

PYTHAGOREAN CUP

Name of the object	Pythagorean cup (with clay)
Recommended ages (from...)	From 7 years old
Thematic areas combined (STEAM)	Science (Physic forces, Pressure, Materials) Engineering Art Mathematics (Measurements) History
Materials needed	<ul style="list-style-type: none">• Around 400 grams of clay per cup• Oven-Baked Clay or self-drying clay• Kiln (special oven for clay)• A precision knife• A ruler• A rolling pin (or a cylindrical object that can serve as one: straight glass bottle or other)• Some greaseproof paper (ideally two +/- A3 sheets per person)• A pen / a straw• A metal spoon• A small glass or other circular object to cut out the diameter of your cup's bottom (should be around 8 cm diameter, can be made out of cardboard beforehand as well)• (Optional: a small bowl with water)• A way to wash your hands afterwards
Instructions step by step	<p>Step 0. What is a Pythagorean cup?</p> <p>Step 1. Setting all the materials up and reading through the instructions and models.</p> <p>Step 2. Building the Cup.</p>

Step by step: how to build the Pythagorean cup

Step 0. The Pythagorean Cup: What is it?

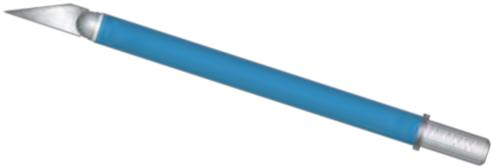


Source: 1 https://commons.wikimedia.org/wiki/File:Pythagorean_cup_from_Samos.jpg

The Pythagorean cup dates back to the 6th century B.C. and originated in Samos, Greece.

A Pythagorean cup (also known as a Pythagoras cup, Greedy Cup, Cup of Justice, Tantalus cup or *i koupa tis dikaiosynis*) is a clay cup that was used in ancient times in order to learn the limits of drinking and in life. Its invention was credited to Pythagoras of Samos. Indeed, if you fill you cup too much, above the limit line, a siphoning effect will cause the cup to drain entirely through the bottom. The Pythagorian cup was also called the Greedy Cup. As if you were too greedy with your drink, the cup would punish you by emptying completely.

Step 1. Setting up all the materials and reading through the instructions and models.

<ul style="list-style-type: none"><input type="checkbox"/> Around 400 grams of clay per cup Oven-Baked Clay or self-drying clay	 A package of FIMO clay and a piece of orange clay. The package is white with red and blue text and images. The clay piece is a rectangular block of orange color.
<ul style="list-style-type: none"><input type="checkbox"/> A precision knife	 A blue precision knife with a silver blade and a silver handle.
<ul style="list-style-type: none"><input type="checkbox"/> A ruler	 A metal ruler with a scale from 1 to 30 centimeters.
<ul style="list-style-type: none"><input type="checkbox"/> A rolling pin (or a cylindrical object that can serve as one: straight glass bottle or other)	 A wooden rolling pin with two handles.

<p><input type="checkbox"/> Some greaseproof paper (ideally two +/- A3 sheets per person)</p>	
<p><input type="checkbox"/> A pen / a straw</p>	
<p><input type="checkbox"/> A metal spoon</p>	
<p><input type="checkbox"/> A small glass or other circular object to cut out the diameter of your cup's bottom (should be around 8 cm diameter, can be made out of cardboard beforehand as well)</p>	
<p><input type="checkbox"/> (Optional: a small bowl with water)</p>	

<ul style="list-style-type: none"> □ A Kiln (special oven for clay) 	
<ul style="list-style-type: none"> □ A way to wash your hands afterwards 	

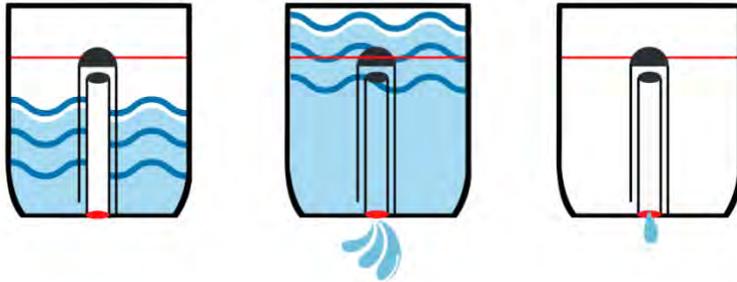


¹ Image for pedagogical illustration purpose; found on e-bay on 07-01-2022; <https://www.ebay.fr/itm/115128958951>

Step 2. Building the Cup

Step 2.1 : Shaping the clay

Time needed: 20-30 minutes.

