NTNU – Trondheim
Norwegian University of
Science and Technology

Concept for motivating toddlers to accept inhalation therapy

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BRUCE

Toy for motivating hospitalized toddlers to accept inhalation therapy.

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SUMMARY

This master thesis is conducted at the Institute of Product Design at NTNU. The subject of the assignment is "Concept for motivating toddlers to accept inhalation therapy".

The project aims at developing a concept for motivating hospitalized toddlers (2-3 years old) to accept inhalation therapy.

The first part of the project was an investigation process to understand the situation: the disease, the children's behaviour at 2-3 years age, the hospital environment, the treatment, etc.

Secondly I started to develop some ideas that led me to the final concept.

After that, having the general concept, the next step was to develop it: the concept, materials, shapes, name for the toy...

In addition I had to keep in mind all the details of the interaction process between the treatment, the target and the project.

Once I had the concept developed was time to go further in all the key aspects such as production, dimensions, pieces' design, electronic components, maintenance and final results.

In conclusion, BRUCE is a toy developed after investigation, detailing and interaction design work. It consists on a toy to improve children's experience of the treatment. Concretely the goal is to engage children between 2 and 3 years with respiratory diseases, while they are taking the medication and entertain them in an active level. Making the kids part of the treatment and making the treatment meaningful for them.

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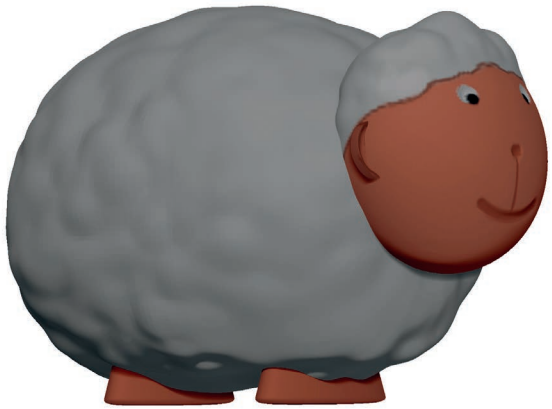


BLOPP

PROBLEM

TARGET

INTRODUCTION

DISEASE

MOTIVATION

The purpose of my project is to develop a concept for motivating hospitalized toddlers to accept inhalation therapy.
It is the result of investigation about a problem and how to solve it, in combination with lot of motivation and hard work trying to design a toy to distract children during an uncomfortable and complicated situation for them.

THE PROBLEM

Hospitalized children who are treated for respiratory diseases often need medication every second hour for several days. The inhalation treatment typically lasts for 7-10 minutes. However, many young children resist and protest against inhalation therapy, *(1,2)*. This causes reduced effect of the medical treatment as well as frustrating situations for the children, parents and nurses.

Is difficult to define the specific reasons as to why young children resist inhalation therapy. A combination of fear, pain and lack of understanding can cause children to resist medical treatment and medical staff in general *(3)*.

Based on information from observational studies and interviews with nurses and parents who have experience with inhalation therapy, we can make some conclusions about why many children adopt a negative reaction towards this treatment in particular *(4)*:

First of all, we have to consider that children are ill so they can feel both vulnerable and tired.
Secondly, the hospital environment and staff are unfamiliar. Since RSV is contagious, the children and their parents live in isolated rooms during the treatment, and being a patient may in itself be a new experience for the children in combination to meet new nurses as well as interact with medical devices can contribute to negative reactions.
Thirdly, the nebulizer device with the attached facemask, in addition to the noise produced by the oxygen machine can be scary. Wearing a facemask can also be perceived as uncomfortable. Furthermore, nurses report that there is general uncertainty about whether the children understand the connection between gradually improved breathing and the treatment.
Fourthly, the duration of each single treatment is quite long and children may therefore become fed up and impatient.
At last, in some cases nurses and parents feel compelled to hold the children in a fixed position because the children resist. This can reinforce children's resistance towards the treatment.

This project aims to contribute to solve some of the aforementioned challenges. It consists on designing a toy to improve children's experience of the treatment. Concretely the goal is to design a toy that can engage children between 2 and 3 years with respiratory diseases, while they are taking the medication and entertain them in an active level. Making the kids part of the treatment can help us to make the treatment meaningful for them.

THE DISEASE

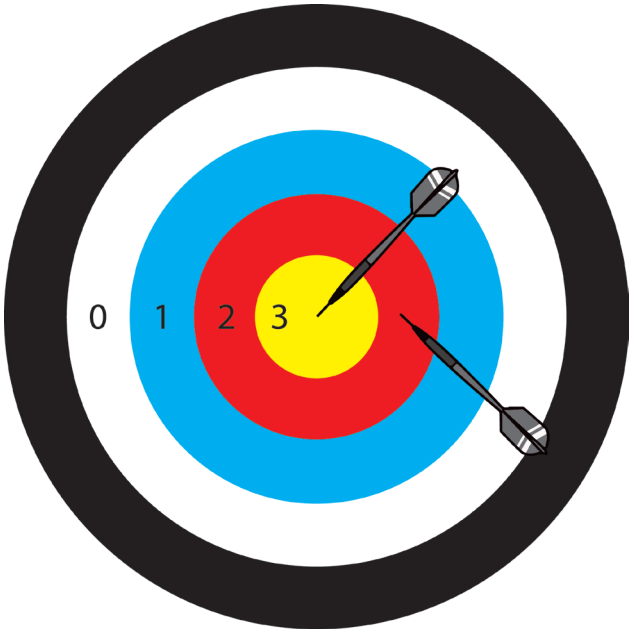
Children who receive this inhalation therapy at the hospital are usually aged three years and younger. Respiratory diseases in young children are often caused by a virus called Respiratory Syncytial Virus (RSV) *(5)*.

In older children and adults, this virus only produces symptoms of a common cold and therefore does not require treatment at the hospital *(5)*. But for young children RSV can lead to serious illnesses *(5)*.

Since these children are so young, the treatment is adapted in such a way that a special breathing technique is not required. The medication for these children is delivered as a mist through a facemask. The children can therefore breathe normally while the medication is administered directly to the airway.

(A)

THE TARGET



At first the target were children between 0-3 years old, as I told this is the range of age where the RSV can lead to serious illnesses, but in the investigation process I realized that kids are really different attending to the age and there are a lot of differences between 0 and 3 years old children. So I decided to focus only in part of them and children between 2 and 3 years old will be the protagonists.

Even though all the participants in the process for taking the medication are important and I will keep them in mind, the most important thing is how the kids reacts to the treatment, the disease and the stay in a hospital. So children between 2 and 3 years old are the main target of this project.

BLOPP

BARNS LEGEMIDDEL OPPLEVELSER

"Children's Pharmaceutical experiences"

BLOPP is a one-year pilot project that aims to find and develop solutions to improve medication of children between 0-6 years old with respiratory diseases. The project will have a high degree of user interaction.

The goals of BLOPP are:

- Motivate children to take their medicines.
- Better interaction between children and parents.
- Helping parent to understand the process of medication.
- Making children, parents, health professionals and experts in child development part of the process.

The group consists of Pharmacist and project manager Elin Bergene, Ph.d Student Marikken Høiseth at The Institute of Product Design and Interaction Designer Ole A. Alsos (PhD).

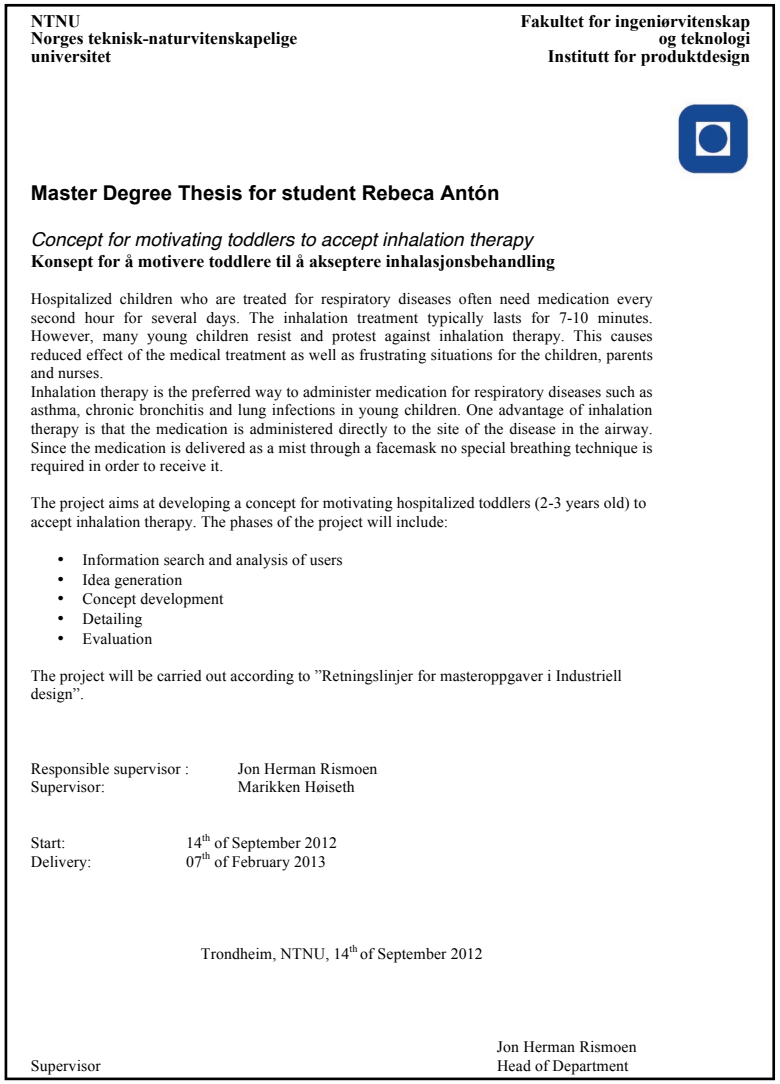
It is financed by the Extra Foundation and a collaboration between Norwegian University of Science and Technology, The Hospital Pharmacy Enterprise and the Norwegian Asthma and Allergy Association.

PERSONAL MOTIVATION

When I was asked to develop this project I said, "yes" without thinking too much. Why?

Because it was not only a design challenge with physical importance. It was a social challenge to make the quality of the children's life better. So I was really happy to try to make their stay in the hospital as good as possible.

In the beginning I was a bit scared because working with kids was new for me and the hospital environment was unknown too. I didn't know how to start but in the moment I started to work, the motivation was enough to start develop the project and here is the result.



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Master Degree Thesis for student Rebeca Antón

Concept for motivating toddlers to accept inhalation therapy
Konsept for å motivere toddlere til å akseptere inhalasjonsbehandling

Hospitalized children who are treated for respiratory diseases often need medication every second hour for several days. The inhalation treatment typically lasts for 7-10 minutes. However, many young children resist and protest against inhalation therapy. This causes reduced effect of the medical treatment as well as frustrating situations for the children, parents and nurses.
Inhalation therapy is the preferred way to administer medication for respiratory diseases such as asthma, chronic bronchitis and lung infections in young children. One advantage of inhalation therapy is that the medication is administered directly to the site of the disease in the airway. Since the medication is delivered as a mist through a facemask no special breathing technique is required in order to receive it.

The project aims at developing a concept for motivating hospitalized toddlers (2-3 years old) to accept inhalation therapy. The phases of the project will include:

- Information search and analysis of users
- Idea generation
- Concept development
- Detailing
- Evaluation

The project will be carried out according to "Retningslinjer for masteroppgaver i Industriell design".

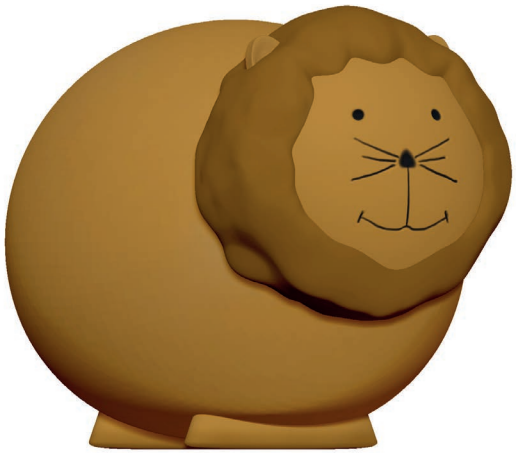
Responsible supervisor : Jon Herman Rismoen
Supervisor: Marikken Høiseth

Start: 14th of September 2012
Delivery: 07th of February 2013

Trondheim, NTNU, 14th of September 2012

Supervisor

Jon Herman Rismoen
Head of Department




RSV
KEY CONCEPTS
INFORMATION
TARGET
FIELD WORK
GATHERING

To start the development of this project the first thing was to investigate. Understand the kids behaviour, know the situation they live at the hospital, how is the hospital's room, investigate the disease, how the treatment works, which is the role of nurses and parents and other factors were important. This part consist of a theoretical research and a field work getting to the place and mixing with the stakeholders.

RSV

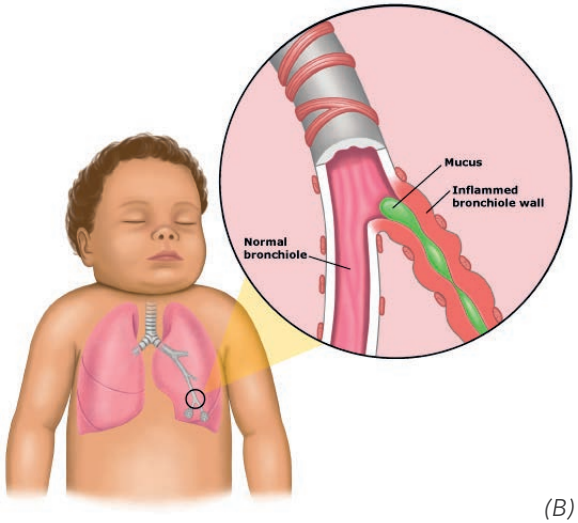
Respiratory Syncytial Virus (RSV) is the most common germ that causes lung and airway infections in infants and young children. Most infants have had this infection by age 2.

RSV season usually runs from November or December through March or April. It is common for RSV infections to linger for 1 to 3 weeks *(6)*.

The virus spreads through tiny droplets that go into the air when a sick person blows their nose, coughs, or sneezes.

While older children and adults with RSV typically get a simple cold, younger children can get bronchiolitis, with wheezing and trouble breathing *(7)*.

Like other viruses that can cause a cold, it is possible to get RSV more than once. And there are other viruses besides RSV that can cause bronchiolitis, including the flu and parainfluenza virus infections *(6)*. Children who have had RSV bronchiolitis may be at increased risk for asthma and other respiratory problems later in life.



(B)

RSV

Symptoms and Treatment

As we said in older children and adults, the symptoms can be comparable with a common cold and does not require treatment at the hospital. But in young children RSV can conclude in serious illnesses. RSV symptoms in young children *(6,7)*:

- Bluish skin colour due to a lack of oxygen (cyanosis)
- Breathing difficulty or laboured breathing
- Cough
- Croupy cough
- Fever
- Nasal flaring
- Rapid breathing (tachypnea)
- Shortness of breath
- Stuffy nose
- Wheezing

(C)

(D)

The treatment of RSV infections depends on the seriousness of the virus. Children with trouble breathing may need to be hospitalized during 2-6 days to get intravenous fluids, oxygen, and sometimes respiratory support on a ventilator. Some kids need to be treated with nebulizer treatments and steroids, like a child with asthma *(8)*.

Consequences of the treatment in the kids (9):

- Face's skin irritation
- Headache
- Increased heart rate due to the nersvous
- Increased heart rate due to the medication

RSV

The device

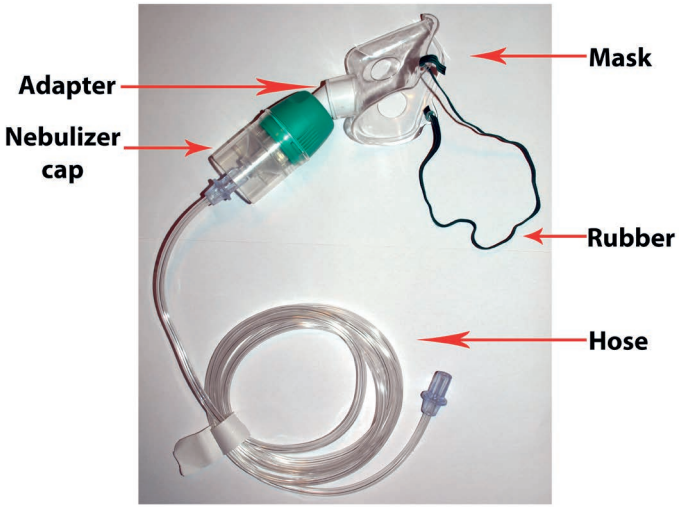
There are two main kinds of nebulizer devices used in the hospital that we have been visiting (St. Olav's Hospital):

One of them is ultrasonic so it doesn't make noise, this one is also more expensive because is necessary to use one "mask kit" for each patient.

The second option is the most extended, is cheaper and reusable, of course sterilizing it after used. The problem of the cheaper one is that it makes a lot of noise and this noise may be one of the reasons responsible to scare the children. We will take this kind of nebulizer in more consideration because is the most extended one.

Main parts of a nebulizer:

The main parts of a nebulizer are the oxygen machine that make the medicine flow trough the mask to the children's respiratory system and the "mask kit".



Kids older than 6 years old do not use this kind of masks. They are able to follow the adult process with a mouth inhalator.

(E)

The mask can be the main factor that causes discomfort. It is made of silicone and covers the mouth and the nose of the children. Also it has a rubber band to hold the mask to the head but usually, the parents or the nurses fix the mask and not use the band.

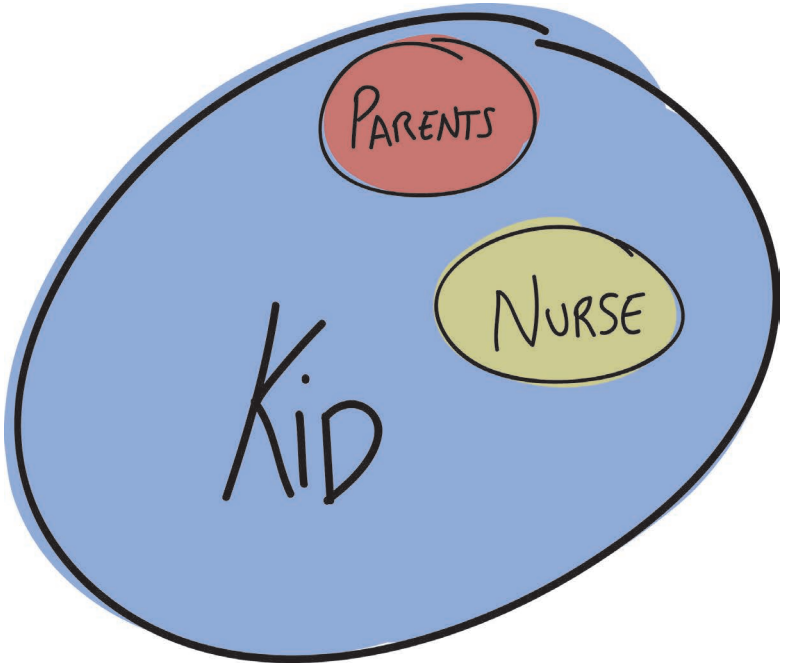
There are also a lot of different shapes for the main part of the mask. Some of them, simulate animals trying to be more interesting for the kids but it is not really useful because they try to play with the mask while they are wearing it, and it is not possible. Because of that, the toy that entertains the kid should be independent on the mask.

TARGET

This project aims to improve the experience of the children hospitalized and treated for RSV. Concretely kids between 2 and 3 years old.

Children change in short time and also their behaviour and their knowledge. So is important to keep in mind the main characteristics of the kids among 2 or 3 years old.

The desire of the children to be independent is always growing, because of that, this age is a difficult stage. Toddlers will experiment new feeling and will explore their world undergoing social and emotional changes. During this stage, toddlers should be able to follow two- or three-step directions, sort objects by shape and colour, imitate the actions of adults and playmates, and express a wide range of emotions *(10)*.



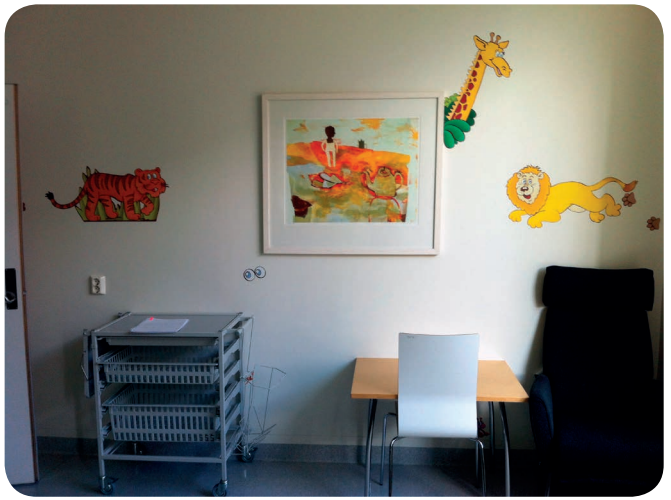
Although children are the main public of the project, is important to keep in mind parents and nurses too. They are the people who are going to be with the kid in the moment they receive the treatment. So they are the key to explain the situation and how to use the toy to the kid.

After searching and reading information about kids behaviour and learning about physical and psychical features of kids between 2 and 3 years old, I took this conclusions about which characteristics should accomplish a product for them *(11,12)*:

- Soft shapes.
- Nice noisy toys.
- Bright colours.
- Senses' stimulation (Sight, touch, smell, taste).
- Represent reality and shapes that they can recognize.
- Synthesis.
- Freedom to use by themselves.
- Abstract and organic.
- Expressive.

FIELD WORK

At the hospital



To get information about the hospitalization of the kids and how the nurses apply the treatment was really useful visit the St. Olavs Hospital. I could see the installations and know how the nurses act in each application of the medication.

The room:

They use to have single rooms for each patient. Ones bigger than other but almost with common characteristics.

Usually the walls are decorated with some stickers to attract children's attention and to make the environment less cold for them.

In all the rooms they have two beds, one for the patient (the kid) and the other for patient's companion, usually his/her father or mother.

Next to the bed, attached to the wall there is a machine with lot of medical equipment. This may be another scaring factor for children.

Another important factor is that they have an isolation room between the corridor and the patient's room. In this place, nurses have to dress properly to come inside the room.
During the application of the medication, the nurse is always inside the room controlling that everything is going on properly. Nurse always wears isolating clothing (blue gloves, mask and white coat). This factor can make the kid to feel afraid, so is really important the way to act of the nurse. One more thing to consider is that nurses have to be alert to shake The blue part of the device in order to prevent condensation.

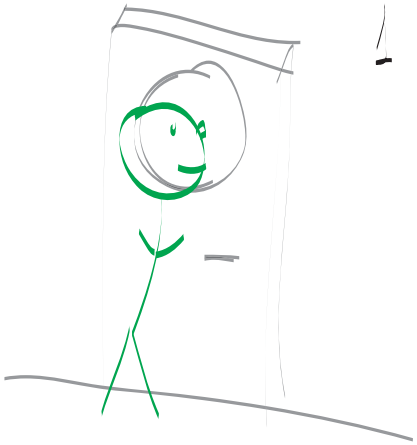
The rooms have also a bathroom inside to let the kid cover all the necessities without going out of the room, due to the requirement to isolate them.

"The most difficult thing is to maintain the attention and calm the kids"

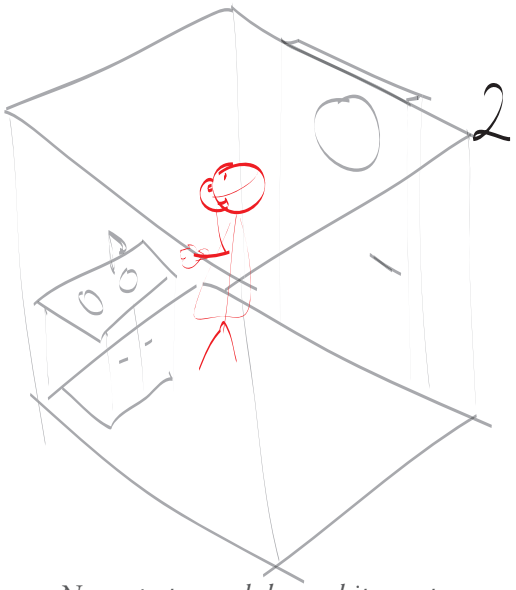
"To inform the parents with as much information as possible is really important and to have them sided with you too"

Nurse

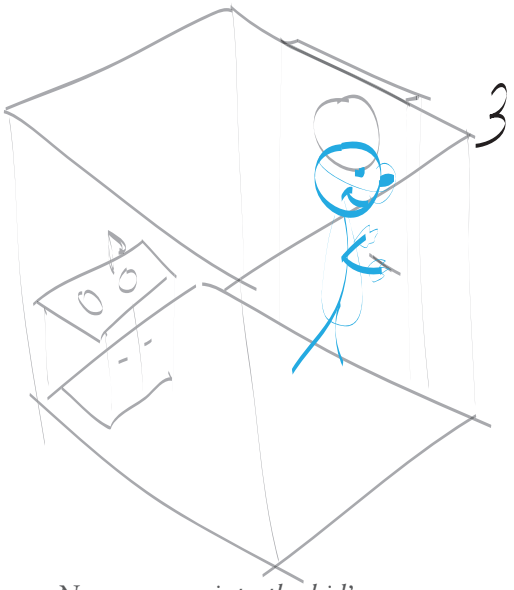
Action chart to prepare the treatment:



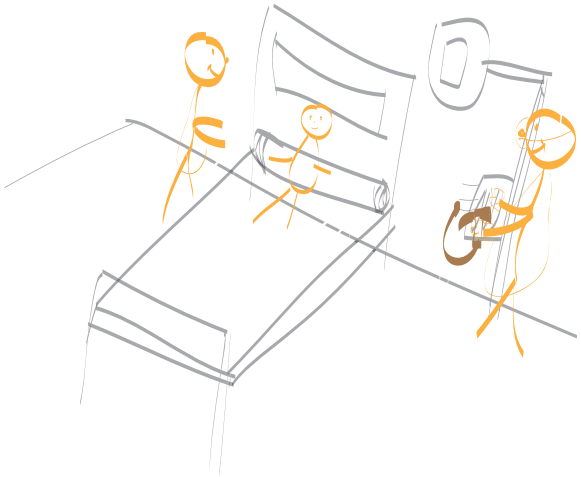
Nurse looks trough the window's door. To be recognized by the kid before put on the mask, globes and coat.



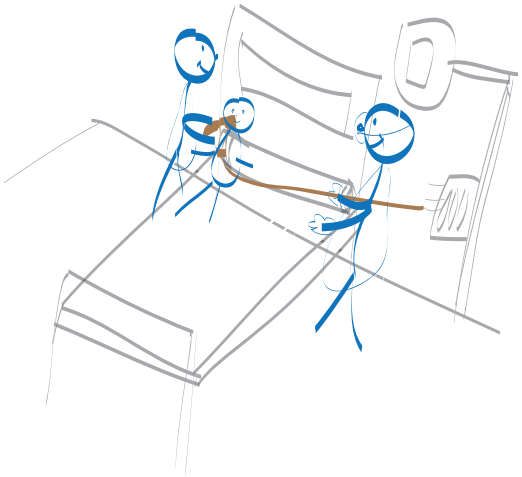
Nurse puts on globes, white coat and facial mask.



Nurse comes into the kid's room.



The nurse prepares the medication and the device.



Treatment takes place.

Nurse gives the reward to the kid.
**Sometimes this happen during or before the treatment.*

FIELD WORK

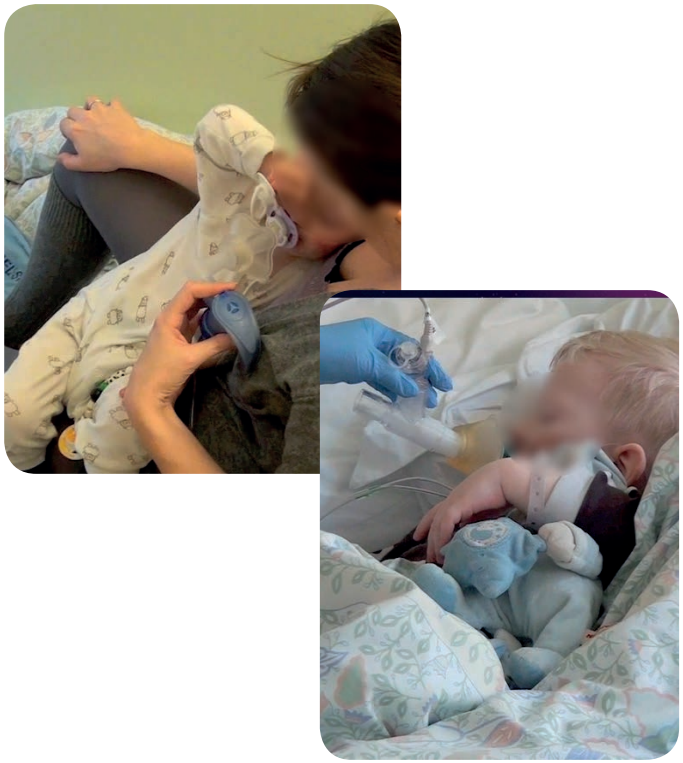
Videos

It was not possible for me to be present during a real treatment, but I was able to see some videos showing real examples of treatment situations. I took some conclusions about different aspects of the treatment.

To give rewards to the kids after the treatment can be effective with some children but, in my opinion, the important thing is to entertain them during the treatment to make it less uncomfortable. So could be interesting to look further in that way.

The noise of the oxygen machine can be one of the main causes of stress for the children.

The duck mask is a bit useful but, in this case at St. Olvas Hospital they only have one so they can't use with all the patients.



Most of the kids wear the dummy during the treatment. This fact makes the medication less effective. But the kids feel more comfortable and many of them have a towel, a teddy bear, or something similar that make them feeling safe.

Devices such as tablets, mobile phones, etc. can help to attract attention of the kid.

The device obstructs the field of vision of the kid.

There are kids that accept the treatment and participate holding the mask.

