

REMIXED

CULTURE / NATURE

Is our current remix culture giving way to a
remixed nature?

Elisabeth Nesheim (Nov. 2009)

UIB: DIKULT 303 Remix Culture

Video URL:

www.multiplum.com/mostly/storyboard/remix-culture-nature-video

Introduction

Remix is a cultural activity that has become increasingly visible with digital technologies and the internet as a global network for sharing. The act of remixing, of making creative comments to existing works appears natural. A part of the human condition.

And this human desire to contribute and comment, appropriate and mix, seems to have entered another realm as well, namely that of nature.

From the earliest myths to modern fantasy literature man has speculated on the existence of godlike hybrids, chimeras, mutants and cyborgs – creatures that with few exceptions wouldn't be produced by nature herself. It needs a guiding hand, a re-creator. We are not seeing Pegasus circling the church towers, and Manticores in lurking in the woods. But we are witness to a range of creations that hardly would come into being by natural evolution.

Through bioengineering we are presented with fast-growing animals, insect-resistant crops, cloned organisms and offers of human gene therapy. This genetic cultivation of nature is reserved scientific researchers in closed-off laboratories, but with artists becoming increasingly well-versed with technology (i.e. in the electronic art movement where artists are engineers or work closely with engineers to realize their works.), we are witnessing a trend of artists entering close collaborations with biologists and genetic researchers, producing works for aesthetic reasons, rather than the greater common good of mankind.

The ethical implications of these endeavors are massive, and every step of geneticists and bio-artists are watched closely and governed by strict regulations.

This article has a two-fold attempt: First, to set in place a definition of remix as a cultural activity, and secondly, to see if this type of activity is possible in the natural domain. I will lean on the work of Eduardo Navas, Henry Jenkins and Lawrence Lessig to land on a conceptual understanding of remix, and look at various works of bioart and tendencies in biological research for comparison. In terms of a discussion on the ethical consequences of biological remixing, this is a topic that reaches beyond the scope of this article, but is nonetheless a very important one.

Remix (not) defined

If I asked ten people if they know what a remix is, I would probably get ten confirmations, but if I asked the same group to pin down exactly what remix/remixing entail, the answers wouldn't be as unison and clear cut.

Current definitions

Remix consist of two words, the prefix «re» which means back or again^[1] and mix that refers to combining, either as joining to things together into a new unit or handling things in parallel. So, remix can be understood as the activity of combining things again – recombining.

RE	Back, again
MIX	1. to (cause different substances to) combine, so that the result cannot easily be separated into its parts 2. to have or do two or more things, such as activities or qualities, at the same time

Although we can talk about remix as an act of recombining, this isn't really nailing the scope of the activity. When confronted with Jxl's remix (music video) of Elvis Presley's Little Less Conversation^[2], saying that Jxl recombined previous Presley material doesn't seem to cover neither the intent nor the ability of the remix-artist. Wouldn't we also be able to call the play of a 2-year-old, building and tearing down Lego towers, recombining?

In the online Cambridge Advanced Learner's Dictionary^[3], I find the following definition of remix (noun): «a piece of music that has been remixed »

Ok, I look for the definition of remix (verb) and find «to use a machine or computer to change or improve the different parts of an existing music recording to make a new recording»

Here, remix as an activity it is connected to a specific practice within the music industry , particularly recorded music, and secondly, the activity has a direct technological element – you need a machine to make a remix. The definition does keep the element of recombining, and also allows for changes and improvements of the the parts.

Yet, it views remix as a musical activity that is carried out on a computer, and even though this would be true for most musical remixes, it excludes or fails to address other remix expressions in terms of media (video, text or mixed-media remixes) and genre (political remixes, fan-remixes, entertainment, learning-remixes), it also fails to address the connection the remix has to the original work.

The original and the remix

The relationship to the original needs to be addressed as any remix seems to depend on the roots for its meaning. But how close or apparent does this relationship need to be? What degree of transformation can a remix allow itself for it still to be a remix and not a new work?

Art and media theorist Eduardo Navas, promoter of remixtheory.net and ph.d candidate at the University of California, has written several articles on the topic of defining remix as a cultural activity. He, as many others, used music as a starting point, in fact he believes that it was in music culture this activity first appeared, with the re-appropriated use of the turntable in DJ-culture of the 70's (Navas 2009)

Navas explores a range of net art projects, new software applications and digital community activities as example cases in his research.

