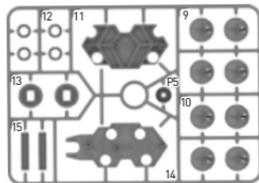
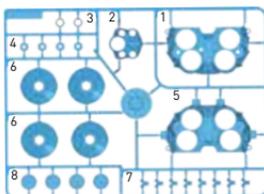
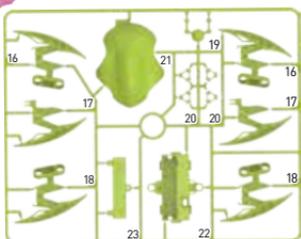


# Gravity Bugs™

## Free-Climbing MicroBot



### Kit Contents



- Blue plastic frame (parts 1-8)
- Gray plastic frame (parts 9-15, P5)
- Green plastic frame (parts 16-23)
- Motor and switch circuit (P1)
- 4 Suction cups (P2)
- 1 Short metal rod (P3)
- 2 Long metal rods (P4)
- 4 White gears (P6)
- 7 Fully threaded screws (P7)
- 1 Half-threaded screw (P8)



#### YOU WILL ALSO NEED:

1 x AAA battery (1.5 volt, type LR03),  
small Phillips-head screwdriver  
(PH00, PH0, or PH1 recommended),  
scissors or diagonal cutters, window  
or other smooth climbing surface

#### Do you have any questions?

Our tech support team will be glad to help you!

USA: support@thamesandkosmos.com  
or 1-800-587-2872

UK: support@thamesandkosmos.co.uk  
or 01580 713000

#### Important!

1. Separate the two types of screws (P7 and P8) before starting so that you can tell them apart. P8 is used on battery box cover.
2. Do not remove the parts from the frames until they are needed so that you can locate the numbered parts during assembly.

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## A WORD TO PARENTS AND ADULTS

With this science kit, your child can build a robot that walks up a window, while learning the physics behind how it works. Please read the instructions and safety information with your child before starting. Stand by to assist your child with any challenging steps of assembly or usage.

Do not let the robot model climb so high up a vertical surface that it goes out of reach. Prevent the robot from falling onto people or objects that might be damaged by it.

We hope you and your child have a lot of fun experimenting with the Gravity Bug!

## SAFETY INFORMATION

**WARNING!** Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Warning: This toy is only intended for use by children over the age of 8 years, due to accessible electronic components. Instructions for parents or care givers are included and shall be followed. Keep packaging and instructions as they contain important information. Store the experiment material, particularly the battery-powered motor and assembled model out of the reach of small children.

### Safety for Experiments with Batteries

- » To operate the models, you will need one AAA battery (1.5-volt, type LR03), which could not be included in the kit due to its limited shelf life.
- » An adult should insert and change the battery. For instructions on how to insert and change the battery, see step 31.
- » Avoid a short circuit of the battery. A short circuit can cause the wires to overheat and the battery to explode.
- » Different types of batteries or new and used batteries are not to be mixed.
- » Do not mix old and new batteries.
- » Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
- » The battery is to be inserted with the correct polarity. Press it gently into the battery compartment.
- » Always close battery compartments with the lid.

- » Non-rechargeable batteries are not to be recharged. They could explode!
- » Rechargeable batteries are only to be charged under adult supervision.
- » Rechargeable batteries are to be removed from the toy before being charged.
- » Exhausted batteries are to be removed from the toy.
- » The supply terminals are not to be short-circuited.
- » Dispose of used batteries in accordance with environmental provisions, not in the household trash.
- » Be sure not to bring batteries into contact with coins, keys, or other metal objects.
- » Avoid deforming the batteries.
- » Have an adult check the model before use to make sure it is assembled properly. Always operate the motorized model under adult supervision. After you are done experimenting, remove the battery from the battery compartments.

### Notes on Disposal of Electrical and Electronic Components

The electronic components of this product are recyclable. For the sake of the environment, do not throw them into the household trash at the end of their lifespan. They must be delivered to a collection location for electronic waste, as indicated by the following symbol:

Please contact your local authorities for the appropriate disposal location.



## ! IMPORTANT TIPS

- You must carefully cut the plastic parts out their frames with diagonal cutting pliers (diagonal cutters) or scissors.
- Remove the parts from the frames only when they are needed.
- Remove excess material (burrs) from the parts before assembling them. Normal scissors do not cut as precisely as diagonal cutters, so you may have to file some of the rough edges down with the nail file.
- Do not push or pull on the wires. They might break off.



