

F. TROUBLESHOOTING

If the motor does not run or move when it hits an obstacle:

- Check that you are using fresh batteries. Some rechargeable batteries may not be able to produce enough electric current to keep the sphere turning when it hits an obstacle. It is recommended to use alkaline battery.
- Check that the battery is inserted the correct way round in the battery case.
- Remove the motor housing cover and check that all the connections between the wires are OK. Also check that none of the connections between the wires are touching each other, as this will cause a short circuit.
- Check that the cogs are sufficiently lubricated.
- Check if the two half spheres are screwed too tight and white spindle of the motor is inserted into the square hole completely. This will add friction to the inner mechanism when it is rotating.

If the motor keeps running when the switch is off:

- Remove the motor housing cover and check that none of the connections between the wires is touching another.

G. HOW IT WORKS

The gears slow the movement of motor, which makes the spindle turn more slowly than the motor. The motor, battery and weight are all on one side of the spindle that turns the sphere. This means that the centre of gravity of the motor assembly is off to one side.

With the motor switched off, the sphere always comes to rest with the centre of gravity below the centre of the sphere, directly above where the sphere touches the ground. If you roll the sphere to one side, it just rolls back again.

When you switch the motor on, the motor assembly turns inside the sphere. So centre of gravity of the sphere moves to one side. This makes the sphere roll because it is unstable. As the sphere rolls, the motor keeps turning the assembly, so the sphere keeps rolling. The rubber ring grips the surface under the robot.

But how does the Robot Smart turn corners? The centre of gravity of the sphere is slightly to one side of the rubber ring. This is why the sphere leans to one side. When the Smart Robot hits an object, the sphere cannot move forwards. But because it leans to one side, it turns to one side. It keeps turning until it can move forwards again.

H. FUN FACTS

- Smart Robot moves using a rotating sphere inside its case. Most mobile robots run on wheels or tracks, and can go over rough ground.
- Bipedal robots are robots that walk on two legs, like humans. They need clever mechanisms and computer technology to walk without falling over. Some bipedal robots can even run and climb stairs.
- Robots that move around by themselves are called autonomous robots. They can't normally see where they are going. Instead, they have touch sensors that detect when they bump into something.
- Some autonomous robots build up an electronic map of their surroundings by remembering where they have bumped into things. Then they can move along without bumping into things again.
- Automated guided vehicles (ATVs) are robots that work in factories, carrying things from one place to another. They find their way by following lines drawn on the floor or underground cables.

- Robot vacuum cleaners move around a room, sucking up dust as they go. When they bump into an object, they turn round. Gradually they clean the whole room. Robot lawn mowers cut grass in the same way.
- Each year robot soccer players play against each other in an international competition called the RoboCup.

FUN MECHANIC SERIES

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I. QUESTIONS & COMMENTS

We treasure you as a customer and your satisfaction with this product is important to us. In case you have any comments or questions, or you find any parts of this kit missing or defective, please do not hesitate to contact our distributor in your country, whose address is printed on the package. You are also welcome to contact our marketing support team at Email: infodesk@4M-IND.com, Fax (852) 25911566, Tel (852) 28936241, Web site: WWW.4M-IND.COM

SMART ROBOT



A. SAFETY MESSAGES

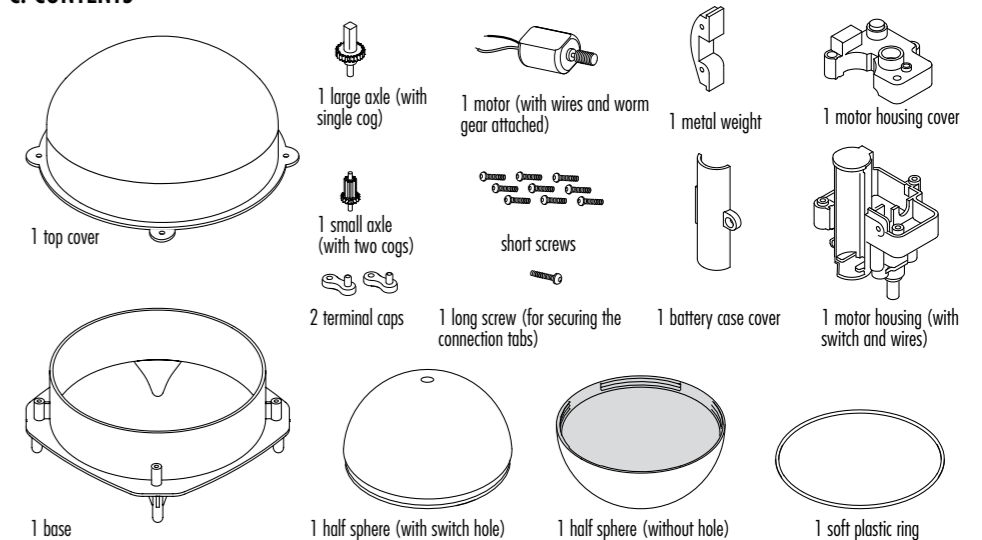
To Parents: Read all instructions before provide guidance to your children.