In one of his earlier articles he proposes this definition of remix:

"the activity of taking samples from pre-existing materials to combine them into new forms according to personal taste" (Navas 2007).

There is the same mention of identifying parts or samples from an existing work and recombine them into something new, as we have seen in previous definitions. He also adds the notion of intent from the remix creator, «the personal taste». In the same article Navas introduces three types of remixes: The extended remix, the selective remix and lastly, the reflexive remix where he argues for the extent a remix is referring to an original work.

The extended remix leaves the original work complete, just extending some pre-existing features of the work. A typical example is the extended version of a track compared to the shorter radio edit version.

In the selective remix particular parts are added to or/and subtracted from the original work, while leaving the intent or the «aura», as Navas puts it, of the original work inherent in the remix.

The reflexive remix is further abstracted from original work(s). Yet, even if the title of a piece is the only explicit reference left – Navas argues that it is of great importance that intent, although challenged, is recognizable by the audience for it to be accepted. This is the reflection aspect, as the viewer is asked to produce his/her own meaning and critique based on the new combination of known signs, symbols and narratives.

In later articles the main point of Navas becomes more clear as he states that «the remix is always allegorical, meaning that the object of contemplation depends on recognition of a pre-existing cultural code» (Navas 2009).

Core elements of the remix, the appropriated parts, are always connected to their roots in history, and although abstracted, these signs need to be apparent to the viewer for the remix to be successful and validated.

This gives an immediate association to the research of Henry Jenkins on fan culture production described in book *Textual Poachers – television fans & participatory culture*, where he argues that the success of a fan video creator lies in his/her ability to present a new narrative based on original material, that unveils suspicions and fantasies already present within the fan community (Jenkins 1992, 238). As an example he refers to fan videos exploring the possible sexual relationship between Captain Kirk and Spock in the Star Trek Universe. He argues that the remix artist primary function lies in the «imaginative juxtaposition» of already created material (225), indicating the clear dependence of the original.

Jenkins as Navas both seem to claim that the remix artist needs to know the original meaning attached to the elements or samples used in the remixed work, as well as having an imagination/taste as well as a clear intention when reconstructing the parts into new narrative. So there seem to be some elements that are crucial for a remix to be a Remix:

▣ **Sampling**

The remix artist need to be able to recognize different elements of an original work for their inherent meaning and purpose.

▣ **Reconstruction**

The remix artist can recombine the inherent meaning/purpose of the sampled parts into new constructs/narratives.

▣ **Reference and relationship**

The extent to which a remix is referring to original work(s) can vary from simple appropriation to pure abstraction, yet there always has to be a explicit link to the origins, which serves as the very source of power of the remix.

The relationship between a work and its remix is also shaped by the intent of the remix artist. Remix can be a method of critique, using specific elements in combination to shed light on a problematic issues or even aim to correct errors. Many remixes pose as challengers, portraying themselves as improvements, the next generation versions of a pre-existing work.

The remix can be statement of support and dedication, like the various fan productions adding to, re-evaluating and extending an existing work. An intriguing example here is the continuous production of Thief II computer game community that is still building fan missions for a computer game that was released in 1998. Here original characters and storylines are explored to the max, in addition to the introducing of an impressive range of side plots and additional characters - now fixed in the Thief Universe^[4]. An lastly, there exist a bunch of remixes that do not seem to have any other intent than that of humor and entertainment.

Remix technology and community

Cut/copy/paste technology and mixed-media

To what extent is the use of technology and mixed-media expression a criteria for remix as a cultural activity?

Navas do hint at the use of technology, particularly digital tools, to produce remixes when he states that:

«Remix culture can be defined as the global activity consisting of the creative and efficient exchange of information made possible by digital technologies that is supported by the practice of cut/copy and paste » (Navas 2009). Some confusion do arise as he begun the same article by stating that remix culture was launched with the **analog** turntable technology of the 70's. Confusion set aside, it is interesting to notice is that he does argue for cut/paste/copy technology as a premise for remix (analog as well as digital), adding that the «codes» of remix have been present in art for a long time already through practices of appropriation and collage (Navas 2007).

Henry Jenkins also offer an insight on analog remix production when discussing fan video art of the 80's-90's realized on home-video VHS machines (Jenkins 1992, 244), He describes that despite the meticulous work of identifying the right sample, copy and pasting it into a new tape, this didn't hinder remix work to be produced.

The cut/copy/paste technology appear to be an important if not necessary tool for remix creation, although the technology doesn't need to be digital.

