

Genome Academy: DNA to Data

9 – 11th April 2024

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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



Fran Gale

Head of Science Engagement



Sam Shingles

Science Engagement Officer



Cassandra Soo

Laboratory programme manager



Aaron Dean

Laboratory Assistant



Chris Adamson

Laboratory Operations
Officer



Jorge Batista da Roche Education Developer



Find all the resources on GitHub

https://wcscourses.github.io/genomeacademy/

Genome Academy



The manual and programme for Wellcome Connecting Science's Genome Academy

View the Project on GitHub WCSCourses/genomeacademy

This project is maintained by WCSCourses

Hosted on GitHub Pages — Theme by orderedlist

Visual Assistive Version

Genome Academy

Welcome to the Genome Academy, a three day programme that will provide an in-depth look into genomics, with a particular focus on how we translate DNA into Data.

Genomics is a rapidly developing field of research and is increasingly weaving its way into everyday life, from playing a role in vaccine development, virus tracking, personalised cancer treatments, unveiling family histories, solving crime, and tackling the planet's fragile ecosystems. There are a wide range of career opportunities in this field, some that didn't even exist several years ago.

Across three immersive days you will learn and experience the end to end process of how we translate DNA into data. The packed programme of activities will include talks on the latest cutting-edge science taking place at the Wellcome Sanger Institute, lab tours, hands-on experience with wet lab techniques such as DNA Extraction, PCR, DNA Sequencing as well as training with bioinformatics tools. You will also get the opportunity to meet a range of different staff working in this field.

Course overview

The Genome Academy is a course designed and delivered by Wellcome Connecting Science, based at the Wellcome Genome Campus, Hinxton.

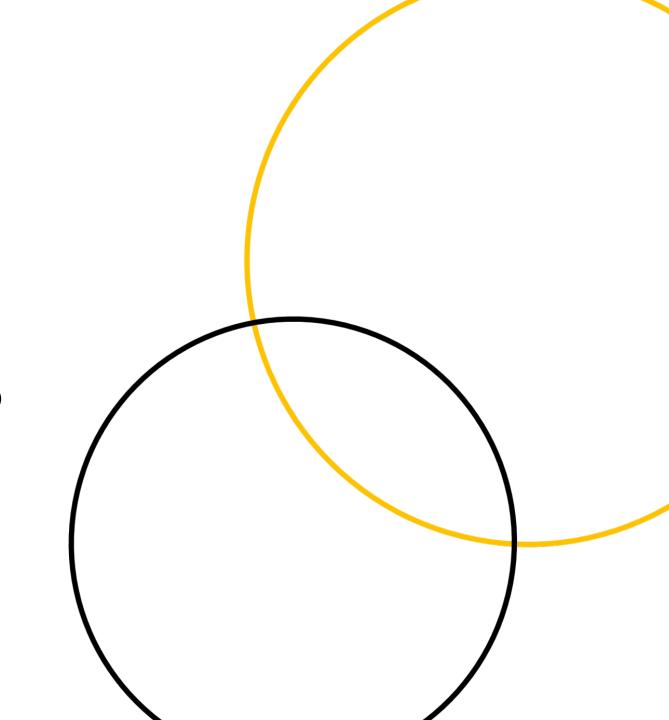
In this section find out who your instructors will be and what you will be

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: Michael Ansah, Tree of Life programme
12:15	Lunch
13:00	Lab practical – running a Lonza Gel
13:30	Lab tour – CASM team
15:00	Reflections on the day
15:30	Depart

Introductions

An introduction to everyone and quick survey to see how we feel at the start of the course



