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### Baby Bidet

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# Baby Bidet

by

Lei Hong

A Thesis Submitted in Partial Fulfillment of the  
Requirements for the Degree of Master of Fine Arts  
in Industrial Design

School of Industrial Design  
College of Imaging Arts and Sciences

Rochester Institute of Technology

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April 23, 2015



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## **ABSTRACT**

This thesis introduces a unique childcare product named Baby Bidet for babies and young couples. Most infants defecate four to six times and urinate ten times daily. The most commonly used product to contain these substances is a diaper. The problem is that diapers spread feces across a baby's bottom and thus frequently cause diaper rash. When parents clean the feces from their babies' bottom, many of them feel disturbed.

This project, in part through market research, has gathered a lot of information about diapers, diaper rash, baby wipes, the process of changing diapers, and so on. Moreover, in order to find valid solutions, the designer visited some users, changed diapers and cleaned a baby's bottom personally. After brainstorming and doing many sketches, the designer chose the most natural way – running water to clean a baby's bottom. The designer also did some research about the related product, the baby bathtub and flowerpot. In addition, making some mock-ups was necessary for considering more details including the issues encountered in the process of design. Eventually, Baby Bidet was born.

Baby Bidet will help ensure that young couples feel more ease in washing their baby's dirty bottom every changing time, and the baby will feel more comfortable and will remain free of diaper rash. In addition to these advantages, Baby Bidet can be used as a baby bathtub at the same time and eventually be recycled as a flowerpot.

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## 1.0 INTRODUCTION



Fig 1-1 Newborn's Family from Google Images

A baby is the most beautiful angel in the world. He or she is created from parents' love. Parents are the wings of the baby, carrying their babies to the vision of the ideal, taking care of them, protecting them from harm, and growing up with them.

A baby needs a lot of attention from his or her parents; the parents need to take care of everything, especially during the neonatal period, which is the period of highest infant mortality rates. The infant's body development is not yet mature, and the resistance of the external environment and the immunity to disease are both weak. Therefore, attention should be paid all the time, including feeding, changing diapers, bathing, dressing, playing and so on. All of these need be addressed by parents.

In addition to their roles as nurturers, parents also need to be cared for. At this point, most new parents were born in the 1980s or '90s, they do not know much about caring of

babies. Taking care of a baby is a science that young couples need to learn. They also need products to ease them in their roles.

Baby Bidet will focus on solving the problem of diaper rash, because this is one of the most troubling issues a small baby will endure. The uppermost function of Baby Bidet is to clean the baby's bottom every changing time; it helps keeping baby's bottom clean, fresh and cool so as to avoid diaper rash.

## 2.0 INSPIRATION STORY

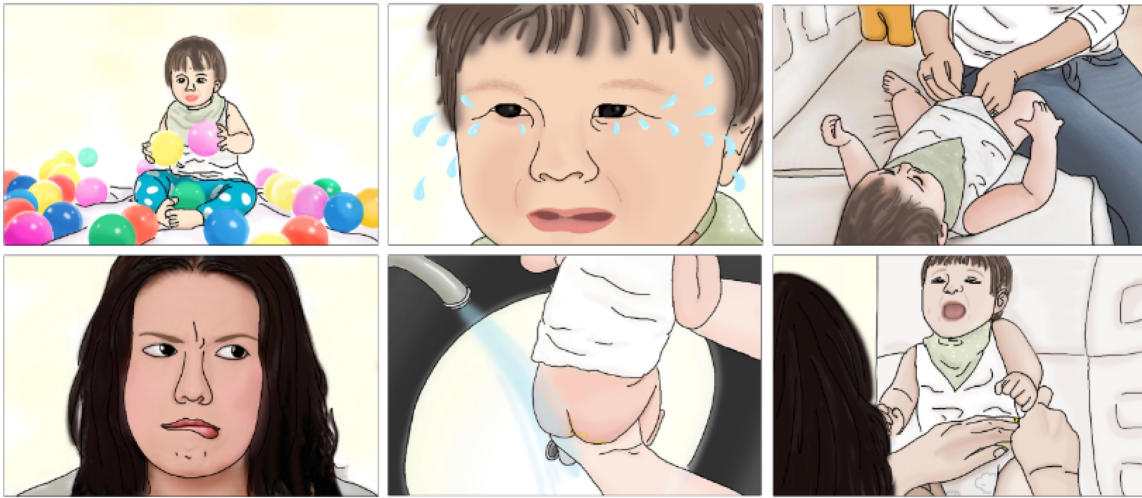


Fig 2-1 Darin Story

- Little Darin is playing with his new toy. He is so happy.
- But, suddenly, he is crying.
- Mother checks his diaper and finds that her baby has defecated again. The feces on his bottom makes him feel so sad!
- Mother has to clean Darin's bottom as soon as possible. She doesn't want to use baby wipes any more, because yesterday she heard the best way is to wash the baby under running water.
- She brings Darin into the bathroom, and holds his bottom under running water. But she feels very uncomfortable with the position. Also, the baby cries again.
- But after this cleaning, the smile returns on Darin's face. (See Fig 2-1)

This is a real story that comes from my sister. Her newborn baby inspired me to design a baby bottom cleaner. My sister is 28 years old, and a new mother who does not know much about caring for a baby. The most difficult thing for her is not feeding, but changing diapers. Her baby defecates a lot, so she has to clean her baby's bottom frequently to protect her baby from diaper rash. Unfortunately, she cannot find a comfortable and convenient way to clean her baby's bottom. Holding the baby in her

hand always makes the baby feel terrible, and the baby does not like the rushing water. Besides, the running water sometimes wets the baby's clothes. I started to think about how to wash a baby's bottom and how a cleaning product could make both parent and baby feel comfortable and safe. Before getting down to design, I realized that one story does not represent all. Besides, I am not a mother and have no experience in this area. Therefore, the first thing I did is research.

### **3.0 BABY RESEARCH**

The infant phase is the fastest and most exuberant phase of a baby's growth and development. During this phase, they need plenty of sleep and usually fall asleep after nursing. A baby defecates or urinates several times a day. Parents have to change the diaper frequently.

#### **3.1 Baby Defecation**

Defecation is the final act of digestion, by which organisms eliminate solid, semisolid, and/or liquid waste material from the digestive tract via the anus.

A newborn baby begins to discharge meconium about 10 hours after birth. Dark green, viscous, and odorless, meconium consists of bile, intestinal secretions, epithelial cells, amniotic fluid, and lanugo. It is drained in two or three days. Then, it turns to normal excrement that is golden yellow and pasty. Babies always defecate unpredictably. Most newborns defecate between three to five times each day, breast-fed infants tend to defecate approximately six to ten times daily, and even defecate every feeding time. This is because the breast milk can be digested and excreted easily. When babies grow to 1 year old, the defecation frequency becomes one to three times per day. Along with increasing food quantity and variety, baby defecation patterns slowly become close to that of adults.

Urination events are much more frequent than defecation events. The urine volume of babies is different between individuals. Because the metabolism of infants is exuberant, the priority food is liquid (especially in infancy), and the bladder capacity is small, they micturate many times daily. Newborns urinate four to five times a day, because they eat like birds. The urination times increase to twenty to thirty per day suddenly after one week, at about thirty milliliters each time. After six months, with the increase of semi-liquid auxiliary food and the renal function gradually improving, the frequency of urination will gradually decrease. They will then urinate fifteen to sixteen times daily, 60



milliliters each time. At about one and a half to two years old, children can really control the urination and micturition by themselves. Prior to this, they have to wear diapers all the time.

When mothers and fathers are asked how many times a day they change their baby's diaper, their estimate is pretty similar: 10 to 20 times daily. According to recent studies, at the end of two years, they will have changed 7,300 or more diapers. Of course, every baby is different. Some defecate frequently; others, not as often. What's normal is what's normal for each baby.