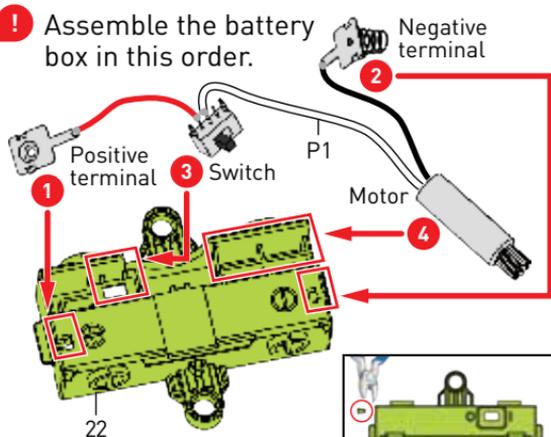
### ASSEMBLY VIDEO!

Scan this QR code to view a step-by-step assembly video and tips on how to use the Gravity Bug.

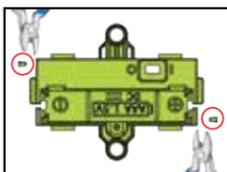


# ASSEMBLY INSTRUCTIONS: 1 OF 5

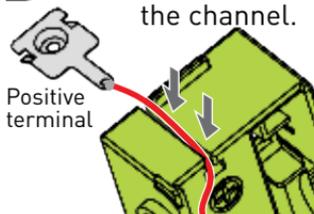
**1** Assemble the battery box in this order.



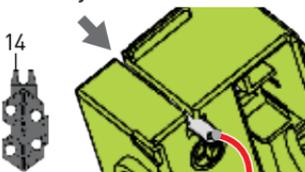
**!** Remove the burrs completely!



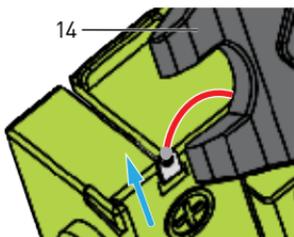
**1** Insert the wire into the channel.



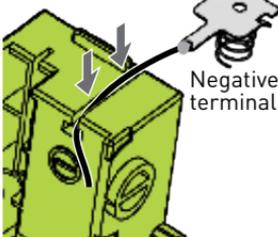
**2** Push terminal all the way in with the tool.



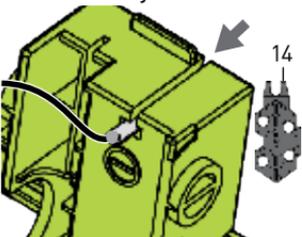
**3** Bend the metal tab down with the tool.



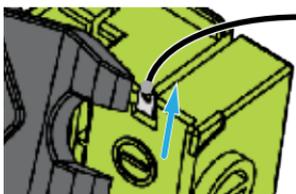
**4** Insert wire into channel.



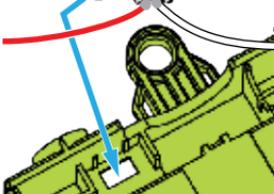
**5** Push terminal all the way in with tool.



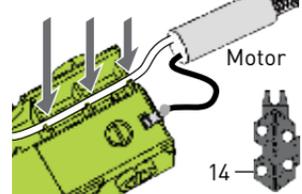
**6** Bend the metal tab down with the tool.



**7** Insert wire into channel with tool.

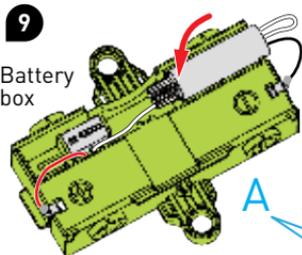


**8** Insert wire into channel with tool.



**9**

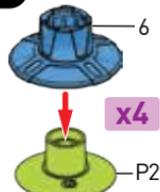
Battery box



Place the motor into the motor compartment above the wire. Make sure the wire is pushed all the way down, out of the way of the motor gear.

A blue capital letter indicates a finished subassembly. Set it aside until it is called for later on.