Wellcome Genome Campus





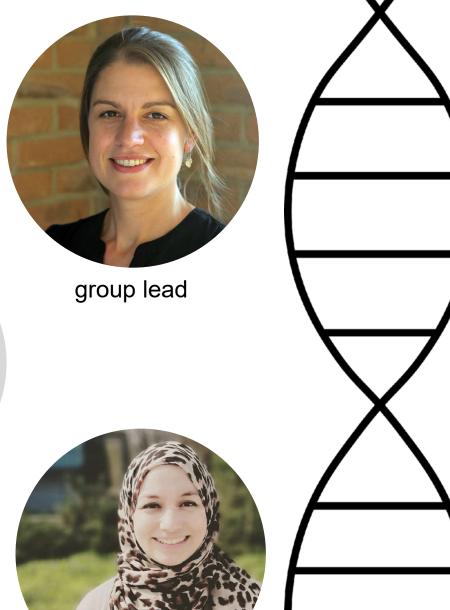






Areas of campus research





computer science apprentices





research fellows

research assistants



genetic counsellors

The Sequencing labs



Cellular operations



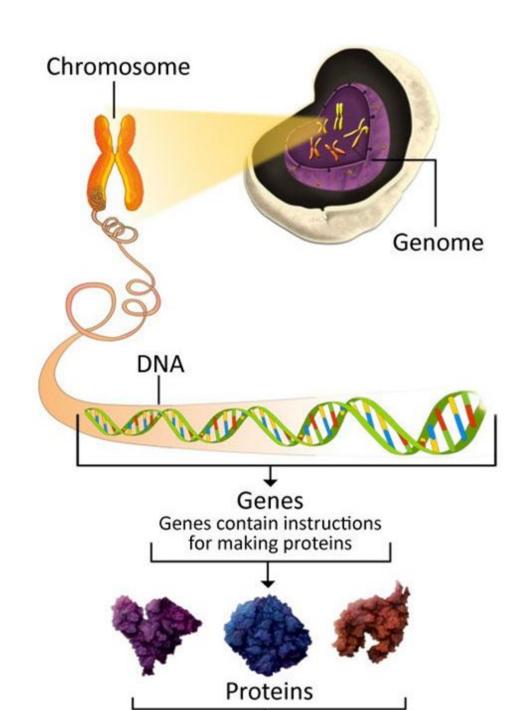
The data centre



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



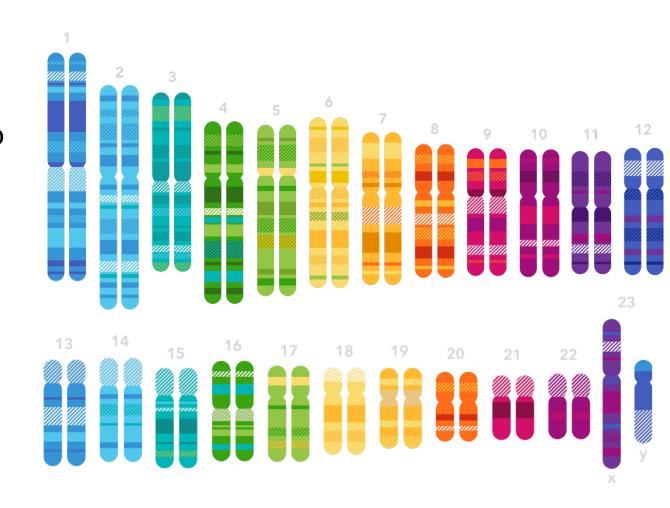
What is a genome?

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

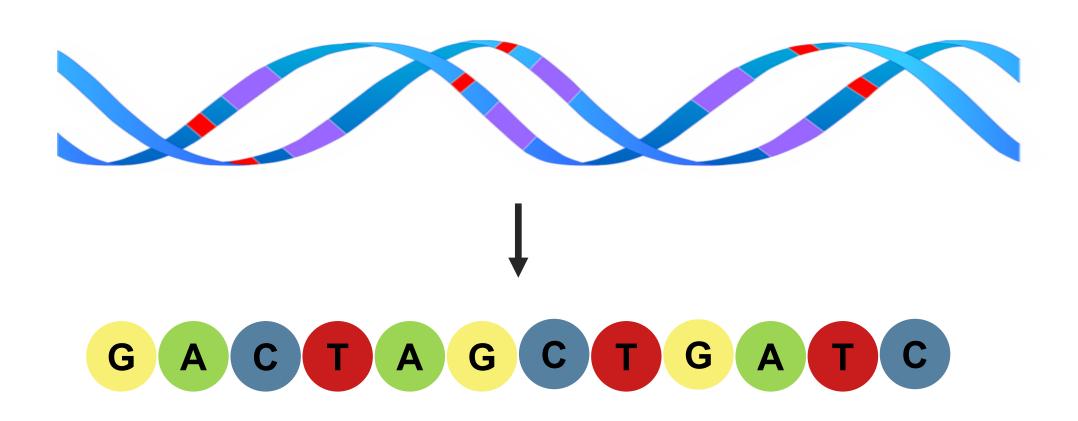
"The Book of Life"

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

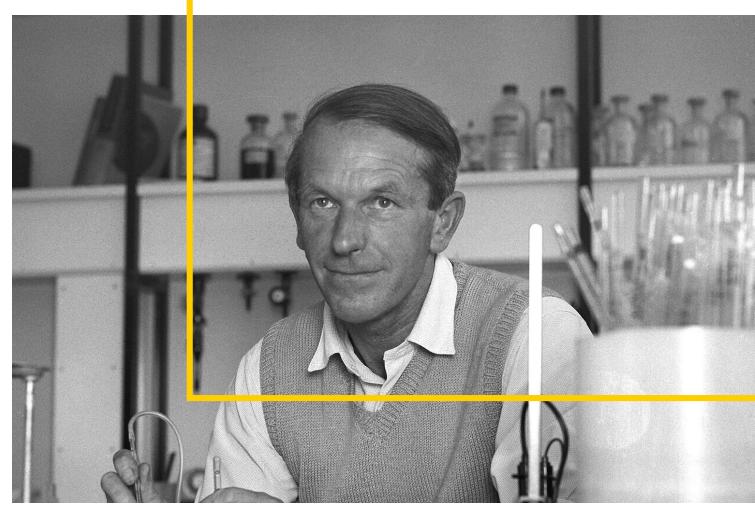


image credit: MRC LMB

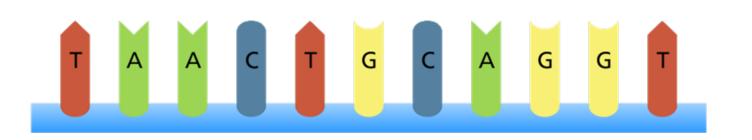
Fred Sanger and DNA sequencing

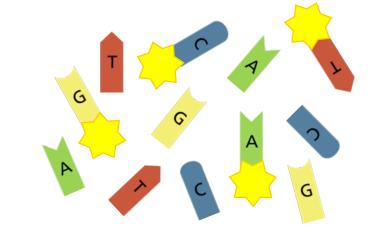
 First DNA sequencing methods was developed in 1977 by Fred Sanger and his team" at the Medical Research Council Laboratory of Molecular Biology in Cambridge, UK.