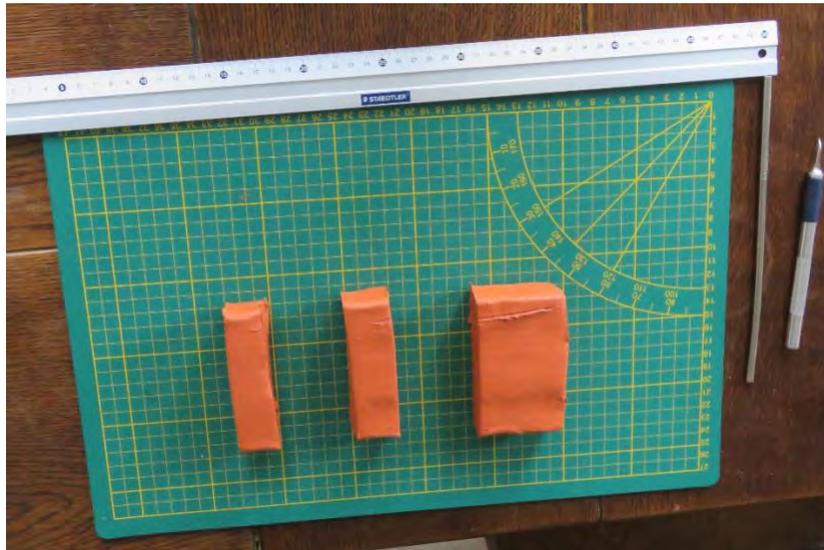


How to do it without a pottery wheel:

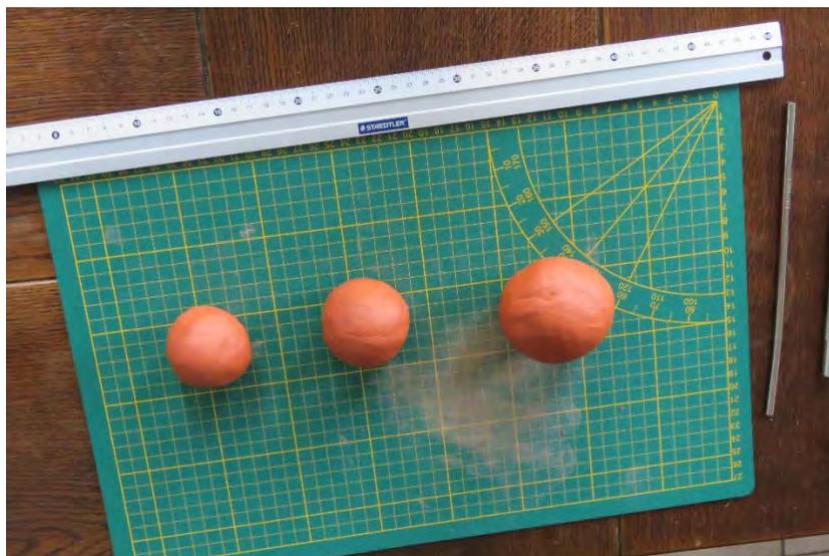


Source: 2 <https://interestingengineering.com/the-pythagorean-cup-the-cup-that-spills-your-drink-when-you-get-too-greedy>

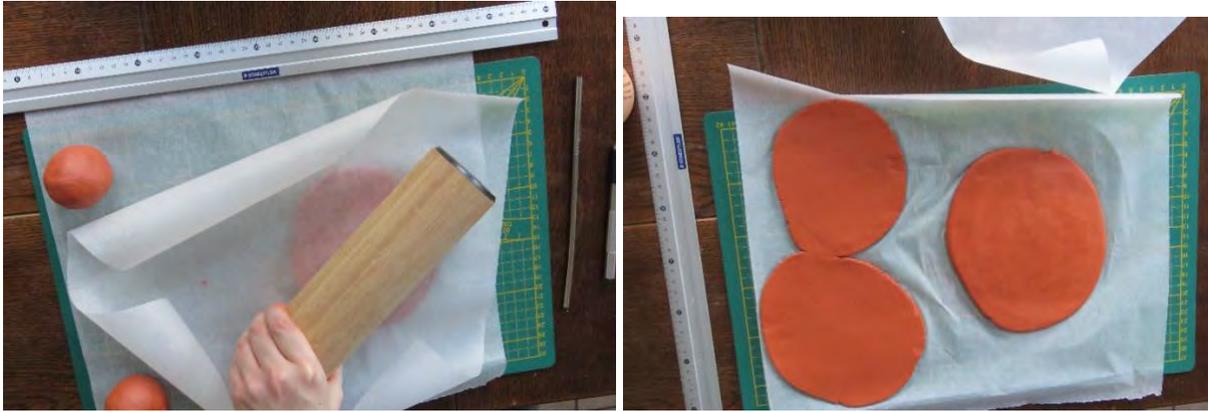
The Pythagorean cup consists of three parts: the cup, the straw, and the cover of the straw. First, you will need 3 pieces of clay. The first is for the cup itself. Normally this piece is the biggest element you will need (you will need 13-15cm diameter). Another one is for the straw and a last one is for the cover of the straw.



