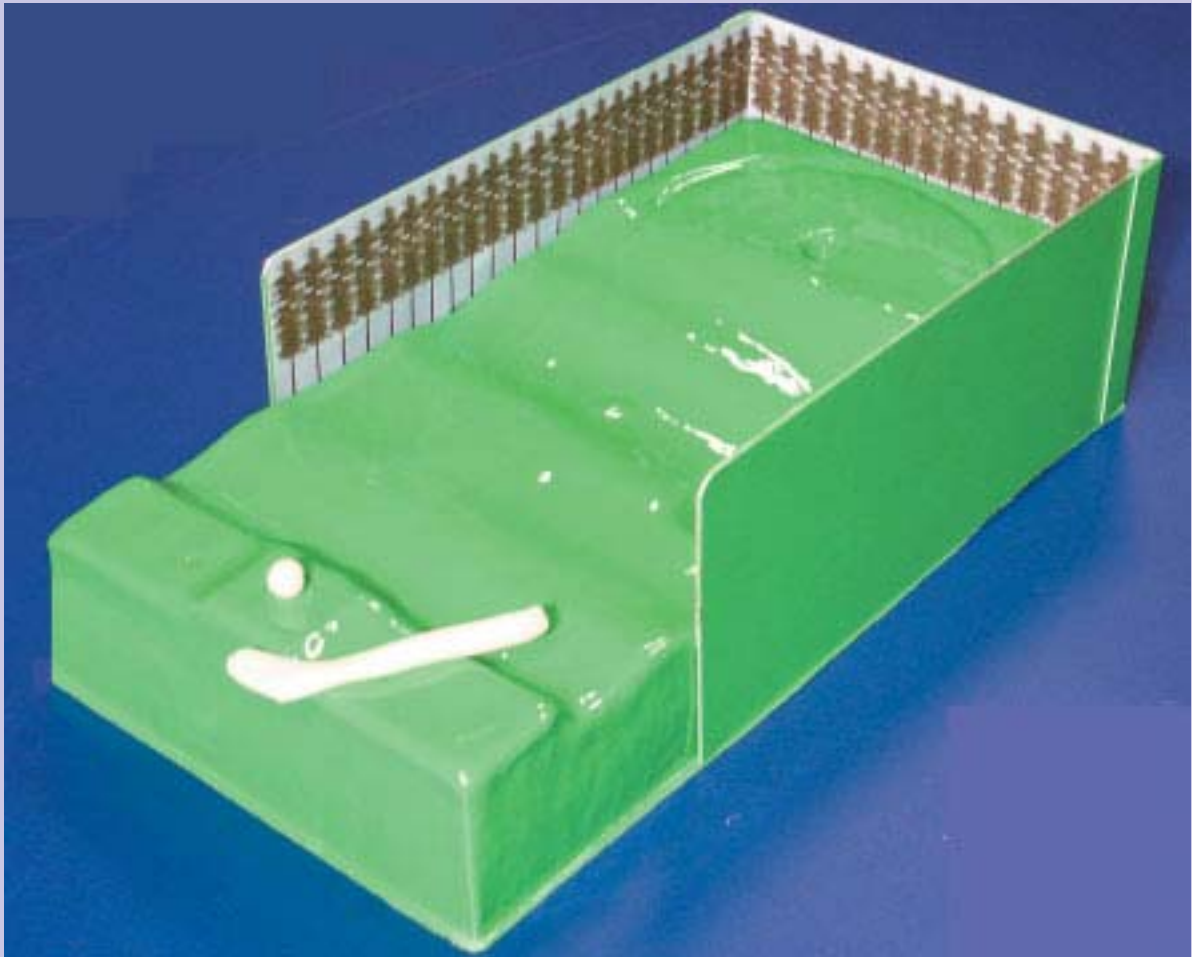


## TABLE GOLF PROJECT



### Target Age Group

Key Stage 3/4

### Skills Learned

Sculpting, Mould Finishing, Vacuum Forming, Resistant Material properties, Finishing, Assembly and Design

### Outline of Project

In this project, students design and make a Table Golf set. This includes a vacuum formed base with Tee, fairway, putting green and hole, along with a golf club and ball.

### Materials to be provided to the Students

1 piece of High Density Expanded Polystyrene 75mm thick, cut to 380mm x 203mm

1 piece of 6mm MDF, cut to 430mm x 226mm\*

C R Clarke Foamould coating Resin

1 piece of HIPS 1.5mm thick, cut to 458mm x 254mm\* (Vacuum Forming).

3 pieces of HIPS 1.5mm thick, cut to 300mm x 150mm (Backdrop).

10 grammes of Polymorph

Double Sided Sticky Pads

4 x No 8 x 50mm Woodscrews

1 x M6 Plain Washer

\* This is based on the C R Clarke 917/725 Vacuum Forming Machine. The dimensions may need to be altered for different makes or models of machine.