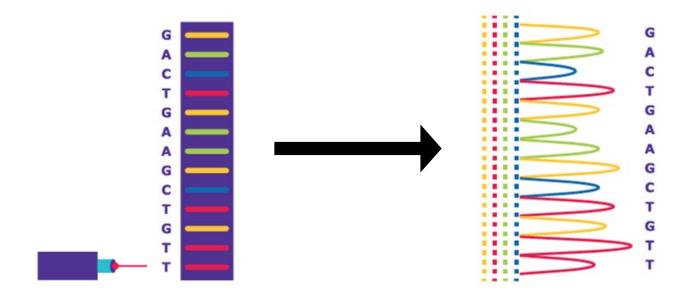
Based on the natural process of DNA replication, but used radioactively labelled "terminator" bases and gels to separate the DNA fragements



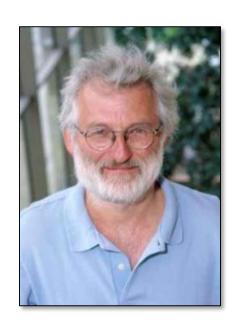
Safer Sanger Sequencing



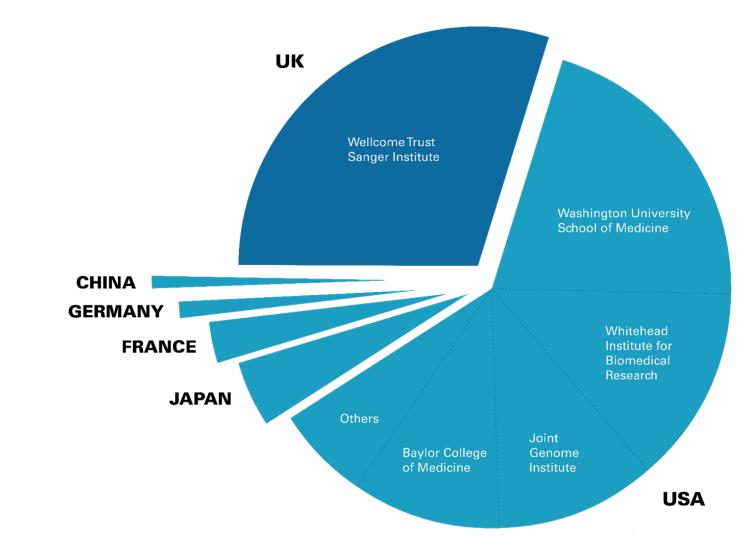