Make a ball between your hands with each piece of clay.



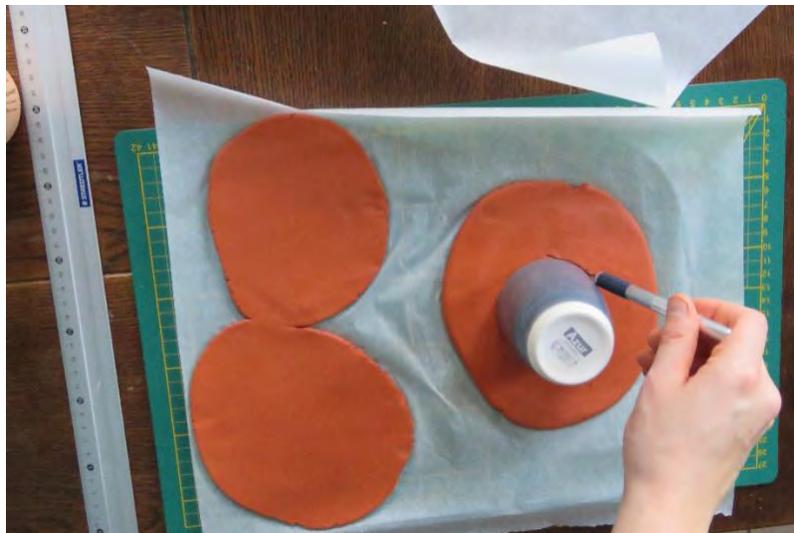
Once it is done, place each ball between greaseproof papers. Then use the rolling pin (or cylindrical equivalent) until each ball becomes a circle that is 5 or 6 mm thick. (No need for the circle to be perfect)



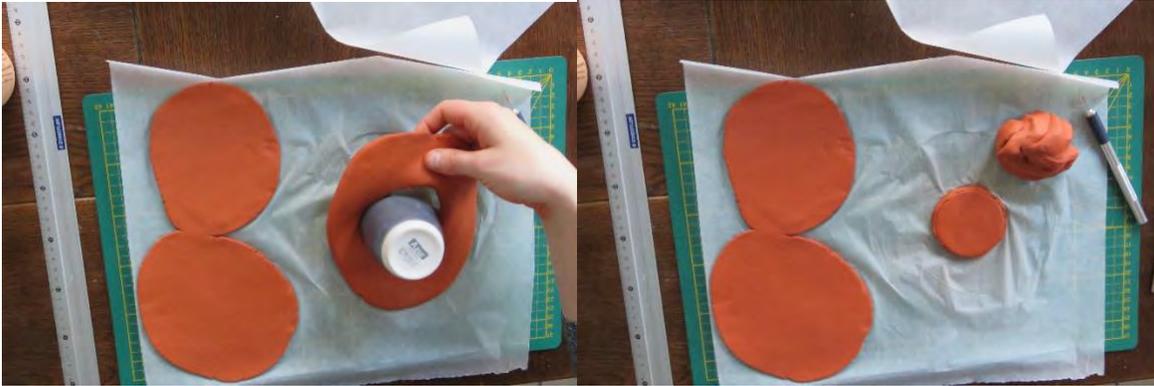
Step 2.2: Putting the Cup together

Time needed: 20-30 minutes.

Take your glass of +/- 8cm diameter and cut out the bottom of your cup in the biggest piece of clay.