FIELD WORK

Kindergarden

The last part of the investigation process was to visit two kindergardens. It was the most interesting part because allowed me to understand more kids' behaviour and learn more about their preferences and skills at the year of 2 and 3.

As most people do, children like to interact with others, especially adults. Though, they prefer to play freely with their own rules, so adults are an equal part of the game and kids impose the rules.

Their toys are in general non realistic representations of the real life. We can know what they are but toys are not exactly same shapes and colours than real objects.

In general all the toys are really colourful. Usually designers apply primary colours that are the first ones that children learn.

Animals and mediums of transport where the most common and popular topics in books or toys.

Children like to do typical thing by themselves but in so many cases and situations the may need adult's help.
Between 2 and 3 years the usually have problems to choose the right direction in the first attempt but they normally try to correct without problem.

Kids use to hold everything whit the all hand and from the biggest part of the object.

KEY CONCEPTS

After all the investigation process I developed a summary about the main concepts that where important to keep in mind during the design process.

IDEA *POSITIONS*

GENERATION

SOLUTIONS

In this part of the project I generated some different ideas about how to solve the suggested problem in the best possible way. Trying to achieve the concepts that I established in advance.

SOLUTIONS

Following the main idea of making less uncomfortable the treatment one of the main concepts was to spend as much time as possible playing with the toy. That means, the kid has to be involved in the game during the time of the treatment so the game should be more or less as longer the treatment is. As we said before, 7-10 minutes.

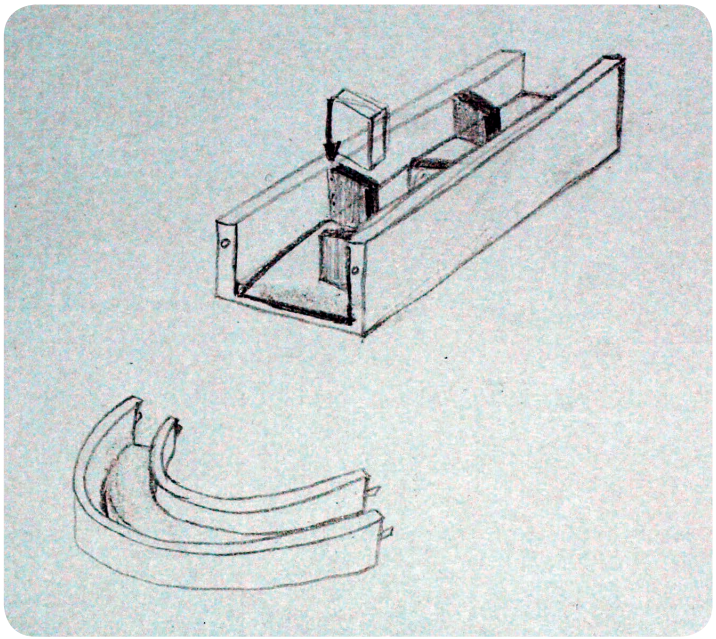
So the best way for solve this question was to design a game that consist on following some steps, instructions or to have something that should be completed.

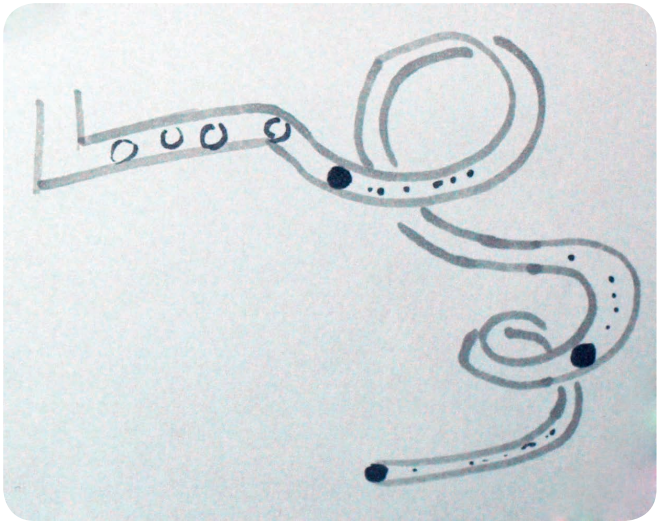
In that way I started to think about which kind of game was better for the exposed problem.

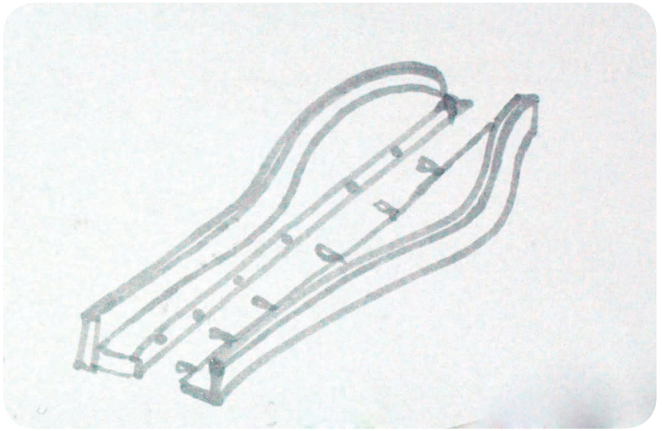
Kids like construction games. I was trying to combine that kind of game with something that allow children to spend time just watching the result of their construction. But not just contemplation, I was looking for something interactive or with any kind of movement.

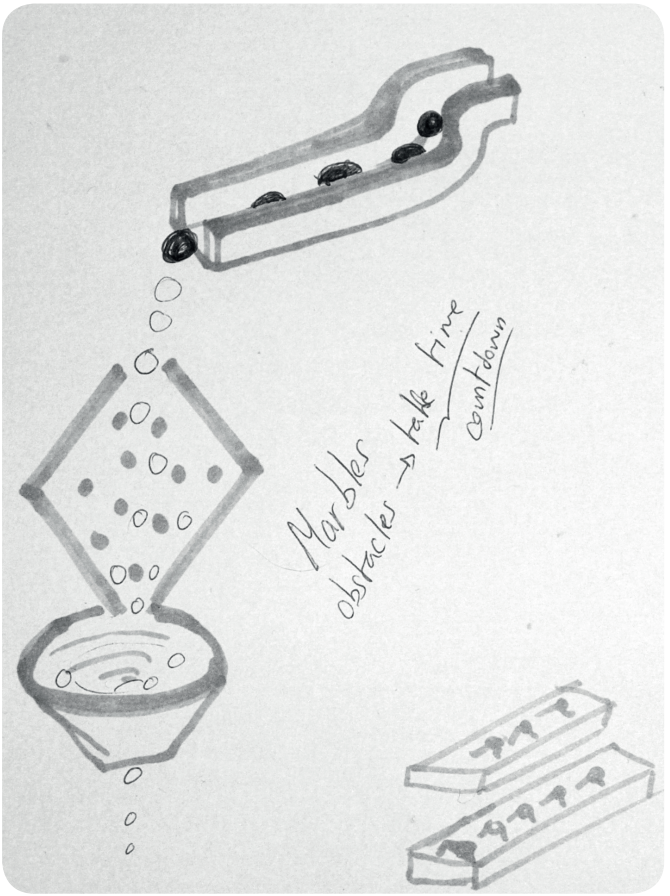
In that way I explored with demountable circuits for marbles. That could be a good idea because it will invite kids to create their own circuit and while taking the medication they can play with the marbles inside the circuit.

But I discarded that idea due to marbles can be dangerous for young children.







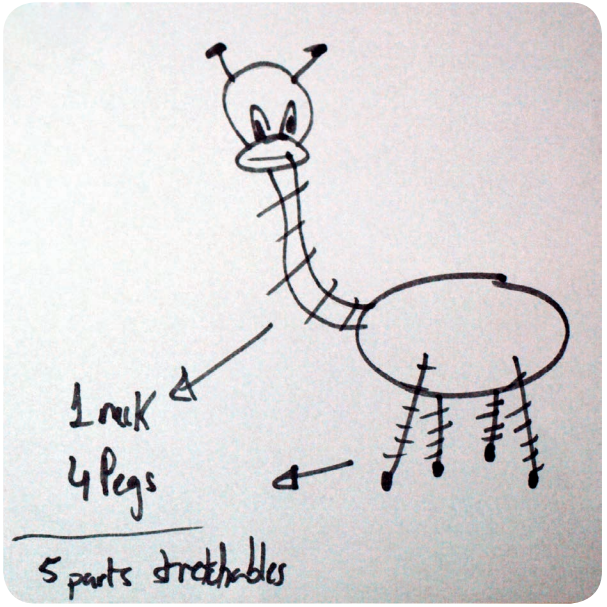

Marbles
obstacles
take
five
countdown

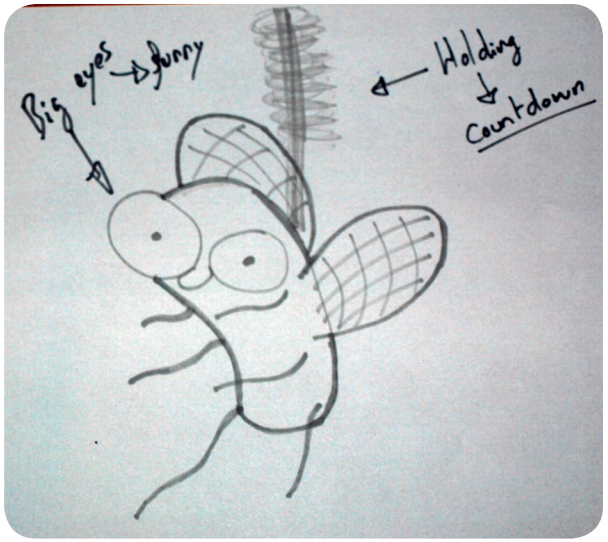
Then I started looking for any solution that was interactive, to maintain children's attention. But at the same time that allow parents and nurse communicate with the kids at the same time.

Another way to design a toy could be something that need feedback, any kind of game with questions that needed to be answered by the kids.

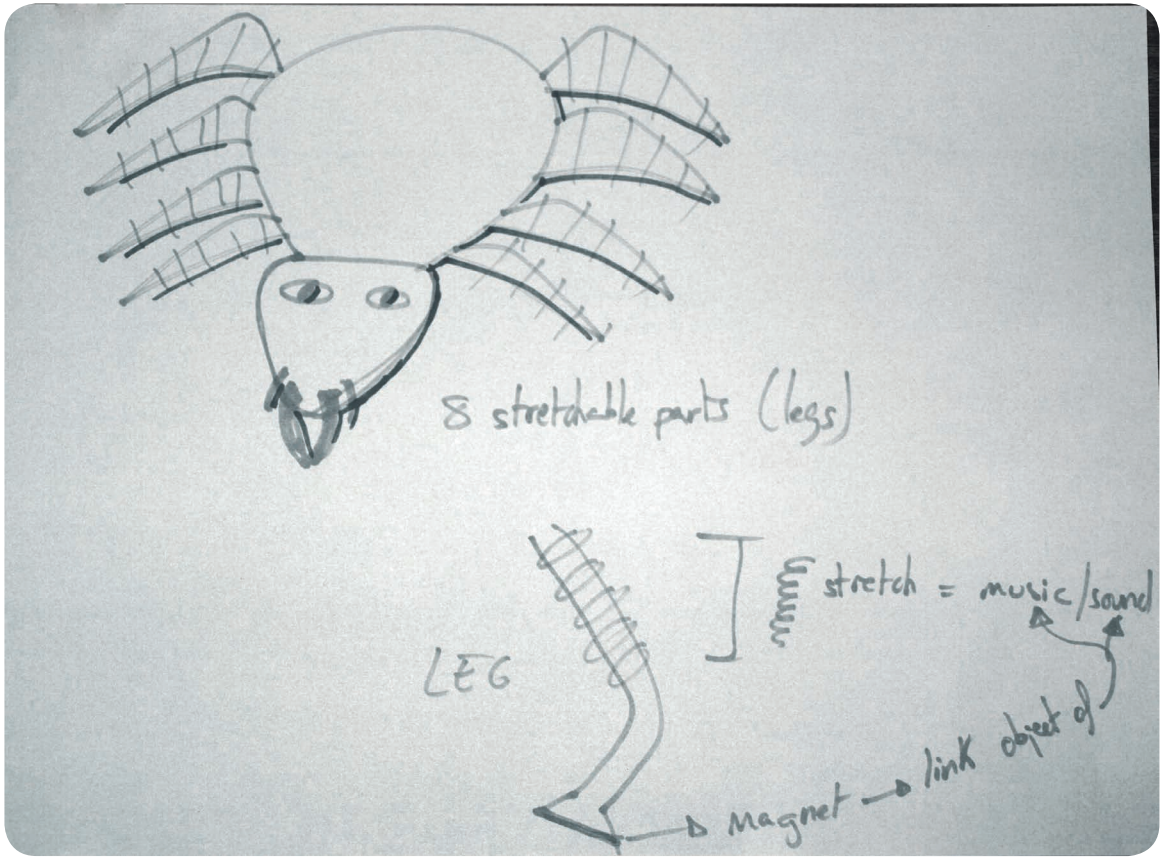
So I started to develop the idea that consist in a main toy with stretchable parts that make sound. And that sound represents any other thing that the kid should connect to the main toy.

In that way, the patient will spend time stretching, listening and thinking before completing the game.





First idea was to design a spider because it has eight legs so kid will be involved during several minutes.



POSITIONS

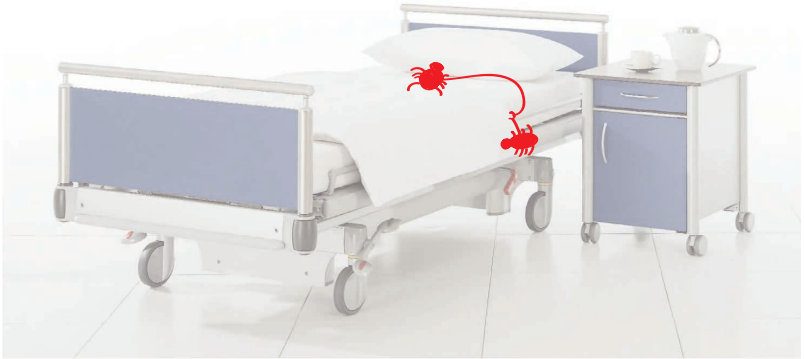
After deciding my way to work, an animal figure with long legs, I was thinking about different positions inside the room. Where to put the toy while is not being used, or during the use.

We have to keep in mind two things. First is not recommendable to let the kids play outside of the treatment because our goal is to connect the treatment with the game to make it more interesting for children. At least is normal to apply the treatment in the bed but is also possible that it took place in a chair or in parents' arms.

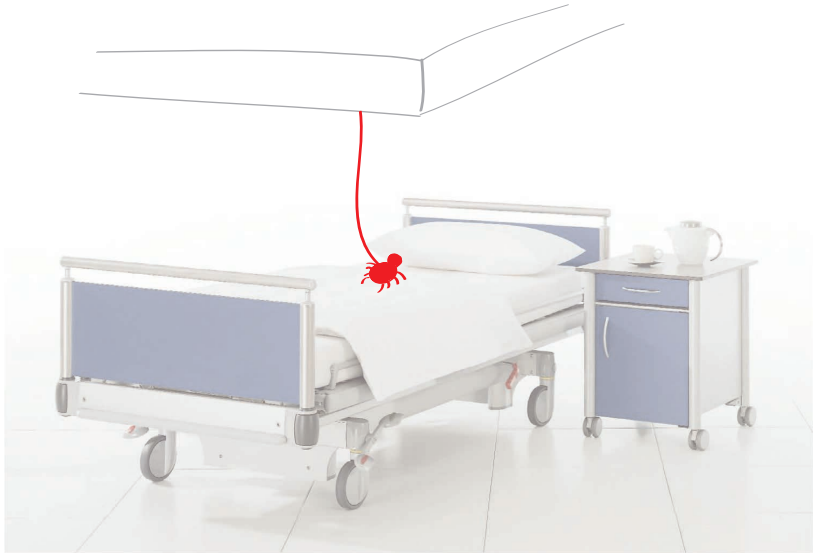
I evaluated five main positions for the toy with good and bad thing each one.

The first option was to attach the toy to the bottom of the bed. While it is not time to play, the toy will be hanging behind the bed. And when it is in use, just stretch out and start the game. In one hand is easy to access to the toy and easy to store it also. But in the other hand, the toy will be always visible. Maybe if the child is too much used to see the toy it will lose efficacy.

(F)

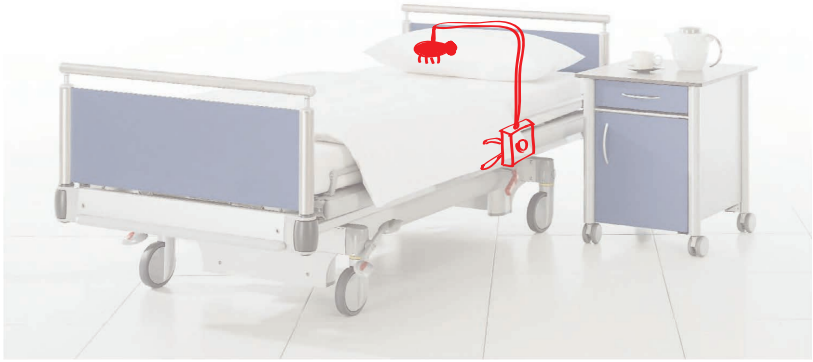


The second option was a variant of the first one. Consists on attaching the toy in one side of the bed. The consequences of this position are almost the same than toy attached to the bottom of the bed.



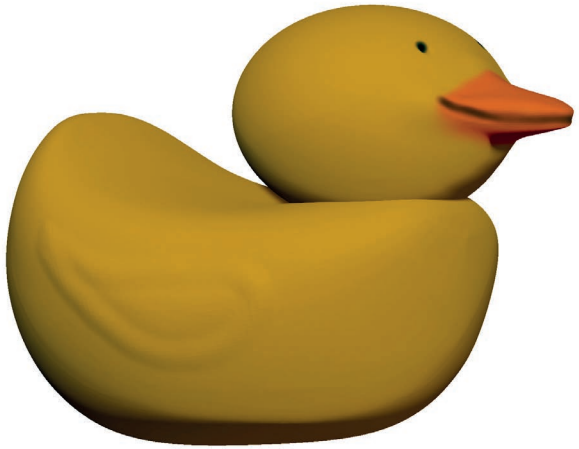
Thirdly I was thinking to put the toy hanging from the roof, but if the toy goes completely up is difficult to stretch it and if it holds in middle height, maybe kids will want to catch it. Thinking in the same way than in the other two cases, the toy will be always visible and that is not recommendable due to the reason explained before.

Other option was to keep the toy free. It means that the nurse or parents can store it wherever and only give it to the kid when the treatment is taking place. This option is also useful because lot of kids prefer to receive the medication in a chair or sofa next to the bed so is useful to move freely.



The last option was to use a branch with a jack system that permit to put the toy wherever, but always hanging from the branch. This is a versatile option but more difficult or slow to prepare each time. Besides it is more complex and make the toy more bulky.

The conclusion was that the best option will be the fourth. This freedom is good to put the toy hidden and use it in all the different situations that are possible taking the medication. As well is easy to bring the toy to the cleaning room and to clean it, really important factor in the hospital.



LITTLE SHAPES

CONCEPT DEVELOPMENT

MATERIALS

NAME

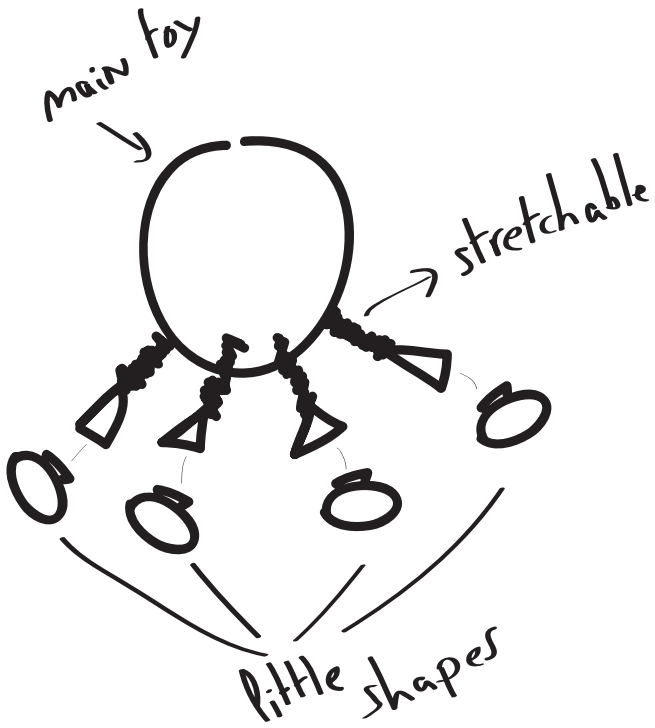
MAIN SHAPE

CONCEPT

Once I decided the way I want to work, it's time to develop the main idea and all around it.

THE CONCEPT

BRUCE consist on a principal shape. This shape will have some stretchable parts that, when the kid stretch, will go back to the original position while producing a sound. There will be also some little toys that are represented by the sounds the main shape has.
So the game lies in stretch one part of the big shape, listen the sound it makes, think about the sound and connect the correct little toy to the main one.



¿Why this kind of game suits to the treatment process?

Because, as we said at the beginning, the main goal is to make the treatment less uncomfortable for the children, and the best way is to involve them during the length of the process. So with this game the kid will have the goal of complete all the connections and each one will spend time (stretch, listen, think, choose and connect) of the treatment. So as much stretchable parts has the toy, as much time of the medication we will consume. But of course we have to keep in mind the users are kids so it should be attractive and not boring so the number of interactive parts will be important.

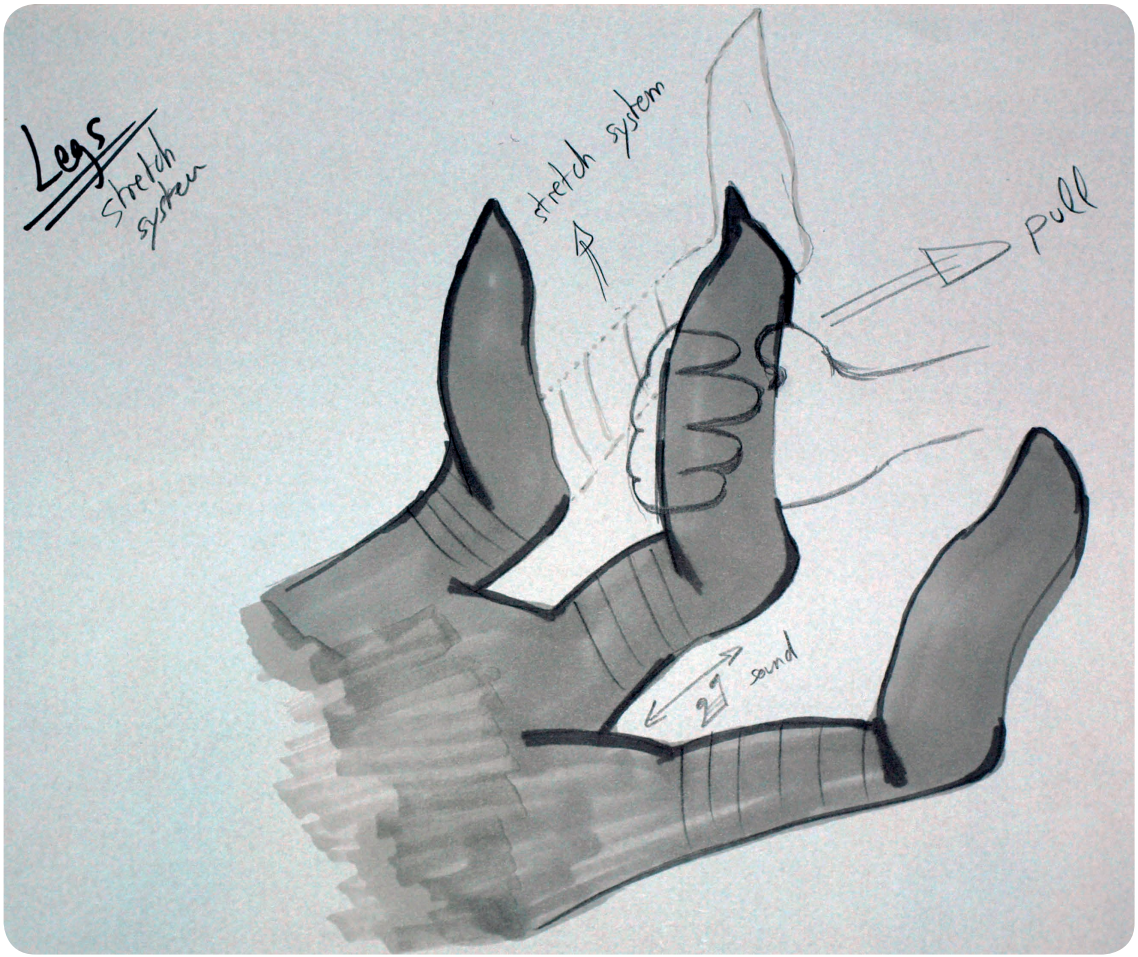
¿And why is it associated to the hospital and treatment situation?

Because it will have the next thread:

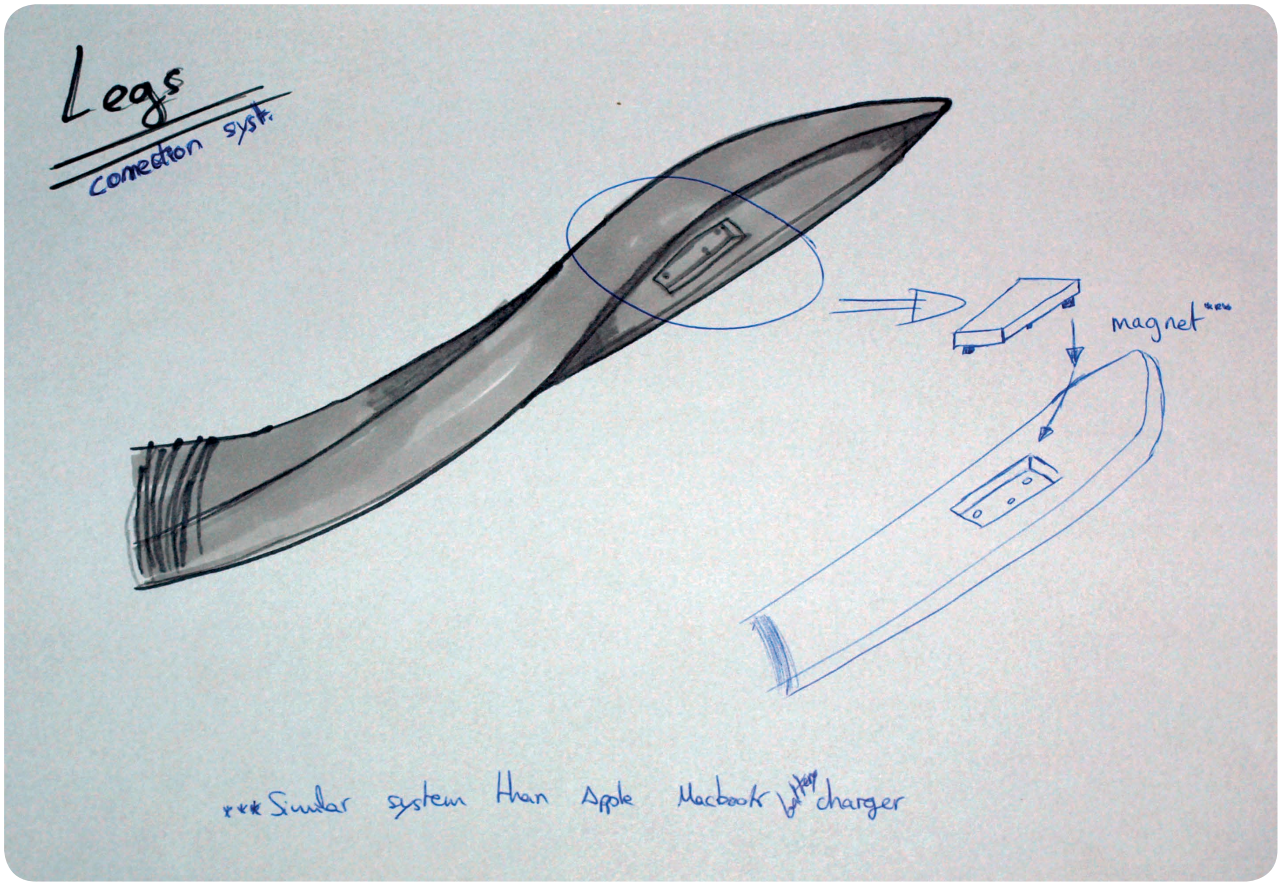
At the moment that parents switch on the toy, it will start making a sound like breathing with difficulties like the children when are ill. In that moment, the kid has to put on a mask to the main shape, like parents do with them, and the toy starts breathing normally for some seconds. After that the kid starts playing; stretching, listening... Until he/she has completed all the sound connections. At that moment, the big toy starts breathing properly again so the kid can remove the mask of the toy. During the time they have consumed playing the treatment of the kid is taking place so it will be finished or almost finished depending on the ability of the kid, we will talk about that in “Interaction design”.

¿How it will work?

