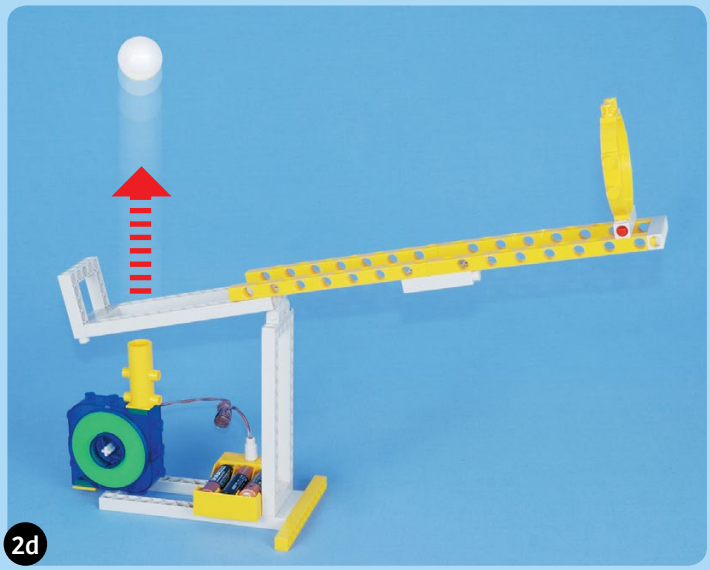
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3

A challenge of your marksmanship

YOU WILL NEED

- **Air-stream batting machine**
- **Polystyrene ball**
- *3 x 1.5-volt batteries (type AA/LR6/penlight)*
- *Sheet of paper (letter size)*

HERE'S HOW

1. Insert the batteries as indicated in the battery box.
2. Now let the white polystyrene ball roll down the ramp toward the air stream. You can adjust its speed by changing the ramp's slope. As soon as the ball reaches the air stream, it will be caught by it and shot upward.
3. You can make the experiment more interesting by rolling the sheet of paper into a sort of baseball bat and trying to hit the ball when it shoots up. It's even more fun if you hit the ball into an empty box or trash can.

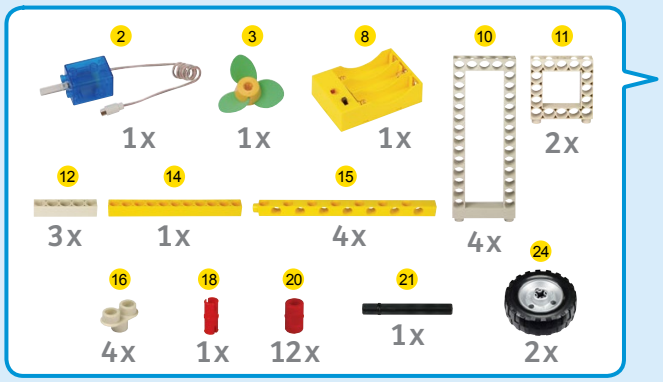
WHAT'S HAPPENING?

As the polystyrene ball is caught and surrounded by the air stream, it remains a few centimeters above the fan tube. It stays stuck there, although you will still notice it moving up and down and sideways. The stream ensures that you will always get a good pitch to hit, after a little practice at least. After a little while, you can even learn to hit it where you want it to go.

DID YOU KNOW...

Real baseballs can move extremely fast. The best professional pitchers can throw up to 161 km/h (or 100 miles an hour).