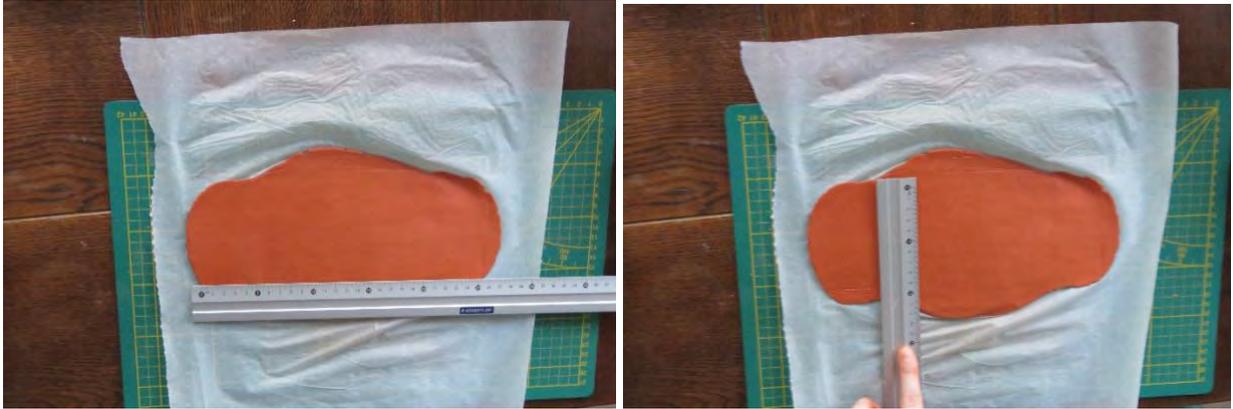
Take the excess off and then re-form the ball of clay with the leftovers.



Reserve the bottom of your cup on the side. (The two other circles as well for now)
Use the rolling pin to get a long strip of flat clay of about 5mm thick. Be as even as possible.



The length on the strip should be able to get around your bottom base. In width, you should have at least 10cm. The width of your strip will be equal to the height of your cup. It is better this cup to be as tall as you can. The ideal height would be between 10 to 12 cm.



Measure your width, add a couple centimetres and cut out the excess.



Measure your required length, add a few centimetres and cut out the excess.

Roll your strip of clay around the bottom of your cup to form the main shape of it (like a glass).



Make sure to join the pieces properly by massaging them together and melding the joints with gentle finger motions so that there are no leaks. You may turn it over and prop it on an upturned glass for either manipulation. Use the spoon to help shape the joints and make them smooth.



Once you form it, take a pen or a straw to create a hole just in the centre of the bottom.



Take the second circle of clay. To form the straw, all you have to do is to wrap the piece of clay around the same pen that you drilled the cup.



Place the straw and cut off one side of excess.



Then, wrap the clay around the straw until the side that was cut touches the other side.
Cut the excess off.



After you have it wrapped around the pen, massage it until it is smoothly joined.



Cut one edge off to make it perfectly straight, then measure 5 cm long from there and indicate your measure (at least 5cm. This is as high as the person will be able to fill the cup. It needs to be at least 1cm less than the height of the inside of your cup).



Then cut the edge to form a perfect straight straw and remove the excess from the straw.



Once you are ready, attach it to the cup by placing the tip of the straw into the previously made hole in the bottom. It may stick a little to the straw, do not panic and twist the straw side to side gently to get it unstuck before removing it slowly. Make sure the straw protects the cup's hole from closing. The liquid must be able to pass through the straw and get drained from the hole. Use your fingers and the spoon to massage the two pieces delicately together until joints. You may wet your fingers for better results.



To make the last piece of the Pythagorean cup, take your third circle of clay and lay your finger on it. You will need to wrap the piece of clay around one or two of your fingers. The idea is that the clay straw that was just made should be able to fit into the shape without touching the sides of it. It should look like an elongated glass, or a big test tube.

Use your finger, or fingers as a measure. Remember that it must be at least 1cm longer than 5cm (the height of the clay straw).

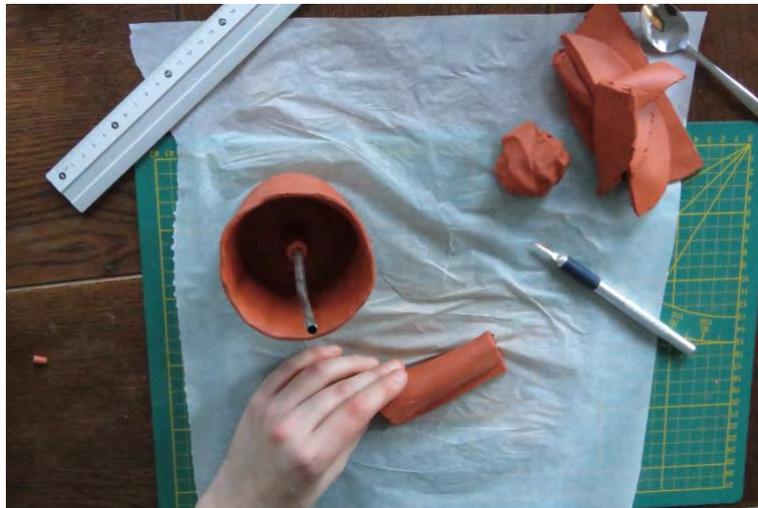
Lay your finger beside it for measure and cut a straight line next to it (not too close, be careful to avoid cutting yourself).



