



# Intro to Outreach

June - 2023

---

Margaret-Ann Withington + Matthew Davies

PhD Students

Department of Chemical and Physical Sciences



Queen Mary  
University of London



# The Importance of Science Communication

Public Health

Financial Wellbeing

Climate issues

Power generation

# Deaths with Covid

Weekly UK death registrations where Covid-19 is mentioned on death certificates

What are the "Christmas bubble" rules in the UK?



- England**
- In tiers one to three, up to two households can join a Christmas bubble on Christmas Day
  - People are advised to avoid travel to other parts of the country
  - In tier four - you cannot join a Christmas bubble

- Wales**
- Up to two households can join a temporary bubble on Christmas Day only
  - Level four local authorities can allow exceptions on Christmas Day

Source: Gov.uk dashboard

Bubbles can be formed outdoors, but only in line with rules of your tier

You can meet up to two households outdoors, but only in line with rules of your tier if you have no symptoms or are self-isolating you cannot join a bubble

# Nearly 5 million UK infections

Estimated people testing positive for coronavirus

## Coronavirus in the UK

Total deaths

Total cases

4,083,242

Daily figure Two-month trend

1,057

Total 1st vaccine doses given

6,423,082

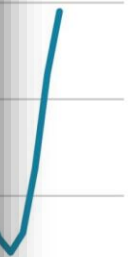
Daily figure Trend from 8 Dec\*\*

110

to 16 Feb



\*\*Figures were weekly until 10 Jan  
Source: Gov.uk dashboard



26 Mar 2022

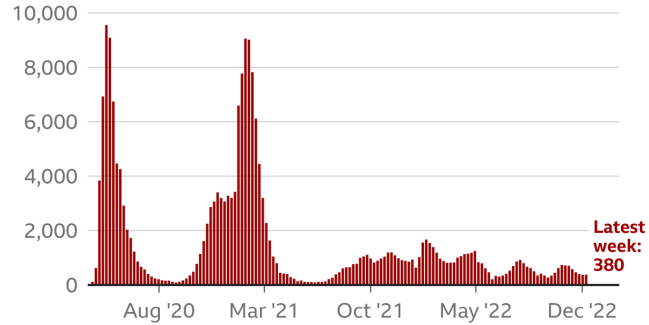
BBC

BBC NEWS

BBC

## Deaths with Covid

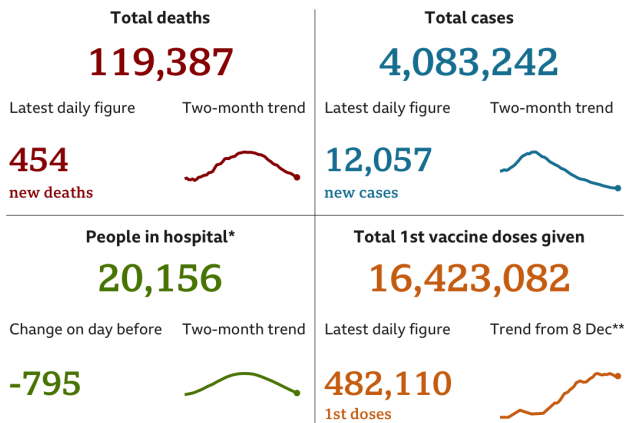
Weekly UK death registrations where Covid-19 is mentioned on death certificates



Source: Gov.uk dashboard, data to 9 Dec



## Coronavirus in the UK



\*Publication dates differ by nation, most recent data for all nations to 16 Feb

\*\*Figures were weekly until 10 Jan

Source: Gov.uk dashboard



## What are the "Christmas bubble" rules in the UK?



### England

- In tiers one to three - up to three households can form a temporary bubble on Christmas Day only
- People are advised to "stay local"
- In tier four - you can't be in a Christmas bubble and cannot travel to other areas



### Scotland

- Up to eight people from three households (not counting under 12s) can form a temporary bubble on Christmas Day only
- No travel allowed to rest of UK
- Level four lockdown starts 26 December



### Wales

- Up to two households can form a temporary bubble on Christmas Day only
- Level four lockdown rules apply, except on Christmas Day



### Northern Ireland

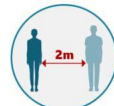
- Up to three households can form a bubble for one day between 23 and 27 December
- You must not travel to Scotland or a tier four area in England



Bubbles can mix indoors in private home



You can't go to a pub or restaurant with your bubble



You can meet people outside your Christmas bubble outdoors, but only in line with rules of your tier

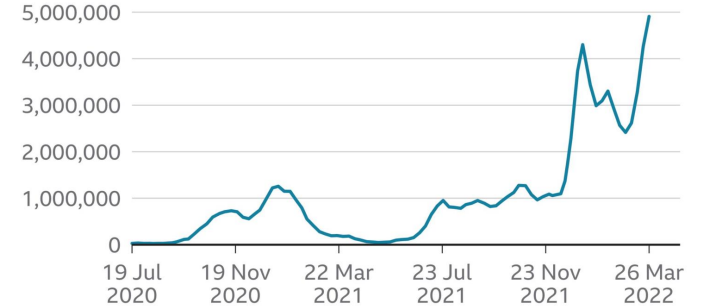


If you have coronavirus symptoms or are self-isolating you cannot join a bubble



## Nearly 5 million UK infections

Estimated people testing positive for coronavirus



Data include Northern Ireland from Oct 2020, Scotland from Nov 2020

Source: Office for National Statistics, 1 Apr



## Early report

## Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

### Summary

**Background** We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

**Methods** 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

**Findings** Onset of behavioural symptoms was associated, by the parents, with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities, ranging from lymphoid nodular hyperplasia to aphthoid ulceration. Histology showed patchy chronic inflammation in the colon in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and MRI and EEG tests were normal. Abnormal laboratory results were significantly raised urinary methylmalonic acid compared with age-matched controls ( $p=0.003$ ), low haemoglobin in four children, and a low serum IgA in four children.

**Interpretation** We identified associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time with possible environmental triggers.

*Lancet* 1998; **351**: 637–41

See Commentary page 611

**Inflammatory Bowel Disease Study Group, University Departments of Medicine and Histopathology** (A J Wakefield FRCS, A Anthony MB, J Linnell PhD, A P Dhillon MRCPsib, S E Davies MRCPsib) and the **University Departments of Paediatric Gastroenterology** (S H Murch MB, D M Casson MRCP, M Malik MRCP, M A Thomson FRCP, J A Walker-Smith FRCP), **Child and Adolescent Psychiatry** (M Berelowitz FRCPsych), **Neurology** (P Harvey FRCP), and **Radiology** (A Valentine FRCS), **Royal Free Hospital and School of Medicine, London NW3 2QG, UK**

Correspondence to: Dr A J Wakefield

### Introduction

We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and bloating and, in some cases, food intolerance. We describe the clinical findings, and gastrointestinal features of these children.

### Patients and methods

12 children, consecutively referred to the department of paediatric gastroenterology with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms (diarrhoea, abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward for 1 week, accompanied by their parents.

