

# Solar Marble Machine Kit

**No Soldering  
Required!**

*The fun of a Marble Machine,  
sized for your desk or window  
and Solarengine™ powered!*



Compact solar cell and circuit board.



All electronic and structure parts included.



Precision laser-cut wood construction.



Marbles run to the top of a wooden spiral and roll back down.

 Ages 14+

 Solar powered  
(no batteries required)

 basic tools required

 1.5 hours build time



**SOLARBOTICS**<sup>®</sup>  
Ltd

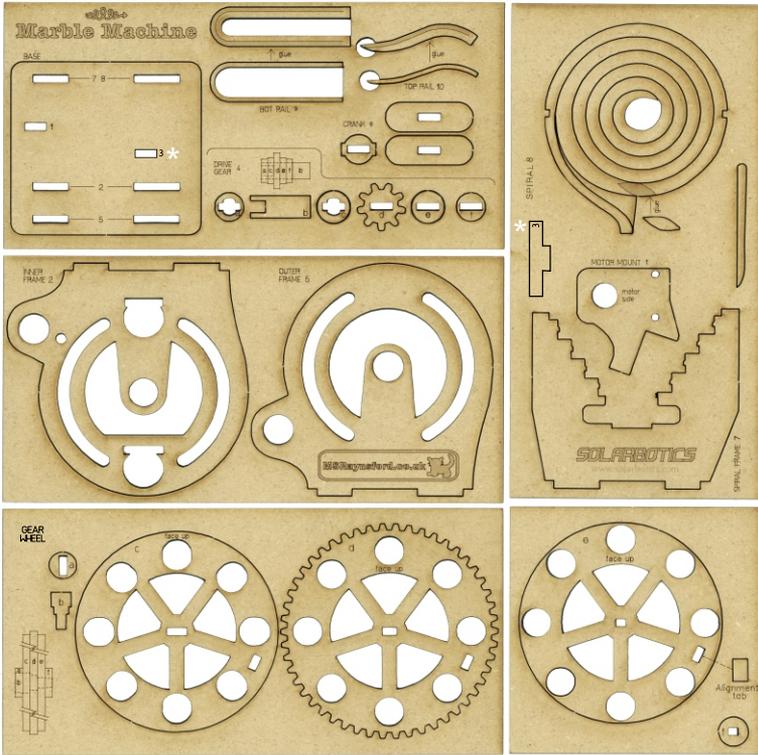
www.solarbotics.com  
1-866-276-2687

 **WARNING: Swallowing hazard!** Product contains small parts. Finished kit is not for young children under five.

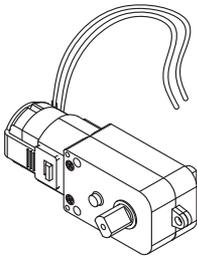
# Solar Marble Machine Kit

## PARTS LIST

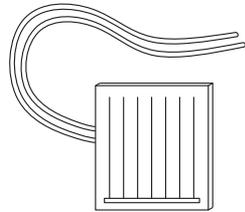
### Set of Wooden Parts



GM3 Motor



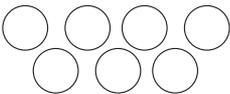
37x33mm Solar Cell



2 x 1/2" #4  
TF Screw



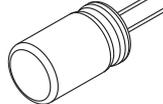
4 x 0.375"  
Steel Marbles



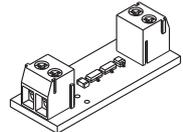
Double-sided  
Sticky Tape



Large Storage  
Capacitor



SolarEngine  
Circuit Board



# The Solarbotics Solar Marble Machine Kit

The Marble Machine Kit is the brainchild of Martin S. Rainsford, as part of his "Lasering one project a day" blog. We fell in love with the design, and worked with him to create this kit - now with the solder-free SolarEngine for easy construction!

## TOOLS:

Although assembly is straight forward, some tools are required:

- Wire strippers (22 gauge)
- Wood or white glue
- Philips #1 screwdriver
- Tweezers (optional)

## Step 1: Assembling the SolarEngine

The SolarEngine is a clever circuit that allows solar energy to be harvested and used even in low light levels. There is no soldering required so all we are going to need to do is connect the motor and solar panel, stick it under some light, and watch it move!