### 3.2 Baby Diaper

A diaper is a kind of underwear that allows an infant to defecate or urinate in a discreet manner, and children who are not yet potty trained also wear it. A child will consume several thousand diapers throughout their childhood.



Fig 3-2-1 Cloth Diaper

Diapers are made of cloth or synthetic disposable materials. Cloth diapers are reusable and can be made from natural fibers, man-made materials, or a combination of both. They are often made from industrial cotton that may be bleached white or left the fiber's natural color. Man-made materials such as an internal absorbent layer of microfiber toweling or an external waterproof layer of polyurethane laminate (PUL) may be used. Cloth diapers are environmentally friendly, as they can be used repeatedly via cleaning, instead of discarding them after one use. Moreover, the cloth diaper has very

strong water imbibition, and it can absorb sweat any time to keep the baby's skin dry. However, that does not necessarily mean the cloth diaper is flawless. Its waterproofing is poorer than that of disposable diaper.



Fig 3-2-2 Disposable Diaper

Disposable diapers contain absorbent chemicals and are thrown away after a single use. It has a layered construction, which allows the transfer and distribution of urine to an absorbent core structure where it is locked in. A disposable diaper does not need to be cleaned and sterilized. It combines many functions such as absorption, waterproofing and wicking, and it's much more convenient than a cloth diaper. But it cannot absorb sweat completely, which can result in a baby feeling uncomfortable if he or she wears the diaper for a long time.

Disposable diapers and cloth diapers have different advantages and disadvantages, so it's hard to say which one is more convenient and suitable.

### 3.3 Baby Diaper Rash



Fig 3-3-1 Feces Across The Baby's Bottom

A diaper always spreads the feces across the baby's bottom, making the baby uncomfortable, and leaving it on too long leads to skin irritation or allergic reactions, which often causes diaper rash.



Fig 3-3-2 Baby Diaper Rash

Diaper rash is a generic term applied to skin rashes in the diaper area that are caused by various skin disorders and/or irritants. It develops when a baby's skin is exposed to prolonged wetness, increased skin pH caused by urine and feces, and resulting breakdown of the stratum corneum, or outermost layer of the skin. With secondary bacterial or fungal involvement, diaper rash tends to spread to concave surfaces (i.e. skin folds) of a baby's bottom, and often exhibits a central red, beefy erythema with satellite pustules around the border.

The best treatment for a diaper rash is to keep the diaper area clean and dry. This also helps prevent new diaper rashes. It is best to lay the baby on a towel without a diaper

whenever possible. The more time the baby can be kept out of a diaper, the better. Here are some tips for preventing diaper rash:

- Change the baby's diaper often and as soon as possible after the baby urinates or passes stool.
- Use unscented soap and a warm washcloth to clean the baby's bottom during a diaper change.
- Put diapers on loosely. Diapers that are too tight may rub and irritate the baby's waist or thighs.
- Always wash your hands before and after changing a diaper.
- Do not use wipes that have alcohol or perfume, as they may dry out or irritate the skin more.

## 4.0 CHANGING DIAPERS

No matter what kind of diaper parents are using, the method for changing a dirty one is the same. They need a place to lay down their baby, a new diaper, a way to clean the baby's dirty bottom, and so on.

### 4.1 Changing Diapers' Environment

When parents are asked where they change their baby's diaper, many said they really liked a changing table, as it can help them organize things and provide a private space for the baby. Others said that they never used it, and instead they would change diapers on the floor or on a bed or wherever they found themselves.

#### 1. Changing Table



Fig 4-1-1 Changing Table

A changing table is a small raised platform designed for as a dedicated place to change a baby's diaper and is always accompanied by a pad. The topmost surface is used to rest the baby being changed. There are usually shelves or drawers to store necessary supplies such as diapers, baby wipes, baby powder and sometimes clothes as a dresser would have during the changing process. The pros for a changing table are more security, especially if the sides are high enough so the baby can't roll off of it; and it can be used directly without extra set-up.

#### 2. Other Places with a Changing Mat

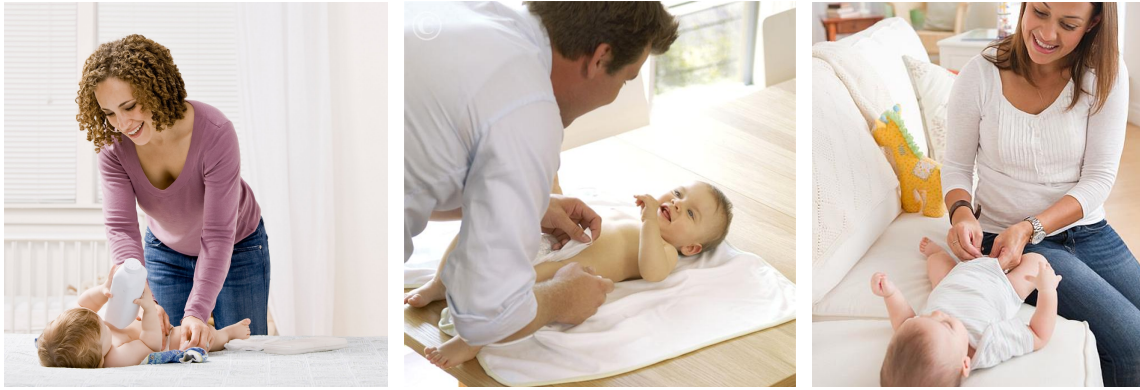


Fig 4-1-2 Other Places for Changing Diapers

Many people feel that changing tables are not necessary. For one reason, a changing table can be a piece of big furniture taking up a lot of space. In many cases, a house or an apartment may not have enough room for a changing table. They would like to change diapers at other places, such as a dining table, a bed, a sofa or the floor. A changing mat is always appropriate in these situations, which ensures that the changing surface is clean. Many mothers like using a changing mat because it is light to carry, big enough for the baby, and it's clean.

## 4.2 Procedure of Changing Diapers

Babies and toddlers who are not potty-trained need to have their diapers changed every few hours to avoid rashes and discomfort.








### 1. Preparation




First, wash and dry your hands, or clean them with a baby wipe. Set up a warm, clean area to lay the baby. Access the supplies, including a clean diaper and plenty of wipes or wet cloths. For some special situations, you have to prepare other items. For instance, for a baby is prone to diaper rash, keep rash cream or petroleum jelly on hand.

### 2. Diaper change

Step	Process	Detail
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1		Place the back half of a new opened diaper under the baby. The top of the back half should come up to the baby's waist to protect the changing table from getting dirty.
2		Pull down the front half of the dirty diaper. If the baby is a boy, you might want to cover his penis with a clean cloth or another diaper so he doesn't pee on either of you.
3		Fold the dirty diaper in half under the baby, clean side up. To do this, you'll need to lift the baby's bottom off the table by grasping both ankles with one hand and gently lifting upward.
4		Clean the baby's front with a damp baby wipe.
5		Let the baby's skin air dry for a few moments or pat it dry with a clean cloth. To help treat or prevent diaper rash, you may want to apply rash cream or petroleum jelly.
6		Remove the dirty diaper and set it aside. The clean one should be underneath the baby, ready to go.
7		Pull the front half of the clean diaper up to the baby's tummy.

8		Fasten the diaper at both sides with the tabs. Make sure the tabs aren't sticking to the baby's skin.
9		Dress the baby and put him or her in a safe place – such as on the floor with a toy – while you clean up the diaper changing area.
10		Fold up the dirty diaper and fasten it closed with its tabs, and put it in the trash or diaper pail. And wash your hands thoroughly, or use hand sanitizer if you can't get to a sink.

Sheet 4-2-1 Procedure for Changing A Diaper

In fact, there's not a right way to change a diaper. Above are a suggested series of steps to change a diaper. The most important of all is that if you change the baby on an elevated surface, be sure to keep one hand on the baby at all times to secure the baby.

