

# Genome Academy: DNA to Data

22<sup>nd</sup> – 24<sup>th</sup> August 2023

**Francesca Gale** Head of Science Engagement

# Before we start – the important bits



If the alarm sounds for more than one minute, please evacuate. Your host will guide you to the nearest assembly point



If you feel unwell or suffer an accident, let your host know and they will summon appropriate first aid



Please stay together and with your host(s) at all times during your visit



All buildings on the Campus are non-smoking

# The core training team





Head of Science Engagement



**Cindy Smidt** 

Science Engagement officer

Science Engagement Officer

**Sam Shingles** 

Laboratory programme manager

**Cassandra Soo** 

Laboratory Assistant

**Aaron Dean** 



Jorge Batista da Roche Education Developer



#### **Wellcome Genome Campus**









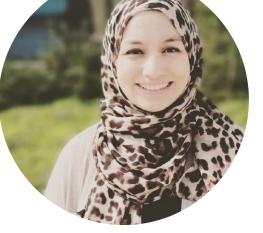
#### Areas of campus research





research fellows





research assistants



computer science apprentices



genetic counsellors



research students

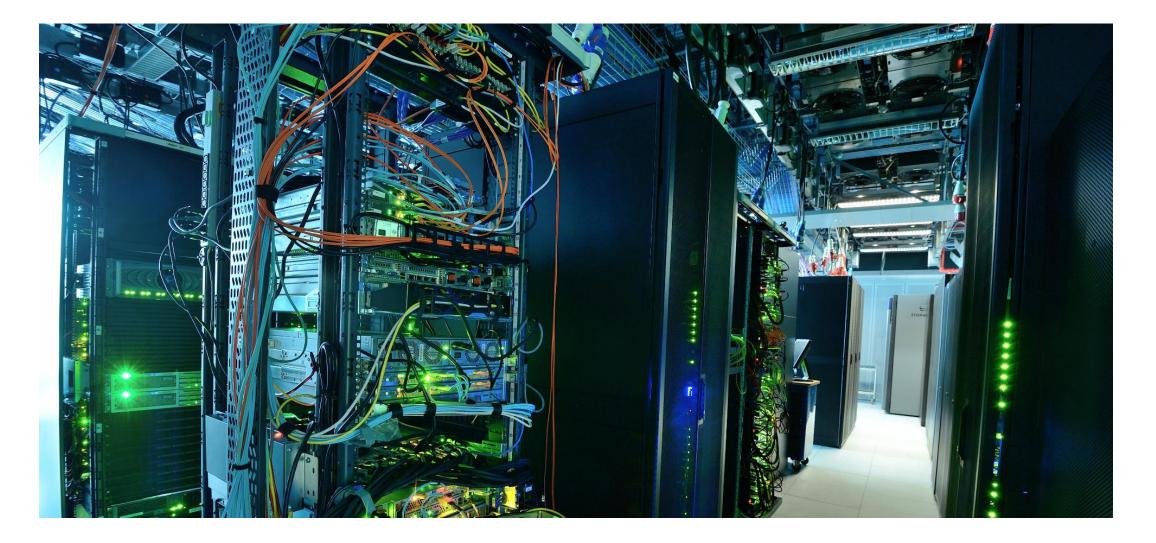
#### The Sequencing labs



#### **Cellular operations**



#### The data centre

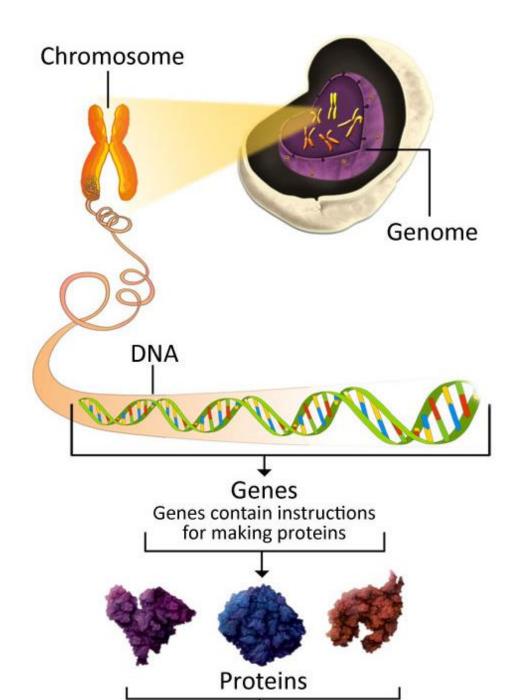


# Time table for today

Time	Activity
10:00	Welcome and Introduction to the campus
10:30	Introduction to lab safety and our practicals
10:45	Lab practical – Pipetting skills and DNA extraction
11:15	Lab Practical – PCR
11:45	Speaker: Petra Korvelić
12:15	Lunch
13:00	Lab practical – running a Lonza Gel
14:00	Lab tour – CASM team
15:00	Reflections on the day
15:30	Depart

# What is a gene?

- A sequence of DNA that carries the information required to make a molecule, usually a protein.
- Proteins have functional roles to play in our bodies



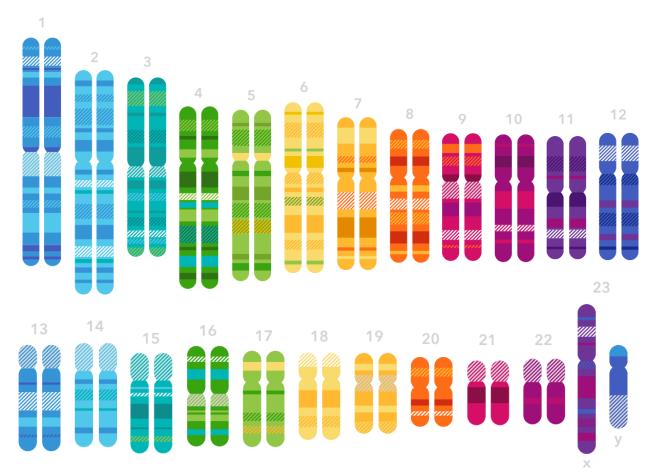
# What is a genome?

A copy of all the DNA instructions used to make an organism

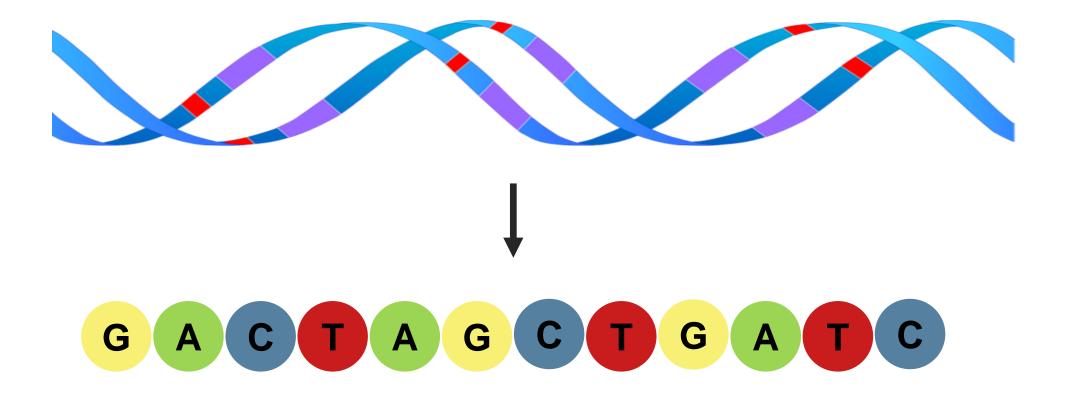
"The Book of Life"

All organisms have genomes

We have 2 copies of our genome packaged in 23 pairs of chromosomes



What is DNA sequencing?