### Clinical investigations

We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant staff (PH, MB) with HMS-4 criteria.<sup>1</sup> Developmental histories included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

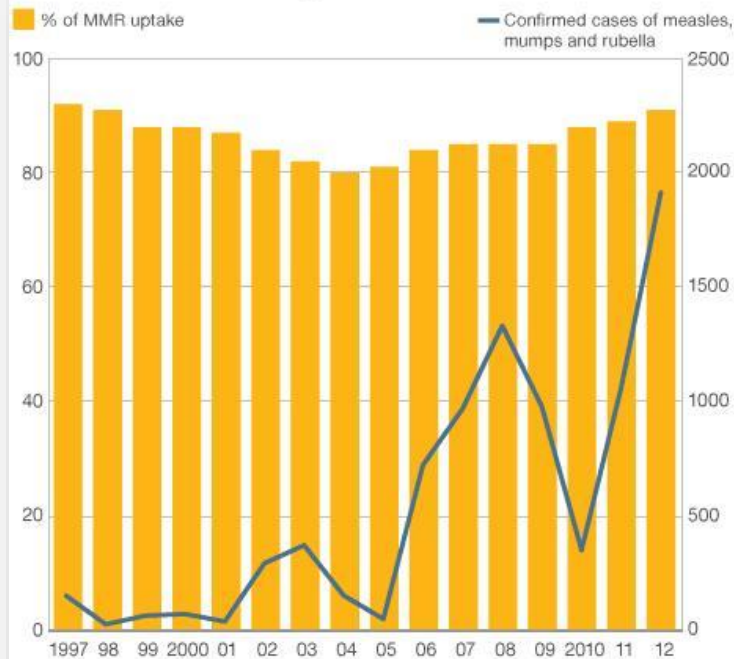
Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

### Laboratory investigations

Thyroid function, serum long-chain fatty acids, and cerebrospinal-fluid lactate were measured to exclude known causes of childhood neurodegenerative disease. Urinary methylmalonic acid was measured in random urine samples from eight of the 12 children and 14 age-matched and sex-matched normal controls, by a modification of a technique described previously.<sup>1</sup> Chromatograms were scanned digitally on computer, to analyse the methylmalonic-acid zones from cases and controls. Urinary methylmalonic-acid concentrations in patients and controls were compared by a two-sample *t* test. Urinary creatinine was estimated by routine spectrophotometric assay.

Children were screened for antiendomyxal antibodies and boys were screened for fragile-X if this had not been done

## MMR and measles in England

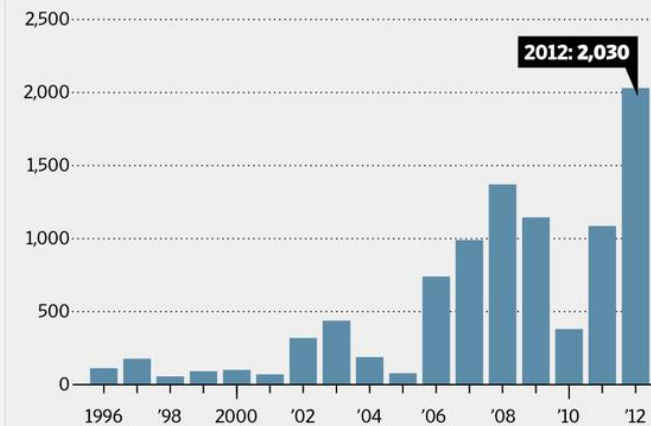


Source: NHS IC

## Worrisome Comeback

Fears that a measles vaccine might cause autism helped lead to a temporary decrease in vaccinations in England and Wales, which resulted in an increase of measles cases there.

### Confirmed cases of measles



Source: Public Health England

The Wall Street Journal

## Early report

## Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

## Summary

**Background** We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.

**Methods** 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.

**Findings** Onset of behavioural symptoms was associated, by the parents, with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities, ranging from lymphoid nodular hyperplasia to aphthoid ulceration. Histology showed patchy chronic inflammation in the colon in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and MRI and EEG tests were normal. Abnormal laboratory results were significantly raised urinary methylmalonic acid compared with age-matched controls ( $p=0.003$ ), low haemoglobin in four children, and a low serum IgA in four children.

**Interpretation** We identified associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time with possible environmental triggers.

Lancet 1998; 351: 637–41

See Commentary page 611

**Inflammatory Bowel Disease Study Group, University Departments of Medicine and Histopathology** (A J Wakefield FRCS, A Anthony MB, J Linnell PhD, A P Dhillon MRCPsib, S E Davies MRCPsib) and the **University Departments of Paediatric Gastroenterology** (S H Murch MB, D M Casson MRCP, M Malik MRCP, M A Thomson FRCP, J A Walker-Smith FRCP), **Child and Adolescent Psychiatry** (M Berelowitz FRCPsych), **Neurology** (P Harvey FRCP), and **Radiology** (A Valentine FRCA), **Royal Free Hospital and School of Medicine, London NW3 2QG, UK**

Correspondence to: Dr A J Wakefield

## Introduction

We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and bloating and, in some cases, food intolerance. We describe the clinical findings, and gastrointestinal features of these children.

## Patients and methods

12 children, consecutively referred to the department of paediatric gastroenterology with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms (diarrhoea, abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward for 1 week, accompanied by their parents.

## Clinical investigations

We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant staff (PH, MB) with HMS-4 criteria.<sup>1</sup> Developmental histories included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

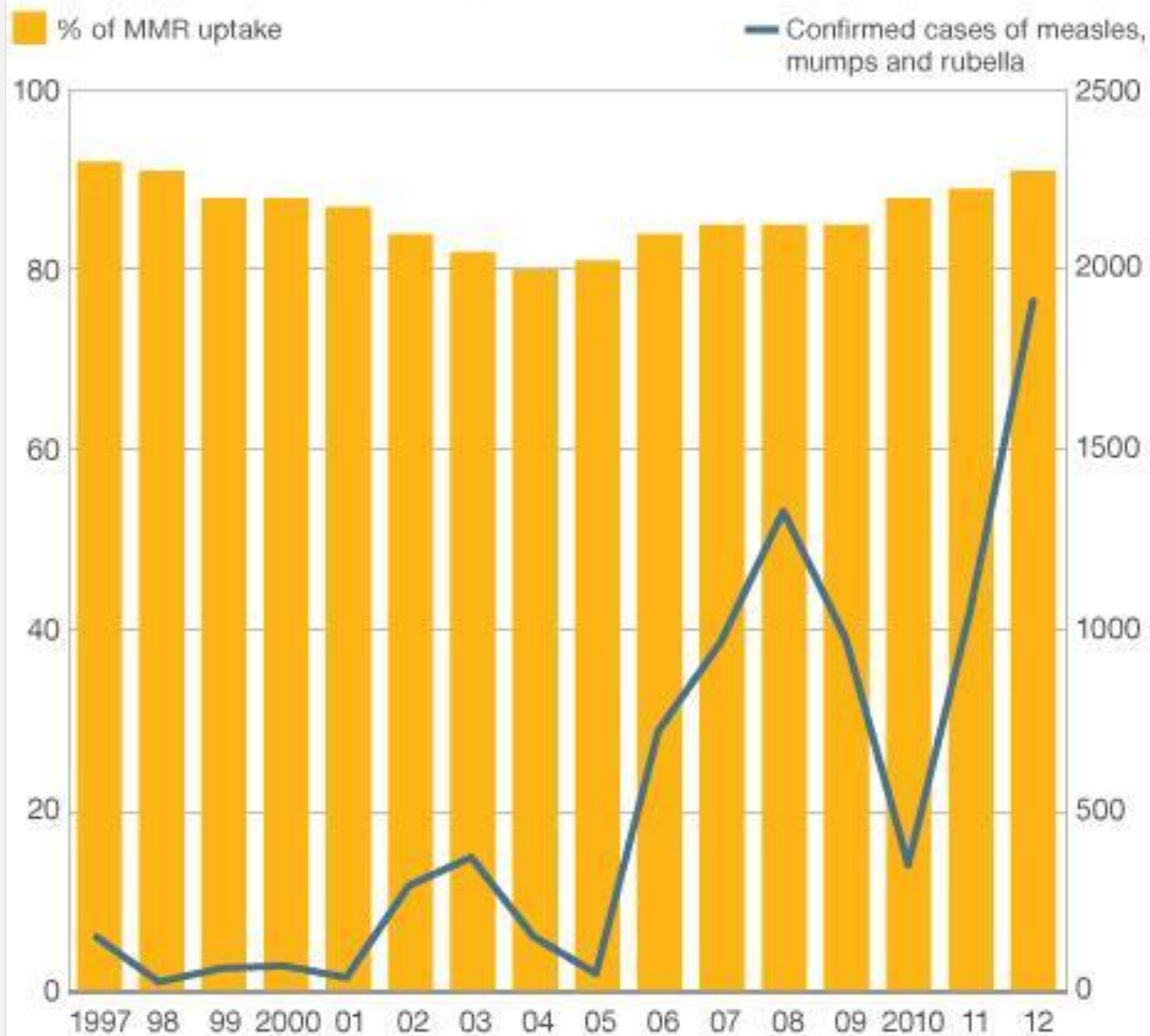
Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

