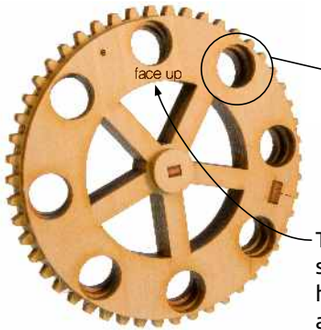
④ Drive Gear Assembly

Set #4 shows the stacking order for the drive gear. Glue is not necessary (but optional).

⑤ Gear Wheel Assembly

Follow the diagram in set #3 and stack the pieces together onto the axle. Again, gluing them together is optional for this step.

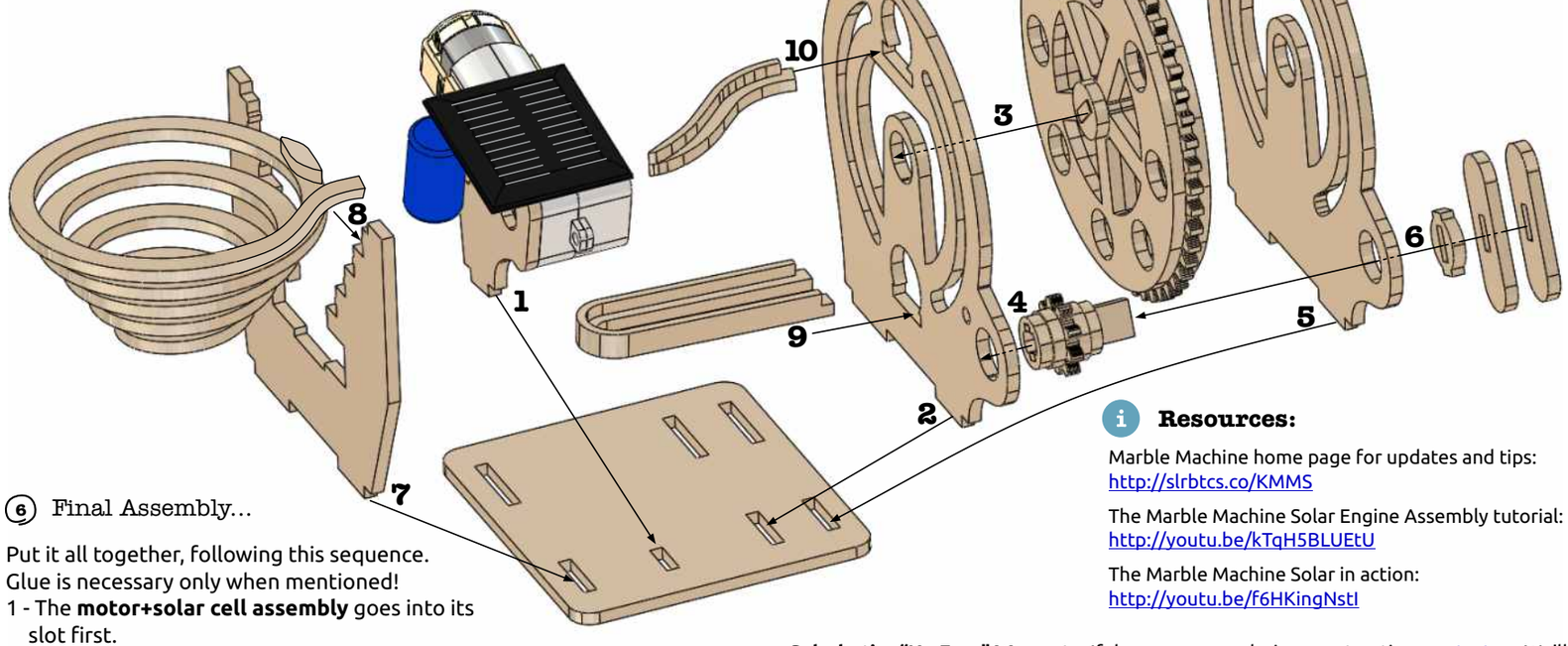


Top

Note:

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

This 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.



⑥ Final Assembly…

Put it all together, following this sequence. Glue is necessary only when mentioned!

1 - The **motor+solar cell assembly** goes into its slot first.

2 - **Inner wheel frame** attaches to the base with double slot/tab.

3 - **Gear wheel assembly** fits into the frame opening..

4 - ... with the smaller **drive gear assembly**, which mates with the motor.