### genomics: then and now

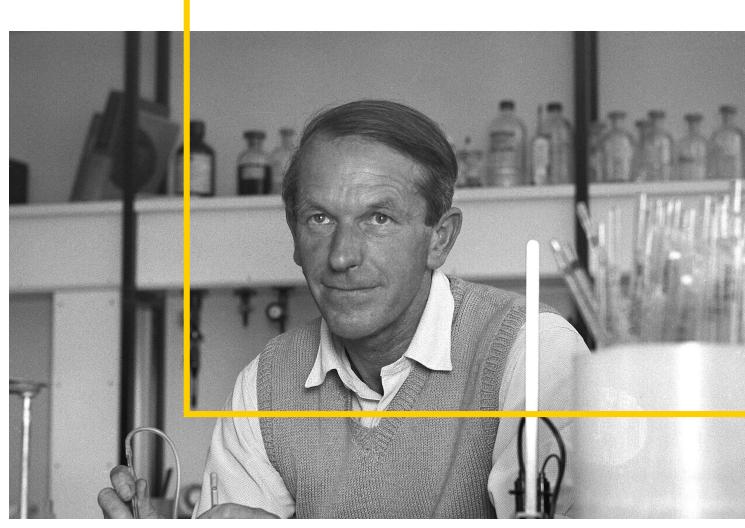


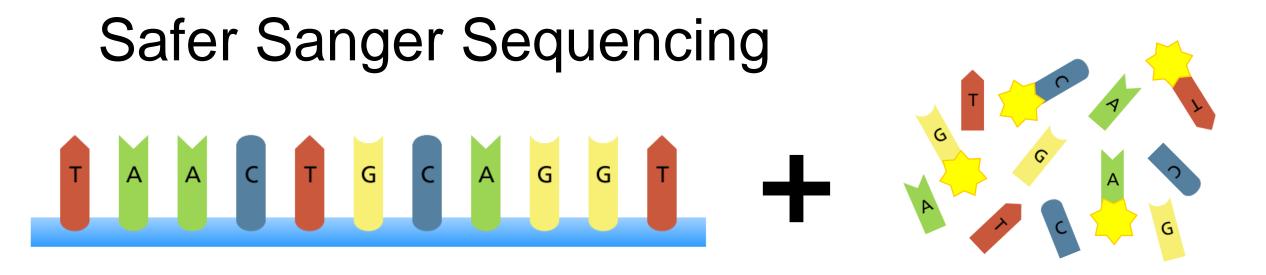
image credit: MRC LMB

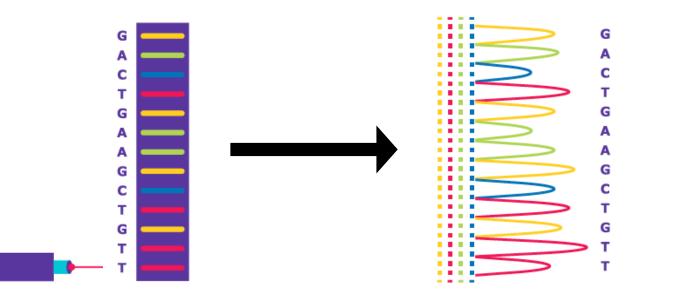
#### **Fred Sanger and DNA sequencing**

 First DNA sequencing methods was developed in 1977 by Fred Sanger and his team" at the Medical Research Council Laboratory of Molecular Biology in Cambridge, UK.

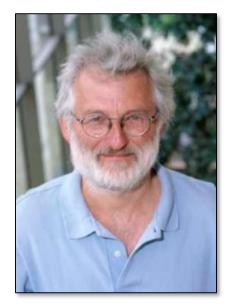
Based on the natural process of DNA replication, but used radioactively labelled "terminator" bases and gels to separate the DNA fragements