CAROUSEL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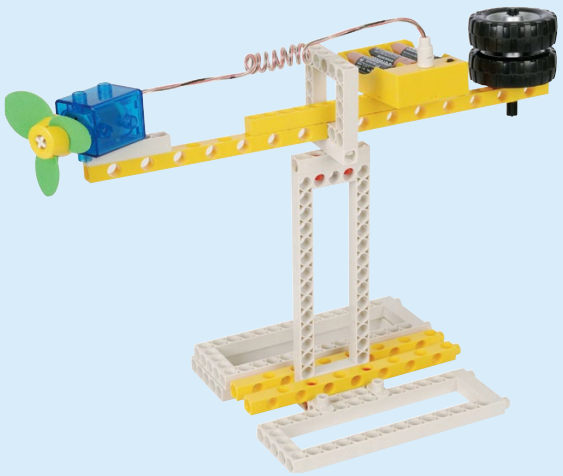

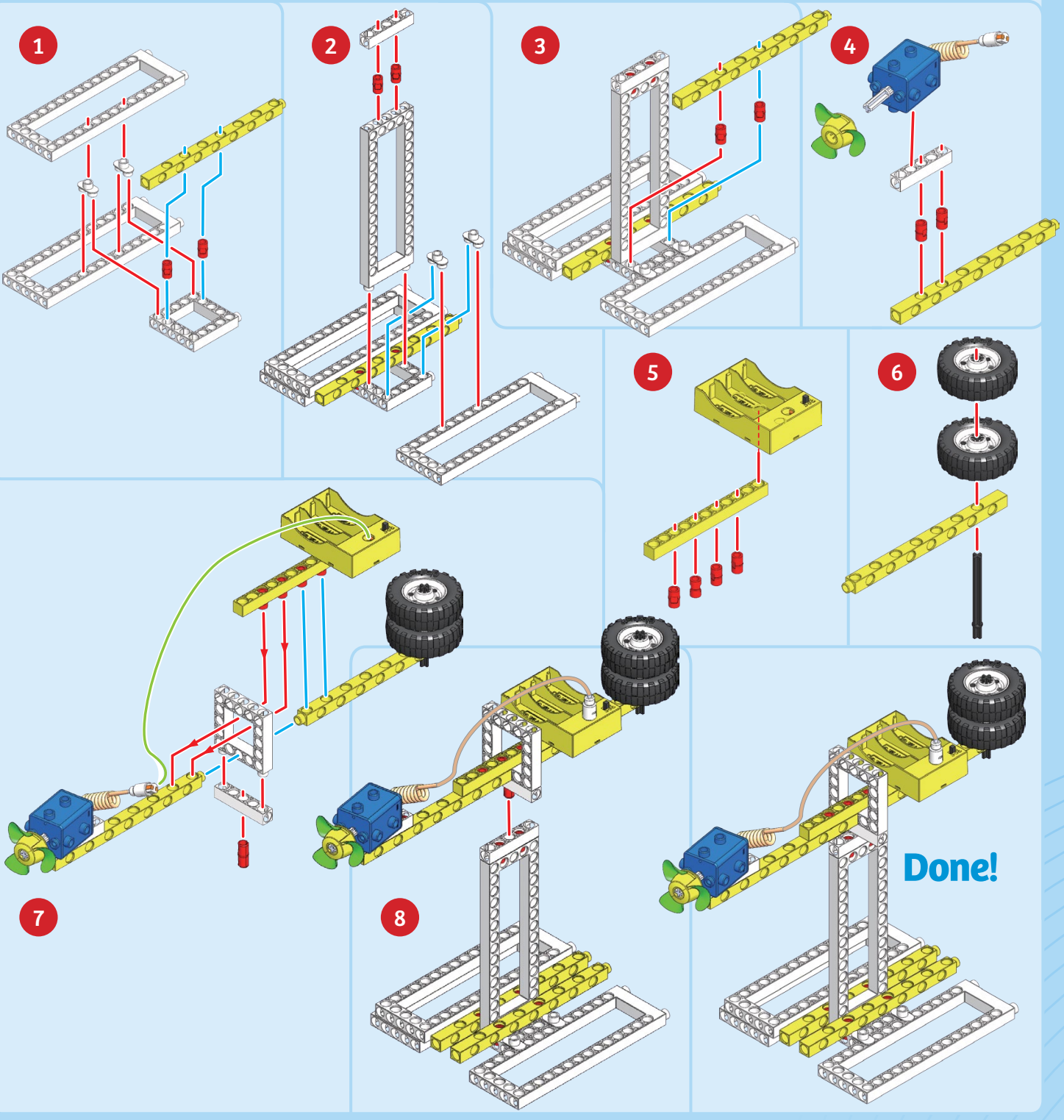
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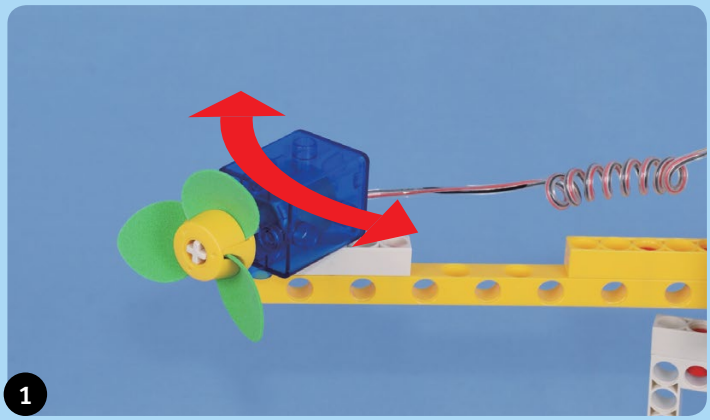
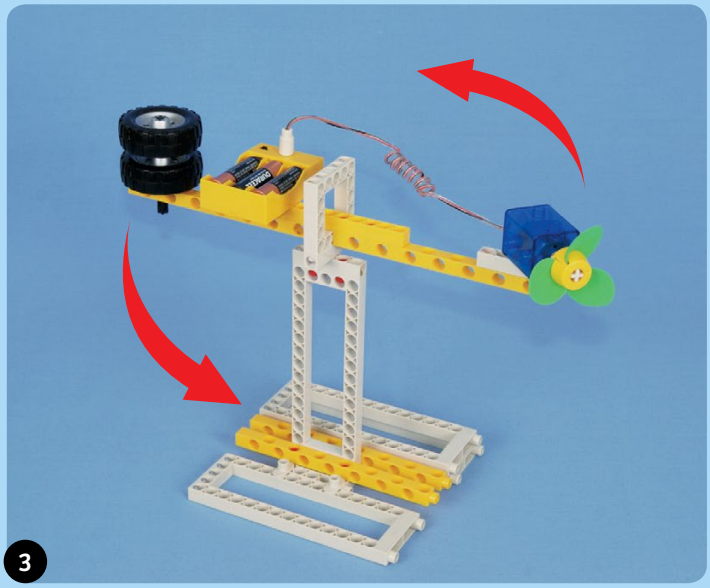
EXPERIMENT 9