## Laboratory investigations

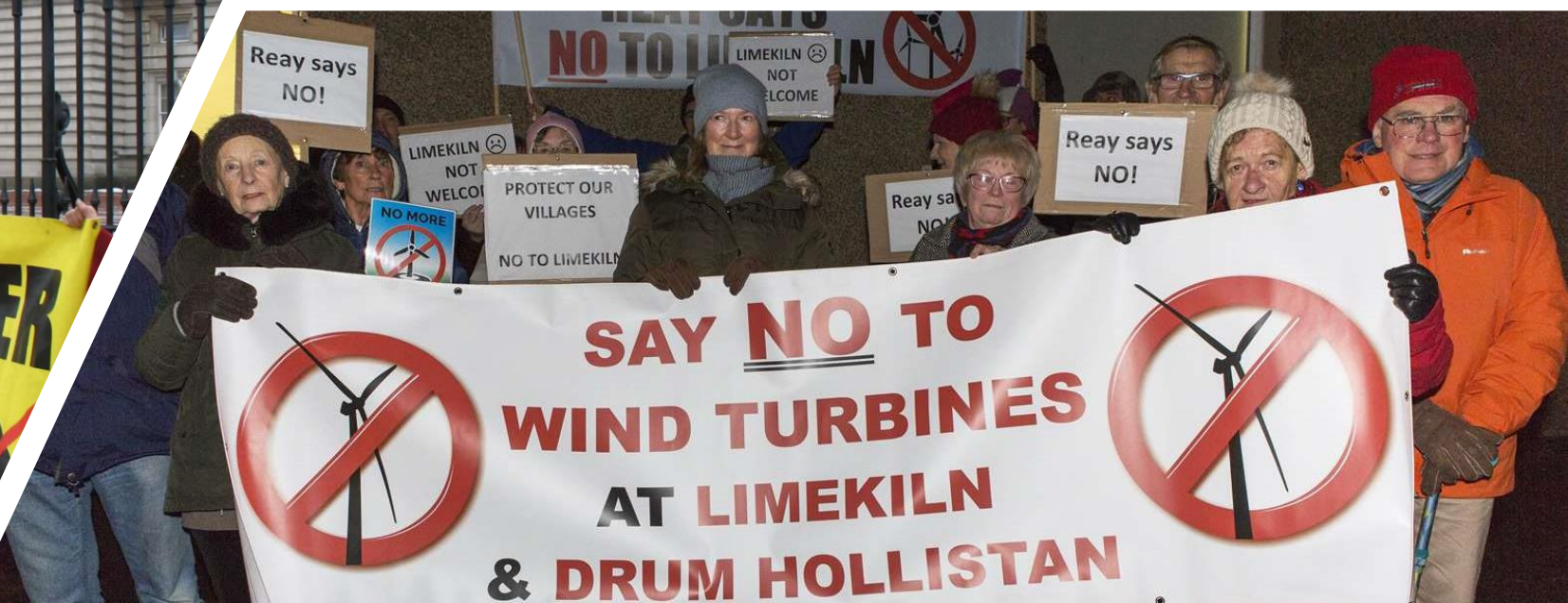
Thyroid function, serum long-chain fatty acids, and cerebrospinal-fluid lactate were measured to exclude known causes of childhood neurodegenerative disease. Urinary methylmalonic acid was measured in random urine samples from eight of the 12 children and 14 age-matched and sex-matched normal controls, by a modification of a technique described previously.<sup>1</sup> Chromatograms were scanned digitally on computer, to analyse the methylmalonic-acid zones from cases and controls. Urinary methylmalonic-acid concentrations in patients and controls were compared by a two-sample  $t$  test. Urinary creatinine was estimated by routine spectrophotometric assay.

Children were screened for antientomycal antibodies and boys were screened for fragile-X if this had not been done

## MMR and measles in England




Source: NHS IC



In 2012, his, now live, prime-time ITV series, [The Martin Lewis Money Show](#) started, which after 12 series is now the most watched current affairs programme on UK television, as appointment to view TV for millions. In 2022, BBC's [The Martin Lewis Podcast](#) started and regularly hits the Apple top 50 UK podcast charts.

## STUDENTS

Guides and tools to help you save money while studying



**Calculators & guide – how much are you expected to give your kids for uni?**

- [Living costs: parents expected to fill gaps](#)
- [Child at uni? Use our parental contribution calc](#)
- [Planning for future? Use our parental savings calc](#)

Guide

### What students from England starting uni or higher...

What English students starting u...

Funding uni



### Student checklist

With student maintenance loans lagging behind inflation, it's even...

Money



### Student loan repayment

It's a simple question spilling from the lips of over four million former...

Guide



### Student bank accounts

Free 0% overdrafts, free railcards and free cash – banks love to ree...

Banking



### Student loan interest is 7.1% – should I panic or pay it off?

You leave university, looking...

Guide



### Martin Lewis: Student Loans Decoded

Martin Lewis: Student Loans...

Student Money





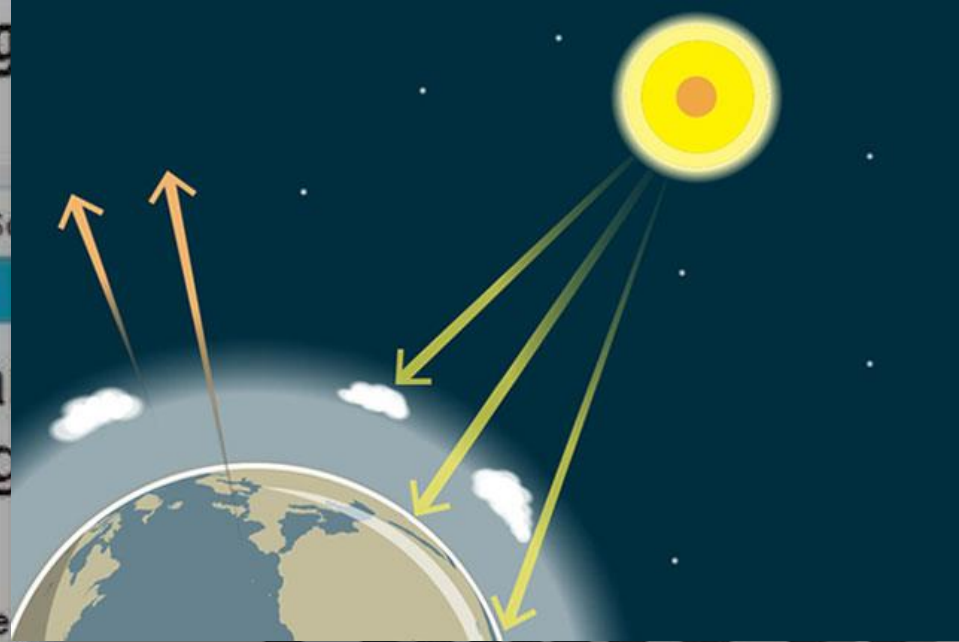
Home News U.S. | Sport | TV&Showbiz | Australia | Femail | Health | S  
Latest Headlines | News | Arts | Headlines | Pictures | Most read | News Board | Wires

### Plastic bags chaos looms: As 5p charge starts in England, shoppers face tangled red tape

- Supermarkets fear complicated exemptions could lead to disputes
- Government launches scheme to reduce litter and protect wildlife



about the revolution at the tills



by angry

### MARKET



### ARS

ge starts today

Union w

13°C

SUBSCRIPTIONS Sign up now for 15% OFF

In Your Area -

Music & Nightlife Food & Drink

to know

Pl

Comfused shoppers and longer queues

DAILY MAIL/MIRROR/BIRMINGHAM MAIL/MEN

ews- TV & Film Weir

Technology Money Travel

arket chaos

es

## 1. Do you believe that the world is round or flat?

I have always believed the world is round

I always thought the world is round, but recently I am skeptical/have doubts

I always thought the world is flat, but recently I am skeptical/have doubts

I have always believed the world is flat

Other/Not sure

Breakdown of Americans, broken down

[+] YOUNGOV SURVEY

## 1. Do you believe that the world is round or flat?

	%	TOTAL	Under \$40k	\$40k-\$80k	\$80k+
I have always believed the world is round		84	79	87	92
I always thought the world is round, but more recently I am skeptical/have doubts		5	6	4	4
I always thought the world is flat, but more recently I am skeptical/have doubts		2	2	3	1
I have always believed the world is flat		2	3	1	1
Other/Not sure		7	10	5	2

# Why is that important?



Science and research often **influence laws** or **governmental guidance** that the general population need to follow



If there is a too low amount of trust in scientific research this can lead to people not listening or respecting the advice of scientists on important matters



Equally bad, if there is too high an amount of trust in individual instances of scientific research it can have negative consequences.



