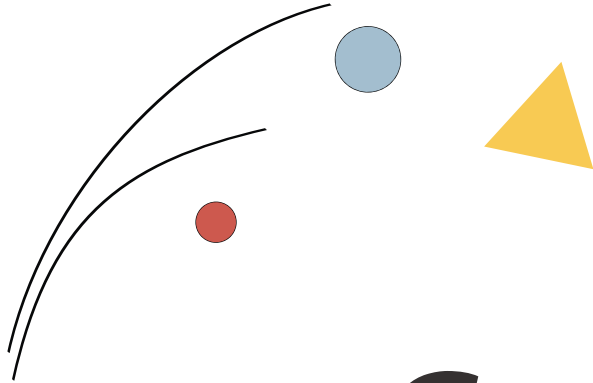


An abstract graphic featuring two curved black lines, a small red circle, a light blue circle, and a yellow triangle, arranged in a semi-circular pattern above the word 'Life'.

# Life

Inspired by Kandinsky

Name: Hanneke Keetlaer

Pathway/year: EMMA DMD, 2007 - 2008

Supervisors: Henk Fakkeldij, Martin Lacet

# ENGLISH SUMMARY

This is the thesis of me, Hanneke Keetlaer. I am an EMMA DMD student at the Utrecht School of Arts, in the year of 2007-2008.

I have been working on the creation of a responsive painting, that would respond to its surroundings. The painting will build a virtual landscape based on a camera feed of the room it is in. In this landscape live virtual creatures, which will have to evolve to survive the changing land.

For my research, I started with the following question:

*How to create a responsive painting that would respond to the public through evolutionary patterns?*

I have found answers to this in genetics, and the art and theories of Wassily Kandinsky. In short:

*The painting will consist of a virtual landscape, which is based on a camera view of its surroundings. In this landscape, a species of virtual creatures will have to survive. The ability of the creatures to survive is based in nature's own ways, and through natural selection, hopefully a strong species will develop. The design of the painting will be based on Kandinsky's art and theories.*

My thesis is written in the form of a weblog, because I found that more appropriate since this project felt as an adventure to me. My supervisor agreed on this. Even though a weblog differs greatly from a normal thesis, I think it worked very well to convey the results of my research, even though I did have a little trouble with it along the way.

# NOTES ON THE CONVERSION FROM A WEBLOG

My thesis has been written as a weblog, therefore it is not structured like a normal thesis. A weblog is structured in posts, which each contain a small part of my research, or perhaps information only loosely related. Also, they contain some information of work I've done for other people (or what they've done for me).

As the posts are written in the order that I've conducted my research, it so happens that different subject intersperse each other. Entries on a similar subject can be grouped together by the means of categories. When the entries are viewed on-line, this is very easy: one click on a category name and the posts are grouped together. On paper, this is obviously not the case.

Also, posts may contain moving images, or even, in one case, an interactive applet. Where this is the case, I have supplied different screenshots and a reference to the supplied CD with examples.

Last, but not least, I have corrected many minor errors when I was laying out my thesis for publishing on paper. I will try to update my weblog as well, but I might overlook some. While I do recommend visiting my weblog if you are missing some of the features in the off-line version, it might contain a few more mistakes.

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# INTRODUCTION

I am Hanneke Keetlaer, a Digital Media graduate student at the Utrecht School of Arts in the Netherlands.

I'd like to work with interaction with groups of people especially in the public space, as well as smaller scale installations for promotional use. I like to work with displays and real time image manipulation. I'd like to work with interaction with groups of people especially in the public space, as well as smaller scale installations for promotional use. I like to work with displays and real time image manipulation.

For my graduation project, I will be developing a responsive painting. While conducting my research and experimenting with various possibilities, I will post about it on this weblog, which doubles as my master's thesis.

## **Responsive painting**

---

I had a little trouble starting of in the right direction. After a few tries, about which you can read in the first few posts, I started on a new project using the key ingredient from my former concepts.

My key ingredient is the use of (virtual) genetics to create something that would evolve due to interaction with the public. I decided to build a painting that would build a landscape based on its real world surroundings. I will use a camera for that, because of its accessibility (low price) and my previous experience with using camera feeds in installations. These surroundings include the beholders of the painting, so this landscape would alter itself as people come and go. In this landscape, creatures would live and have to evolve to be able to survive their land.

Research question

In order to create my painting I formulated the following research question:

*How to create a responsive painting that would respond to the public trough evolutionary patterns?*

Then, I split this in the following sub questions:

*How do genes work, and how can I make them work in my painting?*

*What will it look like?*

*How can I convert the painting's surroundings to a landscape?  
(Or: how will the interaction work?)*

I will research genetic make-up and how this is used in evolution. Also, I will make a motivated choice as to what my painting should look like, so there's a reason behind every element of it. Lastly, I will experiment with cameras (which register the space in front of the painting), and how to create a landscape from that.

Weblog = Thesis?

Yes. As of this year, at our school it is now possible to write your thesis in any form you want. Most still opt for a traditional thesis, but if you want you can, for example, create an interactive DVD or a comic. Of course, it does have to communicate what you want to tell, and you'll need to have a motivation as to why exactly you want to deviate from the traditional path.

My motivation for writing a weblog is that I see this project more of an adventure than anything else. I am trying to express myself, and along the way I will discover the means to do so. My supervisor agreed, and so here it is.

This 'Thesis in a weblog'-thing is quite a new experience: not only for me but also for the supervisors. There are quite a few differences.

First and foremost is the organization of the data: contrary to a normal thesis where related subjects are grouped together, they will be spread out over time, and mixed with other information. Categories are used to group related subjects, but this is not as clear a distinction as in a normal thesis. You can click on the name of a category name to see the entries in it. Some entries fit in multiple categories.

Second, information is spread out over more 'chapters' than would normally be the case, because information is not grouped afterwards.

Third is that the text is much less informal on a weblog. It is written from a more personal point of view, and besides mentioning the results of the research the weblogger has more freedom to express his own feelings. Perhaps even an (attempt at a) joke...

Lastly, a weblog is much more interactive. Not necessarily with the visitors (I choose to disable the possibility of comments), but links to other websites may be added, movies can be shown and interactive applets may enlighten the experience.

# HELLO WORLD!

**MAY 19TH, 2008**

**TAGS: CONCEPT DESIGN**

So... here goes. The very first post on my brand new weblog. If you haven't read the introduction-page, please do. It contains some very useful background information on my project, so you'll at least have some clue about what's going on in the first place.

In this first post, I will tell you what my motivations for creating this art piece are.

First, I have a certain fascination for interactive art in the public space — because you don't see it very often. I think interactive art is a great way to entertain people, but most of it is reserved for art festivals. Those festivals aren't usually visited by the general public and so a large part of the population is excluded from the joy of interactive art. I see it as one of my duties to bring interactive art to the general public — and where better to start than the public space?

Secondly, there is furniture. Although I cannot assert why, I have always wanted to do an interactive art piece with furniture. More exactly, I want a piece of furniture that grows and develops and lives in your home, just like you do yourself.

Lastly, I wanted to create an interactive experience for a group of people — not just one on one. Although the latter can certainly be most satisfying, especially in the public space I want to do more.

With my concept, I think I did a very well job combining those three. Of course I have done some compromising (it is not exactly a piece of furniture like one would normally expect, for example, or one can argue that a part of the interaction does take place in a one-on-one situation). But I am very happy with it, and I hope this journey proves satisfying.

# PROCESS

MAY 22ND, 2008  
TAGS: CONCEPT DESIGN

I think that, as an introduction, I should now tell you a little something about my design process. Where it all started, where I've been and where I stand now.

## Starting out

---

At first, I started out with having to choose between two of my interests: create an art piece for the public space, or create a piece of interactive furniture.

I didn't really know what to do in the public space, except that it had to be something that affected more than one person at a time (you can see my third motivation mentioned in my previous post surfacing here). Was it going to be something for the 'village pump', a hangout, or perhaps a performance? I didn't know.

On the other hand, I had a pretty clear idea what I wanted to do with furniture: to create a piece of furniture that lives, that evolves based on how you use it. But I really (really!) wanted to do something in the public space as well. Then it struck me: I would create a piece of furniture in the public space that would evolve.

Out of the many choices of street furniture available (lamp posts, waste containers, et cetera) I settled with a bench, or a chair, because that has a strong link with the original (domestic) furniture I wanted to work with.

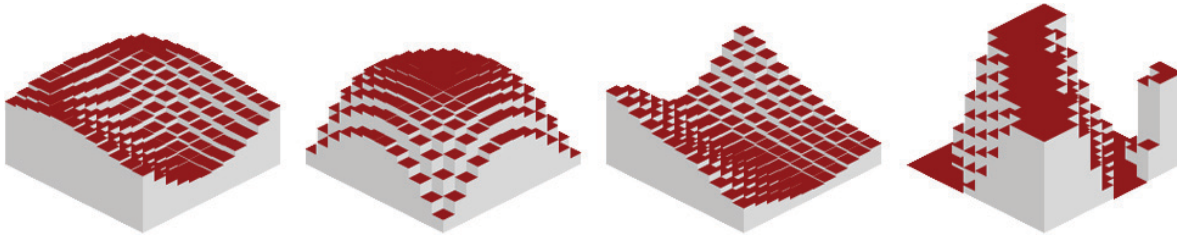
## Transformation

---

Happy as I was with this breakthrough, I started to research techniques to give the chair an ability to transform. Of course, it will be very interesting to put a big lump of clay on the town square and see how it will (under the careful hands of the public) transform, or evolve, in something the public would find the most useful shape. It could end up in hundred little lumps of clay in as many homes, but perhaps people would shape it into a very comfortable resting place.

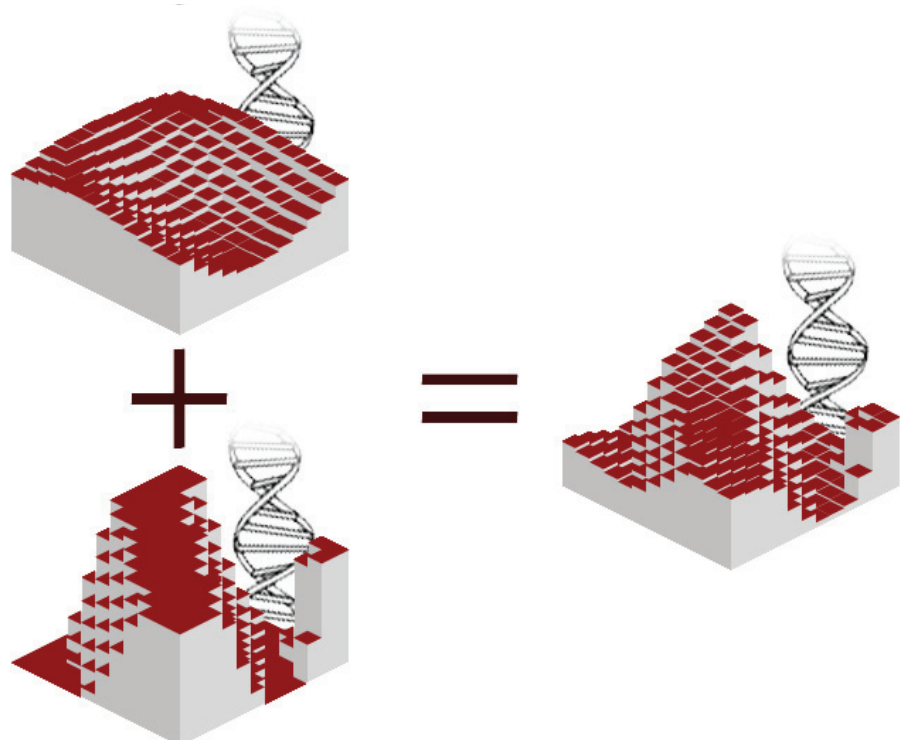
While I found this idea exciting, I did have a few considerations. Foremost, it doesn't have the slightest link with my graduation pathway (which is Digital Media Design). Second, I was more interested in a kind of more biological evolution — e.g. chairs having 'genes' and 'mating' to create offspring.

I set out to search for a way to deform an apparently solid block (or lump) of matter, initiated by some mechanics from the inside rather than hands from the outside. This appeared not as easy as it sounds (as I had expected) so I had to devise my own system. I settled with a number of columns which can move up and down and thus has a (limited) ability to carve a shape out of what would otherwise be just a block.



The heights of the columns will be determined by a set of genes (how exactly these genes will describe the shape is the main focus of my theoretical research). Based on how successful a set of genes is, these genes will have higher survival rates when the 'mating algorithms' will be applied.

I wanted to place several of the chairs in one location, and have them automatically transform when not in use. Shapes that will be used more often and for longer times would have more success and thus a higher survival rate. To speed up this process and to help communicate the idea behind the installation, I decided to include a device that would allow the user to choose from a number of shapes (higher survival rate for chosen shapes), and that would tell him or her about the concept.



## Interaction

Because I am an avid reader, I generally associate chairs with a nice place to read (be it a book, newspaper or the latest news on my cell phone). This inspired me to use an e-book reader as input device for the chair. E-book readers are electronic devices to read texts with paper-like displays, which make them easy to read. When a user would have chosen a shape for the chair and sit down, he or she could use the reader to find out more about the project, read the latest news or choose from a variety of books included on the device.

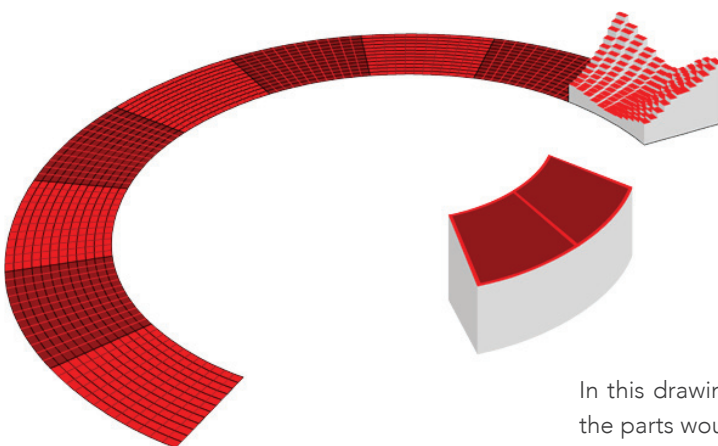


## A Change

Even though you've read a lot about the chair here, I never was totally satisfied with the general 'chair' idea. It posed several difficulties, most importantly the shape: it wouldn't always be chair-shaped. It even would be more than likely not to be shaped like a chair and it would perhaps (literally) take centuries for chairs to be the dominant shape. I imagine I could coax the genes into chair-like shapes, but I also don't want them to lose too much freedom.

It is not a chair

I realised I was designing an art piece, rather than a chair. I wanted people to get curious about it (but give them a means to satisfy that feeling), and to have the public interact with it — not just one on one, but as a group.



Since I wanted to involve the public, get it more social, I devised a new shape for my installation. It will form a bit more than half the perimeter of a circle, at least a few metres in diameter. It would still consist of the columns to have it change its vertical shape. It will be divided in as many as eight or nine sections of the same shape, which will each have its own set of genes and thus will, more or less, act like the chairs in the previous concept.

In this drawing, I have only shaped the rightmost part; shaping all the parts would be a bit too time-consuming.

