MAKE DO AND MEND, ANNA DUMITRIU

1/ THE FEAT COLLABORATIVE RESIDENCY MODEL, PERSPECTIVE OF THE ARTIST

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3/ BACTERIA AS AN ART MEDIUM
Conversation between Anna Dumitriu and Annick Bureaud (podcast)

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1/ THE FEAT COLLABORATIVE RESIDENCY MODEL

as seen by Anna Dumitriu in her position of artist partner in the FEAT project

https://www.youtube.com/watch?v=h6p2PTbpyEE

2/ FROM THE LAB RESIDENCIES: THE MAKING OF *MAKE DO AND MEND*

(Compiled from Anna Dumitriu's reports - All images © by the artist

In order to create the 'mended' bacteria and to bring it back to a « pre-antibiotic era » state for her *Make Do and Mend* artwork, Anna Dumitriu had to remove the antibiotic resistance gene from the *E. coli* genome, insert her 'Make Do and Mend' repair fragment, grow the bacteria on silk fabric, and sterilize them before sewing them onto the suit or using them as independent patches in the various framed works that also form part of the installation.

In order to do so, she had to learn several techniques and new knowledge by spending time in residence in several laboratories which are part of the MRG-Grammar consortium in Israel and in the UK.
Those laboratories are:

The Teichmann Group at The Wellcome Trust Sanger Institute :
http://www.sanger.ac.uk/science/groups/teichmann-group

The Segal Lab at the Weizmann Institute of Science :
https://genie.weizmann.ac.il/

The Synthetic biology Laboratory for the Decipherment of Genetic Codes at Technion - Israel Institute of Technology:
http://roee-amit.technion.ac.il/

The artist worked with a **TOP10 *E.Coli*** strain which is a «lab strain», meaning that it is very well characterized but that has also been subject to many modifications.

The 'Make Do and Mend' repair fragment was designed by converting the phrase from English language to base 4, via ASCII code, to match the ATCG's of the DNA nucleotides.

1/ OCTOBER 2016

Anna Dumitriu was in residence with the Teichmann Lab (http://www.sanger.ac.uk/science/groups/teichmann-group) at the Wellcome Trust Sanger Institute in Cambridge, UK.

She explored their work in trying to understand how enhancer genes influence the 1% of genes (in mammalian cells) that actually make proteins. In the future this area of research is likely to be hugely important in understanding health and disease.

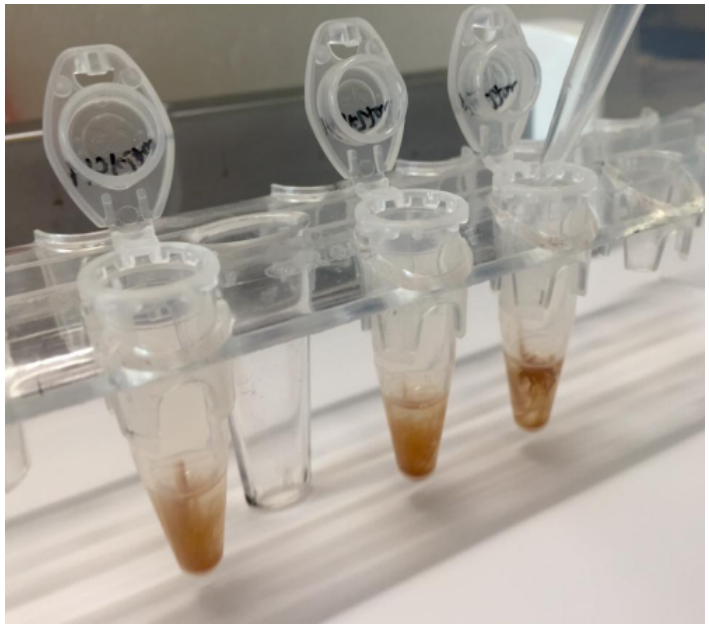
She worked with Sarah Teichmann, Head of Cellular Genetics at the WT Sanger Institute, and researchers including Xi Chen, Michal Kosicki, and Tomas Pires de Carvalho Gomes, looking at ChIP-sequencing, the use of CRISPR/Cas9 gene editing tools, and bioinformatics approaches to handing the large amounts of data produced.

CRISPR/Cas9 is a recent technique for gene editing
Resource:
https://en.wikipedia.org/wiki/CRISPR

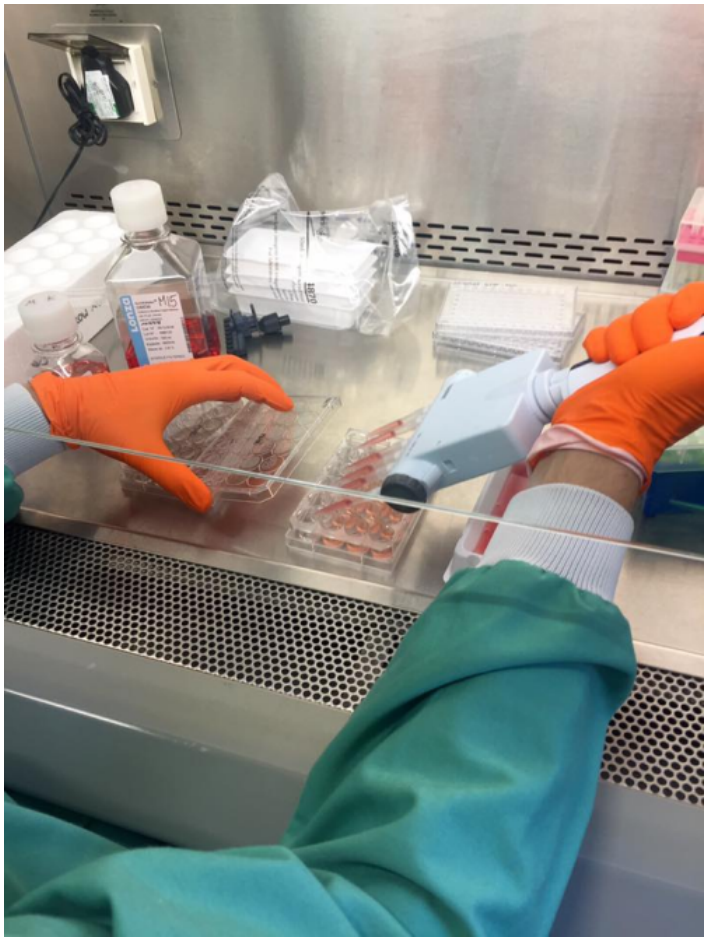
ChIP-sequencing is a technique to study the interactions between proteins and the DNA.
Resource:
https://en.wikipedia.org/wiki/ChIP-sequencing

