# Beyond the genome

# Showcasing Sanger Science

- Celebrating 20 years of Sanger Institute
- DNA sequencing technologies
- Sanger Institute research:
  - Tracking hospital outbreak of MRSA
  - Mapping drug-resistant malaria parasites
  - Cancer genome sequencing
  - Sequencing 1000s of genomes in UK10K
  - Identifying genetic causes of developmental disorders
- Exploring the ethical issues of DNA sequencing

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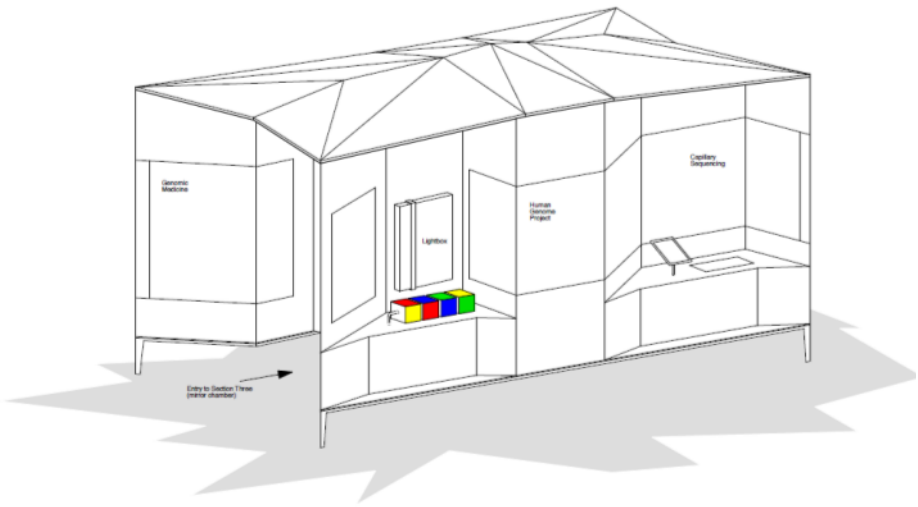
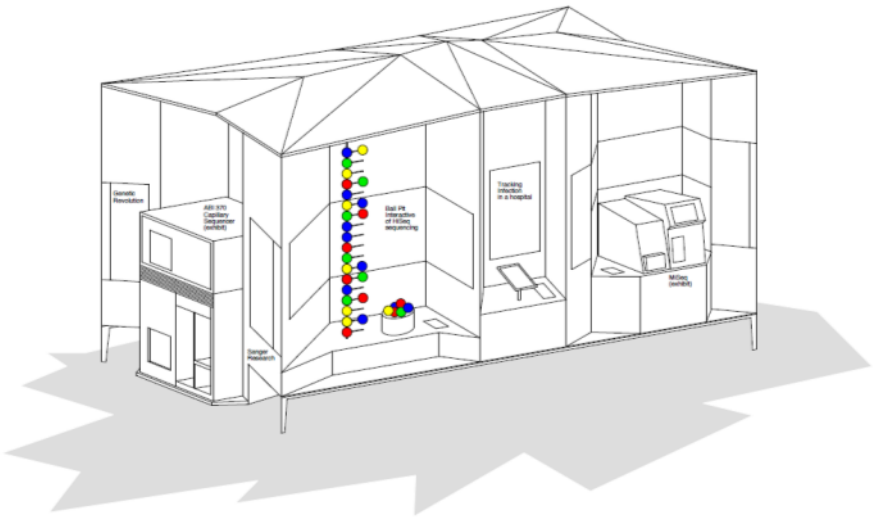
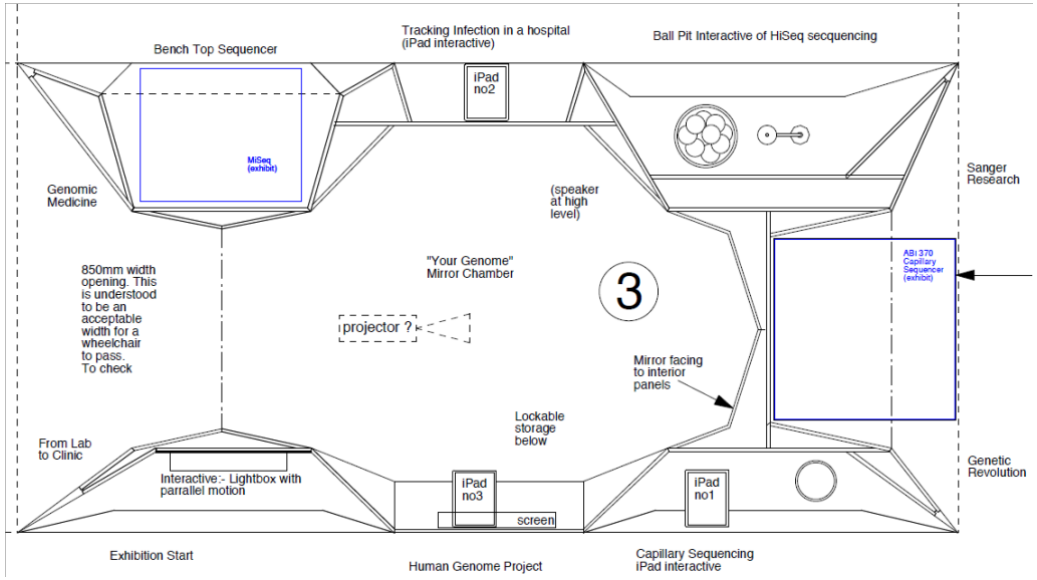
# Scientific stakeholders

- Julia Willingale-Theune – Public Engagement
- Steve Scott – Public Engagement
- Don Powell – Media and PR
- Cordelia Langford – DNA sequencing
- Julian Parkhill / Matt Holden – MRSA
- Julian Rayner – Malaria
- Serena Nik-Zainal – Cancer
- Dawn Muddyman – UK10K
- Anna Middleton – Ethics

