

Putt Putt Boat Instructions

NAME _____

Materials list

- an aluminum beverage can--it should not be dented, or even have been dented and pushed back out
- patterns for engine and straw bend
- scissors
- craft knife
- Masking tape
- a sharp corner as on a table or block of wood
- ruler
- marker
- 3 Flexible plastic straws. 1/4" diameter
- Epoxy
- Toothpicks or popsicle sticks to mix and apply epoxy
- a container that holds water, for finding leaks.
- Cardboard for mixing epoxy and boat prototype
- hot glue gun – low temperature
- thin birthday party candles are and/or metal encased so called tea candles. Birthday candles burn hotter, tea candles burn longer
- aluminum foil
- foam grocery trays
- half gallon milk or juice carton
- stapler

Site created by Slater Harrison with many useful videos and instructions:

<http://www.sciencetoymaker.org/boat/>

Introduction 1 (part 1 video) <http://www.youtube.com/watch?v=2ZF0mjuAxM>

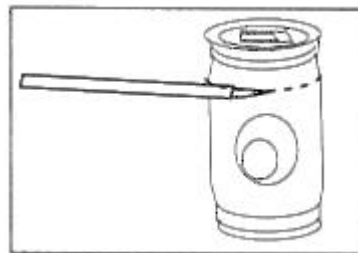
Introduction 2 (part 2 video) <http://www.youtube.com/watch?v=Glehc-CWYG4>

Materials and Tools (part 3 video) <http://www.youtube.com/watch?v=s7xgx4cPjp0>

Step 1 Cut top off Aluminum can (and history of Aluminum) (part 4 video)

<http://www.youtube.com/watch?v=zy3FKGynzP8>

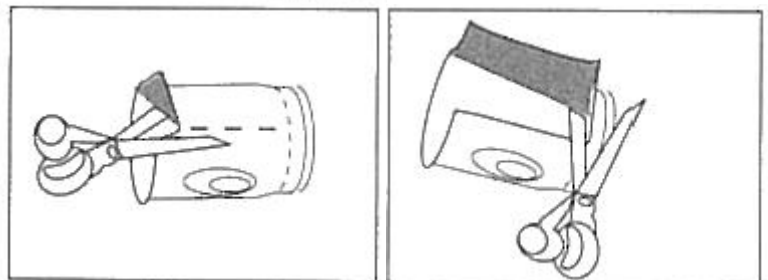
Use a craft knife to make a cut at the edge of the can where it is at full diameter.



Step 2, Cut and trim the middle part of the can

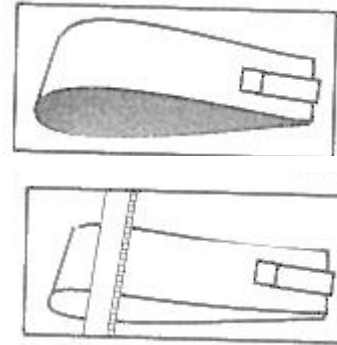
(part 5 video) <http://www.youtube.com/watch?v=Tnzff4YUDj4>

Use scissors to cut the can along its length, then cut off the top and bottom. You should have an aluminum strip at least 2" wide.



Step 3, Fold the aluminum sheet in half then flatten to make a soft crease at the closed end, (part 6 video) http://www.youtube.com/watch?v=d5sAFesi_os

Fold the strip with the shiny aluminum side in. Leave a thin sliver of the inside of the can showing at the edge so it's easier to separate in a later step. Tape the ends together. Flatten the aluminum with a sturdy object and make a soft crease at the closed end



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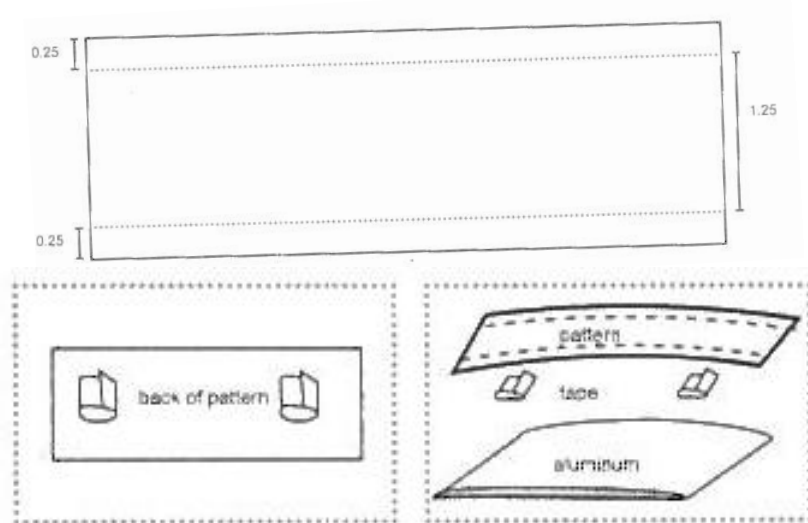
Step 4 Print out width patterns for boiler (part 7 video)