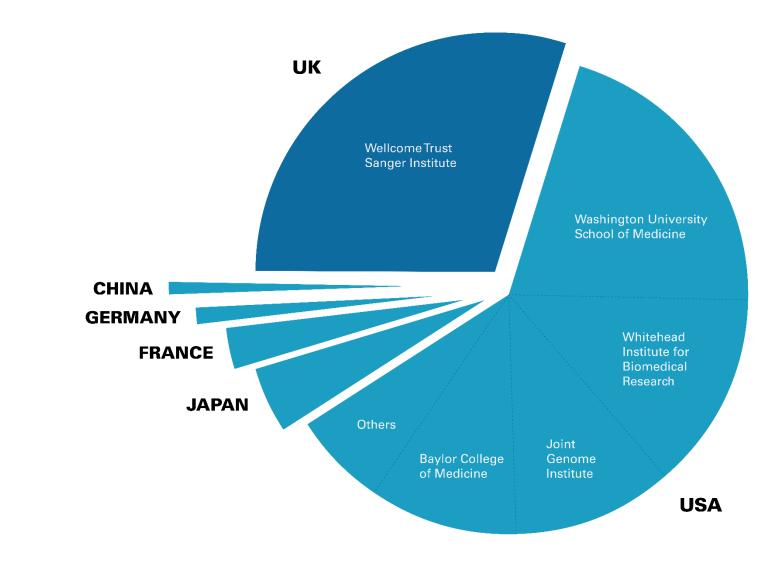




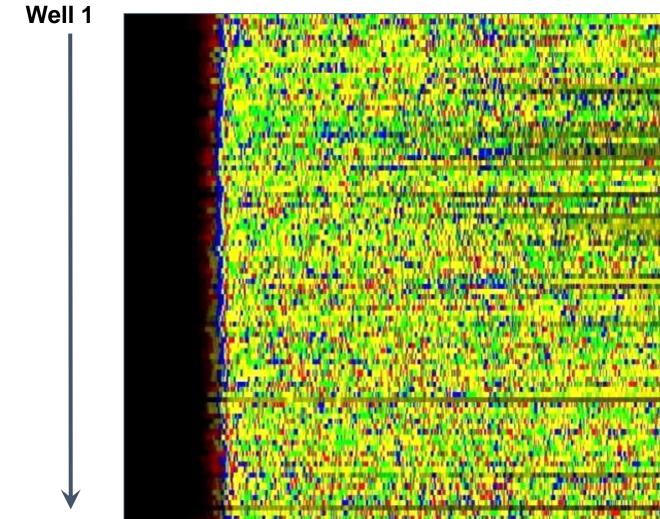
#### The Human Genome Project



John Sulston

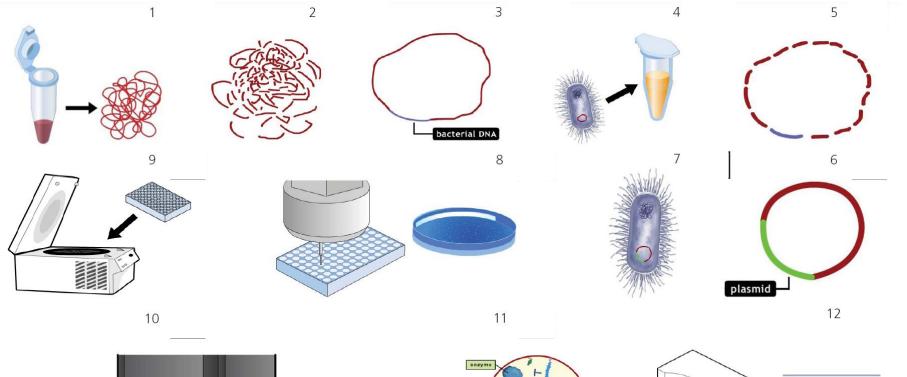


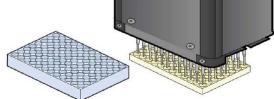
### Sequence output (ABI 3700)