### 1.1

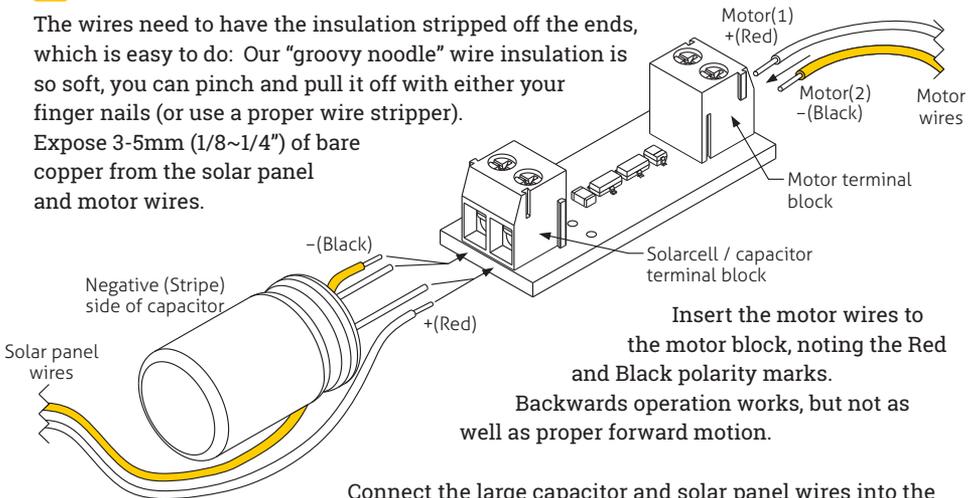
While you won't do any damage by plugging them in backwards, the SolarEngine will only work properly if the solar panel and capacitor are installed as shown. Batteries don't work when installed backwards - the same applies to these parts!

**Connect everything together before moving to the next step.**



The wires need to have the insulation stripped off the ends, which is easy to do: Our "groovy noodle" wire insulation is so soft, you can pinch and pull it off with either your finger nails (or use a proper wire stripper).

Expose 3-5mm (1/8~1/4") of bare copper from the solar panel and motor wires.



Insert the motor wires to the motor block, noting the Red and Black polarity marks.

Backwards operation works, but not as well as proper forward motion.

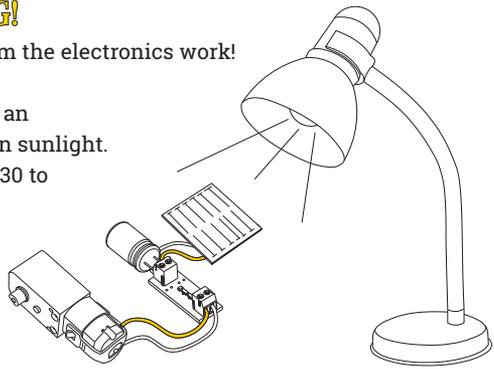
Connect the large capacitor and solar panel wires into the same terminal block connections. If you have trouble getting the wires to stay firmly mounted when you tighten the terminal block screws, try stripping off more wire insulation and wrapping the wire around the capacitor legs.

## 1.2: Testing, testing, TESTING!

Do NOT go any further until you confirm the electronics work!

Place the SolarEngine assembly under an incandescent or halogen lightbulb, or in sunlight. The motor should twitch into life after 30 to 100 seconds.

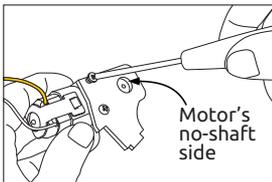
**Note:** Fluorescent and LED light bulbs are not very good for solar energy. They don't put out nearly the right kind of light for best performance.



## Step 2: Motor and Solar Mounting

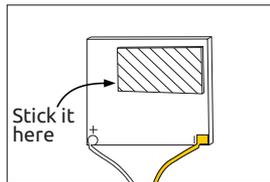
### 2.1

Use the #4 screws to attach the motor to the wooden holder.



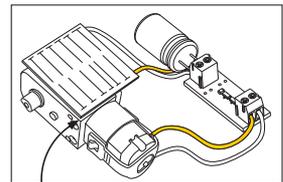
Motor's no-shaft side

Cut the double-sided sticky tape in half. Peel and stick one piece to the solar cell...



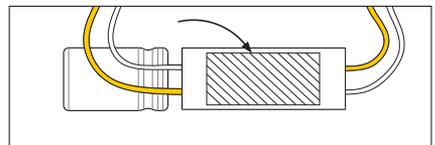
Stick it here

...and attach it to the motor as shown.



### 2.2

Take the other half of the double-sided tape and stick it to the bottom of the SolarEngine circuit board.

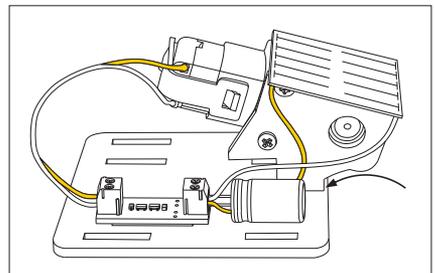


Align the corner of the solar cell to the corner of the gear motor box.