<http://www.youtube.com/watch?v=96rMRBE6wRs>

Pattern: <http://www.sciencetoy maker.org/boat/images/enginePatternJan09.PDF>

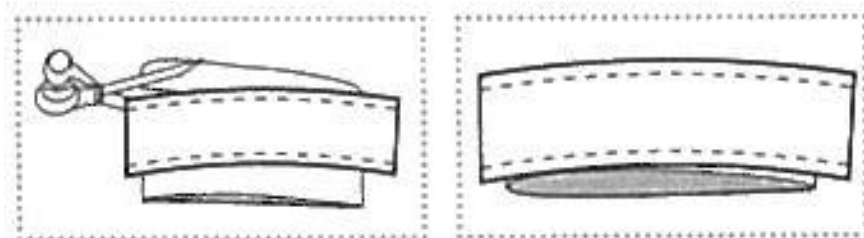
Use a pattern to get the correct width of the strip. Attach it to the strip with tape donuts. There is a pattern at the end of this packet.

You can also make a pattern with a piece of graph paper – total width 1.75", folds at .25" from each end.



Step 5, Cut the aluminum strip (part 8 video) <http://www.youtube.com/watch?v=mH22inmGGxA>

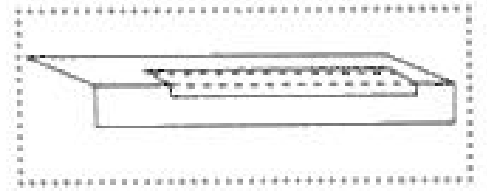
Follow the pattern and cut the aluminum on the solid lines. Leave the length as it is.



Step 6, Use a sharp corner to make clear fold lines (part 9 video)

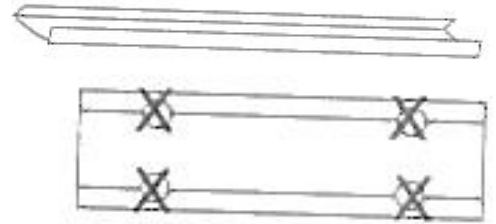
<http://www.youtube.com/watch?v=vhZ6ZMguGkM>

Align the dotted line of the pattern with the sharp edge of a table or the square end of a stiff piece of material.



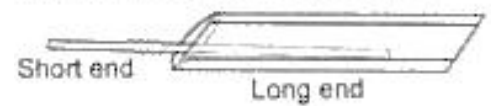
Step 7 Fold the edge flaps the rest of the way over with a credit card or something like it, then pound it flat (part 10 video) http://www.youtube.com/watch?v=E_mHNPEQzuU

Carefully fold down the edges with your fingers. Pound gently on a stiff ruler or block of wood to make a crisp bend.



Step 8 Create a "pocket" (part 11 video) <http://www.youtube.com/watch?v=PUJGbmunJKk>

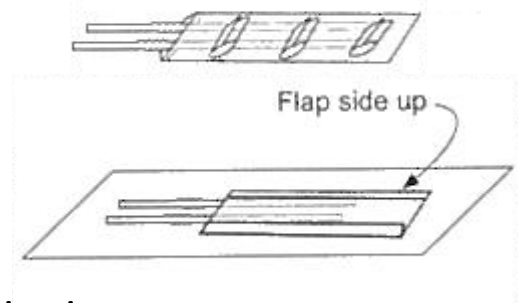
Insert the long part of 2 flexible straws to create a rounded pocket in the engine.



Step 9 Form a curved dome top and flat bottom (part 12 video)

<http://www.youtube.com/watch?v=jfBrZyhKPIO>

Use a 3rd straw (only the short end) to form a curved dome top. Gently push on the edges to make the bottom flat. Tape the engine to a piece of cardboard using tape donuts.