# Our stand








**Designed by Nick Bell Design and Nick Coombe Architecture**

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# Our stand




**Built by Van Rooij & Griffiths**

**Graphic production by Albermarle Graphics**

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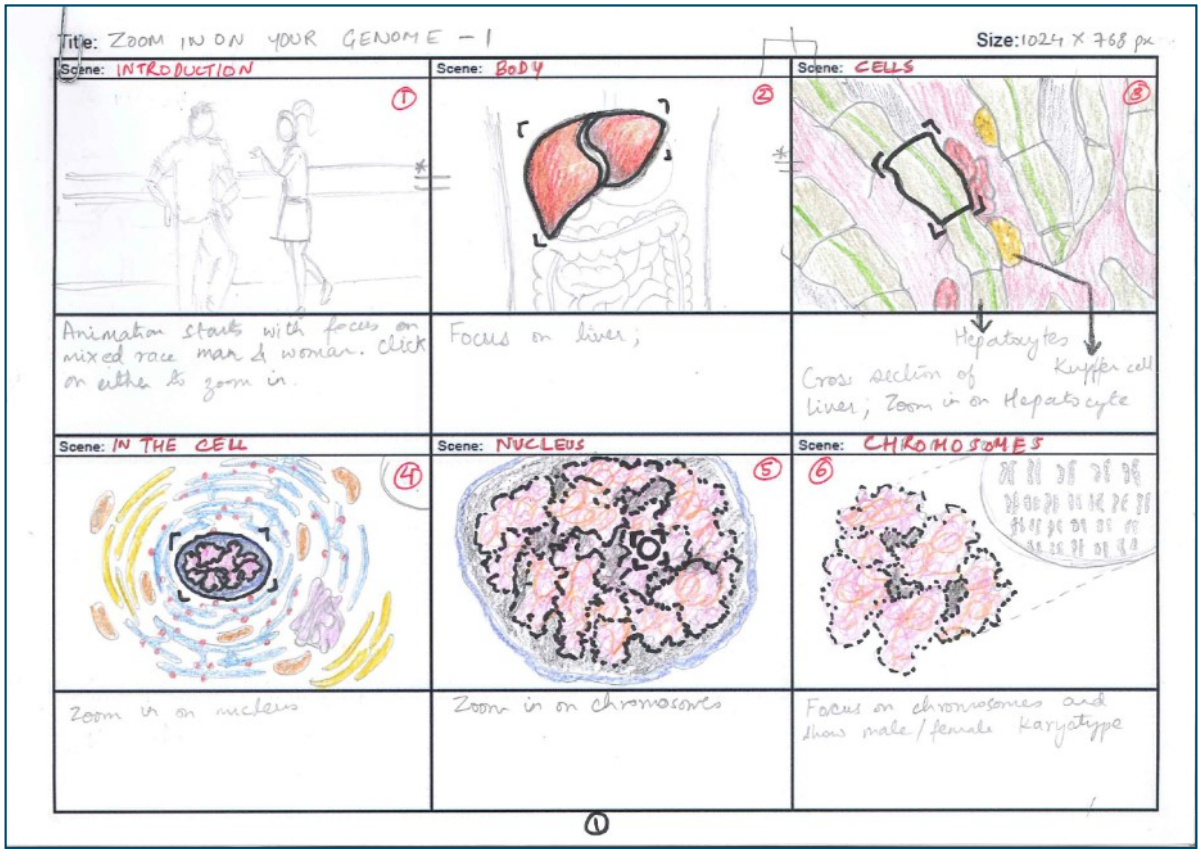
Film and falling letters animation
by Paul Fenn Films