Bioinformatics is the development and the use of computer and software methods and tools to process and understand biological data.
Resource:
https://en.wikipedia.org/wiki/Bioinformatics

Extracting mouse T cell DNA at the Wellcome Sanger Institute.

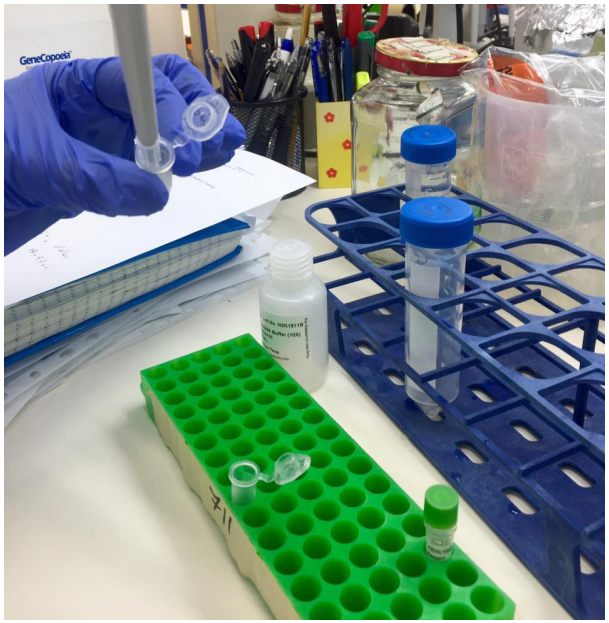


CHiP Sequencing at the Wellcome Sanger Institute.

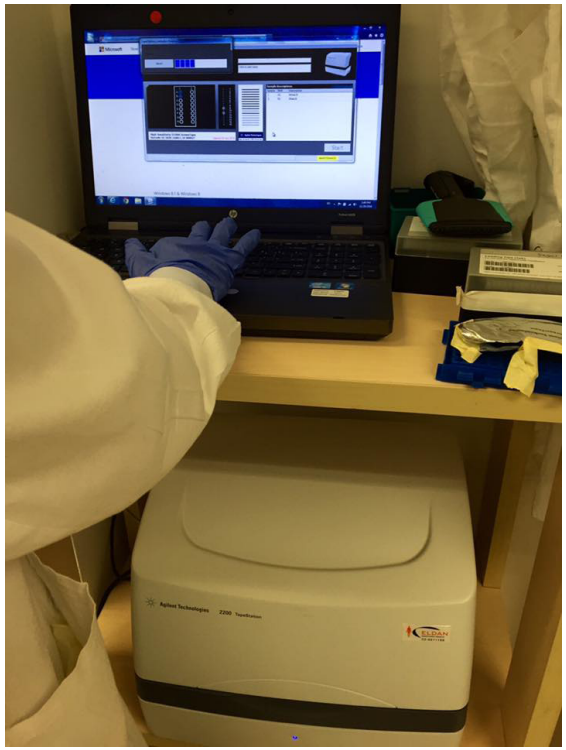


Working with CRISPR to cut mouse embryonic stem cell DNA at the Wellcome Sanger Institute.

2/ NOVEMBER 2016

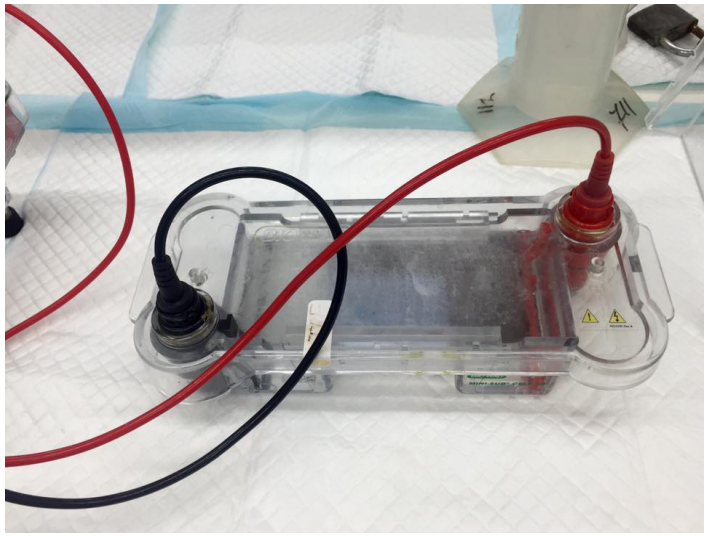


Dumitriu extracts DNA from her microbiome for whole genome sequencing at the Segal lab at the Weizmann Institute Tel Aviv.