### Equipment Requirements

Expanded Polystyrene Sculptor

Vacuum Forming Machine

Injection Moulding Machine (if needed for Golf Club)

## STEP 1

### MAKE THE GOLF CLUB

We have provided an initial shape and size for a suitable golf club in Diagram 1 (see page 16). These dimensions can obviously be tailored to your needs if required, There are several ways of making the golf club, and it may be worth going through these with the students to point out the strong and weak points of each method. A few suggestions are as follows:



Method	Strong Points	Weak Points
Draw a suitable shape using a CAD system. Print your design and stick it to a piece of 5mm MDF. Cut the MDF using a Hegner saw or similar. Finish with fine glass paper.	Easy to achieve in the workshop. Sanding will produce a round handle Quick to produce a single product No tooling	It would be laborious to produce a number of clubs The quality of the finish of each club depends on the skill of the student Limited to 2 dimensional contouring
Heat 10 grammes of Polymorph in hot water. Once the Polymorph has softened, remove from the water and form by hand into the shape of a Golf Club.	Can produce a sculpted shape with 3 dimensional contouring Very quick to produce No tooling	Relies completely on the ability of student to quickly mould the heated material. No consistency if a number of clubs were produced.
Design your golf club using a CAD system. Download the file and cut the club from acrylic using a laser cutter. This technique would also allow for an engraved pattern on the club.	Easy to achieve in the workshop. Quick to produce a single product. A production run of consistent clubs can be made. No tooling	The handle has sharp edges, making it more difficult to use. Limited to 2 dimensional contouring.
Design and make an injection mould for the golf club.	Once the mould is complete, it can quickly produce many identical golf clubs. The mould will be durable, enabling many hundreds of clubs to be produced. Can produce a sculpted shape with 3 dimensional contouring. It would be possible to include the ball in the mould, to reduce manufacturing time.	Precision mould manufacture is required. Very limited possibilities for varying the design of each club.

## STEP 2

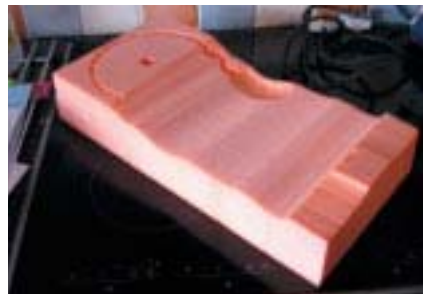
### MAKE THE GOLF BALL

The golf ball should be a sphere of approximately 12mm diameter. This can be purchased (for example a marble), made in the workshop (for example in Polymorph), or included in an injection moulding tool (see above).

## STEP 3

### SCULPT THE GOLF COURSE

Start by cutting a 5° draft angle on the four edges of the expanded polystyrene. This will enable the



forming to be released easily after vacuum forming.

Next, sculpt the shape that you require. In the sample project, we initially used the wire bow to profile

the block, giving a higher Tee area, a contoured fairway, and then a flat putting green.

Once the basic contour has been completed, it can be detailed using the hand sculptor tool. In the sample, we added a bunker to one side of the fairway and a gully around the edge of the putting green. Also, a hole is sunk into the putting green, of a size suitable for the ball made in Step 2.

The mould can be tested at this stage, to ensure that it provides the right level of challenge to the user.

# TABLE GOLF PROJECT

## STEP 4

### COAT THE MOULD

This project demonstrates the ability of expanded foam to be used as a viable mould making material. However, this can only be achieved by coating the mould to ensure release of the finished vacuum forming. The mould should be mounted onto four pins (long nails are very good for this), so that the coating can be applied right down to the bottom of the side faces. Place the mould onto a protective surface (e.g. newspaper, polythene etc). Mix the resin as detailed in the instructions and apply a single coat over all of the surfaces that will contact the plastic.

While the coating is still wet, place the M6 washer on the Tee off position.

Allow the coating to cure as detailed in the instructions (normally overnight).



## STEP 5

### PIERCE THE EVACUATION HOLES

High density foam is closed cell, and as such is not porous to air. Therefore, the mould must be pierced at the lowest point of any evacuation cavity, in the same way as a wooden mould. However, the foam can be simply pierced by pushing a piece of 1mm diameter brazing rod into it. Ensure that each hole goes right through the foam.



## STEP 6

### MOUNT THE MOULD ONTO THE BASEBOARD

Drill four 4.5mm diameter holes in the baseboard and countersink them from the underside. Drill a central 6.0mm diameter hole to allow the air to evacuate. Apply six or eight sticky pads to the underside of the expanded foam mould to provide an air path underneath it. Stick the mould to the baseboard. Turn the complete mould upside down and fit four No 8 x 50mm screws into the foam.

The screws will have sufficient grip in the foam to hold the mould securely to the baseboard.