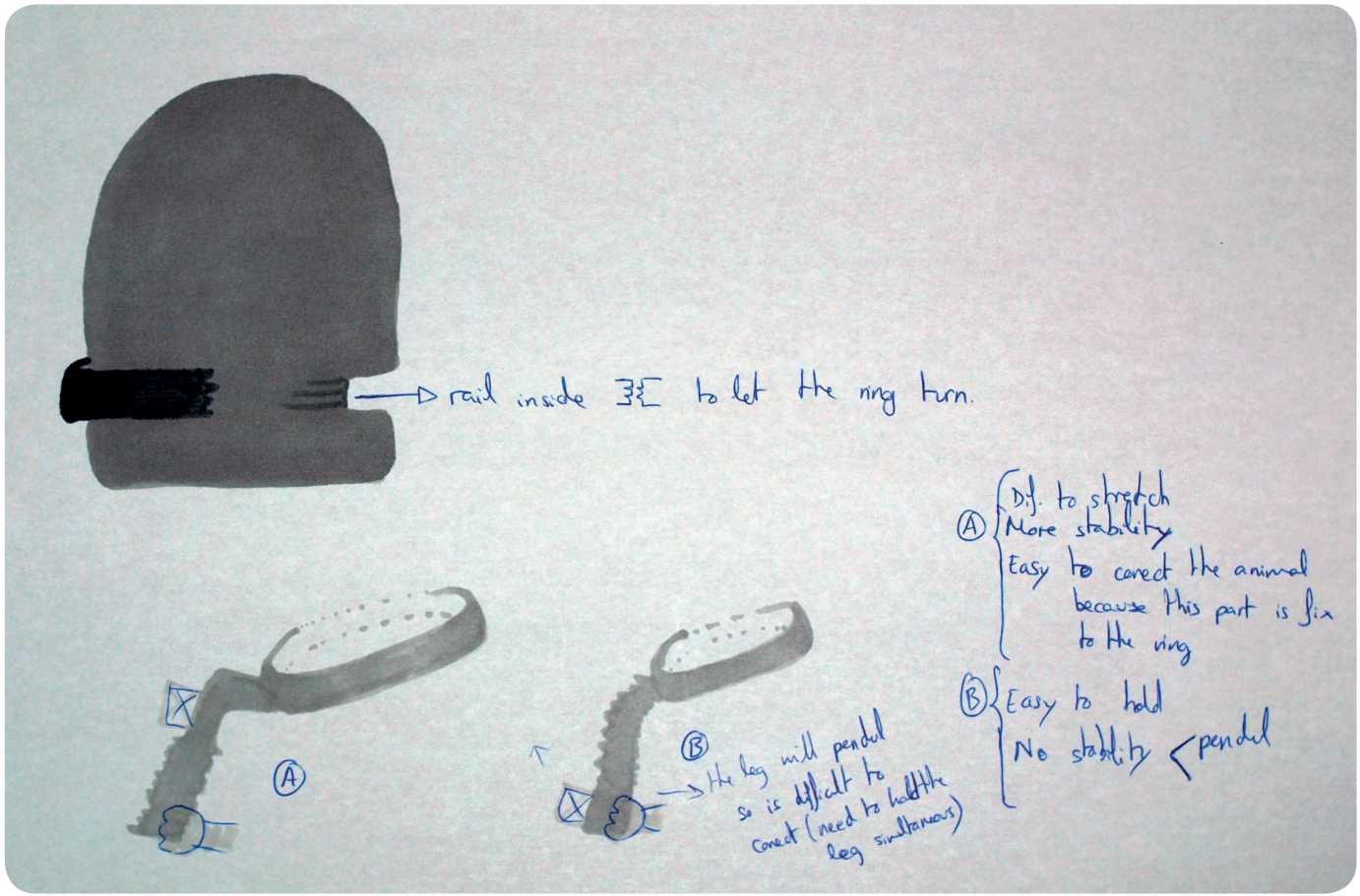
The main shape will have some stretchable parts. The kid will stretch one by one and they will make a sound. One part of the leg should be rigid and non stretchable to let the kid hold it easily. Inside each leg there will be an automatic roll to force the leg go back.



In each leg will be a place to connect little toys corresponding to the sound that the legs made. That connection will be magnetic to help the kids to put them in the right position making the process easier. Besides when the kid connects one little toy, the main shape will light up.

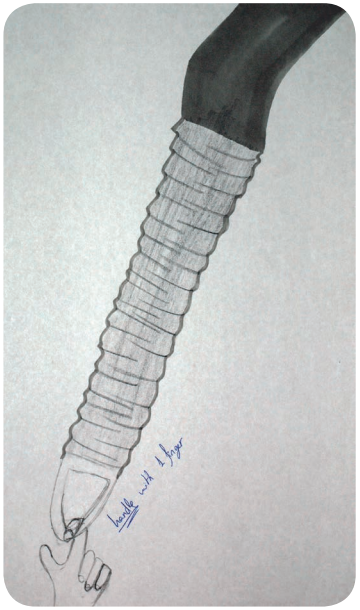


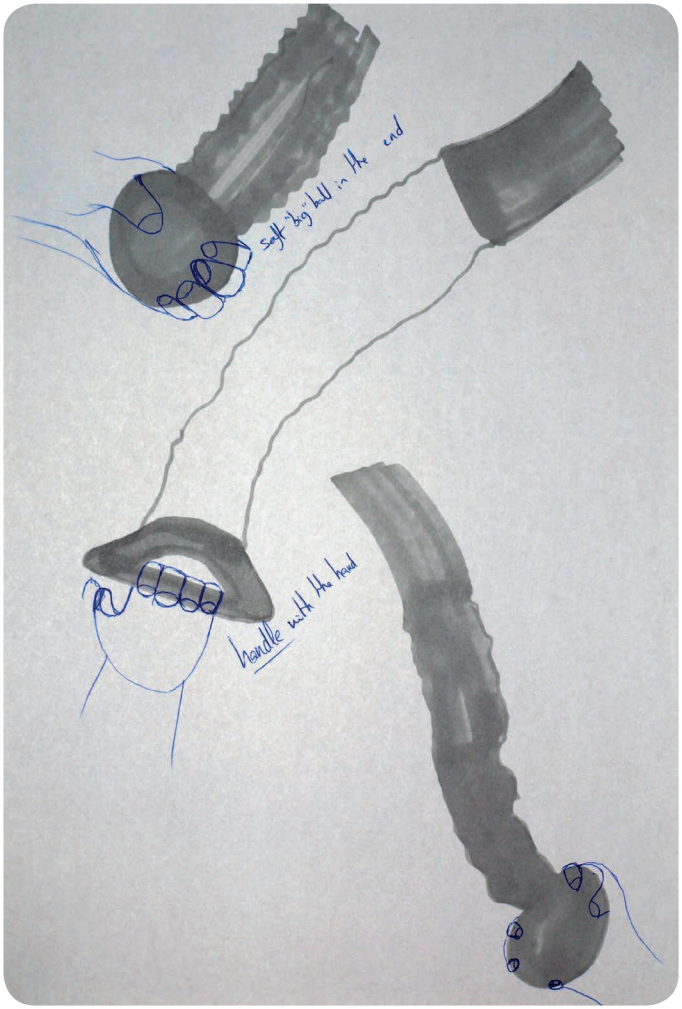
If the legs hang directly from the bottom of the body, will be less comfortable for the kids to stretch them and to connect the animal. Also will make the toy less stable, so will be better to fix the legs a bit up, like in the second third of the body. For that could be good to have a ring that assemble all the legs.



The next question was where is better to put the rigid part of the leg, where the magnetic connection will take place. So to continue giving stability to the body, I decided to put the rigid part joined with the ring so the remaining part of the leg will be hanging from there.

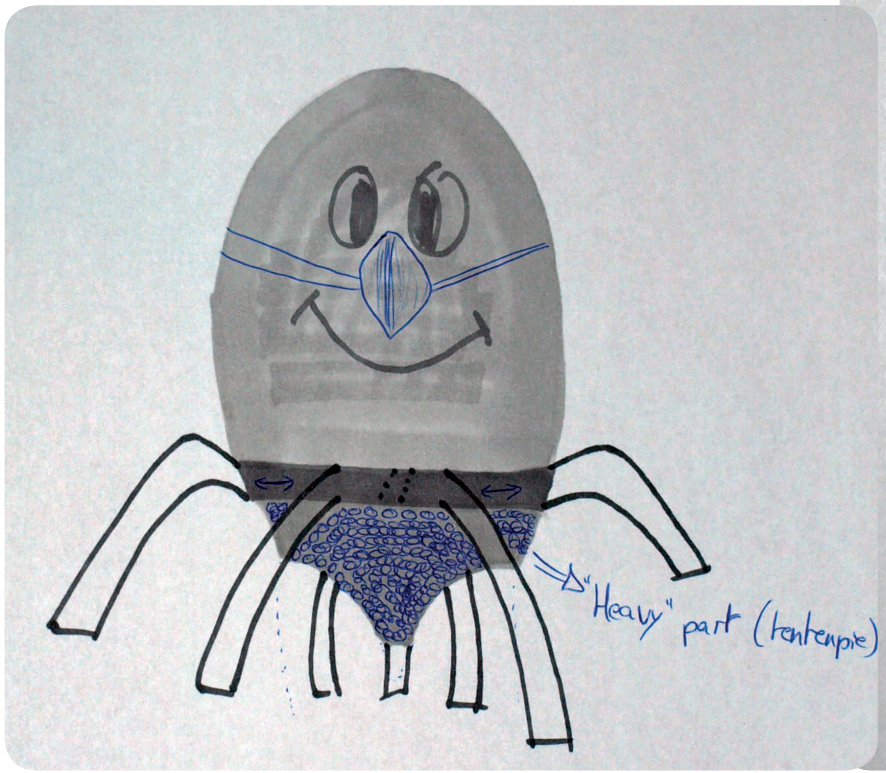
After deciding that the rigid part will be on the top of the leg and also the connection, the stretchable part should have any handle to let the kid hold it and stretch without difficulty.

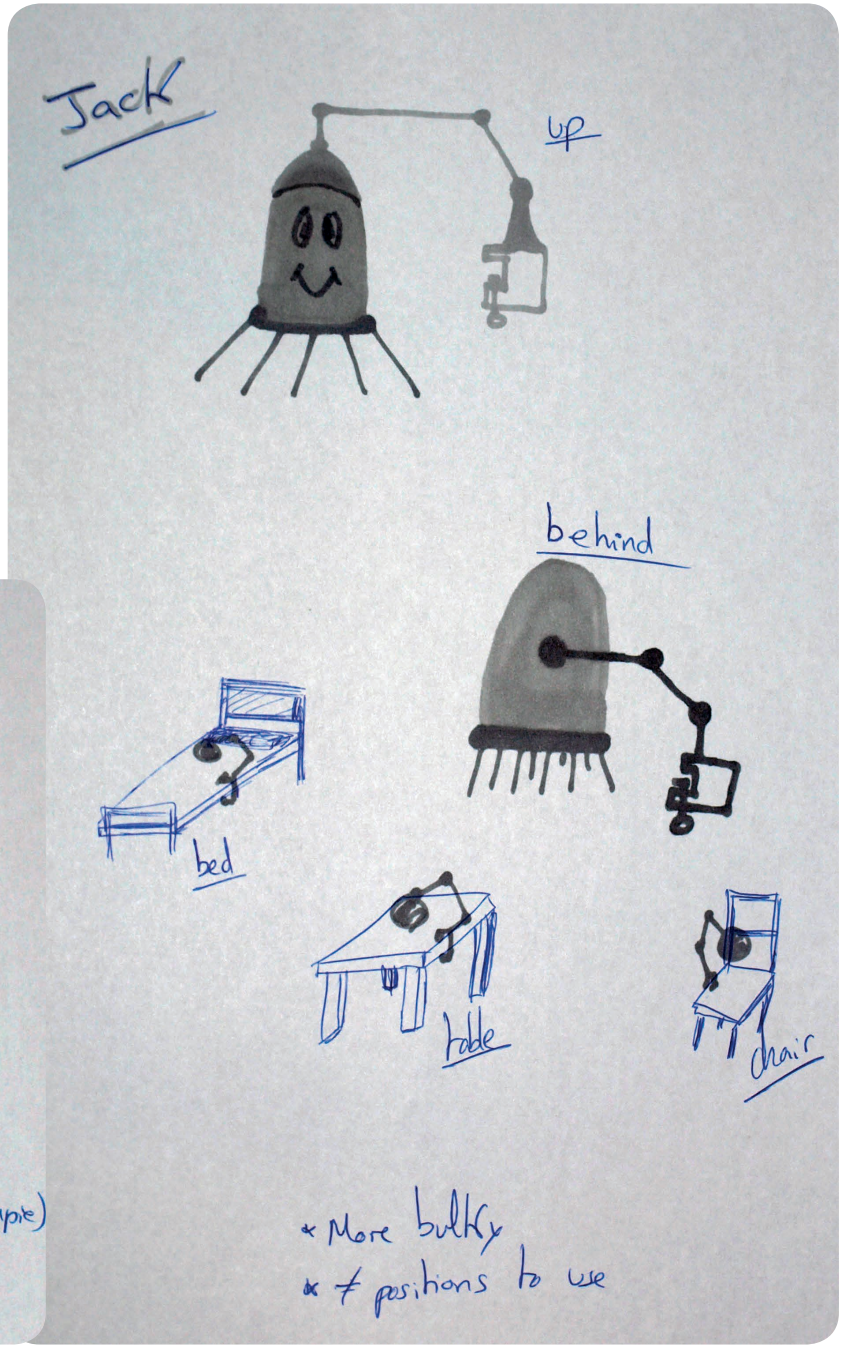




Respect at the way to fix the toy during the use, as we saw in the part of “Idea generation” was better to have it free of movement. But even so there have to be something that fix the toy during the game because if not, it will not be stable while the kid stretches the legs.

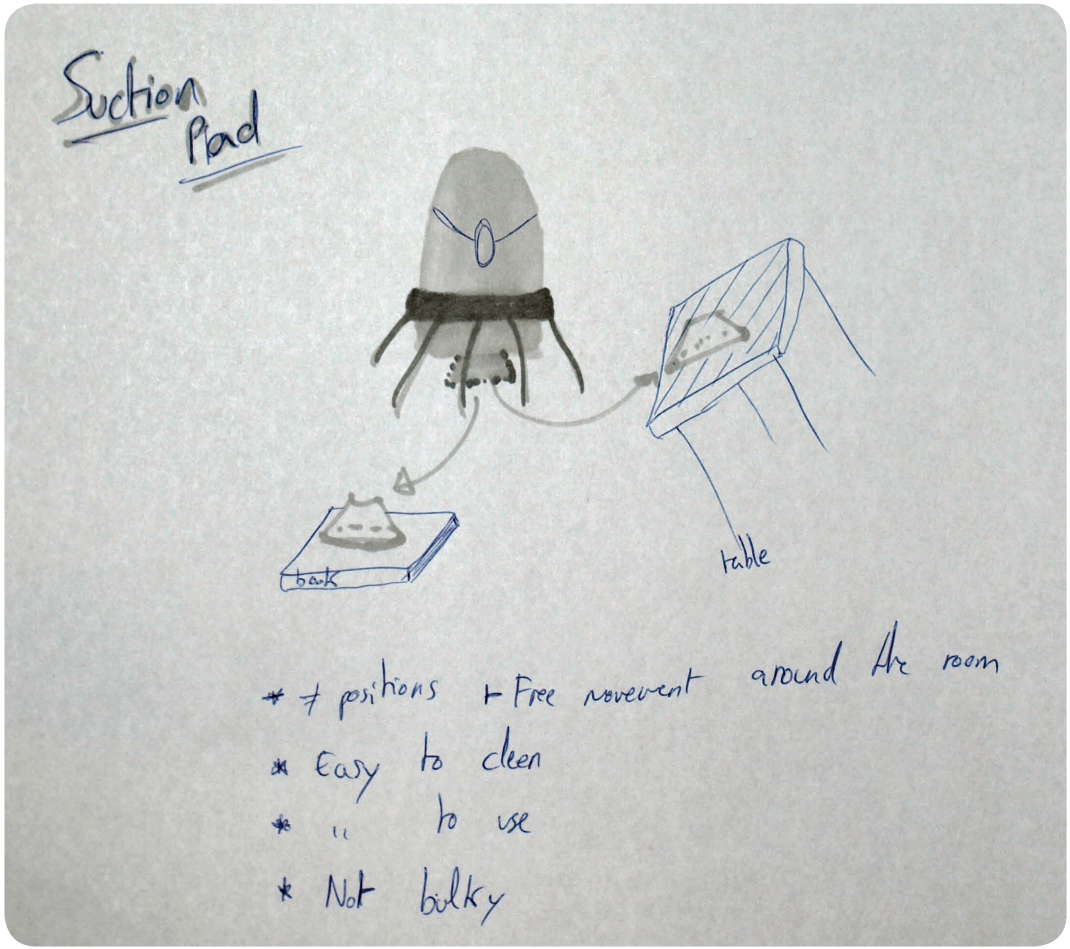
The first option was to add a jack. This will make the toy very stable but at the same time will make it very bulky and complex so I discarded it.





Other alternative was to make the bottom like a tumbler, with this, the toy can be stable between the legs of the kid but is necessary to maintain the legs closed, so the patient will not be free of movement.

The last and best option was to put a suction pad in the bottom of the main body. With this pad, parents will fix the toy in a table, book or any surface in the room. In addition, a suction pad is light and not big so will not make the toy bigger than necessary.



Resume of concepts:

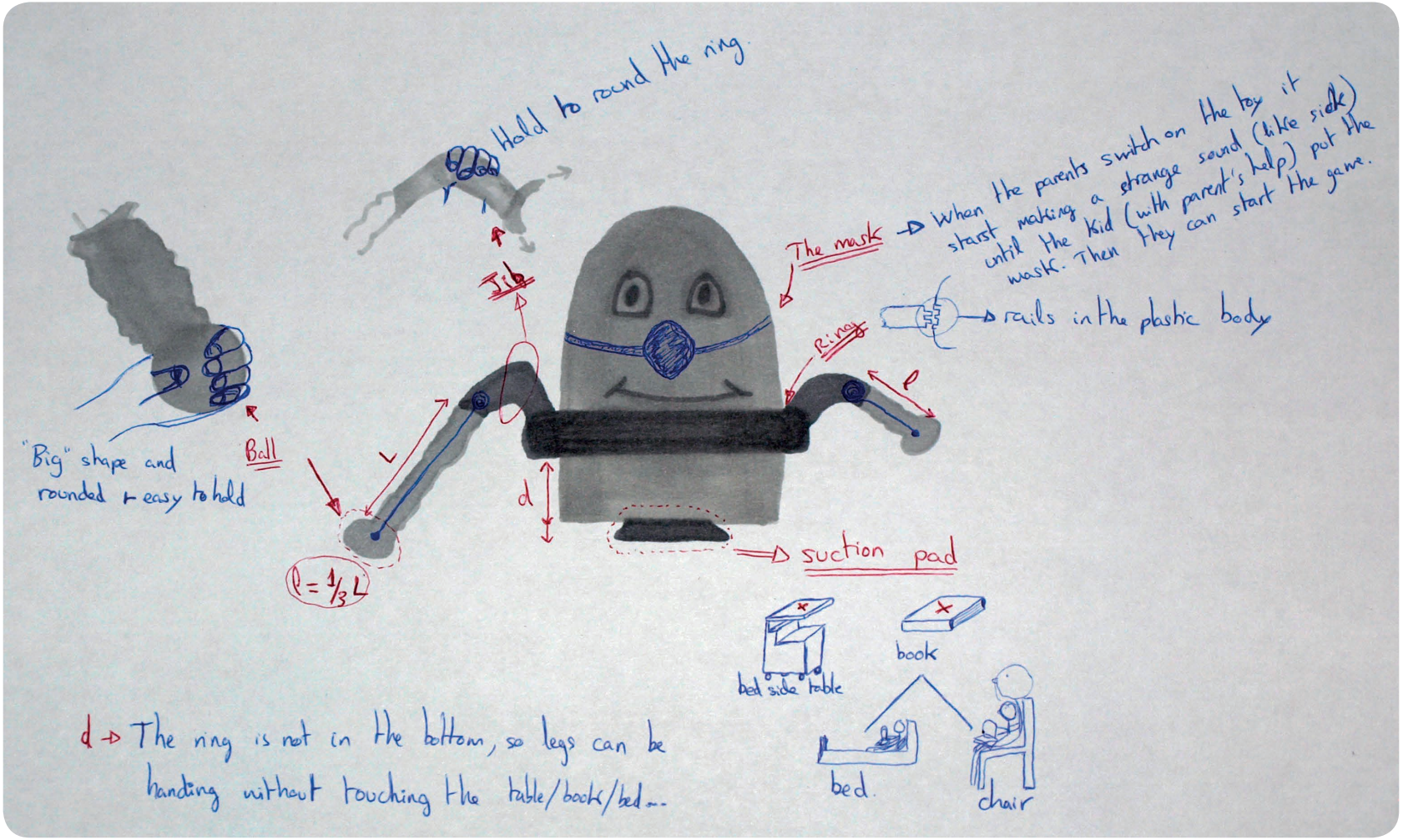
If we divide the body of the main shape in three, in the last part will be a ring. That ring will contain the rigid part of the legs. That rigid part will be useful in two ways. First, it will serve as handle to help the kids round the ring to change the legs' position. Secondly it will contain the male part of the magnet where the little toys will be connected. In the moment each little toy is connected, the main shape will light up.

The remaining part of the leg will be soft and stretchable, but in the end there will be a wider part. That will contain inside a little ball to remain with the original wider shape and kids will hold it better to stretch the leg, so it will serve like handle also.

There will not be nothing mechanical between the body and the ring. Just a hole in the middle of the ring and a shaft in the main body to go through the ring. It will permit the ring turn around the big body.

The suction pad will be placed in the bottom of the main body. It will be semi-automatic like mirrors or GPS' supports for example. It will make it easy and fast. In addition the suction pad will make the toy versatile, users can now fix it wherever they want.

The mask we will use for the octopus, will be a real mask, like child's mask.


Hold to round the ring.
The mask
When the parents switch on the toy it start making a strange sound (like sick) until the kid (with parent's help) put the mask. Then they can start the game.
rails in the plastic body
Ring
P
"Big" shape and rounded → easy to hold
Ball
L
d
P = 1/3 L
suction pad
book
bed side table
bed.
chair
d → The ring is not in the bottom, so legs can be handing without touching the table/book/bed...

MATERIALS

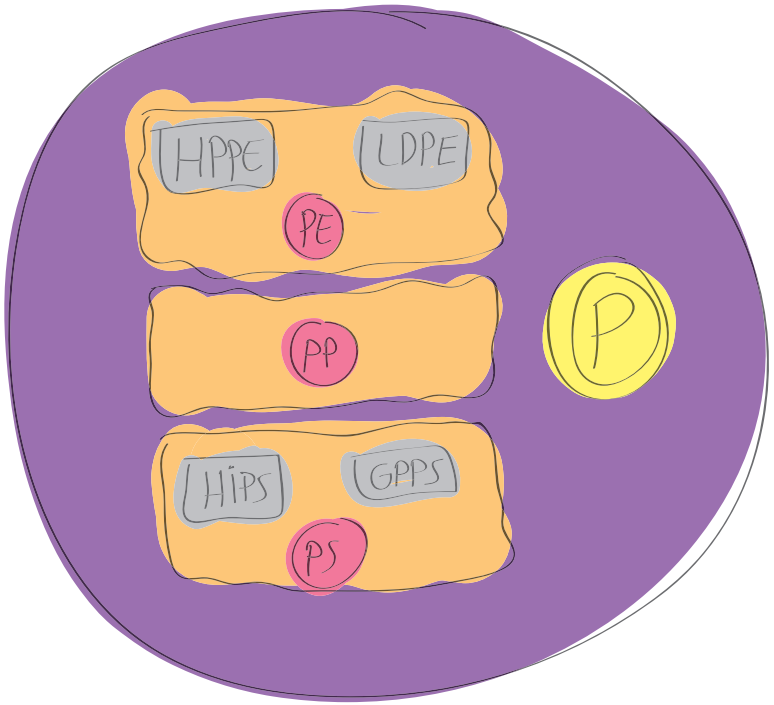
For the selection of the material is really important to keep in mind two main ideas: Design for children and design for the hospital. In consequence there are too many characteristics that our product have to accomplish. Such as softness, versatility and lightness, in case of design for kids and easy to sterilize in case of design for a hospital. Of course in both cases is very important that nothing toxic is used in a product with those finalities. I addition is necessary to choose an elastic material for the stretchable parts.

Polymeric materials work really good in this situations so the investigation is concentrated in plastics. They are easy to clean, light, warm, elastics and cheap. All this characteristics make them perfect for our toy.

(G)

Plastics evaluation:

I made a comparative matrix between the different groups of plastic materials considering the main characteristics that we need and the main features of each kind of polymers.



	HPPE	LDPE	PP	HIPS	GPPS
Used in toys production		*x*	*x*	*x*	
Easy to sterilize			*x*		
Used in medicine			*x*		
Easy to apply colours				*x*	
Light	*x*				
Resistant	*x*	*x*	*x*	*x*	
Translucent		*x*	*x*		*x*

(I)

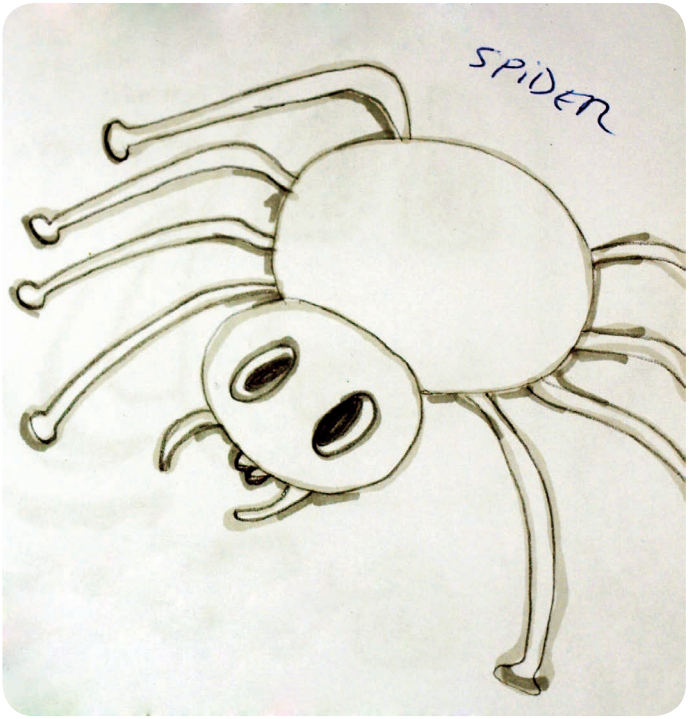
As the matrix above shows, the best material for toys production at the hospital will be the polypropylene (PP). Is the one most used in hospitals so this is a big advantage and is also used in toys' manufacturing.

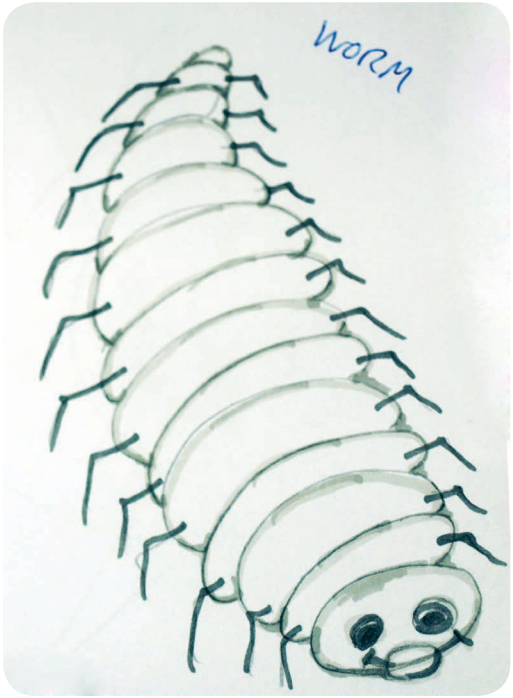
(J)

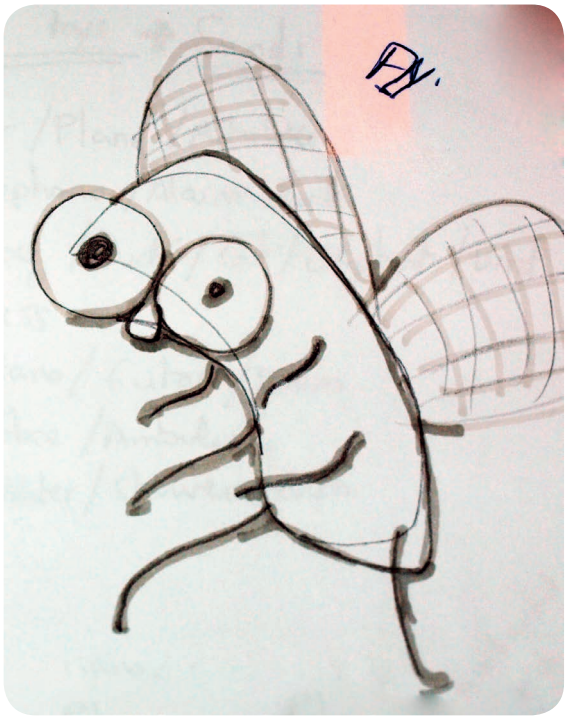
MAIN SHAPE

Since the first moment I started thinking about animal for the main shape, because is animals family most of them have legs that can serve us like stretchable parts of the toy. But I also try with other things.

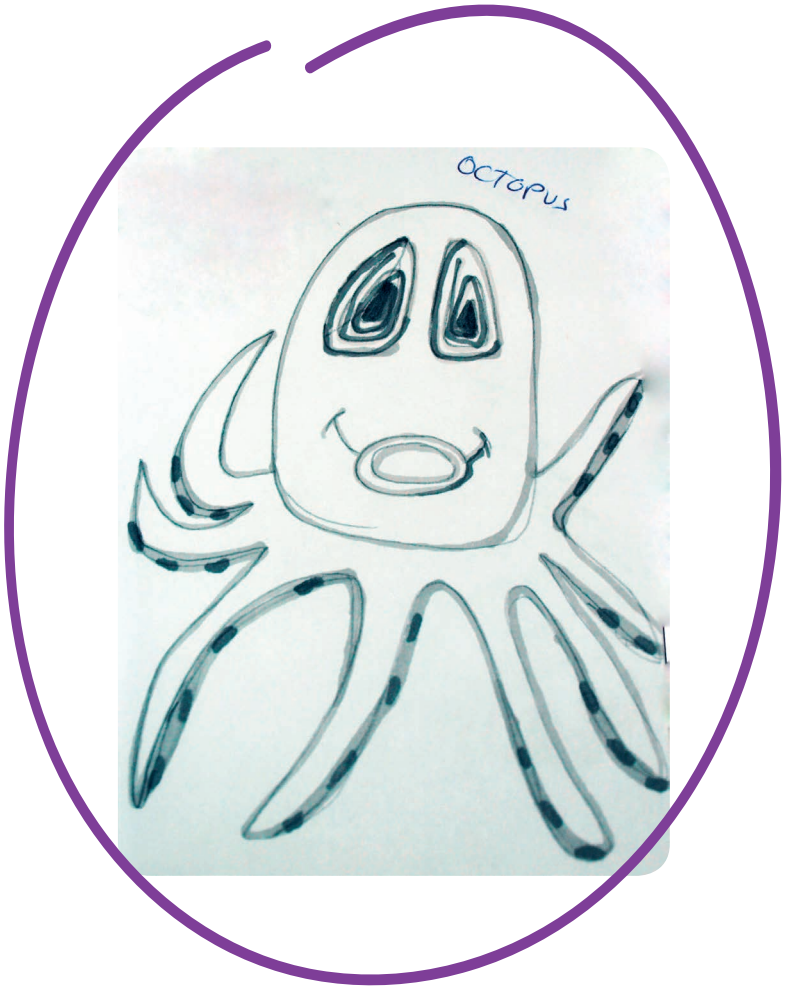
Like we saw in “idea generation” the first concept was a spider but in this step I started thinking about other possibilities.






