AESOP 3D Imaging Workshop – Educational 3D Models

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Dennis Kriel from 3D makerspace http://www.up.ac.za/en/news/post_2062883-south-africas-first-library-makerspace-opens-at-the-university-of-pretoria

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Mouldmaking: The art of using moulds to replicate items is centuries old. The availability of modern materials like silicone, polymers and epoxies has changed the possibilities of complexity and detail to a completely different level. With new technology like 3-D printing becoming more affordable, combined with advances in chemistry, the future is only exciting. When one wants to duplicate an item, a few matters should be considered:

1. Why do I need more of this item?
2. How valuable/unique/fragile is your item?
3. How many do I need?
4. Is the material in which it is made important?
5. How accurate should the copies be?
6. What will it cost per unit eventually?
7. When do I need the items?
8. Is it perhaps available commercially, and more economical?

If you would like a few thousand items, it might be best to do it through a commercial company. With injection moulding, where you can use high heat and pressure, stainless steel multi-part moulds that are water cooled for rapid de-moulding, almost anything is possible. This is a very costly process, and you need a commercial market and big quantities to make this economically feasible.

Something like a unique fossil, for example, would not be available on the market.

You would also perhaps need only a few copies to exhibit in museums and keep the original safely locked away. An item like this would be ideal to duplicate using the techniques we will discuss. We will not be able to discuss all the methods to make moulds, but will focus on a few main principles. For the purpose of illustration we will focus on small items.

Box

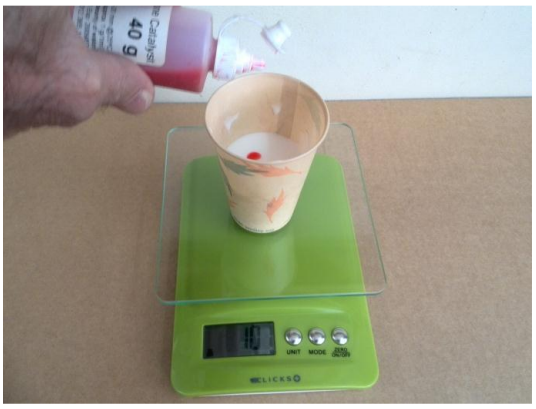
For most items, any material which is sturdy enough to hold the moulding material can be used for a container; Perspex, cardboard, sheet metal, etc. For small items, a paper cup is sometimes adequate. In the case of a two-part or multi-part mould, it is advisable that the mould should be extendable, as every part needs to be cast separately. In some cases, like taking a mould off a vertical surface, a box might perhaps not be possible or necessary. Plaster or concrete can be used for support on larger objects, over the silicone that picks up the detail.

Moulding material

When a solid, stiff object needs to be replicated, the mould material should be flexible to enable you to get the model out of the mould and to take up small undercuts. When the original is soft and flexible the mould could be of a stiff material like polyurethane or plaster, but then the copies could only be made in a soft material like latex, rubber or silicone, otherwise it will be difficult or impossible to get it out of the mould again, even if there are no undercuts.

Method 1

If the item you want to duplicate is flat, with no detail of any importance on one side, you can get away with a simple open mould. Simply fix the item on a flat surface (that will be the bottom of your box), making sure not to damage the original in doing so. Sticky putty or plasticine can be used for this purpose. Build a box around your item, leaving enough room to ensure a sturdy mould, and high enough to cover the object.



Mix your silicone according to the instructions, avoid mixing in any air bubbles. When properly mixed, pour the silicone in one corner, to slowly run over and cover the item completely. When cured completely, remove your box material, then carefully peel away the mould from your model, try not to break either. Experts say it is best to let a mould mature for a day or so before using it, and best to store it upside down to avoid it becoming dusty. It can easily be washed with soapy water and dried with a clean cloth.

This mould you can simply put on a level surface, mix your material of choice, pour until it is level with the sides, and remove it the same way you as the original when cured.

Method 2

In the case where your item is not too complex and you can take the risk to cut on or very close to the surface of it, the following method might be possible. Fix the item on a cone of plasticine, imagine your item like a tree branching upward. The cavity left by the cone will eventually also act as a funnel to cast your item. If there are parts turning down, you will need to create breather tubes to the bottom, or avoid this method.

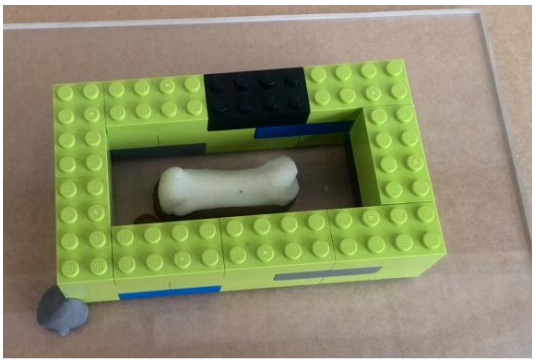
Create a box around the item as described in method 1, leaving a little extra room on the top.

Mix the silicone and fill the box, taking care not to trap any air bubbles. When cured, remove the box material, turn the mould upside down and carefully remove the plasticine cone. Using a sharp knife, cut open the mould on two sides, or better on only one side if you can, just far enough down to free your item. It is best not to cut open your mould all the way and end up with two halves, which might be difficult to realign and hold together. This mould could be held close using string or elastic bands, not too tight, otherwise it will distort. You can also use cardboard to strengthen the corners.