Science outreach is about giving the general population an understanding of how science really works.



# What is “Outreach”?

Forming connections between the general population and researchers.

More generally outreach is about connecting groups which may not naturally come into positive contact.

## Dictionary

Definitions from [Oxford Languages](#) · [Learn more](#)

## outreach

*noun*



/ˈaʊtri:tʃ/

the extent or length of reaching out.  
"the loving outreach of God to the world"

*verb*



/ˌaʊtˈri:tʃ/

reach further than.  
"their pack outreached and outwitted the Welsh team"



Presentations



Going into schools



Attending student poster sessions



Digital outreach (social media, YouTube, etc)



Summer schools



TV Shows and Films



Open Lectures

**Tensile Strength** is the STEM song from the episode **Rocket Ski Rescue**. It is sung by Blaze and AJ, and it plays as Blaze and Grammy are trying out different tensile strength techniques while trying to catch up with the runaway Crusher.



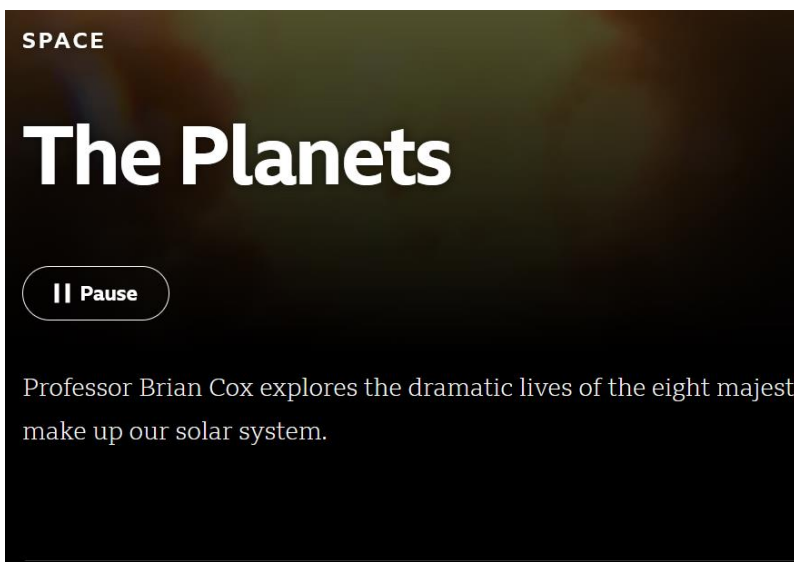
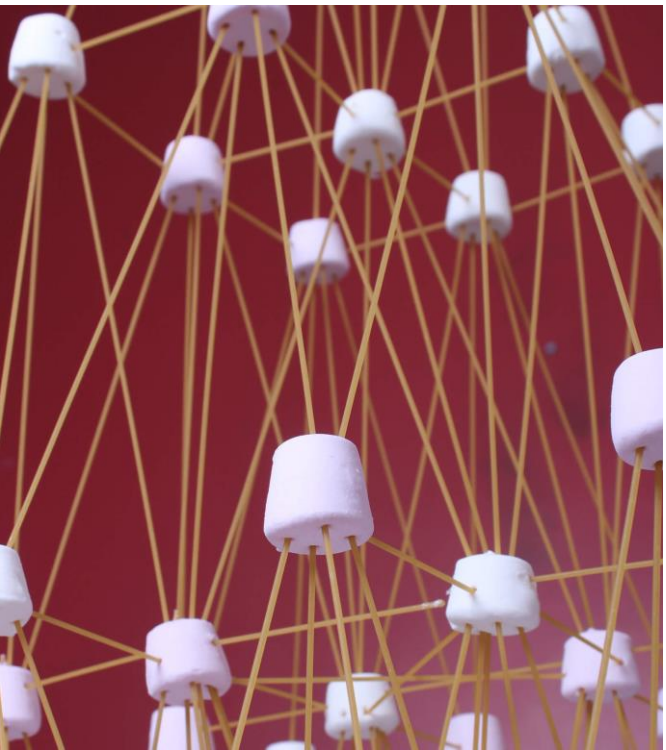
<b>Episode:</b>	Rocket Ski Rescue
<b>Written by:</b>	Matthew Tishler
<b>Performer(s):</b>	Blaze (Nolan Nort) AJ (Jacquez Swa)
<b>Length:</b>	0:52
<b>Key signature:</b>	G major

**Lyrics**

**Blaze, AJ:** Tensile strength (Woo-oo-oo-oo-oo-oo-oo-oo-oo)  
Pull 'til it breaks (Woo-oo-oo-oo-oo-oo-oo)

**Blaze:** Have you ever tried a tug of war  
With a piece of spaghetti?  
'Cause if you're gonna pull with all your might  
Better hope that material is ready

**Blaze, AJ:** Tensile strength (Woo-oo-oo-oo-oo-oo-oo-oo-oo)  
Pull 'til it breaks (Woo-oo-oo-oo-oo-oo-oo-oo-oo)  
Drawn out, stretched out  
How much tension can it take?



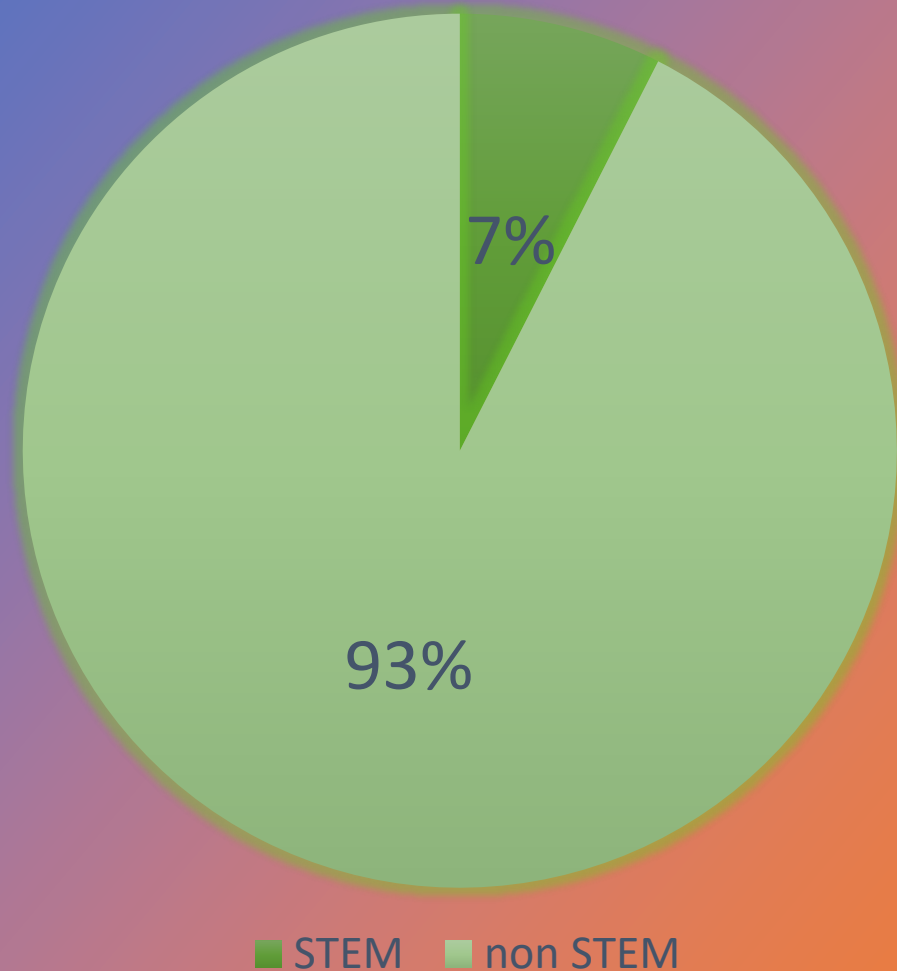
# Who is the target of outreach?

