

# Honors Collegium 177 Biotechnology and Art

## DNA Postal Service: Code your own genetic letter



Name: Angela Liu  
Major: Neuroscience

# ABSTRACT

The DNA Postal Service draws on the analogy of DNA as a message-coding system. Participants will learn to encode individual English letters and compose a personalized message using the DNA code. This project aims to educate the general public about the importance and meaning of the genetic code as a message and the language of life, passed down from one generation to the next. This real-life, interactive application of the DNA sequence will enable the participants to understand the biological process of translation and the Central Dogma relationship between DNA and protein phenotypes.

# CONCEPT / TOPIC

I am interested specifically in educating the general public about the mechanism of DNA as a genetic code for the message of life by drawing an interactive and close analogy with our daily language. In addition, the DNA Postal Service will also provide

Transgenic

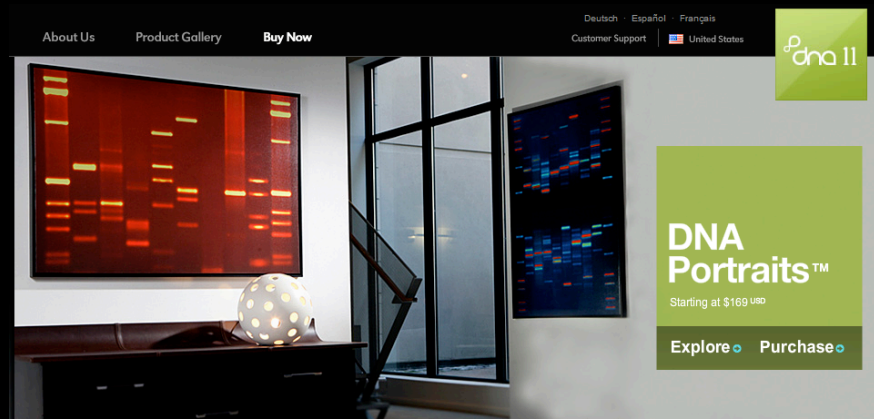
Packaging service and Message Decoding service for incoming mails. An aim of this aspect of the project is to re-orient the public opinion and dispel the fears toward genetic technologies by demonstrating DNA as a natural language for communication at the molecular level of life. The coding and decoding of the DNA message will involve the participant's active understanding of the Central Dogma, which underlies the concept of genetic determinism. The Central Dogma, first described by Francis Crick in 1958, "deals with the detailed residue by residue transfer of sequential information."

This model of the DNA genetic code outlines a linear and unidirectional correspondence from DNA to mRNA to proteins. Since the theory states that "information cannot be transferred back from protein to either protein or nucleic acid," it establishes DNA as the ultimate determining factor that encodes all phenotypic expression of life forms.

# CONTEXT & PRECEDENTS

The increasingly dominant trend of genetically modified (GM) food, transgenic animals, stem cell research, reproductive technologies, and cloning have all spelled important implications of genetic technologies; sometimes the hype around these biotechnologies is accompanied by fearful predictions and worrisome potentials. However, few of the general public is informed about the mechanism of genetic transmission or the even simpler question of what DNA is. This interaction between the science and the media has created a dire divide and serious misunderstanding of the important bio-molecule.

Using DNA as a medium, modern artists such as Eduardo Kac (GFP Bunny) and others have provoked awareness of the social implication of genetic technologies. In addition, artistic commodification of DNA has been promoted by companies like DNA 11, which provides highly customized art works of clients' DNA profiles. While the two approaches seem to paint different images of genes and DNA (the GFP bunny instigates the dreadful awareness of transgenic technologies and DNA 11 portrays the visual beauty of DNA sequences), few projects have proposed to properly educate the public about what DNA is and why it is important as a genetic coding molecule.