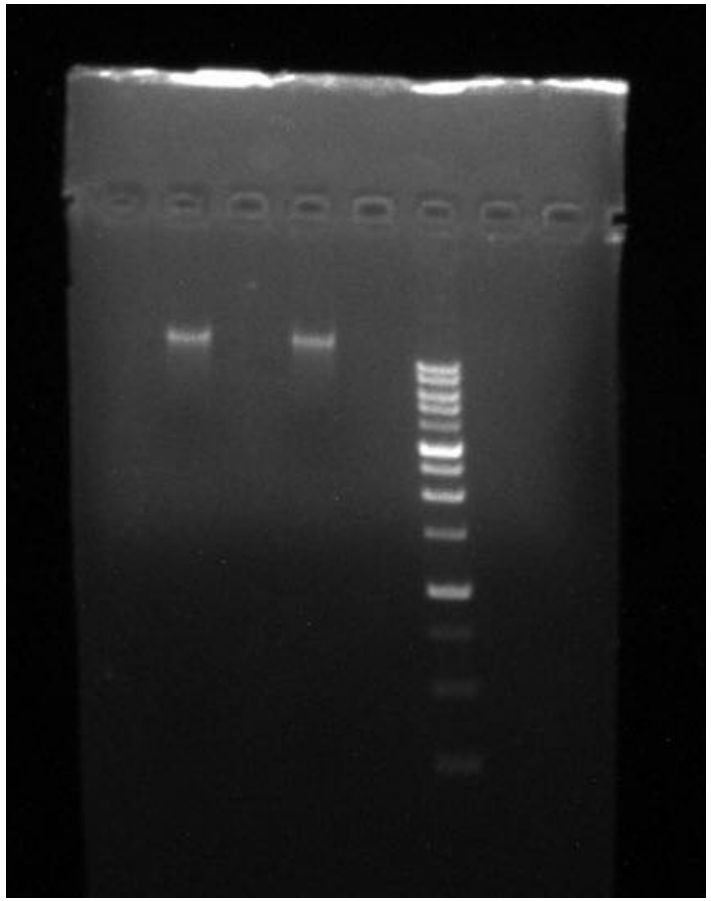


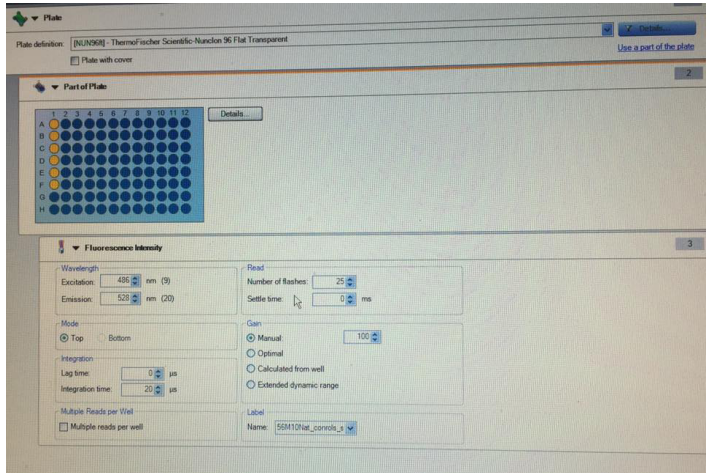
Dumitriu travelled to The Segal Lab at the Weizmann Institute (https://genie.weizmann.ac.il/) in Tel Aviv, Israel where she worked mainly with Adina Weinburger, Maya Lotan-Pompan and Hadas Elisar.

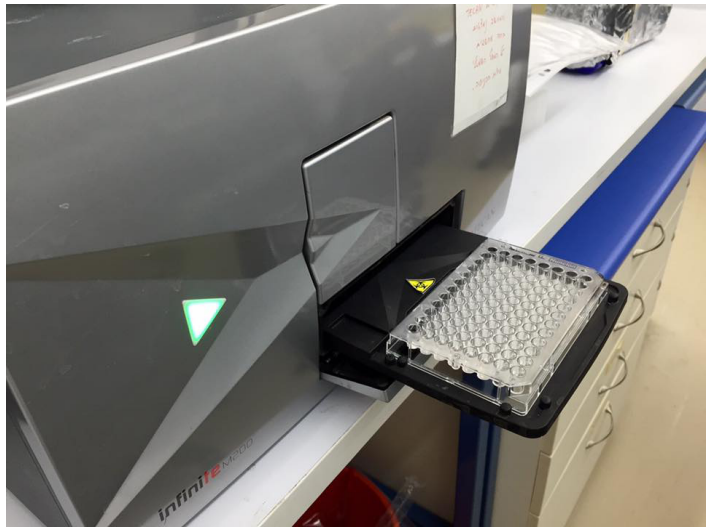
As part of the project she learned to whole genome sequence her gut microbiome and developed an understanding of using synthetic DNA libraries to search for potential targets for novel antibiotics.



Whole genome sequencing at the Segal lab at the Weizmann Institute Tel Aviv.