1. Please read through all instructions before you start.
2. Adult supervision and assistance are required at all times.
3. Intended for children of ages over 8.
4. This kit and its finished product contain small parts which may cause choking if misused. Keep away from children under 3 years old.
5. To prevent possible short circuits, never touch the contacts inside the battery case with any metal.

B. USE OF THE BATTERY

1. Requires one "AA", 1.5V battery (not included).
2. For best results, always use a fresh battery.
3. Make sure you insert the battery with the correct polarities.
4. Remove the battery from Smart Robot when not in use.
5. Replace exhausted battery straight away to avoid possible damage to the kit.
6. A rechargeable battery must be removed from the kit before recharging.
7. Rechargeable battery should be recharged under adult supervision.
8. Do not attempt to recharge non-rechargeable battery.
9. Do not mix alkaline, standard (carbon-zinc), or rechargeable (Ni-Cd) battery.
10. Make sure that the supply terminals are not short circuited.

C. CONTENTS



Also required but not included : 1 x 'AA' 1.5 volt battery, small crosshead screwdriver.

D. ASSEMBLY

Follow these steps to assemble your Smart Robot. Numbers refer to the diagrams.

ASSEMBLING THE INSIDE MECHANISM

1. Identify the motor housing (it contains a switch and the battery case attached). Hold the housing so the switch is facing down. Place the motor into the space in the housing.

2. Before lowering the motor into place, carefully feed the wires from the motor down through the holes in the motor housing.

3. Find the smaller of the two axles with cogs. Drop the end with the larger of the two cogs into the white plastic bearing hole close to the end of the worm gear. The lower cog should interlock with the worm gear.

4. Drop the metal end of the larger axle into the white bearing hole close to the corner of the motor. Its cog should interlock with the top cog on the smaller axle. Apply some lubricant to the cogs. Cooking oil from the kitchen is suitable.

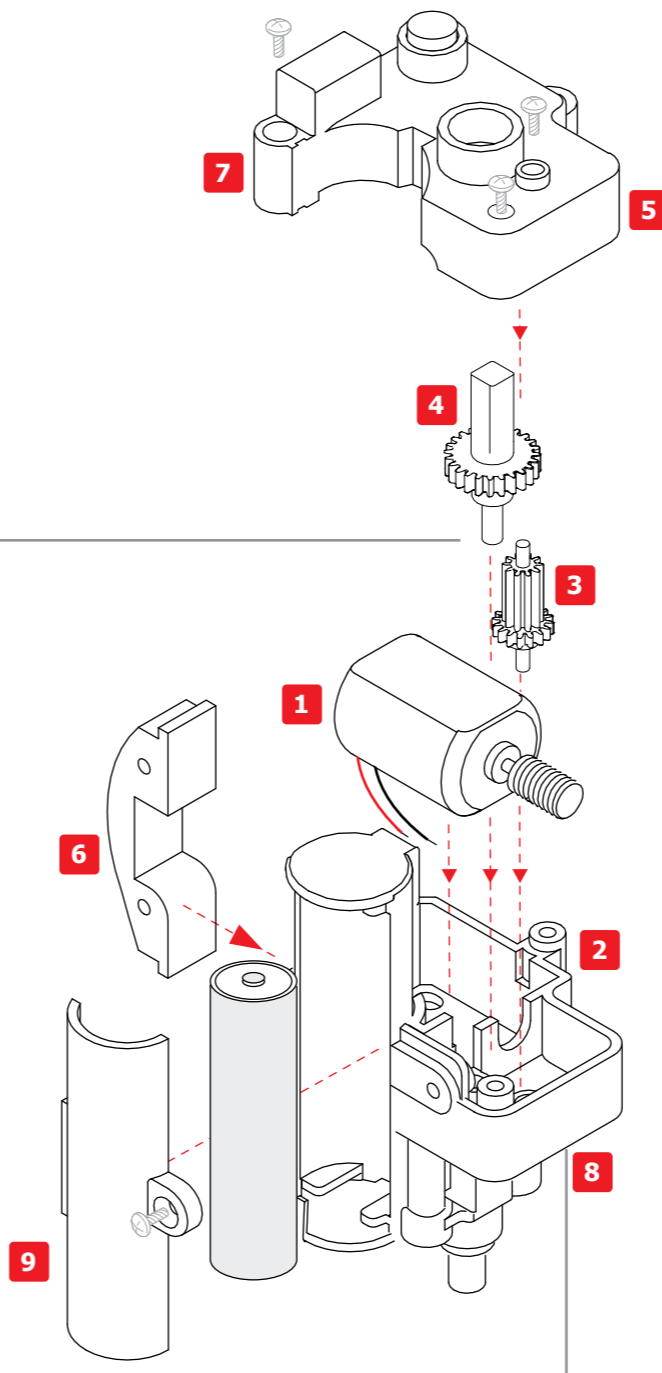
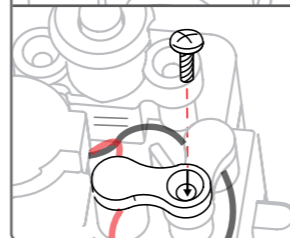
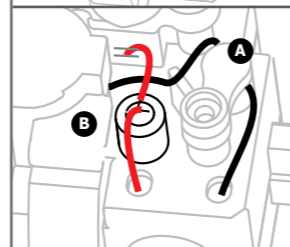
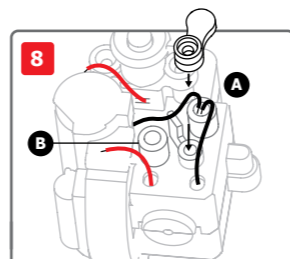
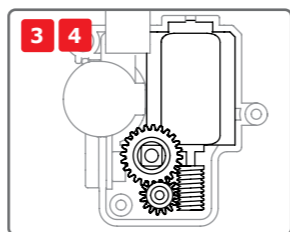
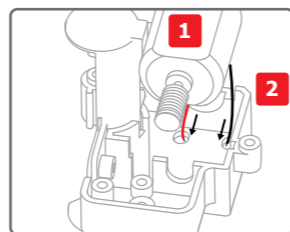
5. Keep holding the motor housing upright so that the axles do not fall out. Carefully lower the motor housing cover into place. You may need to slight wiggle it so that the tops ends of the axles fit into their upper bearings. If the cover does not fit into place properly, remove it and make sure the axles and motor are still in their correct places.