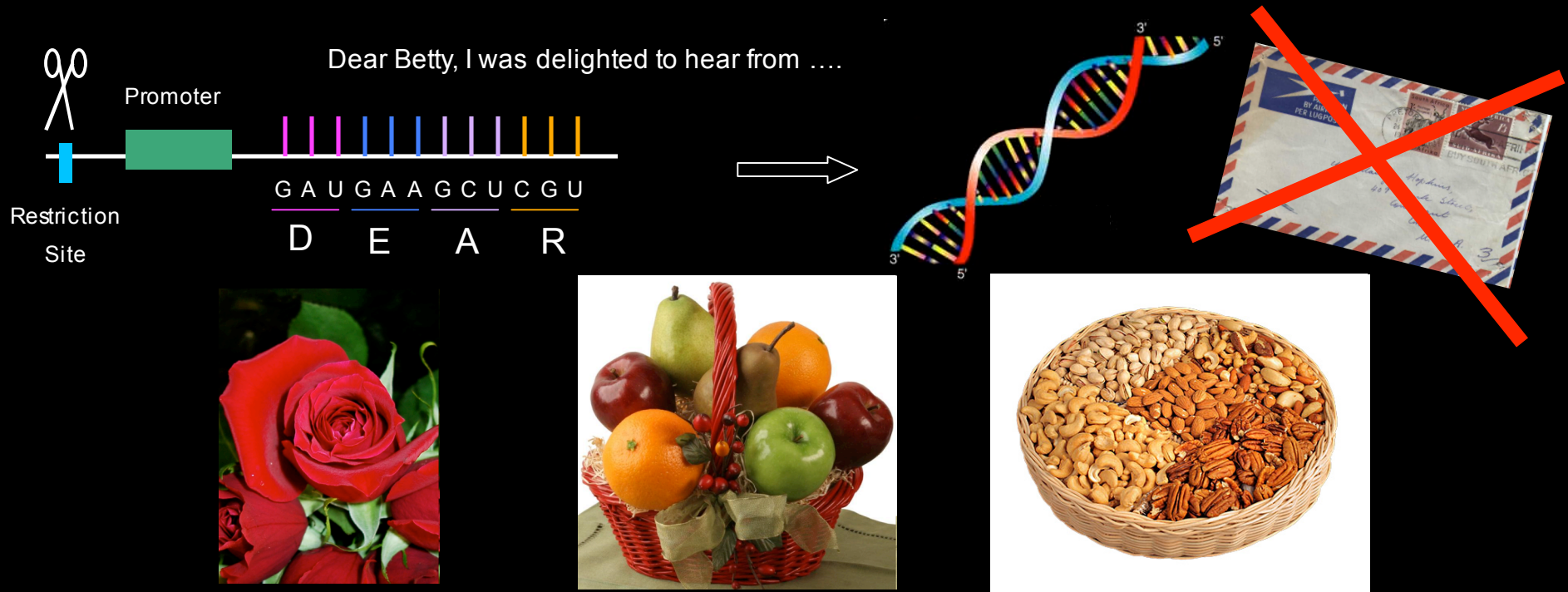
# PROJECT PROPOSAL

		Second letter					
		U	C	A	G		
First letter U	U	UUU } F	UCU } S	UAU } T	UGU } C	Third letter U C A G	
		UUC } L	UCC } S	UAC } T	UGC } C		
		UUA } L	UCA } S	UAA Stop	UGA } T		
		UUG } L	UCG } S	UAG Stop	UGG } W		
C	C	CUU } W	CCU } P	CAU } H	CGU } R	U C A G	
		CUC } J	CCC } P	CAC } H	CGC } R		
		CUA } J	CCA } O	CAA } Q	CGA } X		
		CUG } J	CCG } O	CAG } Q	CGG } X		
A	A	AUU } I	ACU } T	AAU } N	AGU } U	U C A G	
		AUC } I	ACC } T	AAC } N	AGC } U		
		AUA } M	ACA } V	AAA } K	AGA } B		
		AUG } M	ACG } V	AAG } K	AGG } B		
G	G	GUU } S	GCU } A	GAU } D	GGU } G	U C A G	
		GUC } S	GCC } A	GAC } D	GGC } G		
		GUA } S	GCA } Z	GAA } E	GGA } Y		
		GUG } S	GCG } Z	GAG } E	GGG } Y		

## - Step 1 Code Your Own DNA Letter

The DNA Postal Service will be equipped with the biotech facility that synthesizes DNA sequences encoding the letter messages composed by the client. To compose his letter, the client will learn about the concept of codon, and uses sets of three nucleotides to code for the letters, the words, and consequently sentence messages. Each sentence will be ended by a STOP codon, analogous to the use of a period. Moreover, during the synthesis process of the DNA letter, a promoter sequence will sit upstream of the message and the entire promoter-message segment will be flanked by restriction enzyme recognition sites.