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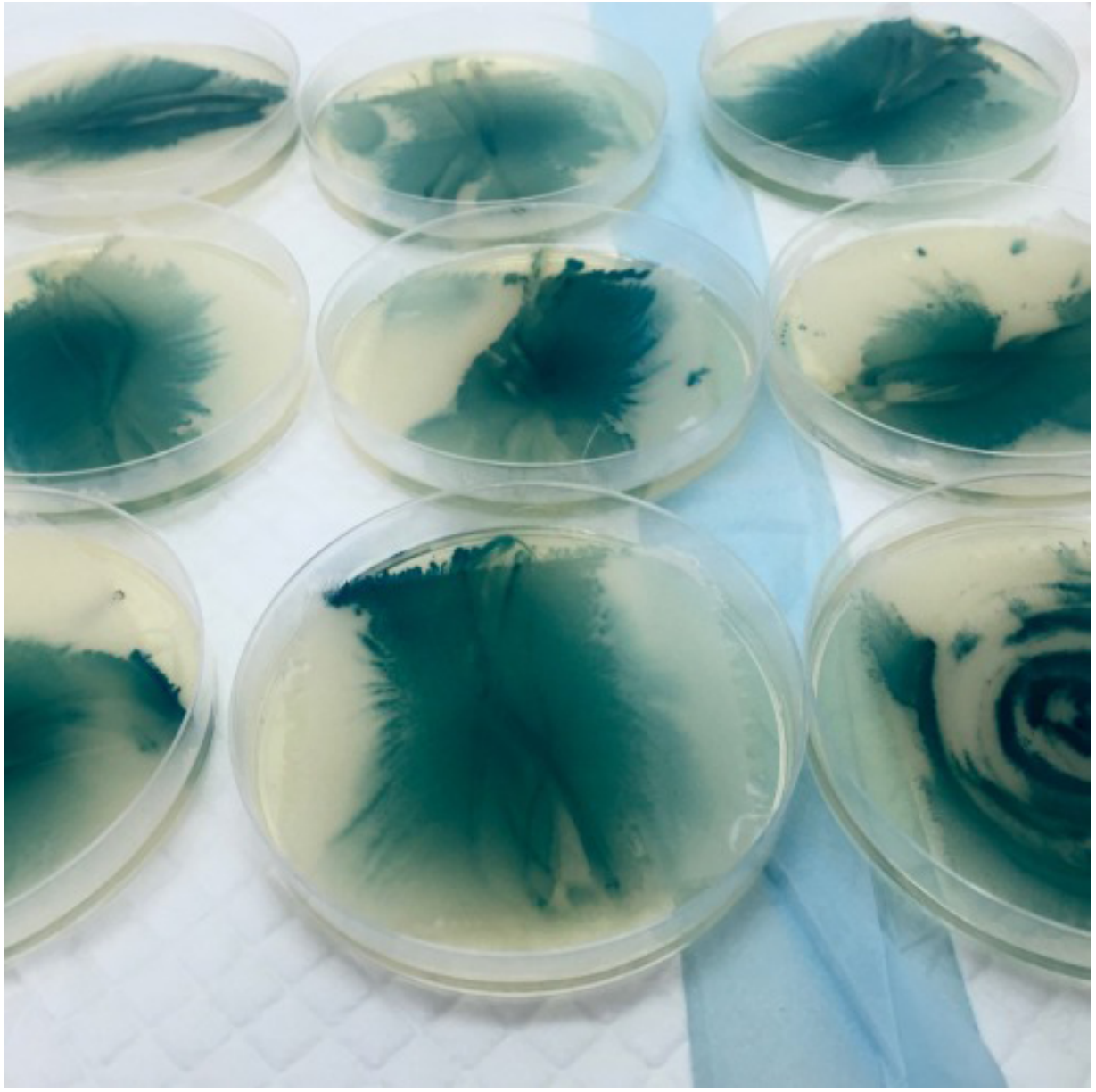
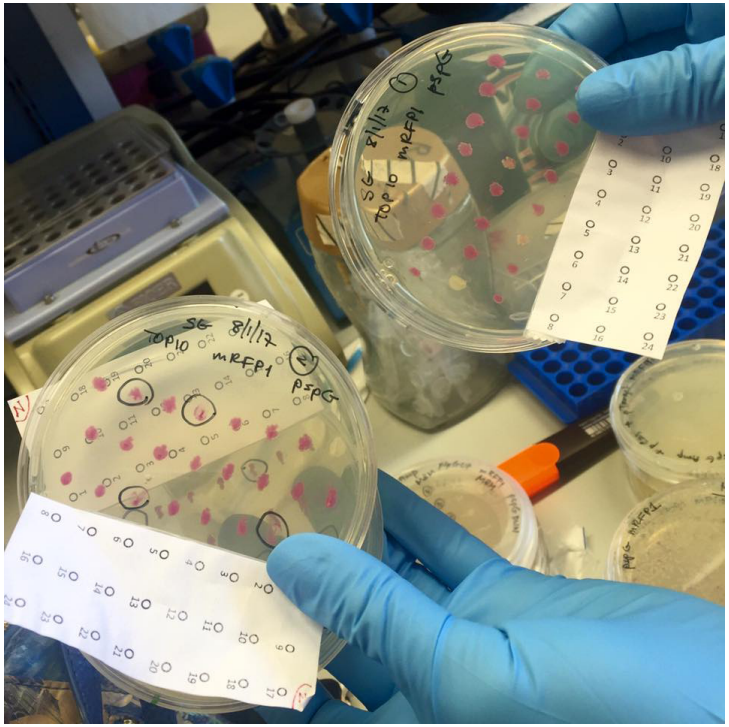
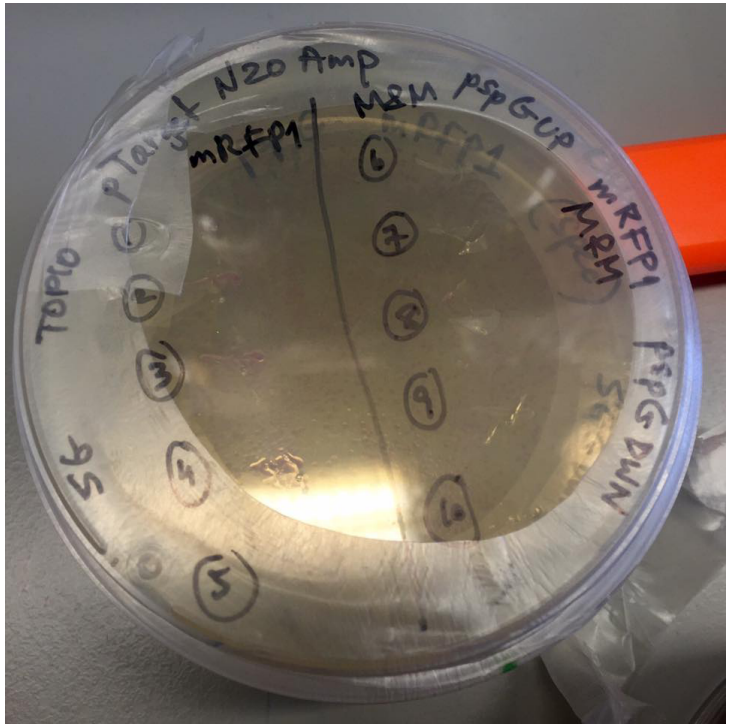