FLY.


SUN



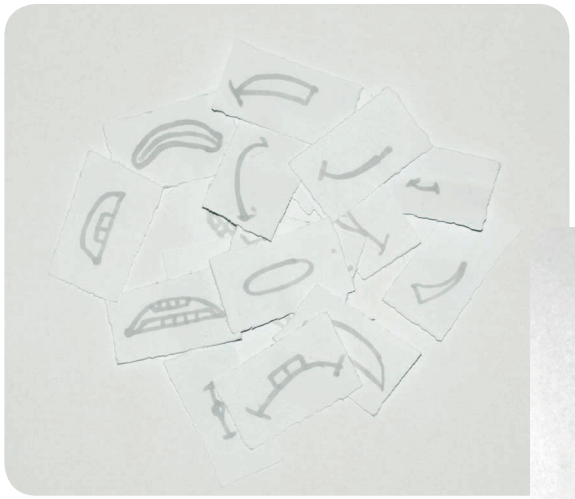
The number of legs is the main way to decide the final shape, in case of the worm, it has too many legs so is not adequate for the situation. The sun for example is not enough and the fly is not used to have long legs, concept that is also important because legs will be stretched during the game.

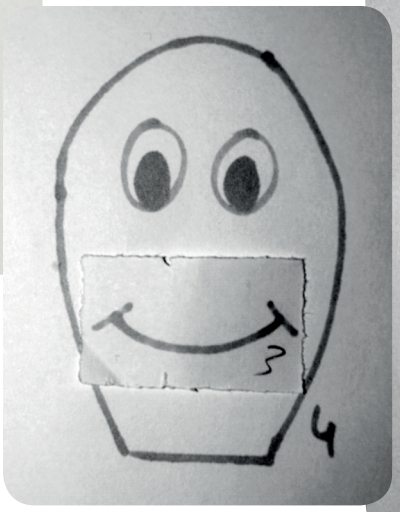
So the best two were the octopus and the spider. I based my final decision in if the animal will scare or not the kids and from my point of view, the spider can frighten children. In conclusion, the octopus will be the best option.

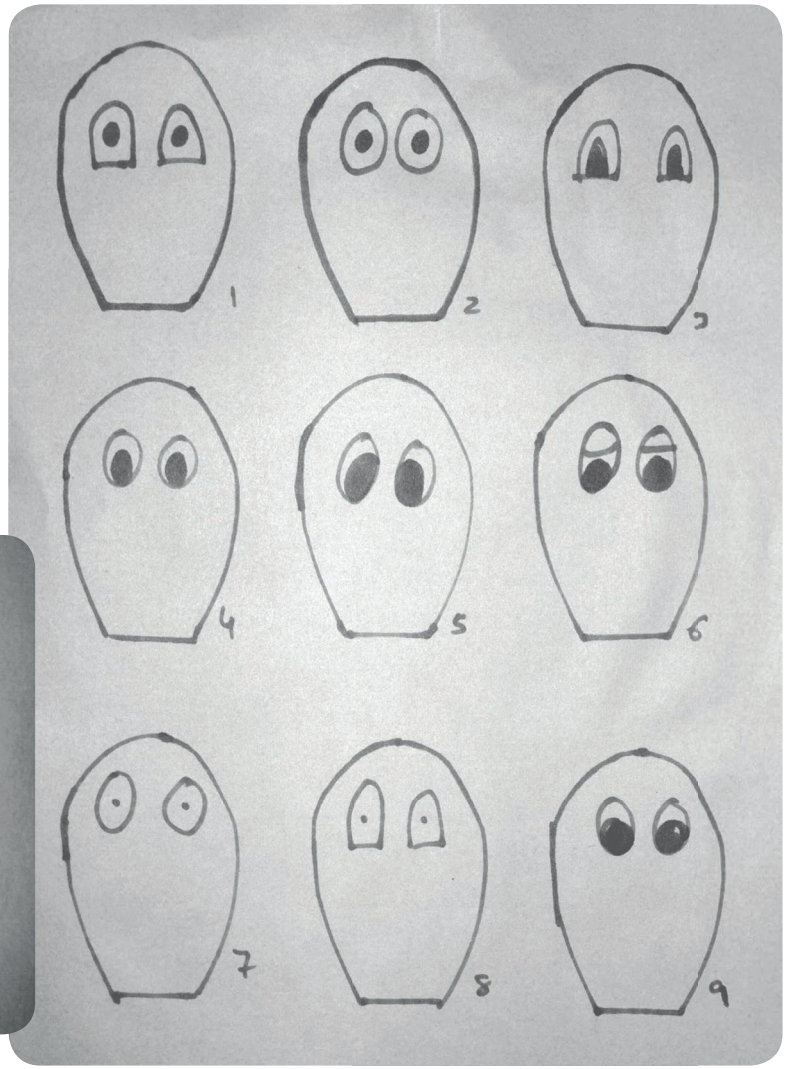
Faces:

One of the most important things to keep in mind to design a toy is that it have to be attractive for children, so not only the shape will be relevant. Also the expression of the toy, in case it has a face, is very important. It will make the toy more or less interesting for children.

For that reason I made a comparative matrix between different faces and expressions for that project. I draw some eyes and smiles, I gave them a number and I scored the different combinations to choose the best one.







MOUTHS	EYES									
	1	2	3	4	5	6	7	8	9	
1	6	7	5	6	4	3	5	3	6	45
2	7	8	5	6	6	3	5	5	7	52
3	8	9	6	9	6	5	6	4	5	58
4	6	7	5	8	5	2	3	4	4	44
5	7	8	6	9	6	5	6	5	4	56
6	3	4	2	5	4	1	2	2	1	24
7	6	6	3	7	5	1	6	5	5	44
8	9	8	6	9	7	5	7	6	5	62
9	7	7	4	7	8	4	6	5	5	53
10	2	2	1	3	2	1	3	2	1	17
11	8	8	6	9	6	4	5	4	4	54
12	6	6	4	7	5	4	5	4	5	46
13	6	6	3	7	5	3	3	2	4	39
14	5	5	3	6	5	4	4	4	5	41
15	6	6	5	7	6	3	5	4	4	46
16	7	5	4	6	6	4	6	5	5	48
17	2	3	1	3	1	1	2	1	1	15
18	7	7	4	8	6	4	5	5	3	49
19	6	6	2	7	4	2	1	1	2	31
	114	118	75	129	97	59	85	71	76	SCORE

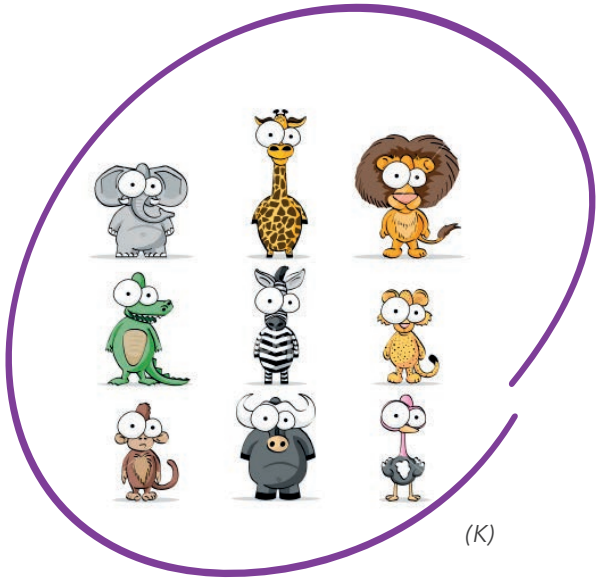
LITTLE SHAPES

Visiting the kindergarden I arrived to the conclusion that means of transport and animals are the most famous topics for kids. In that fields children start learning vocabulary early so are their most popular ambit of knowledge.

So both could be protagonist for designing the shape of the little toys.

But not only the shape will be important. The shape of the little toys will be connected to the sound of the main figure. So is important that the chosen toys have recognizable and nice sounds.

In case of means of transport, sounds are really similar one to each others; motorbike, car, bus, all of them are really similar. So maybe kids and also adults will be confused about which is the correct answer. For that reason I dismissed means of transport. In addition the field of animals will be directly connected with the main shape so every toy will be in concordance. And of course the sounds can be more different between themselves.



(K)

(L)

After that reflection the goal was to choose only eight animals, number of legs the octopus has, between the infinite list of animals that exist in the nature.

First I made a list with animals that I consider better than others with this criterion:

- Easy to define the sound of the animal
- Different to other animals
- Don't scare kids
- More usual for children, more popular

After that I made some rubrics comparing all the animals to choose the best eight.

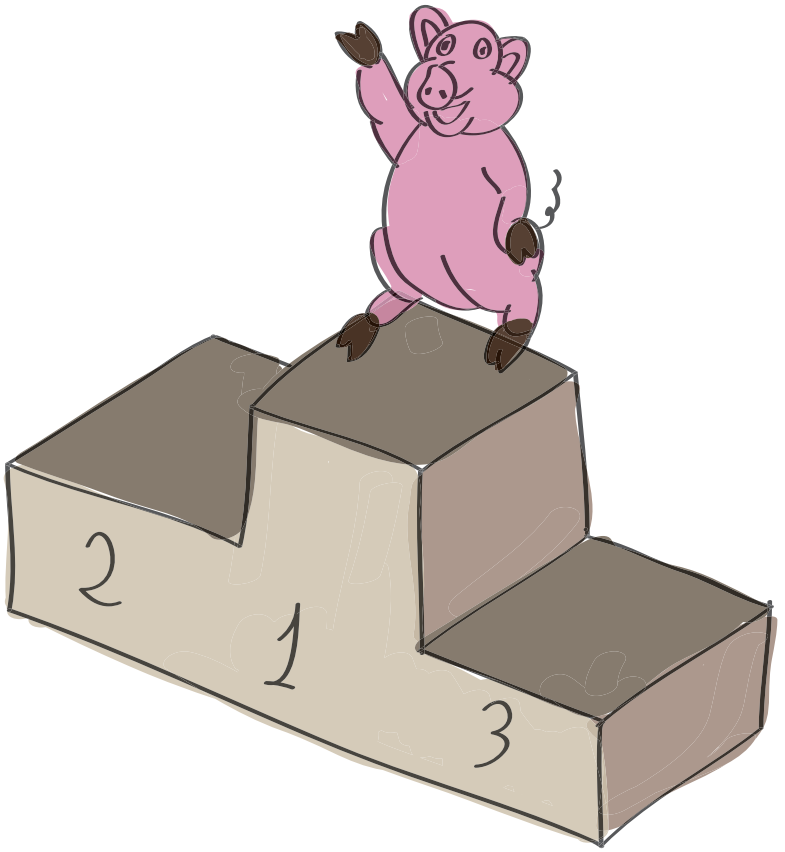
	The weighed sum method					
	Easy to identify the sound	Different than others (físicamente hablando)	Scare kids (negative value)	Common (not exotic)	Famous cartoon carácter	
Weight (%)	25	20	30	15	10	Points
Bee	4	8	7	8	9	6,8
Donkey	6	3	5	5	6	4,95
Horse	8	3	6	8	8	6,4
Pig	8	8	7	7	8	7,55
Dolphyn	2	9	9	6	6	6,5
Elephant	7	5	6	7	7	6,3
Seal	1	6	5	5	3	4
Cock	7	8	6	7	6	6,8
Cat	9	3	8	9	8	7,4
Ant	1	6	9	9	5	6
Giraffe	1	4	7	5	6	4,5
Koala	1	6	8	4	7	5,15
Lion	9	7	6	8	9	7,55
Wolf	9	5	5	7	5	6,3
Monkey	6	7	7	6	7	6,6
Bear	8	6	5	7	8	6,55
Sheep	7	7	8	9	8	7,7
Bird	7	6	9	8	6	7,45
Dog	9	5	9	9	9	8,2
Frog	8	9	7	6	8	7,6
Mouse	2	6	7	6	9	5,6
Snake	3	8	6	5	6	5,5
Cow	8	6	8	8	6	7,4
Duck	7	8	8	8	9	7,85

	Matrix of rate sum					
	Easy to identify the sound	Different than others (físicamente hablando)	Scare kids	Common (not exotic)	Famous cartoon carácter	Rate
Bee	1	2	3	3	3	12
Donkey	3	1	2	2	1	9
Horse	3	1	3	3	2	12
Pig	3	2	2	2	3	12
Dolphyn	1	3	3	1	2	10
Elephant	3	1	2	2	3	11
Seal	1	2	2	1	1	7
Cock	3	2	2	2	2	11
Cat	3	1	3	3	3	13
Ant	1	3	3	2	2	11
Giraffe	1	2	2	1	1	7
Koala	1	3	3	1	2	10
Lion	3	2	1	3	3	12
Wolf	3	1	1	2	1	8
Monkey	2	3	2	2	2	11
Bear	2	2	1	2	3	10
Sheep	3	3	3	3	3	15
Bird	3	2	2	3	2	12
Dog	3	1	3	3	3	13
Frog	3	3	3	3	2	14
Mouse	1	2	2	3	3	11
Snake	1	3	1	1	2	8
Cow	2	2	2	3	1	10
Duck	3	3	2	3	3	14

As we can see in both multi-criteria techniques, there are eight animals common winners and others with good punctuation in an of the matrix.

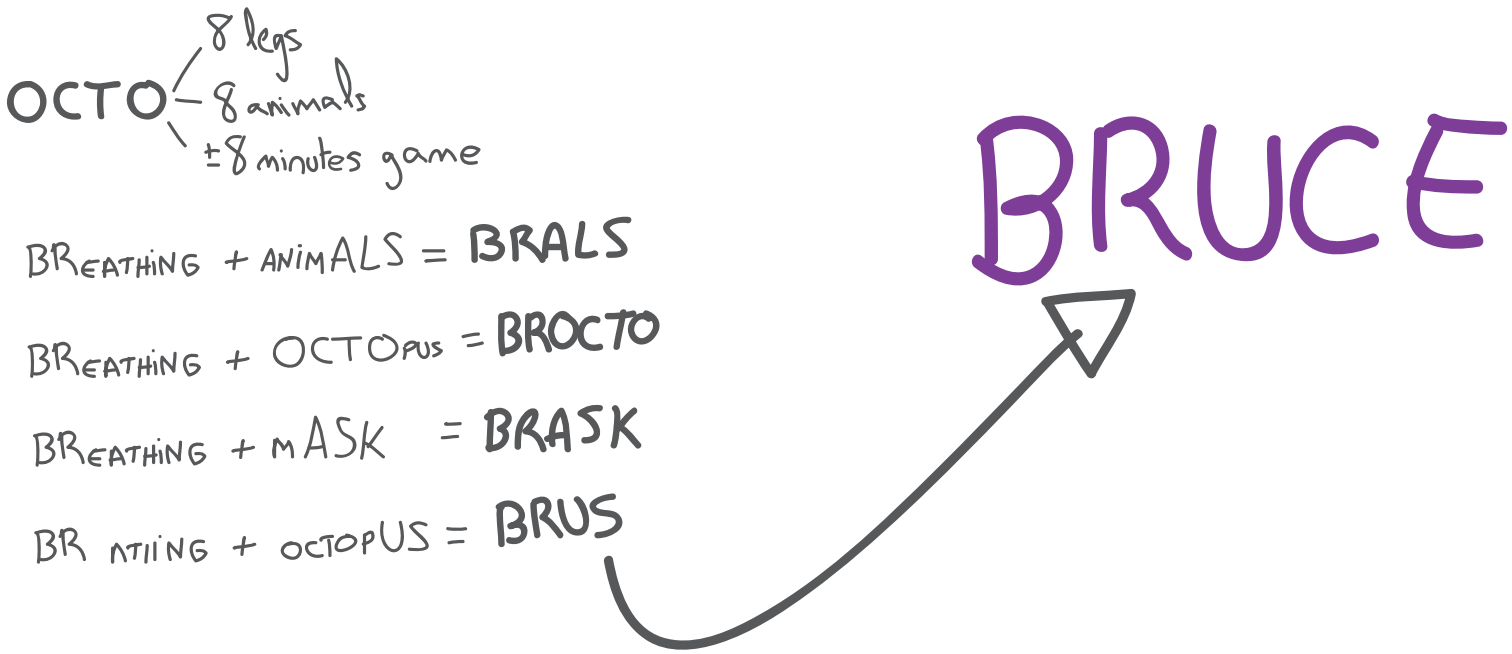
Of course the ones that obtained better result in both matrix are the ones selected for the project:

- Pig
- Cat
- Lion
- Sheep
- Dog
- Frog
- Cow
- Duck



NAME OF THE TOY

After a brainstorming with different possibilities I decided to choose BRUCE. These were the best options:



The first idea was BRUS but in Norwegian it has a concrete meaning (soft drink) so I transformed the name into BRUCE because the pronunciation is very similar and it is a proper name itself.

TIME ESTIMATION

INTERACTION DESIGN

BEFORE

STEP BY STEP

Nowadays is really important to design for the user's experience and for that we, the designers, have to keep in mind all the details of the interaction process while designing a product. With that purpose, in this part I will explain all the steps that will take place during the game, and I will made a time estimation for the game to compare it with the length of the treatment.

TIME ESTIMATION

With the objective to know how much time of the treatment will the kid consume playing, I made an approximate time's estimation with all the steps that children will follow, in a standard situation.

In the moment the kid and the octopus are wearing the mask, the time starts counting (because kid's treatment is taking place):

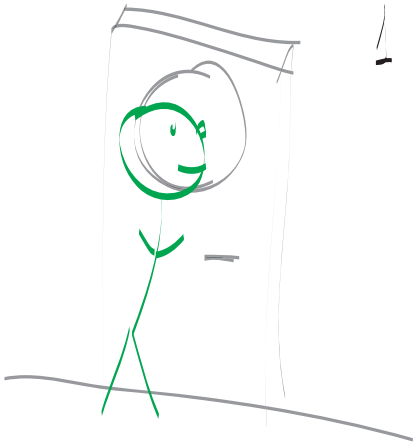
- The parents shows the little shapes to the kid. ±30s
- The kid stretches one leg. ±3s
- The leg makes sound and go back. ±10s
- The kid chooses the correct animal. ±5s
- The kid puts the animal in the leg. ±4s
- The kid and parents round the ring. ±3s
- Again from 2 to 6 seven times more. ±175s

3min 50s

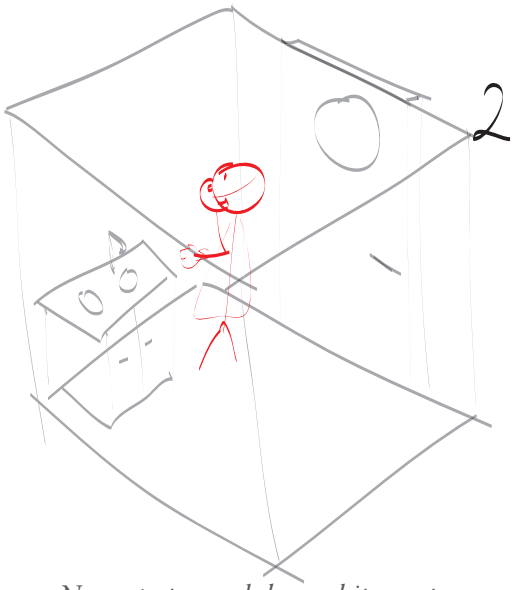
This is the minimum time to complete the game. But if nurse and parents interact with the kid while she/he is playing, the kid needs more time for each part of the game, or other situations that can happen, the time will be increased in approximately double.

×2 = 7min 40s

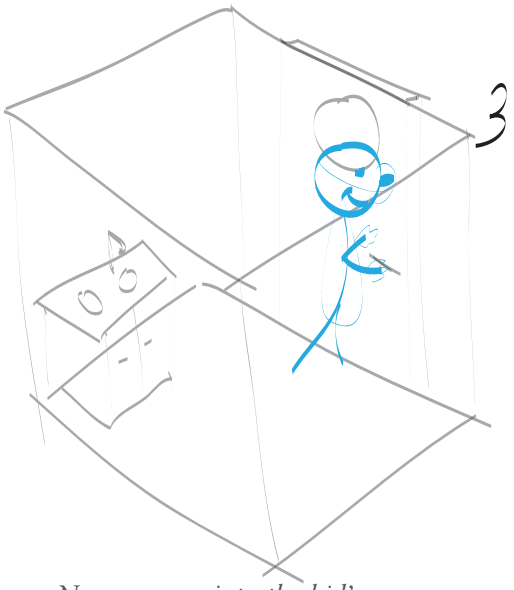
BEFORE THE GAME



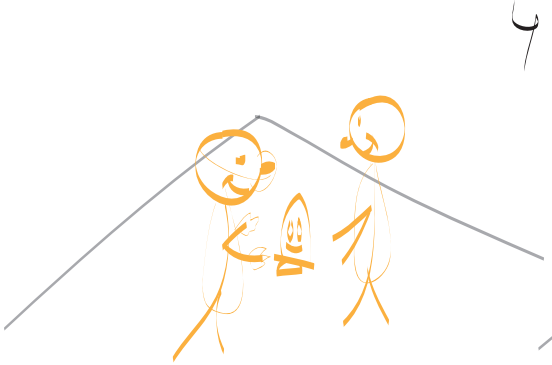
Nurse looks trough the window's door. To be recognized by the kid before put on the mask, globes and coat.



Nurse puts on globes, white coat and facial mask.



Nurse comes into the kid's room.



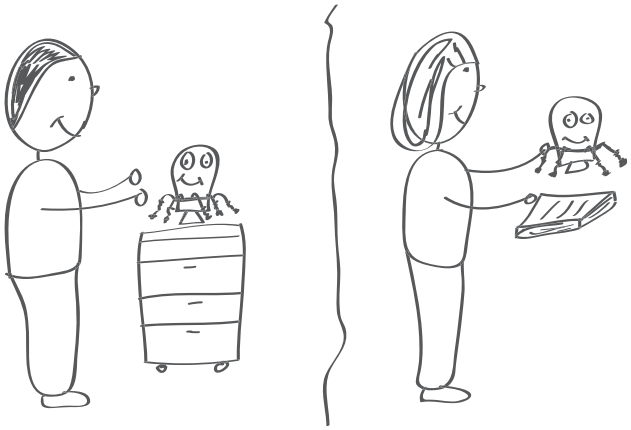
Nurse gives the toy to the parents.

Nurse prepares and connects medication while parents give the toy and explain the game to the kid.

The treatment and the game are ready to start.

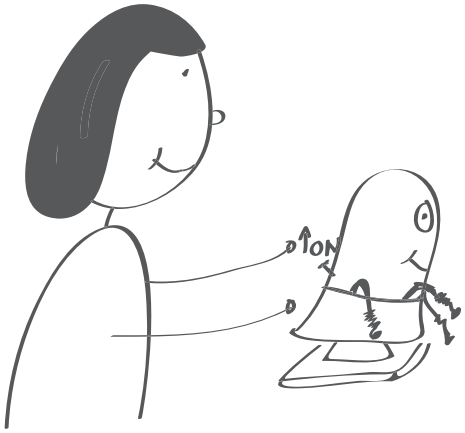
STEP BY STEP

Since the moment that the nurse gives the toy to the parents, this is how the interaction could take place, step by step:

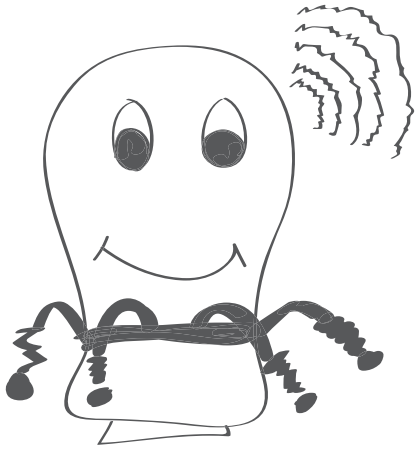


1- Parents fix he octopus in a table or in a book

2- Parents bring the little animals closer to the kid.



3- Parents switch ON the octopus.



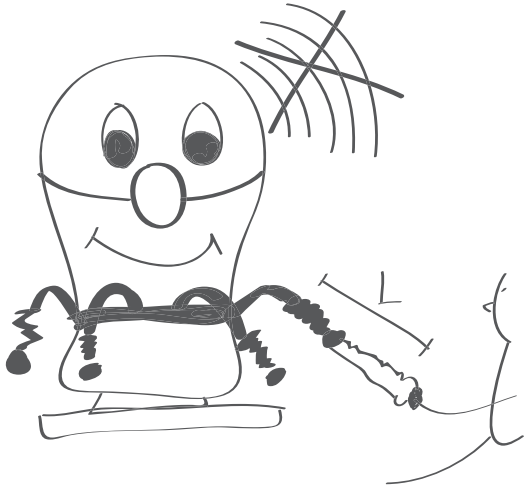
4- Octopus starts breathing strangely.

5- Parents and kid fix the mask to the octopus.

6- Octopus starts breathing normally.

7- Parents/Nurse puts the mask to the kid.

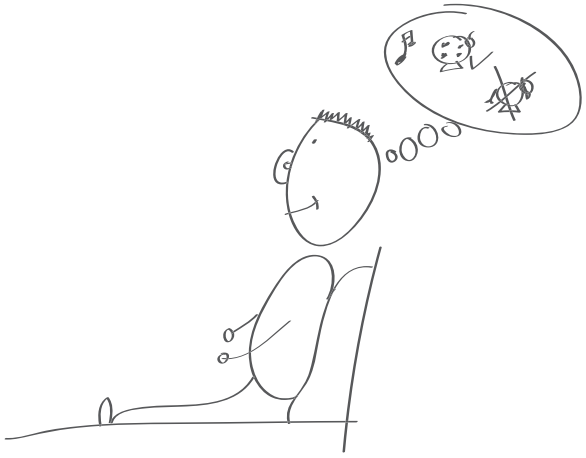
8- Kid stretches one leg.



9- Octopus stops breathing.

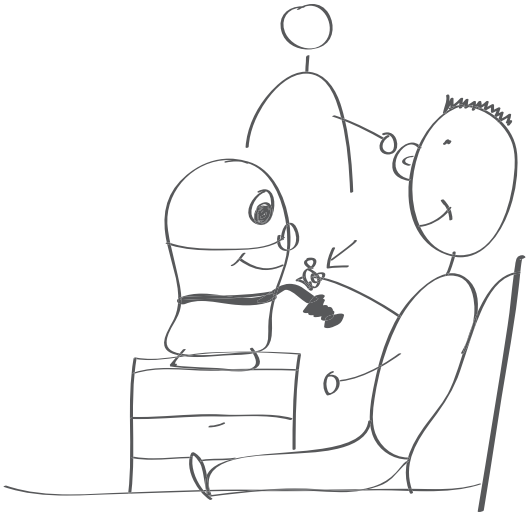
10- Kid lets go the leg and it starts animal sound.

11- Leg goes back to the position. Then the sound stops.

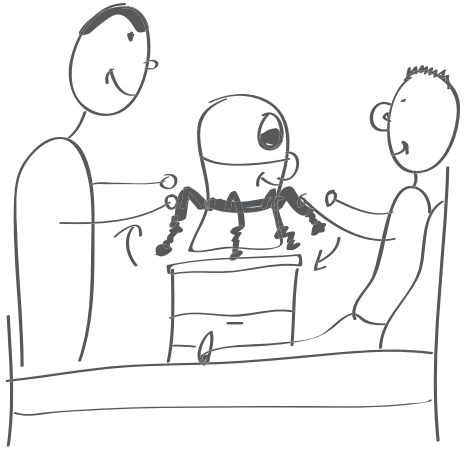


11- Kid thinks about the sound.

13- Kid chooses the correct animal. While parents hold his/her mask.



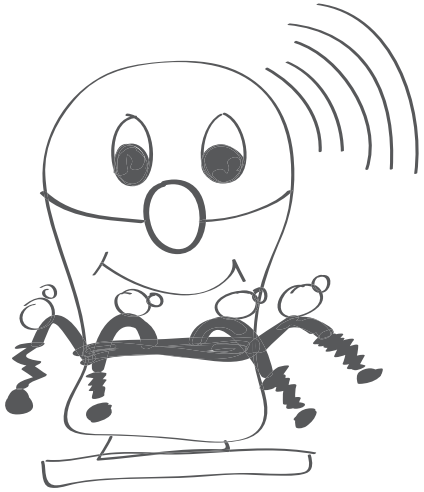
14- Kid fix the animal on the leg.



15- Parent and kid round the ring.

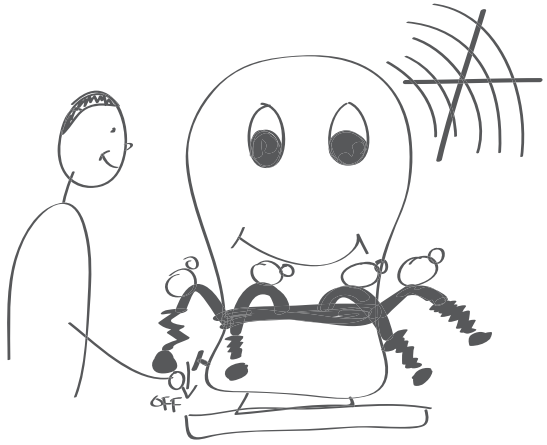
Repeat 8-15

16- Repeat from 8 to 15 until finishing all the legs.

