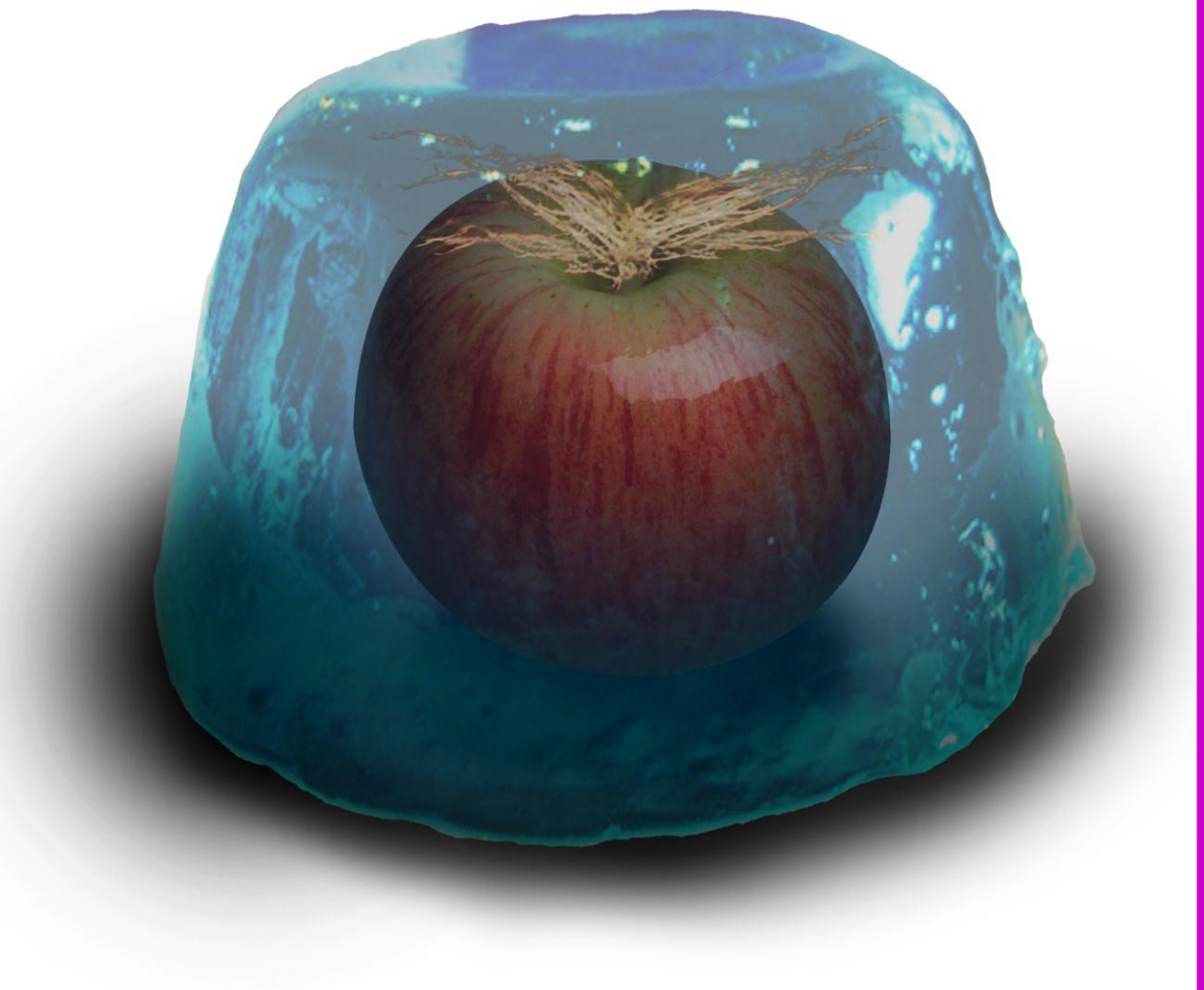


Report

“Adaptive and Informative Skin”

Tom Slijkhuis, Joppe Spaans, Ruud v. Reijmersdal, Jeroen Rood

B1.1

Give a man food and he'll be fed for one day, give him gel and feed him for a lifetime.

TABLE OF CONTENTS

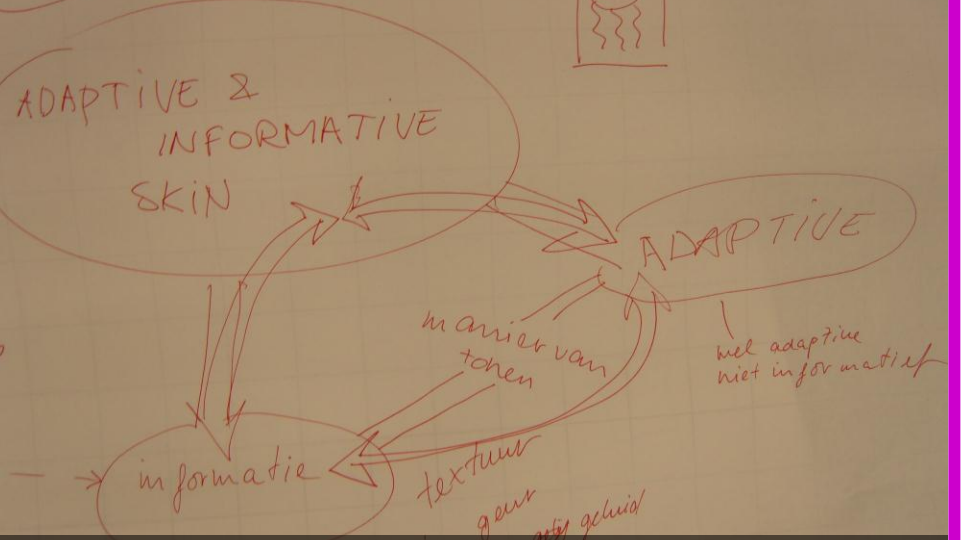


Figure 1: Defining what adaptive and informative skin is.

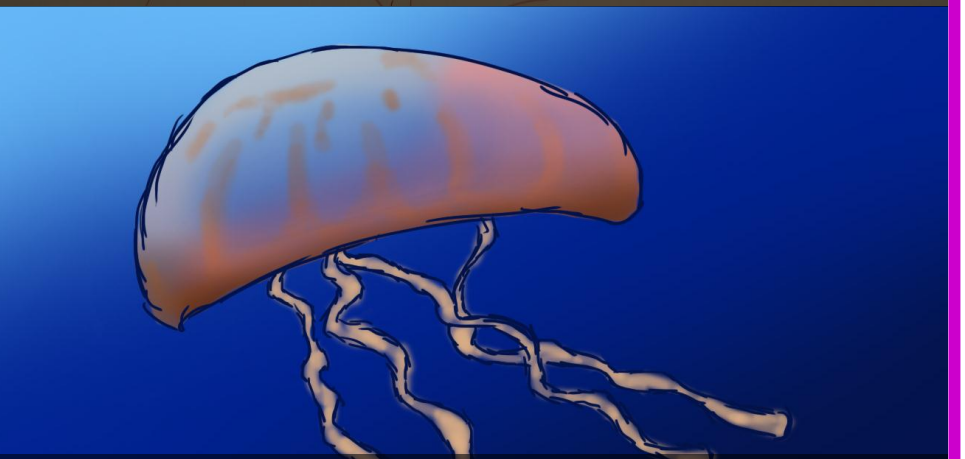


Figure 2: One of our definition inspirations: the jellyfish.

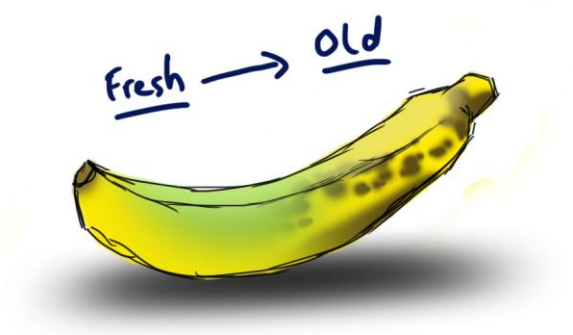


Figure 3: The banana was another piece of inspiration for our definition of skin.

INTRODUCTION

Our project was kicked off by an introduction about the theme. We started with a presentation about the theme, Next Nature, which was done by master students. They gave us an idea about what the theme was about. It was clear that we could work within very broad boundaries. The theme can be pulled into a lot of different directions. There was also some information given about the projects for the theme, adaptive and informative skin in our case. So to that point, our assignment for the project was: create a product that has a skin that adapts to a certain change or input as we liked to call it and give a kind of information.

Questions rose about the project. What can we define as skin? What are the definitions of adaptive and informative? So each team had to think separately about what their thoughts were on the definition of skin. [fig. 1] Then make a presentation out of this and present to the rest of the groups. Skin can be very broadly defined, we think. The first thing that comes to mind is the outer layer of a 'thing' or organism. A jellyfish is a nice example of an organism without a clear 'skin'. Though, the water surrounding it can be seen as a skin for the jellyfish. [fig. 2] The water protects it from the sun and keeps the form of the jellyfish. We also divided objects and organisms that adapt their selves actively, like a chameleon. Other objects and organisms are only adapting their skin because of outside influences like the sun, as is the case with a banana. [fig. 3]

We started our project with a pressure cooker.

PRESSURE COOKER (STEP 1)

Research

All groups that had the same project presented their presentations to each other. From the presentation it had become clear to us that our project can be broadly interpreted. The outside of a cloud can be a skin, but it only forms a visual boundary. It doesn't protect anything really, like human skin does for example. There always is some kind of input, a reaction in the skin and the adaption as an output and information to the outside. [fig. 4] We got a lot of freedom to go in all kind of different directions with this project.

So during our first coach meeting we were introduced by the 1/10/100 method.

