Knock, knock, who's there?....
Using sequencing to open the door to the Microbial World



# What is the Genetic Code? DNA facilities in Teagasc Teagasc and sequencing

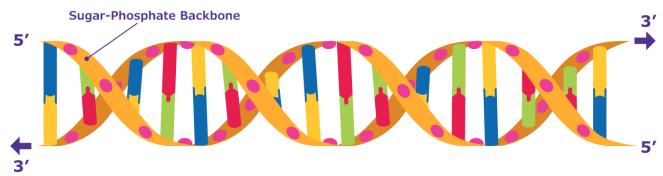


#### What is the Genetic Code?



#### **DNA Structure**



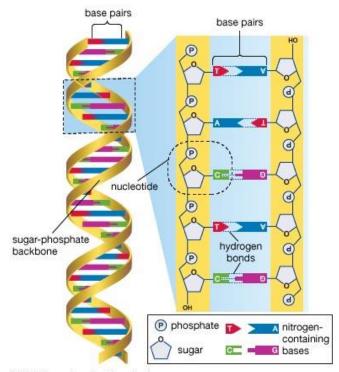


**Complementary Bases** (Paired via Hydrogen Bonds)









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Every 3 basepairs code for an amino acid.

Only 21 Amino acids in total

Amino acids are then the building blocks of proteins, combinations of different amino acids means different proteins are made

Some amino acids can be made from more than one "code" e.g. Phenyalanine can be encoded by TTC or TTT; Methione can ONLY be made from ATG



The entire "string" of DNA is called a genome Human genome is 3 BILLION base pairs

Micro-organisms much smaller genome. E.g. SARS-CoV2 has only approximately 30,000 bases

https://www.medrxiv.org/content/10.1101/20 20.11.16.20232009v1

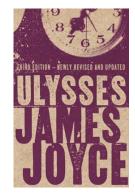
... We estimate that each infected person carries  $10^9$ - $10^{11}$  virions during peak infection, with a total mass of about 1  $\mu$ g-0.1 mg, which curiously implies that all SARS-CoV-2 virions currently in the world have a mass of only 0.1-1 kg – can fit in two cans of coke!

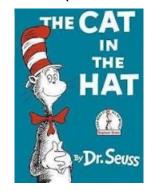




If we view a genome as a book:

- The virus genome has 30,000 nucleotides (LETTERS)
- These form 10,000 amino acids (WORDS)
- That make at least 10 genes (SENTENCES)
- Which encode 29 viral proteins (PARAGRAPHS).
- Four proteins are on the surface (KEY CHAPTER!)







Viruses with different mutations (letters) are referred to as variants or lineages

Original: THE CAT IS IN THE ROOM

Mutation 1: THE CXT IS IN THE ROOM – Sentence changed subtly...no big deal

Multation 3 THE RATAS IN THE ROOM WITS Entended (virus potentially more harmful)



Differences in DNA sequences also distinguish other organisms from each other.....

e.g. Humans share 99% our DNA with Chimpanzees!





#### DNA facilities in Teagasc



# Sequencing facilities at Moorepark









Illumina NextSeq



GridION

Illumina MiSeq



Ion PGM









#### Teagasc and sequencing



#### **Human Microbiome Research**



Human body contains trillions of microbes, outnumbering human cells 10:1

100-150 times more genes

It plays a role in immunity, digestion of food, regulation of vitamins and hormones and even our behaviour

**FORGOTTEN ORGAN** 



#### Fermented Foods: Fact or Fiction

FRIDAY, SEPTEMBER 25, 2009

My Anti-Cancer Treatments: Kefir



My raw goat's milk kefir grains, in a clean Mason jar, just prior to adding raw milk.

#### Kombucha the "Wonderdrink"

by KATIE on MARCH 6, 2013

#### **Does Your Body Need a Miracle?**

Do you believe that healing requires a miracle, or do you believe that our trillions of cells govern themselves and create the bodies that we have? So how does the eye know how to focus or the muscle know how much energy it will need during your walk today? These are the unseen workings of the world of cells that reside within. I believe in miracles and I believe in healing, things unseen and not fully understood, things that require faith in something unseen. I teach classes and talk with people who seem to coincidentally show up in my life. People who have deep desires to be well, or in most cases that their children be well. They are often so unsure of what will work after trying many things; supplements. medicines, and a million other things. They seem to be running out of options; as they become more desperate, as a last resort they're trying what seems to be so simple - changing what they eat. It was just as miraculous to me when I first tried it. The funny thing is that these wondrous foods have been around since time began.



not changing and remaining the same. Waiting to be discovered, to bring life and health to all who will try them. I have gone from

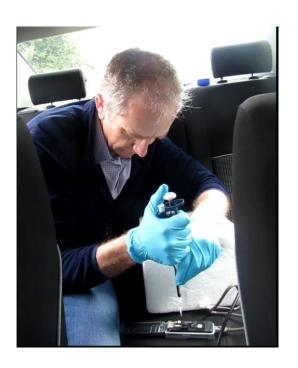


Fermented Foods – do they live up to the hype

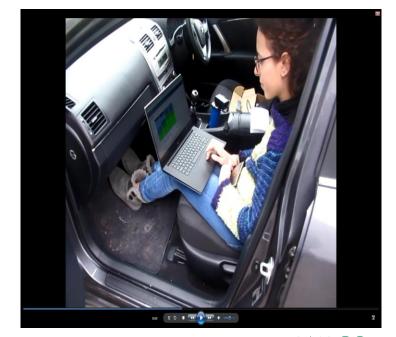
Everyone knows that drinking tea is good for your health but wouldn't it be great if there were a way to make it *even* healthier? Well actually, there is! (Spoiler alert, it's a *fungus!*)



# Identification of bovine respiratory viruses



Dr. Matt McCabe (Teagasc Grange) and colleagues in their "car lab"- rapid identification of bovine respiratory viruses





# **Food Safety and Quality**



Identifying microbes responsible for food defects or food poisoning

Exploiting bacteria and viruses for food safety purposes (Olivia)



# In summary...



#### Food:

Composition of cheese (including artisanal products)
Composition of health promoting beverages (kefir/kombucha)
Identifying microbes responsible for food defects
Exploiting microbes for food safety purposes and to produce nicer tasting foods



#### **Human and animal microbiome**

Probiotics, Anti-psychotics, prebiotics Diet and/or Exercise Methane emissions Animal pathogens



# **Corona Virus Sequencing**



**Dr Fiona Crispie** 

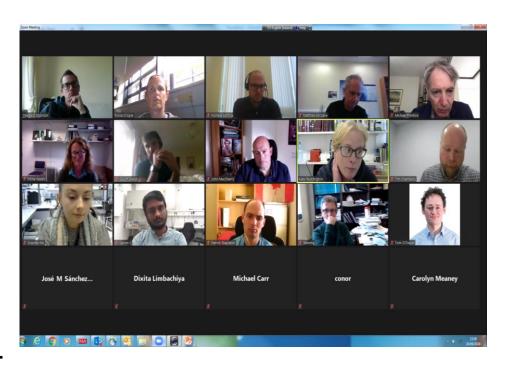


**Dr John Kenny** 



Dr Patrick Stapleton Prof. Paul Cotter









### Acknowledgements