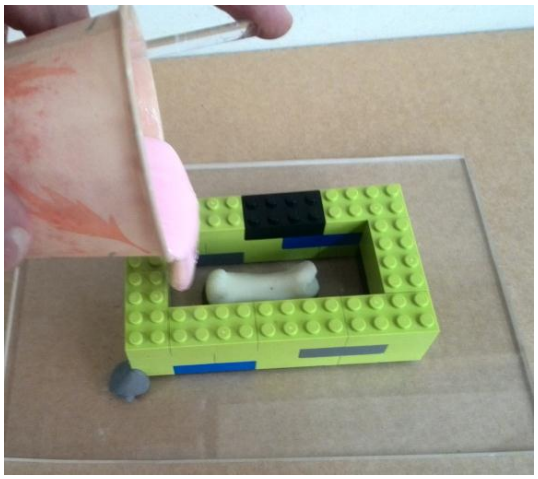
Pour the cast material slowly through the funnel, let cure, remove like the original. Your model will now have a cone shape protruding from it which you can cut off and work until smooth.

Method 3

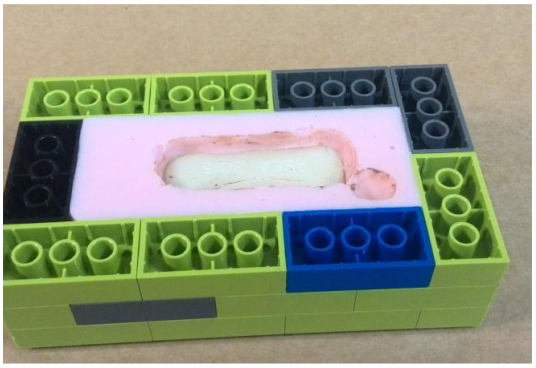
In a case where methods 1 or 2 are not sufficient, a two-part mould might solve it. Build a platform on the bottom of your box roughly the size and shape of your item, 5 – 10mm high for a small item, plasticine works well. Put your model on the platform, orientate it in such a way that the bottom has the least detail. Fill in the undercuts on the item with plasticine, starting from the platform building up, try to end at right angles to the surface of the item. Do not work the plasticine too thin where it meets the item. Work your way around the item, so that there are no cavities. Usually the platform will also eventually act as a key to lock the two halves of the mould together. If, however, the item is very symmetrical, studs or holes should be created away from the item in the plasticine to lock and align the final mould.

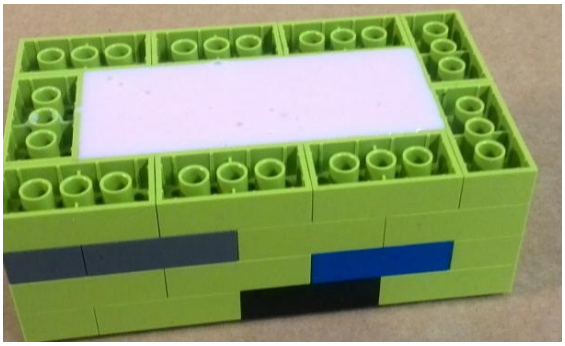


When done, build a box around it like before, and fill with silicone. When cured, do not remove the sides of the box. Loosen the box from the bottom and turn upside down. Remove the platform and the plasticine that was used to fill in the undercuts.



Take care not to loosen or separate the silicone from the item. It is important to clean off all plasticine close to the item, otherwise the mould will not work well. Paint a thin layer of separating agent over all the exposed silicone, a thick gel type liquid soap works well. If this is not done, you will end up with method 2 again, without the funnel. Extend your box so that you can cover the whole area with a 10mm layer, mix a new batch of silicone and fill your box. When cured, remove the sides of the box, find the separation between the two halves in the block of silicone, and carefully work your way around, peeling off the last casting first.





The item can then be removed from the first casting, all the time taking care not to damage the item or the mould. To cast your model, put the hollow part of the mould on a flat, level surface and mix 5 – 10% more material than the actual model will require.

Carefully cast all the material in the bottom part of the mould, then slowly lay down the top part from one side, taking care not to trap any air bubbles. This method will have the excess material spill over. It is best to work on old paper that can be discarded afterwards. When cured, remove like the original. Before storing the mould

or using it again, it important to clean off all casting material from it. There are usually a thin layer of your casting material forming between the two halves of the mould, it is special important to clean this off as this can ruin following castings.

Method 4

Sometimes it is not possible or necessary to use a box for your mould. In the case of a big flat surface you can simply “paint” the silicone over the area to be duplicated. There are also special, thicker silicones or thickening agents available for this purpose. When cured, you can add a layer of plaster or fiberglass over the silicone to act as a support. On big surfaces it might help to use air pressure to release the support from the silicone, as suction between the surfaces will make the initial removal difficult.

Method 5

When complex or intricate items needed to be duplicated, combinations of the other methods can be used. On big projects, the mould could be made in several parts, probably with a framework built around it that can be disassembled, onto which the different parts of the mould could be fixed to secure them in place. Casting of big models like the skeleton of a big dinosaur are usually done in parts and assembled afterwards.

Conclusion

There are many chemical composites on the market for making moulds and cold cast materials, and it changes all the time. The best is to explain to your chemical supplier the basics of what you need to do and follow their advice. There is always a sense of achievement when one can get a good replica in the end from a mould that you planned yourself. Experience and the motivation to try something new in this field, I suppose like in most, is a virtue.