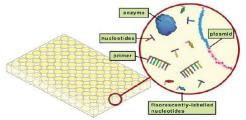


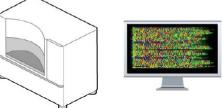


#### DNA to Data

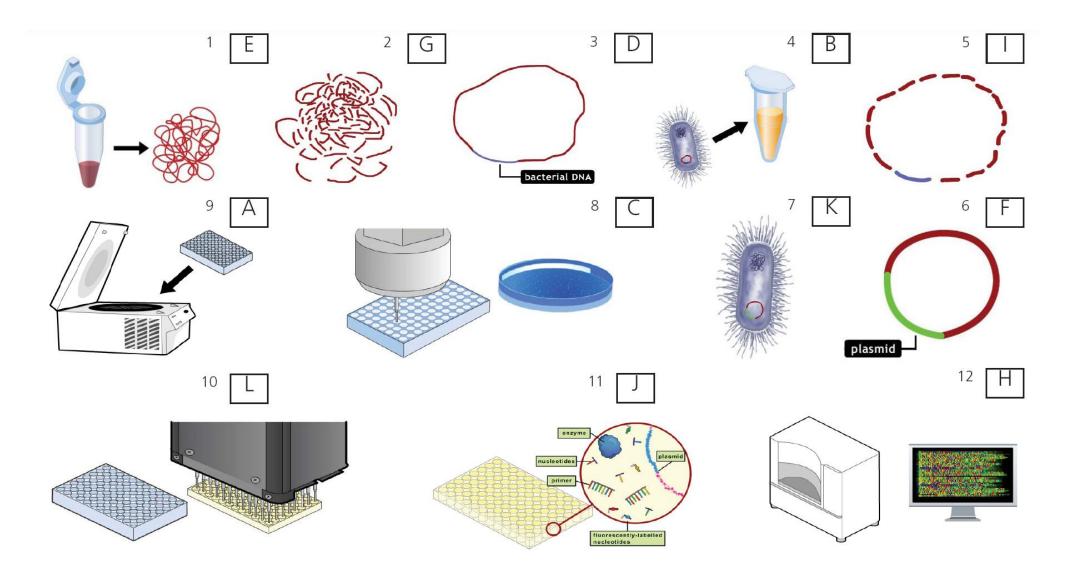








### DNA to Data



#### What does a genome sequence look like?

#### Introns

#### Exons

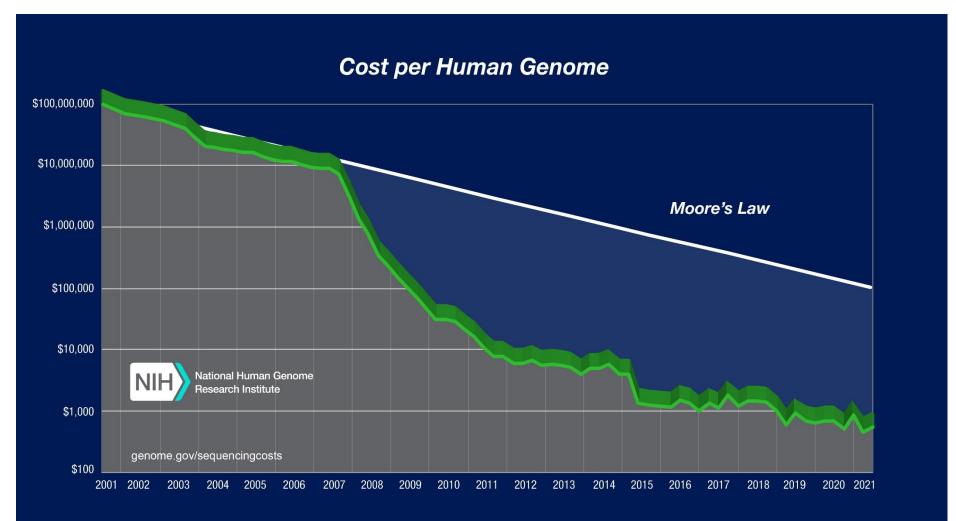
Non-coding DNA

19430551	a cagt cag a cagg c cag a a t cagg c c t g g g c t g g g g g g g t c t c	
19430701	t t c t g c c a c a a g g c a g a a c t a t g a c g a a a c t g a c t a g c c t c t c t g t a c a g a g t c a g a g c t a c g a g c c a c t c t g c c a c t g c c a c t g c c a c t g c c a c t g c c a c t g c c a c t g c c a c t g c c a c t c t c t c t c t c t c t c t c	In
19430851	tgtgccctatctgcccaaccctagttcaccctgatgtcccagctcagcattaatcgtggatccttcgcgggggccccgggggcccccaaccctcttttagggaccacaattccccaactggggggcactgtccccagatgggggca	
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19431601	cete agggeegeegeegeegeegeegeegeegeegeegeegeeg	
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19435051	a a g catcett g g t g t a ctett g a a t g g c t c t g g g t g g g a a a g a a c c t a a g a c a t c t a a t a a t c a g a t g c t c t g g g t g t g t g t g t g t	
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19436701		
19436851		
19437001		