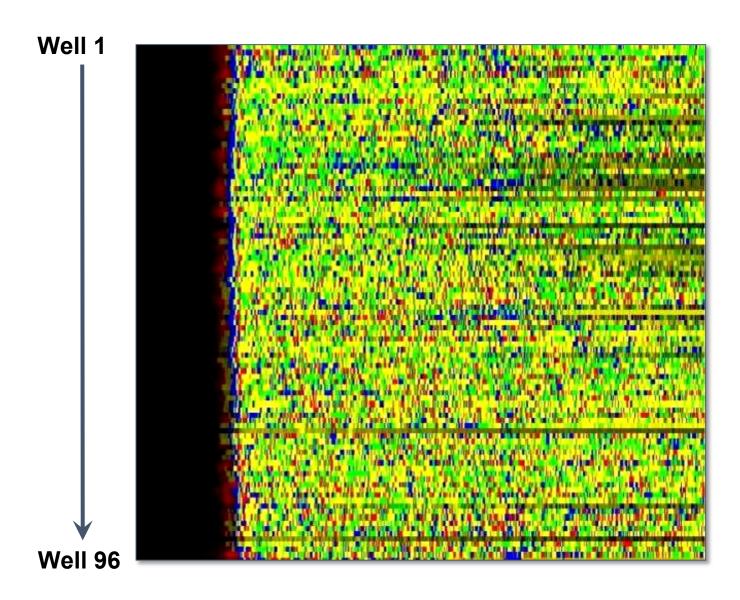
The Human Genome Project



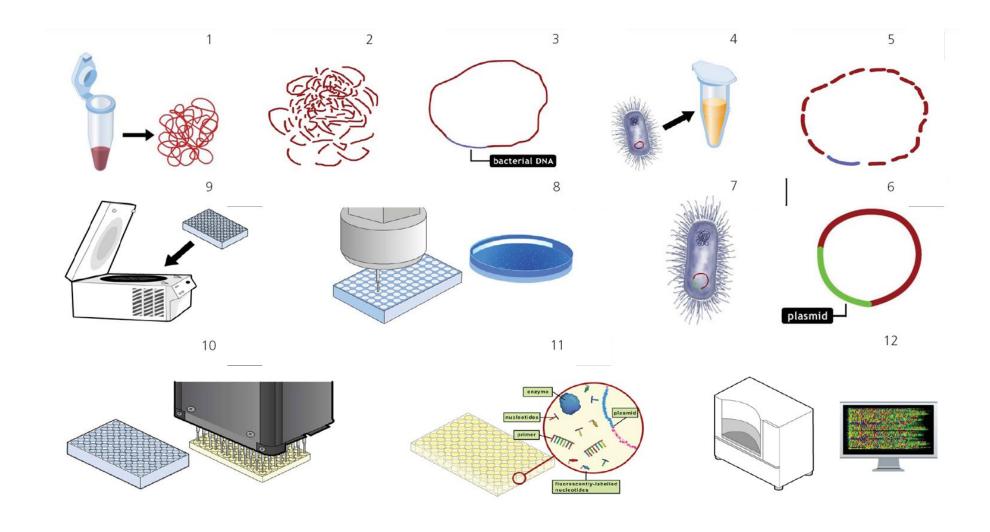
John Sulston



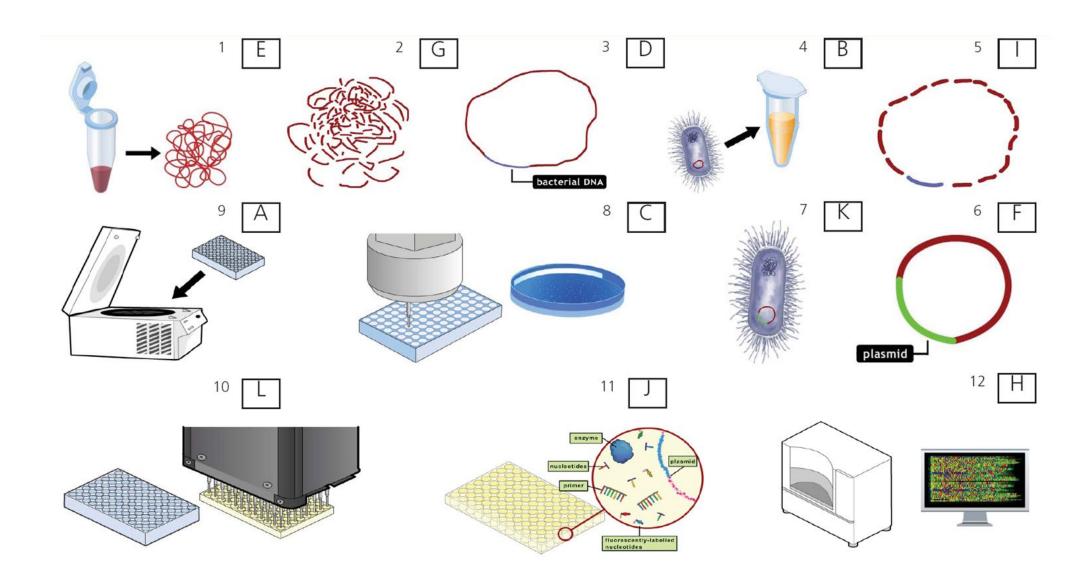
Sequence output (ABI 3700)



DNA to Data



DNA to Data



What does a genome sequence look like?