Around it goes — with air

YOU WILL NEED

› **Carousel**

› *3 x 1.5-volt batteries (type AA/LR6/penlight)*

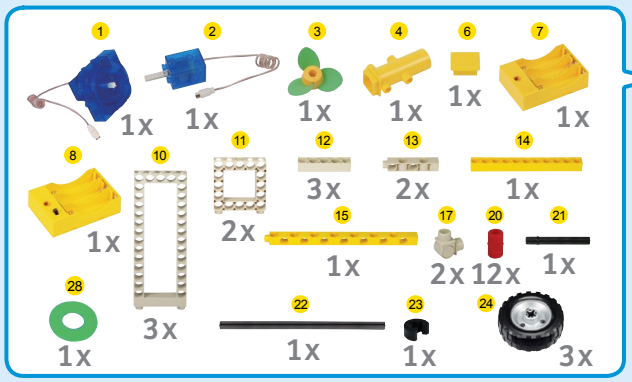
HERE'S HOW

1. After assembling your carousel, check to make sure that the drive motor is mounted at an angle relative to the carousel arm. For the carousel to work, it is important for the motor to be adjusted to an angle somewhere in the range between 0 and 90 degrees.
2. Insert the batteries into the battery box.
3. Now activate the switch on the battery box, and the motor will start up and the carousel will begin turning. Make sure that nothing blocks its movement.
4. Now adjust the angle of the motor. The carousel will turn fastest with an angle of 90 degrees. It will reverse direction if you flip the switch to its other setting.