#### DNA sequencers then vs now

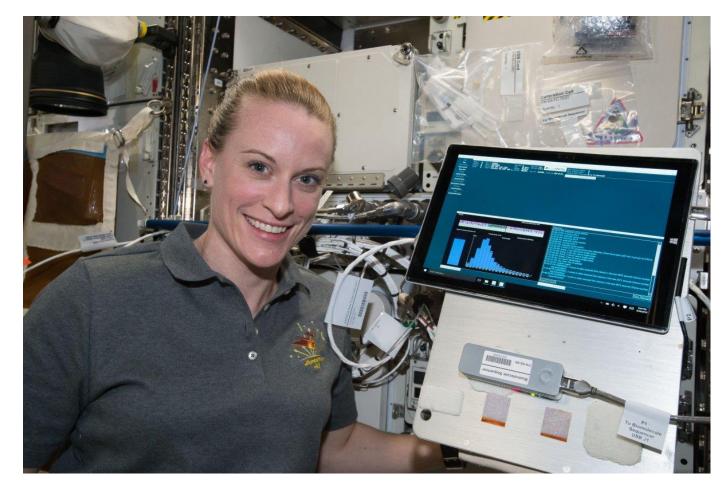


#### DNA sequencing today

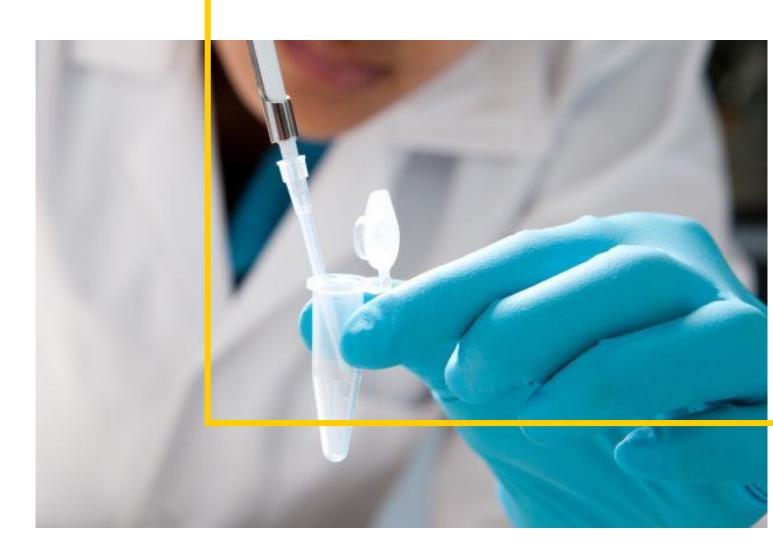


# Sequencing everything and everywhere





#### Getting ready for the lab session



# Virtual lab log in

#### genomeresearch.itslearning.com

User name: your email Password: password

Change your password once you have logged in

# Working Safely in the Lab

**Complete Module 2 Working safely in the lab simulations:** 

- Dressing for the lab
- Lab safety simulation





### What are the key lab safety rules?







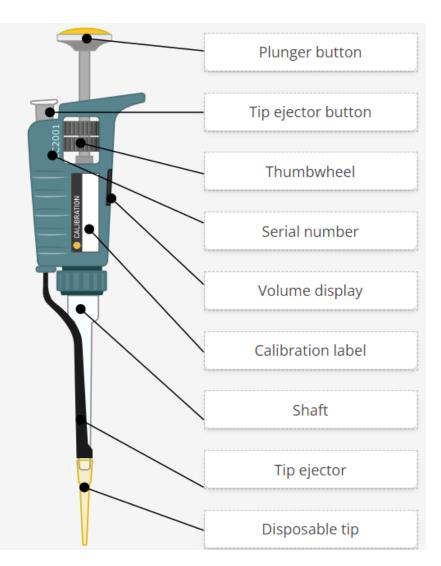
# Practical skills: Pipetting



# What is a pipette?

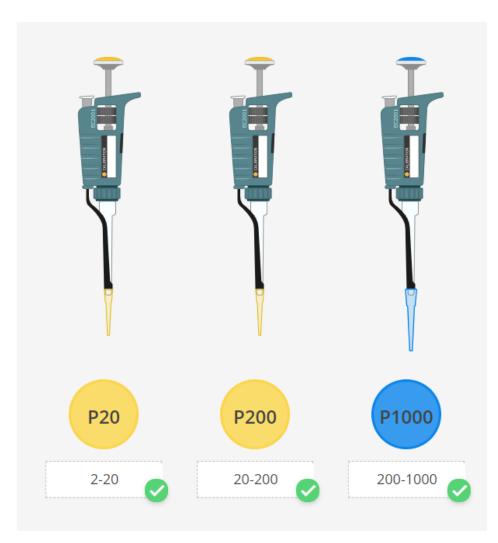


# Key parts of a pipette





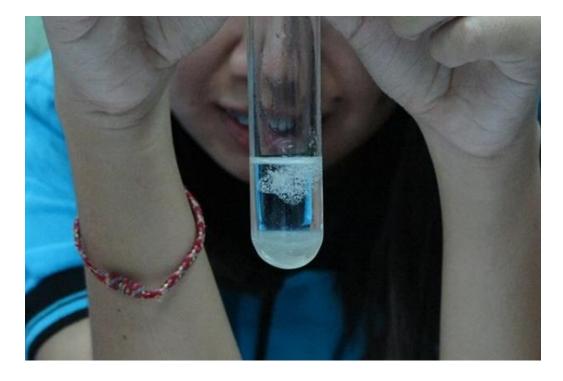
#### Sizes of pipette



### Practical 1: DNA extraction

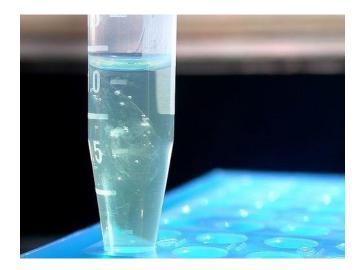
#### Aim:

 Understand three main stages involved in extracting DNA from plant cells and animal cells.



# **Stages of DNA extraction**

- The process of DNA extraction is fairly straightforward, incorporating the following basic steps:
  - 1. Breaking cells open
  - 2. Separating DNA from proteins and other cellular debris
  - 3. Precipitating the DNA with an alcohol
  - 4. Cleaning the DNA (purification)
  - 5. Confirming the presence and quality of the DNA



#### Practical 2: PCR

#### Aim:

• Understand the processes involved in carrying out a PCR reaction.



### **Practical 2: PCR**

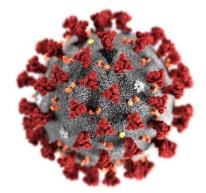
#### Polymerase Chain Reaction

# Uses cell's mechanism of DNA replication to make lots of copies of small sections of DNA

#### Why would that be useful?

# Uses of PCR

- Detection of Virus or bacteria
- Identification of Individuals (DNA fingerprinting)
- Identification of species (DNA barcoding)
- Diagnosis of genetic disorders