### 4.3 Baby Wipes Analysis



Fig 4-3-1 Cleaning a Baby's Bottom

There are four main ways to clean baby's bottom (See Fig 4-3-1): running water, wet towel, the other side of a dirty diaper, or baby wipes. Most people use baby wipes to clean a baby's bottom for convenience. Other people think a natural method is more healthy, such as using running water and a wet towel.



Baby wipes, wet wipes used to cleanse the sensitive skin of infants, have become a standard part of diaper changing kits. These are saturated with solutions ranging from gentle cleansing ingredients to alcohol based “cleaners.” Baby wipes are typically sold in plastic tubs that keep the cloths moist and allow for easy dispensing.



Fig 4-3-2 Baby Wipes

### 1. Baby Wipes Ingredients

One of the biggest problems is new parents not knowing what products to buy for their newborn. Most proponents of organic goods advise new parents to only choose natural products with few and easily recognizable ingredients for good reason.

Surprisingly, baby products, including baby wipes, considered a cosmetic by the U.S. Food and Drug Administration, are often formulated with potentially toxic ingredients.

One common ingredient in all kinds of baby wipes is water. Water can come from a spring, or be filtered from a tap. Other common ingredients are Cetyl Hydroxyethyl cellulose (a plant-based product used as a cleaning agent) and aloe vera gel (a generally accepted plant-based healing agent). Glycerin, a vegetable oil derivative, is also a common element. Citric acid is often used to aid in stability and maintains the pH balance of the product.

In addition, baby wipes contain other ingredients: preservatives, stabilizers and many chemical additives. People might find the preservatives such as potassium sorbate (a mold and yeast inhibitor) and sodium benzoate (an antimicrobial preservative). According to the Center for Science in the Public Interest, sodium benzoate is essentially safe, although it can cause an allergic reaction to individuals who are sensitive to this

ingredient. Additional chemicals you might find in baby wipes that are known to cause minor to more serious interactions include sodium citrate (a urinary alkalizer), ethylhexyl glycerin (a cleaning agent), benzyl alcohol (an anesthetic and bacteriostatic), and coco glucoside (a fragrance).

## 2. Hidden Ingredients in Baby Wipes

According to an Environmental Working Group's (EWG) 2007 analysis of impurities in cosmetics and personal care products, 95% of baby wipes might be potentially contaminated with dangerous chemicals. The hidden ingredients in baby wipes are not listed because they are impurities, contaminants or byproducts of manufacturing processes performed to produce a final product or they get released when a product is in the bottle or the product's ingredients break down and form a contaminant. There are many harmful ingredients in baby wipes such as formaldehyde, nitrosamines, fragrance, and so on. Formaldehyde is recognized as a carcinogen by the U.S. Occupational Safety and Health Administration (OSHA). Additionally, formaldehyde and formaldehyde-releasing preservatives are associated with widespread allergic contact dermatitis. Allergic contact dermatitis is a type of eczema that develops on the skin as a result of an allergic reaction. Nitrosamines are potentially common hidden ingredients in baby wipes as various compounds eventually may break down and recombine into nitrosamines. Numerous studies and databases link nitrosamines to cancer too. They are listed as "possibly carcinogenic to humans?" by the International Agency for Research on Cancer. Fragrance is a mixture of hidden ingredients in baby wipes. Most companies do not disclose fragrance ingredients to US consumers despite the fact that a lot of people have allergies to fragrance. According to EWG, fragrance mixes often contain diethyl phthalate, which is associated with hormone disruption

## 3. The Best Way to Clean

Infants are particularly susceptible to chemically based ingredients and face a far greater health risk from exposure to toxic substances than adults. Their skin is very tender

and delicate. “The basic rule is not to do anything to aggravate the baby’s skin,” says Nelson Lee Novick, M.D., author of *Baby Skin: A Leading Dermatologist’s Guide to Infant and Childhood Skin Care* (1991). “The less you wipe and irritate it, the better.” With babies, less is best. Therefore, the best way to wash a baby’s bottom is under running water each time the diaper is changed. And it’s the most natural way to prevent diaper rash and bacteria.

## 5.0 INTERVIEW



Fig 5-1 Margaret's House

Margaret's House is a childcare center at RIT, and is centrally located on the campus. Deborah Bullock is the Assistant Program Director at Margaret's House. She said they all use baby wipes to clean the babies' bottoms, and she showed me their changing table and the changing process. I asked her if running water is the best way to clean a baby's bottom. Her answer was yes, but they don't have the facilities or time to do that because they have so many babies there.

Personal experience is the best way to walk into product. I asked my neighbor Elizabeth Helm to help me. She just had her baby boy last year. I spent one day with the little boy Josiah. I changed him 10 times during the day, and I washed his bottom under running water every changing time. Josiah did not lie there quietly; instead, he liked turning over or shaking his hands now and then. I must always be concerned with baby safety. Cleaning his bottom under running water was a big challenge, because it felt unsafe to hold him in the sink with one hand and use the other hand to clean his bottom. As I cleaned his bottom every time I changed him, I was constantly running back and forth between the bathroom and the bedroom.

## 6.0 IDEATION

To date, there is no other existing product like this for cleaning baby bottom. The target users are young couples and their babies. And the goal is to design a modern and original baby bottom cleaner, which is portable, safe and convenient. It is aimed at making the parents feel at ease and the babies more comfortable and healthy.



Fig 6-1 Happy Families from Google Images

### 1. Brainstorming



Fig 6-2 Brainstorming

There are some important points that I needed to take into consideration: the functionalities and the characteristics of this product, the way people clean babies' bottoms, the user (babies and parents), and other recycled functions. I summarized some

different ways people used to clean stuff such as washing, wiping, spraying and vacuuming. During the cleaning process, both parents' and baby's feeling are very important. In addition, I thought about the product functions, such as a cleaner for washing the bottom, a dryer for drying the bottom, a baby massage product and so on. This baby product needed to be safe, sanitary and portable. Moreover, space saving is also a plus. (See Fig 6-2)