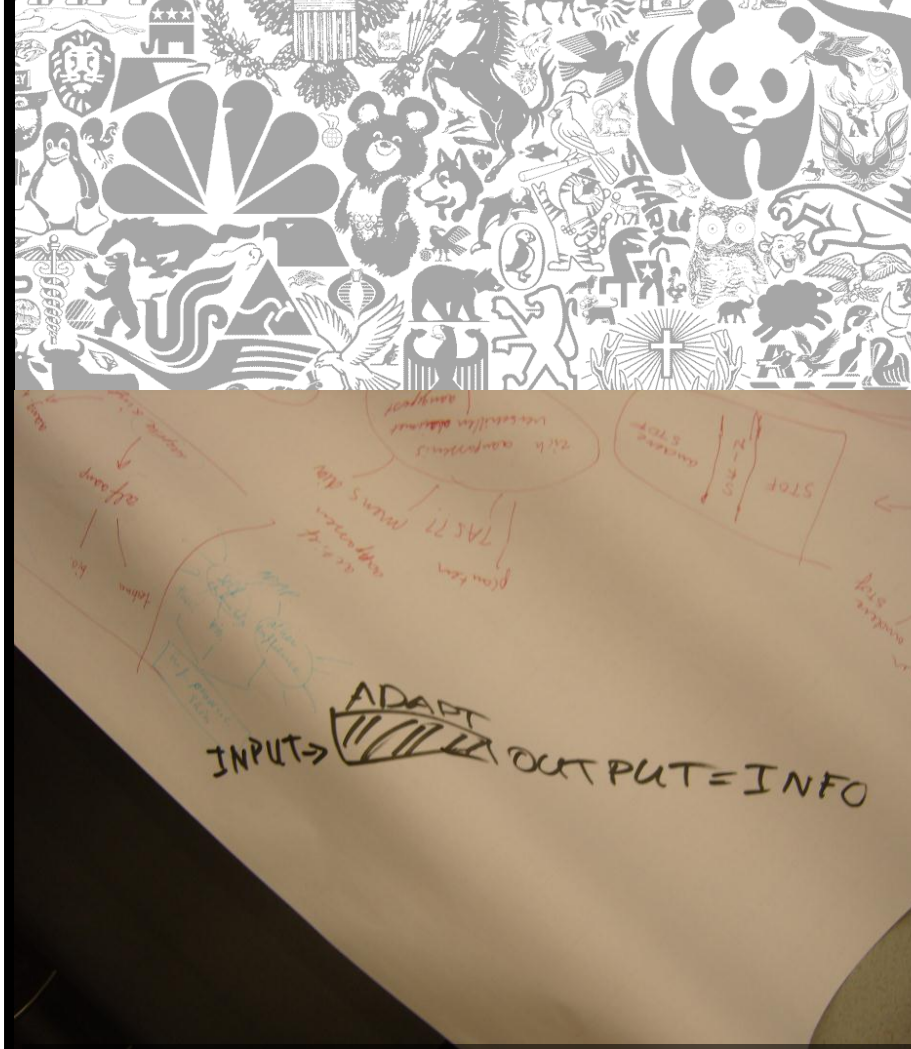


Figure 4: Descriptive model of the process of an adaptive and informative skin

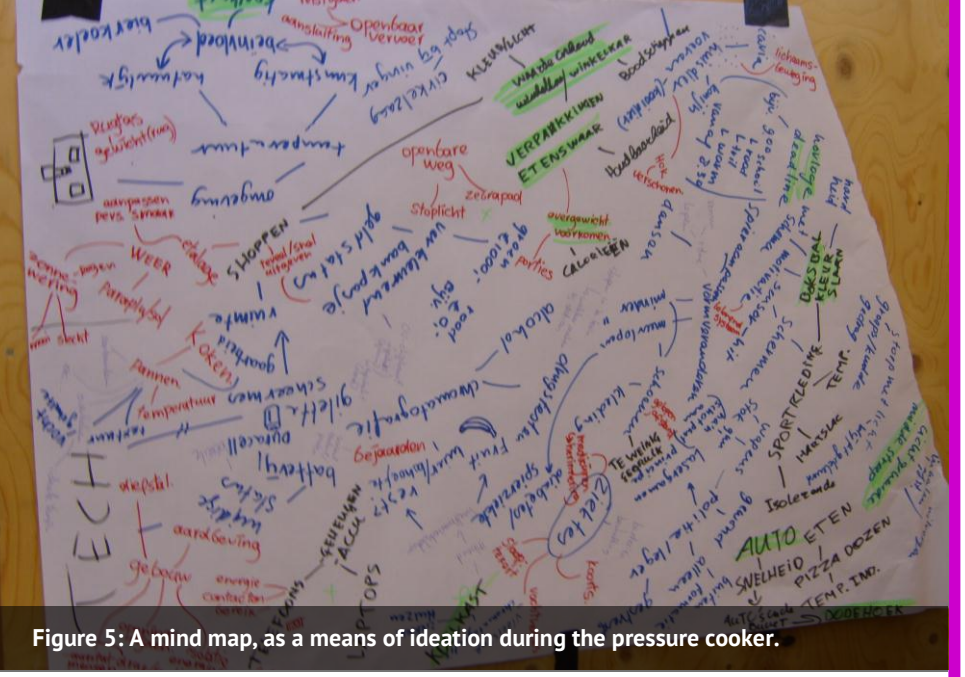


Figure 5: A mind map, as a means of ideation during the pressure cooker.

Figure 6: The shopping cart, the rim would display the user's shopping behavior.

Figure 7: The interactive punch bag.

Ideation

After the research for gaining a context of the thematic as well as the project's assignment, the ideation process began.

The first step we took was making a mind-map. A big A0 sheet of paper was entirely filled with ideas, leading from one to another. Because the schedule was very tight, we had to trim the amount of ideas to just a few. That is where we created a list of ideas, with which we immediately tried to elaborate on each of the chosen ideas.

The elimination of ideas led to six final ideas: at first a shopping cart that could display the shopping behavior of the person using the cart. Secondly, a skin for a car indicating that there is something in the driver's blind spot. Thirdly, a refrigerator indicating the conditions of its contents. Another idea was some packaging giving information about the product's nutritional value, encouraging or discouraging you to take the product. Also among the ideas that were chosen, was an interactive road marking. That means it would tell you when you can overtake, if your speed is too high or if someone is overtaking you. Finally there was a punch bag which skin would change to your performance during workout.

After this elimination, we chose to eliminate further, as we weren't sure what idea to pick yet. The ideas that were left were the punch bag and the shopping cart. [fig. 6,7] We elaborated on those even further, and came to the conclusion that the punch bag would be too much of a gadget or a toy. It wouldn't be more than a useless addition to the traditional punch bag. That is why we chose for the shopping cart to work out.

Results

So we decided to work out the idea of the Shopping cart which should aware people of their shopping behavior. There were some choices which had to be made. We as a group decided to put quiet some effort in the prototype. This meant we needed time so we had to make quick decisions. Two of the main decisions were about the informative part. First, what was it we wanted people to be aware of. Secondly, how were we going to present this to the people behind the shopping cart?

Our main informing point was health. So we could count the calories, but we thought this was no good indication. Since some people buy whole carts full and some people not even half way. We decided to use the scale of five, a settled indicator for healthy food eating. This we integrated in the handle, as can be seen in figure 1. Five turning discs each representing one of the groups in the scale system. As you fill the cart the discs will start turning. When all divisions are balanced nicely in the products you buy the colors will appear. If one of the groups is too dominant this will turn red.

Besides the handle, also the top lining of the cart will also shift color. Between green when you're doing well and red when you are buying groups too dominantly. The shopping cart in figure 8 and 9 gives a good impression. This was, together with the handle bar, our prototype.

The main goal of our cart was not to change people's behavior, but to make people aware of their shopping habits. The cart will only apply to family's who fill up their cart once a week. This way we hope to help people to shop responsibly.

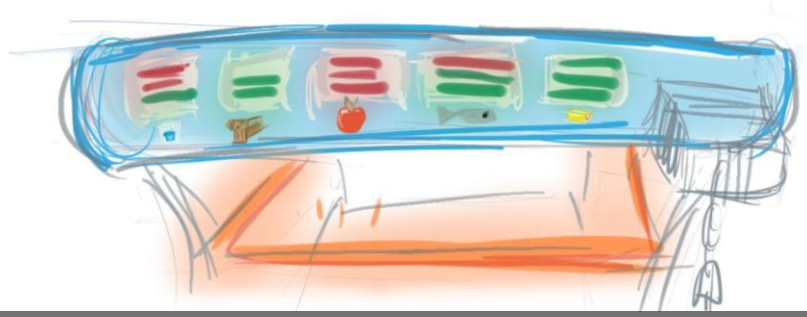


Figure 8: The handle of our shopping cart prototype.

Figure 9: An impression of the interactive shopping cart.

Figure 10: An amoeba, which inspired our principles of our gel concept.

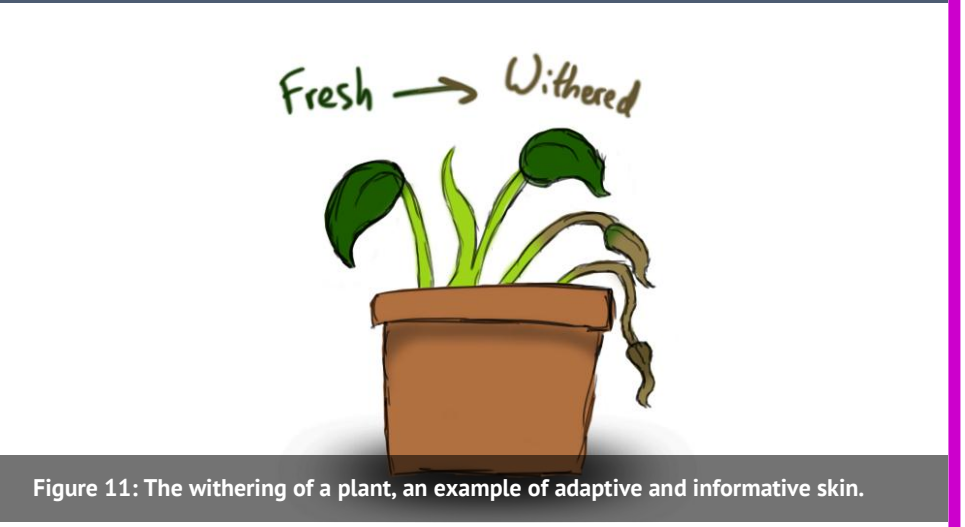


Figure 11: The withering of a plant, an example of adaptive and informative skin.

Figure 12: The Indonesian mimic octopus has an adaptive and informative skin.

STEP 10

Research

During the pressure cooker we did not do so much research concerning the context of our definition of 'Adaptive and Informative Skin', so we decided to first do some research in what kind of adaptive skins can be found in nature this time. We split the group up in different research topics. We had some research topics were existing skins in plants, the same for animals, micro-scale nature and nature on the big scale. [fig. 10, 11, 12]

Some results were the amoeba, a microorganism that encapsulates its food, which means the amoeba could eat through its skin, which also has to be very flexible. Another result was a squid that, because of its flexible skin, could disguise as different species, so it could scare off its predators. Its skin could also turn black in an instant, which would have the same effect.

A result from the big-scale nature was quicksand, with its capability to – just like the amoeba –encapsulate something. The only difference is that quicksand does not eat something, but gets a different structure when it is stressed. Another result was the phenomenon of withering, because of the deteriorating circumstances in a plant it shows on the outside it is dying.

Later on, when we came back together to make a mind map of our results, we came to even more examples than we originally had, as we shared our associations with the topics we didn't research for.

Ideation

So after splitting up the research areas there rolled out a couple of big inspiration sources. [fig. 13]

Within the theme we were free to interpret and explore the ideas, as the project topic is really abstract. That was either really nice as well as quite a challenge, because we also needed to take into account the likeliness to “Adaptive and Informative Skin”.

Quickly everybody was overloaded with ideas and approaches; we wanted to have four concepts to present at the Pre-Interim Exhibition. The four ideas, which we wanted to continue with, were in random approach:

- *Weather-balloon;* [fig. 14]
- *Oxygen Wallpaper;* [fig. 15]
- *Gel Bag;* [fig. 16]
- *Pressure table;* [fig. 17]

The weather balloon convokes the weather inside livings or working areas. It was meant to do this in a natural way without bothering people, to reintroduce the weather in closed areas or environments where the weather outside wouldn’t be noticeable. This would possible in several ways.

For example working with a balloon constructed with a steel moving frame inside, being able to transform the balloon into different shapes smoothly. Another option of the balloon was to give a real sensation of the weather. When the balloon is predicting the weather it produces real heat and shining sunbeams or real water drops blew by a heavy wind, provided that is predicted.

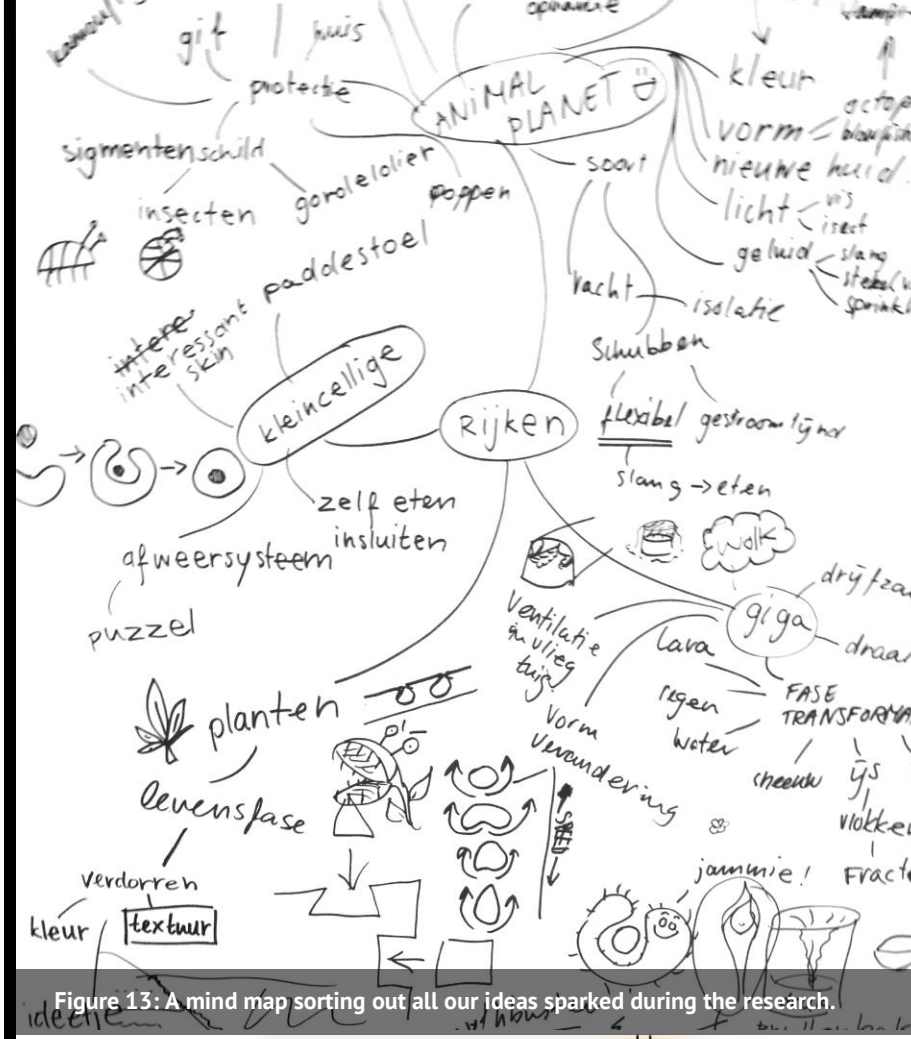


Figure 13: A mind map sorting out all our ideas sparked during the research.