**10**

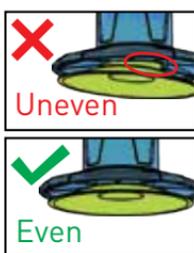
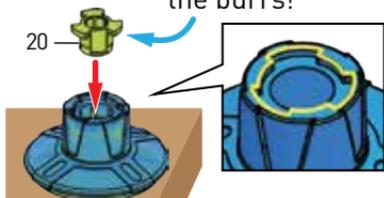


x4 = Do 4 times.

**11**

x4

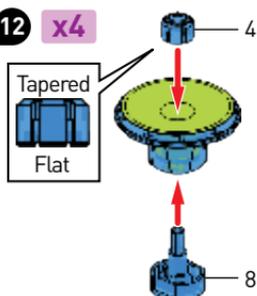
**!** Remove all of the burrs!



Place on a tabletop. Press down until it clicks.

**12**

x4

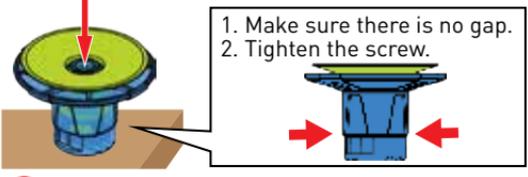
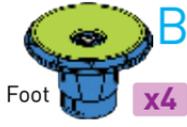


# ASSEMBLY INSTRUCTIONS: 2 OF 5



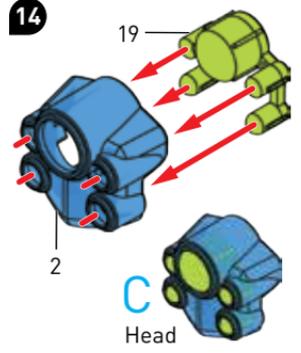
**13** x4 

P7  
Fully threaded screw

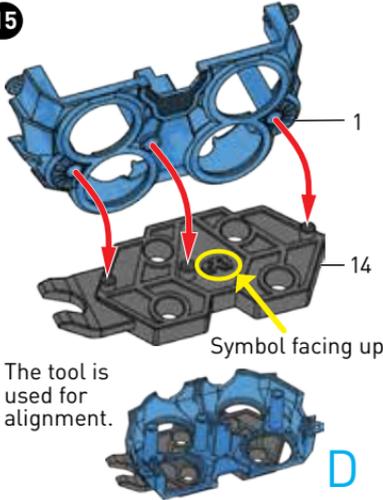


**!** Place on a tabletop. Then screw together.

**14**

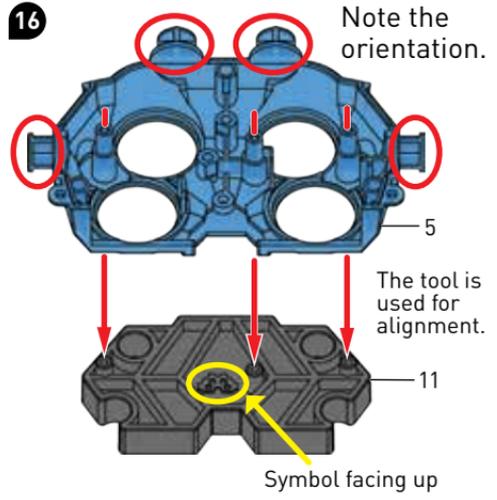


**15**

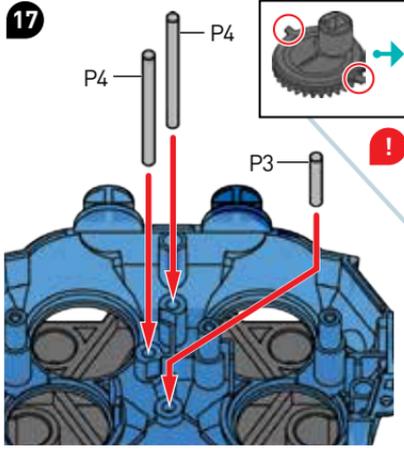


The tool is used for alignment.