Remove the excess, then roll this edge over and around your finger(s) until the straight edge touches the other side. Then perpendicularly (and well away from the tip of your finger) cut the excess off. (For safety, mark the place to make the cut first, withdraw your finger and cut.)



Once that is done, cut the excess along the line where both sides join as well.



Put your finger back in and massage all pieces closed until smooth. If there is an excess at the top, cut it off. Make sure the base is straight as well. You should be left with a sort of clay test-tube.



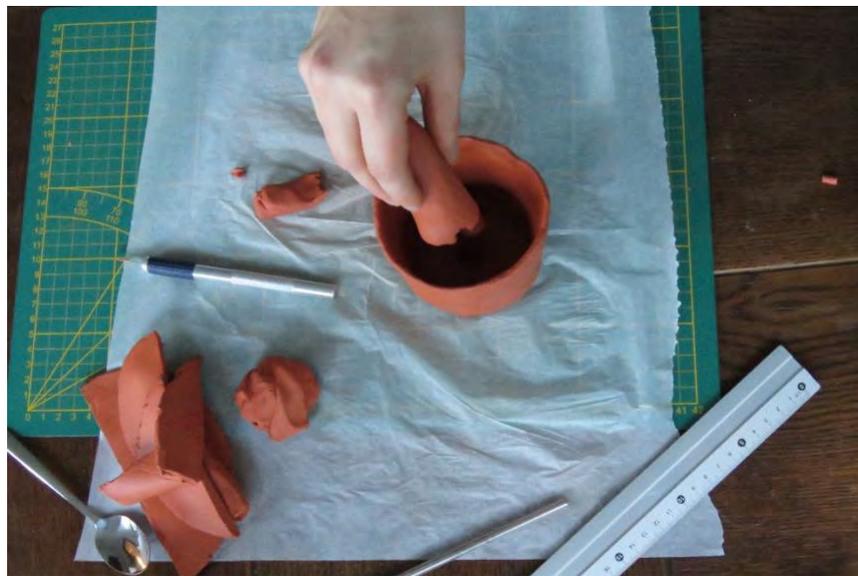
At the edge, on the “mouth” part of the tube, cut a half circular piece to allow the liquid to flow from that point once it is joined with the rest. Make sure it has enough space for the liquid to flow between the straw and the cover of the straw.



Take the metal straw out and check that the clay straw is well attached and that the water will be able to flow out of the cup correctly. You should be able to see the other side through the clay straw. (Be careful, as it is not dry, the cup is fragile and wobbly)



Then, attach this clay tube into the cup, above the clay straw. (Like the cap of a marker, except the clay straw must not touch the cap.)



Once in place, again, massage the joining bits gently with wet fingers and/or the spoon until smoothly joined.



Bake the cup according to the instruction of the clay packaging. You can look around your neighbourhood to find a special oven for clay (kiln), or a makerspace that has one. You can also glaze your cup for a better finish and protection. In order to do that properly, maybe contact your local pottery workshop or artist to make them with him as an extracurricular activity. The process of baking (with a specific temperature, and also changing colours of the glaze) can also be exploited as part of your science curriculum.

Here, we used some air-drying clay (available in craft stores). This has the advantage of not needing to be baked in a kiln. The disadvantage of this, is that you may not use this as a drinking cup **regularly**. Although, once dry, it should be able to sustain a test with water once in a while. However, you won't be able to use it on a day-to-day basis or for drinking.

Baked clay, however, can be done as well in partnership with a pottery that has a kiln to bake your pieces. Either you can create your pieces yourself and bring them to a pottery shop to bake them, or you can create a whole workshop with them. If done properly with a potter, he/she may also help you with a turner and use a different technique.

This blueprint is a very basic way to create a cup in class. The cups can air-dry and be brought back home. The potter will have better tools and techniques at his or her disposal, and a kiln to cook your pieces.

However, baking pieces may result in exploding pieces if air bubbles are left inside the clay, so be careful.

Once it is baked, let it cool down properly. You can use your “greedy” cup!



Source: 3 https://commons.wikimedia.org/wiki/File:Pythagorean_cup_sold_in_Crete.jpg



Source: 4 https://commons.wikimedia.org/wiki/File:Pythagorean_cup_from_Samos.jpg

Youtube tutorials :

- Principle of the Pythagorean cup (EN)
<https://www.youtube.com/watch?v=A-YMHXuiaWw>
- Clay workshop: making a Pythagorean cup (EN)
<https://www.youtube.com/watch?v=xcheMU4az9s>