Figure 14: The weather balloon, situated in an office.

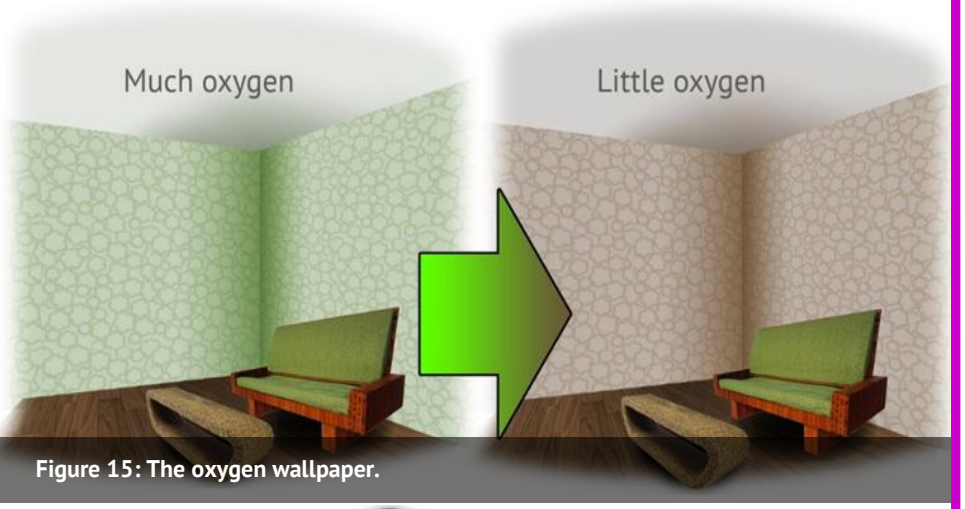


Figure 15: The oxygen wallpaper.

Figure 16: Impression of the gel bag.

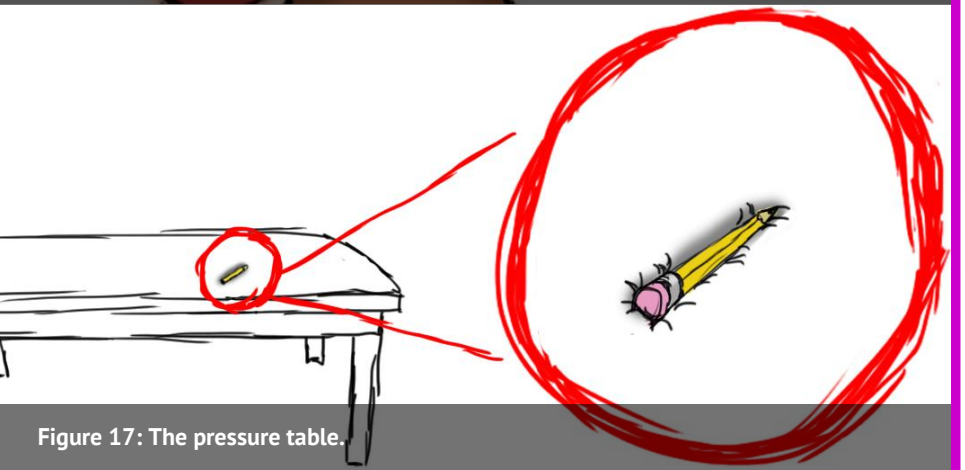


Figure 17: The pressure table.

For the oxygen wallpaper is thought of preventing the decreasing of concentration in for example schools and big desk offices. The wallpaper is showing the user on a natural way that the oxygen level in the area where he is working is too low and that action has to be taken. The way of showing the user that this level is too low can be realized for example with working with e-ink and e-paper. There is no light used, the last thing we wanted to do is to distract the user, so e-ink was the solution of showing somebody something without needing his full attention. E-paper/-ink shows it on a very controlled level. For example with dropping colors or reacting liquids into thin, transparent, liquid wallpaper should create a more distracting but more beautiful result.

The bag is a story on itself. It was inspired by liquid sand, gelatin and the atmosphere. Holding things on their own place and seeing them in the same time. Also, we wanted to create the possibility of getting belongings out or in your bag from any wished direction. The way of realizing this was hard, how do you create a mini-atmosphere with gelatin that was a big question. It was like designing the Big Bang again, hard and interesting.

Left over is the Pressure table, the table with the informative and adaptive skin, which should make the work you are doing on the table more interesting, whatever it might be. For example, after laying down a pencil it would show you where it was by leaving a print, stamp, color, sound or smell for example. Because the scene is really big in this area of smart tables we wanted to bring something on the market without electronics, so it gives you a feeling the table is living with you, not controlled by another hidden chip like a lot of common electronics are.

Elaboration

After the ideation and deciding over the 12 ideas we picked 4 as most potential. We now wanted to elaborate on these ideas. So we made 4 topics; pros and cons, existing products, materials techniques and target group(s) & user perspective. All four of us did one topic per idea. [fig. 18]

Some ideas were easy to make decisions for. We had to eliminate ideas until only one was left. The weather balloon would be an expensive alternative for other products like an online weather-forecast, or a weather station. As for the oxygen wallpaper, it raised some questions about the feasibility and what materials to use. The pressure table was another problem, as there were plenty of interactive tables around, which made it very hard to come up with an original concept. The gel bag had the far most potential.

That's why we discarded two of our chosen concepts, and give our 12 original concepts another look. We added the following alternatives to our selection:

- *Adaptive closet;* [fig.19]
- *Liquid-illuminating floor;* [fig. 20]

An adaptive closet. These days, closets are always fixed squares and rectangles where we can put stuff in. We have to adapt the layout of our stuff to fit into the closet. We want it the other way around. The closet should be adaptable to the stuff you have put into it.

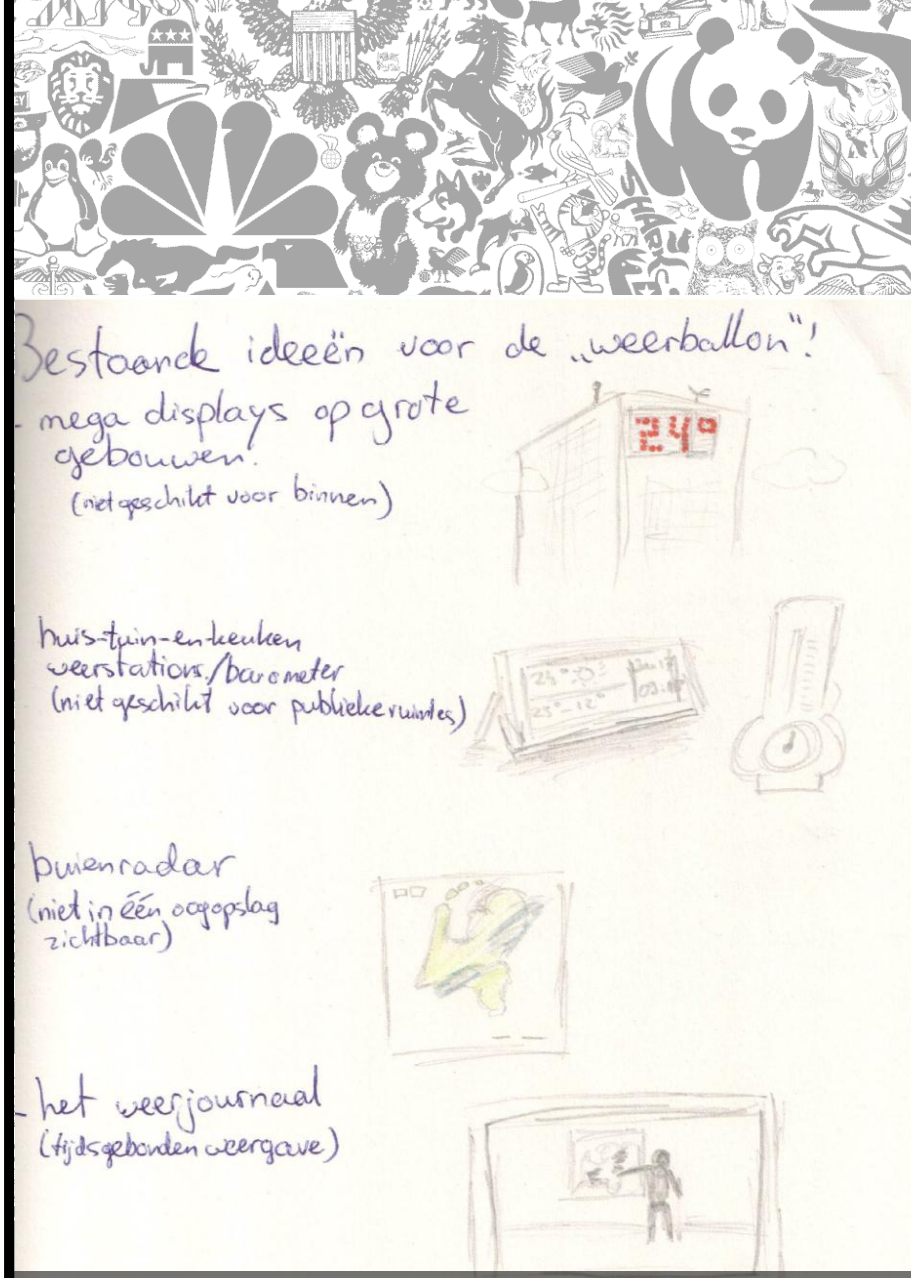


Figure 18: Part of the elaboration: existing products for the weather balloon.

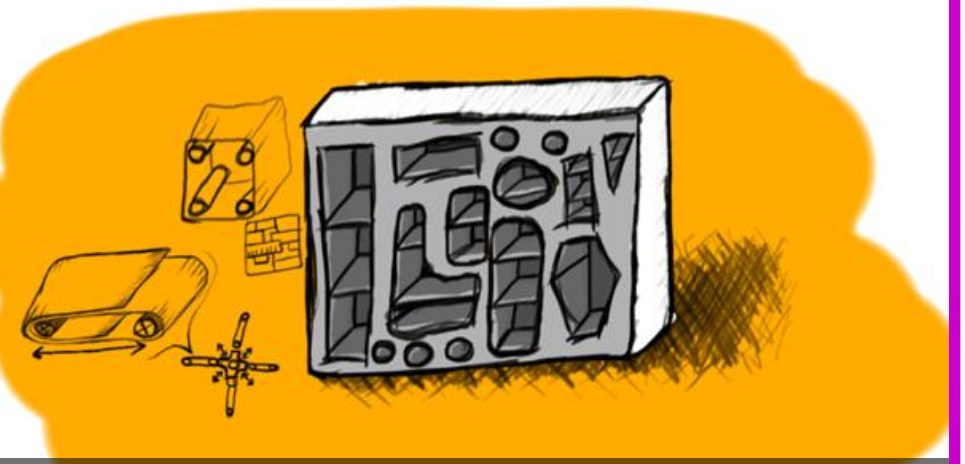


Figure 19: The adaptive closet.