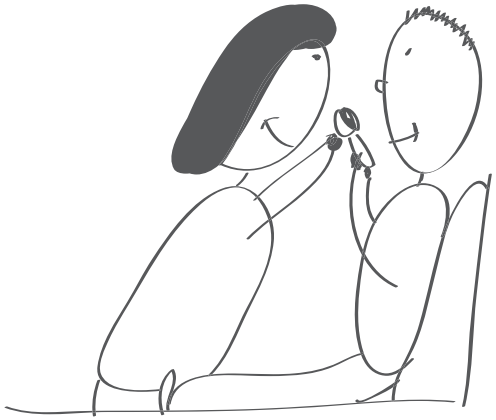


17- With all the animals fixed the octopus stars breathing properly again.

18- Kid and parent remove octopus' mask.

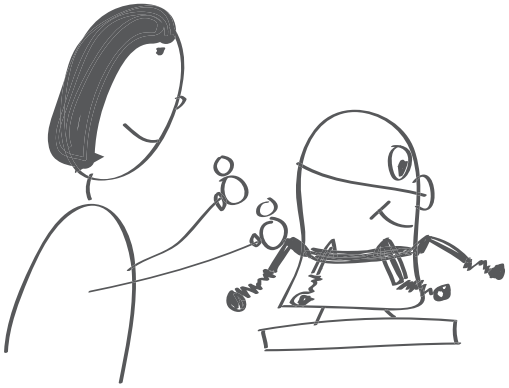


19- Parents switch OFF the octopus.



20- Remove kid's mask.

In case that the game is finished but not the treatment... From 17:



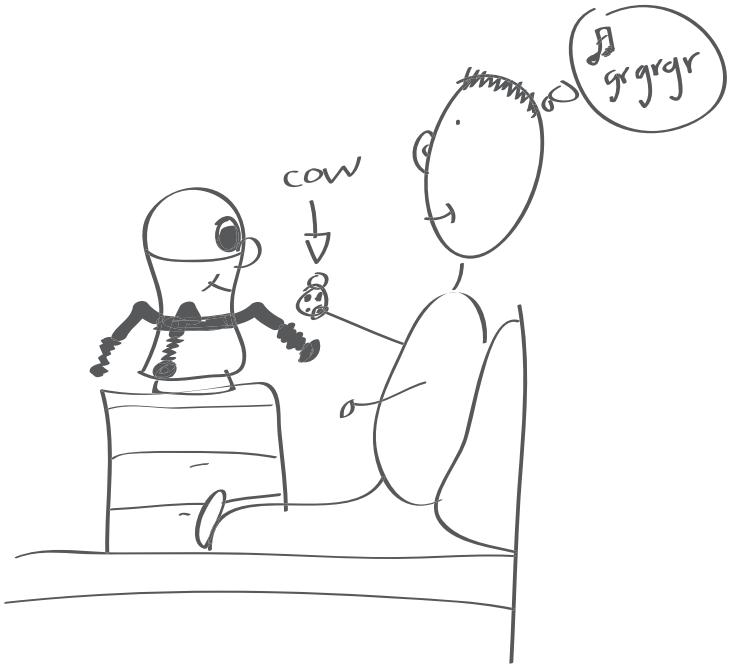
18b- Parents take of all the animals.

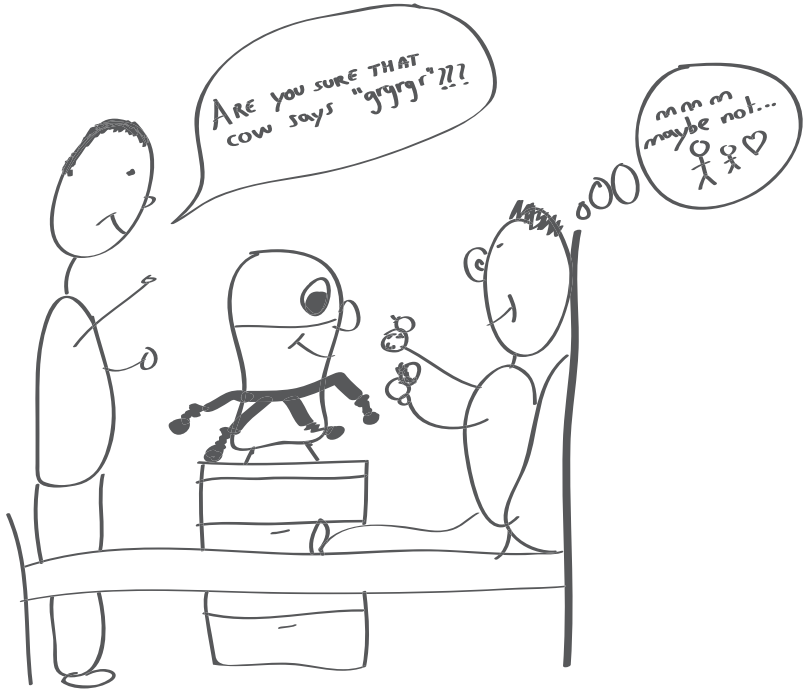
19b- Octopus stops breathing again.

From 8 to 17

20b- Repeat from 8 to 17.

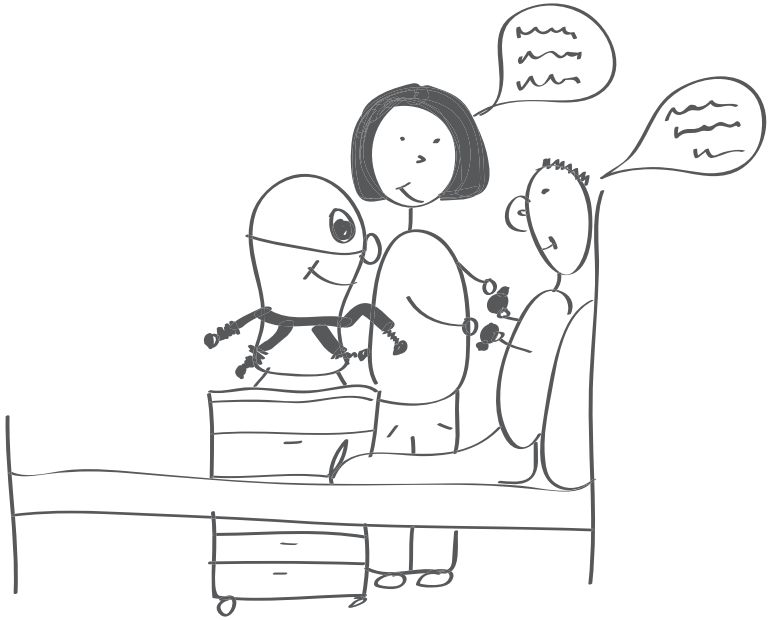
In case that the kid puts an incorrect animal in the leg:





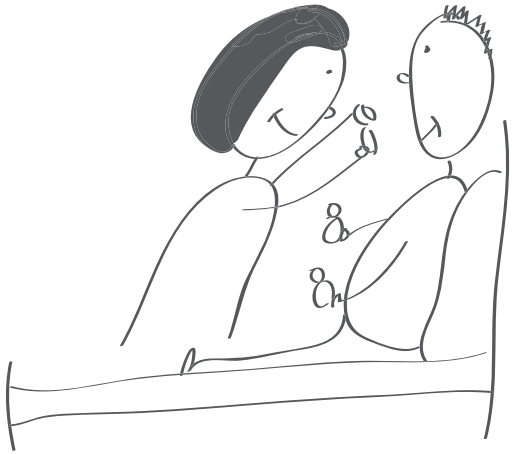
Parents ask if he/she is sure and try to show him/her clues about the correct animal. But not insist that the kid is wrong. This interaction between parents and children will make the kid feel supported.

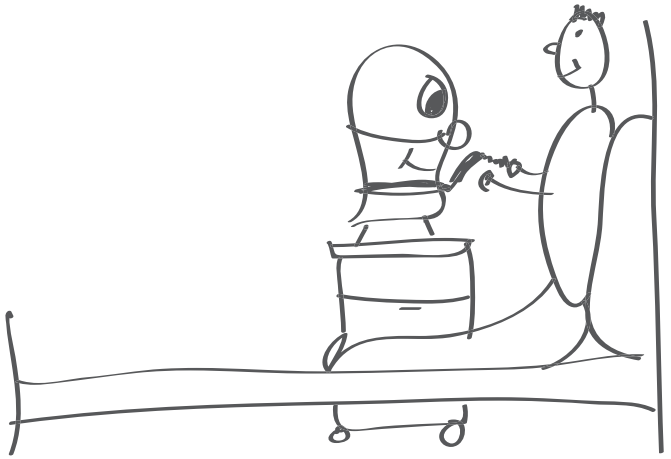
In case the kid doesn't want to fix the animal himself:



The kid will choose the animal and will give it to someone that will fix it in the correct leg.
In this case is also important the interaction between the protagonists.

In case the treatment of the kid ends before the game:

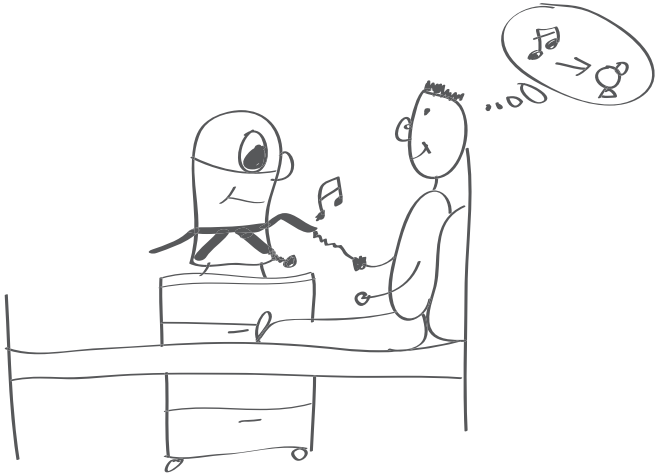




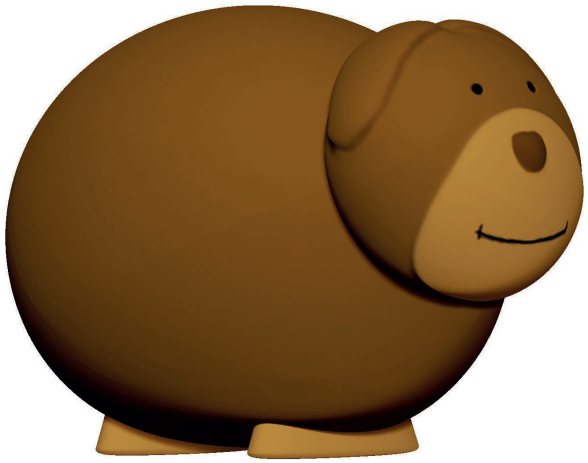
Take of the kid's mask and continue playing until the game finishes.

In case that the kid stretches two legs at the same time:

The octopus will produce two different sounds at the same time.



Kid has to stretch one of the legs again to know which of the animals should put in each leg.




FINAL
CARDBOARD
MATERIAL
DIMENSIONS
DETAILING
MAINTENANCE
ELECTRONIC
PRODUCTION
PIECES

Detailing contains all the information about the final design, such as dimensions, material, production, maintenance, pieces, a cardboard model and a resume with the main characteristics of the project.

MATERIAL

After the comparative of materials we saw in "Concept development", here we will see the main characteristics of the chosen material, Polypropylene (PP).

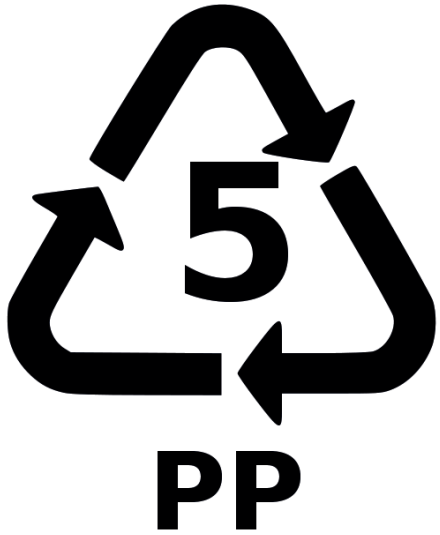
Polypropylene is an economical material that offers a combination of outstanding physical, mechanical, thermal, and electrical properties not found in any other thermoplastic. It is light in weight, resistant to staining, and has a low moisture absorption rate *(13)*.

It's possible to make it translucent but usually pigments are used to make it opaque or add colour *(14)*.

PP resins are one of the more versatile families of thermoplastics. By tailoring the process or the composition, a supplier can produce products ranging from semi-rigid, extremely tough, elastomeric types to very rigid grades that can withstand severe environments, such as autoclave sterilization at high temperatures *(15)*.

This is one of the most important characteristics for our product, the possibility to sterilize is really important for the hospital environment.

There are two main types of PP, homopolymers and copolymers.
For that project is recommendable to use the first one because PP homopolymers exhibit high stiffness, high temperature resistance and excellent chemical resistance *(15)*.



Physical Properties *(16)*:

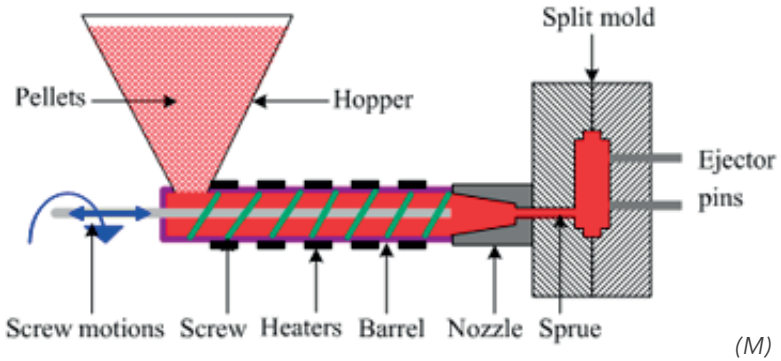
- Tensile Strength:	0.95 - 1.30 N/mm²
- Notched Impact Strength:	3.0 - 30.0 Kj/m²
- Thermal Coefficient of expansion:	100 - 150 x 10-6
- Max Cont Use Temp:	80 °C
- Density:	0.905 g/cm3

PRODUCTION

The production system will be moulded injection. With this method we will obtain a good final result in all the surfaces so we will not need to add any other process besides the assembly.

For polypropylene mouldings, where good surface finish is required, it is common practice to use melt temperatures of 250ºC combined with high packing pressures about 80 MPa *(16)*.

More specifications that we should follow while moulding PP are specified in "D4101–11 Standard Specification for Polypropylene Injection and Extrusion Materials" *(17)*.



(M)

Polypropylene injection moulding advantages *(18)*:

- Rugged material
- Highly resistant to acids, bases and chemicals
- Very good fatigue resistance
- Can be made both flexible and tough
- Excellent machining characteristics
- Economical
- Can be produced opaque, translucent or in colours

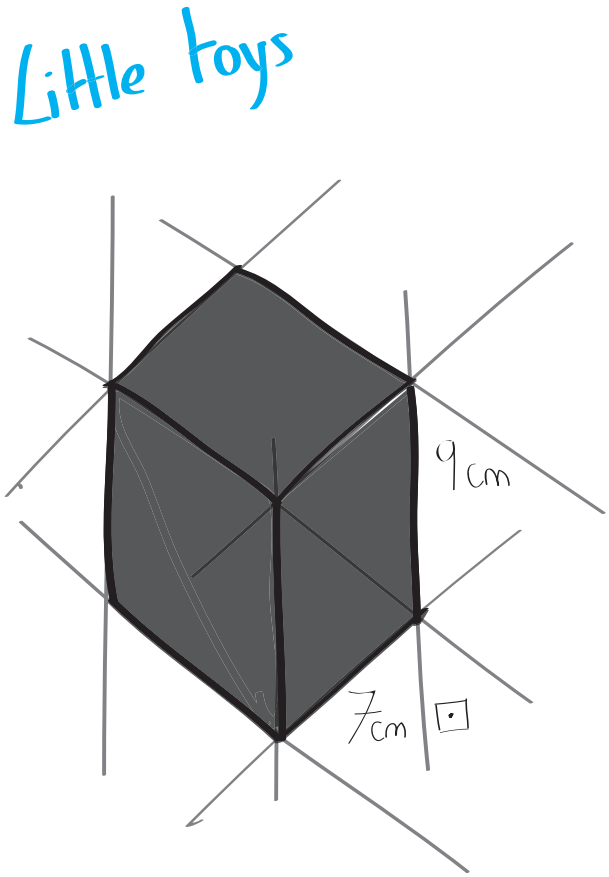
Polypropylene injection moulding steps *(19)*:

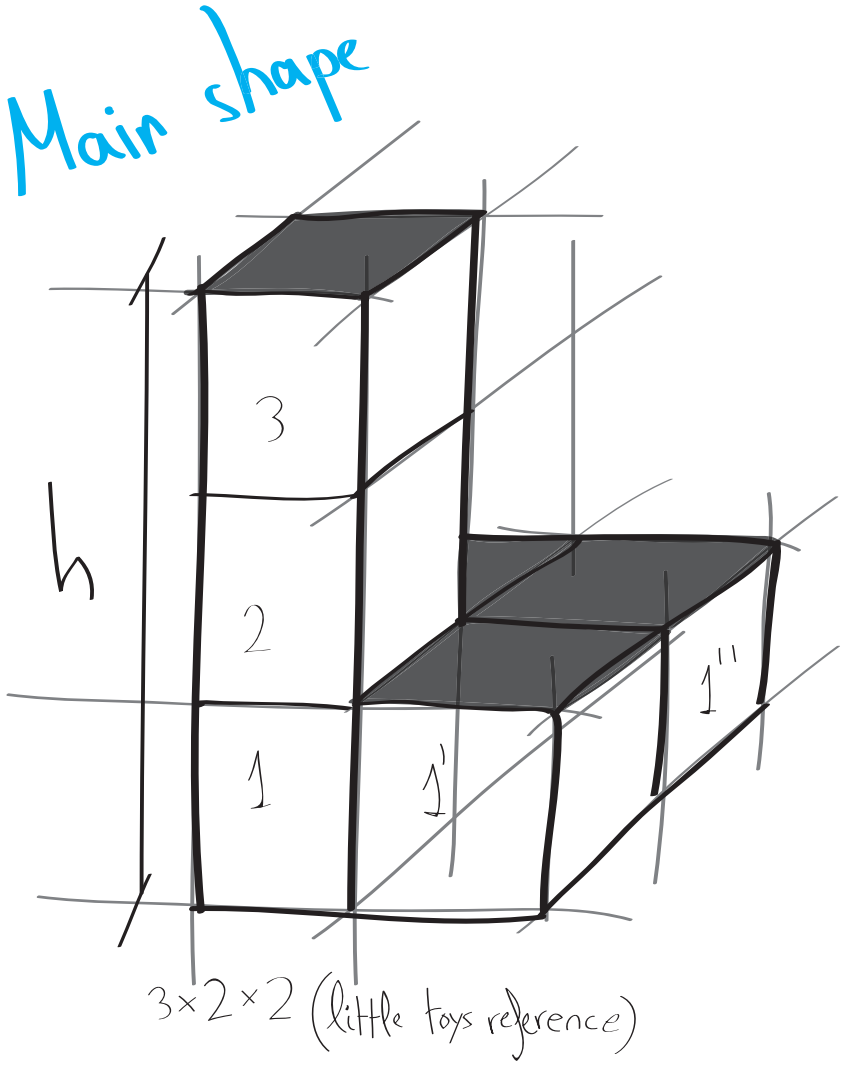
- Preparation of the mould
- Melting of the polymer
- Injection of polymer melt into the mould
- Cooling the mould
- Demoulding

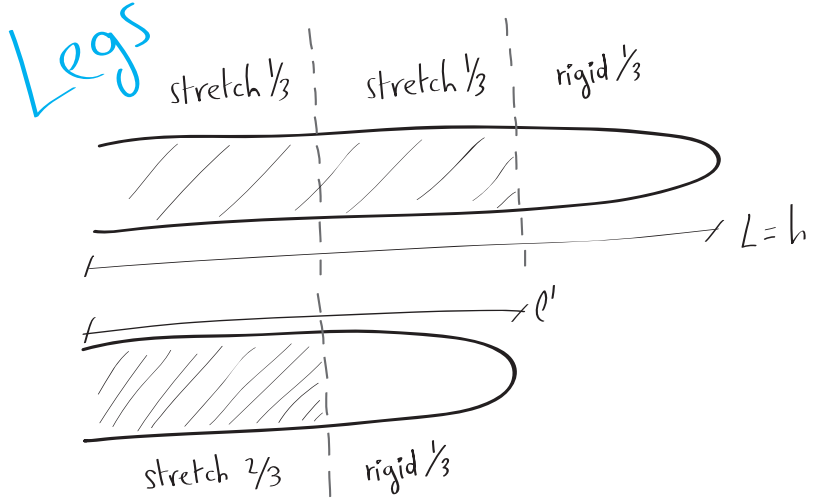
DIMENSIONS

To start developing the final dimensions for the toy, I took as reference one of the toys that I saw in the kindergarden.

This doll was in size perfectly compatible with kid's hands. So I took that reference for the size of the little toys. Taking my notebook as model, I was able to know the maximum sizes for the little toys. The shape will be sculpted inside this references.







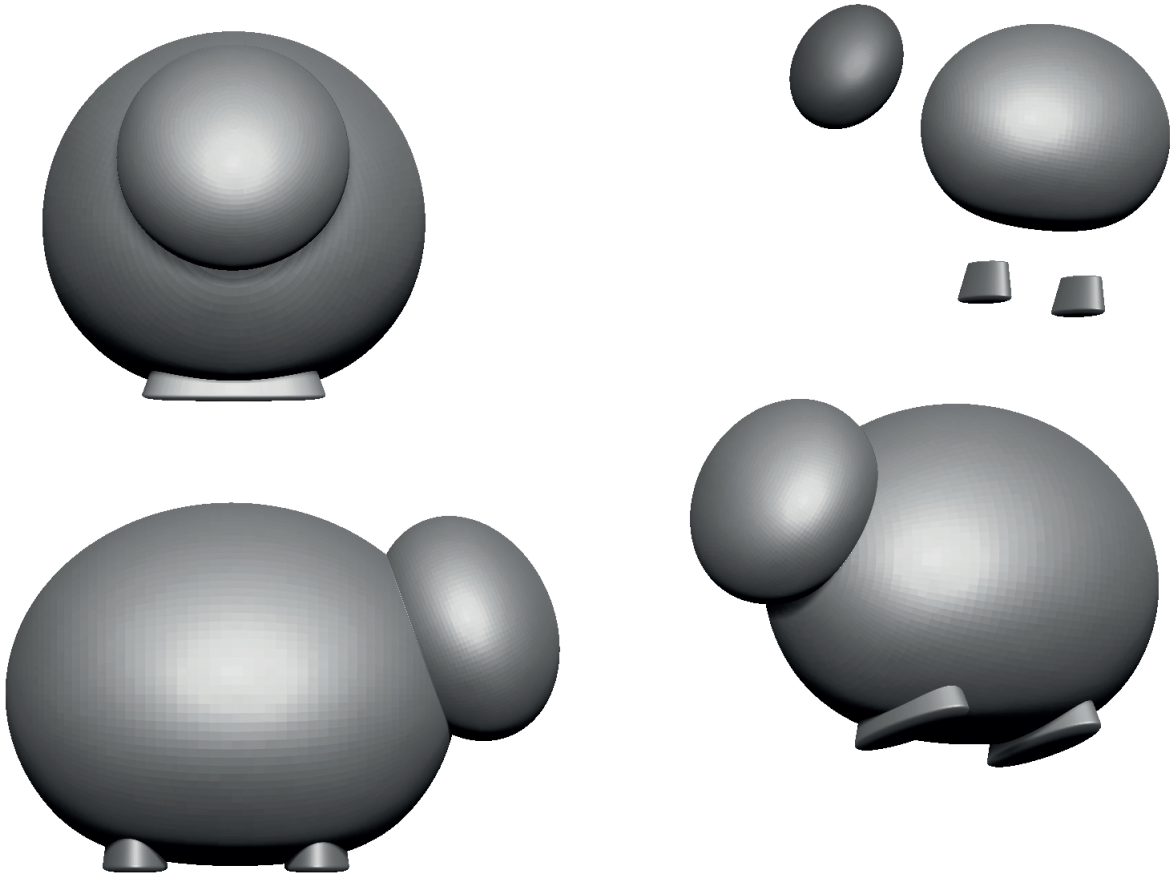
For the main shape, I took references in relation to the little ones. A relation of 3 times in hight and 2x2 times in base.

That was the starting point for the process of design of the final shapes.

The legs will have a relation 1:1 with the hight of the main shape when are stretched.

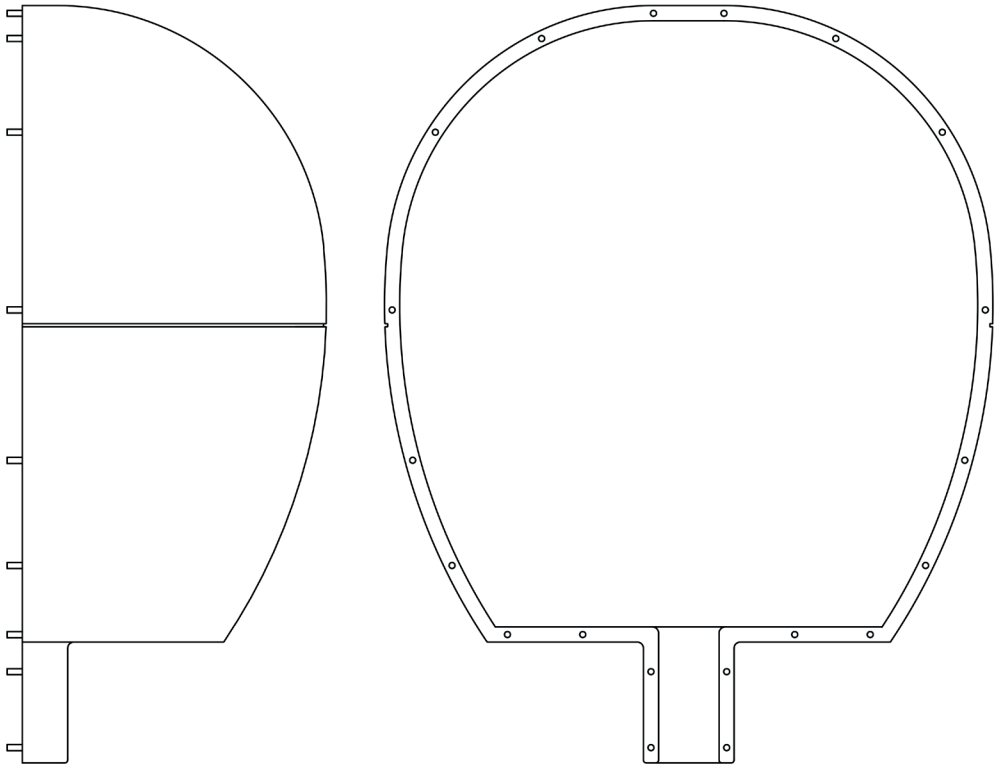
And there will be another relation by thirds, two parts stretchable, and one rigid.

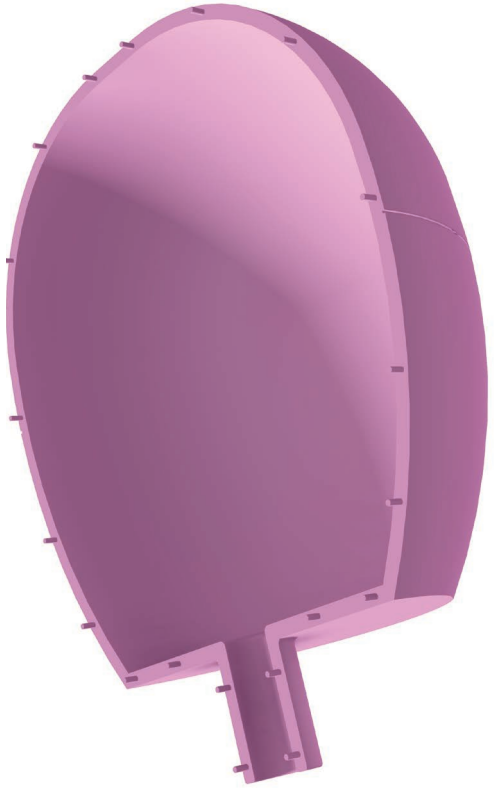
As we will see in the next part, the final shapes of the little toys are based in this pattern, two spheres and two conic frustums. In case of the frog and the duck the pattern suffered some modifications but the starting point was the same than the other animals.