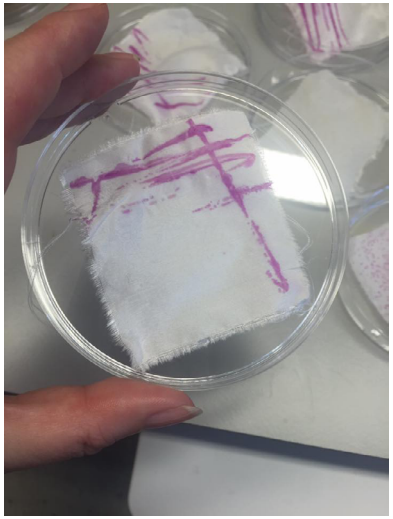
Looking for potential antibiotic targets at the Weizmann Institute. Silk pieces grown with *E. coli* bacteria each with a slightly different gene knocked out.

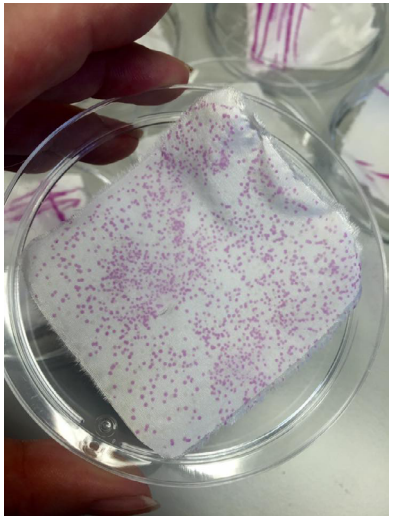
3/ DECEMBER 2016

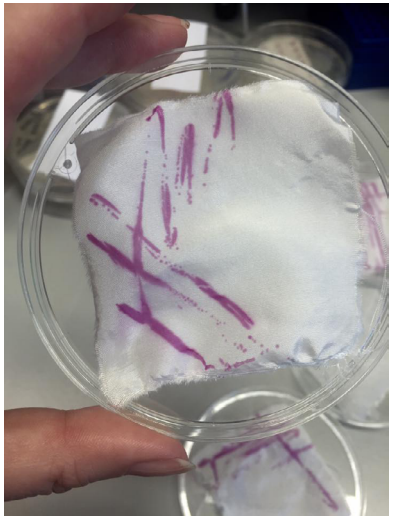
Dumitriu travelled to Haifa, Israel to work with The Amit Synthetic Biology Laboratory for the Decipherment of Genomics Codes at Technion (http://roee-amit.technion.ac.il/) where she learned how to edit bacterial genomes in their regulatory regions using the CRISPR technique.