Figure 20: The liquid-illuminating floor. The liquid lights up orange here.
Trainstation image credit: NederlandMetro

The closet is built from loose square and rectangle shaped units which can change their form by dragging the corners over the wall. That way, there is always the possibility to adapt the closet from the amount and form of objects someone wants to store.

With the liquid-illuminating floor, we wanted to warn people for a wet floor with this concept. This idea originally came from the bathroom, where a wet floor can be very dangerous. The floor lights up when liquid is spilled on it. Sensors detect the liquid and LEDs light up under the transparent floor. This way the spot of liquid on the floor would be entirely illuminated, warning people not only that the floor is wet, but also where the floor is wet.

Results

After we went from twelve to four concepts, we selected four final concepts that had the most potential in our opinion. We needed a clear, joint opinion about the four concepts we wanted to present during the Interim Exhibition. First each team member decided for their selves what their vision was on the concepts we wanted to present. Pros, cons, the own ideas on how it will work and how it will look were the points we needed to take into consideration.

We discussed our visions on the concepts with each other and tried to make one final concept for each of the four. We all agreed, and compromised a little sometimes, to present the most solid concepts which each member of the team could all explain and support it in the same way. We did that al lot during the designing processes this semester. First, each team member came up with their own, individual ideas and concepts and after that we discussed and them, giving feedback to each other to improve the concepts.

The four final concepts for the Interim Exhibition were:

- *Oxygen wallpaper;* [fig. 15]
- *Adaptive closet;* [fig.19]
- *Liquid-illuminating floor;* [fig. 20]
- *Gel bag* [fig. 16]

The posters are included in the appendix, section **[A]**.

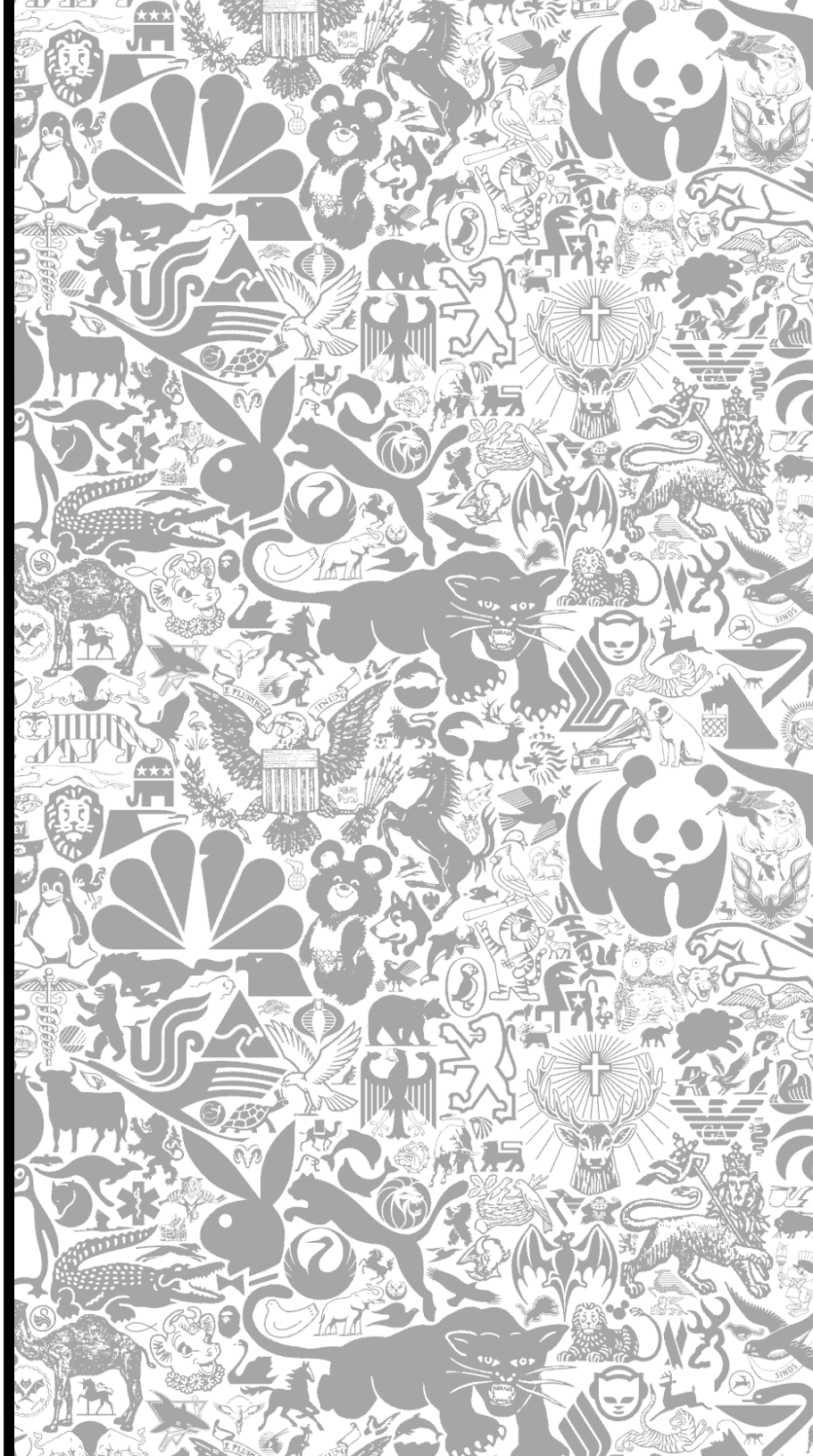


Figure 21: Our stand during the Interim Exhibition

Figure 22: The gel samples we made to test some gel characteristics.

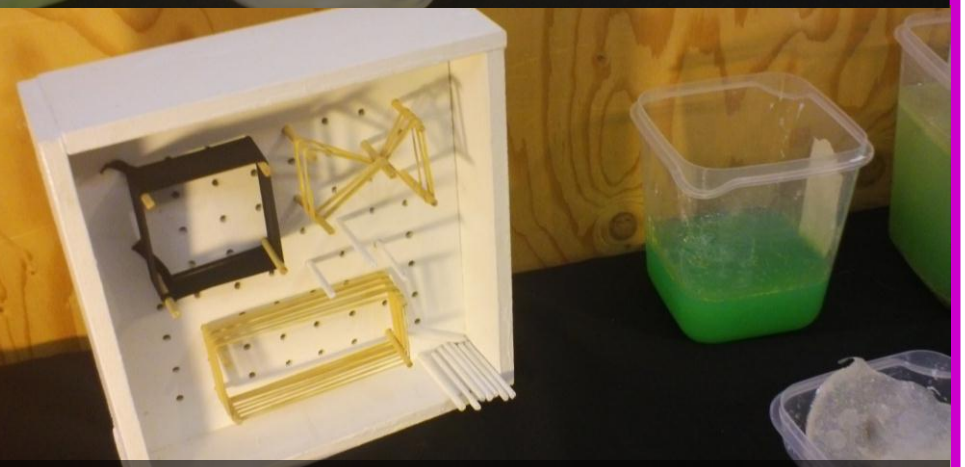


Figure 23: A model made of the adaptive closet.

During the Interim Exhibition we also got feedback from visitors. Getting feedback from different students and coaches was very interesting; because we were expected less different opinions about what concepts had the most potential. We predicted that the jelly bag would receive the most positive reactions from people that gave feedback. It did, but there were also a lot of positive reactions on the other concepts. Even the liquid-illuminating floor had positive reactions, while we thought it was mediocre.

The reaction on the function of the oxygen wallpaper was quite positive. People thought it was a useful goal to let persons within a closed working space knows that oxygen levels are too low. Though, some feedback told us that wallpaper that changes its color so dramatically could be very ‘in the face’ and annoying and a more subtle way would be preferred. Also, because we thought of e-paper to construct the wallpaper of, it was mentioned that e-paper is way too expensive and non-efficient to cover whole walls.

The main thing we got from the adaptive closet was that the closet itself should actively adapt to stuff that someone would put in to it. That would fit more into the adaptive part of our project.

The gel bag surprised many people. It could really be an interesting product someday. It may be used for different purposes than a bag. For instance, it could be used for a book closet. We should be aware though, that this is not going to be developed is some kind of gimmick, but really has a useful function. A main problem was the privacy. It is for all to see what is in the bag, plus the accessibility from all sides that we suggested could be dangerous for thieves. So we had to think of solutions for that, like an extra skin surrounding the gel.

The usefulness of the liquid-illuminating floor was put into question; it was simply not interesting enough. But on the other side, knowing on what kind of surface you are walking can be very helpful. One can walk on ice pretty easily, as long as one knows it's ice.

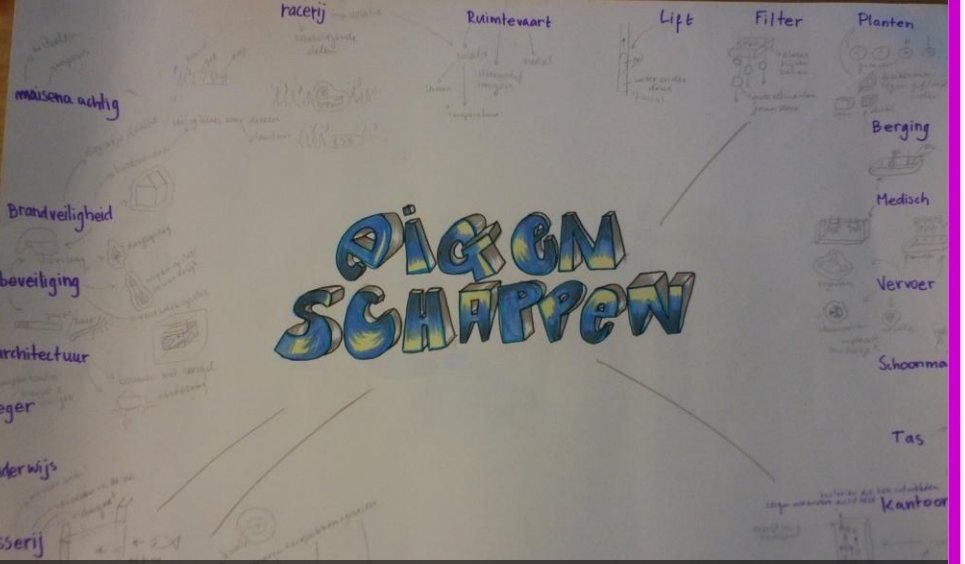


Figure 24: A schedule of what properties/uses our gel could have.

Figure 25: A possible property of gel, namely serving as protection for high impact.

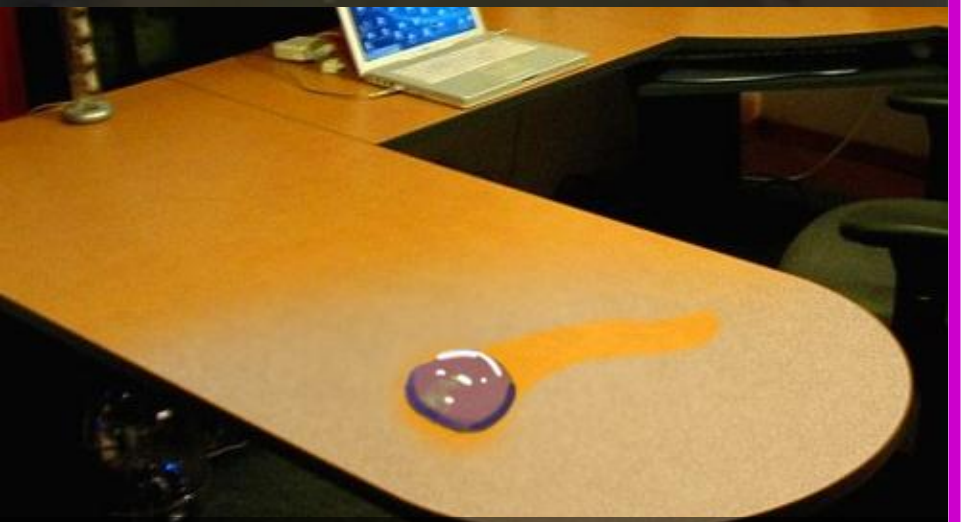


Figure 26: Another possible property of gel, the ability to sterilize and dust off.