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Step 10 Glue the aluminum so it keeps its new shape. (part 13 video)

<http://www.youtube.com/watch?v=f8dEyNACOYU>

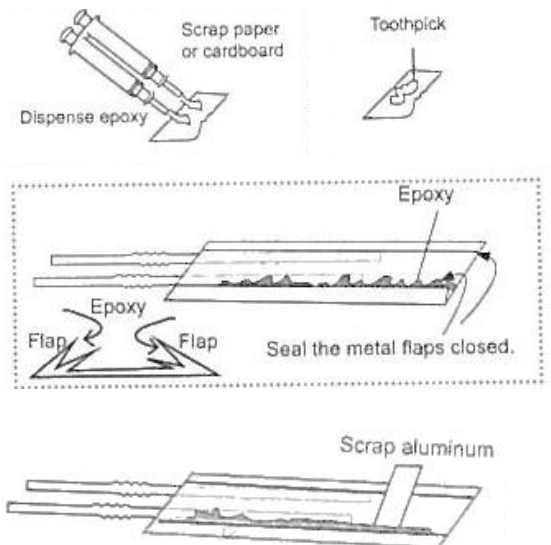
Mix some 2-part epoxy. Use a toothpick to fully seal the sides of the engine. Run the toothpick or a strip of aluminum between the flaps to make sure the epoxy gets in.

Make sure the engine keeps its domed shape.

You do not need to seal the flaps to the engine top.

Do not get epoxy on the straws or the open end.

Set it aside to cure.



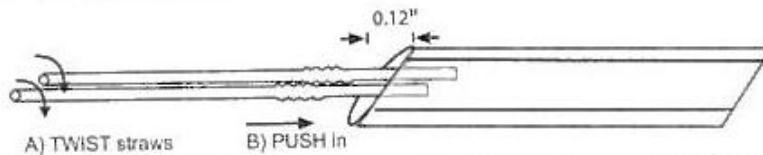
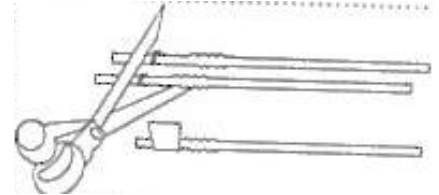
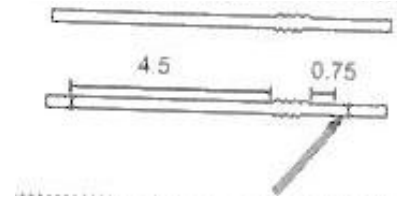
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Step 11 Cut the short end of the straw and glue into engine (part 14 video) http://www.youtube.com/watch?v=QFkyr_yhIOE

Cut the short end of straw .75" from bendy part (not 1.5" as shown in video).

Cut the long end 4.5" from the bendy part

Apply epoxy to straws and insert into engine, leaving .12" between engine and bendy part. Twist the straws after inserting to spread the epoxy around.

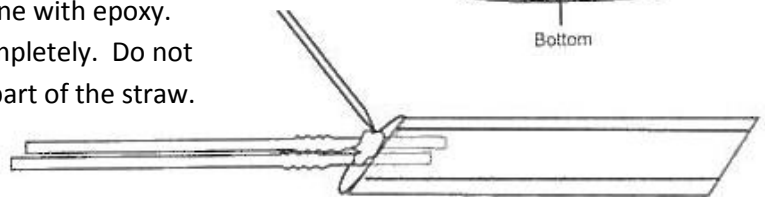
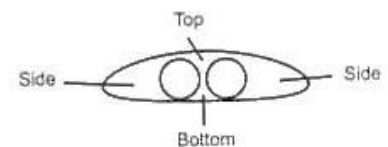


Step 12 Seal end of engine (part 15 video)

http://www.youtube.com/watch?v=7al_hqCKeKI

Seal the open end of the engine with epoxy. Use enough epoxy to seal completely. Do not get the epoxy on the bendy part of the straw.

Set it aside to cure.



Step 13 Check for leaks. (part 16 video) http://www.youtube.com/watch?v=LG_XwHrZviE

Put the engine into a cup of water and blow into the straws to find leaks (bubbles in the water). Patch with epoxy as necessary. If it is correctly sealed you will be able to puff/pull air to make the putt-putt sound



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Step 14 Make a cardboard angle tool (part 17 video) <http://www.youtube.com/watch?v=f9axejVAuDc>

Pattern: <http://www.sciencetoymaker.org/boat/images/enginePatternJan09.PDF>

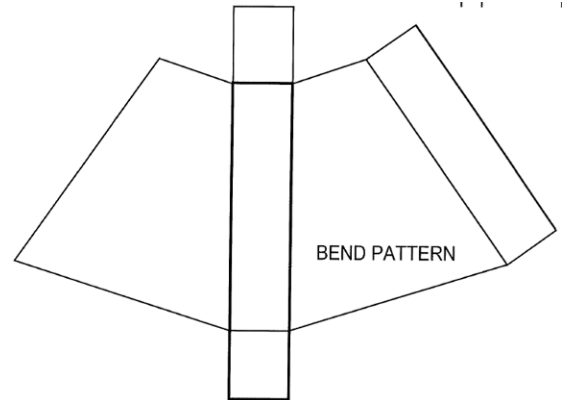
Make a cardboard angle tool to set the angle between the aluminum boiler and the straws.