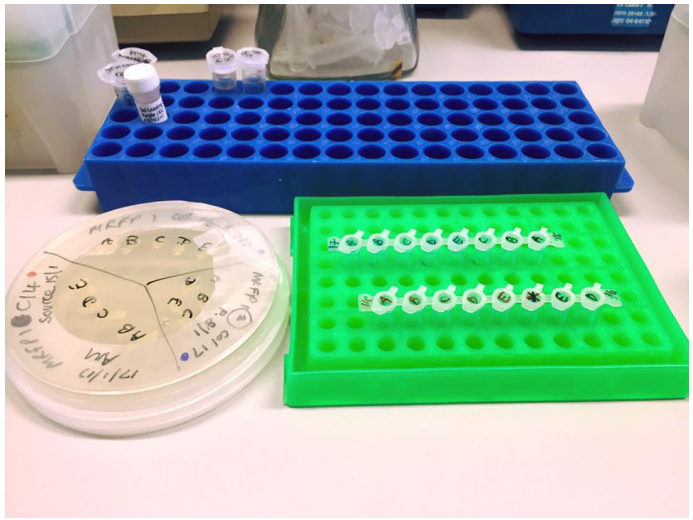




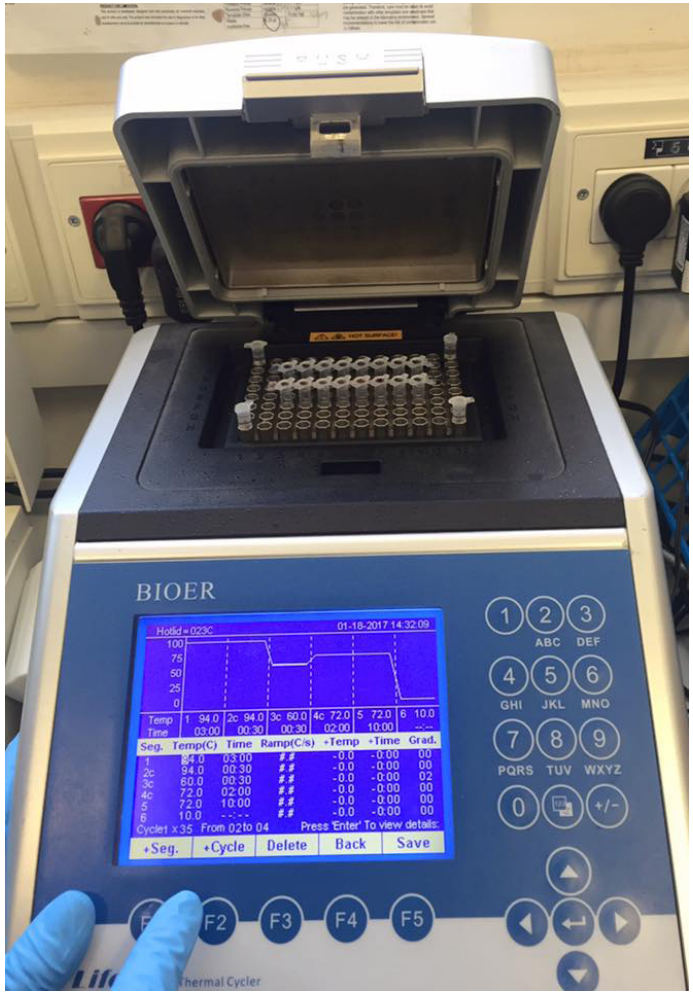


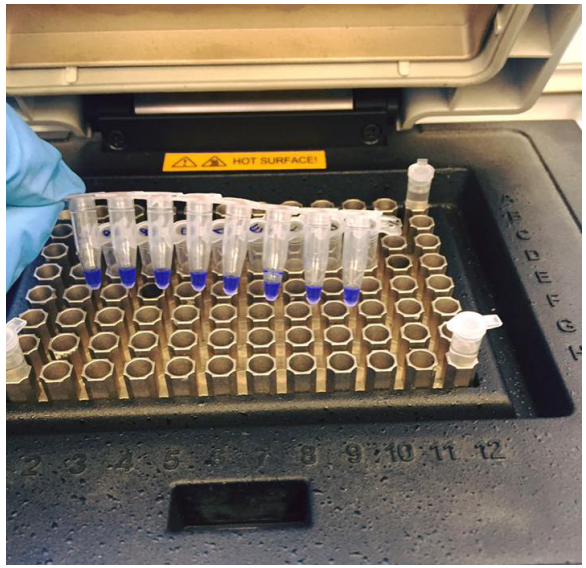


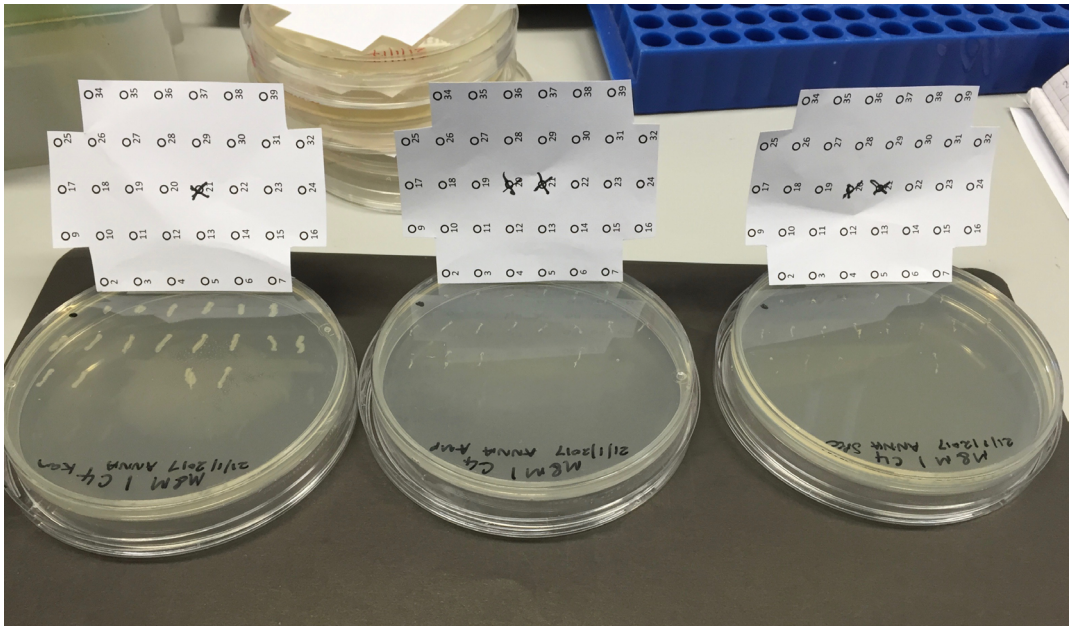
Gene editing at the Amit lab at Technion.



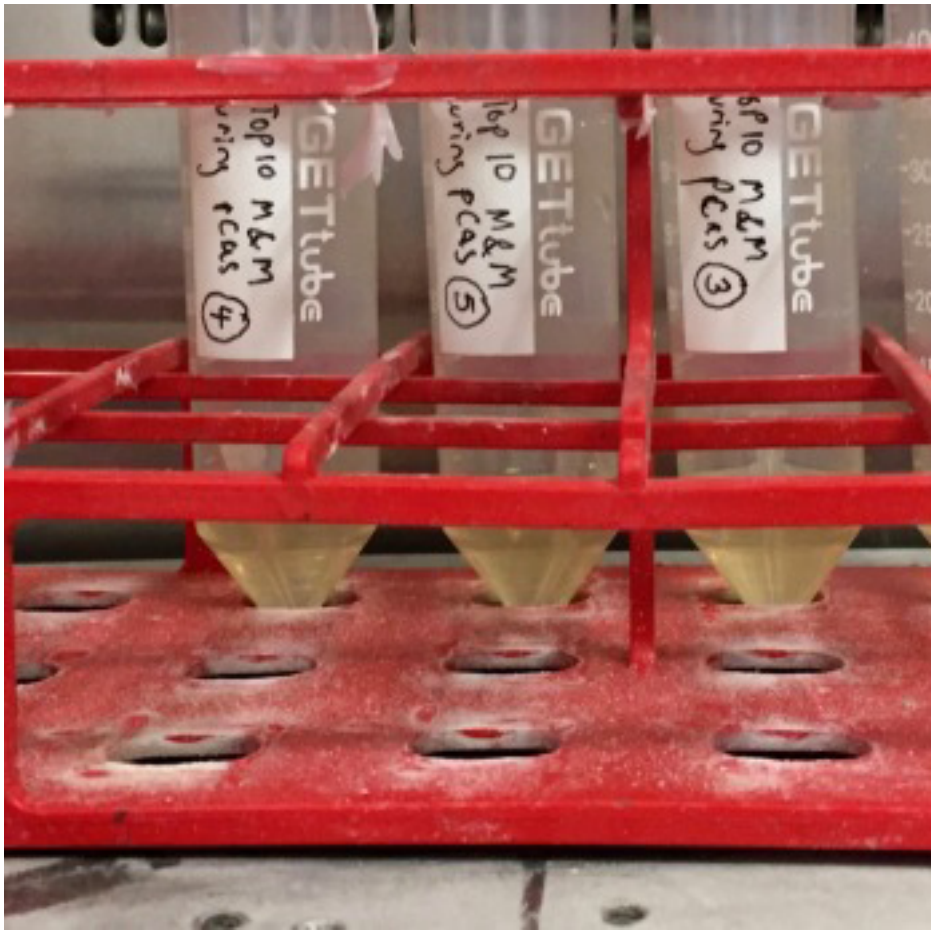
Screening for edits at the Amit Lab for Synthetic Biology at Technion.