At a central spot, a large input device will be placed. This will consist of one or more touch screens, and give the public the ability to change the shape of the installation. A user can change a section to pick one of his/her liking and then try it out. Of course, this will also serve as a means of giving information. Because the shape will take up a large space and will almost constantly be moving it will have an effect on almost everybody near it. Also, because of its shape, people can either sit on the inside of the circle (and hence be more social) or on the outside (and exclude himself).

# AND SO MY EXAM PASSED

**JUNE 13TH, 2008**

**TAGS: META**

It is already two weeks since, but I passed my MOCK exam, if only with an 'orange' star and not a 'green' one. This means that the exam board thinks I will pass my final exam, but that they're not completely convinced.

They rightly pointed out that my project had widened a lot over the past period, and that it had become way to complex. It was not all bad, of course, for they were very enthusiastic about the idea of using the genetic algorithms to create a responsive art piece. We decided that I should take a small piece of the complete project and focus thereon.

Naturally, I decided to go with the genetic part, since both my supervisors and I think that is the most interesting part. The last two weeks were spent designing a new and better to handle concept around this idea.

# RESPONSIVE PAINTING

JUNE 25TH, 2008

TAGS: CONCEPT DESIGN

With my old concept in the trash bin, I had to come up with something new. After a week of discussing ideas with friends, I decided to build a responsive painting.

The painting would be inhabited by virtual organisms, the canvas a virtual world. In this world they would live, go forth and multiply. Based on their part of the world, the environment they live in, is their chance of survival. Some of the organisms would survive better in an environment 'type a', whereas some would do better in a 'type b' and so on. Others might perhaps do better in both, or they might just perish in a second upon entering a part of the world with a certain type of environment.

The world they live in would change through changes in the public. How exactly wasn't clear at this point yet (it is now, but it has another place in this story). Because of this, the world will be dynamic and therefore the chances of survival for these organisms will change continuously, forcing them to adapt to their ever-changing world — or perish and never be seen again.



# UPDATE SCHEDULE

**JUNE 25TH, 2008**

**TAGS: META**

As you might have noticed, I am having a little trouble keeping a regular updating schedule. It's not that there's nothing to tell: there's loads of stuff I've been doing. It's just...

Well, first: I find it hard to put ideas into words. When I try to explain my concept to someone, I'm easily babbling on and on, and never getting to the point. So, just sitting down and write about it all... it takes a whole lot of courage. A 'traditional' thesis would most certainly have been easier, because then you would sit down, get into it and write for days at a stretch. However, it wouldn't be half as interesting!

Secondly: a weblog doesn't seem that important. See, there's always something to be done. If it's not reading about genes and all the funny words that go with them, trying to sketch a new idea or building prototypes it's just plain work. All that seems massively more important than just a weblog. And, frankly, it is. The point is: this weblog is not just a weblog. It is my thesis, which is bloody well important. Somehow, my subconscious mind hasn't quite grasped the importance of that yet, and it keeps steering me away, perhaps partly because I find it hard to start (see the first point).

If I do not guide myself away from this dangerous course of action, things may very well become very problematic, however, I hope that, as of now, I'm still in time to keep myself from rolling over the cliff. I will now dedicate at least two afternoons a week on writing in my weblog: Tuesday and Friday afternoon. Of course, if it becomes necessary I will increase this interval.

# FRIDAY

**JUNE 27TH, 2008**

**TAGS: META**

So today it's Friday and I should update. Too bad I only have a few pieces which do not qualify for a post, and I have to do some preparations for tomorrow, when my parents will come over and help me getting all sort of things done (like fixing the leak in my roof). Tomorrow, of course, will be a very busy day as well, so I hope I'll be able to update coming Sunday.

**Update Sunday, 20:06:**

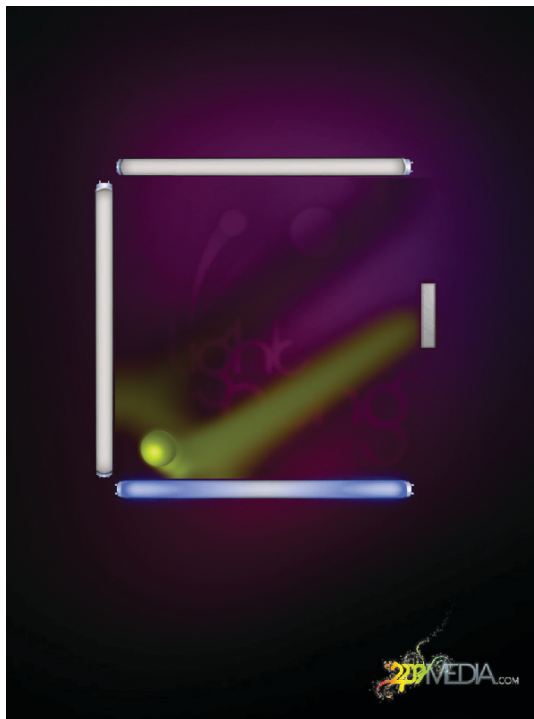
Yesterday I started reinstalling two of our PCs but it didn't go as swiftly as I had hoped. I knew I wouldn't finish it then, but I had hoped to finish it early this afternoon. As it stands, I will finish tonight but I don't think I'll write my post today. So much for an update schedule... but at least I've got a valid reason for not keeping to it ;).

# UPDATES!

**JULY 3RD, 2008**

**TAGS: META, OTHER PROJECTS**

Hello there. Things worked out a lot worse than I had hoped, so it's Tuesday now and up until now I haven't had the opportunity to write. Firstly, I only finished the computer business yesterday morning. Secondly, I am helping my friend Patrick [1] with the technical details on his project and he needed a prototype this Wednesday.



His project is way more complex than this, but for this time, we smacked together a version of 'single player Pong', called Light Pong for the moment. The user can control the paddle by moving anything that lights up, like a cell phone screen or a lighter, in front of the screen.

Anyway, I'm now on the way to a friend's house, and that's over an hour with the train. Time enough to write a little update at the least. I do not have pretty pictures to post, but I'll have them Thursday, so then I'll update.

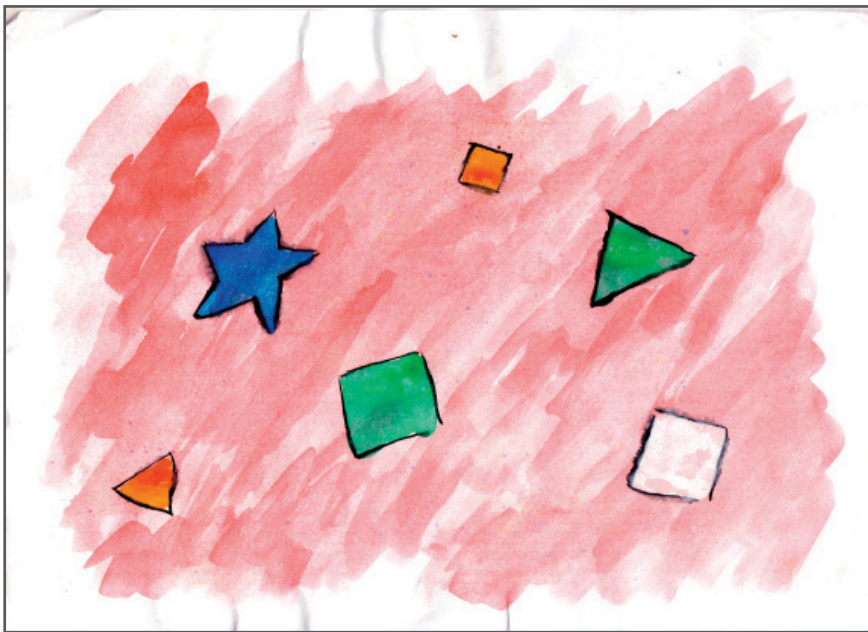
[1] Patrick Boshuis. See his homepage at <http://emma.starsdesign.net>

# CONCEPTS

JULY 3RD, 2008

TAGS: CONCEPT DESIGN

In this posts and the next few, I will tell you about my concept and about how it came to be.



One of my earlier design sketches featured a sort of primeordial sea, in which virtual organisms float around. The organisms had very primal shapes like circles and squares, to emphasize their very own primality.

I would start out with a random population of coloured shapes. The idea was that they could 'mate' with each other, and from that co-operation a new organism would come into existence, combining several properties from its parents. These properties include shape and colour, as well as attraction to (or repulsion from) certain (combinations of) colours and shapes.

The virtual temperature of their sea will be influenced by the number of people looking at the painting: the more people, the warmer it would get. Low temperatures would kill the organisms whereas with high temperatures life would come to fruition. Because of this, I hoped, the organisms in the painting would evolve in such a way that it would attract more viewers: if the image is interesting, more people would look and the more successful the organisms currently on view would be in surviving. However, thinking it over with friends, we concluded that, whilst interesting in its simplicity, statistically it wouldn't work.

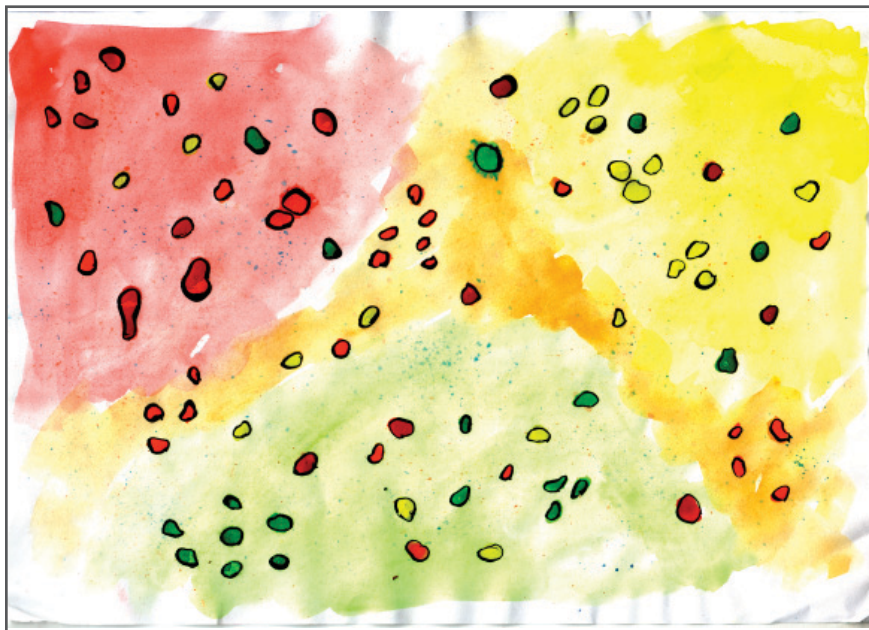
There is a certain distribution of organisms in the starting population. Then, whether the population would grow or die out, this distribution would stay the same, because the chances of survival are exactly the same for each organism. Because of this mechanism, there would statistically be no differentiation, and thus the whole process would be useless.

# MORE DIFFERENTIATION

JULY 3RD, 2008

TAGS: CONCEPT DESIGN

This is another design sketch.



Instead of the primeordial sea in the concept posted earlier, this painting includes a colourful landscape. The organisms still show an affinity with a certain colour, but this time it's not towards the colour of their fellows, but the colour of the landscape. The landscape is this time based on the beholders of the painting: a camera registers an image of them and then the colours will be extracted from that image. With these colours the landscape is rebuilt every several seconds or so, so it will change continuously.

This time, there will be different survival rates for different organisms, so hopefully they will evolve to an 'all-round survivor' which is able to survive on different landscapes.

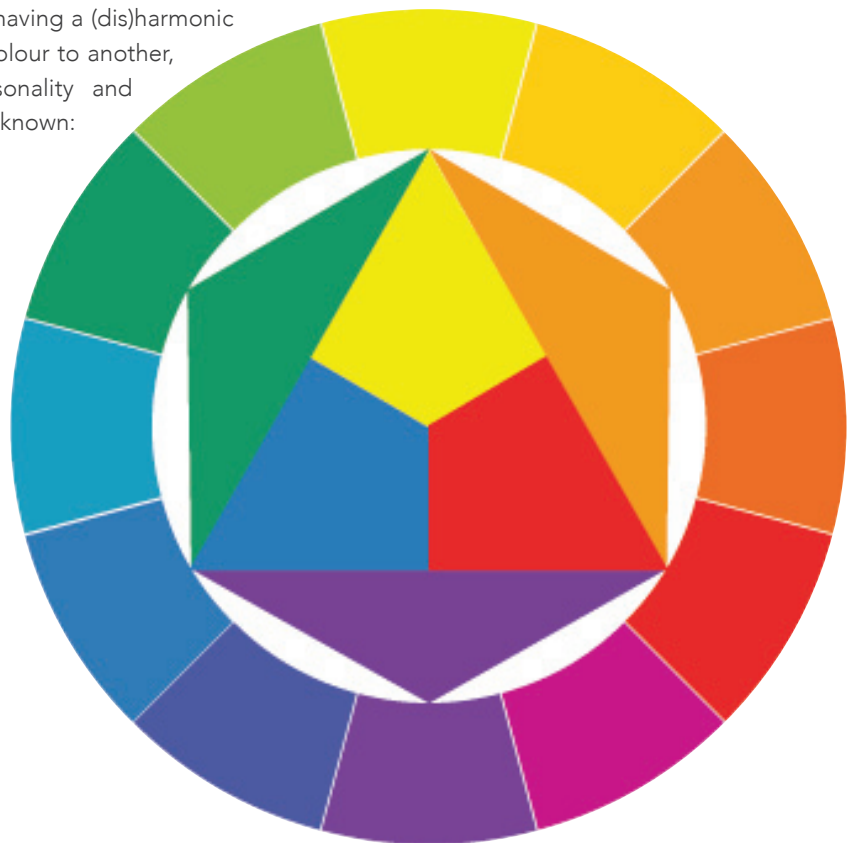
# BAUHAUS INSPIRATION

JULY 4TH, 2008

TAGS: CONCEPT DESIGN, DESIGN

In the first design sketch posted earlier, the organisms to populate my painting had very basic shapes and colours. I liked that very much, so I began looking into the Bauhaus style for inspiration. Bauhaus is one of my favourite art styles, so it would be nice if I could use some Bauhaus influences in my work and add my own touch to it.

Especially Johannes Itten has some very interesting theories on the relations between colour, described in his book *The Art of Color*. It's all about colours forming chords and having a (dis)harmonic relationship. Also there's the effect of a colour to another, the linkage between colour and personality and whatnot. I think his farbkreis is rather well known:



# MORE BAUHAUS

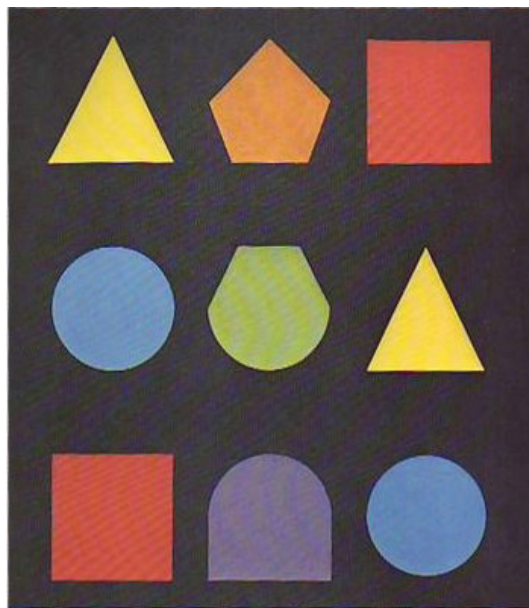
JULY 8TH, 2008

TAGS: DESIGN

A second Bauhaus artist I looked at is Wassily Kandinsky. Though not limited to Bauhaus, I admire his powerful and rich art. He also has this theories on the relation between shape and colour that are very interesting for my own project. The media library at our faculty doesn't sport a book on the man, but as always the internet has a lot of information available.