WHAT'S HAPPENING ?

The drive motor takes the place of a hand nudging the carousel and keeping it moving. In both cases, the propulsion force is greatest if it pushes against the carousal shaft — or pulls, if you flip the switch setting — at an angle of 90 degrees (a right angle).

RACE CAR



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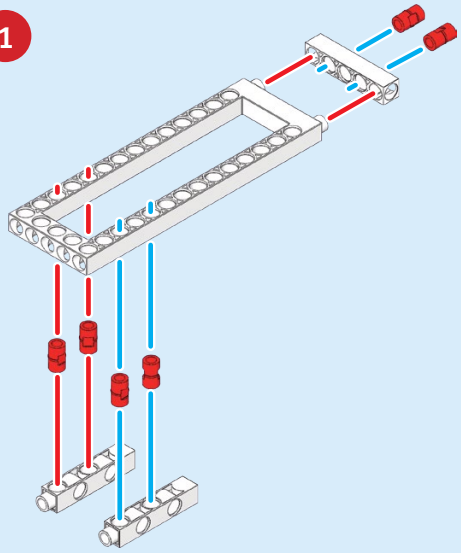
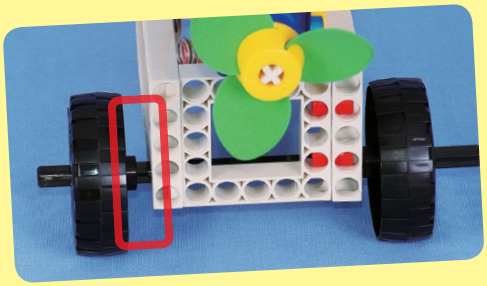


TIP !

Leave a gap of about 1 mm between the wheel and the frame. That way, your car will run without any friction loss.



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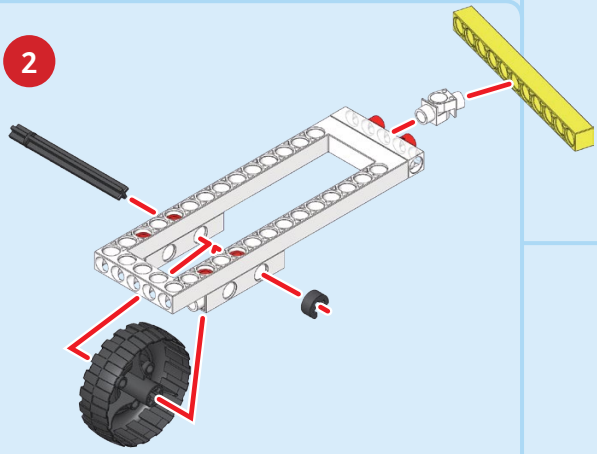

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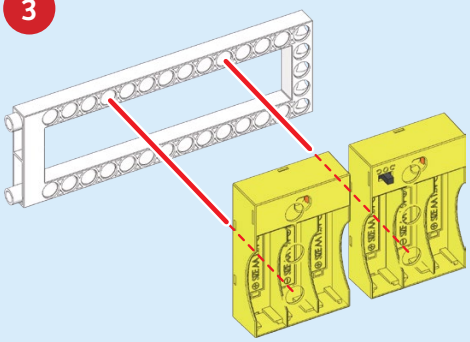