---

Everyone is invited to enjoy and understand science in a meaningful way, but the following groups are often targeted with outreach:

- Secondary School students (14-16)
- Sixth form students (16-18)
- Minority groups

## Careers in the Workforce



# Why is Outreach important?

STEM careers make up around **2.5 million jobs** in the UK.

Research scientists make up an even smaller fraction of that.

Most people are never going to have any sort of contact with research in an academic environment.

They may never read a research paper.

It is important that the information that exists in the research world makes its way into the real world.

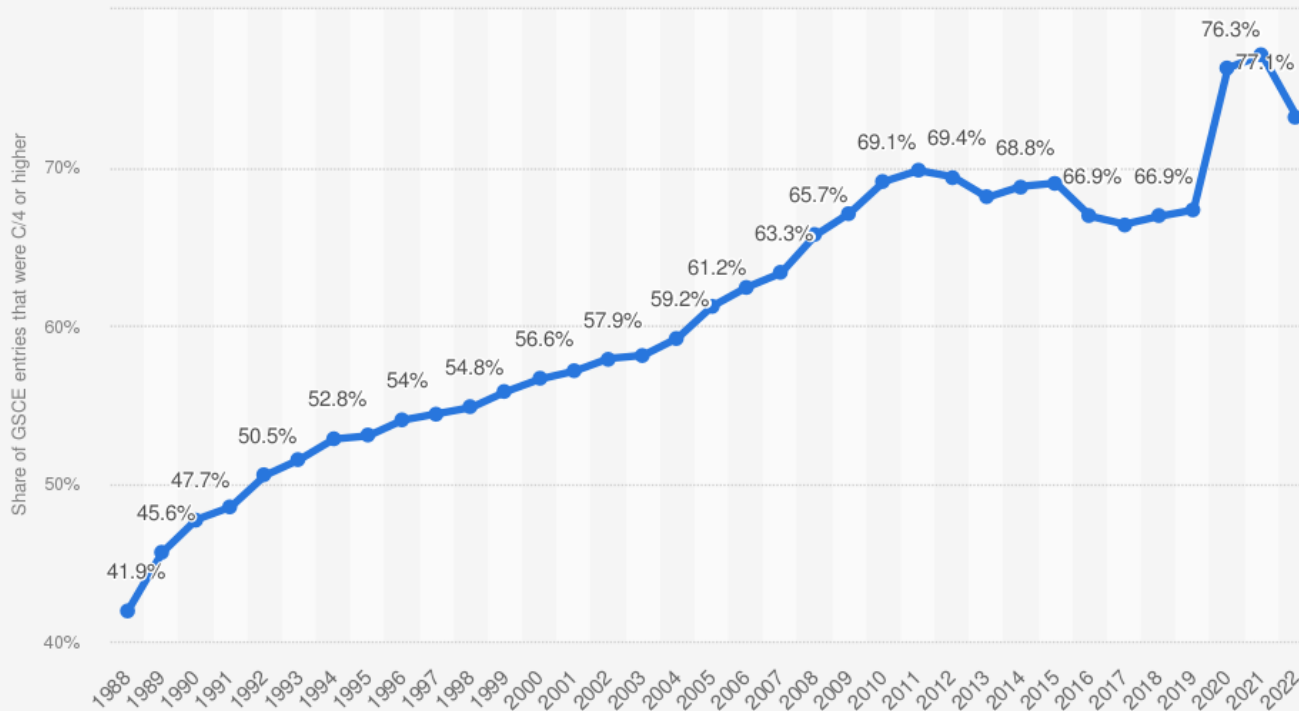


# Benefits to the community

- Open doors to research community
- Make science interesting or enjoyable
- Allow understanding of what a research career could be like
- Minority representation
- Remove fear of science and maths
- Increase their resistance to misinformation



Proportion of GCSE entries awarded a C/4 or higher in the United Kingdom between 1988 and 2022



Sources  
Joint Council for Qualifications; The Guardian  
© Statista 2023

Additional Information:  
United Kingdom; Joint Council for Qualifications; 1988 to 2022

## Moving or reducing STEM fear

Adults have very negative  
attitudes with science and  
mathematics.

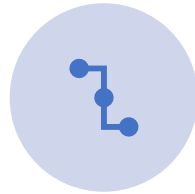
## GCSE results day 2022: Third of students failed to achieve standard pass grade of 4 in English and maths

Education Secretary  
is called for a 'rethink on education policy', arguing that the  
system is failing a large proportion of children across the