5 - **Outer wheel frame** supports the gear wheel assembly and slides into the tabs at the base.

6 - **Crank handle** caps onto the drive gear.

7 - **Spiral frame** slides into the tab slots in the base.

8 - Secure the **spiral rail** at the top, then push the rails down. Pushing down, and sliding each rail back/down/forward under each notch works best.

9 - The **Bottom rail** is wedged into ball entrance & spiral frame, and catches balls from under the spiral. **Glue** is optional, but recommended

10 - The **Top rail** wedges into the inner wheel frame. **Glue** it to the diamond support on the top spiral arm and the ball exit notch.

Load the balls, and manually crank it around watching for sticky motion. Sandpapering the two axle holes is helpful! In sunlight, the motor pulses every few seconds, and a ball will drop near every minute. In indoor light, motor *pulses* will drop to every few minutes (be patient)!

Resources:

Marble Machine home page for updates and tips:
http://slrbtcs.co/KMMS

The Marble Machine Solar Engine Assembly tutorial:
http://youtu.be/kTqH5BLUEtU

The Marble Machine Solar in action:
http://youtu.be/f6HKingNstI

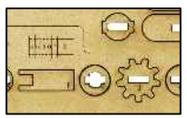
Solarbotics "No Fear" Warranty: If damage occurs during construction, contact us. We'll make sure you get the replacement parts to have a successful Marble Machine experience!

The Solarbotics

Solar Marble Machine

designed & produced in collaboration with MSRaynsford.co.uk

Marble Motion, enabled by Solarengine technology that keeps on moving, even in low indoor light!


Easy to build, with engraved building notes


Precision laser-cut fibreboard construction


All-in-one solar cell and circuit board


Chrome steel marbles

Ages 12 and up

Solar powered (no batteries required)

Soldering & basic tools required

1 hour build time

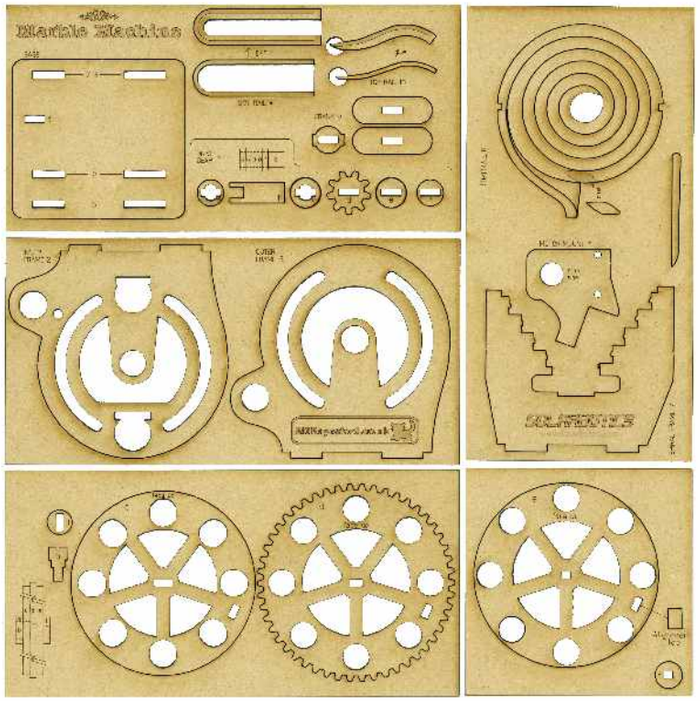
WARNING: Swallowing hazard!
Product contains small parts. Finished kit is not for young children.

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

SKU: KMMS http://www.solarbotics.com/products/KMMS/ Document Revision: May 9 2014

PARTS LIST

a) Set of wooden parts



b) GM9 Motor

c) 2 x #4x½" Screws

d) 7 x ⅜" Balls

e) 4700µF Capacitor

f) SCC3733 Solar Cell

l) Diode

g) PN222A Transistor

h) 1381L Trigger

j) 6.8µF Capacitor

k) 2-conductor wire

i) Double-sided Sticky Tape

TOOLS

Assembly is very straightforward, but you'll still need:

- Soldering equipment (soldering iron, solder)
- Wire cutters
- Philips #1 screwdriver
- Wood or white glue
- Tweezers (optional)

ASSEMBLY STEPS

The Solarengine circuit on the solar cell is the soul of your machine, and allows it to run in low light. <u>Be careful</u> while soldering to the solar cell - it is a fragile circuit board!