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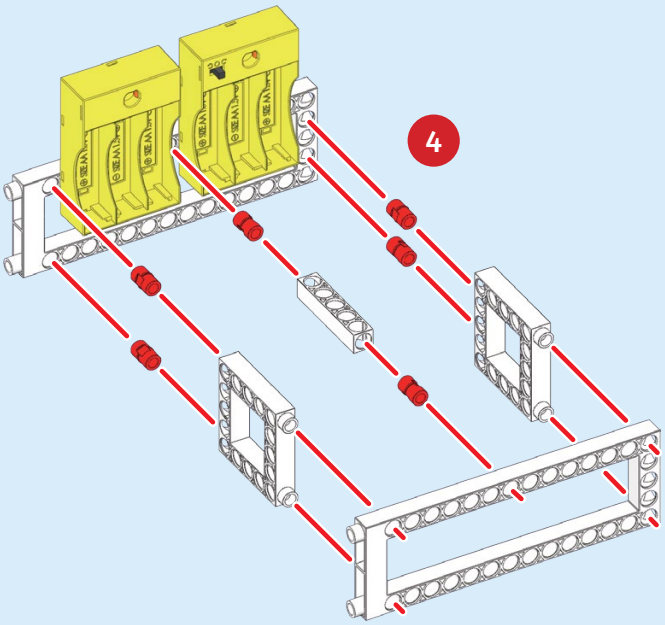

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