# Benefits for *you*



Often it is a paid opportunity



Widen your network



Gain confidence in giving presentations



Practice breaking down your research



Enjoyable



Sense of pride in your work



Variety / break from your research



CV material

Example slide from one of  
my presentations



# Cosmic Con

## March - 2023

---

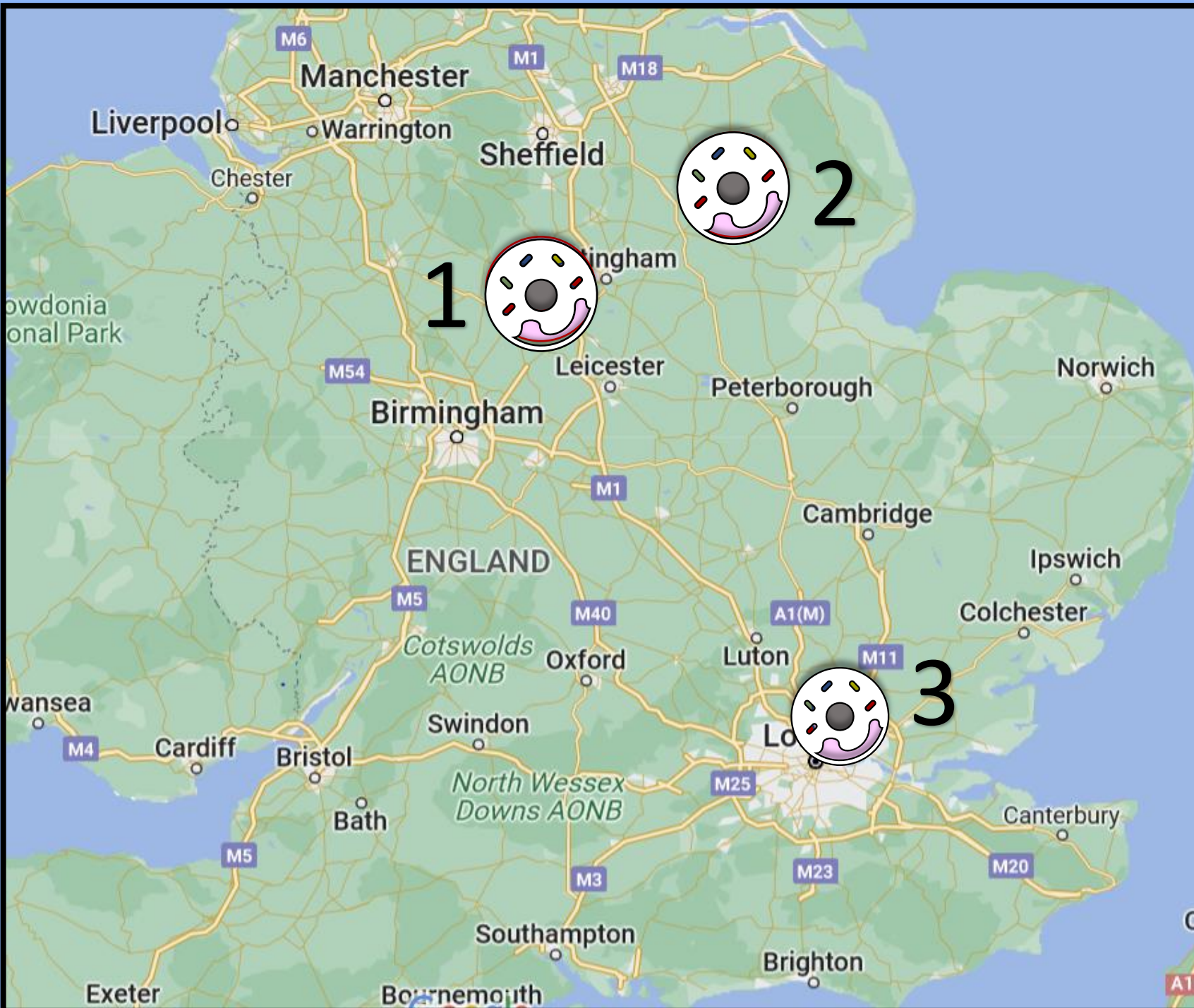
Margaret-Ann Withington

First Year PhD Student

Department of Chemical and Physical Sciences



Queen Mary  
University of London





# Theory and modelling of high-temperature liquids for environmental applications

Supervisor: Professor Trachenko

Queens' Building

# What is Computational Physics???

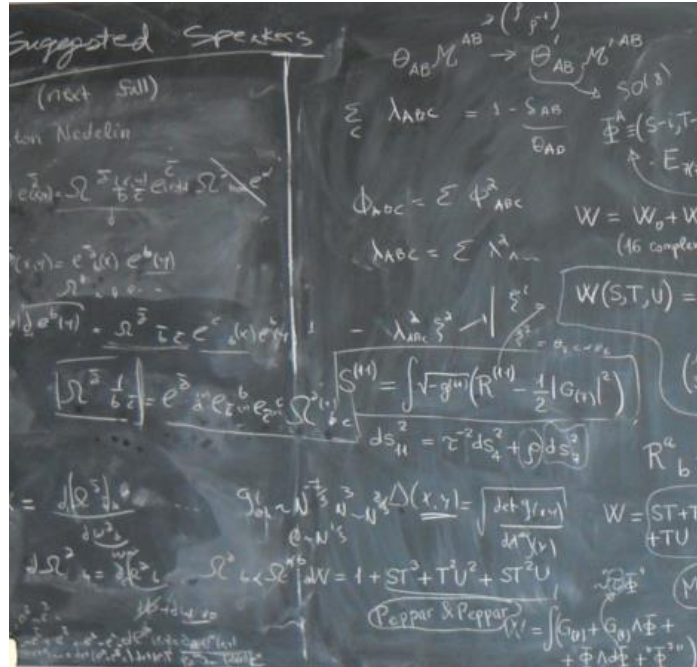
```
* 0 - deliver
* 1 - block
*/
static int icmp_filter(const struct sock *sk, const struct sk_buff *skb)
{
    struct icmp_hdr *hdr;
    const struct icmp_hdr *hdr;

    hdr = skb_header_pointer(skb, skb_transport_offset(skb),
        sizeof(*hdr), &hdr);
    if (!hdr)
        return 1;

    if (hdr->type < 32) {
        __u32 data = raw_skb(skb)->filter.data;

        return ((1U << hdr->type) & data) != 0;
    }

    /* Do not block unknown ICMP types */
    return 0;
}
```



$$F = G \frac{m_1 m_2}{d^2}$$

What do I do?

- I take formulas which have been derived from either experiments or theory

$$\phi(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$E = mc^2$$

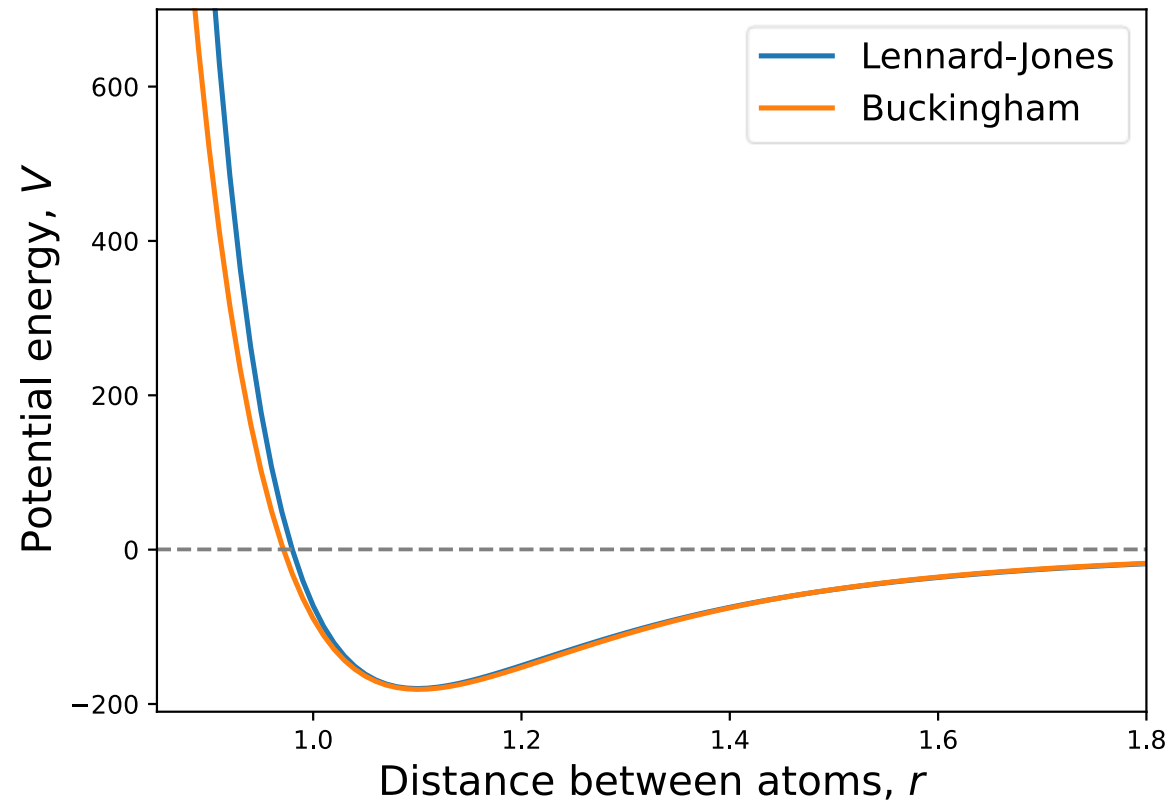
$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$



# Formula to model the interaction

$$U(r_{ij}) = A \exp\left(-\frac{r_{ij}}{\rho}\right) - \frac{C}{r_{ij}^6}$$



$$F = G \frac{m_1 m_2}{d^2}$$

What do I do?