## Shapes

While I am familiar with his work, I learned a about (a few of) his design theories. Especially a blog post by a certain Uncle Eddie is interesting [2]. Firstly, there's the relation between shape and colour:



Kandinsky associates certain shapes with certain colour: a triangle, pointy and fierce, should be painted yellow, a circle is better off with something dull like blue (dull as in 'not bright', not as in 'boring'), and the square gets something in between: red. When shapes get mixed, so do their colours.

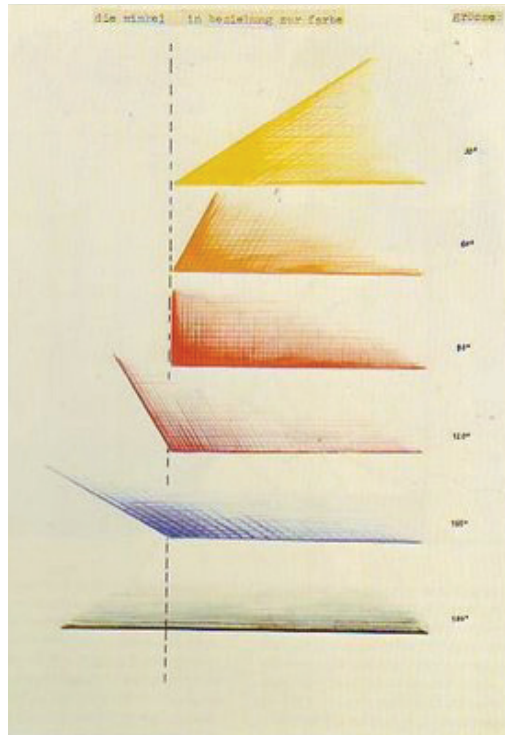
I think a lot also depends on how you define the way the shapes get mixed. For example, a star with 5 points, which colour should that get? Something between the triangle and the pentagon? But it is arguably pointier than a triangle, and I would say it should be more yellow than the triangle for that. I wonder what Kandinsky can tell about that. Somehow, I imagine me taking another trip to the library real soon ;).

[2] <http://uncleeddiestheorycorner.blogspot.com/2007/04/kandinskys-color-theories.html>



## Lines

He doesn't stop at shapes. He also colours lines depending on the angle they're making. There is the angle compared to the border of the canvas, of course, but what I find even more interesting is the angle in the line itself:

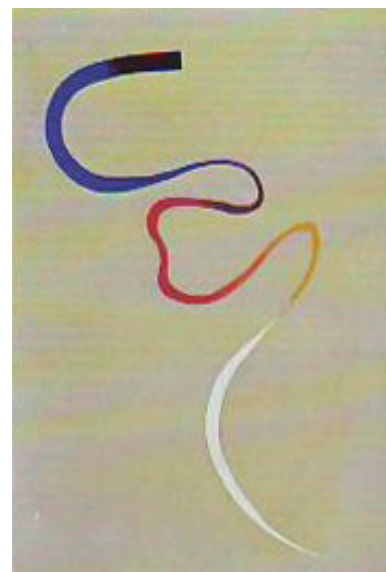


I think this graphic speaks more or less for itself: the duller the angle gets, the duller the colour of the line. This theory is somewhat illustrated in the graphic to the left.

It's not completely correct if you follow the examples above (for example, the second twist from above, the dark purple one, is about as sharp as the yellow one, but it isn't yellow).

Anyway, the curves got me thinking. How cool would it be, I thought, if I could add curved lines to my painting, and have them coloured based on this theory? And not just coloured and curved lines... no, moving lines, as well. Continuously changing shape and colour... I don't know about you, but I think it would be awesome. I'll have to put an experiment together, and quickly.

Also, I just copied the images from the aforementioned blog, and I have no certainty if they are really Kandinsky's work. It's definitely his style, but I have to find better references to be sure.





# WORDPRESS

JULY 12TH, 2008

TAGS: META

I'm having serious problems regarding uploading files in WordPress, my weblog software. To upload, I have to dive into the WordPress code using Firebug [3] (a wonderful add-on, by the way) and edit a line of code every time I want to upload a file. As I've written a post which contains quite a few prototypes, I decided to dive a bit deeper into Wordpress and sort it out to make my job of uploading files a lot easier thereafter.

So if you're waiting for yesterday's post... patience, please. It's going to be worth it! :). If I succeed, it will contain cool colourful and moving things.

## **Update:**

Somehow it wants to use Flash to upload files (which can handle selecting multiple files at once, so there's a definite advantage there), but it doesn't work. Probably because I've the FlashPlayer 10 Bèta installed, but at other computers it gives errors as well (albeit different ones). The automatic fallback to standard HTML fails however, but after deleting the /wp-includes/js/swfupload/swfupload\_f9.swf file it works again. It's a bit dirty, but it works. So now to figure out how to post SWF's in a satisfying manner ;).

[3] <https://addons.mozilla.org/en-US/firefox/addon/1843>

# A FEW EXPERIMENTS

JULY 12TH, 2008

TAGS: DESIGN, OTHER PROJECTS, TECHNOLOGY

The last week I've been into ActionScript almost all the time.

Firstly, I've been expanding the possibilities of Patrick's project, so it is now only really one step away from being able to use a light (like your cellphone's display, or a lighter) as a mouse in ActionScript. It now generates a normal MouseEvent.CLICK for selected objects if you hover your light on it for a set amount of time, and optionally display an animation to inform the user about this.

Secondly, I've spend a whole day trying getting a WiiMote [4] to work with WiiFlash [5], for Daisy's project [6]. That seems to work on almost every system, but not on mine. It works fine with other applications, just not with WiiFlash. I've posted a help request on the forums [7], so if you know how to fix this, please go ahead and tell the world ;).

Last, but not least, I've also been doing some scripting for my own project. I've put together quite a few experiments which you can admire behind the cut [8].

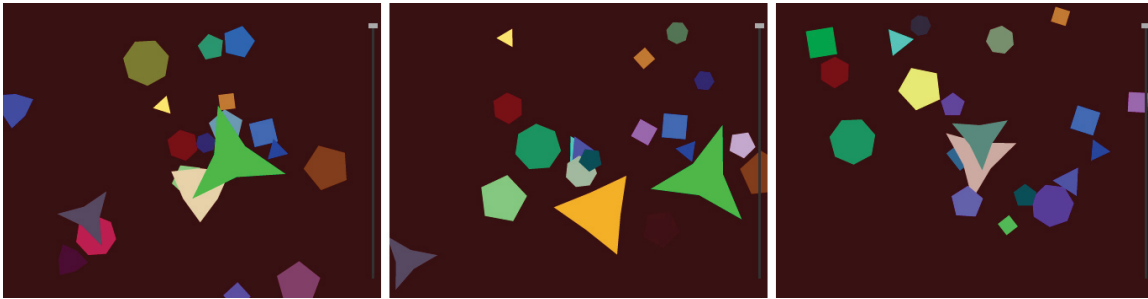
## Shapes

You might remember this painting, sketching random shapes floating around in the virtual primeordeal sea.



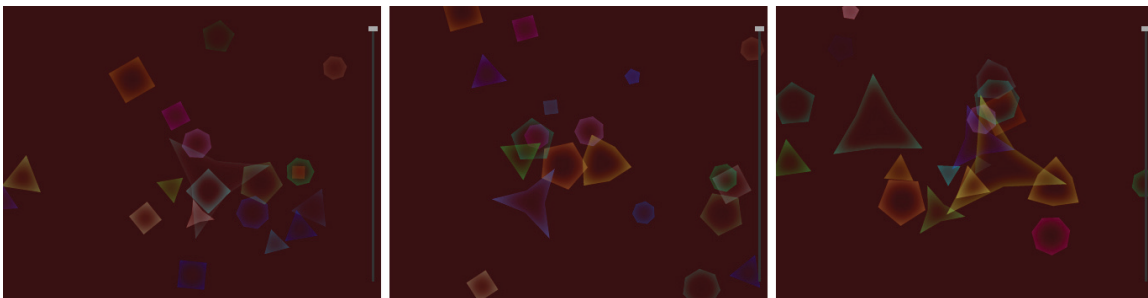
- [4] The input device normally used for the Nintendo Wii, a game console.
- [5] WiiFlash is a library to use the WiiMote in Flash, which Daisy uses to program her project in.
- [6] Diasy Dierikx. See her homepage at <http://www.daisydierikx.nl>.
- [7] [http://wiiflash.bytearray.org/?page\\_id=62&forumactio=showposts&forum=4&thread=42&start=0](http://wiiflash.bytearray.org/?page_id=62&forumactio=showposts&forum=4&thread=42&start=0)
- [8] On weblogs, a 'cut' is used to split a post in two parts, where the second parts only appears in a detailed view, or, in other words: 'behind the cut'.

I've put together a simple Flash application, creating randomly shaped and coloured particles. That was really, really awful to see, so I've modified it a bit so as to create more geometrical shapes like the one in the painting. The colours are random and hold no relation whatsoever to Kandinsky's theories. You can drag the slider to change the background colour from blue ('cold') to red ('hot'), but that's all it does.



See example\_1 on the CD.

I also played around a bit with filters in Flash and I found this very beautiful. Somehow, the hollow shapes seem very delicate to me, just like beginning life. It isn't the design I'm looking for, but I think it is very pretty.



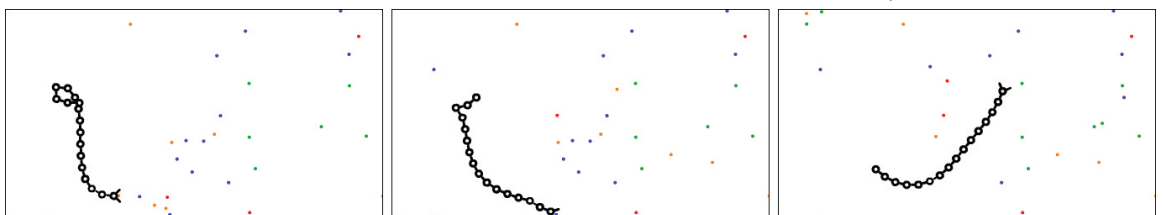
See example\_2 on the CD.

## Creatures and Lines

In one of my last posts, I told you about colouring moving lines according to the angle of the bends in it. As I am into creating something 'living' anyway, I started with creating a simple composite creature, like the ones in *flOw* [9] — only slightly less cool. If I could get that moving, I could start thinking about colouring the segments and all.

Here's my tiny little creature eating random polka dots:

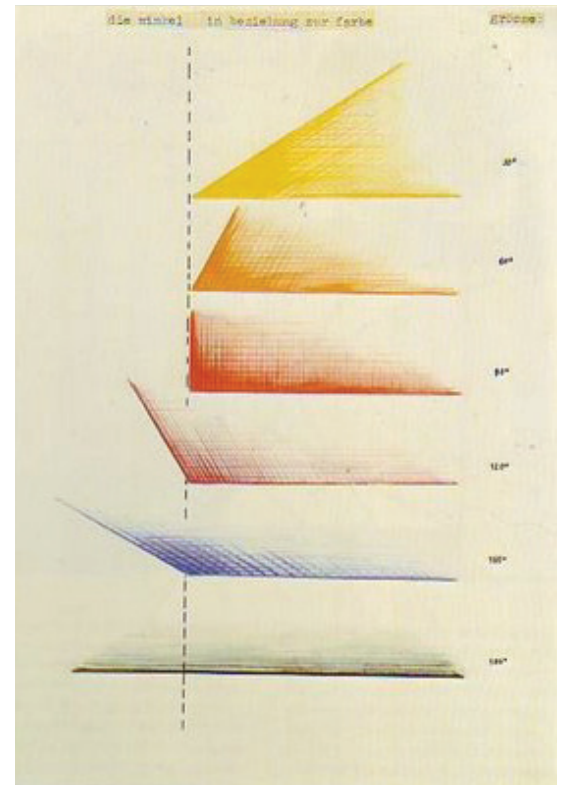
See example\_3 on the CD.



[9] <http://intihuatani.usc.edu/cloud/flowing/>

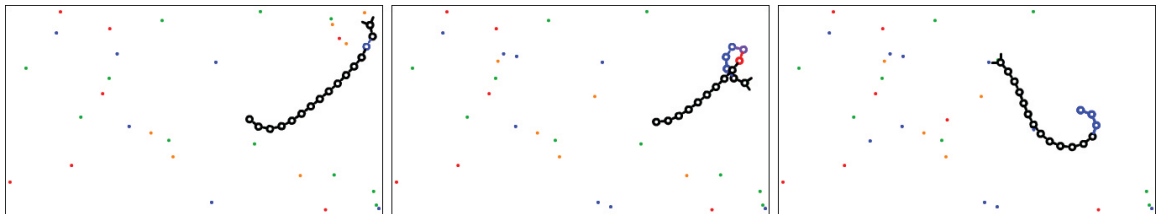
Amazingly, I find this strangely satisfying to watch. In all its simplicity, it has provided me with a good hour of quality entertainment just by eating coloured dots. Due to its Zen-like powers, I baptised it Zenbeestje, which is Dutch and roughly translates as 'Little Zen Creature'. Alas, while definitely cool, I had to move on after staring at my screen for too long.

I started colouring the distinct segments of the creature according to the angle between it and the next one, like in this picture:



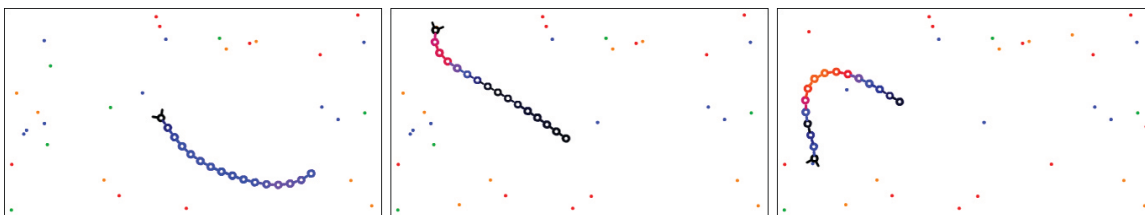
There's no real transition between the colours, it's just black, blue, purple, red, orange and yellow.