### 2.3

Mount the SolarEngine assembly into the slot on the base plate of the Marble Machine.

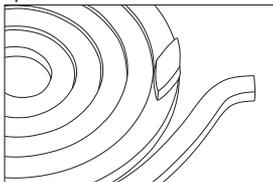
Peel the tape and stick the SolarEngine to the base plate, making sure to align it like shown. Arrange the motor wires (see image) so they will stay clear of the bottom rail during final assembly.



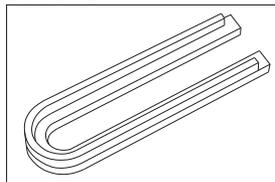
### Step 3. Gluing the Rails

Let's start with the glued parts. Glue the diamond to its shadow marked on the spiral. For the bottom rail assembly, glue the narrow "U" to the larger "U". Finally, for the top rail assembly, glue the thin sliver to the thicker one.

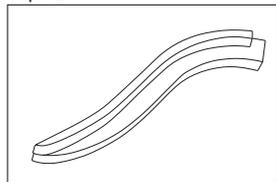
Spiral rail



Bottom rail

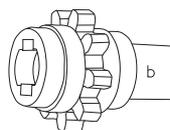
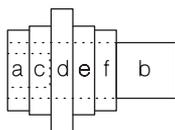


Top rail



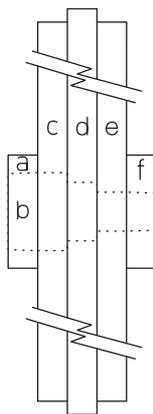
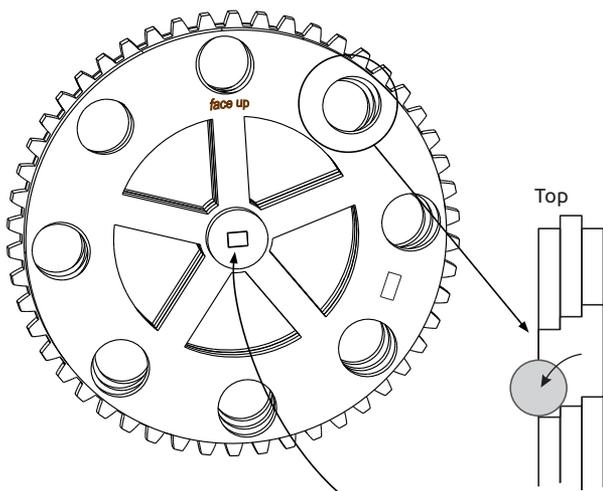
### Step 4. Drive Gear Assembly

Pop out the drive gear pieces from the wooden carrier board and assemble them in the order shown. Glue is not necessary (but optional).



### Step 5. Gear Wheel Assembly

Follow the diagram and stack the pieces together onto the axle. Again, gluing them together is optional for this step.



**!** The holes do not line up vertically! They step-down, to help roll the ball out at the top of the track.

The "face up" text will face away from the spiral ramp during final assembly. The hubs are sized so it fits into the final assembly only one way.

## Step 6. Final Assembly (see next page for diagram)

To put it all together, refer to the exploded Marble Machine diagram below, and follow these steps:

1. **Install the inner wheel frame** into the base plate. The motor should fit snugly against the frame, with the motor shaft in the center of crank shaft hole.
2. **Insert the gear wheel assembly** into the inner wheel frame. The text on the wheel assembly should face outwards, away from the frame.
3. **Push the gear assembly onto the motor shaft**, so that it sits flush against the inner wheel frame. The wheel assembly gears and motor gear should mesh nicely.
4. **Install the outer wheel frame** into the base plate. Both the gear and wheel assemblies should sit inside their respective holes. Make sure that the wheel frame is flush against the wheel assembly.
5. **Install the crank handle spacer** and caps onto the shaft of the gear assembly. Glue is optional.

6. **Attach the spiral frame** by pushing it into the base plate. Glue is optional.

7. **Secure the spiral rail to the frame.** Start at the top, then push the spiral downwards. While pushing, slide the spiral back & forth to lock the rail under each notch. Glue the top end of the spiral rail to the inner frame.

8. **Install the return ramp** between the spiral holder and inner wheel frame. Make sure the motor wires are not obstructing the return path of the marbles! Glue is optional, but recommended.

9. **Wedge the top rail into the inner wheel frame.** Glue it to the diamond support on the top spiral arm and the ball exit notch.

Load all the marbles and manually crank them in, being aware of any sticky motion. Make sure all frame pieces are well seated on the base for proper alignment.

In sunlight, the motor pulses every few seconds, and a ball will drop about every minute. In indoor light, the motor slows to a pulse every few minutes (be patient)!