Transfer the pattern (full size at end of this packet) onto stiff paper.

Cut outline

Score all interior lines and fold back to a closed shape.

Fasten with tape.



Step 15 Bend straws and tape engine to angle tool

(part 18 video) <http://www.youtube.com/watch?v=O-403pV22RM>

Extend straws and bend to proper angle so engine and straws fit closely to cardboard angle tool.

Folded aluminum flaps must face out.

Tape engine and straws to angle tool

Step 16 Glue the straws to hold the correct bend.

(part 19 video) <http://www.youtube.com/watch?v=B2a1BNjglms>

Use low-temp hot glue to glue the bend at the correct angle (35°).

This bend will fit through a hole in your boat, so do not use too much glue.

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Step 17 Make candle holder (part 20 video) <http://www.youtube.com/watch?v=-EijtmNruf8>

Cut a birthday candle into 4 pieces.

Take 1 piece and clear the wax off the end to expose the wick

Get a 2" x 6" strip of aluminum foil and fold over to 1" x 6"

Cup the end of the strip around the candle and use the other end as a handle

Step 18 Prime and Test the engine (part 21 video) <http://www.youtube.com/watch?v=Jvp62IruQwY>

Prime the engine by pouring water into the straws, then cover the straws and shake to engine to make sure there are water droplets inside the engine.

Keeping straws full of water, hold engine by the glue on the straws, and place it in a container of water. Hold a lit candle under the center of the engine for about 30 seconds to see if it works. If it does not work try the troubleshooting step next.

Step 19 Troubleshoot the engine (part 22 video) <http://www.youtube.com/watch?v=Gbm60Xu4UcK>

Look for leaks in the engine by putting the engine in water and blowing hard into the straws. Look for leaks again and patch with epoxy as necessary.

Other problems may be clogged straws, kinks in the straws or bent aluminum.

If nothing can be found, start over again with a new engine.

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Step 20 Clean carbon on engine, design a boat (part 23 video)

<http://www.youtube.com/watch?v=sI5IsaKtchc>

Plan your boat and make a prototype out of cardboard or paper.

The boat must meet these constraints:

- a. Has room for engine and tea candle
- b. Candle located so flame is towards top of engine – away from straws.
- c. Has room for cargo/action figure
- d. Boat is watertight and floats
- e. Boat is stable and does not tip over-use a keel if necessary
- f. Small and light so this small engine can propel it!

A pattern for a juice carton boat is at the end of the packet. Instructions are here:

(3 videos)

Part 1 http://www.youtube.com/watch?v=yy_Z9VeaXvc

Part 2 <http://www.youtube.com/watch?v=4gAVCYJWwY0>

Part 3 <http://www.youtube.com/watch?v=tr1HHVBxSjU>

Hull Pattern: <http://www.sciencetoymaker.org/boat/images/boatHull.PDF>

Deck and cabin pattern <http://www.sciencetoymaker.org/boat/images/deckPat07.PDF>

Here is a Pattern for a flat boat made out of a styrofoam tray:

<http://www.sciencetoymaker.org/boat/images/foamPatternJan08.PDF>

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Step 21 Make boat (part 22 video) <http://www.youtube.com/watch?v=ED95Qvnx-ds>

Boat material options: Styrofoam trays, juice cartons, corrugated plastic

Choose a material and construct your boat.

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Step 22 Optional - Improve performance – (part 25 video)

<http://www.youtube.com/watch?v=P2sbSK79e4g>

Make boat go faster by restricting the ends of the straws

Step 23 Redesign the engine, predict how it might change performance, then try it out.