Navas is unclear on how a proper remix differ from a work that has the «code» of remix within it - as it is not the criteria of production by means of digital technology. Here I will challenge Navas by stating that even basic analogue tools like scissors to cut pieces from one work, pasting them into new combinations (as in the production of a collage) - are sufficient for remix creation, although challenged when it comes to copy (not everything can be duplicated through a Xerox machine). Jenkin's fan artists also struggle with the coping of their fan videos, as each copy noticeable deteriorate the quality of the work, as is the case with analog reproduction.

Another feature of modern remix culture is are the use of several media types. Navas remix definition do not state to what extent remixes are mixed-media expressions, which seem to be a common feature of most remix works today. Film clips from one source are mixed with musical references from another, text is added on top - all presented in one package. Still, looking at remix practice in music today, we are almost exclusively looking at single-media remixes, that is pure audio. (Notice that I am not considering the various sources of samples used, or the multitude of music software and hardware present in different musical

productions, as a media type – which would turn close to everything into mixed-media expressions).

The close connection to digital technology with its inherent cut/copy/paste features, and internet as the greatest sample library per now, invites to a wider use of mixed media expressions. Although mixed media remixes seem to embrace modern remix culture to a greater extent, I argue with the long tradition of musical remixes that it is not a criteria for remix.

Spreading the copy and the idea

The criteria of «copy» in a proper remix tool, is also linked to the ability of the remix production itself to be copied and thus spread.

A rich remix culture is spawned not only from one particular interpretation of an original work, but often the multitude of various remixes addressing the same original works from different angles (looking up Star Trek on YouTube would give you a hint.). This activity is becoming prominent and visible particularly due to digital technologies, where simple editing tools and digital formats allow for quick manifestations of inspiration, but primarily due to internet as the world's largest copying machine – allowing for global sharing with a few clicks. Analog tools and copy methods, can not compete with the digital in this aspect.

Another aspect of spreadability is the sharing of the idea, the concept, the very core of the intent of the remix and the reference to its roots. There are clear indications that remixed works are part of spawning and confirming communities that contribute to the extension of a particular original work. Remixes function as comments and articulations of opinions, and those opinions are shared and critiqued again by members, creating a learning environment.

Jenkins speaks of the success of remixed works happening when it «evokes the cultural competency and shared knowledge of the community» (Jenkins 237).

The fate of the remix seems to lie in its ability of picking up on something key in the original that is of importance to an audience, and share it with that community.

The amateur and the professional

The divide between amateurs and professionals in terms of cultural production seems to blur in modern remix culture, as any person with a computer, web access and simple editing tools have the possibility to recreate and share cultural works.

Law professor and digital rights activist Lawrence Lessig gives an insightful account of what he calls the Read/Write culture of the 21st century in his latest book *Remix – Making Art and commerce thrive in the hybrid economy*, where web technology (particularly web 2.0) invites to a range of social media, collaboration communities and file sharing networks. Every can join, create content and share it – individual motivation and interest, and not a particular professional expertise, is the key driving force. Amateurs and professionals create content side by side.

There are also examples of amateurs putting tremendous effort into creating

seamless remixes for an audience, a dedication that eventually invite the remix artist into the ranks of the professionals of a certain field.

So to sum up

- Remix as cultural activity demands access to a copy/cut/paste technology.
- The simplicity in use of the technology allows a wider group of people become active participants and creators.
- The ability of the copy/cut/paste tool to produce spreadable copies, and a global sharing network will increase the scope and range of the activity.

PART II: Biological remix?

I have searched for the origin of the word «remix», but have yet to find out when or who coined the term. What is certain is that the term appears in the 1956 March edition of *Nature* in the short article «*Cytogenetics of South American Orthoptera*» by Francisco Saez, where he states that: «The undiminished fertility of the inbred plants when pollinated by bees promotes rapid remixing of genetic material under favourable conditions.» (Saez 1956, 490). Remix is here used to explain the result of bees transferring genetic material between inbred plants – the distribution and mixing of different genes.

This use of the word seem to consider natural processes of nature – the exchange of genetic material, as a remix activity. Although that is an interesting perspective, it is not the one I want to explore. In line with the definition presented above, I argue that remix is an cultural expression of human intent and creativity, and it is with this perspective I continue the discussion below. Another important clarification is that even though I will talk about nature in contrast to culture, it is difficult to postulate a clear distinction between naturally occurring objects from cultural ones – considering man's long tradition of cultivating nature.