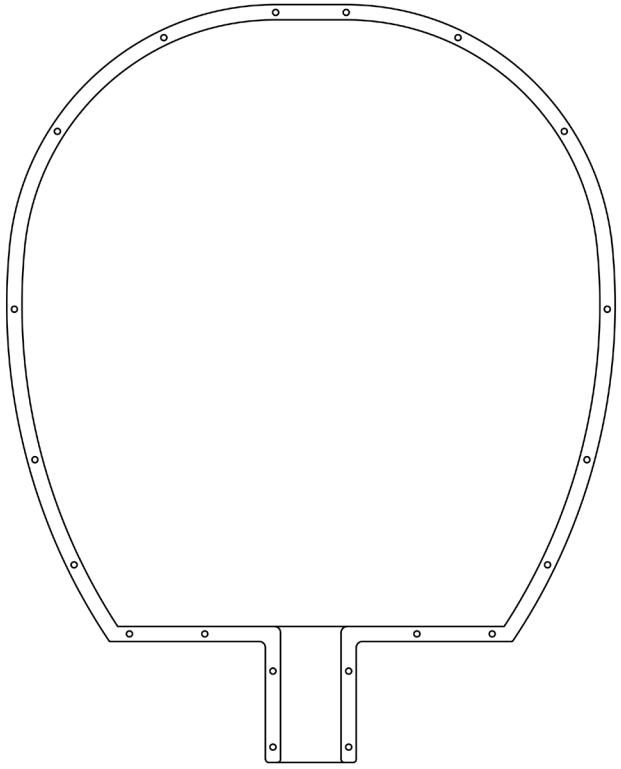


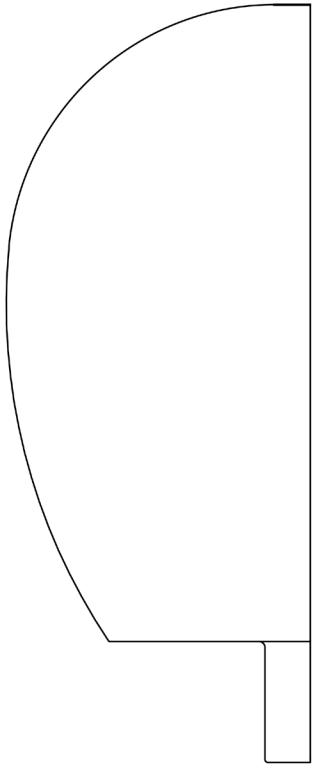
PIECES

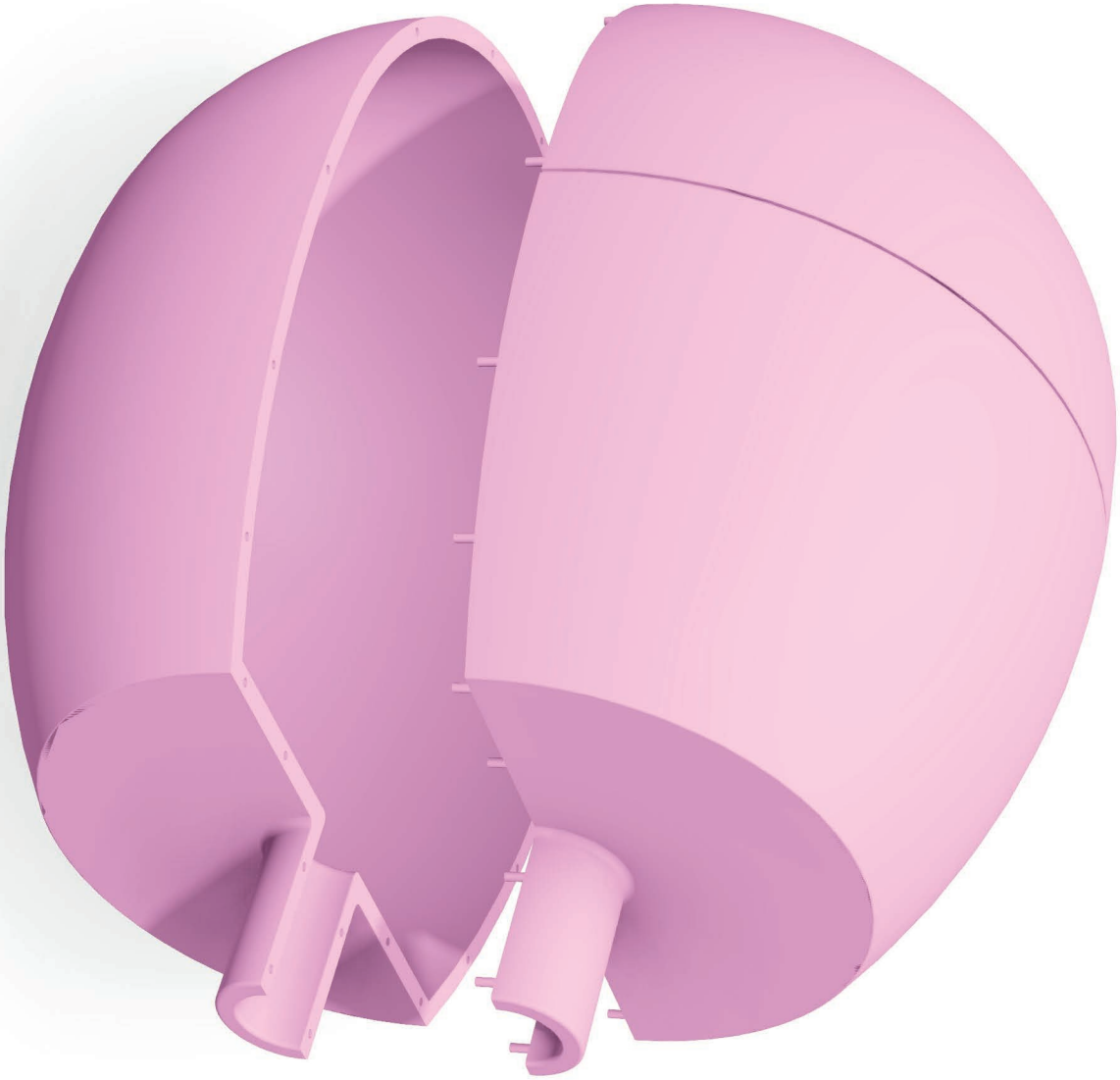
Octopus' head





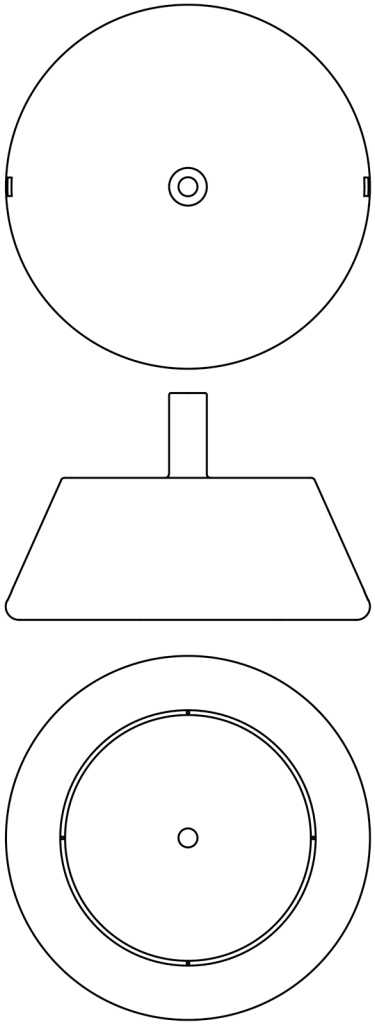


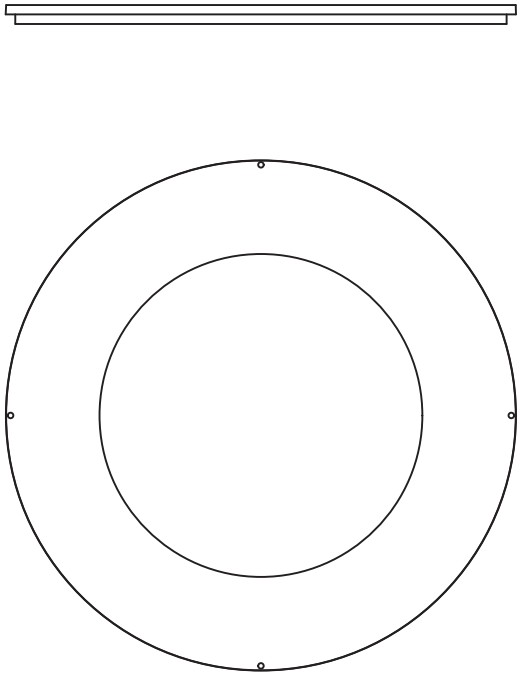




PIECES

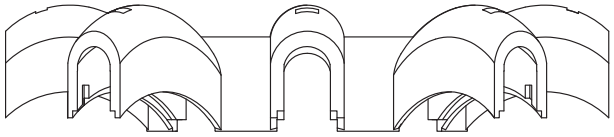
Octopus' bottom

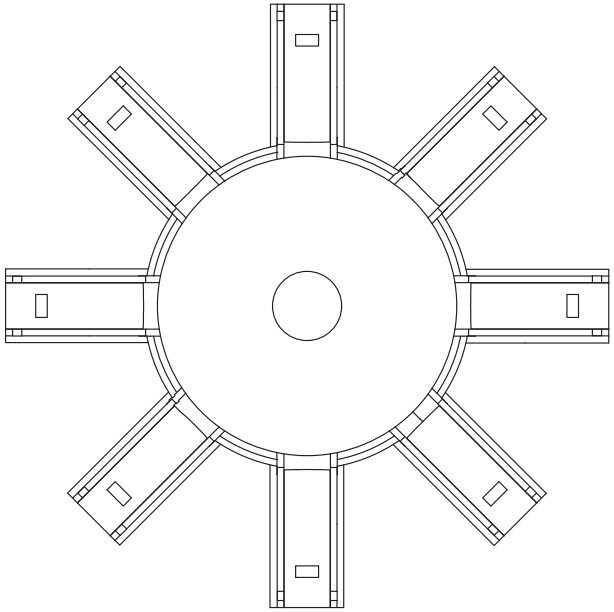


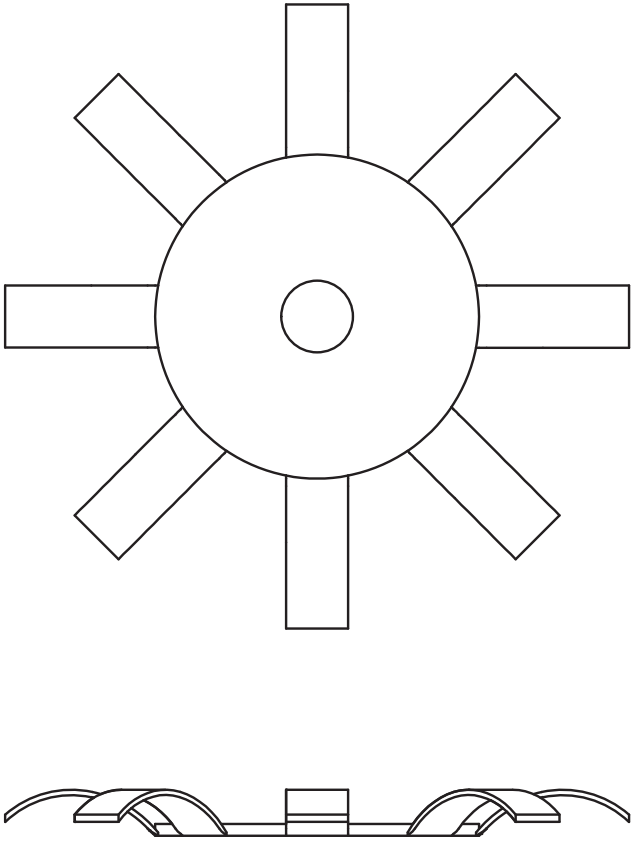


PIECES

Ring

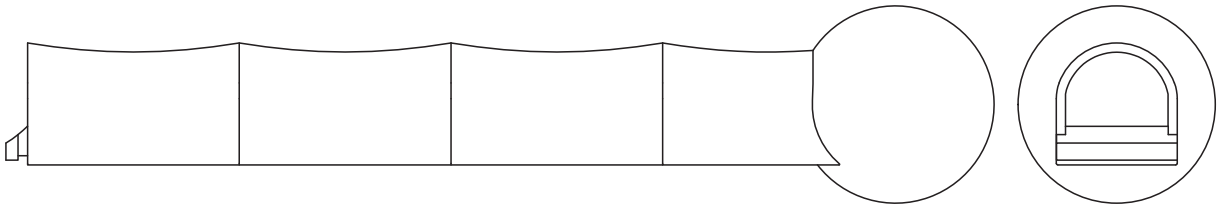


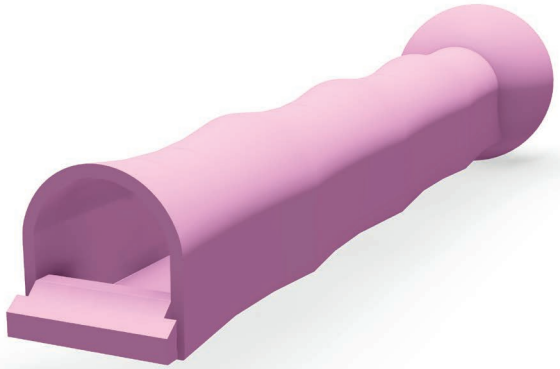




PIECES

Legs

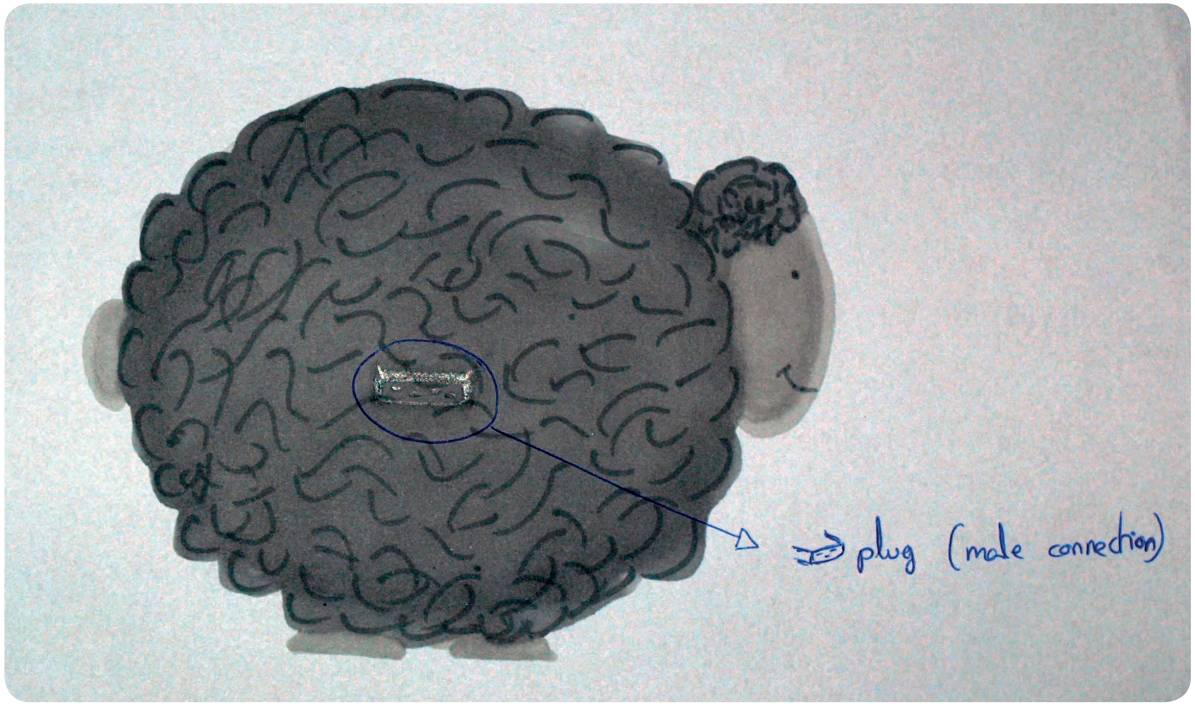


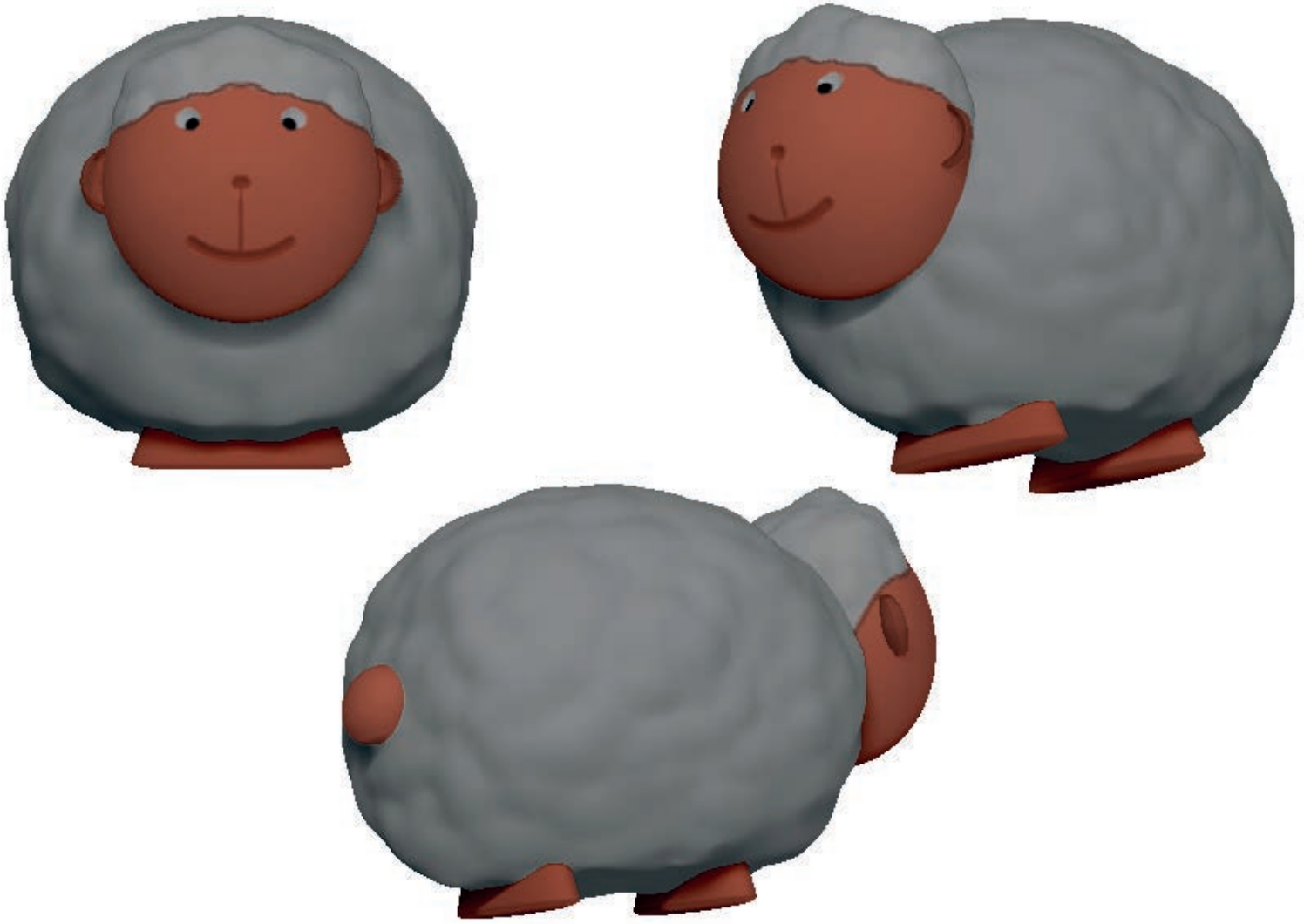


PIECES

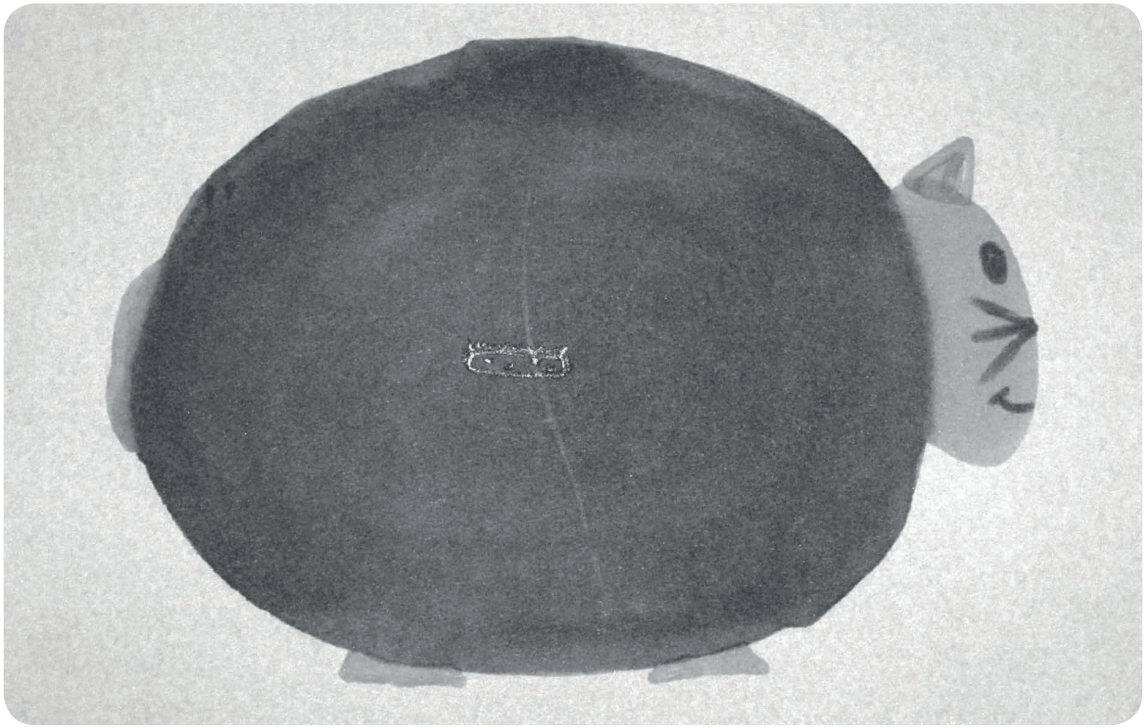
Little animals

The sheep:

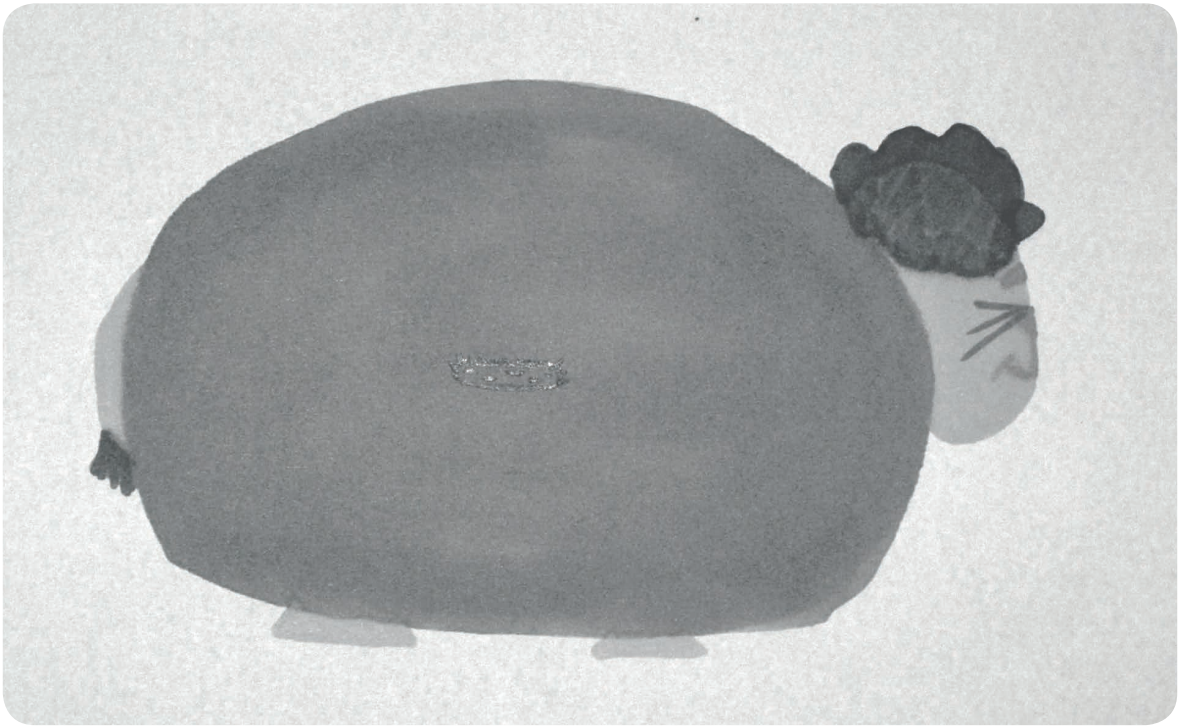


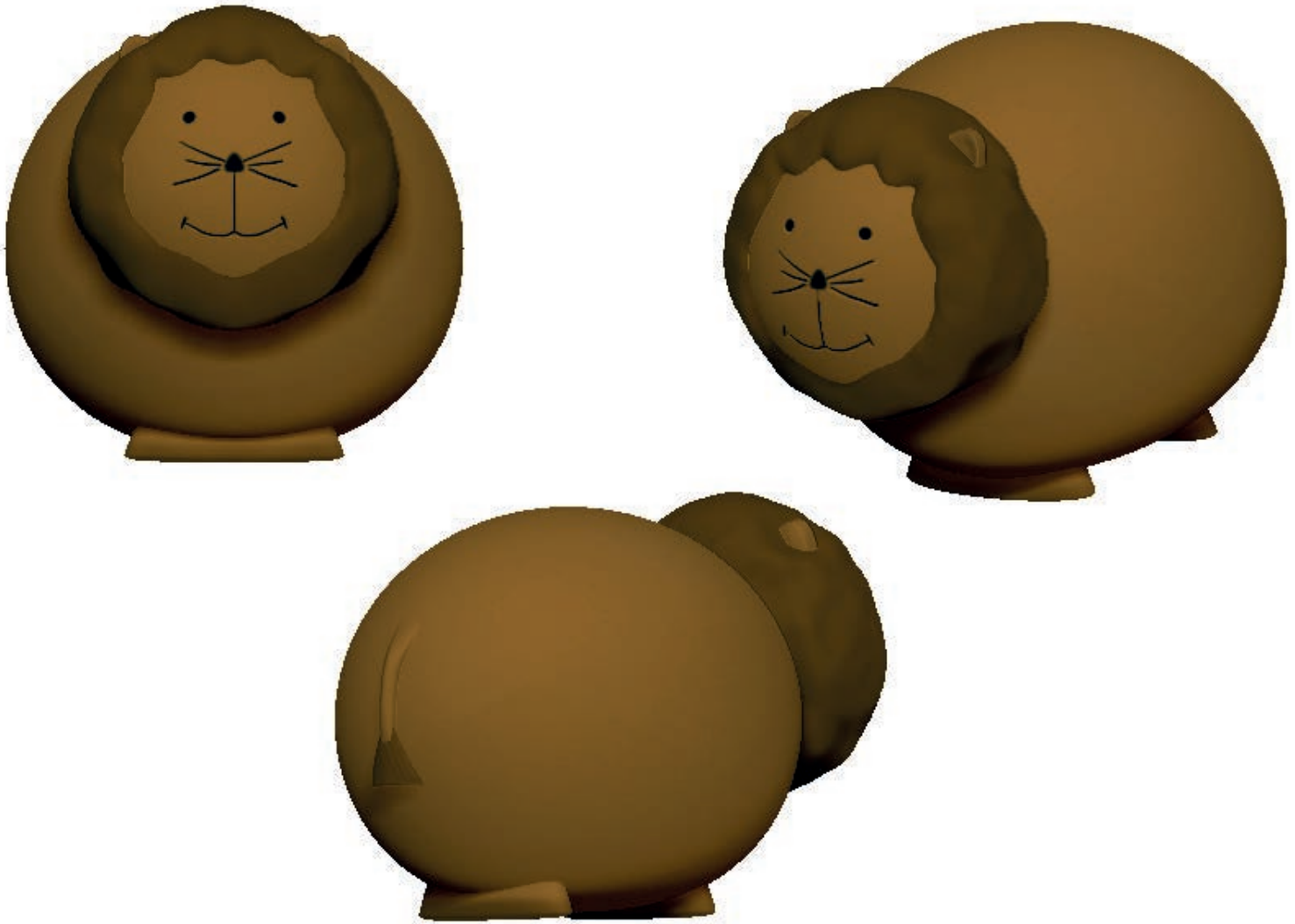


The cat:

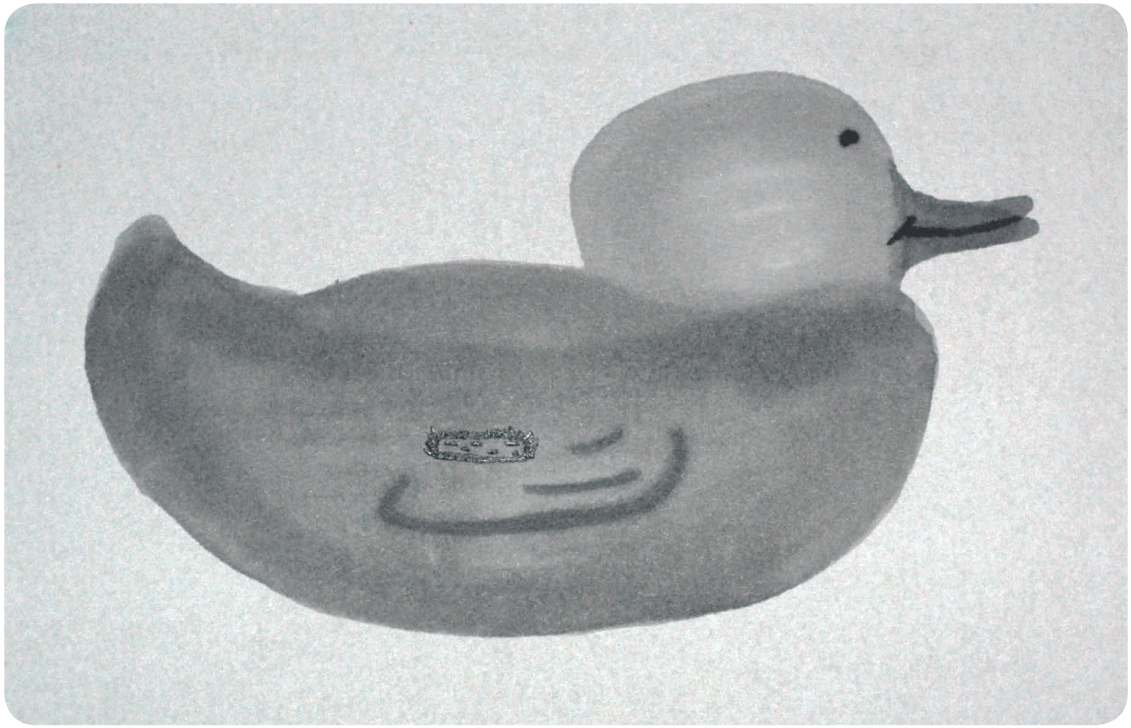


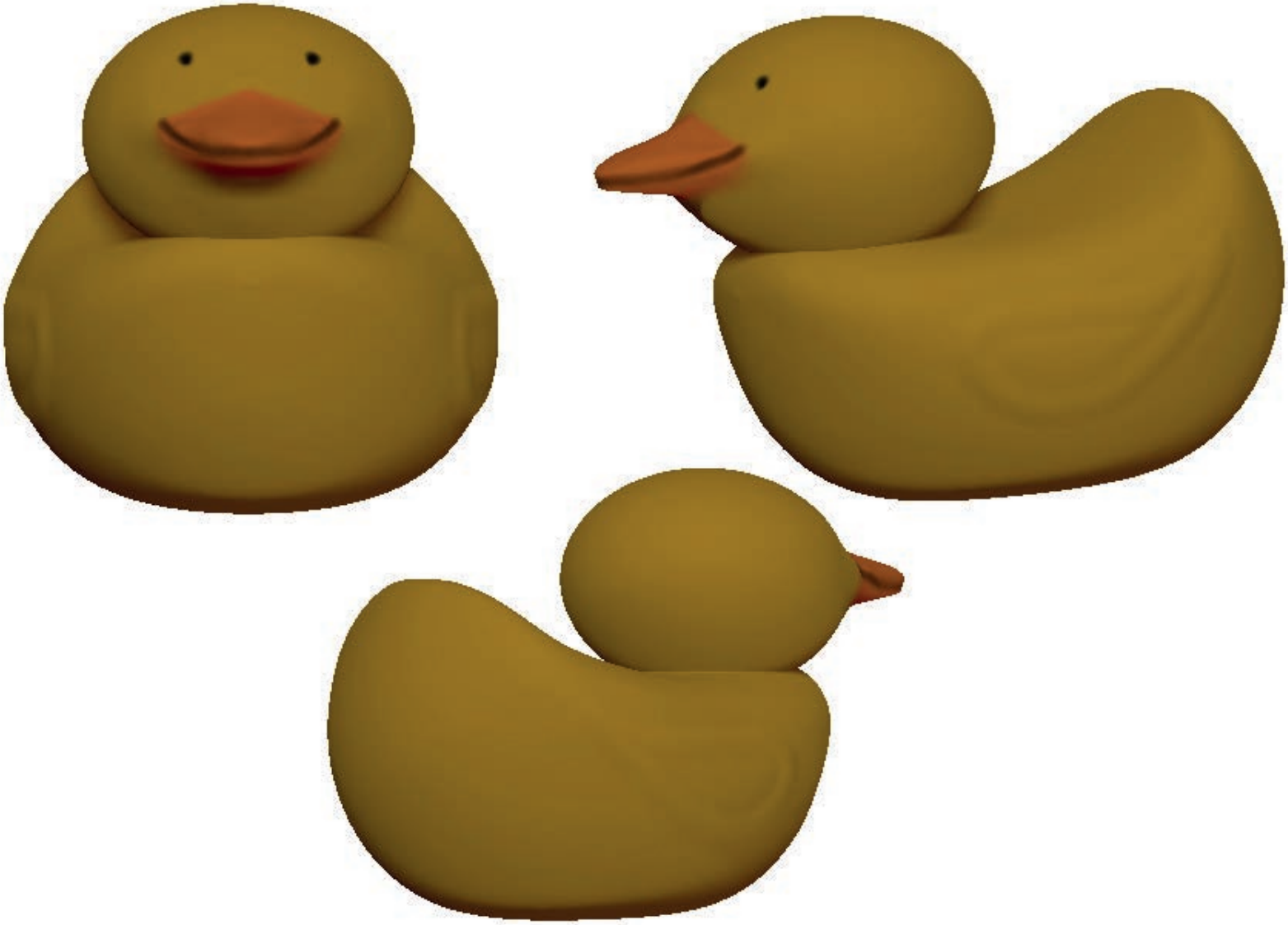
The lion:



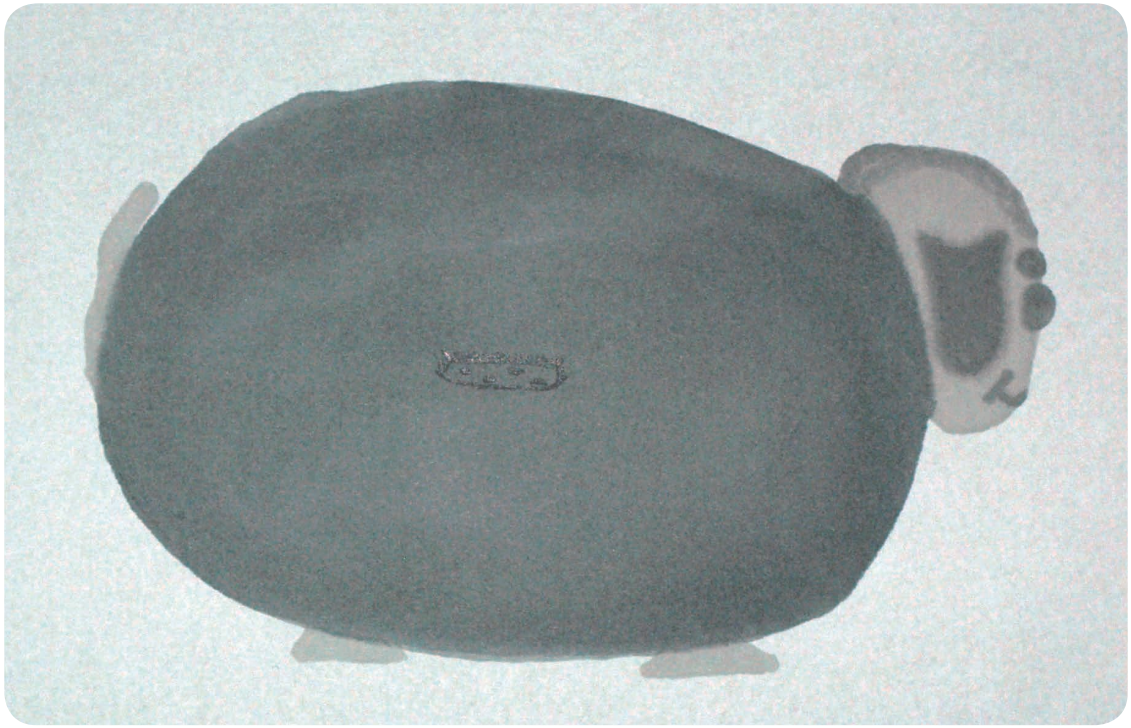


The duck:

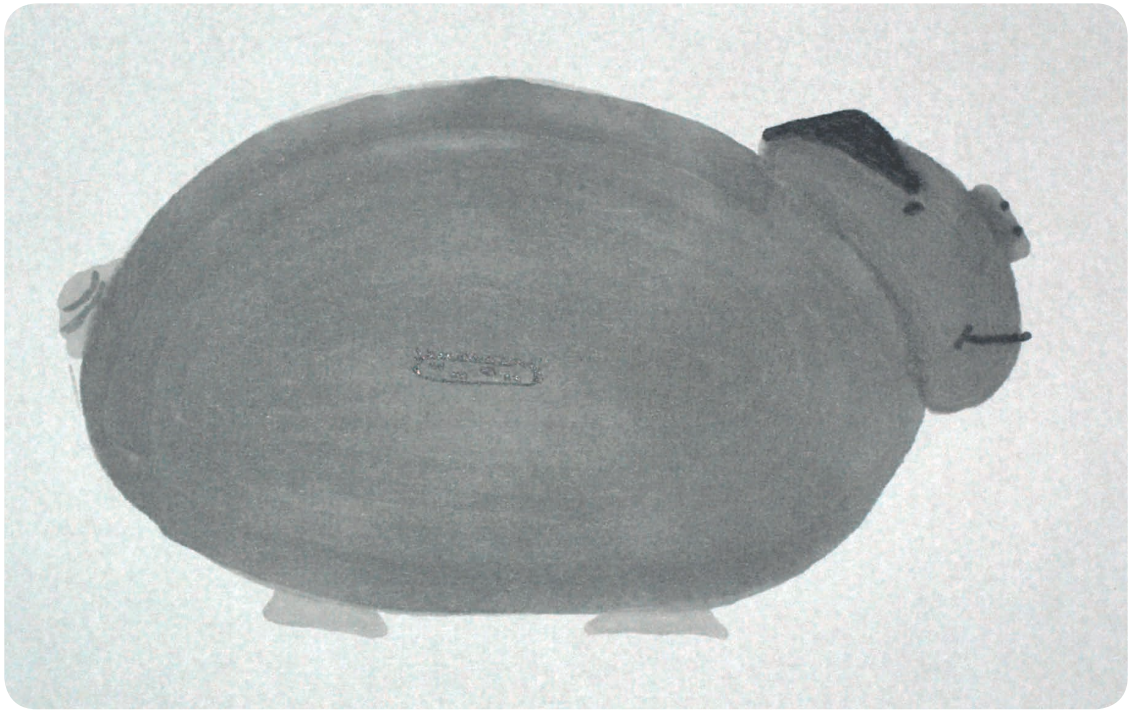


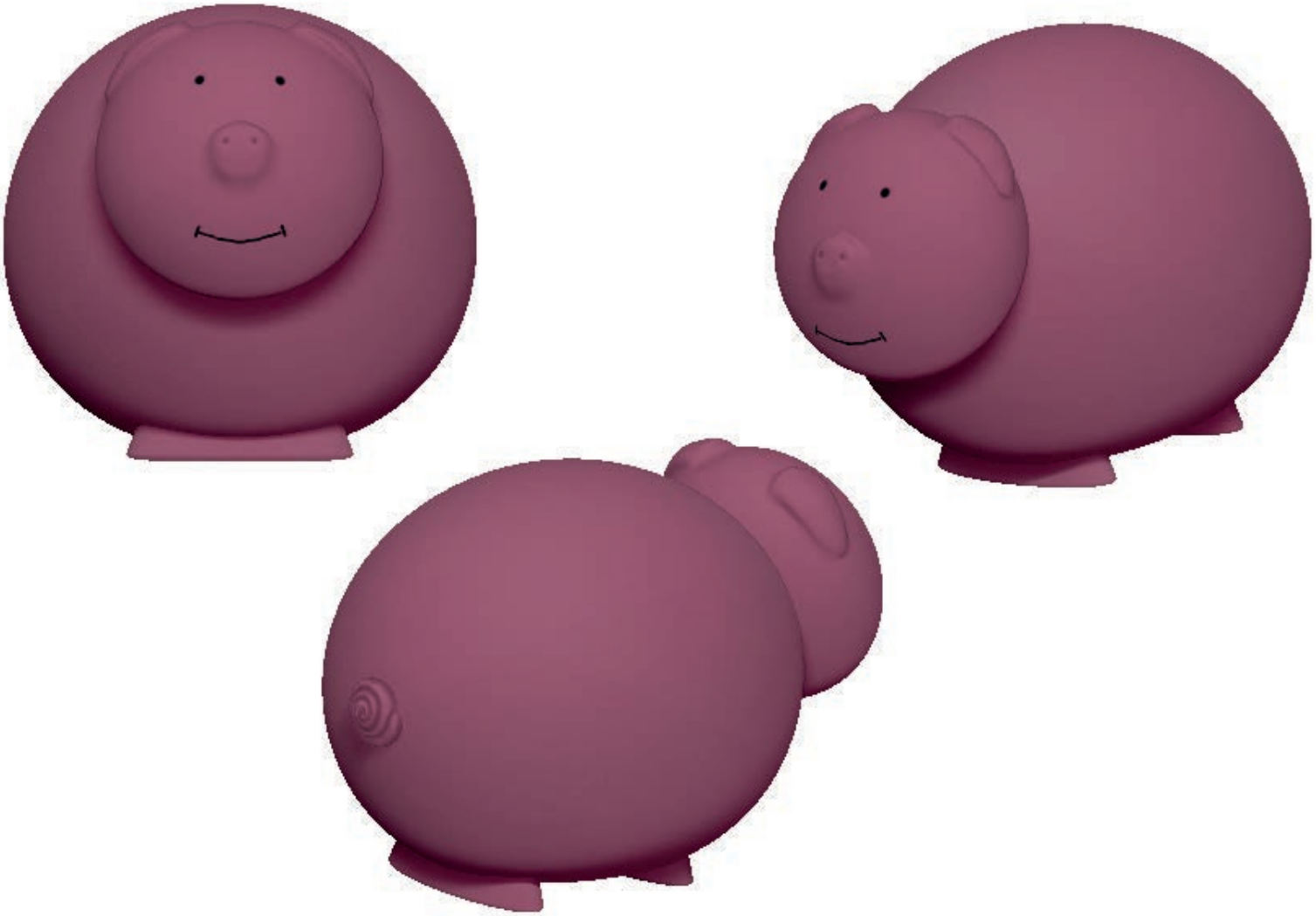


The dog:

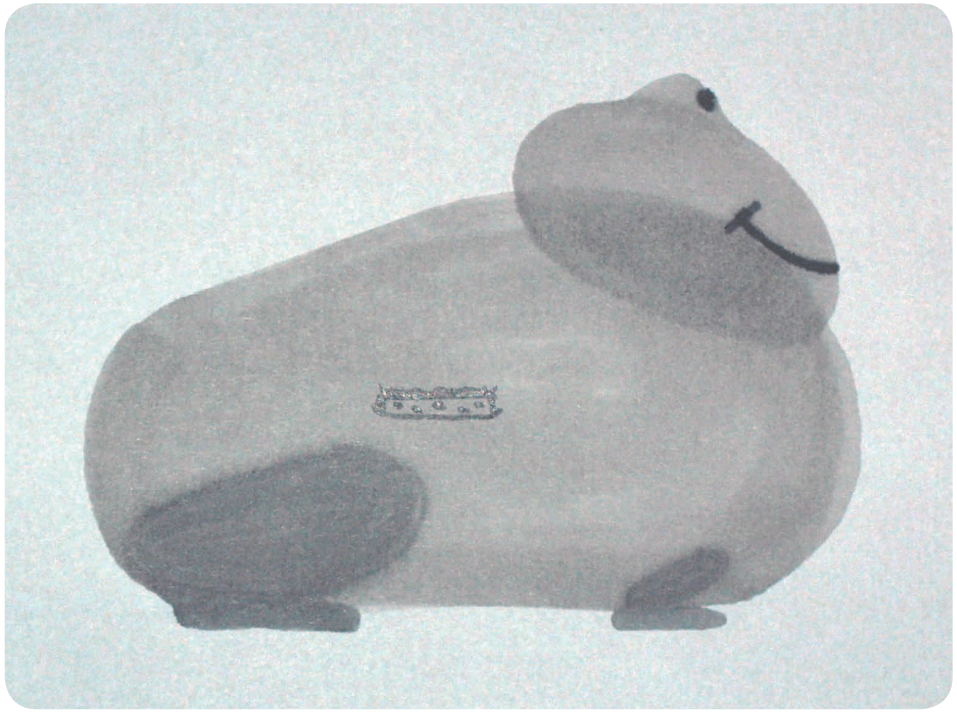


The pig:

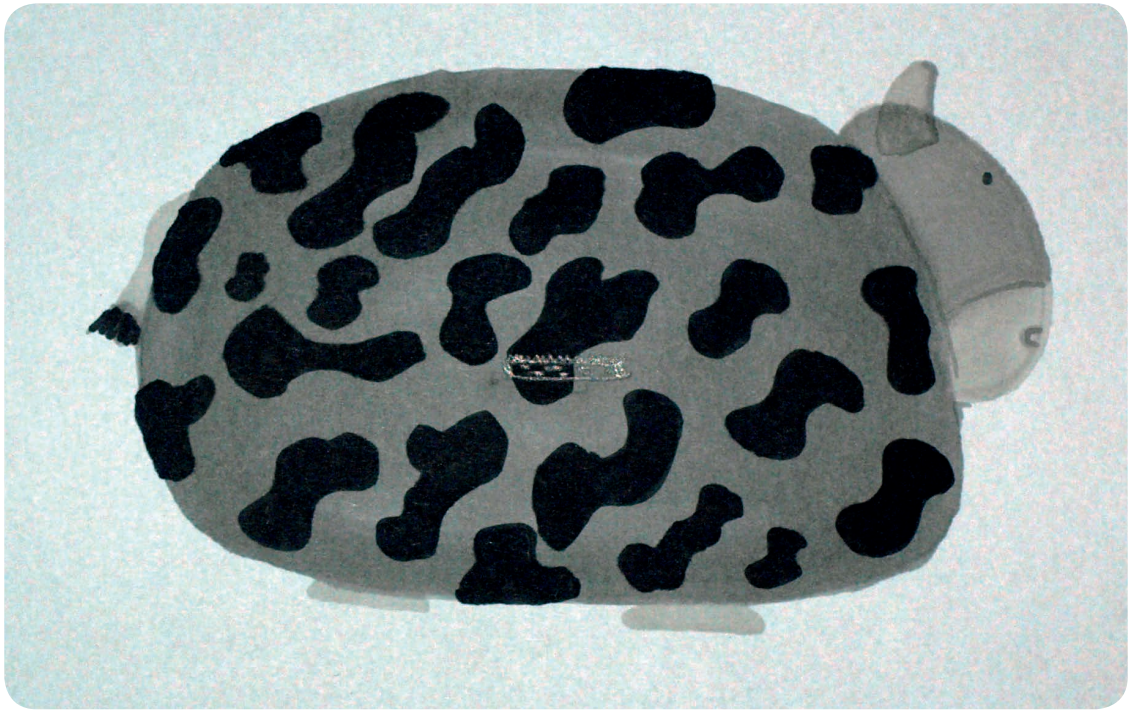




The frog:



The cow:

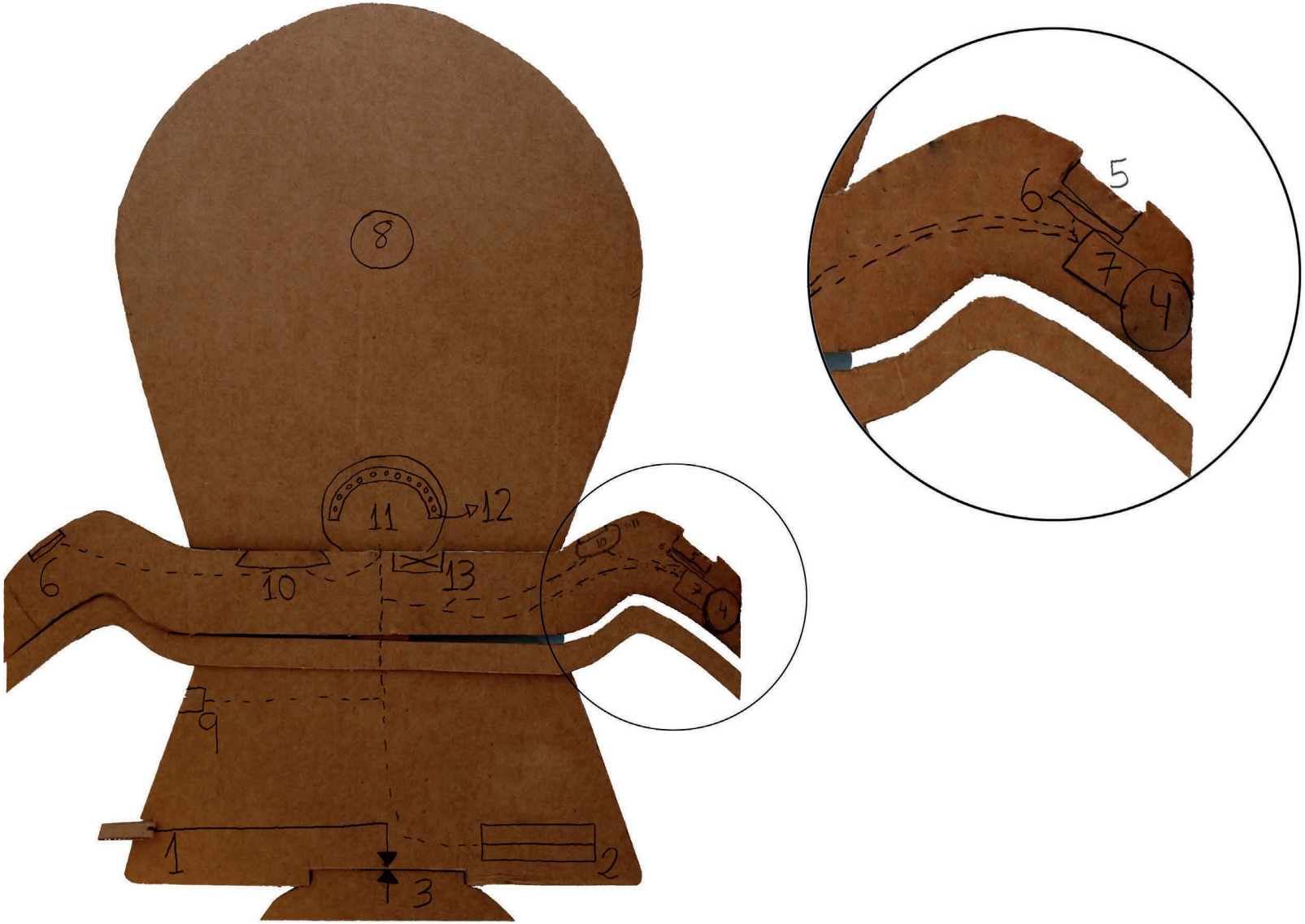


ELECTRONICS

To distribute all the electronic components I made a cardboard model in 2D. There we can see where are located all of them.
The ones that are placed in the rigid part of the ring, will be repeated in all the legs.

Electronic components by number:

- 1.Suction pad button
- 2.Batteries
- 3.Suction pad
- 4.Roll
- 5.Magnet
- 6.Sensor to activate num7
- 7.Engine between magnet and roll
- 8.Mask's sensor
- 9.Power button
- 10.Chip (memory)
- 11.Speaker
- 12.Impermeable membrane
- 13.LEDs


8
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MAINTENANCE

All the pieces are designed to an easy assembly. And all the electronic components will be located allowing an easy replacement.

- Batteries:

In the bottom of the octopus we will have a tap with four screws to allow an easy change of batteries.

- Electronic components:

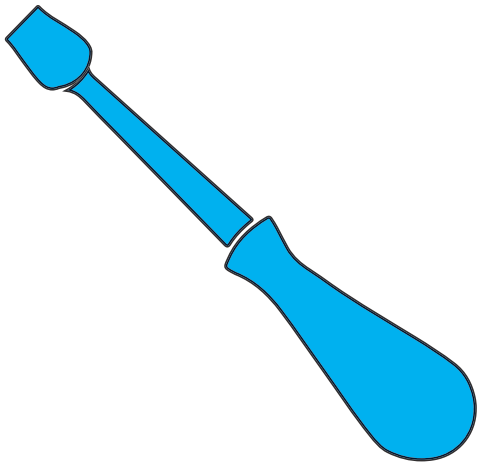
As we saw before, all the electronic components will be placed in the ring. Except the main speaker and the sensor for the mask that will be in the top. The ring will be easy to open, like the bottom, and all the components will be easy to replace or repair.

- Magnets:

Magnets are not necessary to replace, the electrical part that produces the sound after the magnet connection is the important one, and it is in the ring. So the magnets in the little shapes are non removable, because it will not be necessary.

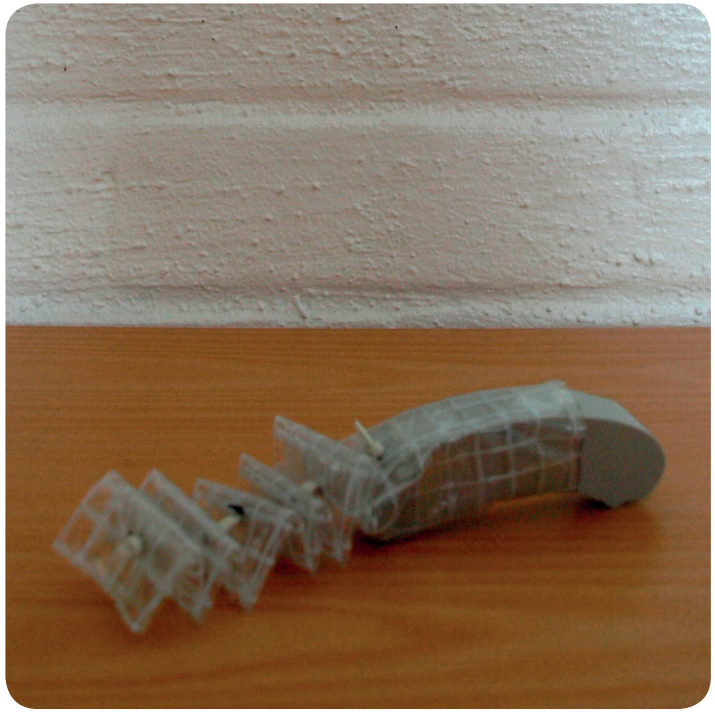
- Cleaning:

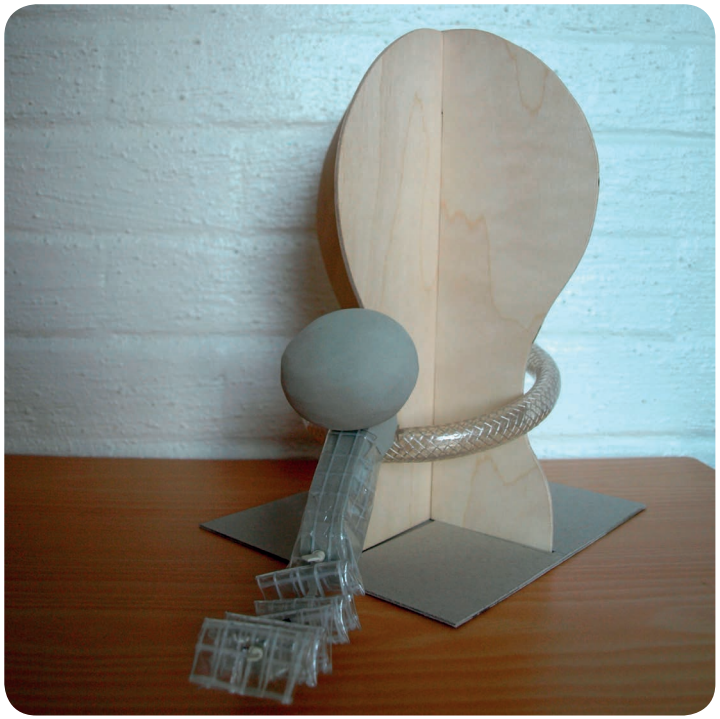
As we show in the characteristics of the materials, polypropylene can be sterilized with high temperatures. The important thing is that the speaker will be impermeable and also all the unions between parts. Will be necessary to sterilize the toy after each patient leaves the hospital because it will be used by another kid.



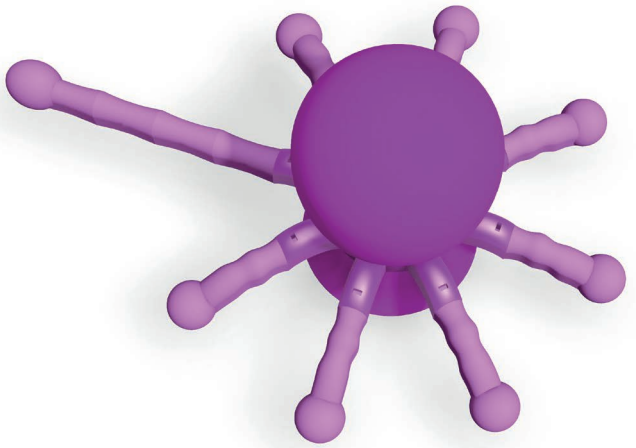
CARDBOARD MOCK-UPS

Some pictures of the physical model that I made in the workshop to feel the real sizes of the toy.

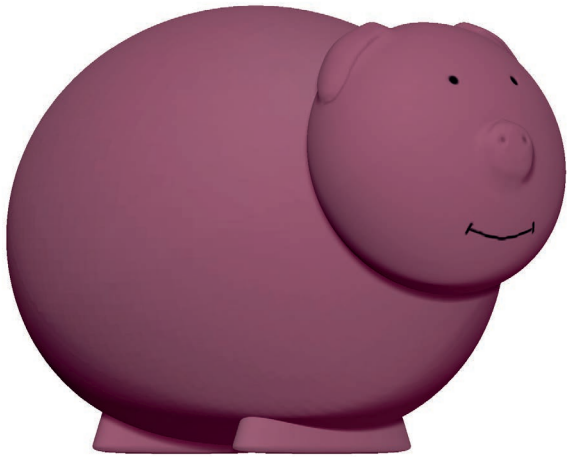




FINAL PRODUCT



Illuminated octopus in the moment any little animal is connected.



SECURITY BUDGET

APPENDIX

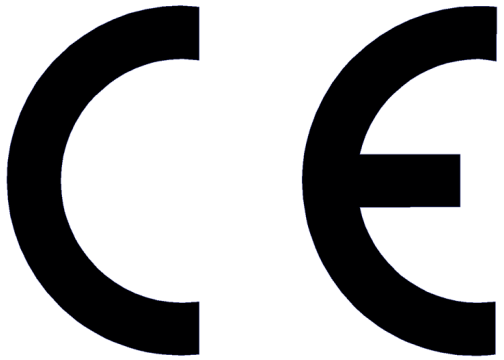
PLANS

The appendix contain some extra consideration that I wanted to include in this project.

SECURITY

This project is above all a toy, and all the products designed for children, mainly toys, should obey some regulation that establish prerequisites the designer has to keep in mind.

Directive 2009/48/EC (That replace directive 88/378/EEC) applies to toys defined as "products designed or intended, whether or not exclusively, for use in play by children under 14 years of age" *(20,21)*.



Major requirements of directive 2009/48/EC (22):

Safety Assessment :
Manufacturers shall, before placing a toy on the market, carry out a safety assessment which is an analysis of the chemical, physical, mechanical, electrical, flammability, hygienic and radioactivity hazards that the toy may present, and an assessment of the potential exposure to them.

EC Declaration of Conformity:
The document, which needs to be continuously updated, shall state the fulfilment of the essential safety requirements and shall indicate which harmonized standards have been used.

Internal Production Control:
Manufacturers shall take all measures necessary so that the manufacturing process, and its monitoring, ensure compliance of the manufactured product with the requirements.

Technical Documentation :
The technical documentation shall contain all relevant data and details of the means (e.g. safety assessment, EC declaration of conformity, test report…) used by the manufacturer to ensure that toys comply with the requirement.