## 2. Design Directions

### 2. Electric Rotating Cleaning Sponge

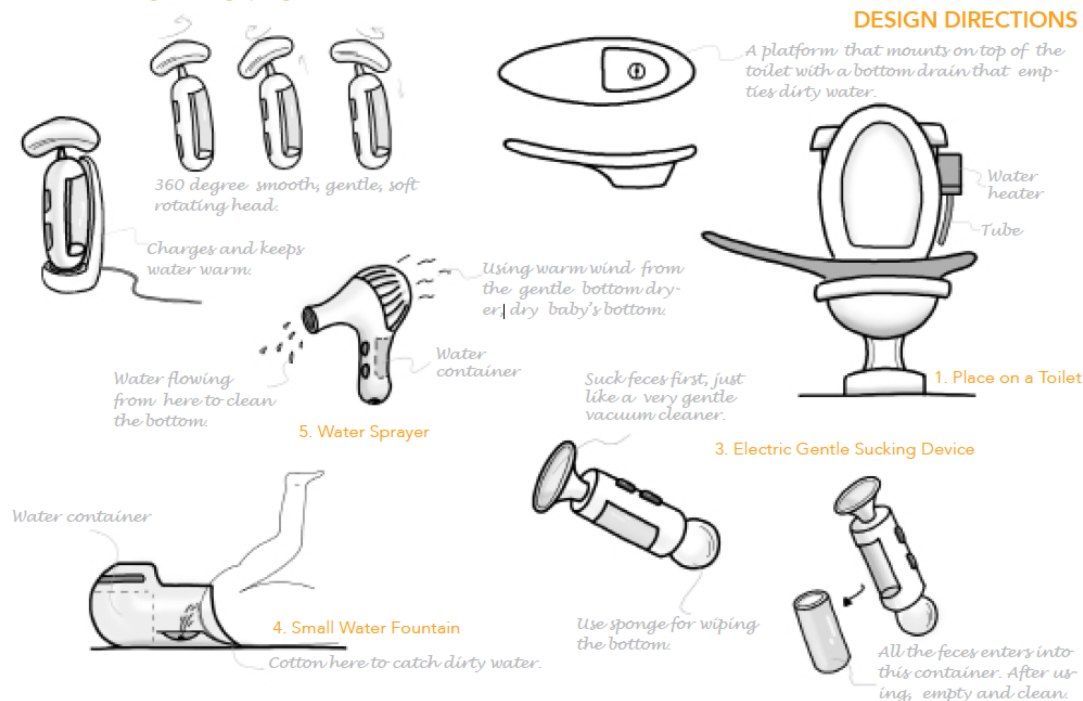


Fig 6-3 Design Directions

I came up with five ideas regarding the washing of a baby's bottom. Some are small devices, such as the Electric Rotating Cleaning Sponge and the Gentle Electric Sucking Device. They are all automatic. The first one applies a sponge ball to clean baby's bottom very gently with 360-degree smooth, soft rotation; the second one has similar principles as a vacuum cleaner: after sucking the feces, a sponge is used for wiping the bottom. Another one is the placement of a small water fountain close the baby's bottom, and it works like a massage cleaner. The last one is placing a changing table over a toilet. When

you wash a baby's bottom, the dirty water can flow directly into the toilet. Compared with the other four, the last one makes the most sense. It's the most natural way to clean a baby's bottom, so I kept thinking in this direction. (See Fig 6-3)

### 3. Development

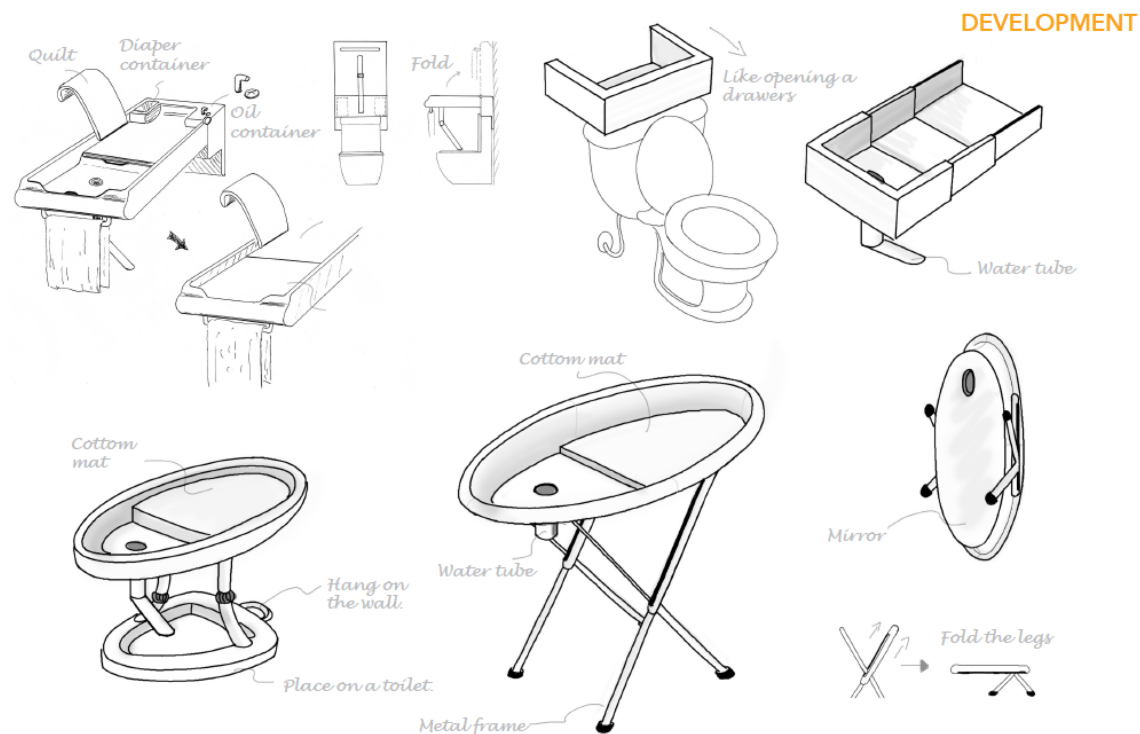


Fig 6-4 Development

After deciding the direction, I came up with four ideas. The first one is a foldable changing table attached to the wall; its major characteristic is therefore space saving. The second one is almost the same as the first except the opened way. The third one shown on the left bottom is a changing plate placed on a toilet, so that after cleaning people can fold it and hang it on the wall. When I considered the practical environmental conditions, the idea depicted in the lower right corner lit the night up. Because many people rent an apartment, they cannot bind a product to the wall (take out the two conceptions on the upper section) and different toilets have different shaped seats (remove the one on the left bottom). The last one's structure, however, is like an ironing board, which is both



convenient and strong. After using it, the user closes the legs and hangs it on the wall as a mirror. (See Fig 6-4)

#### 4. Sketch

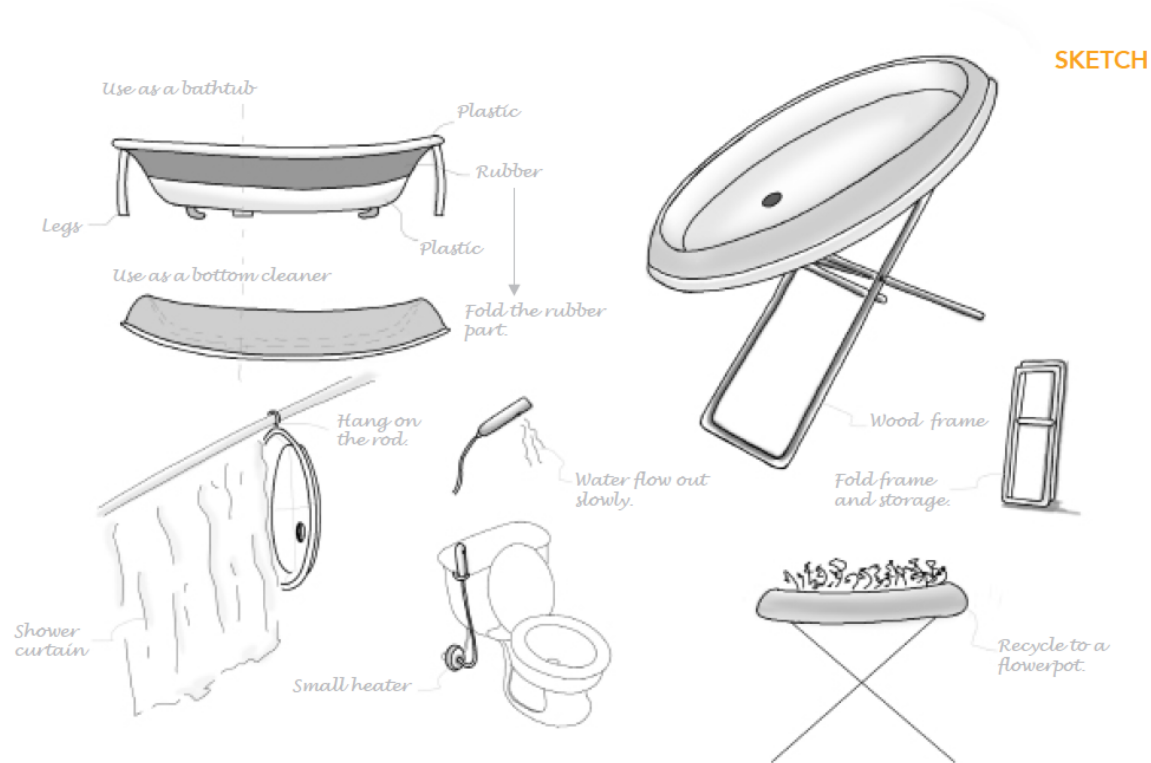


Fig 6-5 Sketch

After the development, I was thinking a baby bathtub is a necessary product for a baby. If I can combine a bathtub with a changing table, then parents do not need to make room for a changing table, and they would have both. Also, it can also be used to wash a baby's bottom. People can complete the whole changing process using this product. Then I thought about the possible future function of this item. Because when I pretend I am a mother, if I buy a product, I hope the product will be useful even after the baby grows up. I first thought it could be used for storage. But I realized that few people would want to store things in it because it had been used to wash a baby's bottom. Thinking in a different direction, I thought the natural material, wood frame, and the shape of the bottom of the cleaner looks like a big pot. My conclusion: a flowerpot in the garden



would be a good direction to recycle this product. So this design was born. The middle part of this product is made of rubber that is soft and resilient, and connected with two pieces of plastic. The rubber section can be folded or expanded. When it is folded, people can use it as a baby bottom cleaner with the frame set up on a toilet. When it expands with its four legs, the function changes to a baby bathtub. After using it, close the product and hang it on the rod. Water comes from the tank's water pipe with a header on it. (See Fig 6-5)