Sampling in nature: Genome projects

«Genes are found on chromosomes and are made of DNA. Different genes determine the different characteristics, or traits, of an organism» (Sarah E. DeWeerd 2003, ch.3).

Genes contain information of all the characteristics in an organism; visible ones like the length of beak on a bird or the color of the eyes on a human, and more hidden traits; like blood type and dispositions for a particular disease.

The aim of identifying and classifying of all genes and what traits they control in an organism, have resulted in several genome projects.

At present time we have classified the entire genome of several species^[5].

The first genome to be fully sequenced was that of a bacteriophage, back in 1977 by Fred Singer and colleagues (Fleishman et al. 1995), and the last 30 years we have continued the effort to include full genome libraries of various plants, trees, insects and animals. The Human Genome Project is probably the most controversial of them all, with the aim to identify the 20.000-25.000 genes in our 46 chromosomes.

The genome projects gives us knowledge of the building blocks of an organism, or if adhering to the remix definition above – we are able to identify the meaning of a particular elements. The knowledge of how to manipulate and re-adapt these building blocks are key to the science of genetic engineering, but also to recent biological art works.

Reconstructing nature - generating new narratives?

In the growing field of genetic engineering we are confronted with practises of enhancing, altering the inherent structure of an organism, primarily in bacterias and plant – but also increasingly in animals. The knowledge gather from various genome projects have given scientist new methods of domesticating nature. When addressing the question of whether biological remixes are possible, let's take a quick look at what genetic engineering is and can do.

Catherine Baker is a writer working closely with American Association for the Advancement of Science (AAAS) that commissioned her to write an introductory book on genomics and ethics related to the Human Genome project. She gives the following introduction to the practice of genetic engineering.

"Researchers have found ways to slice genes out of a genome. They have learned how to make changes to a gene and how to replace one gene with another. This "cutting and pasting" is called genetic engineering, and it's a very useful way to do research." (Baker 1999, 53).

Or quoting professor of biology Steven Nowicki, genetic engineering is based in techniques of «how to cut and paste a molecular DNA, and how to move DNA from one organism into another» (2004)

Genetic engineering is the base of modern biotechnological industry as seen in food production, creating more resistant crops or fast-growing animals[Aqua Bounty's fast growing salmon^[6]. It is also becoming an important factor in modern medical industry, e.g. insulin production^[7].

GE is also an essential technology in wide range of biological research, as seen in the creation of transgenic animals - animals that are enhanced or altered by the introduction of the genetic material of another specimen of the same species or another species completely. One example are the work of scientist Josef Penninger who uses transgenic mice to model human diseases, such as obesity and cancer, and the abilities of our immune system^[8].

Returning to the above criteria of remix of recombining or improving elements from different various works, there seem to be strong similarities in the practice of genetic engineering in terms of technique. We currently do have the technology to cut/copy/paste elements of one organism into another, to promote or remove certain characteristics of a particular organism. In this sense genetic engineering might be just the technology required to enable biological remixes.

The curious scientist and the bio artist.

The examples of genetic engineering above are governed by the drive of the scientist to search for solutions that will reduce poverty, hunger and disease. But we also find examples where organisms are altered by scientists for other

purposes, in the case of the creation of the luminous tobacco plant where genes from a firefly are introduced into the plant. This curious experimentation was set in place for the scientists to get a better understanding how genes instruct cells (R. Monastersky, 311).

Artists have also moved into the field of biological engineering, not to combat disease or fight hunger, rather to invite to social reflection and critique through their art works. Bio artist Eduardo Kac latest project «The Natural History of the Enigma» is the creation of a what he claims to be a «plantimal», the Edunia. The Edunia came into being after Eduardo Kac introduced a gene from his DNA into the red blood veins of a Petunia. The purpose of the project, Kac states, is to bring «a reflection on the contiguity of life between different species», to show that the link between different species of life is fragile and possible to bridge^[9].

The practices of scientists and artists alike are introducing creations that currently do not exist in nature, and possibly never would, had it not been for the creative capacities of man.

Reference and critique

A reflexive remix?

Assistant professor of pharmaceutical chemistry at UCSF, Chris Voigt, leads a student project aiming to create living photographs. Produced through genetically re-engineering, e.coli bacterias respond as pixels in a digital SLR camera, where the amount of light exposure will trigger the production of pigment in the bacteria, thus producing the levels in a picture^[10]. The e.coli's are transformed from being rather harmless bacteria to become a photograph. And the publicly held association relating to e.coli bacterias (being the most common bacteria in our intestines that helps us digest food and create vitamins), are no longer in place when you see them forming a replica of Alfred Hitchcock famous profile^[11].