ttetgecaacaaggeagaactatgacgaaactgattaccactageetetetgtateagagteaagatatggggtggatgagteegtteeecaagggtgtgetttggagecactgecacagagetaagaageceetetgetagaacacace gtaacagtocctottgcagattttcggatottcatcotgccactgaaaggcgcacaagggggatttcatcccggtttcaccttcaggaccgtctgagcacttctcgggcggtgcagacagtggaccactggcaccaaggcccqct cetgggagecaggecgeggcccetecaaggaccacaggtgggcageggaagactcagagccaggggggaagatggccctcgctggggtcaacceggagcacgtgctggggctcaccaggcttccgcggtgagacaaagtccg caqttqcaacccqqqccqccqcaqaqqcaqqqqqcccaqqtqqcqtqqaccqccqtcaccaqctctqcctcqccaqtctqaqtccqacttattaactaqcttcatcatcaacacqcqctattqqqcatcttqcqaqcqccq cagaggaegececeteggeegeteeggetgeactgeggageegaggeegagggegeagaeegaeegaeetagggetagggetagaetggetagaetgtgeeggtgeagaggegegeteeeageaeagggeggggaegggaagggaagggaagg geacegegggeeggactgtgggagggggaegeacgeeggaaggggtageeatgaeggeeteegtgetgegaagtatetegetageeetgegeegactageggattgeeggattgeeeagggegeg acagagtetegetetgtegeceaggetggagtgeagtggeggattteggeteactgeacetetgecteeegggtteaageagttetgeeeeggetteeeggattacaggeggeeaacaceaceageeeggetaatttttgt cttgtatettteagggttetgggaaettggeagaettagagagaeteagaggaggeteattgttgtetttetgggaaeteatteeeatgaggtaaaaeteaategagggetgaeetetgggggtaaaggtgteagtetatgt gtagagaacaaagcaagaatgctggatgtgtggtttgcaaaattaacagcctacaaagtttctcagttaaatttaggccgatgcttttctgtttttccaacattttccaaaccatagattqttqttttttaaatttttaaaatttqaqcaqt tteteaagaagtaagtatteteettgaagggattettgtgtgttttaaaggacacagettaagtttetgttteteeatgaceetteetetteeetgeecatteggaggeeetggagagtgtggggaagatgeaagtattaaaggatatte ctoctgggttaaactaattotoctgootoogootoocaagtagotgggattacaggogoocactaccacgcocggotaattttttgtgtttttagtagaagaggggtttoaccatgttggatgttggtcaggetggtctcgaactoctgat caaceteegeeteecaggeteaagtgatteteetgeeteagetteecgagaagetgggattacaggtgegeaceaceaceagetaatttttgtatttttagtagagacagggtttegecatgttgaccaggetggtetegaacteet gacettgggcaatetgcccgcctttgcctcccaaagtgctgggattacaggcctgagccactgcacccggctgcttttgtactatttcttgtaattgtagtgcacctacacagttctcacaagtactgtggggtggagtacctcctcacca egetgageteatgageteatgeaeageteetteeeeeagtggagggeteagtatggggtaettaeeatettgteteteeggtaggtteatgaggaceaaagaggaaaatgtttaatatttgetttatetattacateaggageteettegg aaaaaaqaaqqaaqqtaqatcctaaaaaaqaaccaaqaaqcaaaqqaqcqcttqaaaaqqaaqatccqaaaactqqaaaaqqctactccaaqaqctaattcctattqaaqattttattacccctctaaaqttcttqqataaaqcaaqqtaaqqatocttototagggatgaagtootoaggacaaaggagtaatatoaggtagttgtgtgtgtgtagttoacacotgtgatagtoattggtcagtaggttgagctgagttgagctgagtcgttgagcctaatgagtoottgtgctcttttggaagcaggaga aagcateettgggtggtactettgaatggetetgggtgggaaagaacetaagacatetaataateeagatgettaagcactgetetggagtteatgttgttgetgteatgeatgaggagtettggetgtttetgateeettgggeetgga gtotgaagoootogootoatootaacagtagaaaaccottggcotootgttttatoatgcagatatotttggttggtatttgttgggattotactgtgtgcagggttaacaggttcatgctgcogcttttgtaagaagtgtgcaccatotat aaaggggcaggtgttaaaagtetteteteacccaagggagtatttgettgggcagagggaagtgetaccagteteetcagateatetgttettttgacagaggaagagaaatgacettggttecaagcateagttgeagetgeagetcacattea acattecatttettaatttqteecaaacttqttttateteetaaqteetqtetqtetqqeaatqqqaatacttqtqteaqttqeaqteacaqaettacatqeeaqtqqaattqqtaaceettaqettetttqeaqaqaqqqeeteaq gtggageteacetttgaggagactgagaggagetetgettetgaagaagtggteettgtacaagcagcaagagggtaagatggagaagcaccatcaggggetatgetagaagcccagcaggaagctetggaggaactgcaactggaa ttttttaaaaaatttttttttgagacagagteteaetetgttgeeeaggetggagtgeagtgaeggaateteeggeteaetgeaaetetgtetetetggtteaaggatteteetgtgteageeteetgagtatetgggattaeaagtgt qcaccaccacqqqqqtaatttttqtatttttaqqaqacaqaqttttqccatqttqqccaqqctqqtctcqaactcctqacctcaaqtqatccqcctaccttqqcctcccaaaqcactqqqattataqqcatcaqccacqcccaqc cagaattaaaattaatteaceaggeeaggeteagtggeteatgeetgtaateeeageaetttgggaggeeaaggtggateaeggaagtgaaggteaggagategagaceateetagetaacagtgaaaceeeatetetaetaaaaata caaaaaaaattaqctqqqcatqqtqqcqqqcqcctqtaqtcccaqctactcaaqaqqctqaqqcaqqaatqqtqtqaacctqqqaqtqqaqcttqcaqtqaqccqaqatcacaccaccactqcactccqqcctqqqtqaaaqqaqqaq agggtatagtgaaaataccaacaggagtcagagtaacagaggagtggtggggaaaggaagttgccagctggaaaggcatgtggagaagcattcctgatgggaaagaccaacaaggagccacctttgtgttttcagctggggttagggg