*See example\_4 on the CD.*



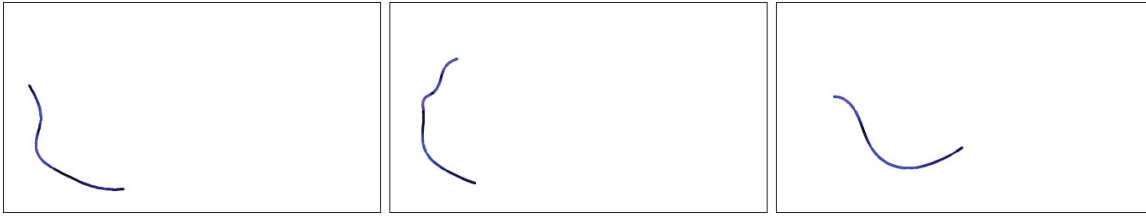
It doesn't work all that well: most segments stay black almost all the time. This is because each segment only compares its angle to the next one, and that's almost always only a few degrees. In the next experiment I fixed that: each segment is now coloured according to the angle between the segments 3 steps back and the segment 3 steps ahead, so the colour is now better suited to the bend in general. Also, the colours now transition between each other, so the colouring is smoother.

*See example\_5 on the CD.*



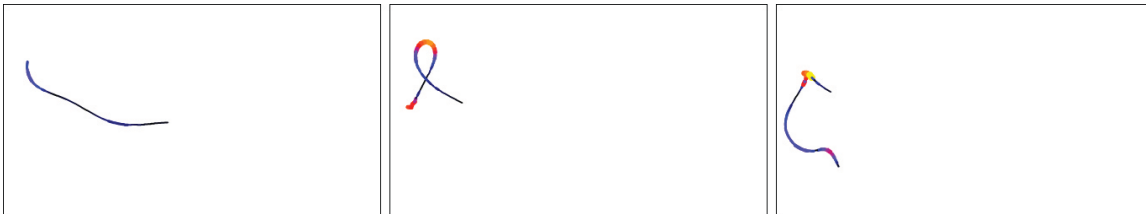
Here, I adapted the graphics a bit. The polka dots don't show any more, nor does the creature have a visible head — it's now more like a line moving about in the picture.

*See example\_6 on the CD.*



Finally, I decided to change the thickness of the line dynamically as well. I don't care much for the effect, but here it is.

*See example\_7 on the CD.*

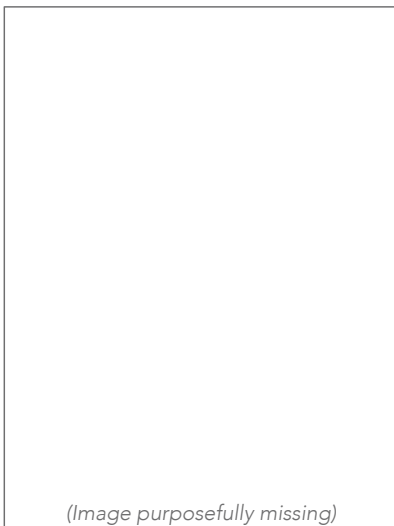


# PRETTY PICTURES

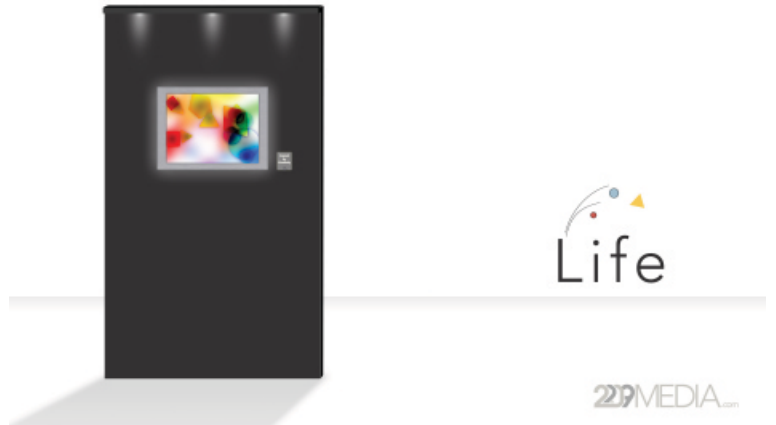
JULY 16TH, 2008

TAGS: DESIGN

Patrick has made me a few pictures... Thanks mate!



*(Image purposefully missing)*



This is a mock-up of the final product presentation, composed together with a name and logo. It will be printed on the front of the postcards we are to hand out at the exposition. Our company logo is in the lower right, so as to make people aware of the fact that they, after we're finished with our studies, can hire us to do equally cool stuff for them.

Look how pretty I am! (Laughing is allowed.) This portrait will be on the back of the postcard. The painting in the background is Composition VIII by Kandinsky. Can you see how it inspired the logo?

This is an early sketch of how the unpopulated landscape may look once it's finished. I love the effects. Circles will be drawn to blue, squares to red, et cetera. The background is not just random blurry stuff, it is based on the image from the camera (really!). I'll do a post on the techniques later.



# WE ARE COMPUTERS

JULY 22ND, 2008

TAGS: THEORY RESEARCH

I don't know if you've ever, like me, marvelled at the wonders of life. I find it terribly fascinating, so if you haven't, maybe I can persuade you.

If you get down to the bottom of it, we're just some very complex, chemical formula or something. Yet, here we are, living creatures. How can we even exist? I am not a religious person myself, but if you just try to imagine the chance that life just came to be... it's not hard to think there might be more to it. Of course, this wouldn't explain where God came from, so to me that's just as improbable as life.

Thing is, improbable as it might seem: here we are. Which, in itself is not as surprising: since life came into existence, it had to have been here, because we're the (living!) evidence of it. Perhaps there's more life to be found in the universe, but at least there is here.

Anyway, before I lose myself in more philosophical rambling, let me get to the point of this post: we are computers.

## DNA

In this part, many biological terminology will show up. I will link all those complicated terms to their respective Wikipedia-pages , just in case you want to know more about them. However, I tried to write my text in such a way that it is not required to read all that information.

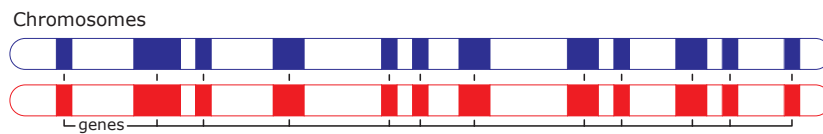
It is pretty common knowledge nowadays that we're pretty much stacked with loads upon loads of heredity information, which defines for a large part who we are, how we look, what we do, et cetera. This information is stored in genes. Of course, who you are is also influenced by external factors as well (education, for example), which cannot be stored in genes. Genes, in turn, make out part of a chromosome. A chromosome is a single piece of DNA.



This is a schematic depiction of a chromosome with a the genes marked on it.

[10] Of course, I cannot link to Wikipedia from paper. Referencing each link would require half a page of links, which are all quite long and nasty to type in. Instead, you'd just better go to the Wikipedia homepage at <http://www.wikipedia.org>, and enter the term you are looking for in the search box. Naturally, you can use any other encyclopaedia just as well.

Apart from many other things, (almost) every cell in your body contains 46 of these chromosomes. They actually form 23 pairs; one chromosome of the pair comes from your mother, the other from your father. Both contain genes that describe the same features, but those do not contain the same information in it. Such a pair is called a homologous pair. There is one odd pair though, which is the pair with the so-called sex chromosomes, because they define your sex. For females, both form a pair just like the others, but for males, both hold different information. Females have 2 so-called X chromosomes, whereas those of men are an X and a Y chromosome. All the other pairs are just identified by a number.



I will not bore you with the specifics of the workings of chromosomes, which I barely understand myself. In essence, a chromosome is a very large molecule, build up from many tiny elements. it is generally depicted as a double helix, with many tiny bars between them like a ladder.

The ladder is a very complex chemical structure, which is well explained on the Wikipedia page on DNA. For the sake of this text it is sufficient to know that the each step of the ladder are is up of a pair of bases. For non-biologists like me, the names of those bases are pretty hard to remember: cytosine, guanine, adenine and thymine. The biologists apparently thought the same, and they usually abbreviate them with their first letters: C, G, A and T.

Every step of the ladder is made up of two of these bases. Also, these are complementary. If the left base is an C, the right one has to be a G and vice versa. The same goes for A and T. So, if you know one side of the ladder, you can describe the other side. This makes it easy to transcribe this molecule, using only the four letters in a (long, long) string.

Now that we can transcribe the code in the chromosomes, we can move on. Remember that I said: we are computers? We are, and our DNA contains the programs we run, encoded in the chromosomes.

from: [http://harfordmedlegal.typepad.com/forensics\\_talk/2006/12/index.html](http://harfordmedlegal.typepad.com/forensics_talk/2006/12/index.html)





## Processing

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The 'processor' in a cell reads one side of the DNA string, and for every gene creates a string of RNA. The DNA contains codes to tell the processor in which way to read it, so it won't mess up by reading the 'program' backwards. This happens in two steps.

The first step is to create primary RNA. Primary RNA is essentially the complement of the DNA string: for example, if there's a C in the DNA string, the primary RNA string contains a G. There's an exception, though: for an A, there's not a T but a U, (for uracil). So, if the DNA sequence is CGAT, the RNA sequence will be GCUA.

The second step is to strip the primary RNA from ineffective parts in the gene. The result is called mRNA, short for messenger-RNA. Not all primary RNA strings are converted to mRNA, they may have other functions, on which I will not elaborate.

Now we have mRNA, we're getting some pretty amazing stuff. This is your actual software, this describes what your cells do in order to make you who you are! If you write down the letters, they actually form some sort of biological bytecode: the actual stuff computer programs feed to your processor, telling it what to do. Every three letters form an instruction, called a codon.

Every instruction tells the processor something. The whole mRNA string contains a program to create a polypeptide chain, which will become (part of a) protein. Proteins consist of one or more polypeptide chains. Proteins actually help build your body and make you live. How these work... that's beyond me. They are pretty irrelevant to my research (which is about heredity), so I will leave that to you, if you're interested.

Each polypeptide chain is build from a set of amino acids, and the mRNA contains the instructions to build them. Building will start at the start instruction. It will attract an amino acid with the name of methionine. The next instruction will all attract a new amino acid and attach it to the acids attracted before, until a stop instruction is reached. At this point, the program will stop, and the polypeptide chain is finished. It will then continue to form a protein.

If you are quick with mathematics, you've already calculated that there are 64 different instructions. Some instructions, however, attract the same amino acid (for example, GGU, GGC, GGA and GGG all attract glycine). In actuality there are 20 different amino acids. Also, the stop instructions do not attract an amino acid.

## In short

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Well, that's quite a complex story, isn't it? To summarize it a bit:

Almost each cell in your body contains your complete DNA. DNA consists of several chromosomes. On these chromosomes reside genes, which form your own personal blueprint. These genes are then converted to sort-of computer programs, called mRNA. This mRNA consists of a string of three-letter instructions for the processor in the cell. The processor will use these instructions to build polypeptide chains, which in turn will be used to build proteins. These proteins are actually responsible for building and maintaining your body.

Isn't that cool? It's quite a wonder, really. And that isn't near all of it...

# BUSY GIRL WITH A HEADACHE

**JULY 24TH, 2008**

**TAGS: META**

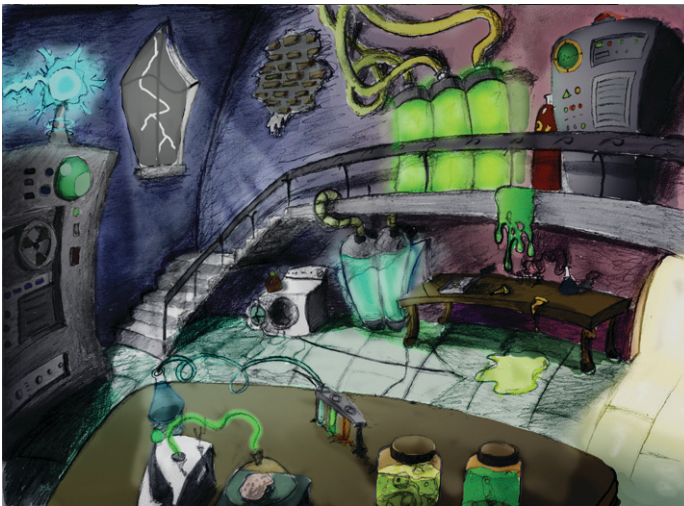
Over the last week, I've been reading a lot about genes, cell-division cycles and reproduction. Pretty complicated stuff, it is. With all those complicated and scientific terminology in addition to it being not quite my primary specialism, it was quite hard to get a grip on it.

Today I've finally managed to finish a summary, including reaching understanding, at least at the level I need for my painting. I was going to post it tonight, but there's quite a few schematics to draw and I am suffering a terrible headache which apparently doesn't want to subside, even though I tried to persuade it to go away with a few painkillers. I've done my summary outside, and I went to the library which is quite a trip, so perhaps I've been too much in the sun today, after the last few rainy weeks. Anyway, tomorrow it should be better, so when I've made those drawings, my post'll be up.

# EXPERIMENTING

JULY 25TH, 2008

TAGS: META, OTHER PROJECTS,  
THEORY RESEARCH



from: <http://drpenguin57.deviantart.com/art/Mad-Scientist-Laboratory-44308664>

Today, I've met again with Patrick. We've been working on various things, mainly some discussion about his project and some experiments, as well as experimenting with some design choices for my project. I think it will be hard to implement, but not impossible. I'll just have to do some more, well, experimenting. With all this experimenting, I'm pretty much sounding like some evil mad scientist, but unfortunately my experiments do not involve explosions and noxious fumes.

Also, I've been doing the drawings I wanted to do yesterday evening. I've just added a few to a post that I started a few days ago, and in the process decided to rewrite it for a large part. Expect it to show up somewhere tonight. Today's post, well, I think it just got postponed to tomorrow. I'm really having trouble keeping to my schedule, but anyway, I'm doing useful stuff, so it's no biggie.

I'm getting really behind on catching up on happenings in my field of expertise, though. I'm afraid it might take me several hours tomorrow to sift through the loads of information supplied by various sources. The positive side of catching up once a week is that you're really making heavy cuts on what articles to read or discard, so in effect, you only get to the most important stuff. The risk is missing an important note here and there, but I gain a lot of time with this strategy. And if something is really important and I miss it, it's bound to show up again some time soon anyway.

# MITOSIS

JULY 26TH, 2008

TAGS: THEORY RESEARCH

Every so often, the cells in your body creates an exact duplicate of themselves. This allows you to grow, and replaces dead cells. This process is called cytokinesis. I will not tire you with that exact process, because for my project, only the division of the nucleus (the part of the cell where it is all buzzing) is important. We call that process mitosis.

Again, I will not elaborate to deeply on the process. It is hard enough to understand as it is, and it's all the information I need. Again, if you want to know more, Wikipedia has an awesome lot of information, and a frightening list of references.

To create a duplicate nucleus, the nucleus first copies just about everything that's inside it, and makes sure one copy is in one half of the nucleus, and the other copy in the other half of the nucleus. Then, it will contract in the middle, until both halves come loose and there are now two identical nuclei, instead of one. After that, the cell itself will divide and both the new cells will repeat the process, et cetera.