A critical remix?

Performance artist Stelarc is preoccupied with the deficiencies of the body as an interface, and seeks to extend it through modern technologies, previously with robotics and later with genetics. In 2006 he collaborated with a scientist to cultivate new ear based on his own genetic material, and then committed to surgery to have this third ear attached to his left arm. The ear has functions of a normal ear, and in one stage of the project (although now removed) a microphone was attached at the end of the ear (inside the arm) to transmit the sounds caught by the ear. As he describes it “a facial feature has been replicated, relocated and will now be rewired for alternate capabilities”^[12].

The ear wasn't set in place for fun or because of a particular physiological need. In

fact, Stelarc uttered that it took him years to get a someone to perform the surgery, as it wasn't a clinical need for it. Rather it was a project that aimed to extend the evolutionary body in the hopes that «if body was altered it might mean adjusting its awareness». Stelarc remake of his body proposes a clear critique of the body in its original state.

Copy and Spread?

I concluded that genetic engineering has provided us with the cut/copy/paste technology that is a premise for remix. But is important to specify that the copying of genetic material and characteristics is not only time-demanding, it is also work that requires an extensive professional expertise and knowledge that is reserved few. All in all it can hardly be compared to two digit requirement of CTRL-C to copy digital information.

The current technology used for manipulating genes are also incredible expensive, making it an enterprise that requires substantial funding or a lucrative bag of holding.

On the other hand, returning to Kac's Edunia, this «plantimal» is fertile, i.e. it produces seed that carry the same genetic code and thus also the protein isolated from Kac's DNA. This new creation has the possibility to copy itself using nature's inherent motor for spreading, and thus thrive in the global shared network that is nature.

Letting nature loose

– amateur experimentation and artist/scientist collaborations

The last years new organizations and collaboration networks have appeared under the slogan of DIY biology. The members are artists, biologists and engineers that collaborate on projects and exchange knowledge and expertise.

DIYBio, a community for amateur biologist and engineers, presents themselves as: «DIYbio is an organization that aims to help make biology a worthwhile pursuit for citizen scientists, amateur biologists, and DIY biological engineers who value openness and safety»^[13]. And their projects consist of DIY microscopy, self genotyping and bacterial photography.

Another organization, Hackteria, founded in 2009, presents their mission as: «The aim of [Hackteria] is to develop a rich web resource for people interested in or developing projects that involve DIY bioart, open source software and electronic experimentation»^[14]

Hackteria also offers workshops teaching their participants how to build and use proper lab equipment, microscopy, create habitats for various microorganisms, place sensors on the microorganisms and finally introducing hardware and software solutions to read and translate the sensor input.

These organizations are not presenting a remix activity as such, but the existence of the organizations, the resources and the workshops they offer, are closing the gap between the white-coated scientists performing their experiments behind closed lab-doors, and the every-day man. And maybe more importantly, they are bridging artists and scientists through the exchange of knowledge and ideas, opening for future collaborations.

The works of Eduardo Kac and Stelarc would never have come into being without the aid of a professional bio engineer, providing the skill to realize the artistic intent of the artists. That such collaborations are becoming more common can also be mirrored in range of genetic art works presented at the renowned electronic art festival Ars Electronica in 2009. The topic of the festival was «Human Nature», aiming to explore humankind's augmentation of nature, especially in the realm of genetics^[15].

Conclusion: A seed is sown

As of today, the cultural remix activity can not be said to have entered the natural domain, although there are clear signs that things are changing. 10 years ago, people were skeptical or even raged by the thought of genetically engineered vegetables and fruits, today close to 75% of all processed food in North America has a genetically modified ingredient. Fish are altered to grow faster, and there are several projects running aiming to adjust the growth genes in other animals as well. What makes it even more tricky is that many of these alterations are not visible to the human eye.

The aim of biological scientists are to a large extent governed by values of creating solutions that aids humanity. When the creative intent of artists enters the equation we are witnessing works that extends such solutions.

Looking at electronic music production of the early 70's, the hardware equipment used to create and structure sounds, close to demanded the skill of an engineer. Today music production tools are so simple in use that everyone can produce a track in a few hours.

Perhaps the same goes for tools of genetic engineering? Today they are intricate and demand a very specific expertise, although many businesses are now offering easy-to-use equipment for rather advanced productions.