STEP 100

After the Interim Exhibition we started discussing the feedback we received, and unanimously decided to work further with the Gel bag concept. Only this gel product had so much more potential. At the Interim Exhibition we presented it as a bag, but why should it be a bag? This was also feedback we received; some people asked us why it was a bag. So we dropped the idea of it being a bag, it now was 'gel'. Left with the 'gel' we had to generate some ideas on this, since there was no concept left. Individually we thought of applications, other than a bag, the gel could have.

Ideation

Ideas we thought of can be seen in the schedule on the right. Also some of the properties the final gel could or should have in case to be usable for our gel. The picture is in Dutch so here some of the properties and applications from the schedule will shortly be clarified. Properties we thought the gel could have:

- *Use the gel as protection;*
- *The gel can move on its own;*
- *Change it shape;*
- *Isolate from heat or sound;*
- *Used as moderating substance;*
- *Dust off objects or sterilize them from bacteria;*
- *Turn into a solid at impact;*

Next to the properties we have the applications:

- *Gel as a fire extinguishing medium;*
- *As an elevator or transport belt to move objects or people safely;*
- *As a plant growing material for example as a vase;*
- *As storage, not to lose things;*
- *As a medical device to sterilize tools, or transport organs;*
- *As cleaning device or garbage can;*
- *Or to be used in restaurants to preserve food;*

As easily can be seen many of the properties are in close connection with the applications we thought of. The most interesting application or idea which popped up was the idea of growing plants in gel. We discussed this idea for a long time.

This lead to 2 different ideas. One was focused on the growing of a flower or bouquet. It would be packed as a present and after a few days or weeks the surprise would grow out. It would replace the vase, and be moldable in different shapes and vary in color. Also the flowers growing out would differ. One minor thing is that flowers usually grow from a plant. In our product the flower has to grow directly out of the seed.

The other idea was an idea more focused on the mass production of goods. The idea was to use gel to grown an apple in from just the seed. With this product we could influence the growth and it would take only little space to do this. So, for example,

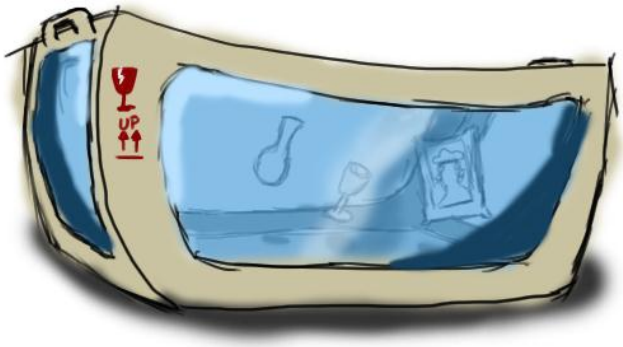
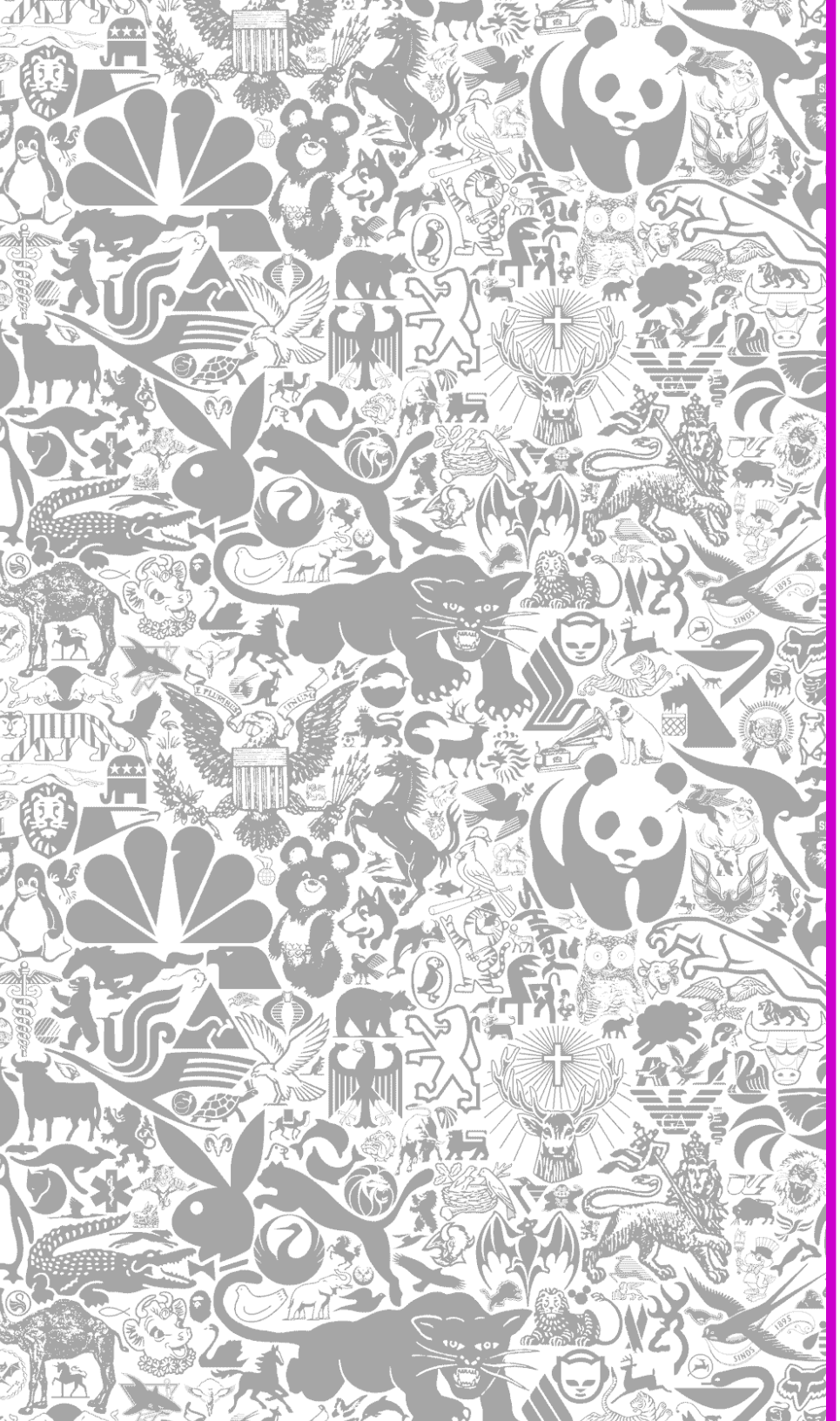


Figure 27: Gel as storage.

Figure 28: Gel as organ transportation.

Figure 29: Gel as a fire extinguishing medium.



many apples could be produced efficiently all throughout the year without the use of an apple tree.

Research

We hope to achieve growing a plant in gel. But for now we do not have the information to confirm if this is possible. So what are some of the possibilities we see but we cannot see as achievable for now. We don't know if a flower will bloom inside a gel. Is it possible to grow a fruit directly from a seed, skipping the tree and flower? Can we make the gel as porous as soil to allow enough gas exchange? Can we provide all the nutrients the plant needs? Can we make a gel tough enough is will hold its shape, without being supported? If so we see great opportunities with our concepts so far.

Though not only the technical feasibility was of our concern. Questions as: Will people like to receive a blob of gel? Do our concepts not have too many limitations in comparison with the existing industrial chain? Will the values of giving flowers change, when packed in gel? Will it be cheaper than the flower pieces you would buy today? Will people be willing to pay the same money for something which is hardly visible?

As written before, some products we already found combining gel and plants also gave some good insights and information.

So gels can be effective as it comes to growing plants. Though it doesn't cover our concepts, since in both gels the plants grows above it. The beads don't act as a whole and the plant grow gel is not firm enough. But both allow plants to grown on it so

that's positive. And the plant growing gel confirms we can add the nutrients needed for the plant.

Plants research

We want to grow plants inside a gel. The gel has so far been the main focus of our project. Now we've given, some, direction we want to go in we'll have to do some research on the other aspects as well. The growing of plants in gel was what attracted us the most. So we had to start find information on the aspect of growing plants too. What's needed for plants to grow? What are the future possibilities? What are the limitations of growing plants?

So if we start from the point of growing a few flowers from seeds inside a gel. The gel is moldable to involve the people in the process, or can have a pre molded shape (For example a toy figure or animal).

The basic needs of a plant were not new to us. Water, light, minerals and air are what plants need to grow. Plants combine carbon dioxide from the air with water from the soil in chloroplasts; add light to form glucose and oxygen. The glucose is the energy for the plant, which it uses to grow. The oxygen is diffused out of the plant and we use it to breathe. The combination of the energy from the glucose combined with the minerals the roots extract from the soil the plant stands in make the building blocks for the plants cells. Some of the minerals a plants needs are: potassium (K), calcium (Ca), nitrogen (N), phosphor (P), magnesium (Mg) and iron (Fe). [fig. 30]

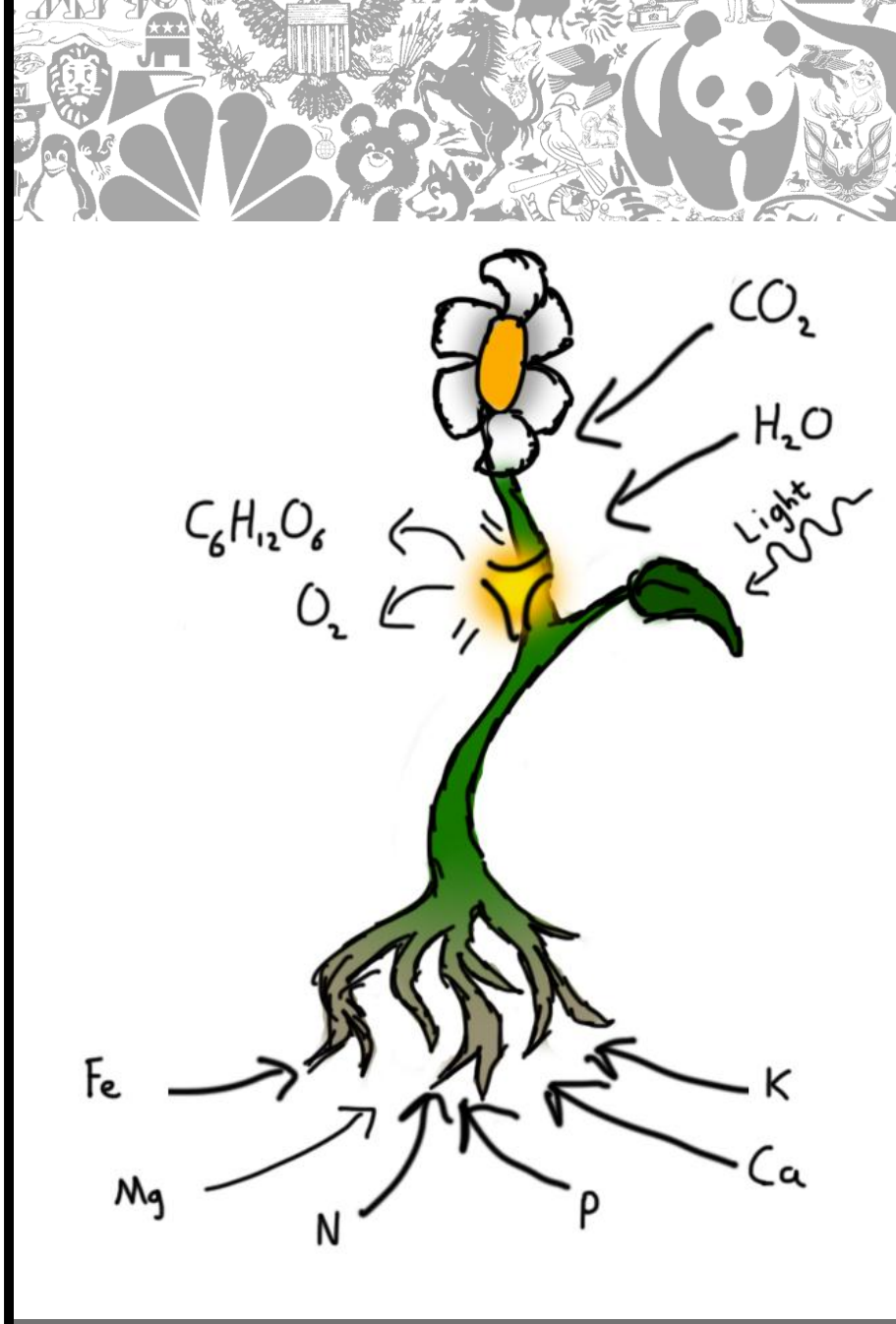


Figure 30: Requirements for a plant to grow.