## 7.0 RELATED PRODUCTS RESEARCH

To determine additional functions, I went back to do more research about the baby bathtub and flowerpot.

### 7.1 Baby Bathtub

A baby bathtub is used for bathing infants, especially those not old enough to sit up on their own. It can be either a small, stand-alone bath that is filled with water from another source, or a device for supporting the baby that is placed in a standard bathtub. Both types are designed to allow the baby to recline while keeping its head out of the water.

#### 1. Toddler Tub with Sling



Fig 7-1-1 Toddler Tub With Sling

Babies do really grow very quickly, so different age groups have different types of bathtubs. A sling over a plastic tub is adaptable to a child's growth. A sling prevents the baby from slipping off the bathtub, causing injuries. A baby who is not yet old enough to sit can lie down on the sling. Then when the baby reaches four months old, the baby's neck and head muscles strengthen rapidly and are strong enough to hold the body so that they can sit on the tub. Different bathtubs have different sizes. According to the market research, the height range is from 8.2 inches to 15 inches; the length is between 29 inches and 36 inches; and the width range should be 15 inches to 21 inches.

#### 2. Blooming Bath and Bathtub Ring



Fig 7-1-2 Blooming Bath and Bathtub Ring

Blooming Bath is a cute, cuddly and convenient product to bathe a baby. People place it in a sink to create a soft and safe space for bathing. Moreover, the bathtub ring has a belt to fasten around the baby's body, and then put the baby in an adult bathtub like in a "pool." The baby can play securely in the water while the parents wash him safely.

### 3. Baby Bath Support



Fig 7-1-3 Baby Bath Support

Baby bath support is very important for giving a baby a wonderful bath in a big bathtub, whether sitting or lying in the chair. There is a fixed crotch to prevent the baby from slipping and to provide comfort for the baby and convenience to the parents, so bath time is much easier and more fun.

## 7.2 Flowerpot



Fig 7-2-1 Flowerpots from Google Images

A flowerpot is a container in which flowers and other plants are cultivated and displayed.

### 1. Recycled Flowerpots



Fig 7-2-2 Recycled Flowerpots from Google Images

Recycled flowerpot is a huge fashion trend in the flower market. Instead of buying a normal flowerpot in the market, people prefer to make them by themselves, thereby making their lives more interesting. Old pants, old shoes, old toilets and old car tires have become gardening enthusiasts' favorite containers. On the other hand, we have the desire and ability to protect the environment. Environmental protection is a big challenge for every human being. Using abandoned and useless products is a great way to protect our environment.

### 2. Artwork Flowerpot





Fig 7-2-3 Artwork Flowerpot from Google Images

The artwork flowerpot is another option in which to raise flowers and decorate the garden or the house. Gardening enthusiasts can make the flowerpot more colorful. Infinite originality is the talent of gardening enthusiasts, and they have inexhaustible ideas to make the flowers more interesting and attractive.

### 3. Vintage Baby Bathtub from Hungary



Fig 7-2-4 Vintage Baby Bathtub from Hungary



Fig 7-2-5 Vintage Baby Bathtub Other Functions

The baby bathtub with stand from Hungary is a good example of a recycled flowerpot, and happens to be similar to my design idea. Porcelain washtubs like this baby

bathtub, common throughout central Europe in the 1930s, make beautiful containers for culinary herbs and other edible plants. People can get creative with bathtubs and this is perfect for creating gardening space. People found that this object fits in anywhere, such as coolers, a flower planter and unique storage for any room including storing towels in the bathroom and even use as a sink. This Hungarian tub proves that my design idea is practical.

## 8.0 BATHROOM and HUMAN MEASUREMENT

### 1. Bathroom Environment

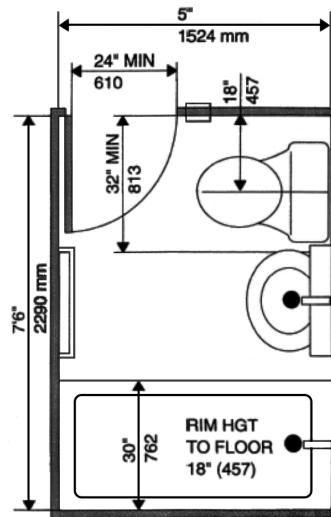


Fig 8-1-1 Bathroom Environment Dimension

Bathroom is a room for personal hygiene. Its main characteristics are humid, warm and small. Due to this product being set up above the toilet, space around the toilet is necessary. Fig 8-1-1 is a layout of rather minimal bathroom. According to this layout, the minimal width of a toilet space is 32 inches.



Fig 8-1-2 Home Depot Market

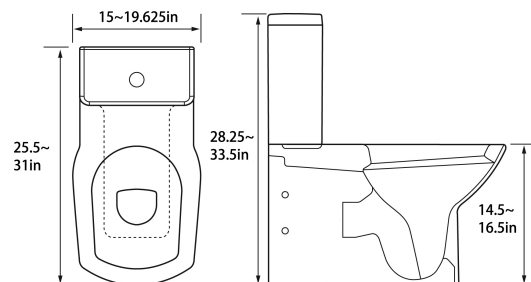


Fig 8-1-3 Toilet Dimension

I went to the Home Depot to do toilet research and measure all the toilets' dimensions, because the whole toilet is important for the design. In the marketplace, there are many different kinds and different sizes of toilets. Some of them are tall, and some are short. Some of them are integral-type, and some are disconnect-type. The

measurement is quite different. The height of a toilet should be between 28.25 inches and 33.5 inches, the width is 15 inches to 19.625 inches and the seat height is 14.5 inches to 16.5 inches (See Fig 8-1-3). I found that install a heater on the water pipe is not a good idea. I realized I had to design a container with a sprinkler for cleaning.