**16**

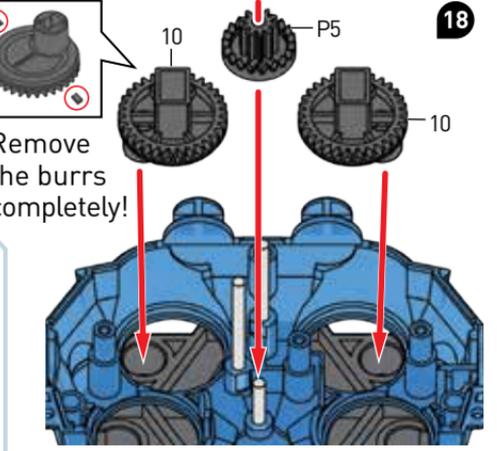


**17**

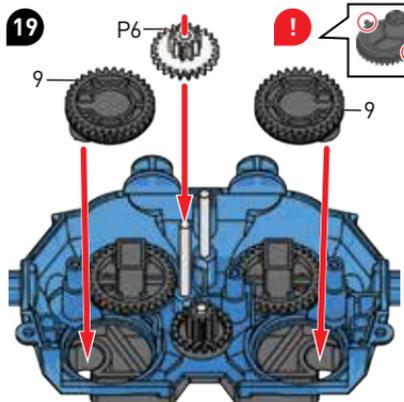


**!** Remove the burrs completely!

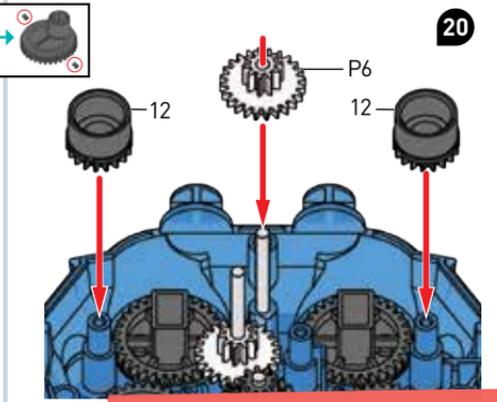
**18**



**19**

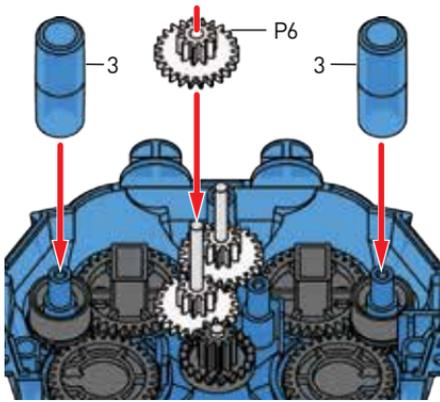


**20**

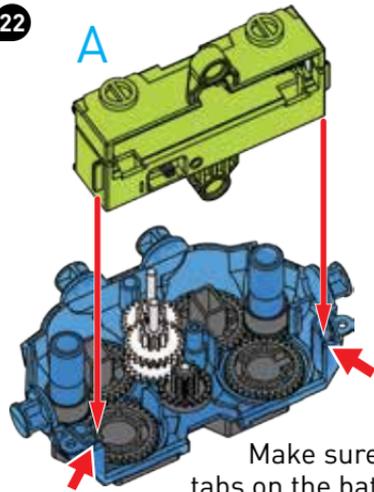


**CONTINUED ON BACK**

21

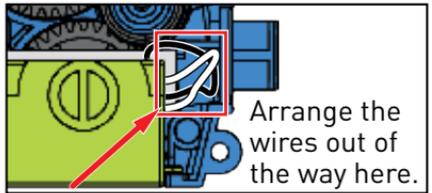
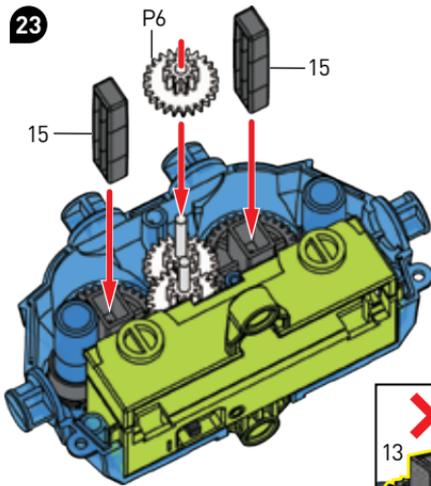


22



Make sure the tabs on the battery box slide into the grooves on the blue body half.