- I take formulas which have been derived from either experiments or theory
- I model the interactions of particles assuming that the rules the formula describes are true

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$

# Modelling the interaction using DL-Poly4



```

nacl
      2      3      13824      15000      1.000000E-03      1.500000E+01
      67.1612515385      0.0000000000      0.0000000000
      0.0000000000      67.1612515385      0.0000000000
      0.0000000000      0.0000000000      67.1612515385
Na      1
-18.10715305      -3.312389984      -9.409266956
-4.648638307      10.52072175      6.276509891
6168.531240      4271.099622      4607.821112
Na      2
-31.12052490      -15.29035837      -31.89463522
2.328577980      -8.370260885      4.073692946
5844.545324      -12157.10020      -9403.326380
Na      3
-12.48772428      -6.237894756      -28.59027300
-6.001902249      5.392709551      -16.43330035
1853.691122      7180.266115      -2965.421140
Na      4
-20.89655185      26.42527320      -10.47920175
-4.644223236      -6.855655735      1.728095501
2038.665509      -5101.931868      1549.868202
Na      5
-23.77947079      -32.64558964      -11.72310371
-9.032524497      14.96286633      -2.592303965
3516.625312      6925.609760      -1520.942892
Na      6
-24.14865909      -25.02597839      -25.01369579
27.50672061      0.7530957322      19.23211372
-3364.712908      1916.179321      -1424.858151
Na      7
-18.89557432      -22.90545147      30.42390388
6.168669220      6.064578244      -2.700720508
5619.612575      7128.526638      -7571.780878
Na      8
-30.67962579      -27.16071722      -24.82457217
5.965451349      -32.75600514      -9.509978135
-4761.566830      2743.233227      3721.235939

```

```

[btY222@frontend11 LiF]$ ls
1000 1200 1400 1600 1800 200 2150 2350 2500 2700 2900 350 550 750
1050 1250 1450 1650 1850 2000 2200 2400 2550 2750 2950 400 600 800
1100 1300 1500 1700 1900 2050 2250 2450 2600 2800 300 450 650 850
1150 1350 1550 1750 1950 2100 2300 250 2650 2850 3000 500 700 900
[btY222@frontend11 LiF]$

```

```

DL-POLY : Lithium-Fluorine
temperature      1000
pressure         0
steps           1000000
equilibration steps 10000
scale every 1
timestep         0.001 ps
ensemble npt ber 1.0 1.0
cutoff          8.0 angstrom
ewald precision 0.0000001
print every 10 steps
job time        2000000 seconds
close time      100 seconds
finish
~

```

```

DL-POLY : Lithium-Fluorine
units eV
molecular types 2
Lithium atoms
nummols        6912
atoms 1
Na              6.941      1      1      0      1
bonds 0
constraints 0
finish
Fluorine atoms
nummols        6912
atoms 1
Cl              18.998     -1      1      0      1
finish
vdw            3
Na      Na      buck      197.89      0.299      0.04557
Na      Cl      buck      603.74      0.299      0.49936
Cl      Cl      buck      1822.23      0.299      9.0509
close
~

```

$$F = G \frac{m_1 m_2}{d^2}$$

What do I do?

- I take formulas which have been derived from either experiments or theory
- I model the interactions of particles assuming that the rules the formula describes are true
- **I check whether the information the simulation gives me lines up with current experimental values**

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$



- Do the results the model is giving me make sense?

$$F = G \frac{m_1 m_2}{d^2}$$

What do I do?

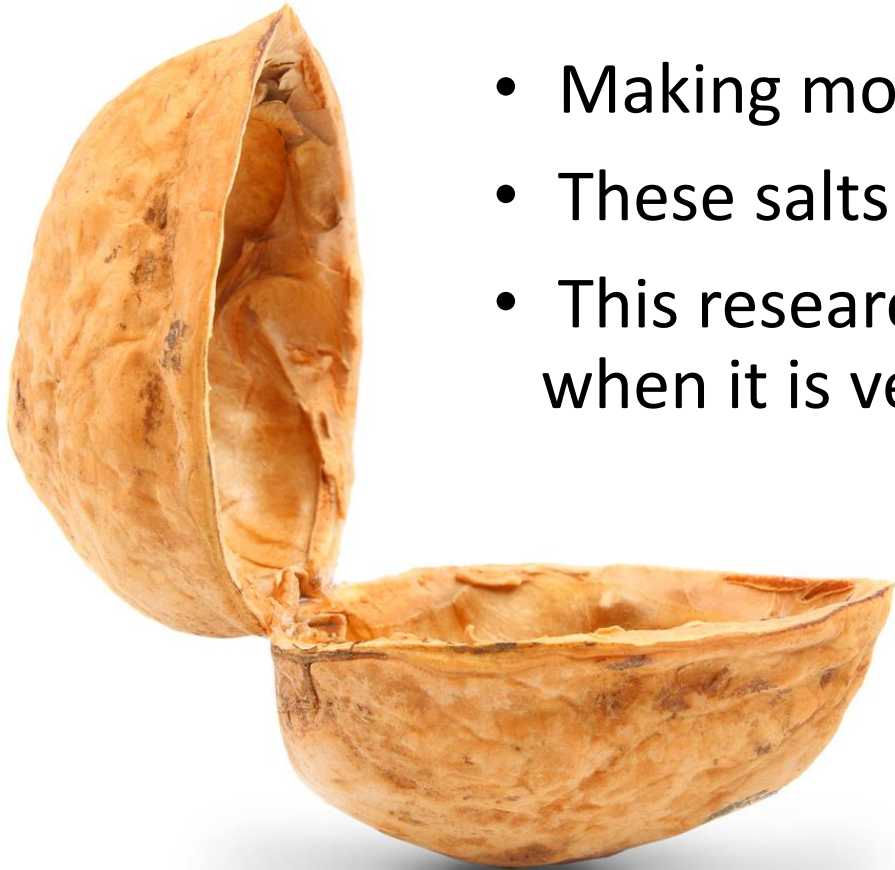
- I take formulas which have been derived from either experiments or theory
- I model the interactions of particles assuming that the rules the formula describes are true
- I check whether the information the simulation gives me lines up with current experimental values
- **I take the information it gives me back and use it to calculate properties of the material**

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$

# My Research – In a nutshell

- Making models of molten salts (like table salt)
- These salts are used in the nuclear power industry
- This research also explores the state of matter when it is very hot and high pressure