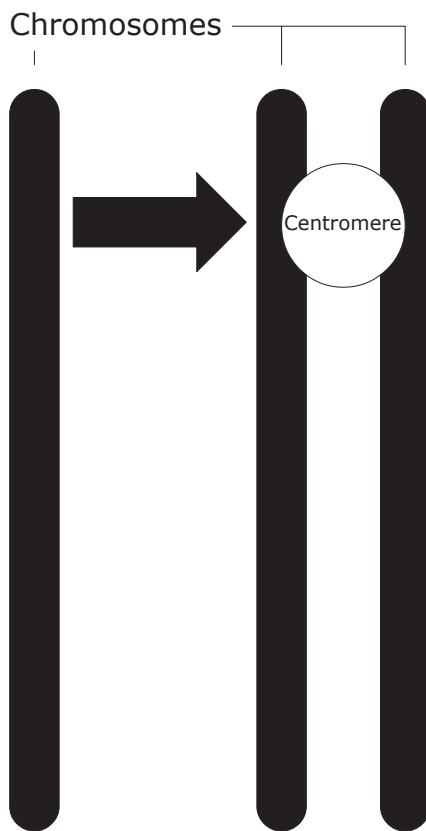
One of the major feats of this duplication is the duplication of the DNA (which, mind you, is present in all but a few cells). As you already know, there are 46 chromosomes present. Those chromosomes vary greatly in length, but all together they would be over 2 meters in length if you were to roll them out! When you consider that the length of a base pair is only a few molecules, there must be a whole lot of information there.

If you were to transcribe all the base pairs, with one letter per pair (C, G, A or T), you would need about 3.000 books with 330 pages each. Except for the most avid readers, many won't read that many books in their whole life. Still, it is copied in somewhere about six to eight hours!

For those of use more into computers than into books (or who want something more exact than 'a book of 330 pages), here's another calculation. In total, your DNA consists of about 6 billion base pairs. Each base pair can have 4 different values, which can be stored in 2 bits, so you'd need about 12 gigabits to store this information. That's one-and-a-half gigabyte. I still remember the time when my computer had a hard drive of 30 megabytes...

## Copying

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To copy a chromosome, both sides of the 'ladder' are detached from each other, and at every base, the complimentary base is attached (C to a G, G to a C, et cetera). In effect, the result is two identical strings of DNA. This copying takes place with about 40 bases per second at thousands of places simultaneously, so that's why it is so fast. Still, we've got some pretty efficient copying computers ;). When a chromosome is copied, it is still attached to it's twin at a spot called the centromere. Sometimes, such a pair is called a 'division chromosome'. I will continue that habit, so as not to confuse this pair with a homologous pair of chromosomes.

After that, all the division chromosomes line up in the centre of the cell, and they will be pulled apart. One half will then go the the one side of the cell, the other to the other half, and the cell can split itself into two.

## Errors

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Those tiny cells doing so much hard work — that can't always go right. It is estimated that about 1 in 100.000 bases contains an error. Many errors are already corrected during copying, but after copying your cell will start checking for errors. This takes another two to four hours, but after that, the error rate is about 1 in a billion. Because there's a lot of 'empty' space between the genes, the chance that a gene is actually affected is 1 in 100.000 at most. Then again, since every cell contains 2 sets of 25.000 to 35.000 genes, on average 1 in 2 daughter cells contains an error in its genes.

# LANDSCAPE

JULY 27TH, 2008

TAGS: DESIGN, TECHNOLOGY

Behind the cut a video which displays the dynamic landscape in which my creatures will reside. The images is based on the input from a camera, from which a few colours are selected (red, orange, yellow, green, blue and purple). This image is then blurred out to generate the soft tones here present.

There are quite a few steps in-between the video and the final image, to keep it a bit low on resources. As it is now, it takes 40-45% of one processor core, so there's about 55% left for my creatures (unfortunately Flash does not support the use of multiple cores yet). That should be enough, I hope!

The video is a bit jerky, but that's because of the screen capture program. In reality, it is updated 12 times per second, which is smooth enough. I can later raise the frame rate if there are enough resources left.

*See example\_8 on the CD.*



The algorithm to create the image is not very complicated, but it is rather costly in terms of processing power. The steps used to process the image are below:



To begin with the leftmost image: a camera takes a picture every second. This is then added to the second picture, with 90% transparency and a blur. This makes sure the image transformation will be smooth, that there will be no immediate changes in the landscape and that there are no hard edges. In the last image, I have run an algorithm which recognizes the colours in the middle image. It lets a few colours through, and displays them clearly. Other colours become white. They are 'rounded' to the nearest colour, so a shade between red and orange becomes either red, orange or white if it isn't close enough to either. Also, the lightness and saturation of these colours are discarded, so dark red for example becomes bright red, and a greenish grey becomes green.

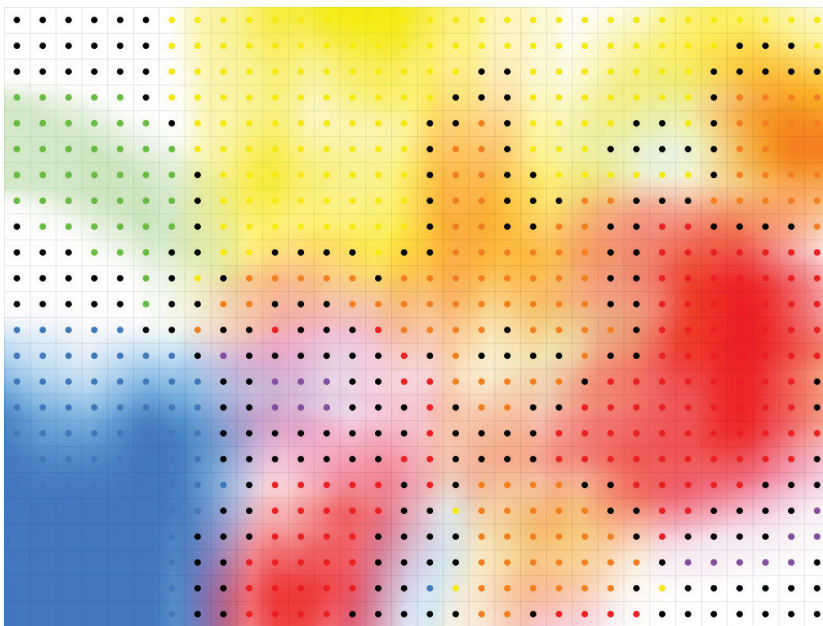
# THE EYE OF THE BEHOLDER

JULY 28TH, 2008

TAGS: TECHNOLOGY

Now that I finally have a final version of the landscape, I can continue to work on the rest of the software. Of course, I could have created the creatures before, but that would be much harder than doing them now as I can't test them.

As you've seen in the last post, performance will become a bit of an issue here, so I've been working on the 'eyes' of my creatures. When I let them see the whole world, there's a lot to process, so I've decided to lower it all down a bit. On the exterior, I doubt anyone will notice!



For the creatures, I've lowered the resolution of the whole image down to  $32 \times 24$  pixels. So, instead of  $1024 \times 768 =$  over 785000 pixels, it has to check only  $32 \times 24 = 768$  pixels! That's only 0.1% of the complete image.

In the image below, I have visualised this. The original is in the background, and the coloured dots show what colours the creatures will see. I've replaced white with black dots, so they're easier to see for us humans.

It isn't perfect yet: as you can see, some spots get the wrong colour. But then, it's just a very quick implementation...

Quite content.



# WHAT CREATURES, ANYWAY?

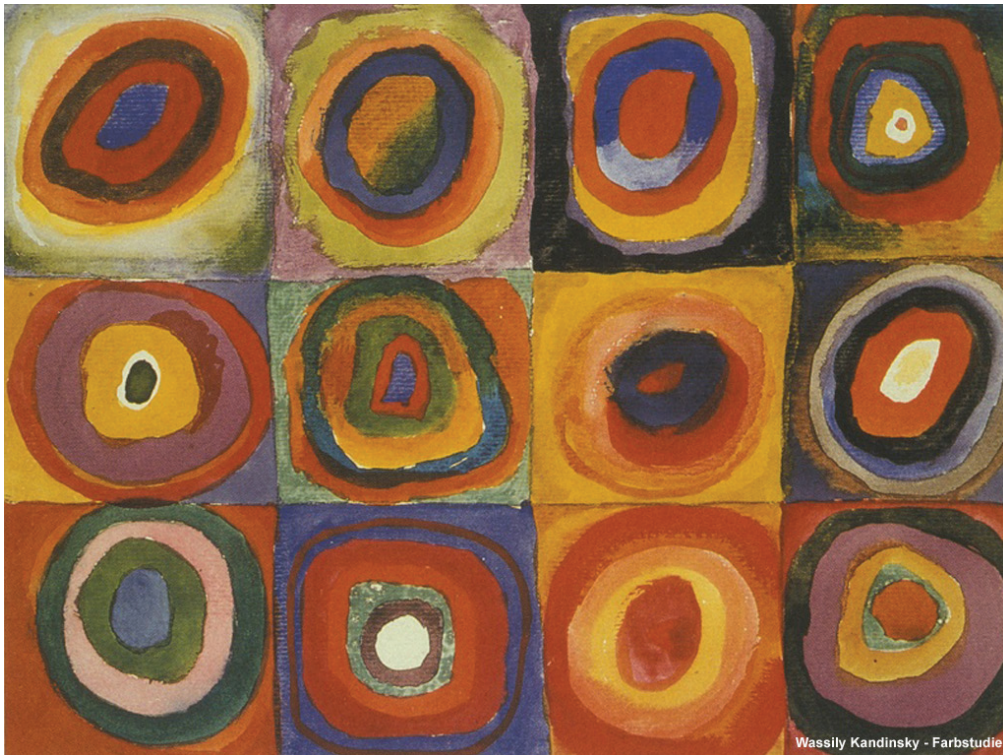
JULY 28TH, 2008

TAGS: DESIGN, TECHNOLOGY

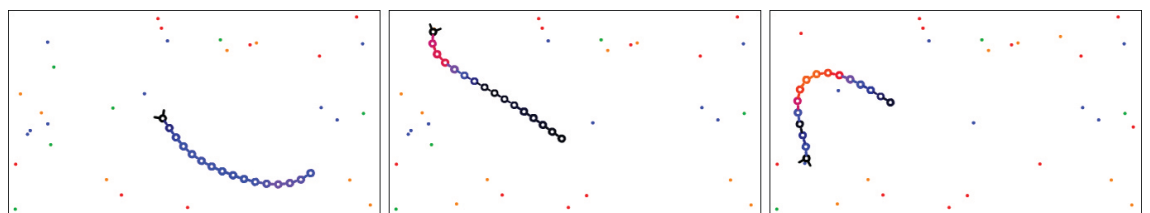
I've been babbling a lot about my virtual landscape with virtual creatures but I've never shown you what they'll look like. To be honest, it's not completely worked out... but for a large part it is, too.

The inspiration came when Patrick (my Art Director ;)) was browsing through images of Kandinsky's paintings, after he had seen the creatures I made to create the moving lines.

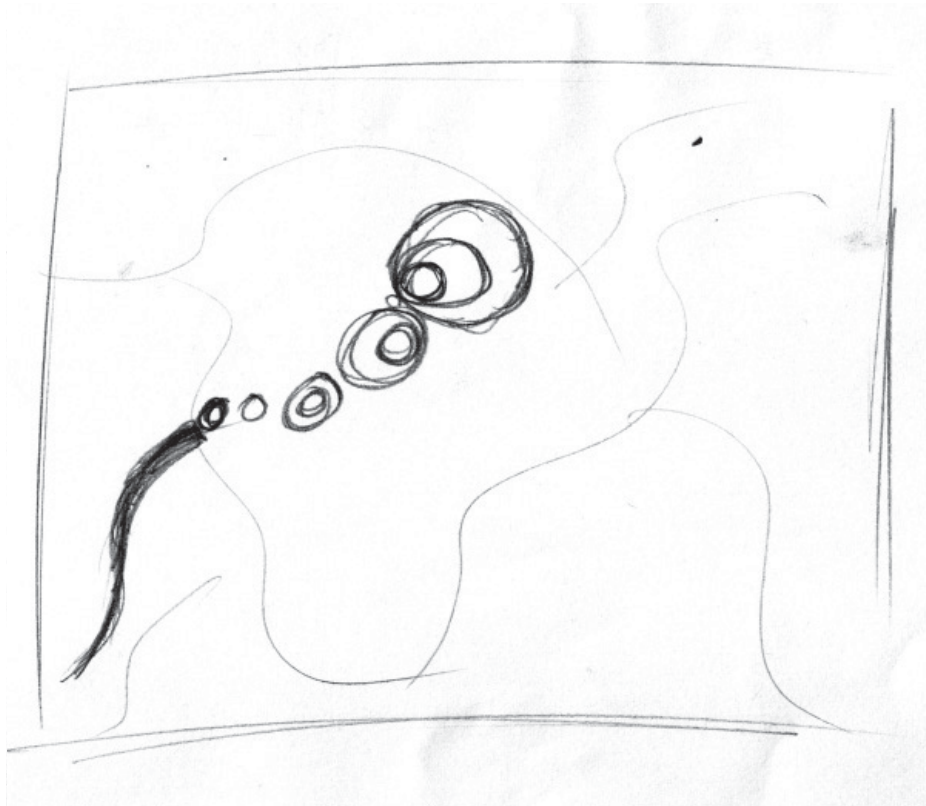
The inspiring painting was this colour study:



So, multiplying that with:



Ultimately became the following sketch:



I think it'll end up a tad smaller than this one here, but I like the idea very much. The circles can actually display a lot about the creature, for example what colours it likes, how healthy it is, or how strong. I've plenty of ideas here, but that's something for a post on the creatures behaviour.

To create the circles, I've whipped together another tiny experiment. The colours and sizes are totally random. Click for a new one!



*See example\_9 on the CD.*

# MEIOSIS

JULY 31ST, 2008

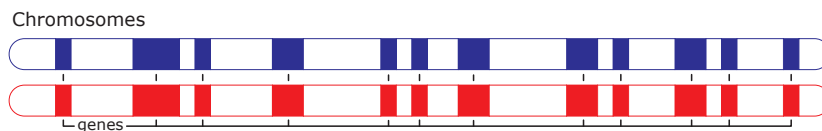
TAGS: THEORY RESEARCH

Last time I blogged on the subject, I discussed how cell nuclei divide themselves and copy the whole DNA-structure so as to preserve it in every cell. All quite stunning, but not that much use for my project which, due to technical, knowledge and time constraints has to be simplified a lot. Emulating everything is just not feasible.

More interesting is meiosis, which is the creation of gametes: the actual cells used for reproduction (in other words: sperms and ova, or eggs).

## Gametes

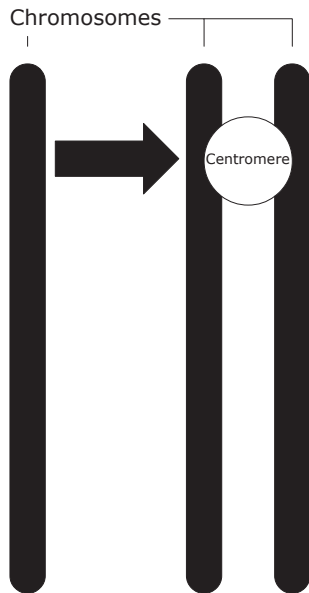
Gametes are about the only cells in your body not containing 46 chromosomes, but 23: only 1 of the 2 chromosomes of each homologous pair. After the ovum and the sperm 'melt' together, they once more form a single cell, complete with 46 chromosomes: 23 from the mother, and 23 from the father: again 23 complete homologous pairs. Refresh your mind with this image:



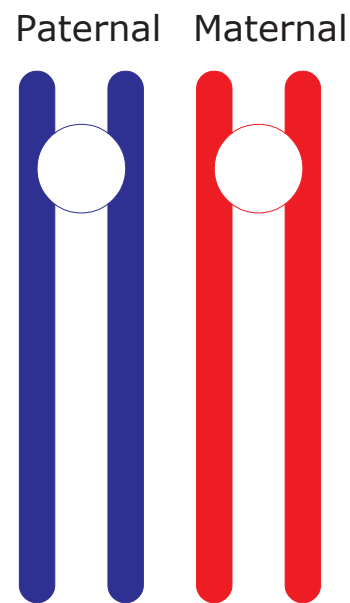
Gametes originate from 'normal' cells with 23 complete homologous pairs. So, somewhere in the process, this number has to be reduced and that process is called meiosis.