This, of course don't provide you with the know-how of biological micro-systems and the consequences of mal-practice. However, with the rise of DIY biology organizations, we are witnessing communities dedicated to teach amateurs with an interest and motivation, the basics tricks of the trade.

With this in mind. I believe the next 10 years are more than likely to produce creations earlier limited to human imagination.

NOTES

1. Prefix/Suffix dictionary: <http://www.prefixsuffix.com/rootsearch.php?navblks=1011000>
2. The remix video Elvis Presley vs Jxl «A little less conversation» are combining original content from several media sources. Jxl presents a well-known Elvis song in a new dress, adding new funky beats while keeping Elvis' singing more or less exact intact with original. Videowise Jxl is drawing on known scenes from the Elvis music video Jailhouse Rock, where Elvis popular hip-moves are replaced by modern and equally popular dance expressing. In this way Jxl is placing two separate Elvis expressions in a new context, creating new links between original material. Knowledge about previous Elvis works and an intention about a new works seems to be present. <http://www.youtube.com/watch?v=BSkDQYe2FY>
3. Cambridge Advanced Learner's Dictionary: <http://dictionary.cambridge.org>
4. Thief Fan Mission Community: <http://www.ttlg.com/forums/showthread.php?s=720f0e0cc23a57b41b917d2fe5330ef6&t=48202>
5. For a full list of the status of various genome projects, consult the NCBI Entrez Genome Project online database <http://www.ncbi.nlm.nih.gov/sites/entrez?db=genomeprj>
6. Fast-growing salmon and trout the main products of the commercial business Aqua Bounty <http://www.aquabounty.com/products/products-295.aspx>
7. Introduction to human insulin production: <http://www.littletree.com.au/dna.htm>
8. Josef Penninger's faculty home page on the University of Toronto web site: <http://www.immunology.utoronto.ca/faculty/directory/penninger.htm>
9. Eduardo Kac's homepage and description of 'The Natural History of the Enigma': <http://www.ekac.org/nat.hist.enig.html>
10. Science Daily review of the project: <http://www.sciencedaily.com/releases/2005/11/051123171556.htm>
And the full project description PDF: <http://www.voigtlab.ucsf.edu/presentations/Caltech2006.pdf>
11. Ecoli image of Alfred Hitchcock: <http://artofscience.wordpress.com/2009/10/06/e-coli-bacteria-can-draw/>
12. Stelarc's homepage and description of the Third ear on Arm work: <http://www.stelarc.va.com.au/earonarm/index.html>
13. DIYBio homepage: <http://diybio.org/about/>
14. Hackteria homepage: http://hackteria.org/?page_id=2
15. Ars Electronica 2009 festival description: <http://www.aec.at/humannature/en/>

BIBLIOGRAPHY

Jenkins, Henry. 1992. *Textual Poachers – Television Fans and Participatory Culture*. New York: Routledge

Navas, Eduardo. 2009. *The Bond of Repetition and Representation*. Posted on Vague Terrain. <http://www.vagueterrain.net/content/2009/01/remix-bond-repetition-and-representation>.

Navas, Eduardo. 2007. *3 X 3: New Media Fix(es) on Turbulence: Turbulence: remixes + bonus beats*. Comissioned by Turbulence and New Media Fix. http://turbulence.org/texts/nmf/Navas_EN.html

Saez, Francisco A. 1956. Cytogenetics of South American Orthoptera. *Nature* 177: 490

E. DeWeerd, Sarah. 2003. *What is a Genome?* Ed. Barbara J. Culliton. Genome News Network http://www.genomenewsnetwork.org/resources/whats_a_genome/

Baker, Catherine. 1999. *Your Genes, your choices: Exploring the Issues raised by genetic research*. American Association for the Advancement of Science (AAAS) http://www.ornl.gov/sci/techresources/Human_Genome/publicat/genechoice/yourgenes.pdf

Nowicki, Steven. 2004. Video lecture series: *Biology: The Science of Life*, lecture no. 29. The Teaching Company. <http://www.youtube.com/watch?v=7jZ5m2pDulE>

R. Monastersky. 1985. Firefly Gene Sets Tobacco Plants Aglow. *Science News* Vol 130, No. 20: 311

Kac, Eduardo. 2008. *The Natural History of the Enigma*. Posted on ekac.org. <http://www.ekac.org/nat.hist.enig.html>

Stelarc. 2006. *Ear on Arm*. Posted on stelarc.va.com.au. <http://www.stelarc.va.com.au/earonarm/index.html>