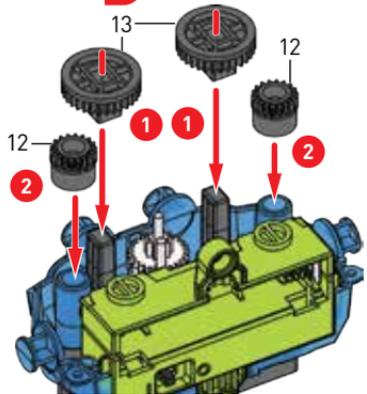
23



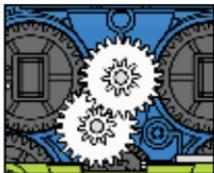
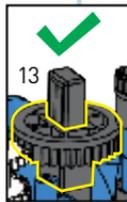
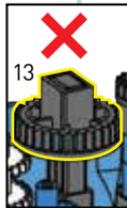
Arrange the wires out of the way here.

24

! Assemble in order.

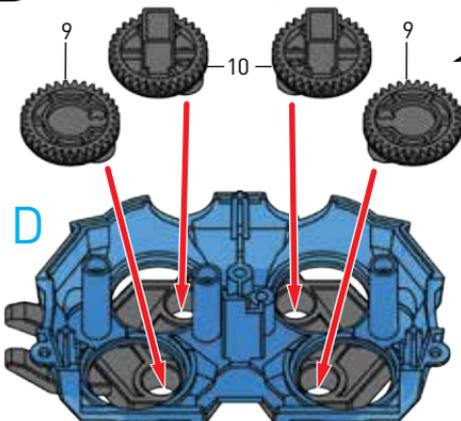


Make sure you insert the pieces in the correct direction.

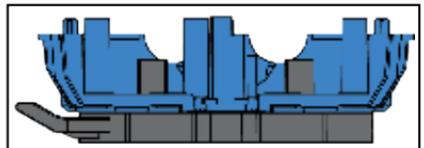


Make sure the gears mesh and are engaged with each other. (They won't turn at this point, due to the tool.)

25 Use the tool to align the gears perfectly.



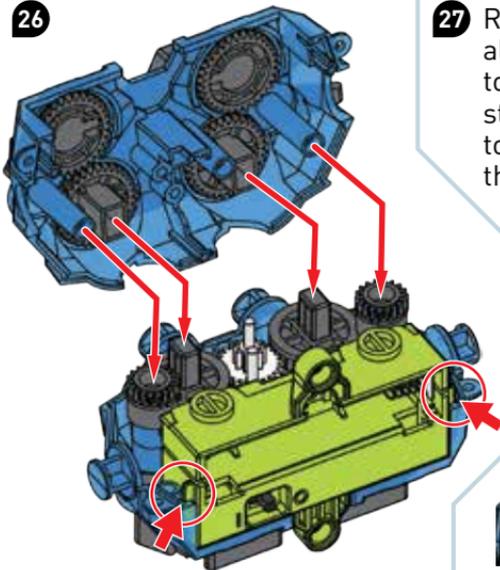
! Remove the burrs!



Make sure you push the gears down all the way to the tabletop.

## ASSEMBLY INSTRUCTIONS: 4 OF 5

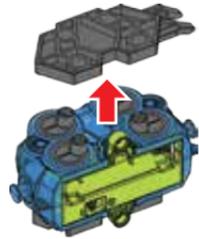
26



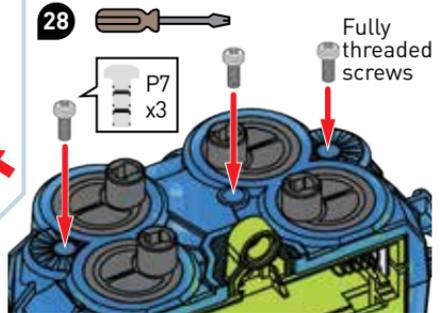
**!** Make sure the grooves on the upper body half slide onto the tabs on the battery box.

27

Remove the alignment tool, lifting straight up to not disturb the gears.



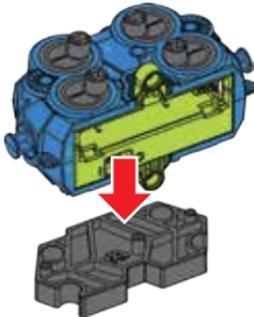
28



**!** Don't over-tighten the screws. If the gears don't turn when you test it in step 31, loosen these screws a little.

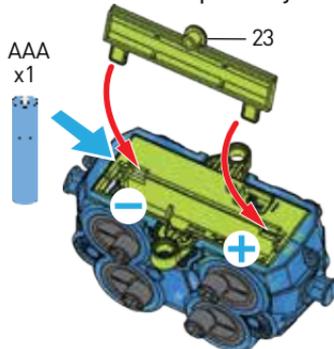
29

Remove the second alignment tool.