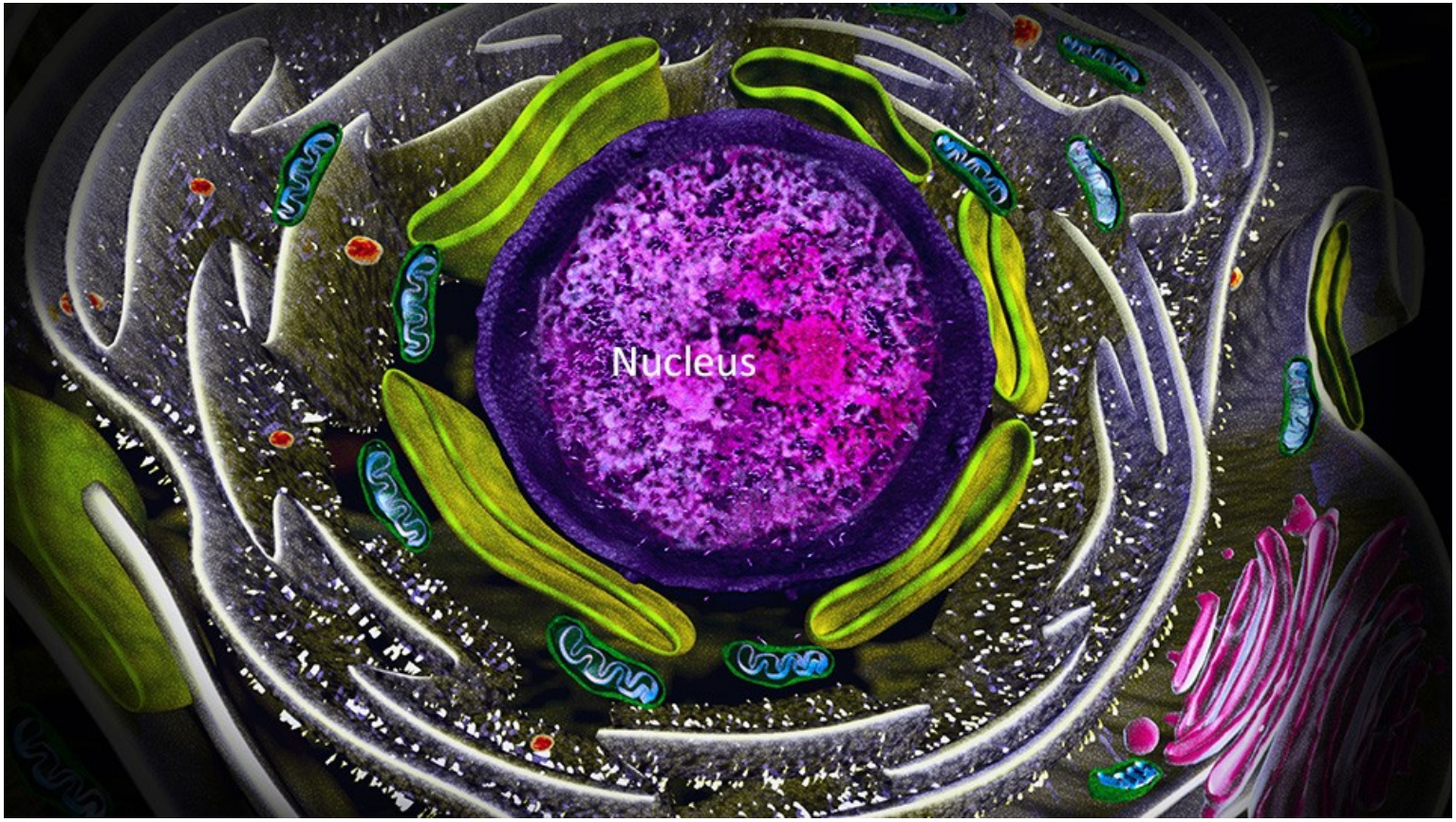
# Activities

## Zoom into your genome



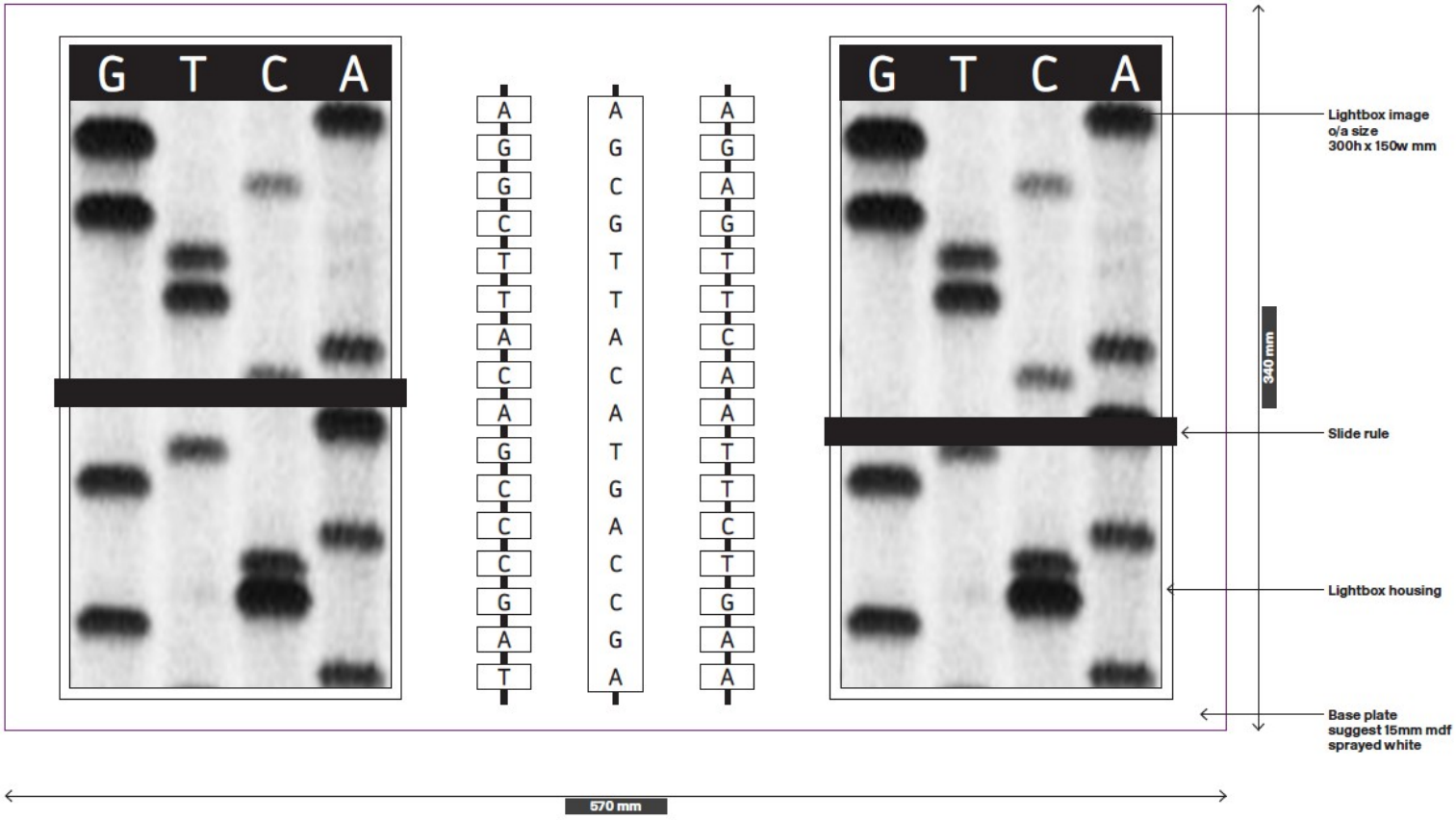
# Activities

## Zoom into your genome



# Activities

## Try your hand at sequencing

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# Activities

## Try your hand at sequencing



**Built by Machineshop**

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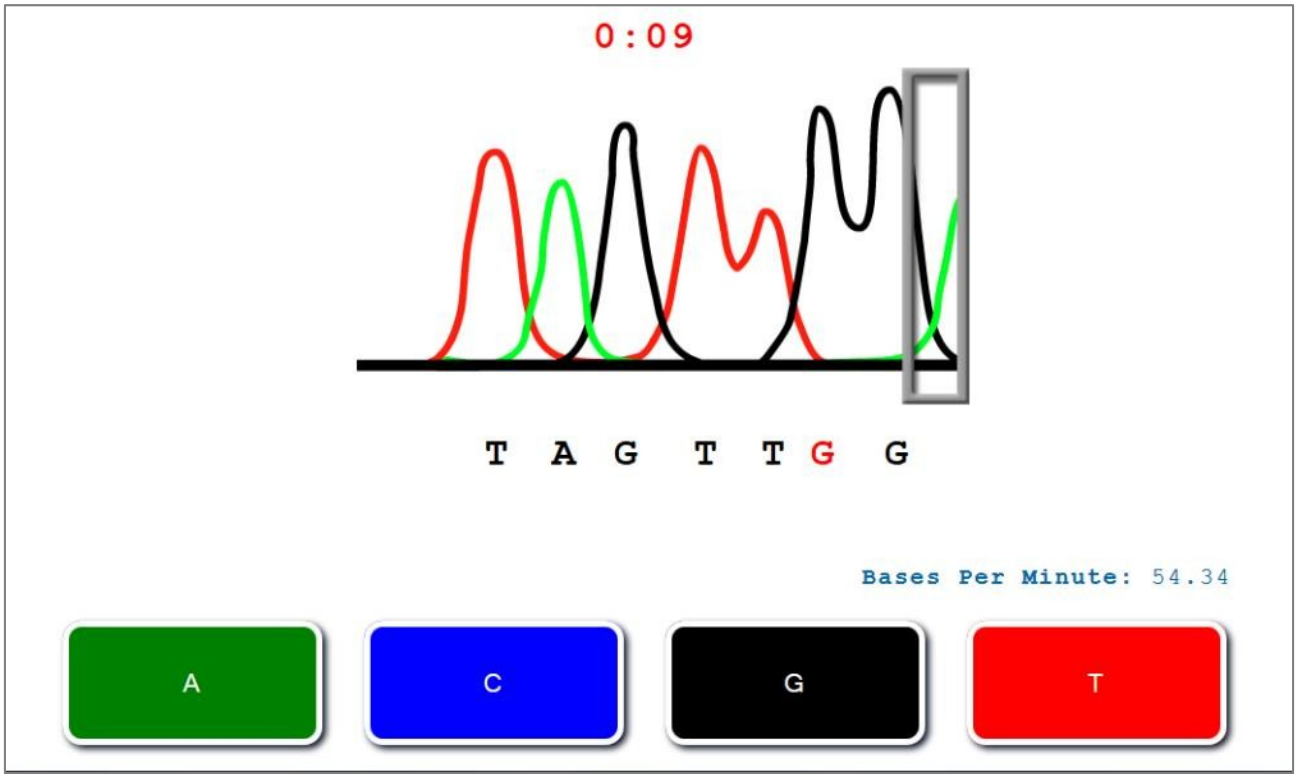
# Activities