# Project Proposal (cont.)

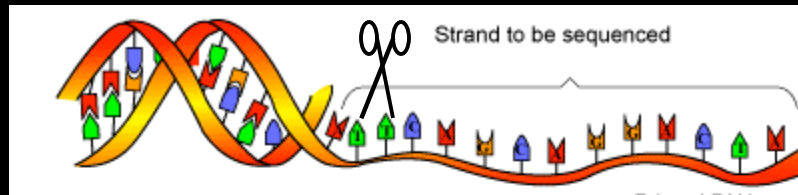


## - Step 2 Transgenic Packaging Service

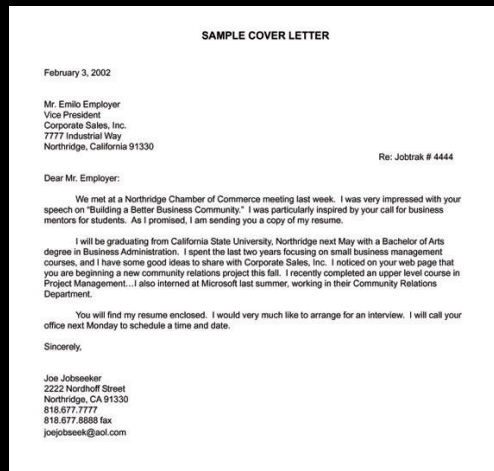
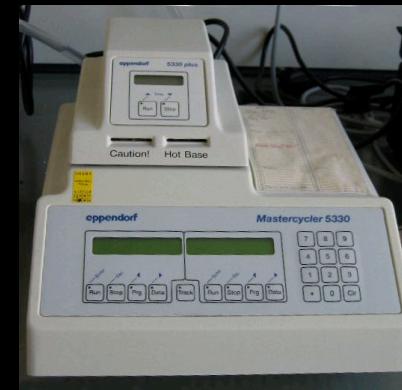
After the composition of the letter, the client can choose from a variety of transgenic organism packaging options. Unlike the traditional color design boxes at the Post Office, the DNA Postal Service offers secured privacy protection of your message by embedding it in the genome of a variety of life forms, including flowers, fruits, plants, animals, and many more. To also educate the public about the make-up of DNA sequence, the genetic letter will be embedded in the non-coding “junk DNA” portion of the packaging organism’s genome; therefore the concern for the letter being capable of altering the phenotype of the packaging organism can be avoided.

# Project Proposal (cont.)

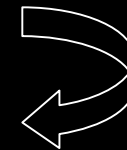
Isolate DNA letter by action of restriction enzymes



PCR



Sanger Sequencing Method



## - Step 3 Message Decoding Service

After the DNA mail has been delivered to its destination, the local DNA Post Office will provide DNA sequencing service and decode the letter using genetic technologies such as the Sanger Method. Before sequencing, the DNA letter from the transgenic package will be isolated by the restriction enzymes and amplified using primer specific for the promoter sequence in Polymerase Chain Reaction (PCR). This thus complete the experience of the real-life analogy of DNA as a language for communication. A thorough walk-through of the process will educate the general public about the mechanism of genetic coding and its importance.

# Conclusion

The predominant genetic technologies today base on the theory of the Central Dogma, which consequently associate with multifarious social implications such as genetic determinism and race population genetics. With the DNA Postal Service project, each step of (1) coding your own DNA letter, (2) transgenic packaging, and (3) message decoding service will engage the general public in the interactive metaphor of DNA as a language for communication at the molecular level. The DNA postal service represents an interactive learning about the mechanism of genetic coding via the codon, the genomic DNA make-up of the non-coding introns, or “junk DNA”, and the genetic technologies of DNA sequencing and PCR. The project can achieve a wider understanding of the mechanism of the genetic code and dispel misunderstandings about genetic technologies. The most important impact of the DNA Postal Service will expand a better-informed public discussion of genetic technologies and re-connect the divide between genetic science and the community.



# References

1 Crick, F.H.C. (1958): On Protein Synthesis.

2 Crick, F. (1970): Central Dogma of Molecular Biology

3 B. J. McCarthy and J. J. Holland (September 15, 1965). "Denatured DNA as a Direct Template for *in vitro* Protein Synthesis". *Proceedings of the National Academy of Sciences of the United States* **54**: 880–886. doi:[10.1073/pnas.54.3.880](https://doi.org/10.1073/pnas.54.3.880)

# Bibliography / Links

## Single-Letter Amino Acid Code

[www.biochem.ucl.ac.uk/bsm/dbbrowser/c32/aacode.html](http://www.biochem.ucl.ac.uk/bsm/dbbrowser/c32/aacode.html)

## Polymerase Chain Reaction

*Polymerase chain reaction (PCR)*

[www.dnalc.org/ddnalc/resources/pcr.html](http://www.dnalc.org/ddnalc/resources/pcr.html)

## Sanger Method

[www.bio.davidson.edu/Courses/Molbio/MolStudents/spring2003/Obenrader/sanger\\_method\\_page.htm](http://www.bio.davidson.edu/Courses/Molbio/MolStudents/spring2003/Obenrader/sanger_method_page.htm)

## Introns and Exons

[post.queensu.ca/~forsdyke/introns.htm](http://post.queensu.ca/~forsdyke/introns.htm)

## DNA11 | Personal DNA portraits, pictures, prints and paintings as art.

[www.dna11.com/gallery\\_portraits.asp](http://www.dna11.com/gallery_portraits.asp)

## GFP BUNNY

[www.ekac.org/gfpbunny.html](http://www.ekac.org/gfpbunny.html)