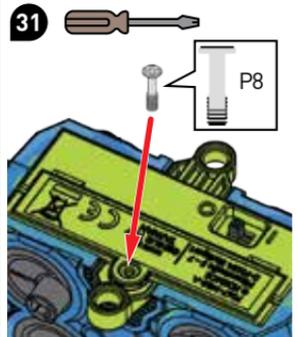
30

Insert the battery with the correct polarity.



**!** Note the polarity markings.

31

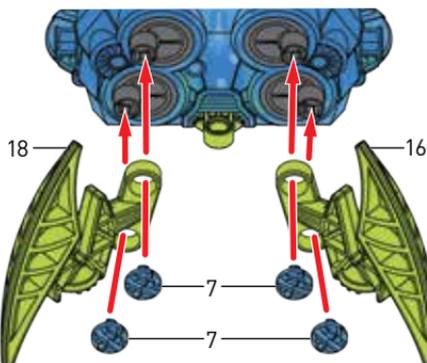


**!** Turn it on and make sure the gears turn.

32

x2

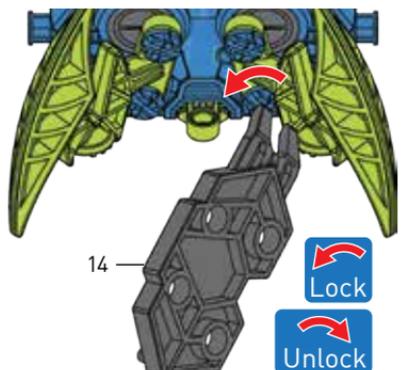
Attach two legs with four locking bolts onto each side of the body.



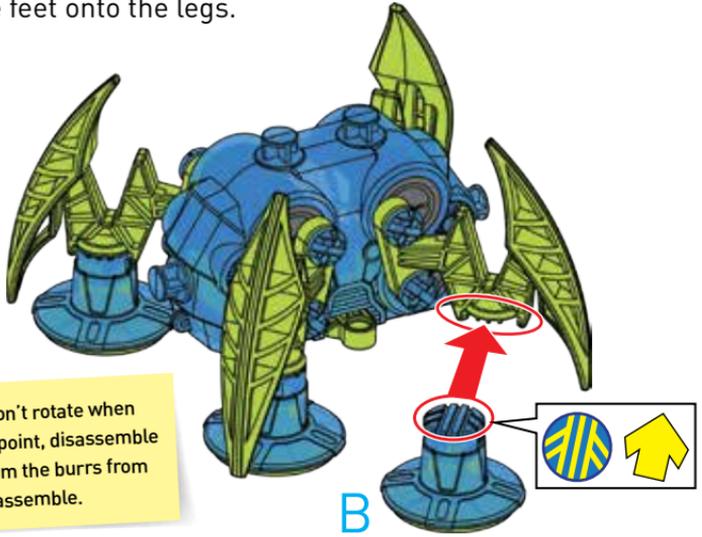
33

x2

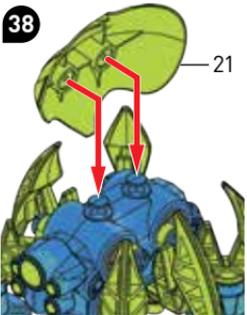
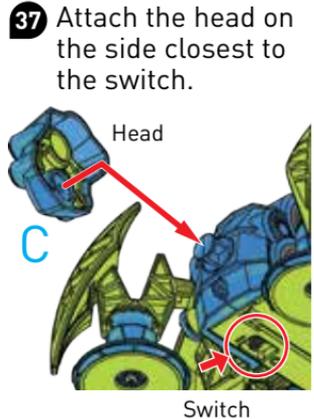
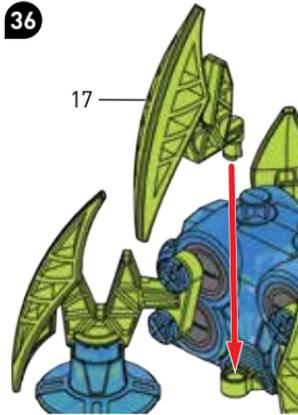
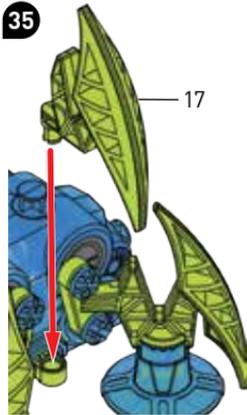
Lock each bolt in place by inserting the tool into the slot and turning it counter-clockwise until it clicks.