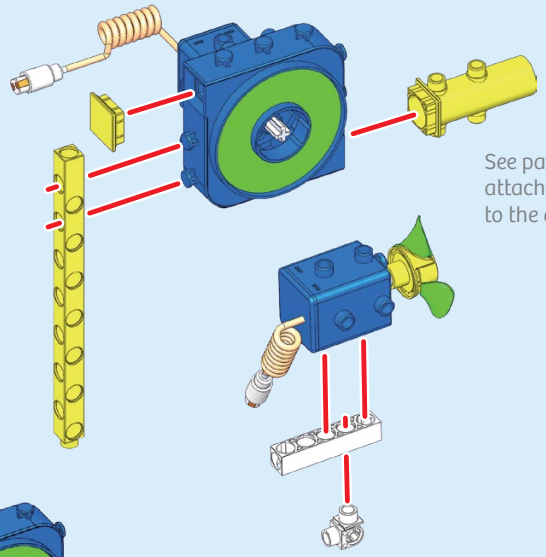
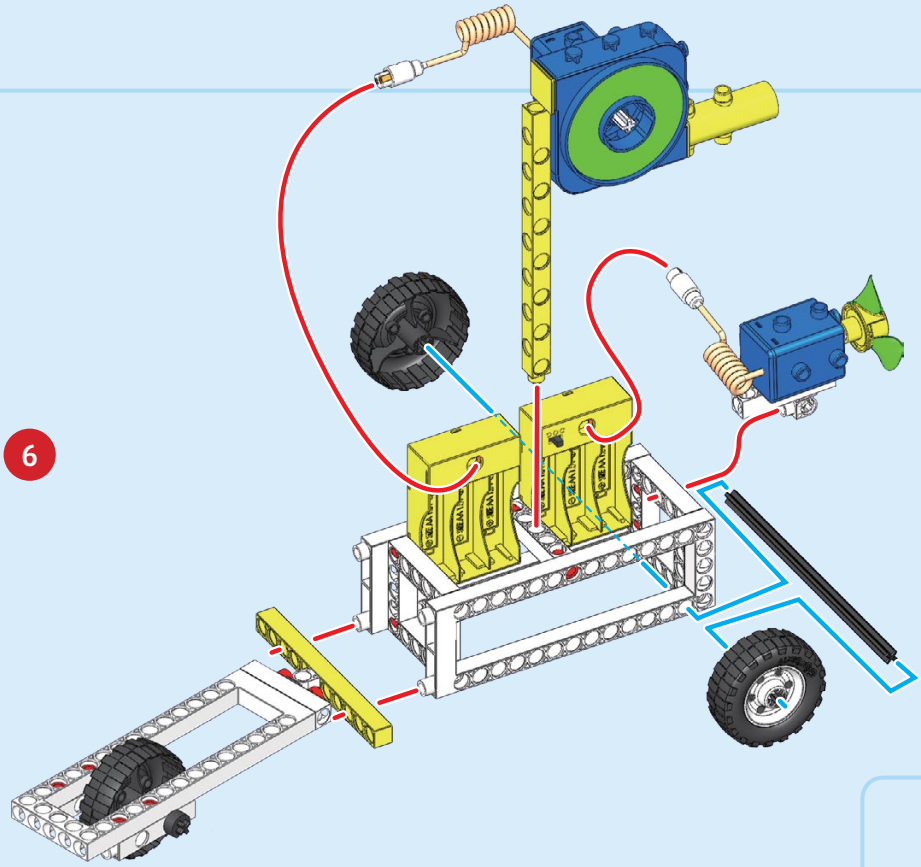
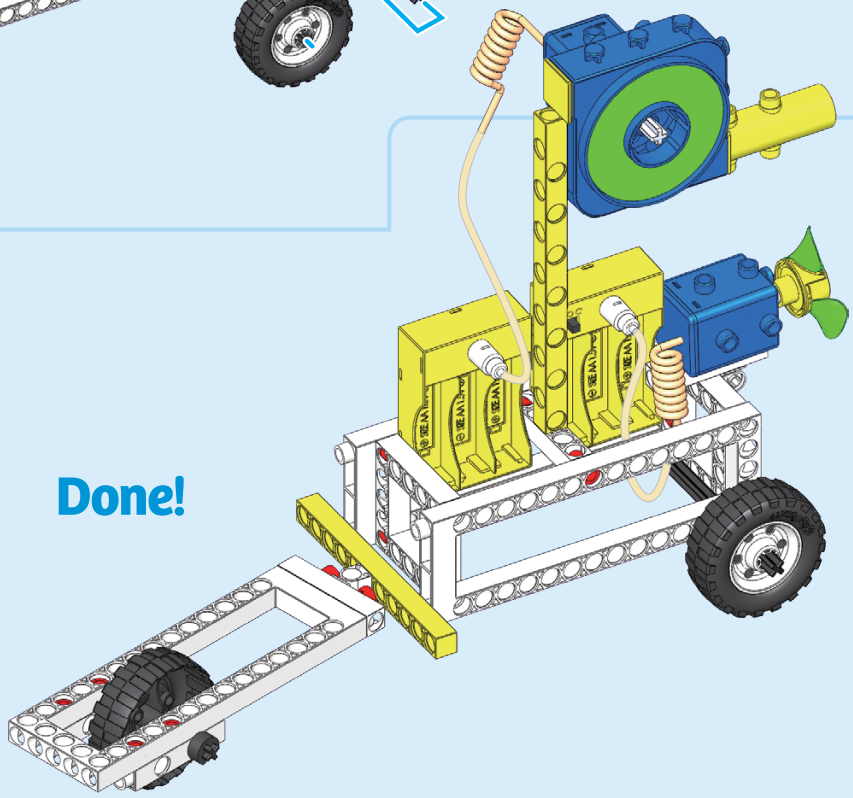