Introns

Exons

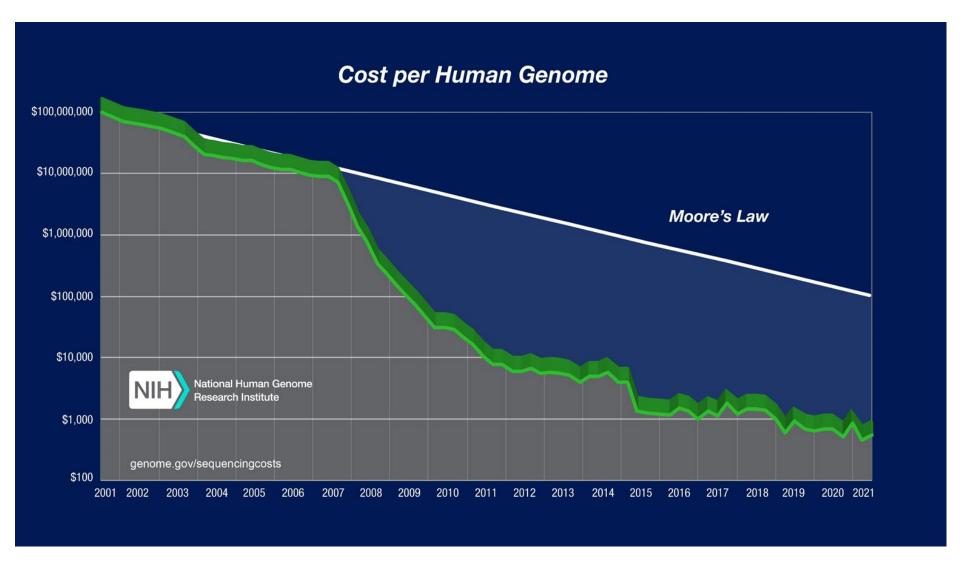
Non-coding DNA

DNA sequencers then vs now



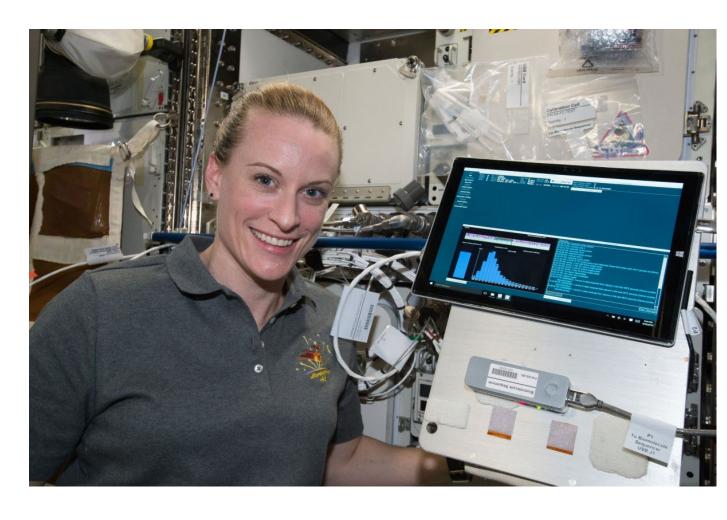


DNA sequencing today



Sequencing everything and everywhere





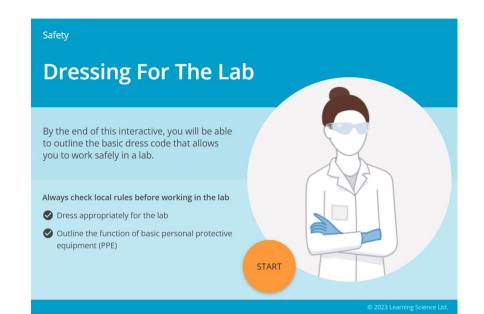
Getting ready for the lab session

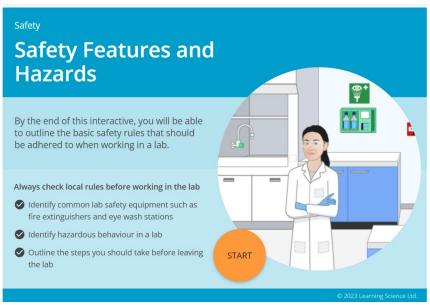


Working Safely in the Lab

Complete Working safely in the lab simulations:

- Dressing for the lab
- Lab safety simulation





What are the key lab safety rules?













Practical skills: Pipetting

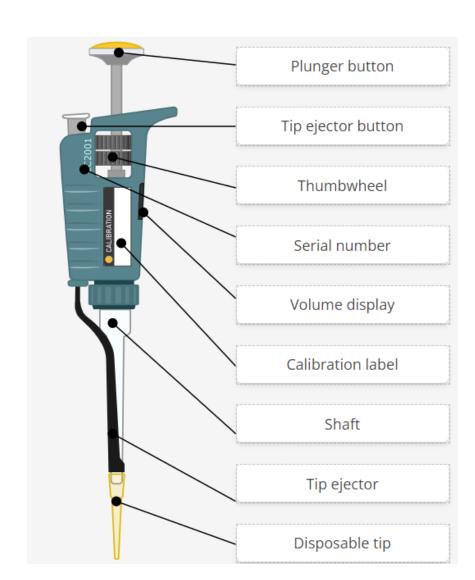


What is a pipette?