## You vs. machine




**Created by Nicholas Tieman (freelancer via elance.com)**

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# Activities

## You vs. machine


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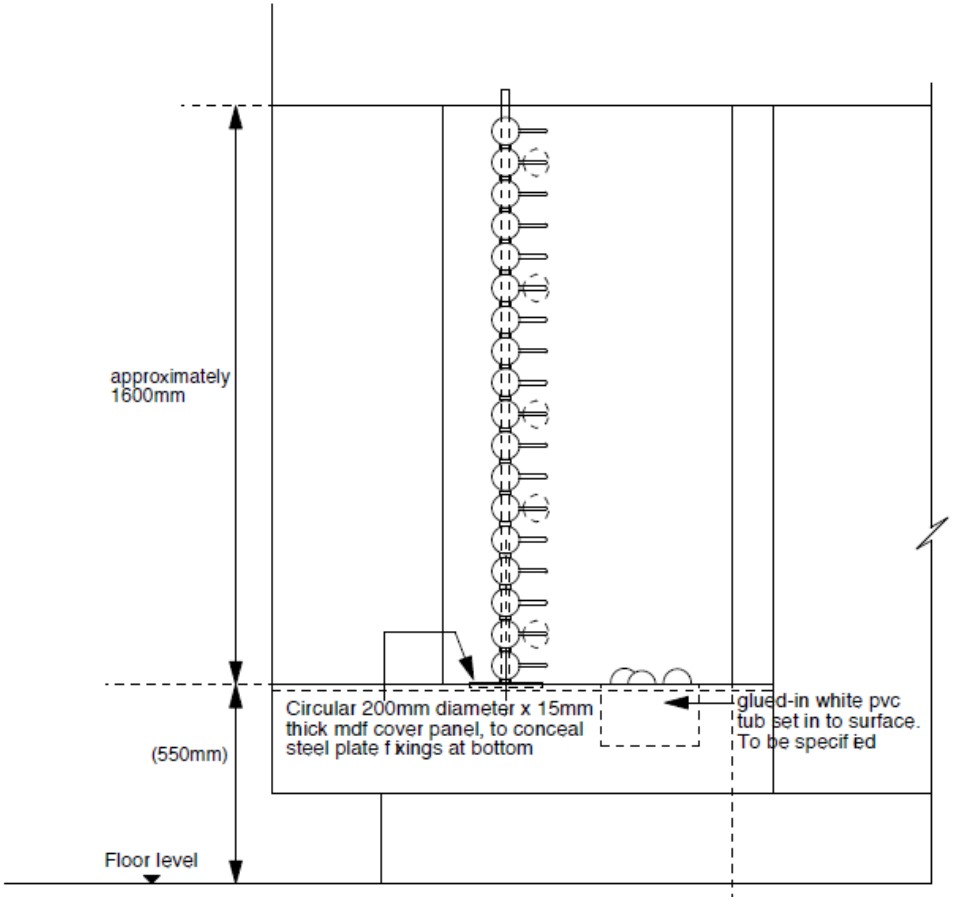
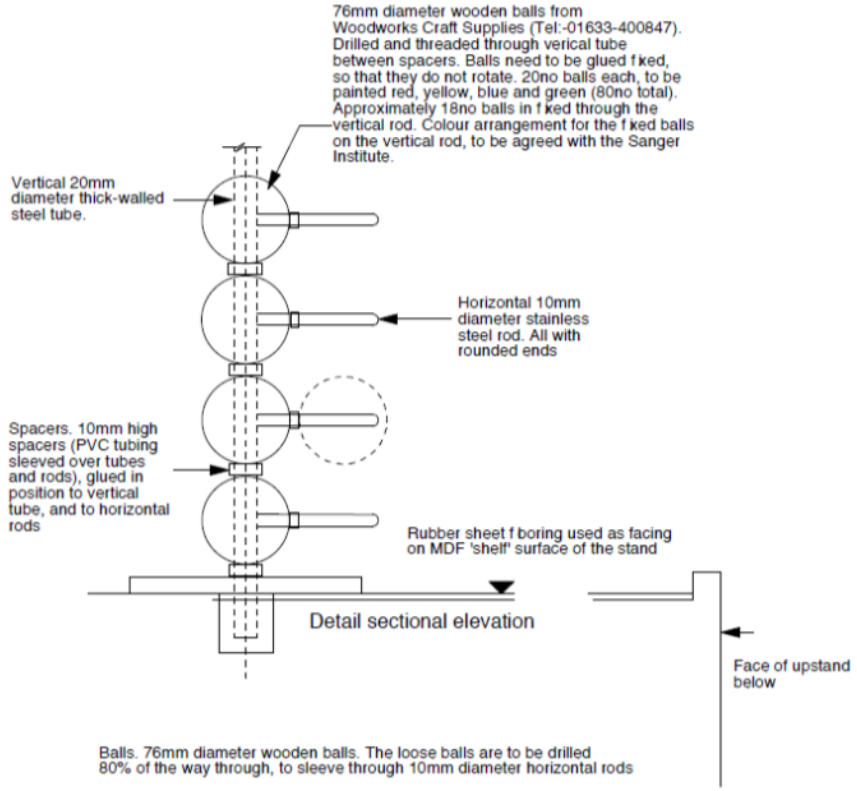
# Activities