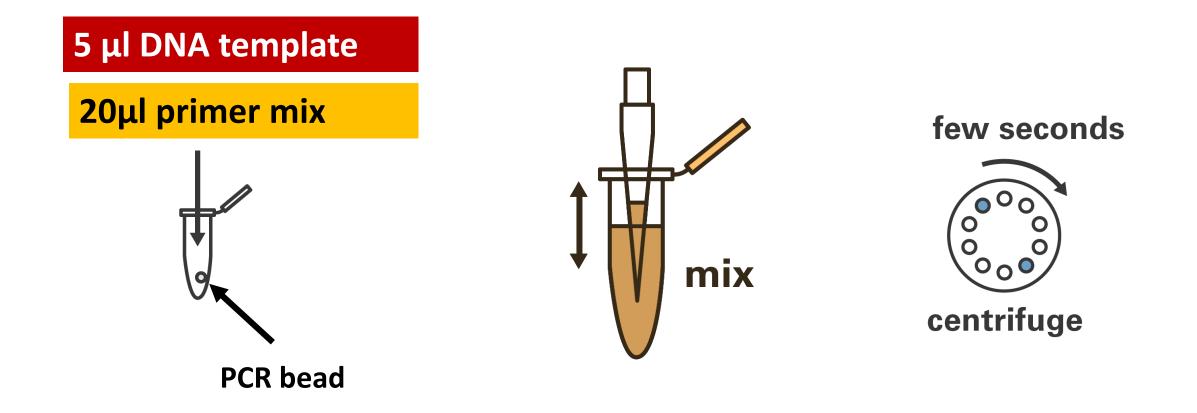




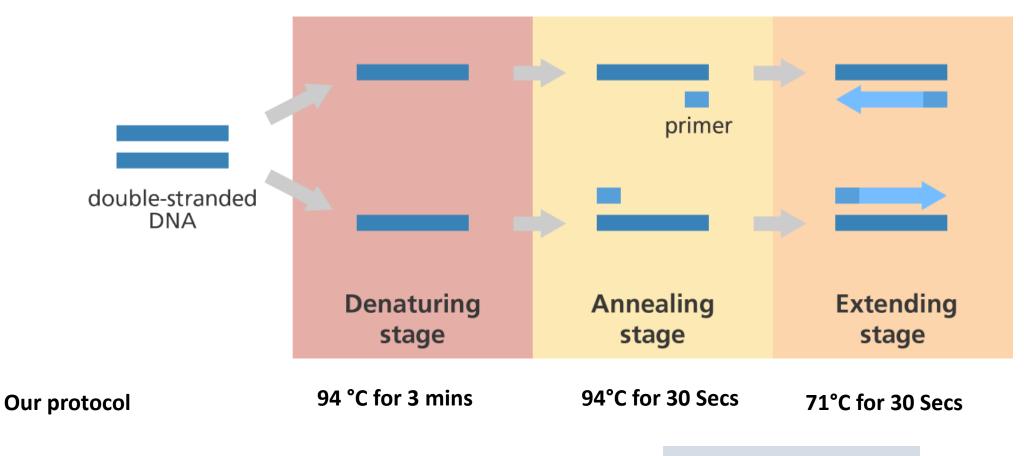
# What do you need for a PCR reaction?

- A DNA template to be copied
- A primer a short piece of DNA that is designed to bind with the DNA you want to copy
- DNA bases the building blocks of the DNA molecule
- **DNA polymerase** enzyme to build the new DNA fragments
- Buffer this ensures the conditions remain stable for the reaction to take place.
- A thermal cycler a machine that heats and cools the sample

# What will we be doing in the lab?

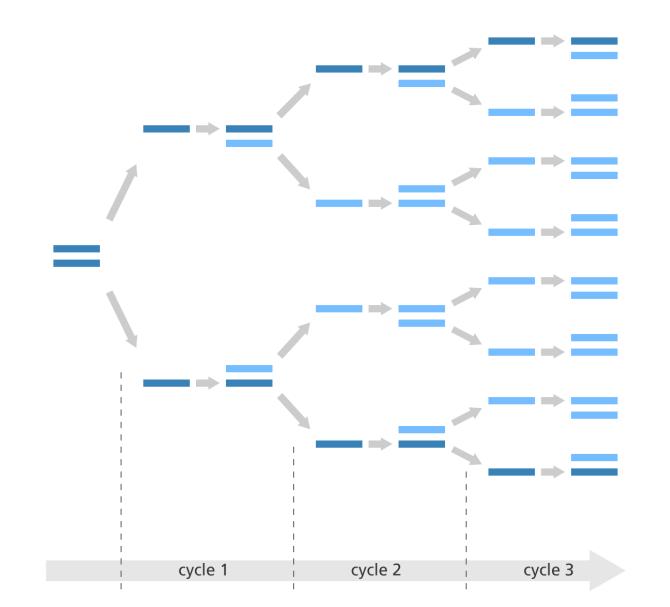


### PCR cycling conditions



Repeat for 20 cycles

#### What will be happening in the PCR machine

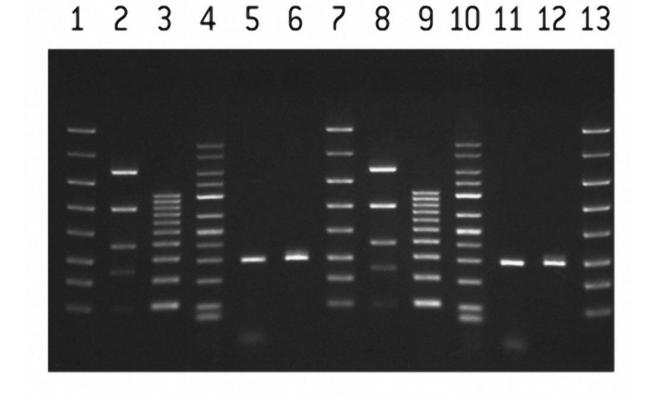


# Using the Lonza Flashgel system



# **Visualising results**

Gel electrophoresis can be used to view whether your PCR has been successful



#### Lonza Flashgel (Gel electrophoresis)