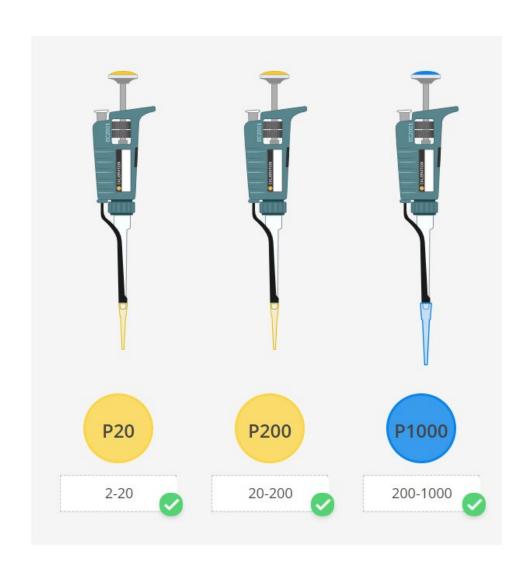


Key parts of a pipette





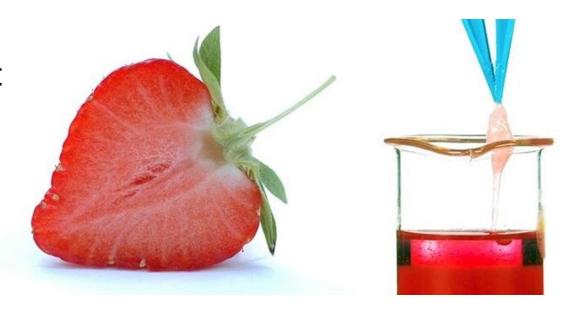
Sizes of pipette



Practical 1: DNA extraction

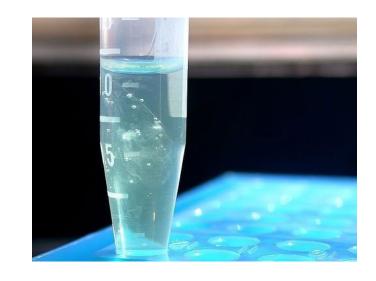
Aim:

 Understand three main stages involved in extracting DNA from plant cells (strawberries)



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

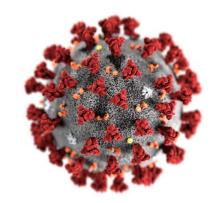
Polymerase Chain Reaction

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







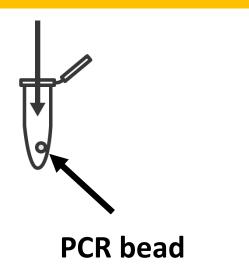
What do you need for a PCR reaction?

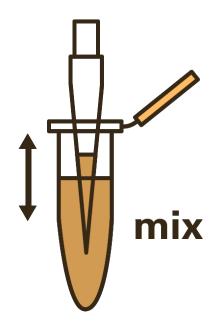
- A DNA template to be copied
- A primer a short piece of DNA that is designed to bind with the DNA you want to copy
- DNA bases the building blocks of the DNA molecule
- DNA polymerase enzyme to build the new DNA fragments
- Buffer this ensures the conditions remain stable for the reaction to take place.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

What will we be doing in the lab?