Figure 31: Gel beads, balls of gel that absorb water.

Figure 32: Existing plant grow gel.

Gel research

Before illustrating the research results on gel we of course have to think of the properties the gel needs to full fill its function. So what characteristics do we need to find in our gel in order to grow plants in it and let it replace a vase or tree? The gel has to be firm and keep its shape; It has to be able to hold and pass enough water; the shape has to be flexible to some extend; light has to pass through; it has to let gasses diffuse in and out. We than could go on the hunt for gels which already exist and could be suitable for our ideas. We were not just on the hunt for gels supporting our plant idea; also we tried to find more gels which matched some of our other properties. These other gels could be interesting for future ideas and exploring the possibilities of gel.

Gel beads [fig. 31]: Small gel balls, replace water in vases for flowers. Have a decorative function since the esthetics are better than simply water, but hold enough water to provide the flowers. Also the gel balls keep the water so well it prevents it from evaporating.

Plant growing gel [fig. 32]: This gel kit is used to teach kids how plants grow. The gel is provided in different colors with nice transparent containers. The seeds provided are fast growing flowers and all nutrients are available inside the gel.

Silica gel [fig. 33]: This is the gel you find in sanitary towels and the small bags you find with for example medicines which are to be kept dry. These hard grains suck up water very well and keep it in.

Moving gel [fig. 34]: We found two very interesting gels, due to a constant chemical balance the gel could change without being influenced from the outside. One gel was in constant movement as if it was walking. The other gel kept shifting colors all the time in random order.

Figure 33: Silica gel, gel that absorbs water.

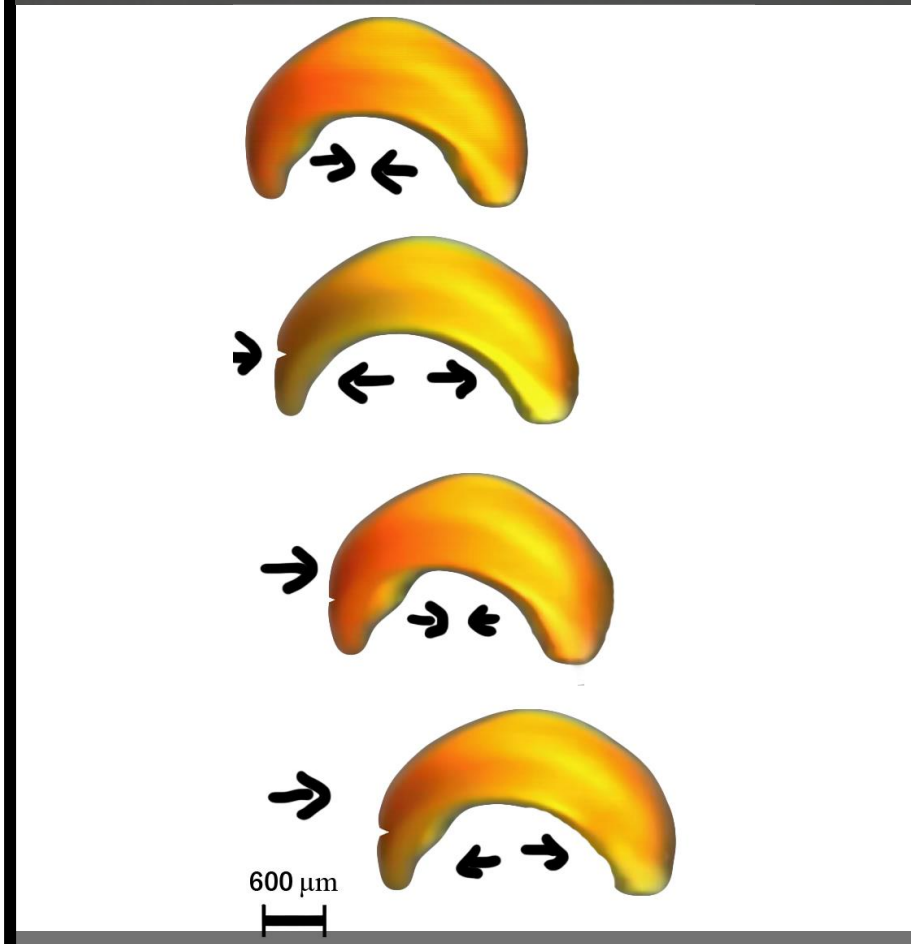


Figure 34: Self-oscillating gel, which repeats processes by itself, like moving.

Figure 35: An experiment with growing seeds in home-made gelatin.

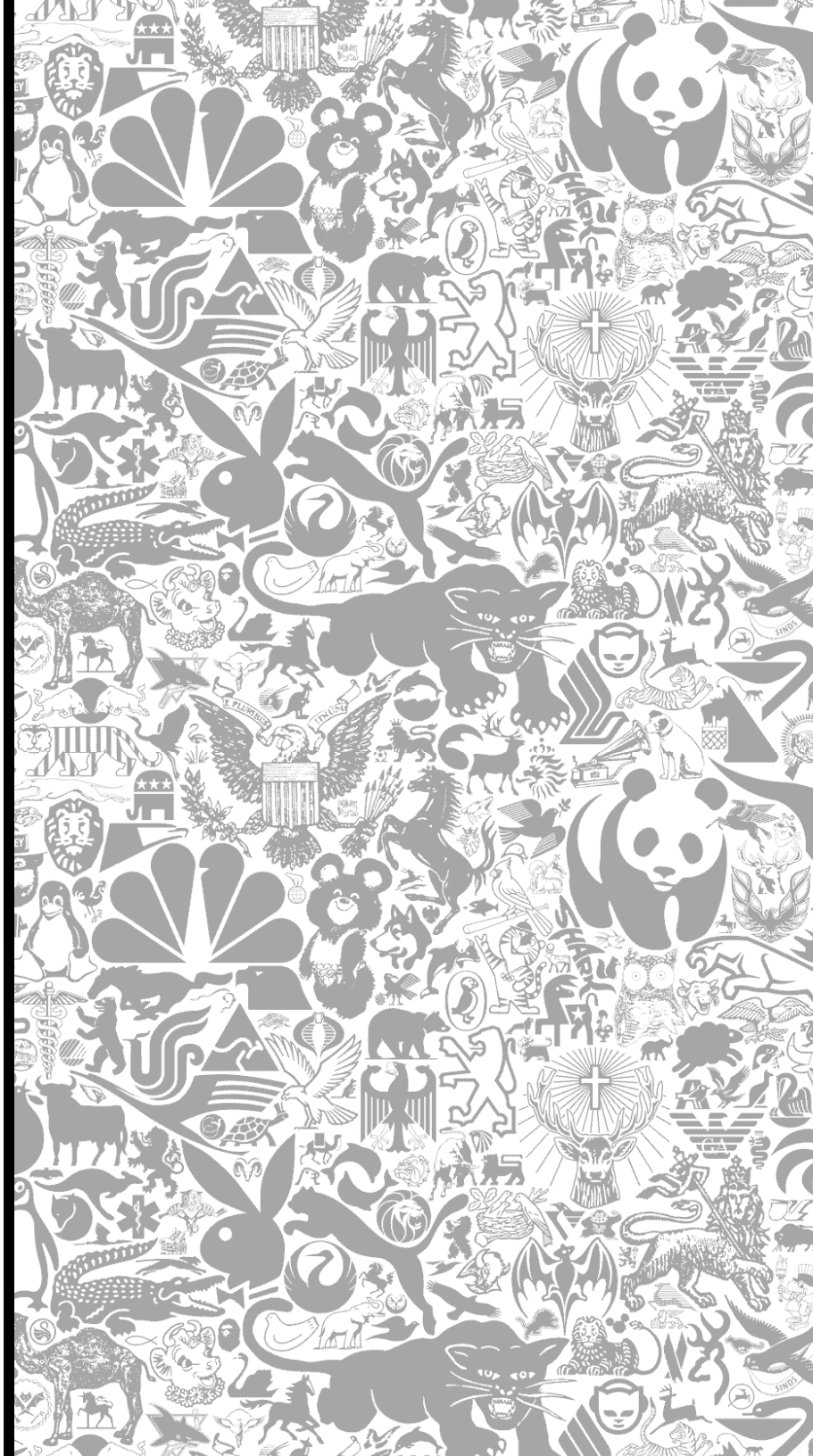
Parallel to the gel research we have been working on some other experiments as well. We set up some samples using radish and spinach seeds. We wanted to see if the seeds would be able to grow in the gelatin, which of course is also a kind of gel. Using different quantities of gelatin sheets we could influence the thickness of the gelatin. Also we did a few samples on cotton pads as a control if the seeds were still intact. By adding flower nutrient mix to half of the samples we also looked at the influence of the extra nutrients during the sprouting of the seeds. The results, which were hardly visible on the pictures [fig. 35], showed neither the thickness of the gelatin or the presence of added nutrients was of low influence.

This small experiment consisting of twelve samples was clearly aimed on the growing of plants. Also we did some field research on other gel substances. Gel you can buy in toy stores in fact. We thought of some gels we already knew and bought them, to be able to feel the gel in our hands. So we bought Silly putty, toilet gel and slime. On the internet we had seen some movies on magnetic silly putty. So we bought iron oxide and magnets and tried to achieve this to. Interesting was how the silly putty encapsulated the magnet like an amoeba its food. Also the magnet would come out perfectly clean, which was of great value for us considering the gel bag of before. We felt the different textures of the gels we bought played with them for a bit. Had a look at how they reacted under stress, how they kept in shape when laid down.

Unfortunately we didn't manage to get our silly putty magnetic. Adding some iron flakes helped. But probably our magnets weren't strong enough to attract the silly putty. There was some reaction and some force between the silly putty and magnet was to be felt. Though this force was never as strong as visible in the movies we saw.

Setting up meetings

Both to gel and plant have we been seeking information? But in both cases the information we could find during research doesn't cover all of our questions. We still don't have confirmation whether our concepts are technically feasible. So we now had to take the advice of our coach, consult experts, and do something with it. So we went on the internet searching for names, addresses, companies and universities. After having done several calls we managed to get 2 meetings which we hoped would give us the information we need. We tried a garden center, a seed inspecting company and the University of Wageningen, but ended with DPI and "Teelt de grond uit". The Dutch polymer institute would be able to help up with the gel part and "Teelt de grond uit" with the plant side of our project.



DPI meeting

As our project and ideas were growing further and taking shape it was definitely time to consult some experts. Gel is one of the main items in our concept so we had to find someone who could tell us more about gel. It happens to be that the DPI (Dutch polymer institute) is on the same terrain as our university. Polymers play an important role in artificial gel products. That we had already found out. The step to the institute was very small; at the institute we got a name, Johan Tiesnitsch. He should be able to help us further. We contacted Mr. Tiesnitsch and made an appointment.

We sent Mr. Tiesnitsch an email containing info about our project, concept and what we hoped to learn from him. Of course we had set some questions of things we wanted to know from Mr. Tiesnitsch. Firstly we wanted to know a bit more about his product, a cooling vest using gel. After that we wanted to hear some more general information about. We of course had done research into gel, but what more was there to know? What elements make a polymer? What makes a polymer a gel? And of course how does a hydrogel work? After some general information we continued with the main goal of the meeting. We wanted to know about the possibilities of gel regarding our concept.