## Differences

The process is very different from mitoses, but it also holds many similarities. The first step is essentially the same; all chromosomes are duplicated:

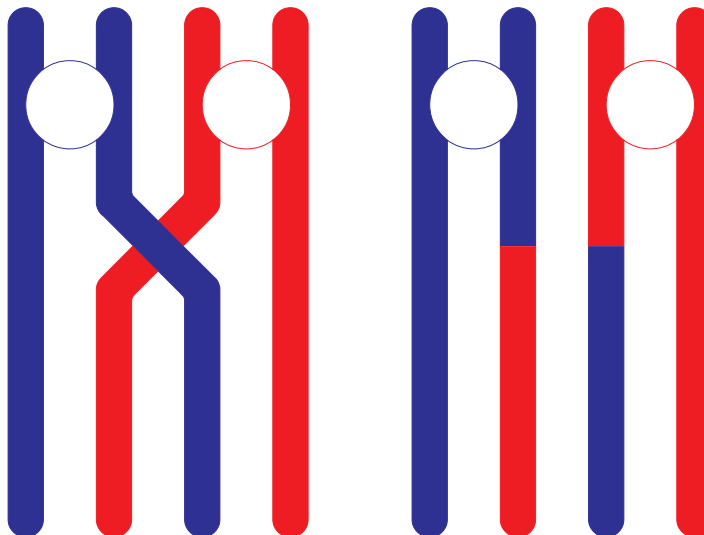


After this duplication, the process deviates for a very important bit. Now that all the chromosomes are copied, the homologous pairs of division chromosomes group together:



## Crossover

When this happens, they will start to crossover. In this process, the chromosomes will 'mix up'. This happens in a few steps, which are displayed in the schematic below:



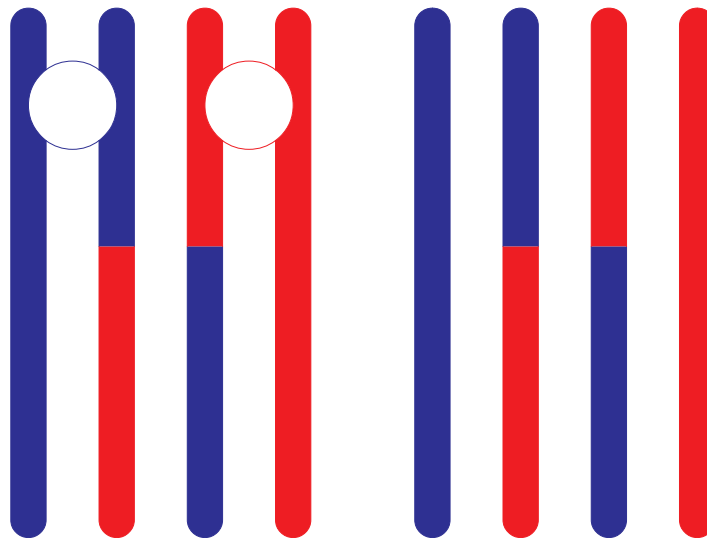
The 'legs' of the chromosomes will swap over, and part of the DNA structure is swapped between the paternal and maternal chromosomes, resulting in 4 different chromosomes, still tied together at their centromeres. This usually happens more than once, especially for the larger chromosomes. For now, we will assume that this example is the final result of this chromosomal interaction.

Then, the chromosomes will line up in the centre of the nucleus, as they would in case of mitosis. However, they are still grouped as homologous pairs and they will not be pulled apart at their centromeres: instead, one of the two altered division chromosomes will go to one nucleus, the other to the other nucleus. Both new nuclei now contain 23 division chromosomes, instead of the 46 normal chromosomes. Now the cell will divide as well.

## Another division

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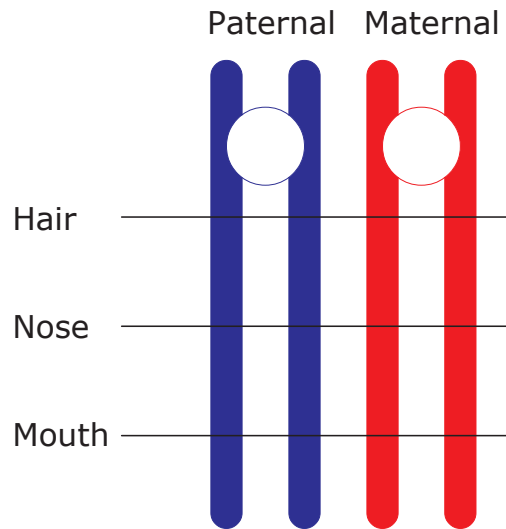
Now, we have two new nuclei in two new cells, which will attempt to divide again, almost immediately. This time, the chromosomes will not duplicate, as they are already division chromosomes. The chromosomes again line up in the centre of the cell, but now they are split at their centromeres.



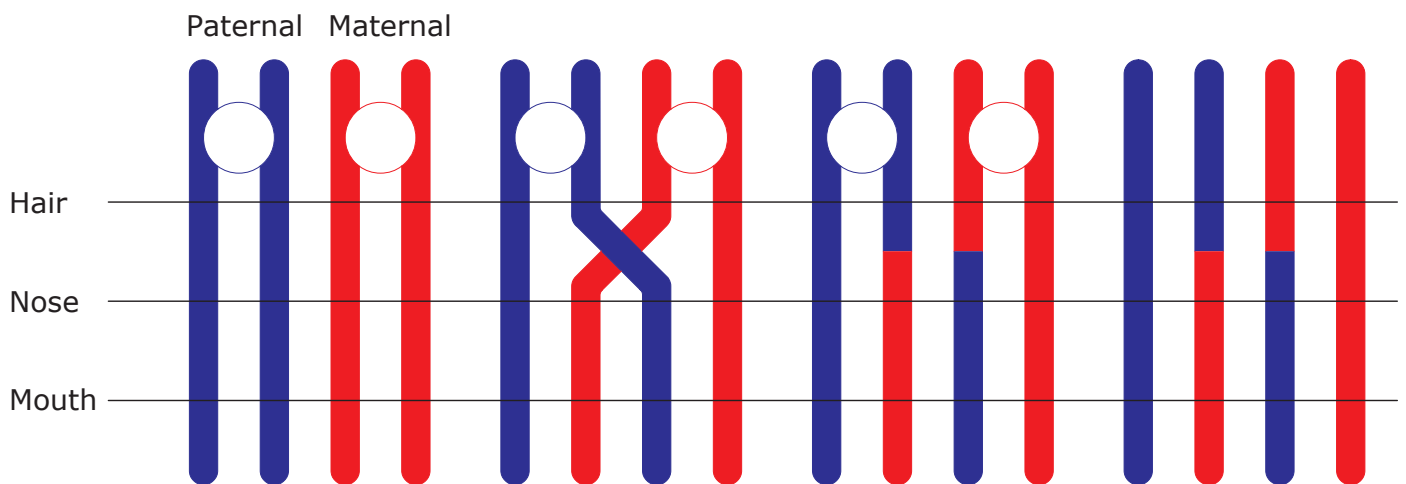
Since there are two cells dividing, we will end up with four cells, among which the different legs of the chromosomes are distributed. Each cell nucleus has effectively 23 chromosomes. During reproduction (the ovum and the sperm coming together), they will form a new cell again, with 46 chromosomes. For men, this would also mean that half of the cells end up with X sex chromosomes, and the other half with Y sex chromosomes. In effect that would theoretically result in a 50% chance for a boy (XY) and 50% for a girl (XX).

## Enlargement of the gene pool

This whole cycle serves to enlarge the gene pool available, because if the chromosomes wouldn't cross over there would be no change. Imagine a chromosome which has three genes on it, say, hair, nose and mouth:



When we put this through the whole process, we'd end up with the following:



One chromosome contains all genes from the father (left), one contains all genes from the mother (right) and the other two a mix: hair from the father, nose and mouth from the mother (second), hair from the mother, nose and mouth from the father (third).

So, that's why we're not all the same!

# ÜBER DAS GEISTIGE IN DER KUNST

AUGUST 1ST, 2008

TAGS: DESIGN

Some time ago, I mentioned that I would search for more references about Kandinsky's theories. Unfortunately, I haven't been able to find much. Our school library doesn't have a single book by his hand, which I found quite surprising. Then, I began searching libraries but after looking through 13 catalogues of libraries in Utrecht, Amsterdam, The Hague and Rotterdam among others, I've only found his book/essay *Über das Geistige in der Kunst* (Concerning the Spiritual in Art). Fortunately, there was a Dutch translation available. A free English translation can be found here [11] at project Gutenberg, but it lacks the few diagrams the printed edition has. I would have liked a peek in some of his other works, but there's no helping it.

Unfortunately, *Über das Geistige in der Kunst* does not discuss the exact theories that I discussed in the aforementioned post. There are a few other things to be learned, though.

## On shapes and lines

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In this book, Kandinsky does relate colours and shapes, if briefly. He states:

*"It is evident that many colours are hampered and even nullified in effect by many forms. On the whole, keen colours are well suited by sharp forms (e.g., a yellow triangle), and soft, deep colours by round forms (e.g., a blue circle)."*

He doesn't mention the red square, nor the theory that if you 'mix' shapes you have to mix their appropriate colours. I know I have read about that theory in a book somewhere but I can't remember where. I do however need some theory on which to build up my landscape, so I think I may stick with this. It does seem to fit, and I like it. I might change the colour, though, based on the theories Kandinsky did discuss in this book.

Also very important is that there's nothing on the lines either! I did have a few ideas on how to implement them and they are so amazingly cool! However, so long as they don't fit the theme... I'd hate to see them go, though.

[11] <http://www.gutenberg.org/dirs/etext04/cnspr10.txt>

## Contrast

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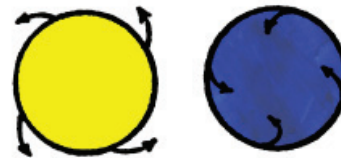
The colour theories Kandinsky discusses in *Über das Geistige der Kunst* mainly consist of four different contrasts. I have summarized them below.

### I: Yellow versus Blue

The first contrast is warm versus cold, yellow versus blue. Kandinsky puts it as follows:

*"Generally speaking, warmth or cold in a colour means an approach respectively to yellow or to blue. This distinction is, so to speak, on one basis, the colour having a constant fundamental appeal, but assuming either a more material or more non-material quality. The movement is an horizontal one, the warm colours approaching the spectator, the cold ones retreating from him."*

He illustrated the movement as follows (colours were added by me):



Yellow jumps out at the spectator, it tries to fill the page (or screen, in our case) with its bright colour. Blue on the contrary tries to draw you into its depths. The movement of yellow is rather excentric, it swirls out, and blue concentric.

### II: White versus Black

This second contrast is described by Kandinsky in a quite definitive way: Life versus Death. This white and black, light or dark, can be mixed with yellow and blue. One can make yellow more alive by adding white and make blue more subdued by adding black. It is also hard to darken yellow, there is no such thing as dark yellow. He refrains from mentioning light blue, however.

### III: Red versus Green

When one tries to cool yellow down by adding blue, at some point it becomes green:

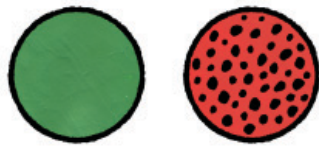
*"An attempt to make yellow colder produces a green tint and checks both the horizontal and excentric movement. The colour becomes sickly and unreal. The blue by its contrary movement acts as a brake on the yellow, and is hindered in its own movement, till the two together become stationary, and the result is green."*



So, green is stationary, unmoving. The opposite must be a lively, moving colour: red. The English translation doesn't describe this as eloquently as the Dutch one, so here's my English translation of the Dutch text:

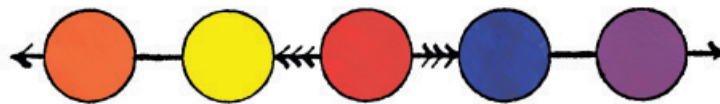
As one imagines red as the characteristic warm colour without boundaries, it works as a very lively, moving, restless colour, however without the frivolous character of yellow which spreads out in all directions. Despite the energy and intensity, red strongly arouses an immense and purposeful power. This sparkling holds a self-contained glowing, a well-nigh manly maturity.

The following picture illustrates this contrast:



#### IV: Orange versus Violet

Red, says Kandinsky, can be either warmed or cooled. When you warm red with yellow, you get orange. When you cool it down by adding blue, you get violet. This he illustrated as follows:



Kandinsky says the following about orange:

*"Warm red, intensified by a suitable yellow, is orange. This blend brings red almost to the point of spreading out towards the spectator. But the element of red is always sufficiently strong to keep the colour from flippancy. Orange is like a man, convinced of his own powers."*

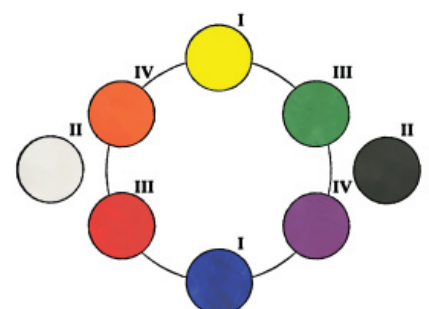
Red cooled to violet is a colour of mourning in many cultures, which fits perfectly according to Kandinsky:

*"Just as orange is red brought nearer to humanity by yellow, so violet is red withdrawn from humanity by blue. But the red in violet must be cold, for the spiritual need does not allow of a mixture of warm red with cold blue."*

*Violet is therefore both in the physical and spiritual sense a cooled red. It is consequently rather sad and ailing. It is worn by old women, and in China as a sign of mourning."*

#### All contrasts together

When we place all the contrast together in a circle, we get the following figure which illustrates it well:



# TIME

**AUGUST 3RD, 2008**

**TAGS: META**

Time is running out! Only a week and a day left before I'll have to hand in my thesis. That's quite soon and there are still loads of notes and thoughts that I have to write down. I'm doing quite well with the coding and designing thing (the latter with the help of Patrick, of course), but this last week I will have to pull my attention away from that and to writing posts. After that, there is still a little over two weeks to finish the rest.

Unfortunately this means that you will not see the completion of the visual and technical aspects of my installation in my thesis. Of course, I can continue writing on my weblog (which is my thesis), but then it wouldn't be in the thesis I have to hand in the 11th (which should be complete and have no additions after that date except for minor fine-tuning). I mean to say, it is not official, then. I might continue writing, with perhaps a special tag attached, but I don't know yet.

At any rate, I'd better get a move on writing my thoughts down. It does help make them clearer, too.