- 34** Attach the four suction-cup feet to the legs. Pay attention to the direction of the arrow pattern on the tops of the feet when sliding the feet onto the legs.



**TIP!** If the legs don't rotate when the power is on at this point, disassemble the model, carefully trim the burrs from the gray gears, and reassemble.



## EXPERIMENT: CLIMBING A WINDOW

First, test out your Gravity Bug on a smooth, horizontal surface, like a tabletop. Turn it on and it should walk forward.

Then, stick it to a smooth, vertical surface like a large glass window. Press the suction cups firmly to the surface. The surface must be extremely smooth.

Make sure the surface is clean and dust-free. Cleaning the suction cups or the surface with water can also improve the robot's grip.

Turn on the switch and watch the robot climb. Keep your hands below the robot at first to catch it in case it falls.

Experiment to see which surfaces your Gravity Bug can climb!

## TROUBLESHOOTING!

If you are having trouble getting your Gravity Bug to climb, scan this QR code for help.



**DONE!**



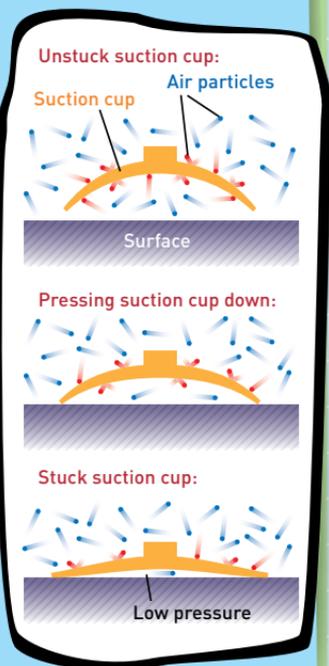
! CHECK IT OUT

## HOW DO Suction Cups WORK?

**Suction cups** use air pressure to stick to hard, smooth surfaces where a partial **vacuum** can be created. A suction cup has a cup-shaped surface made of a flexible material, like silicone, rubber, or plastic.

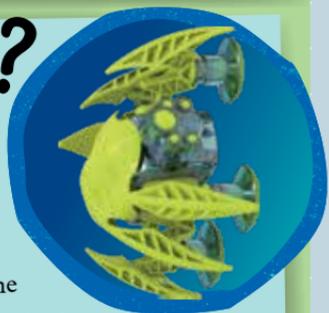
When this cup is pressed against a hard surface, the air inside the cup, between the cup and the surface, gets pushed out. The regular atmospheric air outside the cup, which contains many more **air particles** per unit volume of space than inside the cup, remains the same. These air particles are constantly flying around through the air and hitting things, making a tiny impact, the sum of which is **air pressure**.

Because there are a lot more air particles per unit volume on the outside of the cup than there are on the inside, the air pressure is higher on the outside. This difference in air pressure is what keeps the suction cup stuck to the surface.



## HOW DOES THE GRAVITY BUG Climb?

By pressing its suction-cup feet onto the window, the Gravity Bug creates a **negative pressure** there. This means that the air pressure existing there is lower than the environmental air pressure all around it. This negative pressure ensures the Gravity Bug stays stuck to the smooth surface, as the pressure of the atmosphere outside of the suction cups is pushing them toward the surface, while there is virtually no pressure pushing them away.



It is important that the contact between the suction cup and the climbing surface is free of gaps and as airtight as possible. Gaps caused by dust or dirt cause leaks that allow additional air to enter, destroying the negative pressure. Moistening the suction cups can improve the grip. The thin film of water fills in the small gaps and makes for a better seal.

You can create a negative pressure by gently sucking air from an empty water bottle with your mouth. You feel the negative pressure as soon as your lips are pressed against the bottle opening. The force that you can feel is the reason why the Gravity Bug sticks to vertical surfaces. Again, it is important to ensure that the contact between the bottle and your lips is airtight.