Creating the **Top10 Make Do and Mend strain** of CRISPR edited *E. coli* bacteria at Technion.



Top10 Make Do and Mend strain of CRISPR edited *E. coli* bacteria at Technion.

Chromogenic Agar in Birmingham lab.

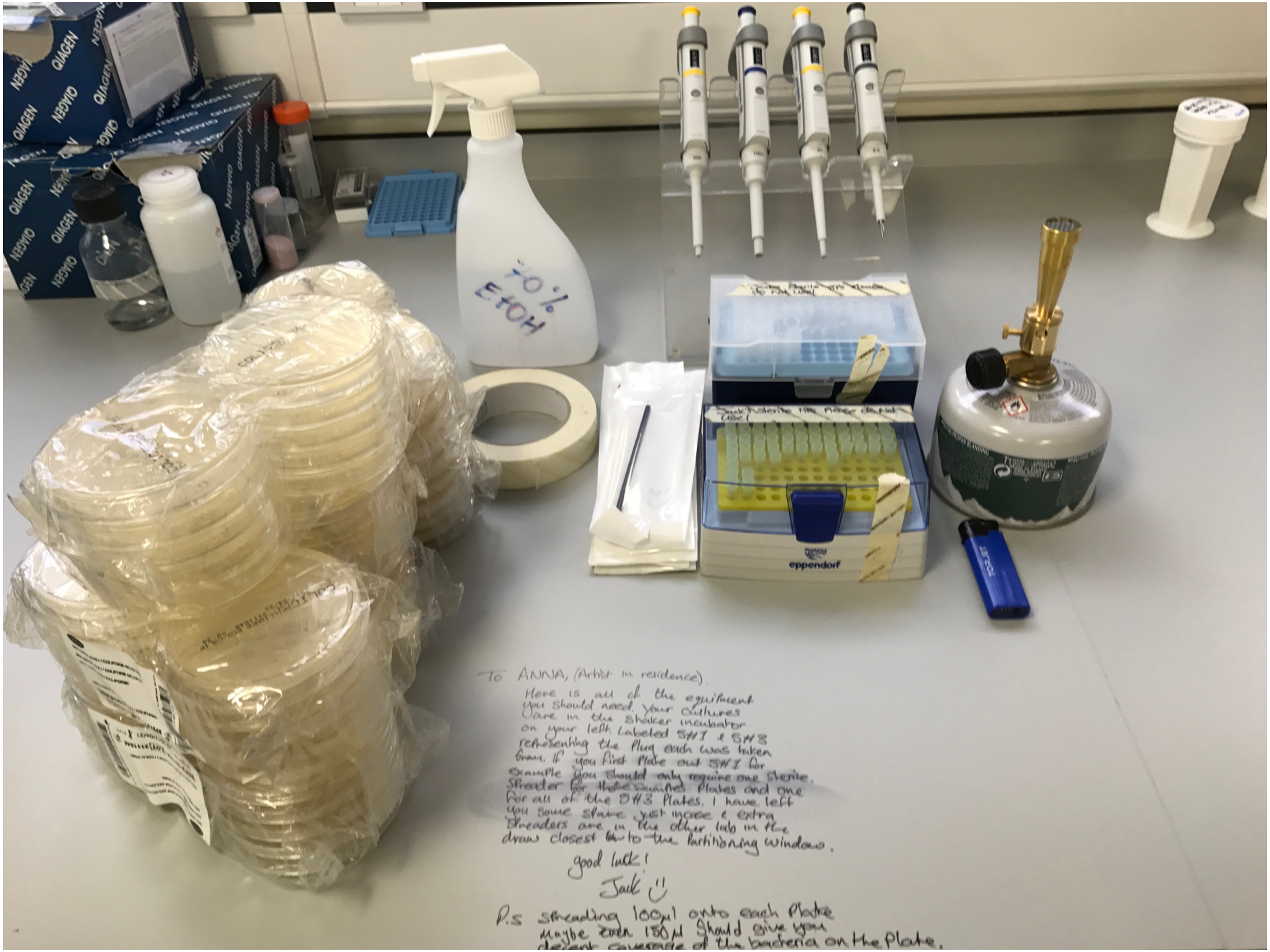
4/ JANUARY 2017

Dumitriu went back to The Amit Synthetic Biology Laboraroty at Technion in Haifa to complete the work.

5/ GROWING THE 'MENDED' BACTERIA

To grow the modified 'mended' bacteria, Dumitriu needed chromogenic agars, a growth medium (nutrient for bacteria) with substrates that react to certain enzymes resulting in different coloration of the bacteria colonies.