Chemical Compliance:

- Toys must comply with EU chemicals legislation, including REACH.
- Toys shall not contain carcinogenic, mutagenic, or toxic for reproduction CMR 1 and 2, substances.
- Cosmetic toys, shall comply with Directive 76/768/EEC.
- Toys shall not contain allergenic fragrances.

BUDGET

This budget includes all the raw materials we need to produce the toy and the subcontracted pieces (electronic stuff). The labor cost from estimated times spent on production and assembly process of each item is also included.

To write up the budget I took as reference numbers, prices and labor cost from Spain. Production costs and design royalties are based in 30% and 10% of the material cost respectively.

The estimation is for 1500 units. Quantity based on the number of hospitals, 790, that there are in Spain at the end of 2012 *(23)* and assuming we will produce almost 2 toys for each hospital.

We have to consider that if increase the level of production, the price will go down due to the amortization of the project, moulds, etc.

Suppliers:

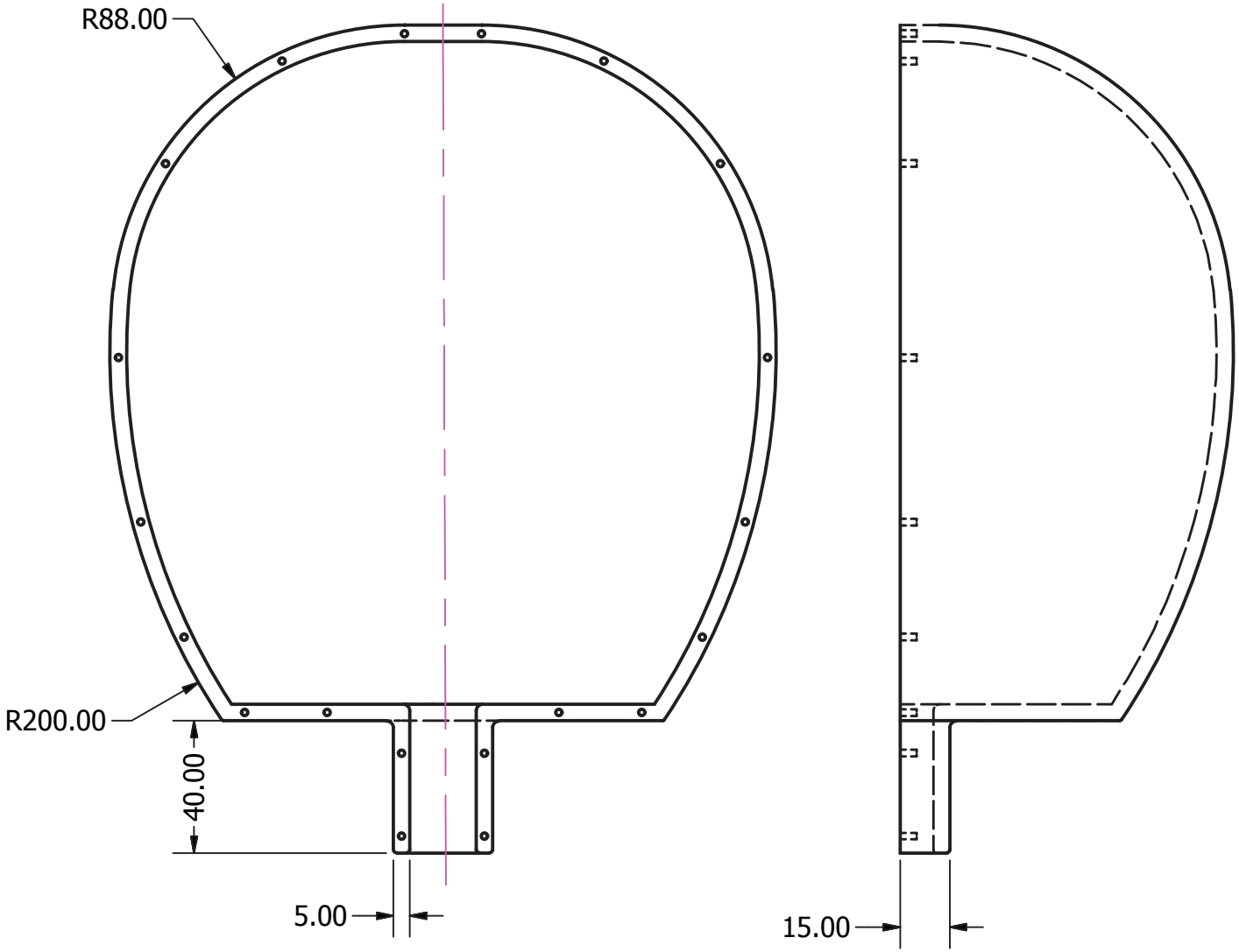
ELEMENTS				
Element	**Provider**	**Especifications**	**Price (€)**	**Price (NOK)**
Battery	www.pilanet.es	LR06-AAx12-Panasonic	0,22	1,62
LED Superflux	www.ledsinternational.com	led superflux Bag 1000u	0,051	0,38
Suction pad	www.gindart.com	CA-143-BL	2,32	17,08
Extension spring	www.muellescastellon.com	Muelle de fuerza constante	0,37	2,72
Magnet	www.aimangz.es	Neodimio Bloque 4-3-2	0,23	1,69
Sensor	www.electan.com	Sensor capacitivo	1,35	9,94
Power button	www.grupelde.com	7.214.021.011	1,9	13,98
Speaker	www.cetronic.es	FE-385M	1,97	14,50
Impermeable membrane PP	es.made-in-china.com	Impermeable membrane PP	0,04	0,29
Chip (memory)	www.todoelectronica.com	24LC16B smd	2,32	17,08
Injection moulds little shapes	www.chinaplastic.org	Injection mold	1270	9347,20
Injection mould base tap	www.chinaplastic.org	Injection mold	2062	15176,32
Injection mould ring tap	www.chinaplastic.org	Injection mold	2062	15176,32
Injection mold base	www.chinaplastic.org	Injection mold	4390	32310,40
Injection mold ring	www.chinaplastic.org	Injection mold	4390	32310,40
Injection mold head 1	www.chinaplastic.org	Injection mold	3300	24288,00
Injection mold head 2	www.chinaplastic.org	Injection mold	3300	24288,00
Polypropylene	www.petroquim.cl	PH2615 (Bag 25kg)	20,5	150,88

Complete toy:

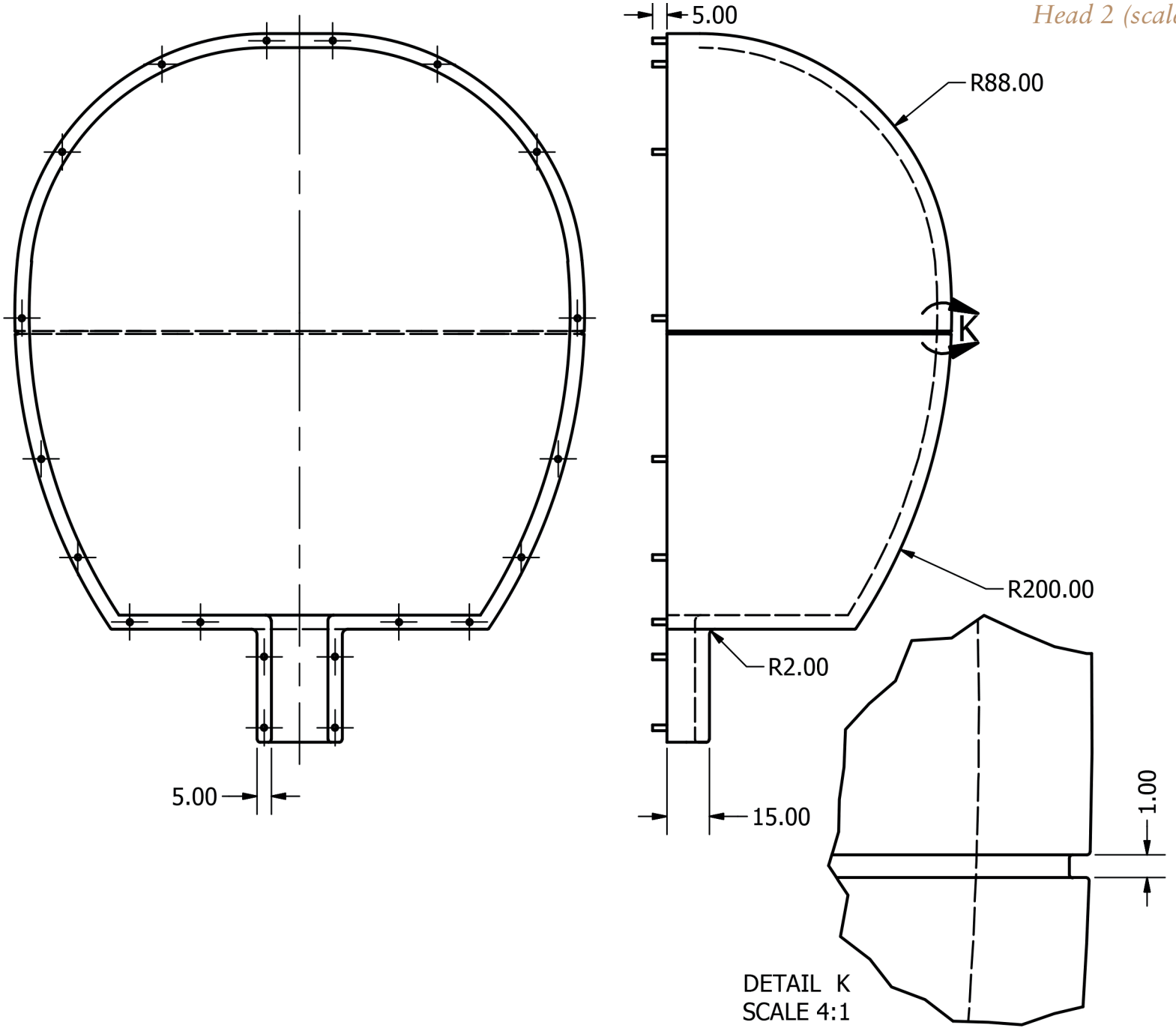
TOY PRICE			
Item	**Quantity**	**Price (€)**	**Price (NOK)**
Battery	4 units	0,88	6,48
Led bulb	2 units	0,10	0,75
Suction pad	1 units	2,32	17,08
Roll	8 units	2,96	21,79
Magnet	8 units	1,84	13,54
Sensor for the magnets	8 units	9,35	68,82
Power button	1 units	1,90	13,98
Speaker	1 units	1,97	14,50
Impermeable membrane	1 units	0,04	0,29
Chip (memory)	1 units	2,32	17,08
Sensor for mask	1 units	4,35	32,02
Injection moulds little shapes	8 units	6,80	50,05
Injection moulds octopus	7 units	13,00	95,68
Plastic	250 g	20,50	150,88
Production	30%	20,50	150,88
Royalties	10%	6,83	50,27
TOTAL		**95,66**	**704,07**

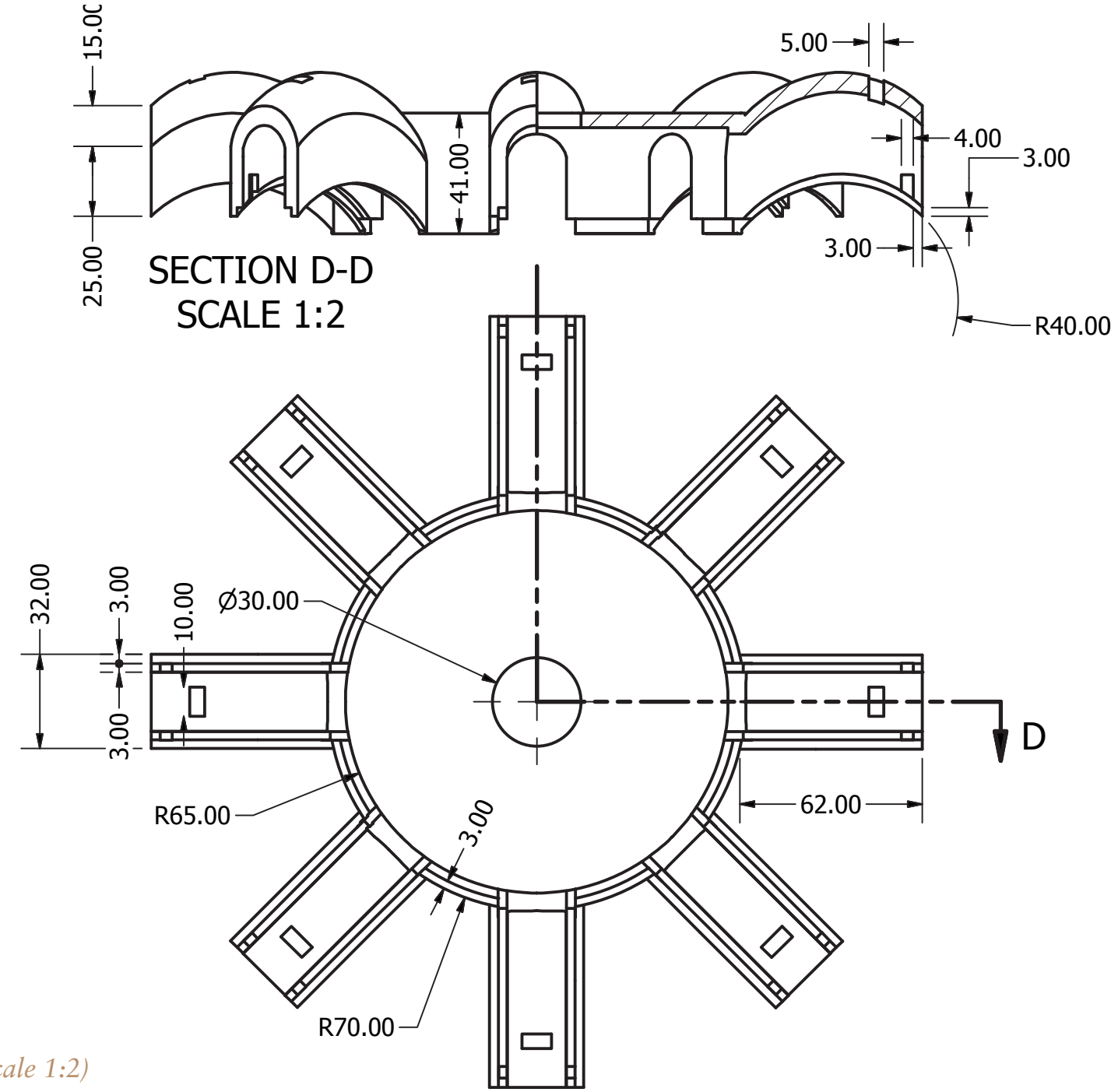
PLANS

Head 1 (scale 1:2)



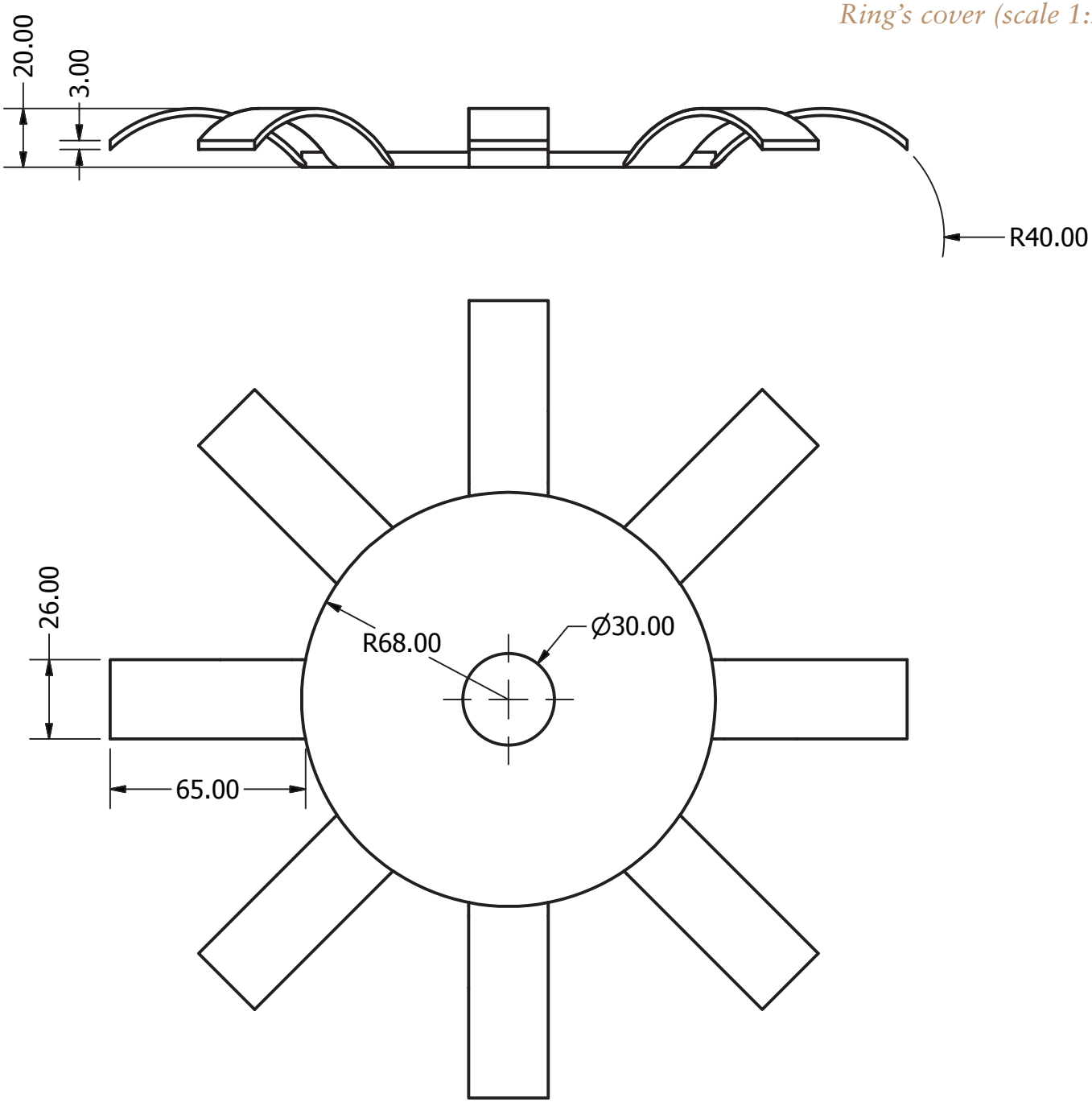
Head 2 (scale 1:2)

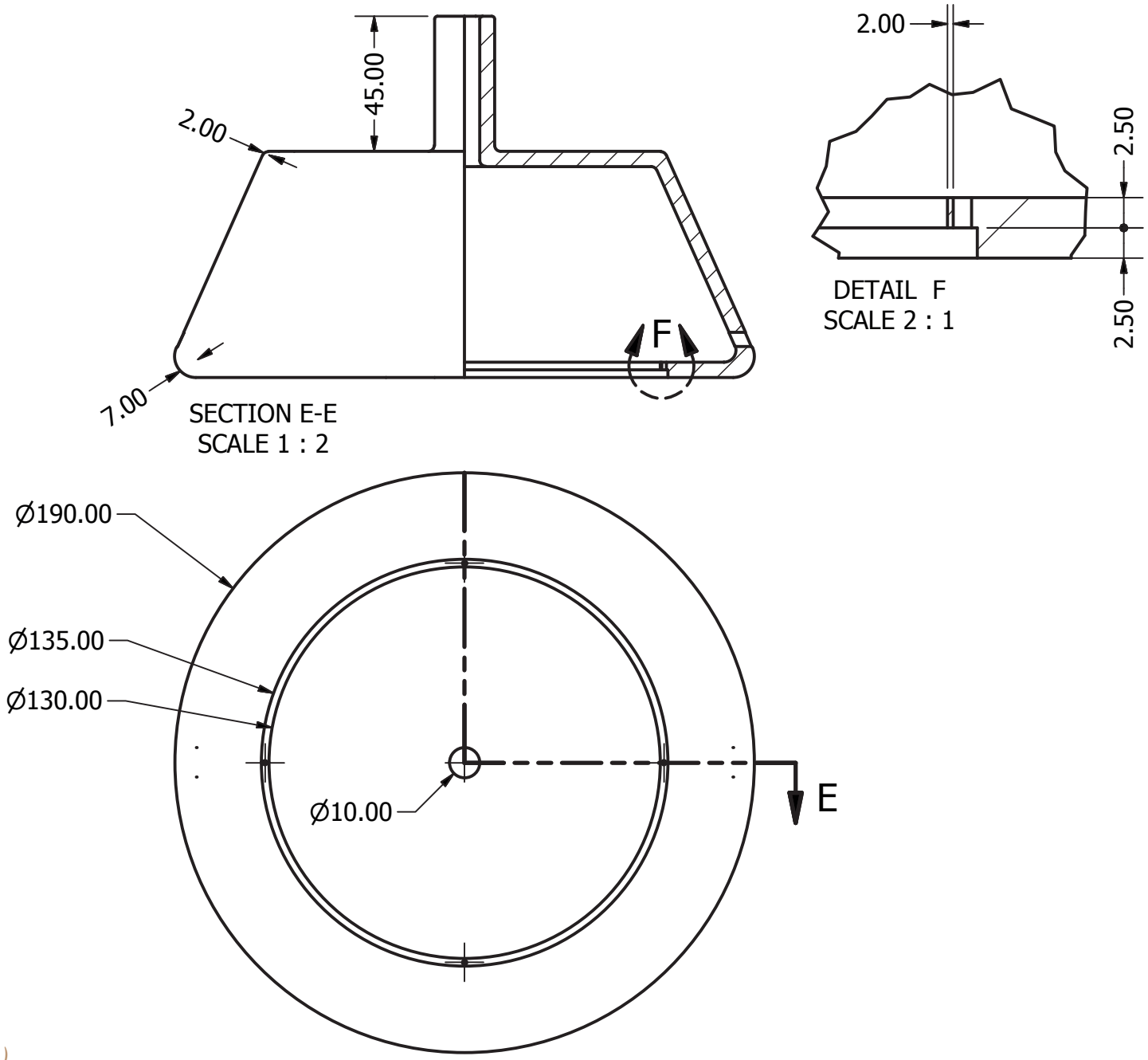




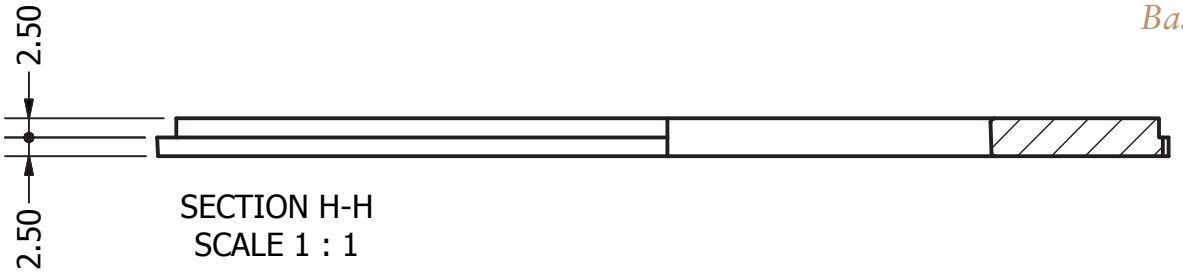
Ring (scale 1:2)

Ring's cover (scale 1:2)

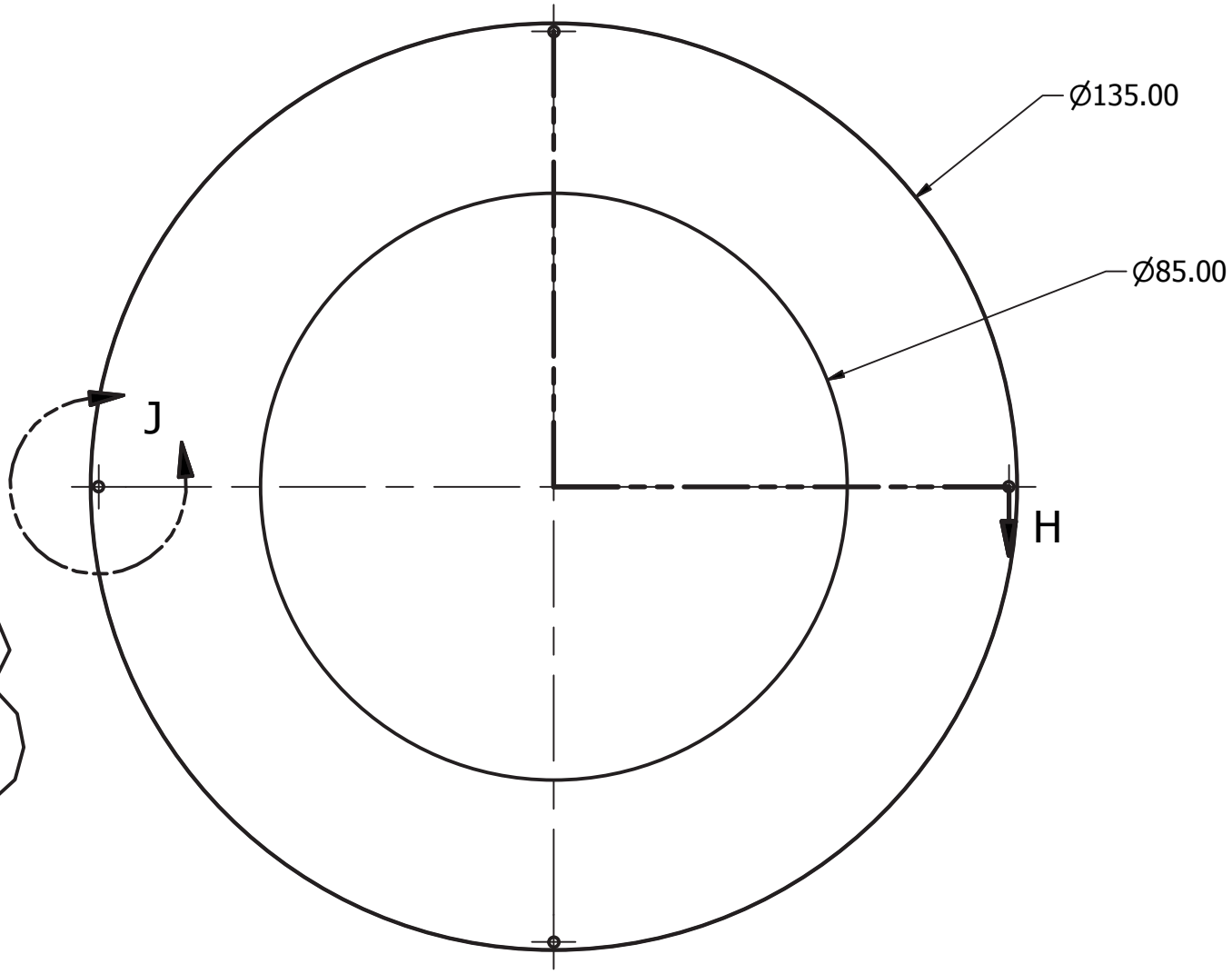




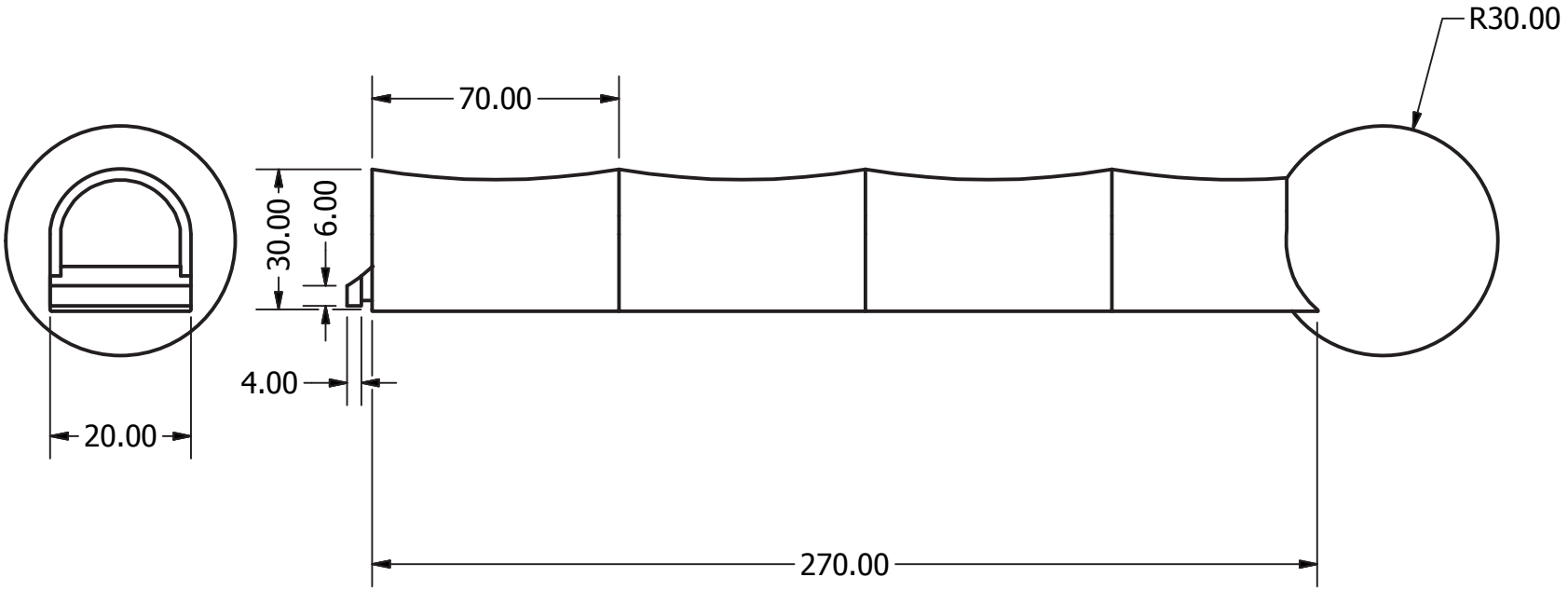
Base (scale 1:2)



SECTION H-H
SCALE 1 : 1



DETAIL J
SCALE 2 : 1



Leg (scale 1:2)

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