See page 4 for how to attach the foam rubber to the air motor.

6





Done!

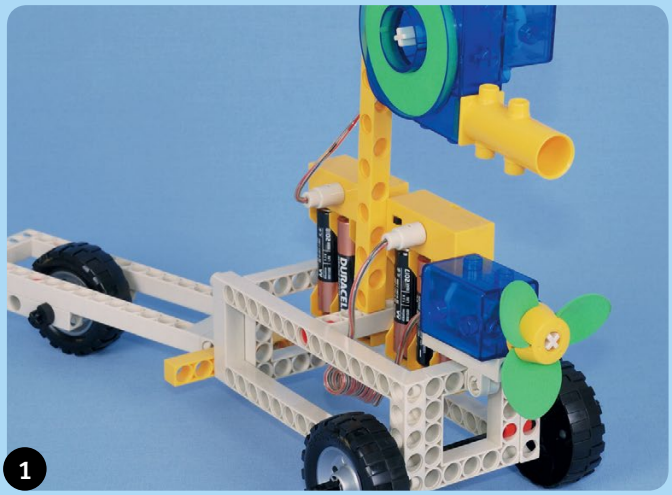
Speed Test

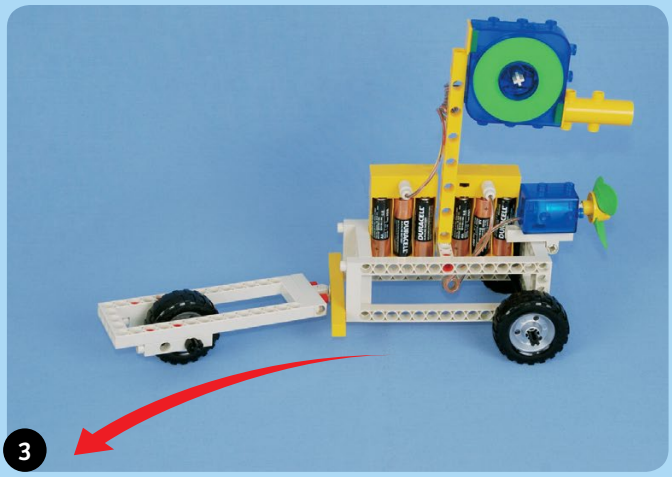
YOU WILL NEED

› **Race car**
› *6 x 1.5-volt batteries (type AA/LR6/penlight)*

HERE'S HOW

1. Insert the batteries as indicated in the battery box. The car will immediately race off!
2. If you want more speed, you can add the propeller drive motor with the battery box switch. Be careful to set the switch in the right position, though — otherwise it will act as a brake.
3. Would you rather drive in a circle? If so, turn the front wheel sharply for a tight circle, or just slightly for a wide one.





WHAT'S HAPPENING?

The air motor produces quite a recoil. This same reaction principle is also at work in rockets shot off into space. In our case, the recoil pushes the race car forward and off it goes. If you also add the drive motor (with the right switch setting, of course), the car gets even more thrust and goes even faster.

DID YOU KNOW...

There are cars that are even faster than race cars. In 1997, a rocket car performed a test run at a speed of over 1200 km/h.

CHECK IT OUT

What can air do?

As you now know, air in motion can exert remarkable force. If the wind is blowing hard enough, you can sometimes barely walk. A really strong wind can snap trees like matchsticks. Air works invisibly, but it can hold airplanes aloft in the sky. On the other hand, air can act as a powerful brake due to the force of air resistance. To keep this force as low as possible, modern-day cars are tested in wind tunnels.

WHAT DOES AIR SMELL LIKE?

Air is actually a mixture of nitrogen, oxygen, carbon dioxide, and noble gases, and it has no smell. Of course, it might still smell, but what you're smelling is not the air itself, but tiny particles suspended in it, such as the odor molecules of a flower.

HOW MUCH DOES AIR WEIGH?

Every substance has some weight, even gases. Because air is a mixture of various gases, it will obviously weigh something too. 1 liter of air weighs about 1.3 grams. 1 cubic meter of air (in other words, 1 x 1 x 1 meter) therefore weighs about 1.3 kilograms.

CHECK IT OUT

What is an air jack?

If you are driving a car on sandy or boggy ground, you might get stuck or blow a tire. If that happens, an ordinary steel car jack won't help, since it needs hard ground to support itself. For soft ground, an air jack works better. An air jack is like a big cushion that you put under the car and inflate with air, which in turn lifts up the car. Clever!

To keep this from happening...

... AN AIRBAG FOR YOUR HOUSE

A Japanese inventor has invented a sort of airbag system for small buildings in earthquake-prone areas. The moment that sensors detect the first slight foreshocks, airbags installed under the house gradually start to fill with air and lift the house up by a few centimeters. Now, instead of sitting directly on the ground, the building is resting on a cushion of air lying like a rubber sandwich between the ground and the house. This cushion absorbs all the shocks and the house remains undisturbed and undamaged.

HOW DOES AN OCTOPUS MOVE THROUGH THE WATER?

By the reaction principle! You learned about this in Experiment 10. The octopus is pushed forward with the same force with which water is squirted backward out of its body.

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