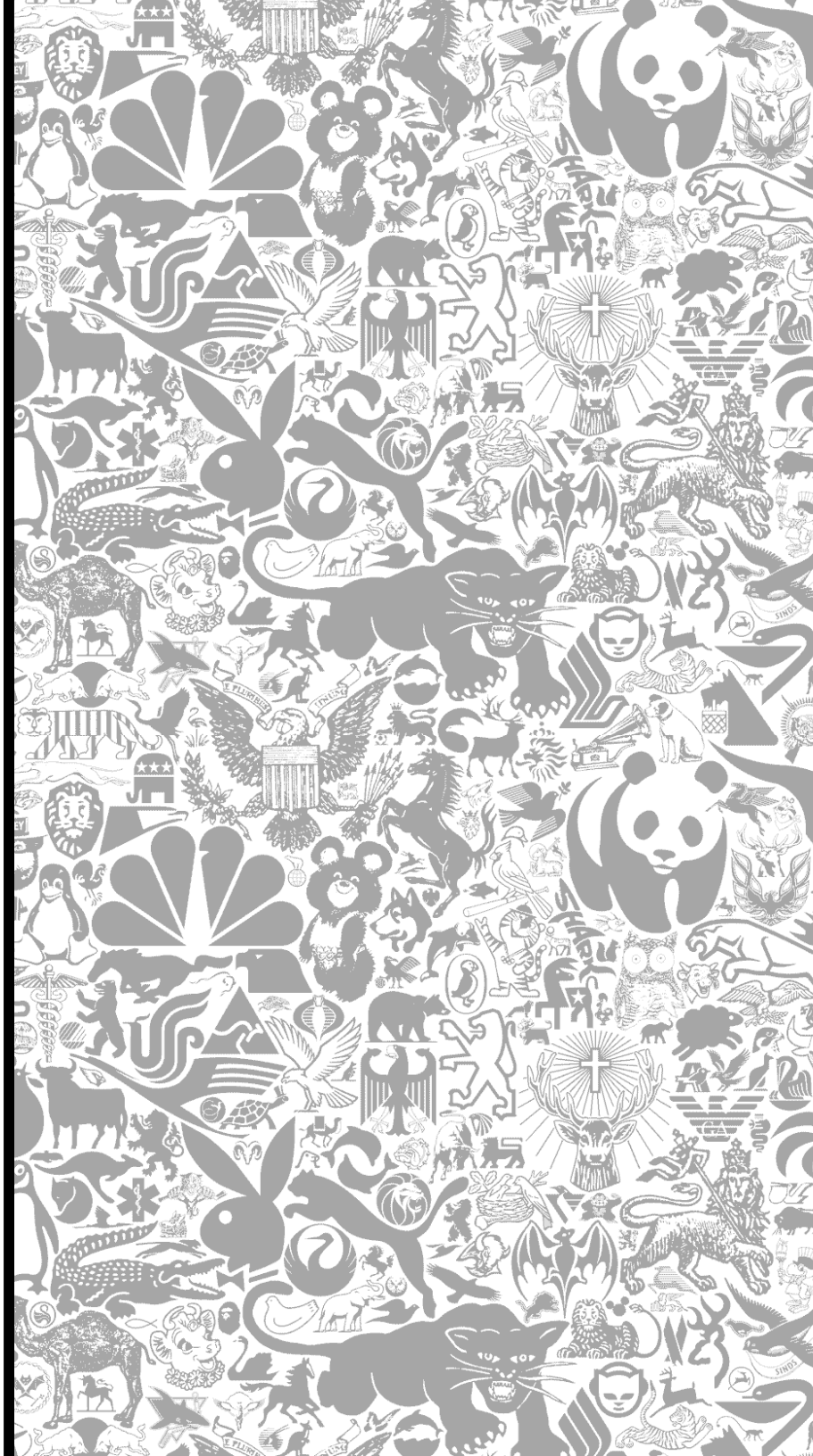
Summary DPI meeting

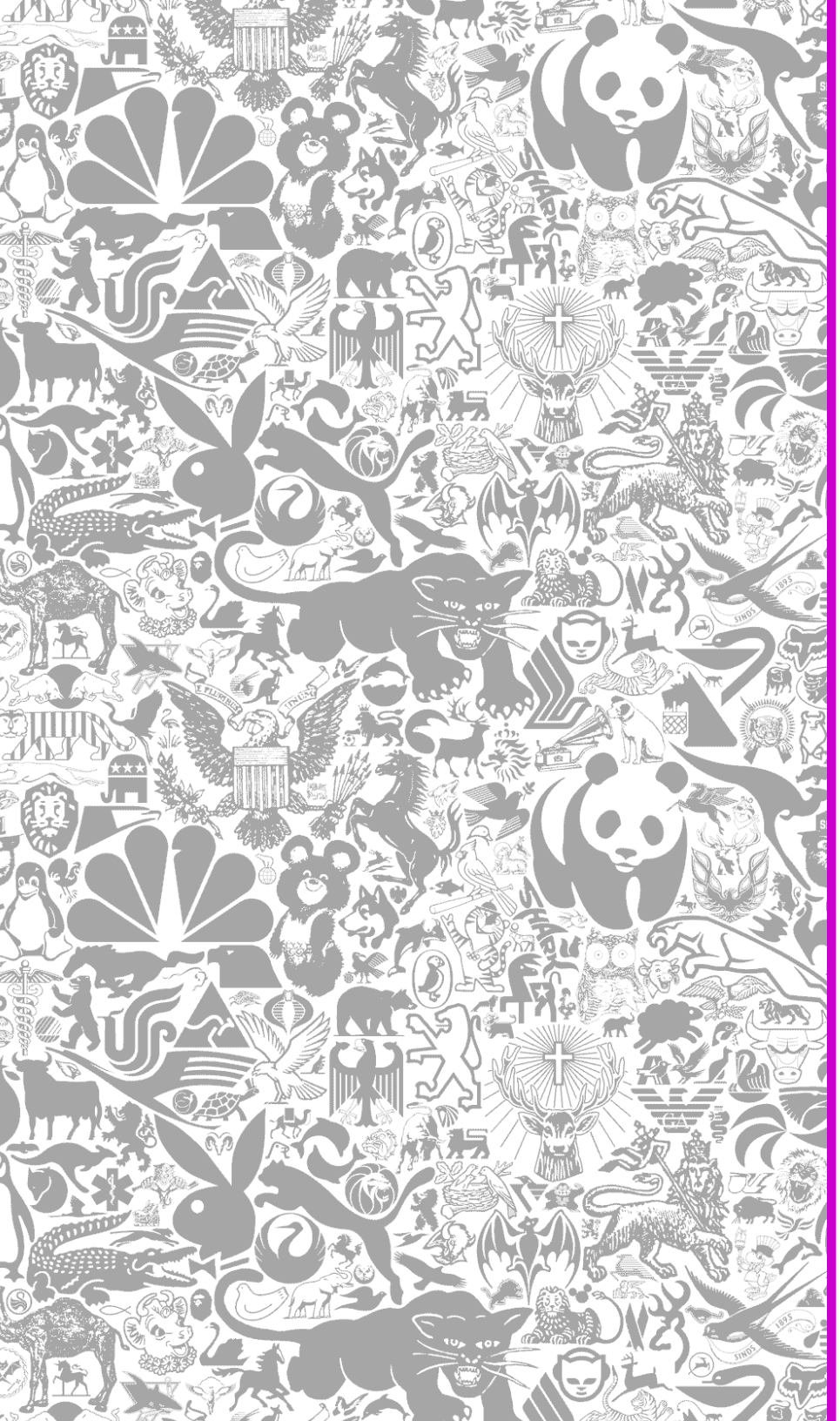
We started by introducing each other, and Mr. Tiesnitsch gave us some information on his product. He developed a gel vest which helps professional sports people to cool down faster. The unique selling point of his vest was it could be put in the freezer as well. An important property of the gel he chose it could freeze and defrost without being damaged.

After this introduction we elaborated our concept a little further than in the e-mail. So we could turn to the subject of our gel quickly. We asked about the gel beads we had seen, and he told us this was also a hydrogel. Hydrogel is according to him the gel we have to focus on for our product. A hydrogel, he told us, is a gel which can absorb water up to a 100 times its own weight. Probably cross-linked gel structures would be most ideal since these are strong and keep shape well.

Since he knew we wanted to grow plants inside the gel he addressed the salty structures of the minerals could damage the gels structure and make it fall apart. So that could be dangerous for our concepts. Then we asked the question if enough gas could reach our plant or fruit to enable it growing. He ensured us the gels structure was porous enough to let gas diffuse in and out easily. So that was good news to us.

Then, Mr. Tiesnitsch came up with an interesting fact, which could open a lot of doors. He said there are already gels which structures could be changed easily. For example with UV light hardening the outer layer of the gel, although this could damage our plant. Also with temperature differences or varying PH levels we should be able to make the gel more fluid or make it thicker. There are even gels which are hard in high temperatures and fluid with cold temperatures. Too it was possible to





use magnetic force instead of UV light, to not harm the plant, to change the structure or viscosity of the gel. He also suggested using the gels weakness. Since it can be very fluid, by shaking it up it could be possible to spread the minerals. The minerals which have been used up in certain areas, by shaking the gel these exhausted areas can be refueled with minerals. It should also be no problem to use gels with different viscosity, a harder outer layer with a more fluid gel in the center. What Mr. Tiesnitsch also mentioned was the same thing as the feedback we received at the mid-term, people might not like the feeling of gel. Many people find the feeling of gel not appealing. We told him about the use of gelatin, but he said this was a natural product and most likely to bulge out so not to ideal. **The possibilities with gel are numerous!**

The plant part of our concepts was also addressed shortly. His thoughts were that genetically modification, which we might need, is not very well accepted yet. But he saw opportunities in the roots of plants. Since some parts in the gel might be out of resources, the roots will naturally search for new sources so that was definitely an advantage.

Mr. Tiesnitsch also sent us a bag of SAP (Super absorbing polymer) too give us a feeling what the gel we would be using in the future would be like. Besides the sample he also sent us information in the form of a pdf with information on hydrogels. This article can be found in the appendix. Some benefits mentioned in this file about hydrogels: They are biocompatible, can be injected, are easy to modify, can have timed releases of nutrients. Of course the limitations are also included: They are high in costs, have very low mechanical strength, are difficult to load, can't be sterilized very well and are none adherent. Only the high costs are a limitation we have to worry about though. The bottom line is that cross-linked hydrogels have good potential for our product.

Meeting in Lisse with Kasper Slootweg

As soon we had a clear image of the ideal scenario we thought about how reasonable this was. We needed to have as much proof as possible to make this project feasible.

After we had the meeting at the DPI for some research on the gel, we went to the Dutch company 'Teelt de grond uit' in Lisse. There, we spoke with Kasper Slootweg.

We were interested in his opinions about our project, what a plant needs to survive and what the modern developments are in agriculture.

The most important points we wanted to know and confirm were what the main, essential conditions, nutrients, etc. for a plant are to survive and in which extreme conditions a plants could grow. The following info was won:

A fruit growing directly from a seed is something that may be possible in the future, mister Slootweg told us. The problem is that genetic modification, that can make this possible, is not merely accepted by the masses. Legal issues are also a problem with that. Experiments with genetic modification are often done in countries with no strict rules for that.

The main problem mister Slootweg pointed out was that a plant needs time to develop. This is a very important factor. He gave us an example of an experiment in which someone managed to grow grapes on an immature plant with the help of hormones. The plant was too young to grow grapes, but with hormones is possible to trigger the plant to grow a fruit. Though, the grapes were very bad. It proved that, in the present, simply needs enough time to develop to a mature plant to produce good fruit.

We also have to be very careful with minerals that a plant needs. They could be form a danger for the structure of the gel. Though, a plant needs a relatively very little amount of minerals to grow.

So the previous three points mean that our project is futuristic, but not absolutely unrealistic and there are lots of developments on agriculture.

Growing plants is all about the right nutrition at the right time. If we could integrate all nutrition needed (also the gasses) in the gel, a plant could theoretically grow inside of it. Mister Slootweg also pointed out that even leaves could have enough strength de grow inside the gel. Some plants do develop their fruits more easily than others. For example, a potato doesn't need a lot of complicated hormones to develop. It starts to grow right away, continuous to the plant attached to it.

It was earlier mentioned that people are scared of genetic manipulation. That is probably not the only problem with our concept. People want real products from real plants and not some perfectly formed apple that was grown inside some kind of nasty gel. But we also discussed the goal for our concept. One option is to develop this as a solution for the world's shortage of food. In that way, people would be more accepting towards the concept we think.