## Build DNA

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# Activities

## Build DNA



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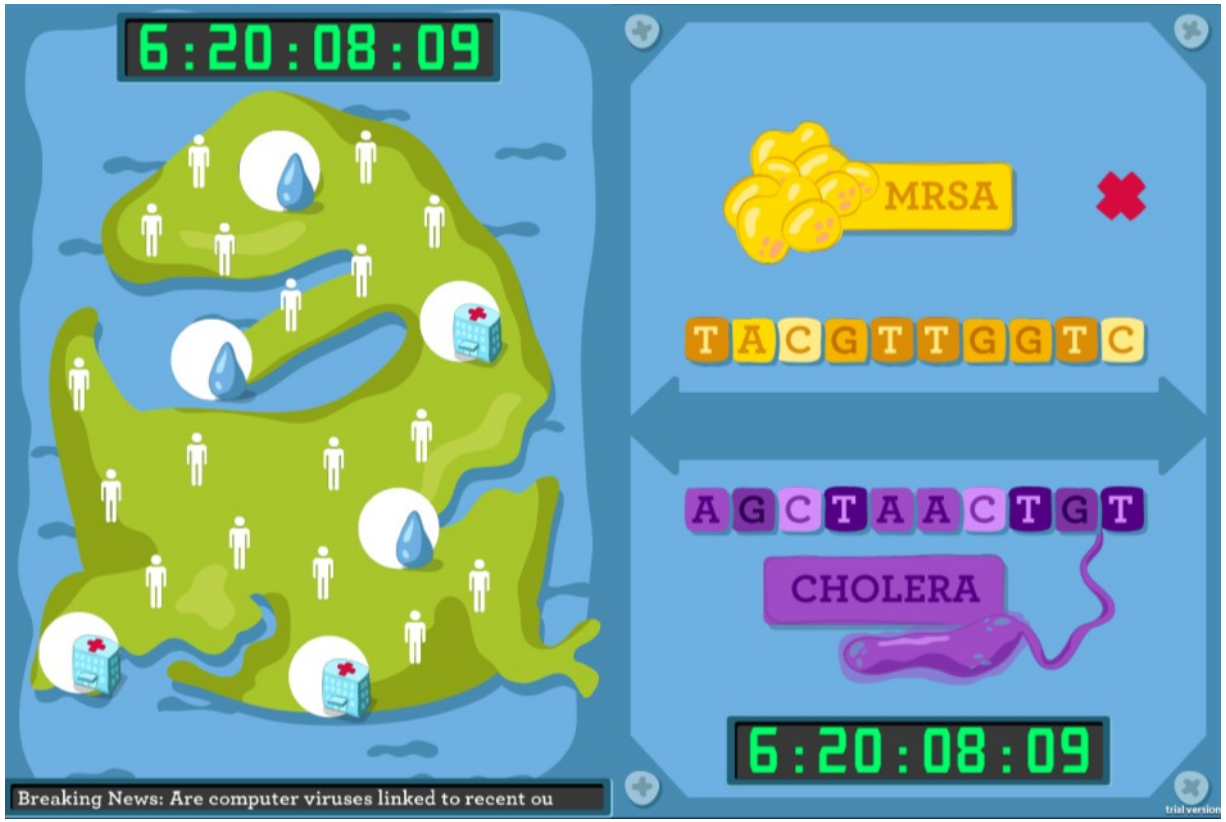
# Activities

## Game Jam – Bug outbreak




**Created by Opposable Games via Royal Society**

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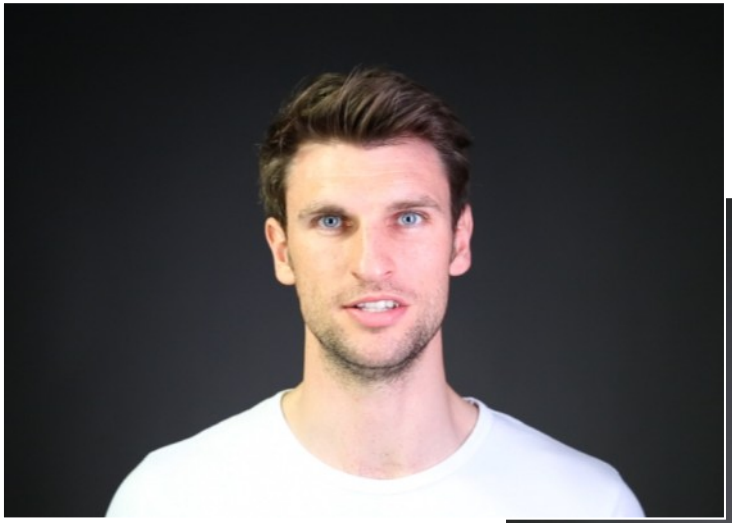
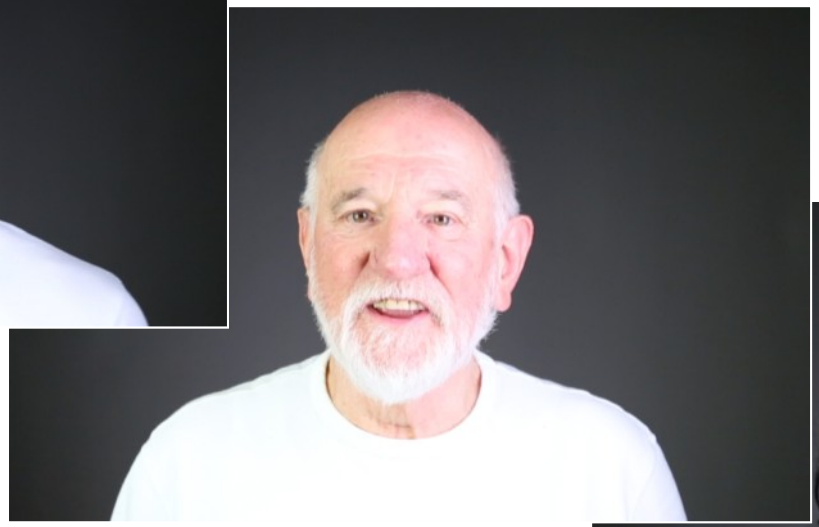
# Activities