## 2. Human Factors

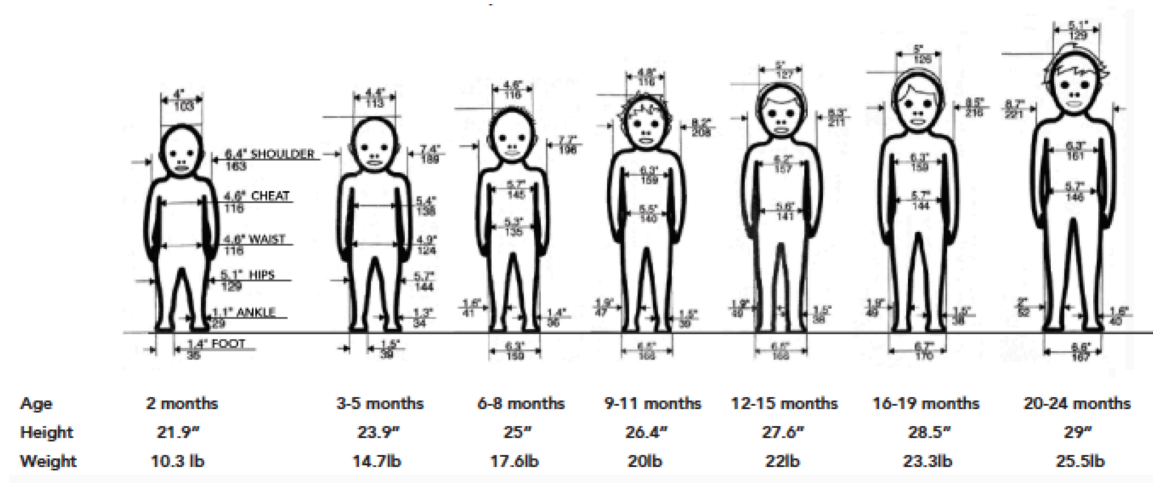


Fig 8-2-1 Baby Human Factors

Babies wear diapers until they are at least two years old, so Baby Bidet will spend two years with babies. According to the 2001 book *The Measure of Man and Woman: Human Factors in Design* by, when a child grows to two years old, in average dimension, his or her height is about 29 inches, the shoulder height is 23.2 inches and weight is about 25.5 pounds. Additionally, when a child is two years old, the shoulder width is about 8.7 inches and the child's bottom width is about 7.2 inches. (See Fig 8-2-1)



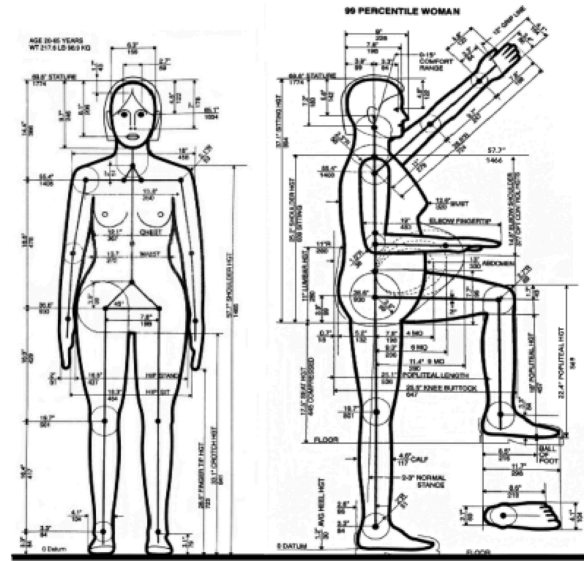


Fig 8-2-2 Woman Human Factors

Measurement of this product is not only important for the baby but also for the baby's parents. As showing in the Woman Human Factors (See Fig 8-2-2), 99% women are 69.8 inches tall. To avoid bending back, the hand working height is 33.1 inches - 44.1 inches. Hand working height range is between the fingertip height and the lumbar height when a person is standing. The height of the baby bottom cleaner should be among the hand working height range. As this product is a baby product, the baby's psychological condition should be taken into consideration to make the baby feel safe and not scared. The lowest height is much safer and therefore better. Thus the height of the baby bottom cleaner should be 34 inches.

## 9.0 MOCK-UPS

Before confirming all the details of this design, I had to make some mock-ups to make sure whether all the functions could work.

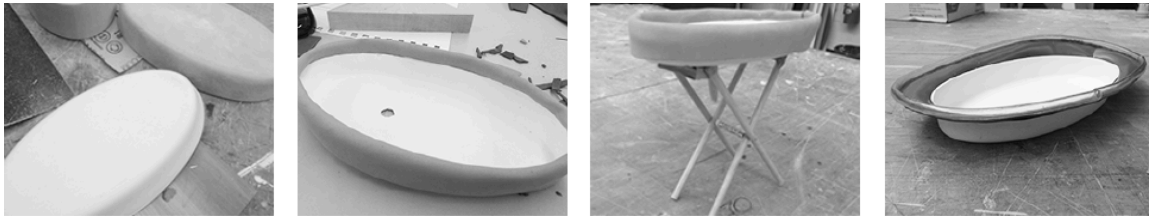


Fig 9-1 Mock-ups

Firstly, I used a blue form to make a model of the bottom part. And then I used a vacuum-forming machine to make a mockup with styrene. After that, I cut a piece of form paper instead of rubber to make the middle part, and adhered the cut form paper to the bottom section. But I found that the cut shape was wrong. After folding the form paper, the paper radian was incorrect. I figured out this shape is supposed to be a backward subuliform shape, which means the top is larger than the bottom. So I changed the method according to the top shape of the styrene section, and I drew an oval line on the rubber and cut it, and tried to adhere this outside part of the cut rubber to the styrene section, but it turned out the shape was still wrong, with too many cockles on the rubber. I had to figure out this shape before moving on.



Fig 9-2 Web Seal and Rubber Components

I googled and found some companies that produce rubber components. A company called WebSeal Inc in Rochester has been providing solutions for sealing challenges for

48 years, and they have many different kinds of rubber material. I visited their company and discussed with the professionals at WebSeal about the production of the rubber part and asked them to help me make the prototype. The professionals said this product can be produced and they could do it, but it would be very expensive. The model of the rubber section alone would cost \$5,000. So we discussed how to make the rubber part by hand, and they said I could use fabric to figure out the shape and then cut it on the rubber. Then they showed me many different types of rubber and I found a perfect one for my design. It's soft, strong, flexible and foldable. When I went back to campus, I also used a vacuum-forming machine to make the top section. Then I set both up in the right place, using fabric to figure out the shape of the rubber part. I adhered the cut fabric on a piece of rubber and cut the shape. I adhered this rubber to other two sections, and it worked out in the end. The rubber can be folded and expanded very easily.

The wood frame is made of wood. I made the legs parallel first. But the paralleled legs do not leave enough space to set it on a toilet. So the legs have to change to a trapezoid shape, and the bottom is wider than the top. And it worked. Moreover, the support stick between the legs had to be set higher than the toilet seat. To increase the friction force between the feet of the frame and the floor, the surface on the feet must be parallel to the floor.

## 10.0 Baby Bidet

Baby Bidet is a unique baby care product. It is used for changing diapers, washing babies' bottoms, and giving babies a bath. Additionally, it can also be recycled to serve a flowerpot. Not only is it a product for the baby, but eventually it becomes beautiful scenery in your garden. There are three functions of this product: baby bottom cleaner, baby bathtub and future flowerpot.



Fig 10-0 Baby Bidet

## 10.1 Baby Bathtub









Fig 10-1-1 Baby Bathtub with a Baby

This is the first function of Baby Bidet: use as a bathtub. Parents can select their favorite color for their boy or girl.



Fig 10-1-2 Baby Bathtub

Name	Image	Detail
Top Edge		It is made of plastic.
Water Hole Cover		When it is used as a bathtub, close this cover to seal up the hole so the water does not run out.
Rubber Section		It is made of rubber, which is soft and strong.

Legs		They are hidden under the top edge. You can turn them over to make it stand on the floor. The legs will support the bathtub.
Locking Frame		When Baby Bidet is used as a baby bottom cleaner, it will hold the wood frame and avoid tipping.
Base Section		This part is made of plastic. Ridges will prevent the baby from sliding.

Sheet 10-1-1 Baby Bathtub Details

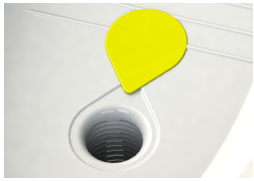

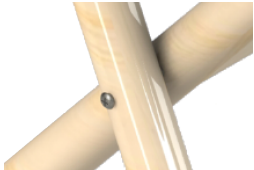

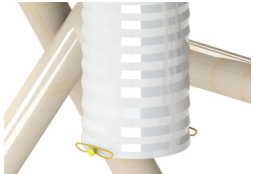

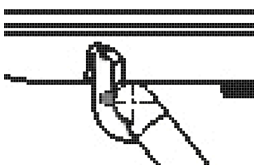
## 10.2 Baby Bottom Cleaner



Fig 10-2-1 Baby Bottom Cleaner

This is the second function of the Baby Bidet: use as a baby bottom cleaner. The basic diaper changing process includes removing the diaper, cleaning the baby's bottom, and dressing a clean diaper. Parents can complete all these steps on the Baby Bidet.