# NO MORE ITTEN

**AUGUST 3RD, 2008**

**TAGS: CONCEPT DESIGN, DESIGN**

I have decided this some time ago already, but I haven't told you yet: even though I find Itten's theories very interesting I won't use them for this project. The reason behind this is that I have chosen Kandinsky to be my inspirational source, and therefore shouldn't be influenced by someone else (except myself, of course). It will result in a much clearer final result.

The theories of Itten hold merit, and have given me loads of ideas. They will likely inspire coming projects (as will no doubt Kandinsky).

# MUTATIONS

AUGUST 3RD, 2008  
TAGS: THEORY RESEARCH

I've already mentioned that one in two cells contain an error, or, more scientifically correctly speaking, a mutation in one of the genes. Since gametes (ova and sperms) contain only half the information, the error rate is in fact one in four, but as they will be combined later on, statistically it becomes one in four again.

Of course, if a cell contains a mutation in itself, this mutation will be copied to its daughter cells as well (unless of course it gets corrected by a mutation which reverses the earlier mistake — fat chance!). As will be evidenced by a simple look around, this doesn't necessarily in offspring suitable only for horror movies. In fact, it sounds a lot worse than it is. Sometimes, it is even a good thing, too.

## Kinds of mutations

As discussed earlier, polypeptide chains (which, later on, make sure we live and all that) are created from some sort of computer programs which are encoded in our DNA (with mRNA as a sort of 'transporter' of the program from the DNA to the polypeptide chain building 'computer'). If there is a mutation in the DNA this will be finally result in a different polypeptide to be made.

These DNA programs consist of many instructions (or codons, in biology terminology), all three letters in length. Biologists and programmers (convenient!) call the readout of such a set of instructions a frame. As these frames are read from a mRNA string, we will continue with examples from a mRNA string.

In normal state, this is our mRNA string, with the different acids the frames represent. I will abbreviate the names of these acids, as they only serve here to portray the changes the mutations make.

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| GCC | UAC | GAC | AUC | GGU |
| Ala | Tyr | Asp | Ile | Gly |

### Missense mutations

With a missense mutation, a letter is changed, resulting in a different acid to be added to the polypeptide.

|     |            |     |     |     |
|-----|------------|-----|-----|-----|
| GCC | <b>UCC</b> | GAC | AUC | GGU |
| Ala | <b>Ser</b> | Asp | Ile | Gly |

### Silent mutations

Like missense mutations, silent mutations change a letter. In this case, however, the instruction changes into a synonymous instruction which adds the same acid. This doesn't seem like a problem at once, but it adds to the deformation of the data as a whole and may therefore be important when combined with later mutations.

|     |            |     |     |     |
|-----|------------|-----|-----|-----|
| GCC | UAU        | GAC | AUC | GGU |
| Ala | <b>Tyr</b> | Asp | Ile | Gly |

### Nonsense mutations

Nonsense mutations change a letter as well, but now the frame reads 'stop' instead of an acid, so no complete polypeptide will be formed.

|     |             |     |     |     |
|-----|-------------|-----|-----|-----|
| GCC | UAG         | GAC | AUC | GGU |
| Ala | <b>Stop</b> | -   | -   | -   |

### Insertion of a frame

Sometimes, base pairs get added to the string; e.g. a letter is inserted. When three letters get added, in effect a frame is added. There are two scenarios. The first is that it is inserted between two instructions. This results in the addition of one acid to the polypeptide.

|     |     |            |     |     |     |
|-----|-----|------------|-----|-----|-----|
| GCC | UAC | <b>GTT</b> | GAC | AUC | GGU |
| Ala | Tyr | <b>Glu</b> | Asp | Ile | Gly |

The other scenario occurs when the base pairs are inserted somewhere halfway a frame. That way, the polypeptide is not only lengthened with one acid, also it affects two acids:

|     |     |            |            |     |     |
|-----|-----|------------|------------|-----|-----|
| GCC | UAC | <b>GCA</b> | <b>UAC</b> | AUC | GGU |
| Ala | Tyr | <b>Ala</b> | <b>Tyr</b> | Ile | Gly |

### Deletion of a frame

At other times, base pairs get deleted. When three of these are deleted, a whole frame goes missing. This can be a complete frame, resulting in the polypeptide missing an acid:

|     |     |            |     |     |
|-----|-----|------------|-----|-----|
| GCC | UAC | <b>GAC</b> | AUC | GGU |
| Ala | Tyr | <b>Asp</b> | Ile | Gly |

Again, it can also happen halfway a frame, and result in a different acid to be added in one place (and two correct ones missing):

|     |     |               |     |
|-----|-----|---------------|-----|
| GCC | UAC | <b>GACAUC</b> | GGU |
| Ala | Tyr | Val           | Gly |

### Frameshift mutations

With the exception of mutations resulting in a 'stop' instruction, the mutations mentioned above have limited impact. Never worry, though, because nature has found a way to screw up badly. It can so happen that only one or two base pairs will be inserted or deleted. When that happens, the reading frame 'shifts' one position, which results in the whole polypeptide being constructed in the wrong way. For example here the addition of one letter to the string:

|     |            |     |     |     |     |
|-----|------------|-----|-----|-----|-----|
| GCC | <b>UUA</b> | CGA | CAU | CGG | U.. |
| Ala | <b>Leu</b> | Arg | His | Arg | ... |

It could just happen that it even misses a 'stop' instruction and continues to build and build... I wouldn't know if there's some sort of emergency break for that.

## Other things

A mutation can occur at many other places. Most of our DNA isn't actually used, so mutations in these parts aren't usually problematic. However, sometimes it can be bad even if a mutation does not directly affect a gene, because it may affect how the DNA is read. Possible mutations are the total inactivation of a whole gene, or disrupt the process of cutting out unused parts of a gene and thus include them (or exclude other parts).

## How bad is it?

Fortunately, in real life things do not work out as in horror movies. Even if a gene is affected, many proteins with slightly different compounds actually do the same thing. Given the number of mutated genes, and looking around, I would judge that most of the time the effects are neutral, or very minimal. Unfortunately I cannot back this up, however.

## Positive effects

When speaking of mutations, most people think of negative effects. Many times they are neutral, and at times the effects can be positive as well. This is what makes evolution work! Without mutations happening, genes wouldn't change and we would still be one celled organisms floating around in the primeordial sea. But at some moment, a gene got changed and a different organism got 'born'. If this organism was better suited to the world than its ancestors, it would survive and give life to equally mutated organisms. When you keep this process happening over and over for billions of years, you might get humans. With animal senses, massive muscles, near instant healing and retractable bone claws [12]. Or so they say.

[12] This reference was linked to [http://en.wikipedia.org/wiki/Wolverine\\_\(comics\)](http://en.wikipedia.org/wiki/Wolverine_(comics))

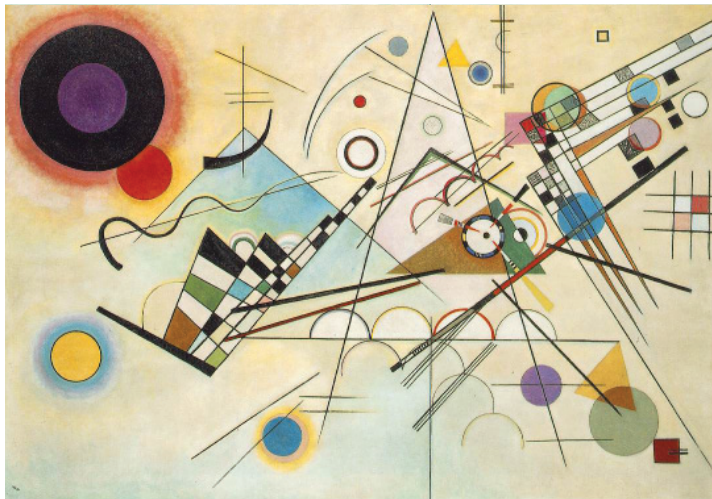
# KANDINSKY INSPIRATION

AUGUST 4TH, 2008

TAGS: DESIGN

As it most clear at the moment, I have found much of my inspiration in Kandinsky's abstract paintings (not his earlier work). In this post, I want to highlight a few paintings that I consider important for my project.

Probably the most important one is Composition VIII:



I am not one who is very capable of telling why he enjoys or dislikes a painting, but I'm guessing it is in the clarity of it: almost everything is clearly delimited, the shapes are very much there. It is a happy, enthusiastic painting, even though the black hole in the top left tries to draw you in.

This description also fits Multicoloured Circle rather well:





It is a bit colder though, with all the blues instead of the yellows. Also, it is a bit messier. A bit like an underwater world, it seems to me, but that could just be my mind trying to put a name what it sees.

My creatures will be modelled with this clarity in mind. I want them to be very distinctive from the background, but they must, of course, still be very abstract. They depict creatures, but I want a single screen shot of it to be an abstract image. I won't give them a face for example (a suggestion someone made), as that would give it away.

As I've already mentioned earlier, the following colour study also partly inspired my creatures-to-be:



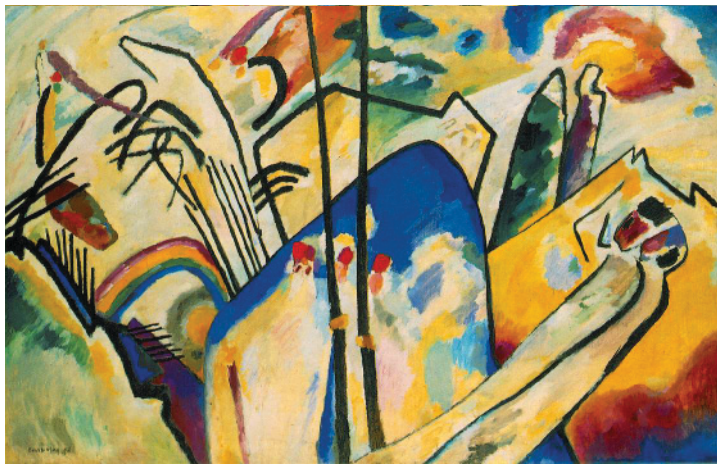
Yellow Red Blue is very colourful as well:

When you look at this painting, you can see that I tried to model my background to its cloudy background. Also, I will add geometrical shapes to it, if a bit more subdued so my creatures can live in the foreground.





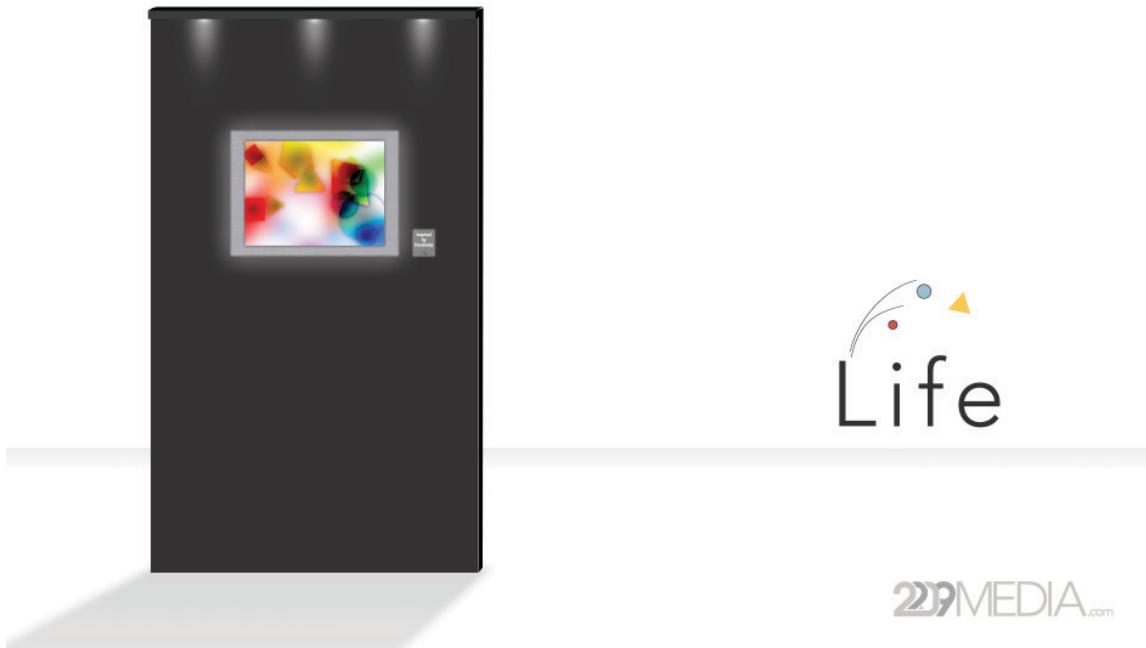
Improvisation 31 and Composition IV (among others) also inspired my background. If not as vague as Yellow Red Blue, both are very colourful. First up is Improvisation 31, then Composition IV:



# THE WALL

AUGUST 5TH, 2008

TAGS: DESIGN



The above image is a mock-up of what my final presentation will look like. Of course, this design was chosen for a reason.

As I was creating a painting (albeit a responsive one), it is made to be hung on a wall or something very similar. However, it is also a computer display, with cables and all, and that would be... well, untidy at least, unless I have some way to hide those. Since I have near nothing to say about where in the exhibition hall my painting is going to be shown, and since I don't dare hope to get permission to actually open up the wall to hide my cables in it, I had to come up with something.

I decided I would work this to my advantage. As it is an exhibition, I imagined the ideal exhibition space for my painting. That would be a modern gallery or museum, so, we (Patrick was my aid in this again, of course) decided to go modern... Brushed metal and lights, to be precise. Behind the picture frame, I will add lights that shine onto the wall, a bit like Philips Ambilight [13]. I hope I even have time to construct this, so it won't be as sophisticated as true Ambilight.

[13] <http://www.seductionbylight.com/>

Also, we settled for a black (or rather dark grey) wall. While paintings are usually portrayed on a white wall, this is not only a painting, but also a display. It actually emits light, so it doesn't need much (any) from its surroundings. A dark wall works well to enhance the colours, and the light behind the frame will work very well to smooth the contrast so it is softer on the eye. Possibly, we'll work some of Kandinsky's woodcuts in the background, in a low-contrast colour (a bit darker or lighter than the background), so as not to forget the master.

Then there are the few spots on top; not really necessary, but it does add to the atmosphere. Last, but not least, the nameplate: if I can manage, it will be acrylic glass with my name and the name of the painting engraved and shining softly. That would be a nice detail!

All in all I am very happy with the design. As this is not top-priority, not everything may make it, though... There's still loads of work to be done to actually get the design sketches to actually work. Well, I guess I'll just work like a madman to get it all finished in time!

# HEREDITY

AUGUST 5TH, 2008

TAGS: THEORY RESEARCH

Finally, we get to the part where the future gets important. First, we have genes which make up a large part of who and what we are. Second, we've seen how these genes get duplicated, and mixed by crossing over. Third, mutations can occur, so actually the number of different possible genes keeps growing. In short, there's a lot of variation.

Charles Darwin was the first to come with scientific proof that, by means of natural selection, this variety can contribute to the improvement (in ways of preservation) of a species.

*"[I]f variations useful to any organic being ever do occur, assuredly individuals thus characterised will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterised. This principle of preservation, or the survival of the fittest, I have called Natural Selection."*

(The Origin of Species, 6th edition, p102-103, London, 1872)

In that time, it wasn't known where this variety and accidental differences originated (even Darwin wondered at that), but the fact that it existed was observed. Even today, we do not know all ins and outs, but we know a fair bit more.