Figure 36: Our final concept: a plant-growing gel, for instant fruit/legume growth.

Figure 37: One of the possible scenarios for this concept: plant-growing in space.

END RESULT

The concept that we present at the final exhibition in the next nature space is a gel where plant foods can grow in [fig. 36]. The true value of the gel is to create the best efficient environment for the fruits and vegetables to grow. The gel forms an hundred percent controllable environment for the plant food. The gel can function in extreme conditions, like super cold or dry and hot surroundings.

To emphasize the possibility of these extreme conditions, we showed two locations on the exhibition posters where the gel could be placed. The first location is the surface of the moon and the other one in the desert [fig. 37]. The moon is the most futuristic one, because our gel needs to diffuse gasses with its surroundings. Considering that the moon has no atmosphere, it is impossible. The location appeals to the imagination of people, that is why we chose it. The second one is in the desert. This environment lacks many requirements of plants to grow, which the gel provides.

It is not only the gel that has special functions. The plant itself also has to be adapted for our ideal scenario. We want to get rid of the plants and trees. It would be desirable to create fruits and vegetables directly from a seed. The seed is implemented in the gel, germinates and grows, for example, an apple. Nutrition like water and minerals is transported to the apple by a little network of roots.

The posters of the final exhibition are included in the appendix, section **[B]**.

OVERALL TEAMWORK REFLECTION

We formed a good team overall this project. A great advantage is that we came along with each other very well and there weren't any complicated conflicts. So the good thing was that we had a smooth cooperation and no people stopping their study.

We had two workshops about teamwork. In the first one we were given some tips and techniques to have a proper meeting with good planning, goals and a satisfying result. We almost never had some kind of written out agenda for our meetings, but because we were a motivated team and naturally working together pretty well, that wasn't an issue. We had a lot of discussions and brainstorms that were useful for our creative process.

In our second teamwork workshop, we had a little meeting that was analyzed by the workshop coach. We had to have a meeting like any other and we discussed about what direction we would go next considering the project. We received quite positive feedback as a group on the meeting. Everyone had room and time to express their opinions and important, useful things were written down. The only negative thing mentioned is that we sometimes drift away from the subject a little. This was recognizable feedback, because we experienced that sometimes during the project. It is easy to drift away from the subject. It is not always a bad thing because it's good for the team spirit to have some fun and inspiration can come from anything. We split tasks as much as we could. That worked very well, especially before the interim and final exhibition when we had lots of things to do. Concluding, we simply were a good functioning, motivated team and we did not experience big problems.

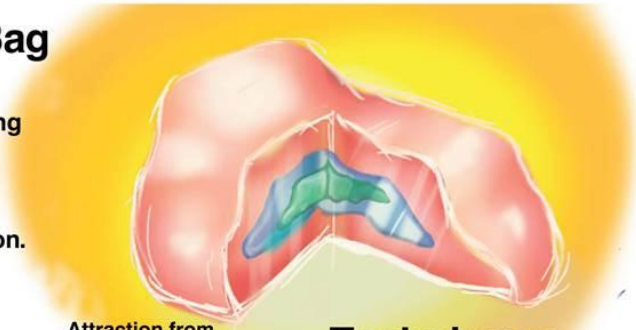
APPENDIX

[A] – Posters Interim Exhibition

NEXT NATURE

Concept Jelly Bag

In a blink of an eye knowing what
is in your bag.
put things in and taking them out from any direction.
Drag things on their place just where you want them. All in your little world. But is this world realy so small...



Attraction from the inside

Techniques

Working with attraction on a scale, or a membrane.

Clean worksurroundings

Transport

Hygiene

Profecional Aims

Aplications

The normal human

Student: Tom Slijkhuis, Jeroen Rood, Ruud v. Reijmersdal, Joppe Spaans B1.1
Coached by: Flip Ziedses des Plantes

NEXT NATURE

Adaptive & Informative Skin

Air quality wallpaper

This wallpaper adapts it's color to the air quality. It's inspired by the withering of plants. The less oxygen the room contains, the more the wallpaper "withers".

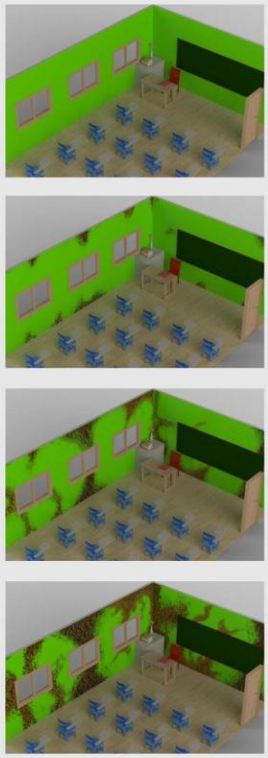
Possibilities

It is most suitable for public spaces like classrooms, gyms or offices. Moreover, it could be used in study rooms.

Techniques

E-Ink technology could be used for projection on the wall. It has some advantages compared to LCD-screens. It's less energy-consuming, and it doesn't use backlight. This way the wallpaper acts like real paper, and on the long run isn't annoying to look at.

From good air quality in the classroom...

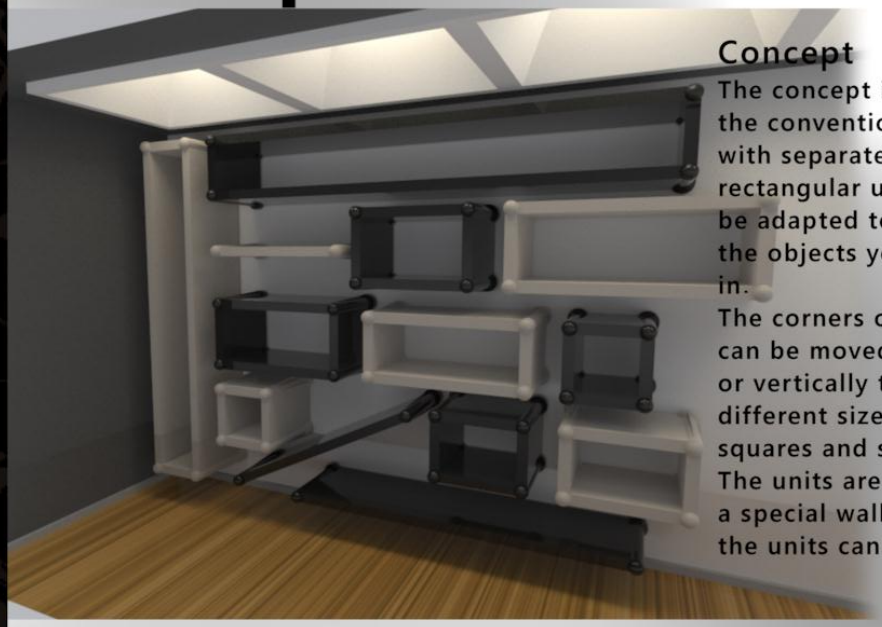


...to bad air quality in the classroom.

Student: Tom Slijkhuis, Jeroen Rood, Ruud v. Reijmersdal, Joppe Spaans B1.1
Coached by: Flip Ziedses des Plantes

NEXT NATURE

Adaptive cabinet



Concept

The concept is to replace the conventional cabinet with separate square or rectangular units that can be adapted to the shapes of the objects you want to put in.
The corners of these units can be moved horizontally or vertically to create different sized rectangles, squares and shelves.
The units are attatched to a special wall over where the units can be shifted.

Adapt the cabinet to your needs...

TALL

SQUARE

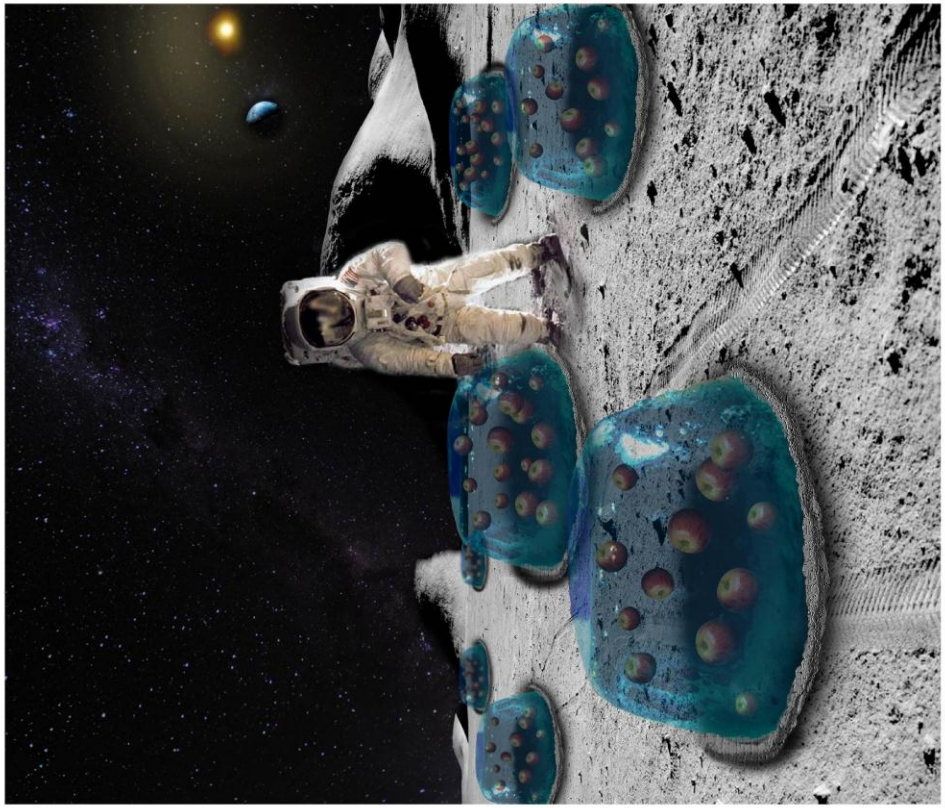
WIDE

Student: Tom Slijkhuis, Jeroen Rood, Ruud van Reijmersdal, Joppe Spaans
Coached by: Flip Ziedses des Plantes

[B] – Posters Final Exhibition

NEXT NATURE

Plant-growing Gel



Growing plants in space

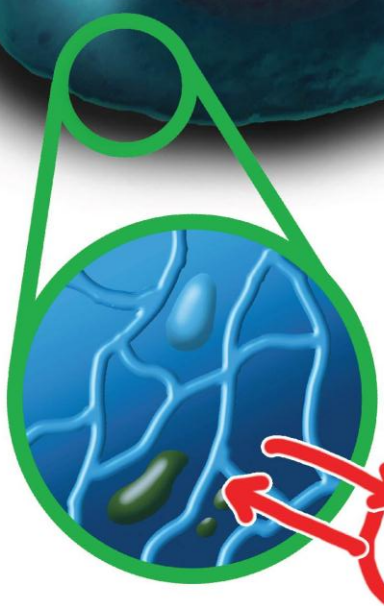
Students: Jeroen Rood, Joppe Spaans, Ruud van Reijmersdal, Tom Slijkhuis. B1.1
Coach: Flip Ziedses des Plantes

NEXT NATURE

Plant-growing Gel

The **growing process** of plants is able to be **accelerated**, and it's possible to grow fruits and vergetables way earlier and faster. In the **future**, it will be possible to **grow fruit instantly from a seed.**

The gel is able to fullfil the plant's needs, as it **can hold water, nutritions and diffused gasses.**
It also can absorb even more when dehydrated.



A gel that meets most of the requirements, is **polyacrilic acid**, this has a **cross-linked** structure. It can absorb and store (extra) nutritions and water as well as ventilate diffused gasses.

Water
Nutritions
Air

Students: Jeroen Rood, Joppe Spaans, Ruud van Reijmersdal, Tom Slijkhuis. B1.1
Coach: Flip Ziedses des Plantes

NEXT NATURE

Plant-growing Gel

Growing plants in the desert

Students: Jeroen Rood, Joppe Spaans, Ruud van Reijmersdal, Tom Slijkhuis. B1.1
Coach: Flip Ziedses des Plantes


SMOKEY
SHARK
E PLURIBUS
UNUM
SINDS
1895
SMOKEY