6. Before screwing down the motor housing cover, slot the metal weight into place next to the battery case. It only fits one way up. You'll have to lift the cover off the housing very slightly to do this.

7. Make sure the motor housing cover is in place properly and secure it with screws.

8. Connect the black wire from the battery case to one wire from the motor. Make connection to the shorter connection slot first (marked A). With the terminal cap, connect the black wire from the battery case to one wire from the switch. After first pair of wires connected, connect together the remaining two wires (one from the switch and one from the motor) at the taller connection slot (marked B). Then secure the two connection tabs with the long screw.

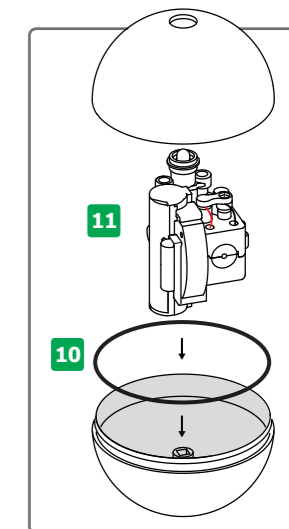
9. Insert an AA battery into the battery case. The negative terminal of each battery (the flat end) goes against one of the springs in the battery case. If the motor runs, press the switch once to turn it off. Add the battery case cover and secure it with a screw. Now test everything by pressing the switch. The motor should run and the white spindle should turn. If the motor does not run, see the troubleshooting guide below. Press the switch to turn off the motor again.



ASSEMBLING THE SPHERE

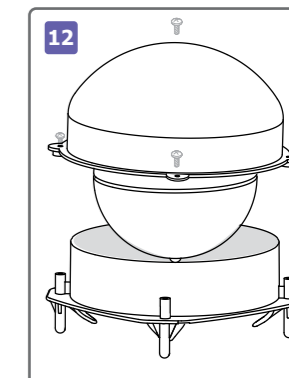
10. Fit the soft plastic ring around the screw thread on the half sphere without the hole in it.

11. Fit the motor assembly into the half sphere so that the white spindle on the assembly fits into the square hole in the half sphere. Screw on the other half of the sphere so that switch cover fits through the hole. Don't over-tighten the screw thread.



FINAL ASSEMBLY

12. Put the top cover onto the base and secure it with four screws. Congratulations. Your Smart Robot is ready to go!



E. OPERATION

Switch on the motor and push the sphere into the cover. Put the Smart Robot on a smooth surface (such as a vinyl floor) and watch it go. Your Smart Robot does not run on carpeted flooring.

When it bumps into something, it automatically turns left or right and carries on going. Smart!

Try making a course using books for the Smart Robot to follow. You could even make a maze to see if the Smart Robot can escape.

If you keep the sphere hidden when you show the Smart Robot to your friends, it will be a mystery to them how it moves and steers itself.