## Your views





**Film created by Paul Fenn Films**
**http://www.youtube.com/watch?v=XetPyb0X9x0**

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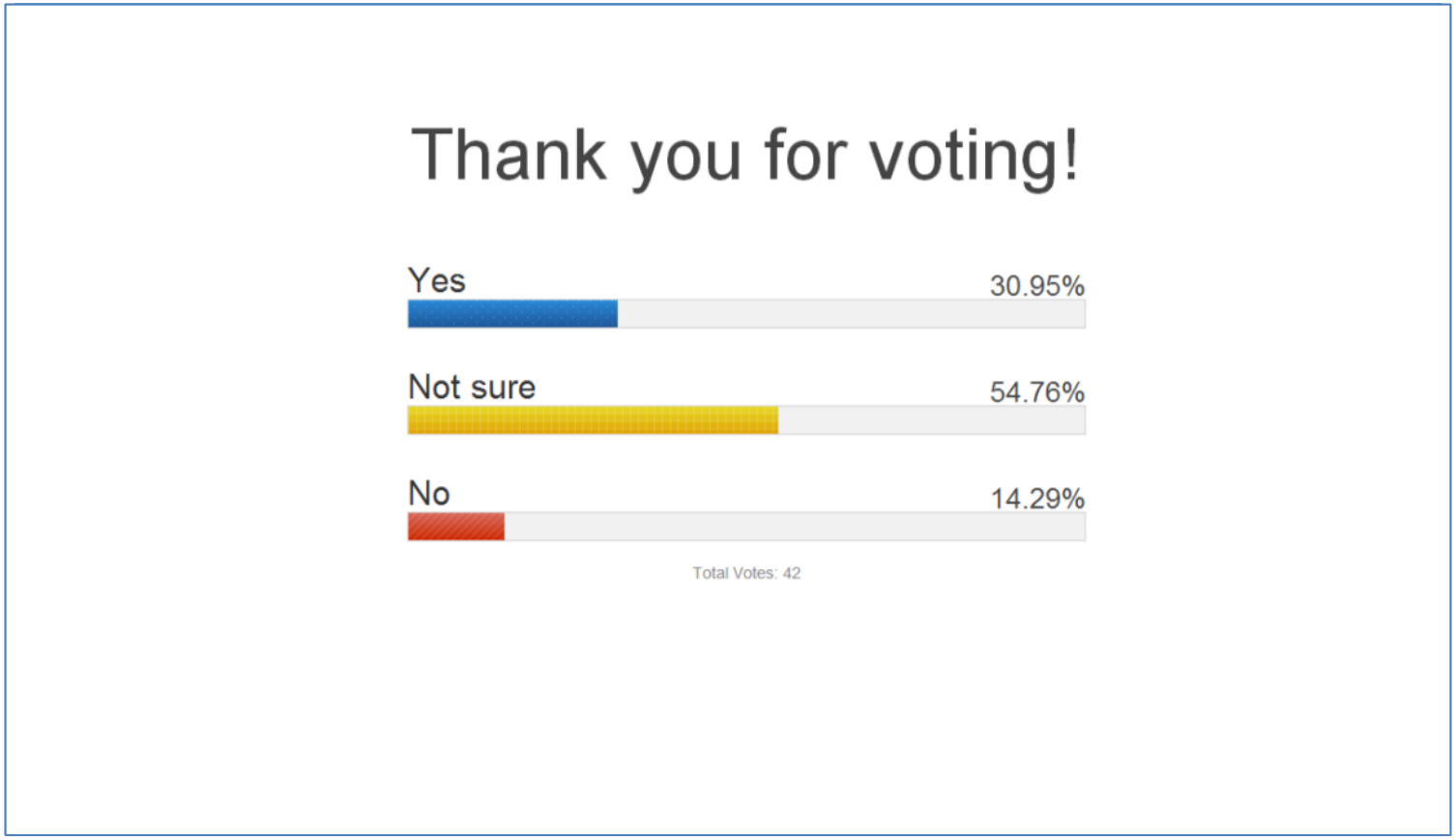
# Activities

## Transatlantic ethics poll

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# Online


## Further reading


- Harris, S.R. et al. 2012 Using whole genome sequencing to dissect the cause and effect of a meticillin-resistant Staphylococcus aureus outbreak: a descriptive study?. Lancet Infectious Diseases 13, 2, 130-136.
- Manske, M. et al. 2012 Analysis of Plasmodium falciparum diversity in natural infections by deep sequencing. Nature 487, 375-37
- Garnett, M.J. et al. 2012 Systematic identification of genomic markers of drug sensitivity in cancer cells. Nature 483, 570-575


Genes influence a person's appearance, characteristics and their susceptibility to disease. They can even help archaeologists identify long lost kings. Rapid advances in DNA sequencing are providing scientists with the ability to explore the human genome, or genetic code, in more detail. This is leading to new discoveries about the genetic causes of human disease and new ways to improve our health.

### How it works

This exhibit demonstrates how the combination of expertise from science, technology, engineering and maths, utilising powerful computing, can uncover the changes in DNA that lead to a variety of human diseases. For example, the Cancer Genome Project compares DNA from tumour


Presented by Wellcome Trust Sanger Institute


**Anna Middleton**
Wellcome Trust Sanger Institute

**Karola Rehnstrom**
Wellcome Trust Sanger Institute

**Richard Durbin**
Wellcome Trust Sanger Institute

**Serena Nik-Zainal**
Wellcome Trust Sanger Institute

**Julian Rayner**
Wellcome Trust Sanger Institute


### Images

### Exhibit blog

**Day 7 (last day!): Our volunteers**

# Blogging


Home Archive

## Would you have your genome sequenced?

Your genes can tell you about your past, present and future medical health. But what would you want to know from your genes? This is one of the questions we are asking this week on our stand *Beyond the Genome* at the Royal Society Summer Science Exhibition.