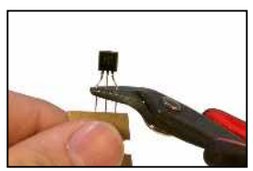
The introduction to soldering video: http://youtu.be/sgPY4B-3H10

Warning: do not bend any component leads after they are soldered. The copper solder pads on the solar cell are easily pulled off to board!

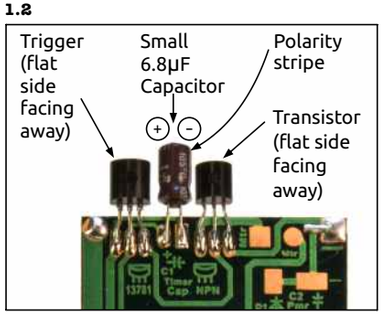
1 Solar Engine Circuitry

1.1

Take the small 6.8µF Capacitor (j), Transistor (g) and the Trigger(h) and trim all the leads down to ~3mm (1/8") long, like shown here.



1.2

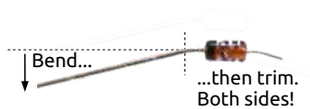


Solder these parts to be backside of the solar cell, which acts also as the circuit board. You can use tweezers to hold components - they can get pretty hot.

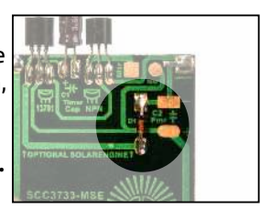
Make sure to match the orientation. Backwards parts don't work!

1.3

Prepare the diode (l). Gently bend, then trim down both diode leads to ~2mm long (3/16").

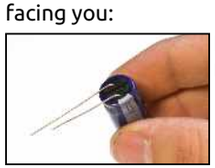


Solder the diode as shown, with the black stripe **up.**



1.4

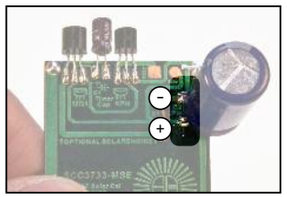
Prepare the large 4700µF Capacitor (e) by gripping it with the stripe facing you:



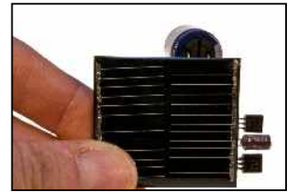
Bend the leads 90° over to the left...

...and clip them off, close to the body.

Solder it in, fully on the solder pads next to the diode and the stripe facing away...

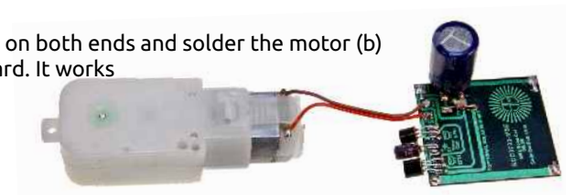


...so the leads are barely visible from the other side.



1.5

Strip the wire (k) on both ends and solder the motor (b) to the circuit board. It works equally well installed either way.

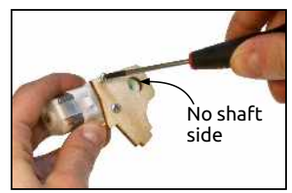


Test by exposing to light for at least 1 minute, the motor will pulse every 2 to 5 seconds. If not, double check all solder connections!

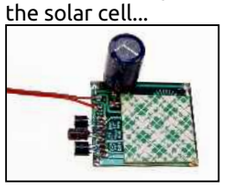
Pop out ONLY the wooden parts needed for each step, as the carrier board shows the parts' labels.

2 Motor Mount

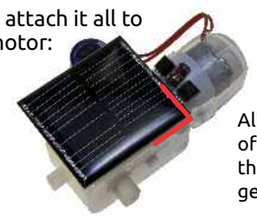
Use the #4 screws to attach the motor & solarengine assembly to the wooden holder, then put it aside for later.



Peel and stick the double-sided tape to the solar cell...



...and attach it all to the motor:



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

3 Gluing Rails

Glue takes time to cure, so let's get it started with Spiral set #8.
Glue the diamond to it's shadow marked on the spiral.
For Bottom rail set #9, glue the narrow "U" to the larger "U".
On the Top Rail set #10, glue the slim sliver to the finger rail.

Spiral rail (set 8)

Bottom rail (set 9)

Top rail (set 10)