Getting those agars turned to be an expensive endeavour in Israel as she would have needed to buy huge quantities. Therefore, she sent the bacteria back to the UK to labs licensed to work with genetically modified organisms and with which she has collaborated before (Heather Macklyne at the University of Sussex and Dr Rob Neely at the University of Birmingham).



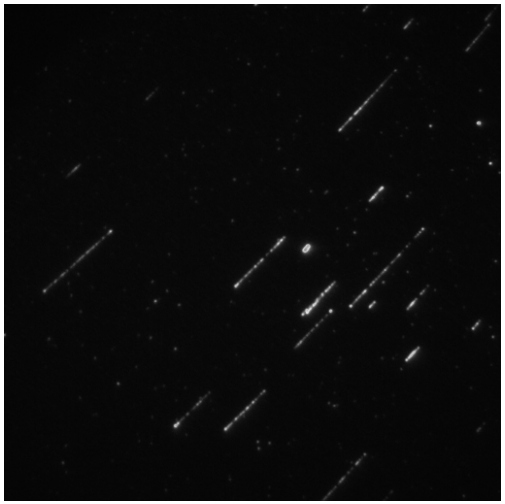
Birmingham Lab: Equipment with note left for the artist.

Autoclave for sterilising bacteria

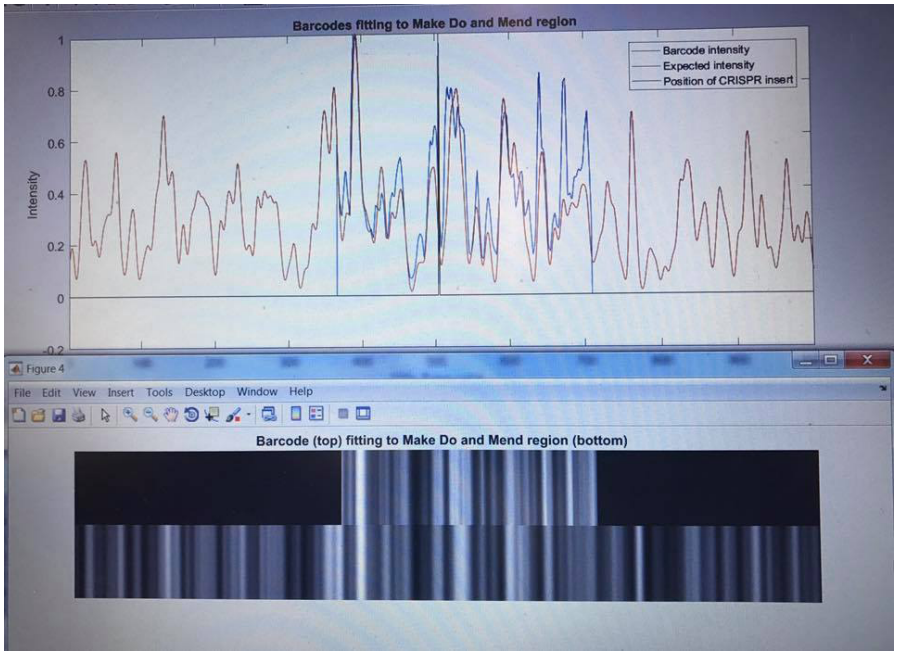
6/ HEALTH & SAFETY

Bringing modified organisms outside of the laboratories and exhibiting them in public places can be done only under strict rules and health and safety regulations. The silk pieces of fabrics with the 'mended' bacteria were sterilized before beeing sewn onto the WWII woman's suit.

Modifying the genome in this manner is not as easy as the word «editing» might suggest in our digital routines. It is very complex and fiddly with no guarantee of success. It is possible to really know whether you have been successful or not only until every step is completed and less that 10% of such experiments to modify a genome this way are successful. Working non stop, it takes about three weeks to complete the process assuming you are successful at the first try.



DNA fluorescence microscope image of the
'Make Do and Mend' CRISPR edit on *E. coli* genome



Visualization of the DNA sequence of the 'Make Do and Mend' CRISPR edit on *E. coli* genome

7/ MOVING FURTHER IN 2017

Beyond her residency with the FEAT MRG-Grammar consortium, Anna Dumitriu is pursuing another residency in the Department of Chemistry at the University of Birmingham in the lab of Dr. Robert Neely.

In June 2017, she could see the actual repair fragment region of her CRISPR genomic (homologous recombination) edit «Make Do and Mend» *E. coli* using cutting-edge technics of optical DNA mapping technologies. Dr. Neely group is pioneering fluorescent labelling of the DNA molecule using an enzymatic approach. The result is a visualization of the DNA sequence, something akin to a barcode that can be used to easily identify species.

3/ BACTERIA AS AN ART MEDIUM

Conversation between Anna Dumitriu and Annick Bureaud (podcast)

https://creativedisturbance.org/podcast/bacteria-as-an-art-medium-meeting-with-anna-dumitriu-eng/

4/ *LEONARDO* ARTICLE ABOUT THE PROJECT

«Make Do and Mend» : Exploring Gene Regulation and CRISPR Through a FEAT (Future Emerging Art and Technology) Residency With the MRG-Grammar Project», Anna Dumitriu, *Leonardo*, MIT Press

http://olats.org/feat/Dumitriu-leon_a_01466.pdf

CREDITS

« Make Do and Mend » has been created by Anna Dumitriu in collaboration with
Dr Sarah Goldberg and Dr Roee Amit, The Synthetic Biology Laboratory for the Decipherment of Genetic Codes, Technion, Israel,
http://roee-amit.technion.ac.il
MRG-Grammar https://www.mrg-grammar.eu
With additional help and advice from Dr Heather Macklyne, University of Sussex, UK
http://www.sussex.ac.uk/lifesci/people/biochemistry/person/231366
Dr John Paul, Kevin Cole, and Dr Nicola Fawcett, Modernising Medical Microbiology, UK http://modmedmicro.nsms.ox.ac.uk

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