5 μl DNA template

20μl primer mix

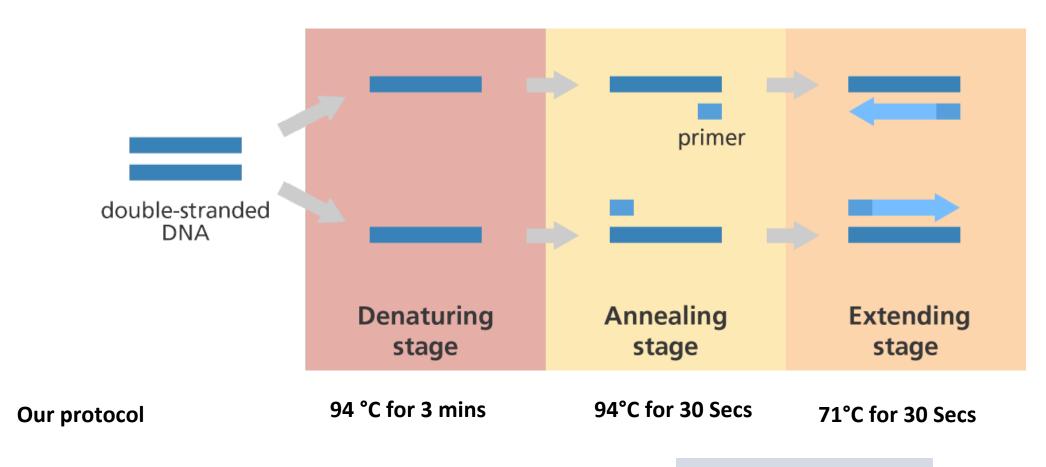




few seconds

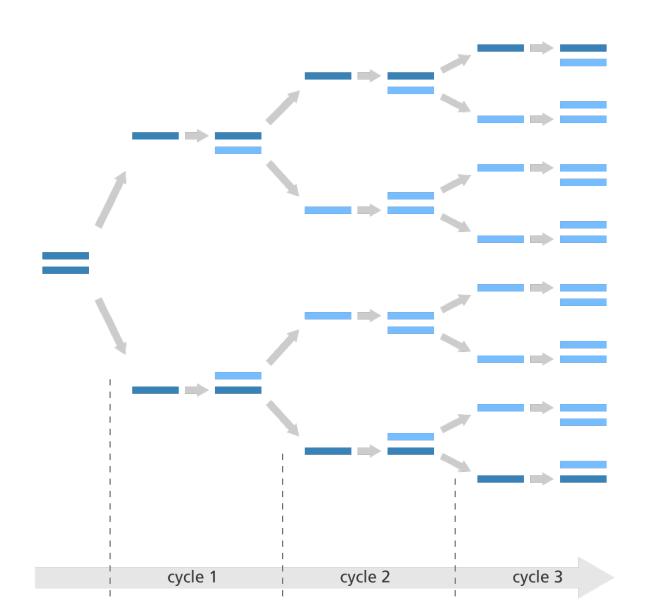
centrifuge

PCR cycling conditions



Repeat for 20 cycles

What will be happening in the PCR machine



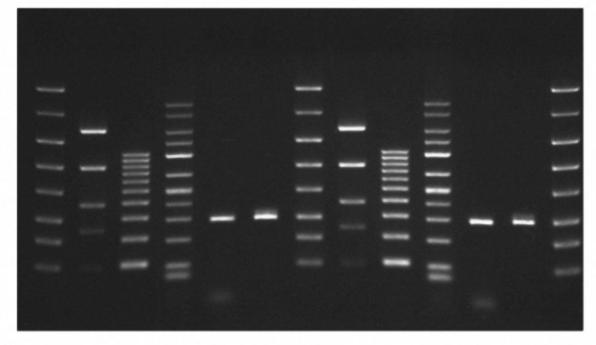
Using the Lonza Flashgel system



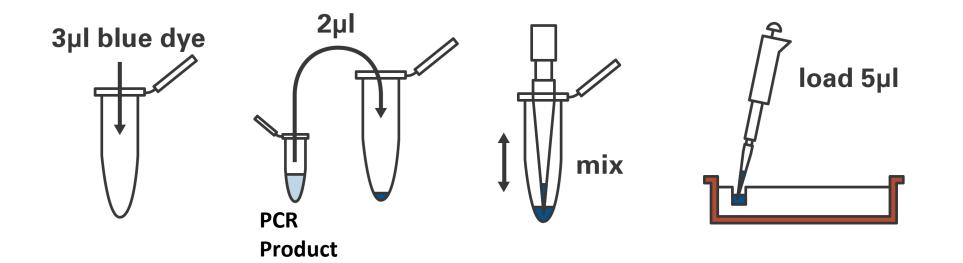
Visualising results

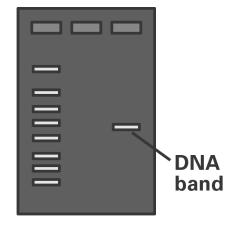
Gel electrophoresis can be used to view whether your PCR has been successful





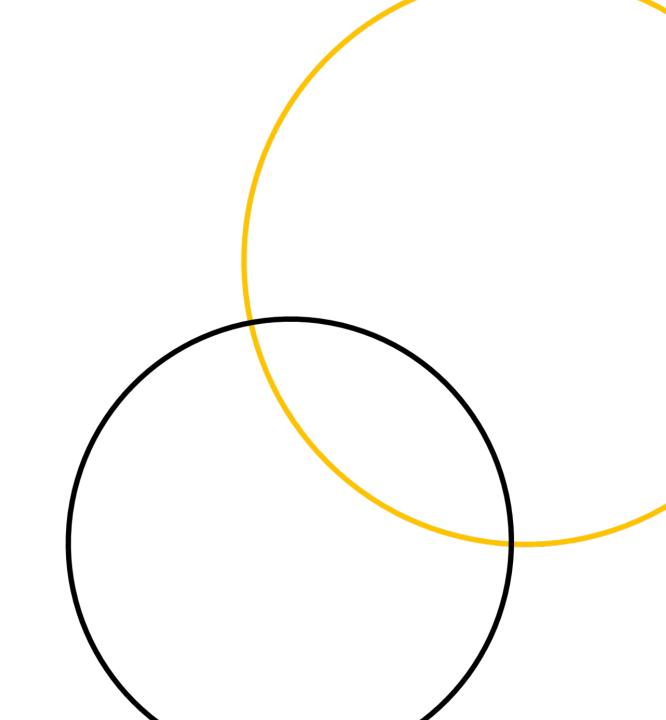
Lonza Flashgel (Gel electrophoresis)





Reflections Day 1

Genome Academy: Day 1





Today has met my expectations.



Did you learn anything from today that you didn't know previously?



What was your most enjoyable or most interesting moment from today?



Was there anything from today that you would like more information on or clarified?



What are you most looking forward to for tomorrows session?