DNA sequencing is gradually becoming cheaper and cheaper and it won't be long before the cost of sequencing a human genome will be less than £1,000. Today, a CT scan carries a similar cost so it is not unrealistic for us to start thinking of DNA sequencing as an affordable tool that could eventually be used in our NHS hospitals. This is great when we consider the possibility of being able to accurately discover the DNA changes responsible for a cancer to ensure the best drug is given (http://bit.ly/19QN6DU). Or, being able to sequence the genomes of bugs that are part of an MRSA outbreak (the idea being to choke the bugs at source and prevent the MRSA spreading further). Or even for DNA sequencing to become a standard part of a newborn child's medical records, that can be referred to if they become ill later in life.

But hold on for a moment! What does all this information mean and what if we don't want to know all of it?

Let's step back from the wonders of science and technology to think about this for a minute. When we sequence a human genome we are looking at 3,000,000,000 letters of DNA, finding out about all 20,000+ genes in one go. Realistically, each person's genome contains an average of around 100 different things of interest. Some of these may take effect on a person as they grow into an adult and some may be relevant to their future children, if they have them. It has been estimated that counselling someone through all of this information would take around five hours.

So do you want to know from your genome? Would you want to


Home Archive

## Introducing the 'father of genomics' : Fred Sanger

nger Institute takes its name from the double Nobel Prize winner 'her of genomics', Frederick Sanger. The techniques Fred and his es developed during the 1970s are still being used today in s. His pioneering work defined genomics and provided the n for the way we explore genomes today, both here at the stitute and worldwide.

r, who will celebrate his 95th birthday in August, was born hire. His interest in biology originally stemmed from his ', and Fred initially set out to study medicine at the f Cambridge. During his time there he specialised in r, allowing him the opportunity to work alongside some g biochemists at that time. It comes as no surprise the chemistry inspired him to leave the path of medicin at area. As a conscientious objector during the Secor


Home Archive

## Beyond the Genome - the week so far

We're now over half way through the Royal Society Summer Science exhibition, so, what's happened so far? Well, we've had an amazing response to our stand *Beyond the genome*. Visitors have been clambering to play with our hands-on interactives, racing to sequence DNA as fast as they can. Our *You vs. Machine* game has brought the competitive spirit out of visitors, our explainers and even other exhibitors! Our neighbours on the *Zebrafish genetics* stand are currently top of the table. Please someone come and knock them off the top spot!!!

We've had some great chats with visitors about how DNA sequencing has changed and revolutionised what we understand about human health and disease. The rapid advancement of DNA sequencing technologies has astounded many people: from the incredible reduction in the time it takes to sequence a human genome, to the sharp fall in the cost of DNA sequencing. All of this technology is enabling us to do amazing research on the genetics of humans and also the genetics of organisms that cause disease such as viruses, bacteria and eukaryotes, like malaria and tapeworm.

We've also had interesting, and challenging, conversations about the social and ethical issues of DNA sequencing. Our inner future chamber beams DNA sequence on to visitors and encourages them to think about what they would like to know about their genome. We're certainly getting to hear plenty of opinions, which is fantastic. A lot of visitors seem very curious to find out what secrets might be locked away in their genomes - what they might be able to find out about

future health. But others seem

# Volunteers

| | Morning | Afternoon | Evening | Overnight | |
|---|---|---|---|---|---|
| Sunday | | | | Group A | |
| Monday | Group A (10:00-14:00) | Group B (14:00-18:00) | Group A (18:00-22:00) | Group B | Group A |
| Tuesday | Group B (10:00-14:00) | Group C (14:00-17:30) | Group B (17:30-21:00) | Group C | Group B |
| Wednesday | Group C (10:00-13:30) | Group D (13:30-17:00) | Group C (19:00-22:00) * | Group D | Group C |
| Thursday | Group D (10:00-13:30) | Group E (13:30-17:00) | Group D (19:00-22:00) * | Group E | Group D |
| Friday | Group E (10:00-13:30) | Group F (13:30-17:30) | Group E (17:30-21:00) | Group F | Group E |
| Saturday | Group F (10:00-13:30) | Group G (13:30-17:30) | Group F (17:30-21:00) | Group G | Group F |
| Sunday | Group G (10:00-12:30) | Group H (12:30-15:30) | Group G (15:30-1800) | Group H | |

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# Volunteers

**MONDAY 1 JULY**

| Start 10.00 | | | Finish 14.00 | Start 14.00 | | | Finish 18.00 | Start 18.00 | | | Finish 22.00 | Accomm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steve Scott** | | | | **Steve Scott** | | | | **Steve Scott** | | | | **Steve Scott** |
| Group 1 -1 | Confirmed | James Torrance | Genome Referencing Informatics Group | | | | | Group 1 -1 | Confirmed | James Torrance | Genome Referencing Informatics Group | No accomm |
| Group 1 - 2 | Confirmed | Sarah Smith | Pathogens | Serena Nik Zainal some time | | | | Group 1 - 2 | Confirmed | Sarah Smith | Pathogens | Sarah Smith |
| Group 1 -3 | Confirmed | Lia Chappell | Malaria | | | | | Group 1 -3 | Confirmed | Lia Chappell | Malaria | Lia Chappell |
| Group 1 -4 | Confirmed | Anna Middleton | HumGen | | | | | Group 1 -4 | Confirmed | Serena Nik Zainal | CGP | No accomm |
| Group 1 -5 | Confirmed | Valerie Vancollie | Model organisms | | | | | Group 1 -5 | Confirmed | Valerie Vancollie | Model organisms | Valerie Vancollie |
| Group 1 -6 | Confirmed | Howard Lightfoot | CGP | | | | | Group 1 -6 | Confirmed | Howard Lightfoot | CGP | No accomm |
| Group 1 -7 | Confirmed | Wendy Jones | Barrett Faculty | | | | | Group 1 -7 | | | | *Anna Middleton* |
| | | | | Group 2 -1 | Confirmed | Tomislav Illicic | Teichmann | | | | | Tomislav Illicic |
| | | | | Group 2 -2 | | | | | | | | Group 2 - 2 |
| | | | | Group 2 -3 | Confirmed | Karen Kennedy | Admin | | | | | Karen Kennedy |
| | | | | Group 2 -4 | Confirmed | Lucy Yates | CGP | | | | | No accomm |
| | | | | Group 2 -5 | Confirmed | Sandra Reuter | Pathogens | | | | | Sandra Reuter |
| | | | | Group 2 -6 | Confirmed | Chris Illingworth | Genome Referencing Informatics Group | | | | | Chris Illingworth |
| | | | | Group 2 -7 | Confirmed | Amy Cain | Pathogens | | | | | Amy Cain |