Name	Image	Detail
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Water Hole		Dirty water flows from this hole directly into the toilet.
Cotton Mat		Create a soft flat rubber surface for the baby. A stair can avoid baby clothes getting wet. And the two canvas belt can adhere to each other by HOOK&LOOP can avoid baby from moving.
Stainless Steel Frame		Stainless steel frame is sprayed with wood paint, and it can be opened and closed very easily. It is used to support the Baby Bidet above the toilet.
Rubber Leg Pad		It will prevent the frame from moving. It is strong and safe.
Foldable Tube		This foldable tube makes dirty water flow into the toilet, keeping the Baby Bidet clean. And the rubber band is used for locking the foldable tube.
Foldable Belt		Made of stainless steel. It will control the open angle of the wood frame.
Lock the Frame		Keep the base section from moving.

Sheet 10-2-1 Baby Bottom Cleaner Details





Fig 10-2-2 Sprinkler

This sprinkler is used as a water faucet. Put warm water into the container, press the button and then water will smoothly and softly flow out from the pipe and clean the baby's bottom.

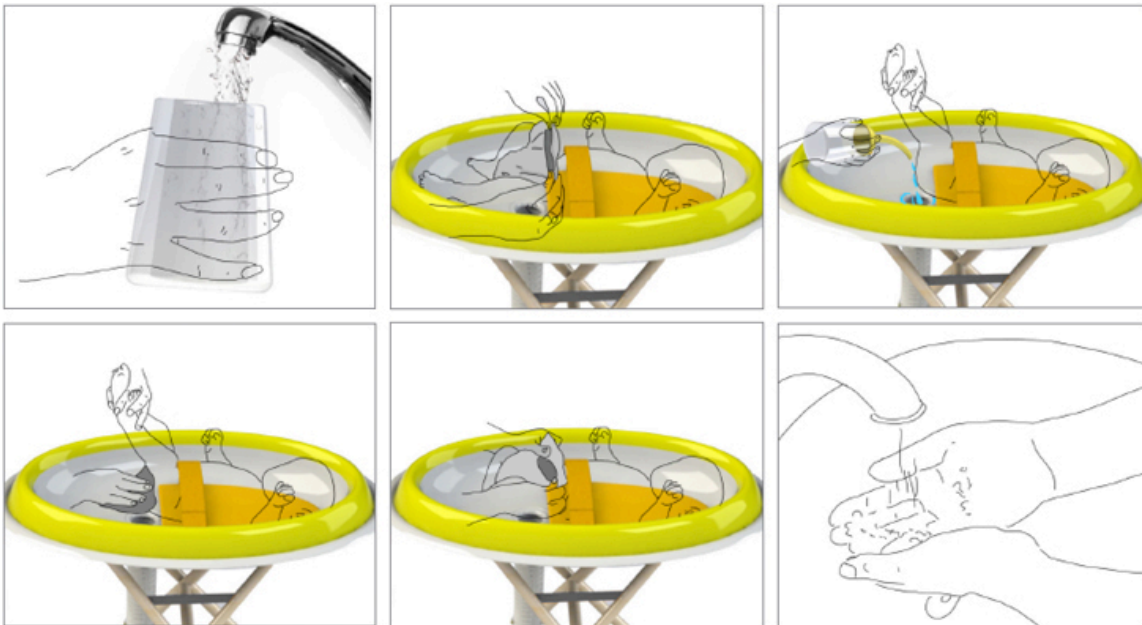


Fig 10-2-3 Using Baby Bottom Cleaner

To use this product, put some warm water in the sprinkler first and seal the cap. Then, put the baby on this product and fasten the belt to keep the baby safe. Take off the



baby's pants, open the dirty diaper and throw it into the trash can; you do not need to worry about the base section being dirtied. Wash the baby's bottom with the running water that is flowing from the sprinkler: the rest of the water in the sprinkler can be used to clean the base section, and the dirty water will flow directly into the toilet. After cleaning up the baby's bottom, pat the baby's bottom dry with a clean cloth, and then dry the Baby Bidet base section before putting a new diaper on. Put a new diaper on the baby, and then dress the baby. Last but not least, wash your hands and the baby's hands. Both changing and cleaning are done on this product. It provides an easy, convenient and comfortable way to change a diaper and clean a baby's bottom. Parents will find it easier to change diapers and wash the dirty bottom. (See Fig 10-2-3)

### 10.3 Flowerpot



Fig 10-3-1 Flowerpot

The third function is flowerpot. When the baby grows out of diapers, they will not need either the baby bathtub or the baby bottom cleaner functions. Baby Bidet can be recycled and used as a flowerpot in the garden to make life more beautiful. Before raising plants in this flowerpot, close the water hole cover so it can hold soil. Baby Bidet provides four different lovely color options. All these colorful products will be perfect for the garden.



Fig 10-3-2 Flowerpot in Use

## 10.4 Baby Bidet Transformation and Storage

### 1. Transform Baby Bathtub



Fig 10-4-1 Transform Baby Bathtub

With only 2 steps you can fold this product and store it (See Fig 10-4-1). The volume is reduced by half after folding. The foldable feature saves space and promotes easy storage. Step one is turning the four legs over and hiding them under the top edge (See Fig 10-4-2), and the second is pressing the top edge and folding the rubber part under. Then you get a folded Baby Bidet.

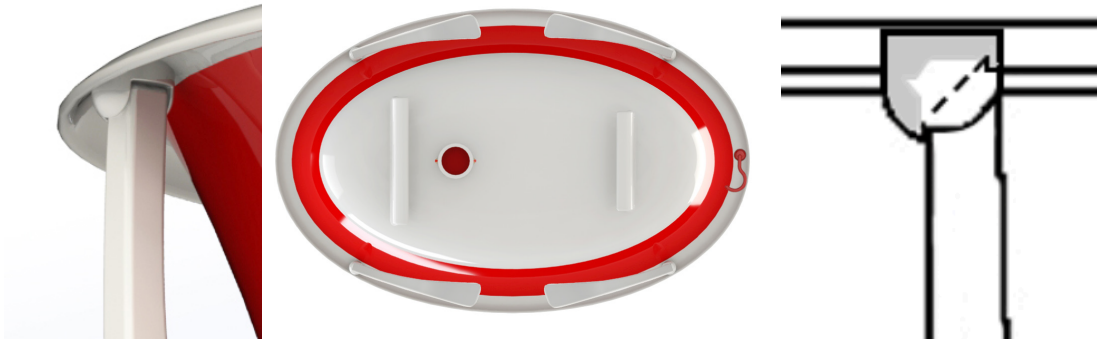


Fig 10-4-2 Folding Legs

## 2. Storage

If you have a shower curtain rod in the bathroom, you can rotate the hanger and hang it on the shower curtain rod.



Fig 10-4-3 Storing on a Curtain Rod

If you do not have a shower curtain to hang the Baby Bidet, it can stand against the wall.