Plan a change to some feature of the engine (size, straws)

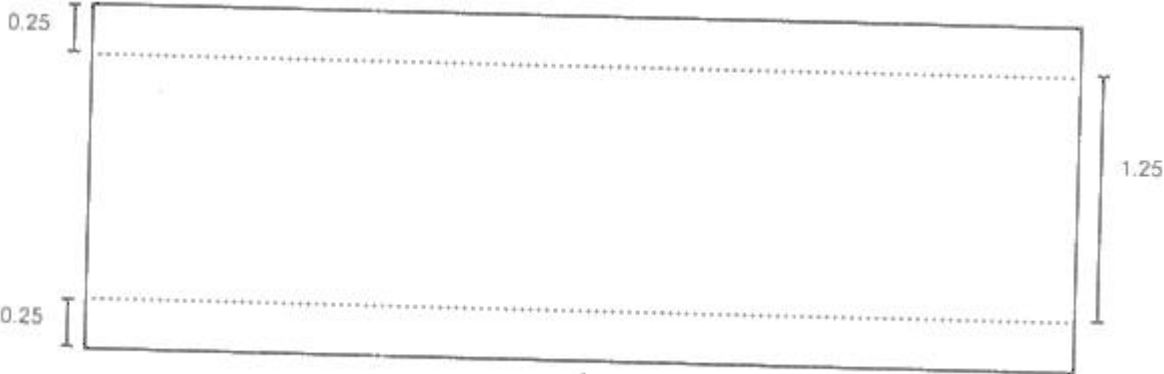
Predict how it might change performance

Design and build the new engine

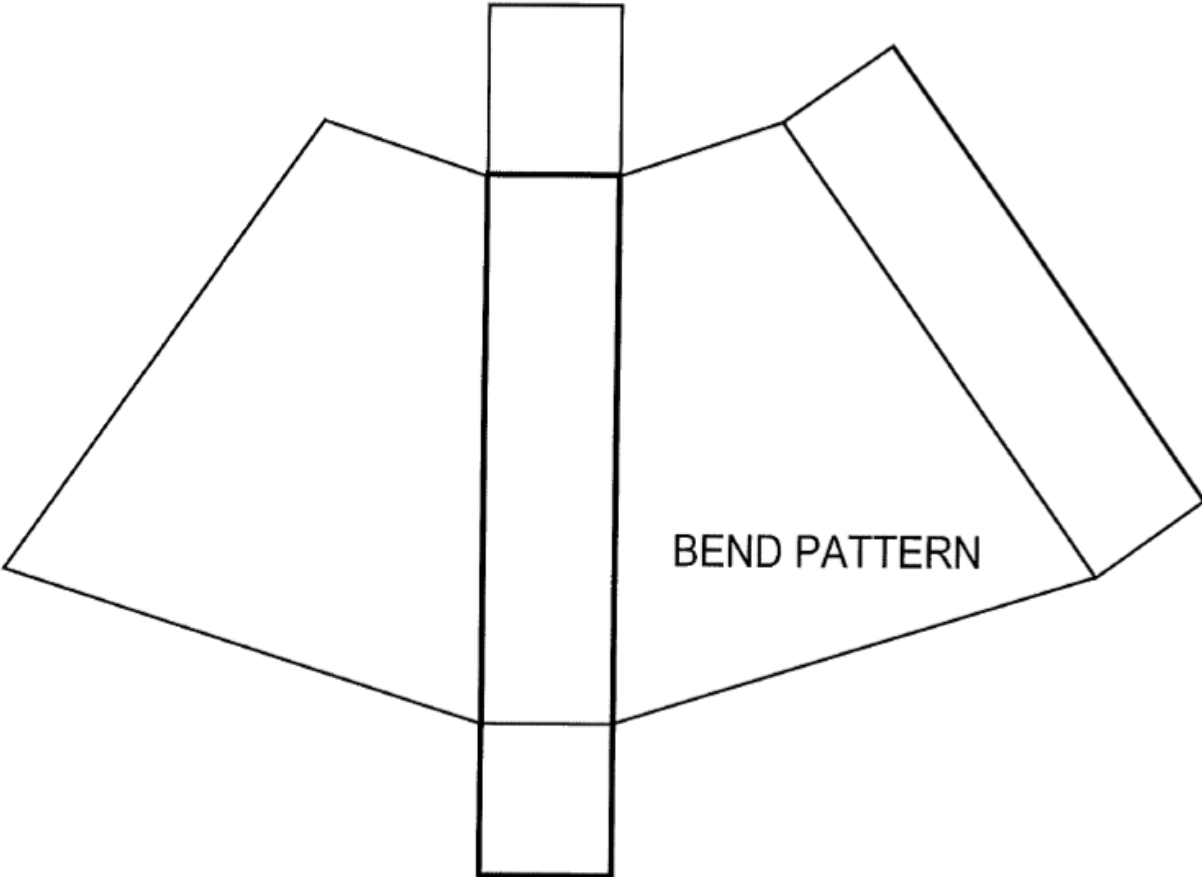
Test it out on its own, in your existing boat, or a new boat

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Pattern to use on Aluminum from Step 4



Pattern to create Angle Tool from Step 14



Pattern to create cardboard boat from Step 14