**TUESDAY 2 JULY**

| Start 10.00 | | | Finish 14.00 | Start 14.00 | | | Finish 17.30 | Start 17.30 | | | Finish 21.00 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steve Scott** | | | | **Steve Scott** | | | | **Steve Scott** | | | | **Steve Scott** |
| Group 2 -1 | Confirmed | Tomislav Illicic | Teichmann | | | | | Group 2 -1 | Confirmed | Tomislav Illicic | Teichmann | Tomislav Illicic |
| Group 2 -2 | | | | | | | | Group 2 -2 | | | | Group 2 - 2 |
| Group 2 -3 | Confirmed | Karen Kennedy | Admin | | | | | Group 2 -3 | Confirmed | Karen Kennedy | Admin | Karen Kennedy |
| Group 2 -4 | Confirmed | Lucy Yates | CGP | | | | | Group 2 -4 | Confirmed | Lucy Yates | CGP | No accom |
| Group 2 -5 | Confirmed | Sandra Reuter | Pathogens | | | | | Group 2 -5 | Confirmed | Sandra Reuter | Pathogens | Sandra Reuter |
| Group 2 -6 | Confirmed | Chris Illingworth | Genome Referencing Informatics Group | | | | | Group 2 -6 | Confirmed | Chris Illingworth | Genome Referencing Informatics Group | Chris Illingworth |
| Group 2 -7 | Confirmed | Amy Cain | Pathogens | | | | | Group 2 -7 | Confirmed | Amy Cain | Pathogens | Amy Cain |
| | | | | Group 3- 1 | Confirmed | Klaudia Walter | HumGen | | | | | Klaudia Walter |
| | | | | Group 3 - 2 | Confirmed | Lucy Crooks | HumGen | | | | | Lucy Crooks |
| | | | | Group 3 - 3 | Confirmed | Magdalena Zarowiecki | PathGen | | | | | No accom |
| | | | | Group 3 - 4 | Confirmed | Christine Boinett | Pathogens | | | | | No accom |
| | | | | Group 3 - 5 | Confirmed | Anna Middleton | HumGen | | | | | Anna Middleton |
| | | | | Group 3 - 6 | Confirmed | Hayley Bennett | Pathogens | | | | | Hayley Bennett |
| | | | | Group 3 - 7 | Confirmed | Katja Kivinen | Malaria | | | | | No accom |

**WEDNESDAY 3 JULY**

| Start 10.00 | | | Finish 13.30 | Start 13.30 | | | Finish 17.00 | | Start 19.00 | SOIREE - DRESS CODE | | Finish 22.00 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steve Scott** | | | | **Steve Scott** | | | | **Steve Scott** | | | | | **Steve Scott** |
| Group 3- 1 | Confirmed | Klaudia Walter | HumGen | | | | | | Group 3- 1 | Confirmed | Klaudia Walter | HumGen | Klaudia Walter |
| Group 3 - 2 | Confirmed | Lucy Crooks | HumGen | | | | | | Group 3 - 2 | Confirmed | Lucy Crooks | HumGen | Lucy Crooks |
| Group 3 - 3 | Confirmed | Magdalena Zarowiecki | PathGen | | | | | | Group 3 - 3 | Confirmed | Magdalena Zarowiecki | PathGen | No accom |
| Group 3 - 4 | Confirmed | Christine Boinett | Pathogens | | | | | | Group 3 - 4 | Confirmed | Christine Boinett | Pathogens | No due to Soiree | No accom |
| Group 3 - 5 | Confirmed | Anna Middleton | HumGen | | | | | | Group 3 - 5 | Confirmed | Anna Middleton | HumGen | Anna Middleton |
| Group 3 - 6 | Confirmed | Hayley Bennett | Pathogens | | | | | | Group 3 - 6 | Confirmed | Hayley Bennett | Pathogens | Hayley Bennett |
| Group 3 - 7 | Confirmed | Richard Durbin | HumGen | | | | | | Group 3 - 7 | Confirmed | Richard Durbin | HumGen | Fellow | *Richard Durbin* |
| | | | | Group 4 - 1 | Confirmed | Yasin Memari | Humgen | | Steve Scott | | | | Yasin Memari |
| | | | | Group 4 - 2 | Confirmed | Stuart McLaren | CGP | | | | | | Stuart McLaren |
| | | | | Group 4 - 3 | Confirmed | Frank Schwach | Malaria | | | | | | Frank Schwach |
| | | | | Group 4 - 4 | Confirmed | Will Proto | Malaria | | | | | | Will Proto |
| | | | | Group 4 - 5 | Confirmed | Kevin Dawson | CGP | | | | | | No accom |
| | | | | Group 4 - 6 | | | | | | | | | Group 4 - 6 |
| | | | | Group 4 - 7 | Confirmed | Elizabeth Wynn | | | | | | | No accom |

78 staff expressed interest and 55 attended

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# Budget

| Work Package | Cost |
|---|---|
| Stand Design and Build | £55,780.34 |
| AV hire | £2,231.76 |
| Digital content | £2,842.94 (Game Jam = £2,000.00) |
| Accommodation for 55 explainers (Queen Mary, University of London) | £4,982.00 |
| Travel for 55 explainers (Cambridge>London & around London) | £3,551.66 |
| T-shirts (80) and wrist bands (2,500) | £2,215.20 |

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# Sponsors

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ESGI


Deciphering Developmental Disorders

UK 10K

RARE GENETIC VARIANTS IN HEALTH AND DISEASE

MRC | Centre for Genomics and Global Health

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# Tips

- Plan with Royal Society early
- Plan stand build early
- Delegate responsibility
- Provide training for volunteers
- Be prepared to compromise
- Have lots of explainers
- Have giveaways with website on for more information
- Make it a memorable experience!

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# Legacy

- Physical exhibit on campus
- Reinvigorated staff
- Enthusiasm for public engagement
- New perspectives
- Community of researchers
- Increased interest in our research

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# Life after the RSSE


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# Life after the RSSE


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# Credits

- Exhibit designed by Nick Bell Design with Nick Coombe Architecture
- Built by Van Rooij & Griffiths
- Graphic production by Albermarle Graphics
- Films and falling letters by Paul Fenn Films
- AV equipment from Creative Staging
- Sequencing interactive by Machineshop
- You vs. machine app by Nicholas Tieman (freelancer via Elance.com)
- Bug outbreak by Opposable Games (via RS)

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