## Video Resources

The Solar Marble Machine in action: [bit.ly/solarMarble](http://bit.ly/solarMarble)

The Solar Marble Machine home page for updates and tips:

[solarbotics.com/product/kmms/](http://solarbotics.com/product/kmms/)

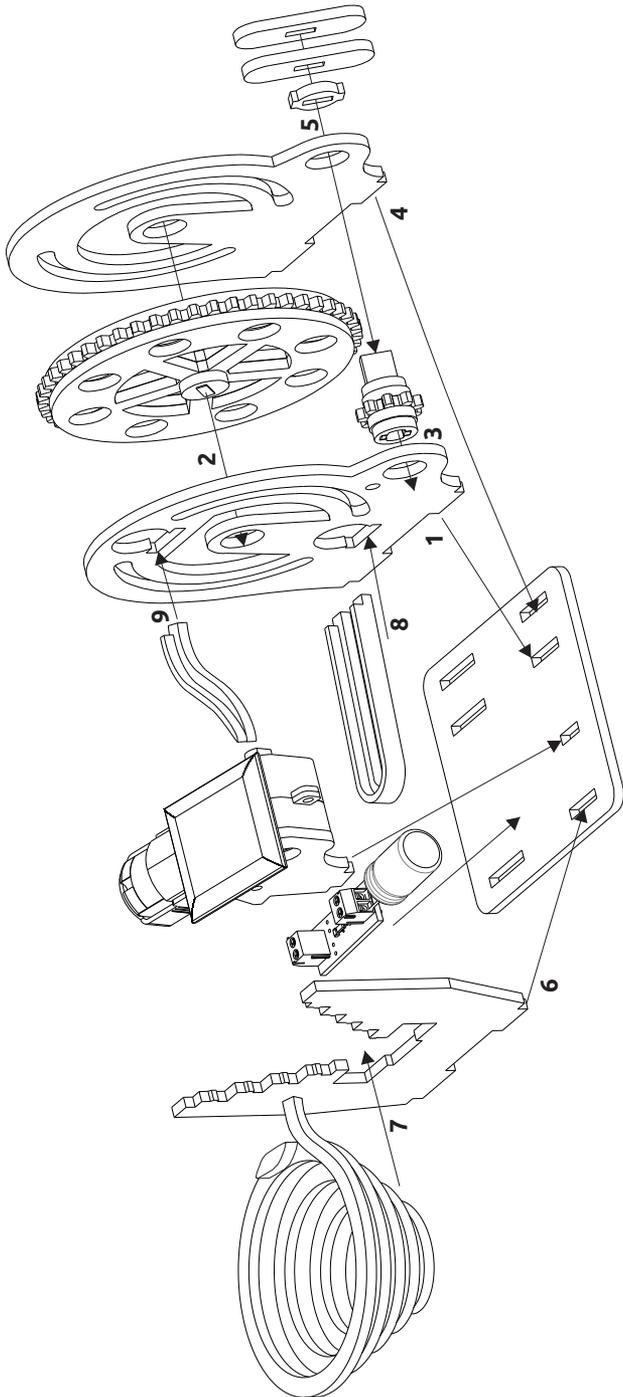
Tips on soldering:

[https://youtu.be/28OFNIXg\\_k](https://youtu.be/28OFNIXg_k)

See it in action:



FINAL ASSEMBLY DIAGRAM



# The Solarbotics Solar Marble Machine Kit

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## TROUBLESHOOTING

If your Marble Machine isn't fully functional, check this troubleshooting list:

**The marble doesn't consistently run the entire length of the spiral:** Find the ledge where the marble jumps off and shift the spiral forwards or backwards slightly to make that section of ledge a bit larger. Also make sure the surface that the machine is sitting on is completely even and horizontal.

**The motor is not moving:** Make sure your circuit is soldered correctly. Most errors are fixed by re-soldering. Check the orientation of all polarity-sensitive components and their location on the circuit. Look for broken wire connections.

**The wheel assembly gets stuck while turning:** Use some sandpaper wrapped around a pencil and sand the shaft holes of the two inner wheel frames. This will reduce the friction on the wheel assembly shaft, making it spin easier. Check to see if any glue from the top rail has dropped into the inner wheel frame and gummed up the works.

**Solar engine not working:** see step 1.1.

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## SOLARBOTICS "NO FEAR" WARRANTY

If damage occurs during construction, [contact us](#). We'll make sure you get the replacement parts to have a successful Marble Machine experience!

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Visit us online for more info and cool stuff:

[www.solarbotics.com](http://www.solarbotics.com)

**Questions or  
comments?  
Let us know!**



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