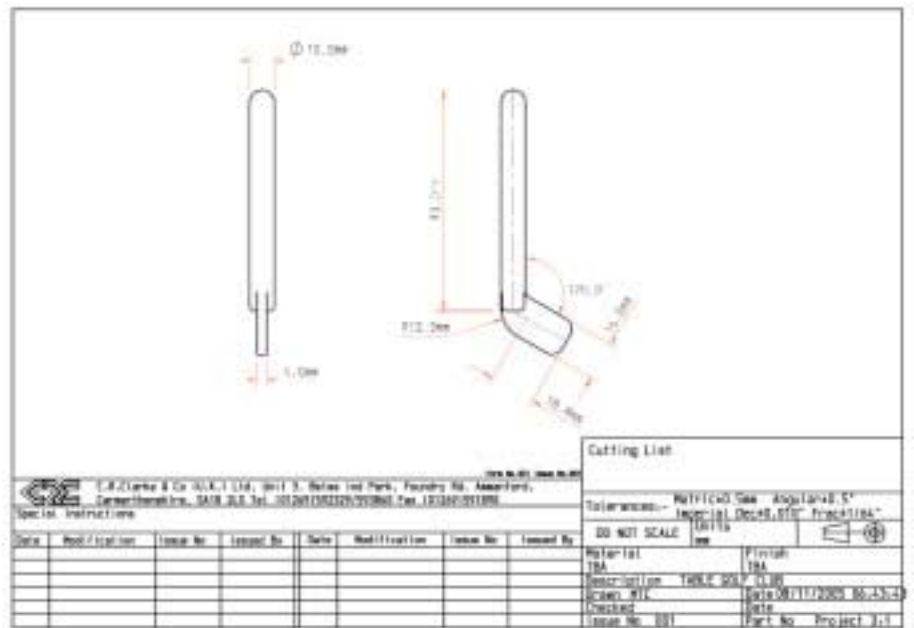
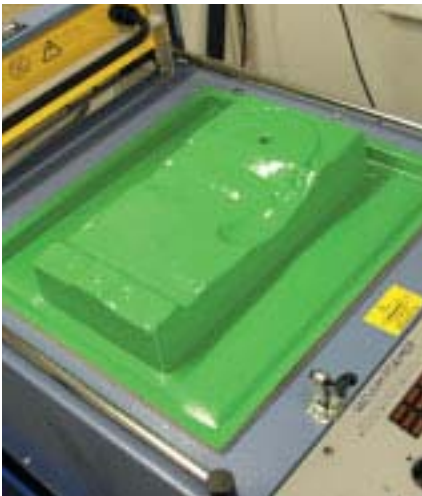


Diagram 1

## STEP 7

### FORM & TRIM THE MOULD

Load the completed mould into the vacuum forming machine and form as normal. Note that the plastic behaves very differently over the foam mould. Most moulds (e.g. MDF, resin) are quite thermally conductive, and chill the formed material quite quickly. By contrast, the foam is an excellent insulator and therefore holds the heat in the plastic being formed. For this reason, the vacuum cycle will be much longer when using the foam mould. The completed forming can be trimmed using a C R Clarke Profile Router or similar. It is beneficial to leave a small flange at the bottom of the forming to add some strength to it.



## STEP 8

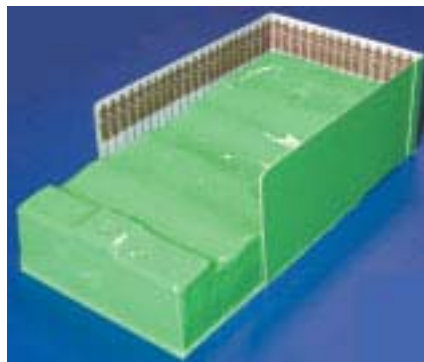
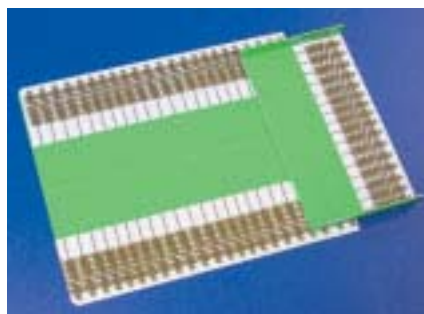
### CUT THE BACKDROP PIECES

Cut the three pieces of HIPS into suitable shapes to stop the ball falling off the table when the game is being played. The corners at the Tee end should be rounded to prevent injury to the player. At the green end, the corners can either be butted together or heat folded and overlapped.



The inside faces of the backdrop can be decorated with paint or images stuck onto it, to represent a realistic background.

Glue the backdrop pieces into place around the base using a polystyrene solvent cement.



## STEP 9

### COMPLETION

Any details can be painted onto the face of the completed game, for example a sandy colour to represent a bunker.

Your Table Golf game is now ready to play.