Fig 10-4-4 Storing against a Wall

### 3. Setting up Baby Bottom Cleaner

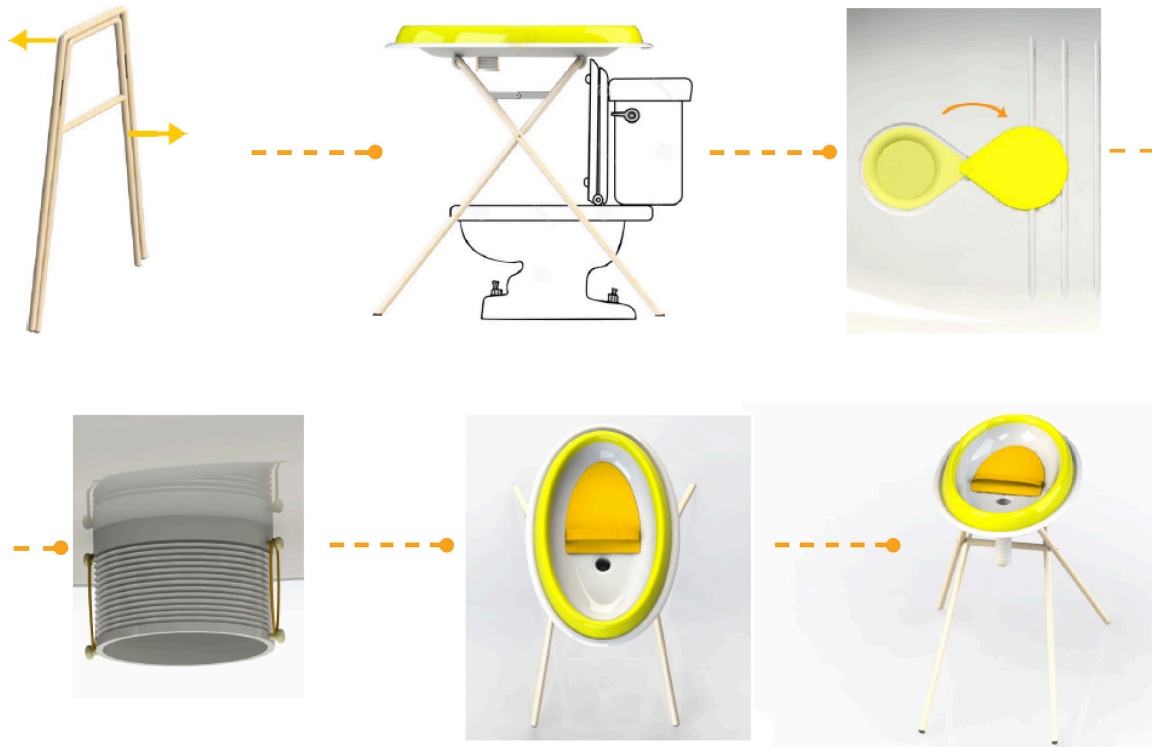


Fig 10-4-5 Setting up Baby Bottom Cleaner

Open the stainless steel frame, and place it above the toilet, with the water hole outside. Place the baby bottom cleaner on the frame, and open the water hole cover. Then, loosen the rubber band on the tube under the base section, and the tube will open by itself. Place the cotton mat on it. Now, the Baby Bidet is ready for the baby. (See Fig 10-4-5)

## 10.5 Material and Measure

### 1. Material

Baby Bidet is made of ABS plastic, rubber, stainless steel, canvas and cotton. It is portable and nothing is harmful to a baby. I changed the wood frame to a stainless steel frame, since metal is stronger than the wood. White pine as an example, its density is 0.4. Stainless steel's is 7.75. Let both frames have the diameter of 1 inch, and calculate the weight of a 1-inch height cylinder.

Material	Formula	Weight
Solid White Pine	$\Pi * r^2 * h * \rho$	0.314g
Hollow Stainless Steel (0.1 inch Thickness)	$\Pi * (R - r)^2 * h * \rho$	0.243g

#### Sheet 10-5-1 Material Quality Comparison

Hollow stainless steel is stronger than solid white pine, and its weight is lighter. Applying wood paint on the hollow stainless steel makes the Baby Bidet more perfect and looks natural.

#### 2. Measurement

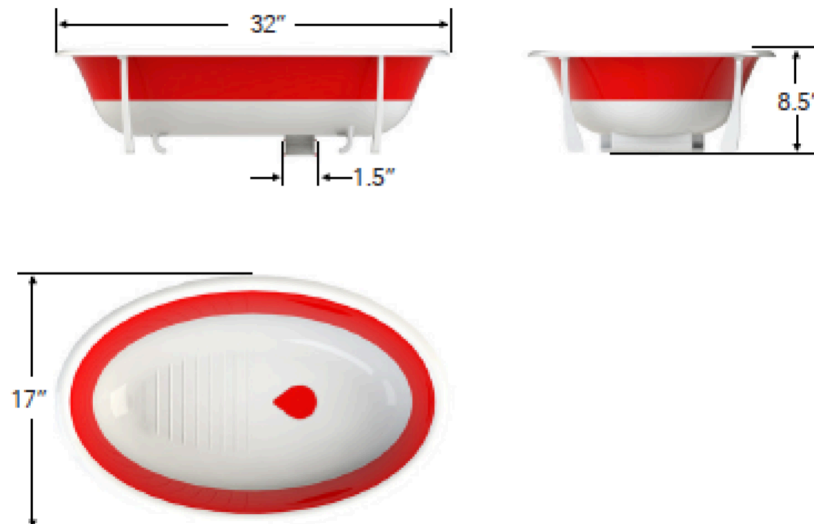


Fig 10-5-1 Baby Bathtub Measurement



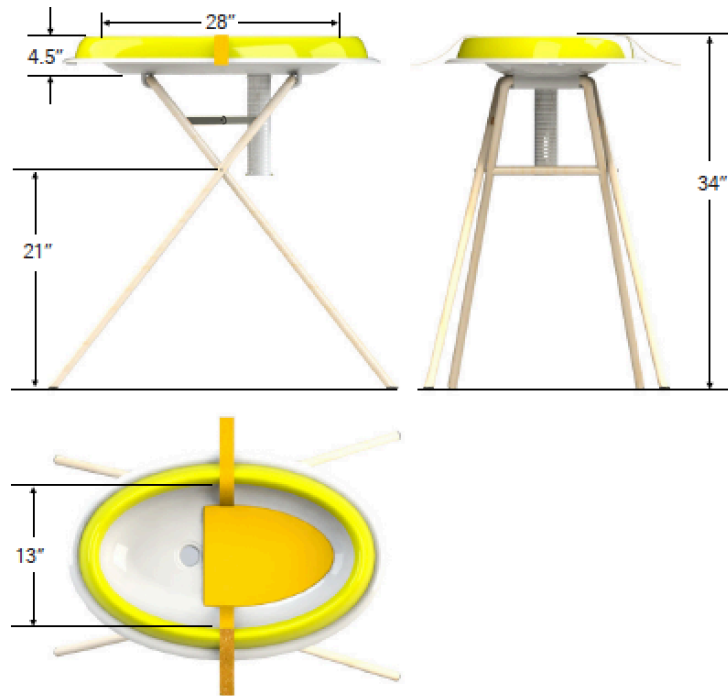


Fig 10-5-2 Baby Bottom Cleaner Measurement

According to the Human Factors, the height of the baby bottom cleaner at 34 inches is comfortable for a parent's back. The support stick of the frame has a height of 21 inches, which is higher than the toilet seat. According to the growth process of the baby, until they are about two years old, the average height of a baby is 29 inches, and the baby's shoulder width is 8.7 inches. Because all babies bend their legs when they are changed, the 28-inch length of the base section is sufficient. The width is 13 inches and the height is 4.5 inches.

## **11.0 FEEDBACK**

I visited a few users and showed them my design, and all the feedback was very positive. These users are 30-50 year-old parents who have a newborn baby or have two or three children. Some mothers feel this product is convenient for baby caring because it can be used as baby bathtub and bottom cleaner. Some fathers like the flowerpot, and said that they would like to raise plants in it. Elizabeth said, “I love this design. If it is available on the market, I would buy it. That way I would not need to throw out my furniture to empty a space for my baby equipment.” She also said “I love the flowerpot. I think it is a great idea.” After reading all the information regarding the Baby Bidet, Cindy raved about the brilliant idea. She is a mother of three, and wishes this had been available when her children were babies.

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