## **Alleles and zygosity**

A gene describes some part of our bodies. Many of these features however, differ among people. For example one's skin colour, or the fact that you do or do not grow hair on the backs of your hands. In these cases, the different possibilities are called alleles. As we have two copies of almost every gene (one on our father's chromosome, and one on our mother's), we can have one or two alleles per gene, but that doesn't mean there are more possibilities.

The allele that occurs most often is called the wild type. If an allele occurs in less than one percent of the population, it is considered a mutant allele.

If you have a pair of alleles where both are the same, you are called homozygous for that gene. When both differ, you are heterozygous. When there is but a single gene (for example on the X chromosome by males), it is called hemizygous.

## **Dominance and recessivity**

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When there's a homozygous or hemizygous situation, the outcome is pretty clear: there's only one possible option. With heterozygous situations, this is different.

Some alleles are 'stronger' than others, if that is the case, they are called dominant. The weaker allele is called recessive. This dominance is relative to these specific alleles, for it is possible that an allele that is recessive to a certain dominant allele, is also dominant over another.

When a dominant allele occurs in conjunction with a recessive allele, the dominant allele gets preference. An example is that the allele telling your body to grow hair on the back of your hand is dominant over the allele telling your body not to do so. So, if you've got both, you get hair on the back of your hands, because that's the dominant allele. This also means that the recessive allele cannot manifest itself unless it appears in a homo- or hemizygous situation (or in a heterozygous situation with another allele that it is dominant over).

Sometimes, both alleles have different influences. This is generally well portrayed by pigmentation (for example skin colour), which mostly blends. In such a case, both alleles are partially dominant.

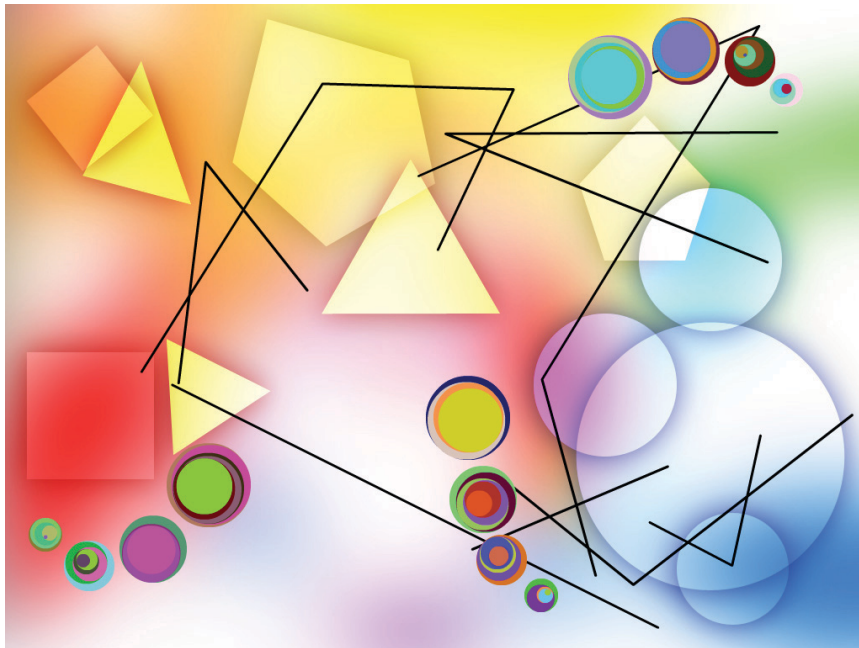
Of course, there are also many deviations... But I dare say this is complicated enough!

# A NEW MOCK-UP

AUGUST 6TH, 2008

TAGS: CONCEPT DESIGN, DESIGN

I have created another mock-up of the final product. The background is almost the same as the one shown before, but I have changed the effect to something I am more likely to be able to achieve in Flash.



What's the theory behind all this?

## **Background**

First up: the background. The blurry bottom layer is, as discussed, derived from the video feed. This is actually the most important thing (besides the creatures) as this creates the world my colour sensitive creatures have to live in.

The geometrical shapes layered over the blurry layer depend on this layer. I am actually thinking of making them smaller, and acting as 'food' for the creatures. This is something I have to play with, after I've delivered this thesis in paper form. The shapes will be attracted to their respective colours. Kandinsky was already quite clear on the circle (blue) and the triangle (yellow), and I have no doubt I can match the other colours later on.

## Lines

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The lines are random now, but I will use them later to connect points that I use internally to calculate safety and routes for the creatures, so they may act as guides for the creatures to rely on (if they are so inclined). They may still seem random to the outside world though, but they won't be. Again, the specifics are not yet determined, as my main focus is on the evolution of my creatures.

## Creatures

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Ah, yes, my dear creatures. They are the three sets of circles on the top. The creatures 'live' inside my painting, and have to survive in these lands of colour. They are sensitive to the colours, need to eat, and need to mate in order to preserve their genes — or, if they are genetically flawed: become extinct at the soonest possible occasion. I will do a post on their genetic make-up tomorrow.

# CREATURE BUILDING

AUGUST 7TH, 2008

TAGS: CONCEPT DESIGN, DESIGN

After a lot of puzzling, I've put all the information I've gathered together to create a suitable set of genes for my creatures — or should I say: chromosome? I also think I've got a suitable system for reproduction.

## Behaviour

I want my creature to be sensitive to the colours in the painting. I have designed a behaviour for it to accommodate this sensitivity.

### General sensitivity

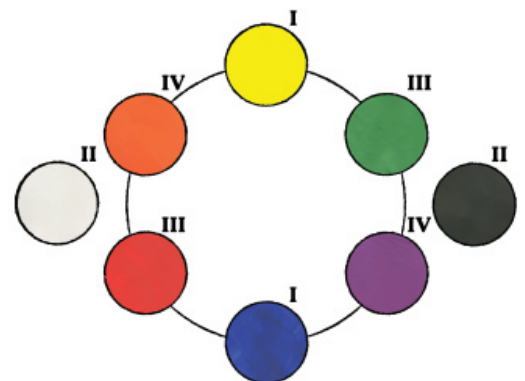
First, there is general sensitivity. In my case, this means that a creature gets healthier when it is in an area with its preferred colour, and gets sick in another. We've already seen Kandinsky's four contrasts, but to refresh your mind here they are again:

I have grouped preferences and dislikes like the contrasts. If a creature prefers one colour of a contrast, it dislikes the contrasting colour as much. Since I do not use black in my algorithm, and everything defaults to white (which equals life, according to Kandinsky), contrast II is not very suitable for this, but the other three are. So we have:

- I: Yellow vs Blue
- III: Green vs Red
- IV: Orange vs Violet

Then, the creature has a sense of awareness about this. This awareness is selected per colour. This awareness basically means how well the creature knows a certain colour does him well (or not). To illustrate this with an example:

The creature has a very great liking of yellow, and thus gets very sick from blue, the contrasting colour. It knows very well that yellow is good for it, but it has almost no clue as to how bad blue is. Since it knows well about yellow, it will try hard to get to some yellow ground, but because it is not very much aware of how ill it would get from blue it could make the choice to travel over a large piece of blue painting, just to get to the yellow. It will get very sick, and perhaps die, but it wouldn't know why.





## Food

Food is basically arranged in the same way: contrasting colours are opposites as well. The values of liking may be different, however. So even though our example creature above has a special fondness of the colour yellow, it might not like yellow food so well but prefer the red ones. However, if a creature likes a certain colour, it will always like food of that colour, and vice versa, so it doesn't have to walk through, say, poisonous red lands to get to the red fruits it needs to survive. This to give the evolution at least a little helping hand.

However, there's also an awareness statistic for food. It may happen that a creature doesn't know a fruit is poisonous to it, and happily eat it because it is hungry.

## Other traits

There are a few other traits to take into account.

### Mating

When certain conditions (like being healthy and having a full stomach) are met, the creature will try to mate. If the creature is warm blooded (metaphorically speaking) it will try to mate earlier than when it has a cold heart. This will be linked to its general sensitivity to the first contrast, as that is warm versus cold.

### Speed

Some creatures are more athletic than others. Some really sprint towards their goals (possibly in such a rush that it completely ignores poisonous lands), whereas others take it easier. This is linked with the third contrast; stationary versus moving.

### Intelligence

Intelligence is linked with the amount of liking the creature takes to orange. I found this fitting because of Kandinsky's statement:

*"Orange is like a man, convinced of his own powers."*

### Moodiness

This is linked to violet, the colour of mourning. The higher the creature scores on violet, the more depressed it is, and it will be very hard to get him happy.

## Statistics

The creature will have two statistics that can be influenced during its life. The first is health, which is influenced by its environment and the food it consumes. Second, there is hunger, or satisfaction. If a creature doesn't eat, it becomes hungry over time.

It will display visual clues of these two statistics:



**Satisfied and healthy**  
50% lightness and 100% saturation



**Hungry and healthy**  
75% lightness and 100% saturation



**Satisfied and unhealthy**  
50% lightness and 50% saturation



**Hungry and unhealthy**  
75% lightness and 50% saturation

## Chromosome

In order to make it all not too complicated to put this in a genetic make-up, the creature will have one chromosome and there will be no different sexes, just like snails and other hermaphrodites (strictly speaking, hermaphrodites are both male and female at the same time). It will however have one chromosome from each parent.

The following schematic displays an example of all the different genes. Please note that the sensitivity and food values are symmetric: a high value for yellow means a low value for blue, as explained above.

The genes will be visualized on the creature's physical appearance. The first and largest circle ('head') will display the sensitivity genes, the second sensitivity awareness, et cetera. The colours will be sorted in a high-to-low order from the outside to the inside.

|   |  |  |  |  |   |                                    |
|---|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---|------------------------------------|
|   | Sensitivity                                                                       | Awareness                                                                         | Food                                                                              | Awareness                                                                         |   |                                    |
| [ | Yellow                                                                            | +3                                                                                | 9                                                                                 | +1                                                                                | 4 | Warm colour, mate earlier          |
|   | Blue                                                                              | -3                                                                                | 3                                                                                 | -1                                                                                | 4 | Cold colour, mate later            |
| [ | Green                                                                             | -1                                                                                | 4                                                                                 | -3                                                                                | 0 | Stationary colour, slow            |
|   | Orange                                                                            | +1                                                                                | 6                                                                                 | +3                                                                                | 6 | Moving colour, fast                |
| [ | Light Orange                                                                      | -2                                                                                | 0                                                                                 | -2                                                                                | 5 | Convinced colour, good pathfinding |
|   | Purple                                                                            | +2                                                                                | 7                                                                                 | +2                                                                                | 7 | Mourning colour, unhappy           |

All in all there are 18 genes:

- 3 genes for sensitivity
- 6 genes for sensitivity awareness
- 3 genes for food
- 6 genes for food awareness

## Reproduction

As my creatures are more statistics than real living things, I don't need to duplicate all the genes every time (it doesn't even have the cells to put them in! ;)), so I will simulate the formation of gametes when two creatures decide to mate. Therefore, for both parents, the chromosomes will perform a crossover for a random number of times and then one from each parent selected to create their offspring. Also, mutations may occur.

### Alleles

When the new set of chromosomes is created, a new problem shows up. It is very likely that there are two alleles present for each gene. I could of course decide to make a love for red dominant over a love for green, but then I would create a large disequilibrium. With the massive number of traits available for us humans, it doesn't matter so much, but with only 18 genes available it would statistically make sure 'green-lovers' will become extinct. The genes would live on, but it wouldn't manifest itself very much, which could be very problematic. When my product is in a more finished state, I will however do some experimenting to see how this will develop in reality.

To try for a more balanced approach, for now I decided that larger absolute values are dominant over small ones. So if there is one allele that says: +3 for red, -3 for yellow, and one that says -2 for red, +2 for yellow the +3/-3 one will be dominant because 3 is greater than 2.

Considering the awareness genes, I will implement an order of dominance, so this will also be applied to my project. I think it is more interesting to have a random order of dominance (which would be the same for all the creatures, of course) than to make larger numbers dominant over smaller ones. It adds that bit of randomness found in nature.

To not forget partial dominance, I will use that for the other traits like speed and intelligence. That will also result more differentiation, because there are more possible outcomes.

# REFLECTION

AUGUST 8TH, 2008

TAGS: META

This concludes my thesis. From now on, I will be working on putting it together in a document, so it can be delivered in paper form coming Monday. In this post, I will reflect on the process of writing a weblog, and offer some advice to future students considering to write their thesis as a weblog.

## Positive

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I think writing my thesis as a weblog was a great experience. While I find the writing of a normal thesis or paper can be quite boring at times, I haven't had that problem with my weblog. I think this is mainly because there is more variation in writing: usually, you write everything of a single subject at one time. Also, I liked that there is more freedom to express myself, and that I have been able to add interactive applets to it.

## Negative

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It has not been all roses, though. As I've already mentioned, it can be quite hard to write regularly. Usually, I was so busy with other things that writing for my weblog got postponed. You may have noticed that the post count of the last days has increased massively, because I was far behind with writing everything down.

## Advice

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My biggest problem has been that I procrastinated writing. My advice to you is therefore simply: Do not do this! Write every time there's some development! It is very liberating to write a weblog instead of a normal thesis, so please don't spoil it for yourself by having to do it all in the last week like I did.

I'd recommend setting an update schedule for yourself. It will encourage you to write. The two days per week I set for myself were not enough. By far. You'll need much more than that; I'd suggest updating at least four times per week, but better would even be to sit down for an hour at the end of each day and write your post. Do not worry if you cannot complete a post, because it would be somewhere halfway your researched topic. Write a draft, and finish it the next day — it will save you time then, so it is easier to start.

# CONCLUSION

During my research, I have tried to answer my research question:

*How to create a responsive painting that would respond to the public through evolutionary patterns?*

The sub questions this posed were:

*How do genes work, and how can I make them work in my painting?*

I have been able to devise a genetic description for virtual creatures that will live in the painting. This description mainly determines how able they are to survive. Also, I have created an algorithm based on the workings of nature to let the creatures create offspring. Through natural selection, only the 'good' genes should survive and the 'bad' ones should wither away. I have not yet been able to test this, as I am still working on my project.

*What will it look like?*

The answer to this question was found in Kandinsky's theories and art. The choice for Kandinsky is arbitrary: I choose it because I felt it was the right thing. The rest of the design is derived from his abstract paintings and theories about colour and shape.

*How can I convert the painting's surroundings to a landscape?  
(Or: how does the interaction work?)*

Through experimenting, I have found a way which builds an abstract and soft clouded image from a camera feed which registers the surroundings of the painting. This image will serve as a background for the painting, as well as be the most important part of the landscape the creatures will live in. If the image from the camera changes, so does the landscape. The creatures will have to adapt to that, which brings us back to the first sub question.

To answer the main question in short:

*The painting will consist of a virtual landscape, which is based on a camera view of its surroundings. In this landscape, a species of virtual creatures will have to survive. The ability of the creatures to survive is based in nature's own ways, and through natural selection, hopefully a strong species will develop. The design of the painting will be based on Kandinsky's art and theories.*

# APPENDIX: REFERENCES

## **Literature**

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