End of example



# THE EQUIVALENCE PRINCIPLE

---

Matthew W. Davies

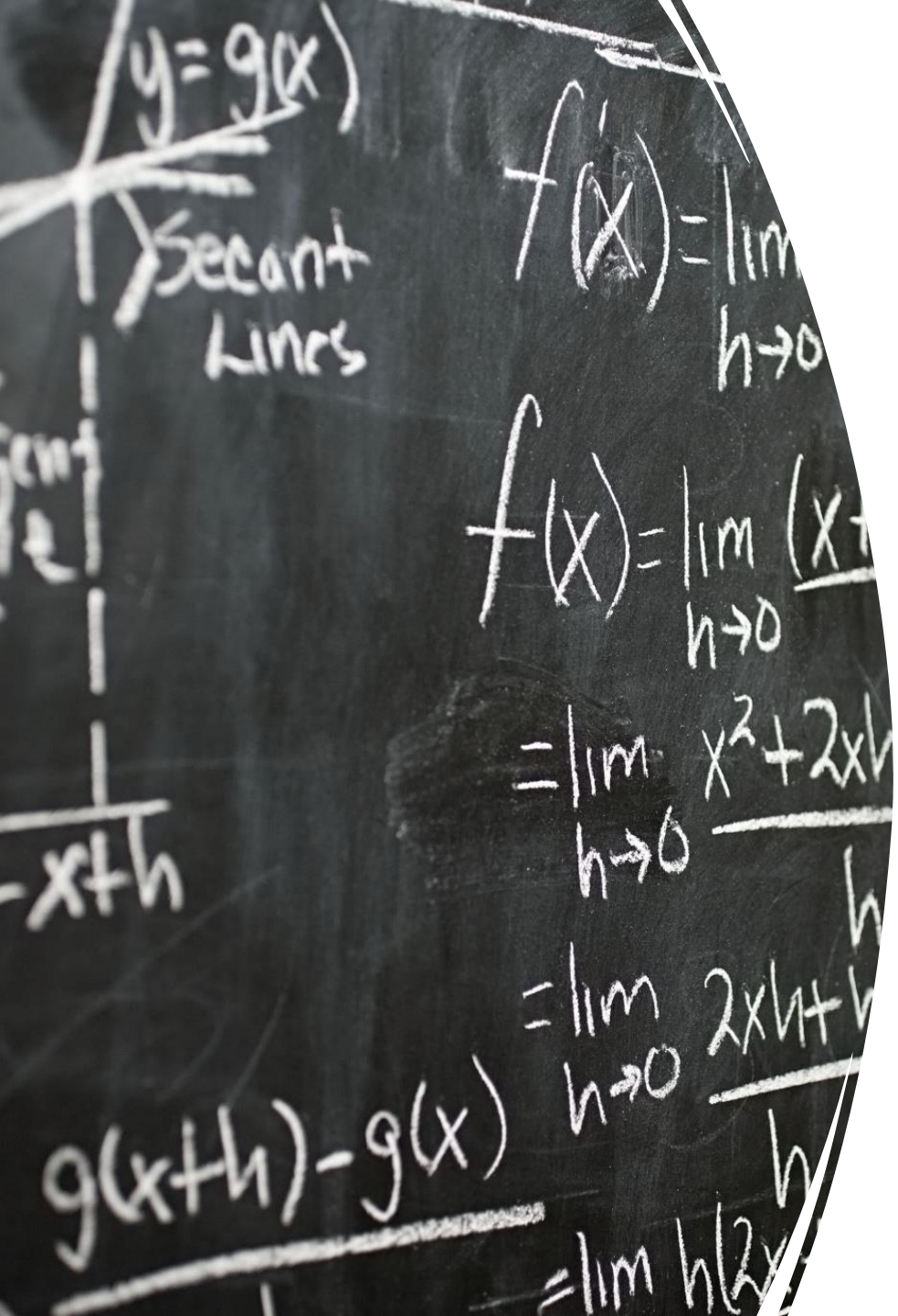
Queen Mary University of London



# LEARNING OBJECTIVES

---

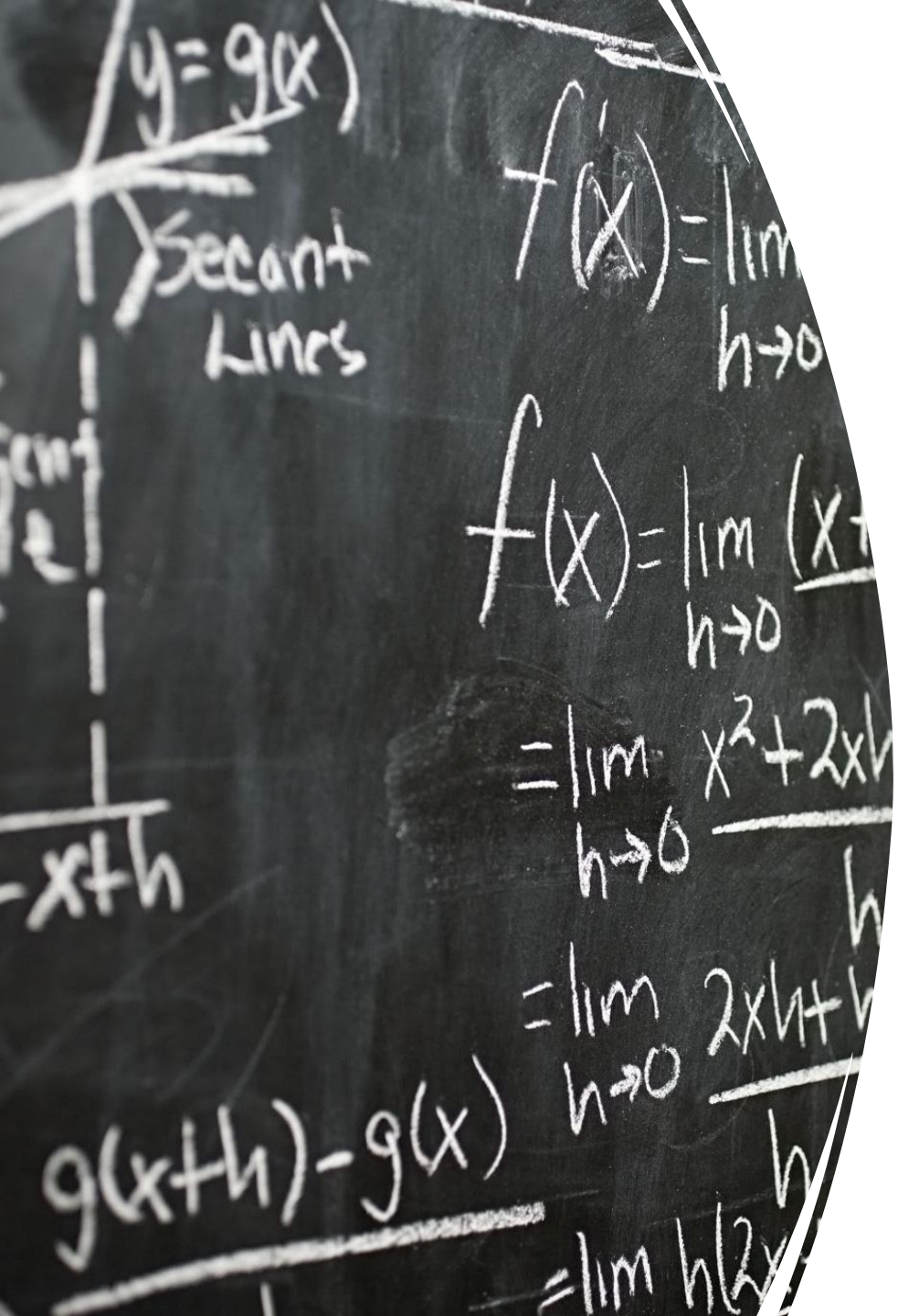
Overall Objective: To understand the problems and peculiarities of Newton's Laws of Motion and how solving them leads to the key principles of General Relativity



# LEARNING OBJECTIVES

Overall Objective: To understand the problems and peculiarities of Newton's Laws of Motion and how solving them leads to the key principles of General Relativity

1. To understand what a "frame of reference" is and that there are a special class of reference frames called "inertial reference frames"



# LEARNING OBJECTIVES

Overall Objective: To understand the problems and peculiarities of Newton's Laws of Motion and how solving them leads to the key principles of General Relativity

1. To understand what a "frame of reference" is and that there are a special class of reference frames called "inertial reference frames"
2. To introduce the concepts of "absolute space" and "fictitious forces"

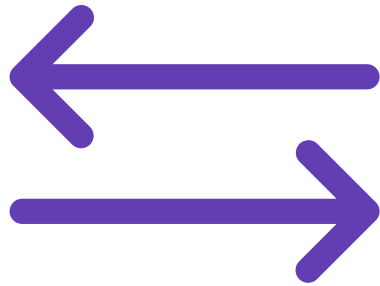
# LEARNING OBJECTIVES

Overall Objective: To understand the problems and peculiarities of Newton's Laws of Motion and how solving them leads to the key principles of General Relativity

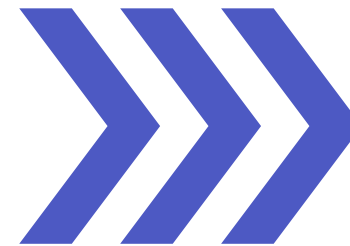
1. To understand what a "frame of reference" is and that there are a special class of reference frames called "inertial reference frames"
2. To introduce the concepts of "absolute space" and "fictitious forces"
3. To understand Einstein's Equivalence Principle, one of the key principles of General Relativity

# WHAT IS MOTION?

---



What does it mean to move?



How do you know when you are moving?

WHAT ARE  
NEWTON'S LAWS  
OF MOTION?

# WHAT ARE NEWTON'S LAWS OF MOTION?

First Law: An object will continue to move in a straight line with uniform velocity, or remain at rest, unless acted upon by an external force



# WHAT ARE NEWTON'S LAWS OF MOTION?

First Law: An object will continue to move in a straight line with uniform velocity, or remain at rest, unless acted upon by an external force

Second Law: The rate of change of momentum of a body is equal to the resultant force exerted on that body

# WHAT ARE NEWTON'S LAWS OF MOTION?

First Law: An object will continue to move in a straight line with uniform velocity, or remain at rest, unless acted upon by an external force

Second Law: The rate of change of momentum of a body is equal to the resultant force exerted on that body

Third Law: Every action has an equal and opposite reaction

# WHAT ARE NEWTON'S LAWS OF MOTION?

First Law: An object will continue to move in a straight line with uniform velocity, or remain at rest, unless acted upon by an external force

# DOES NEWTON'S FIRST LAW MAKE ANY SENSE?

---



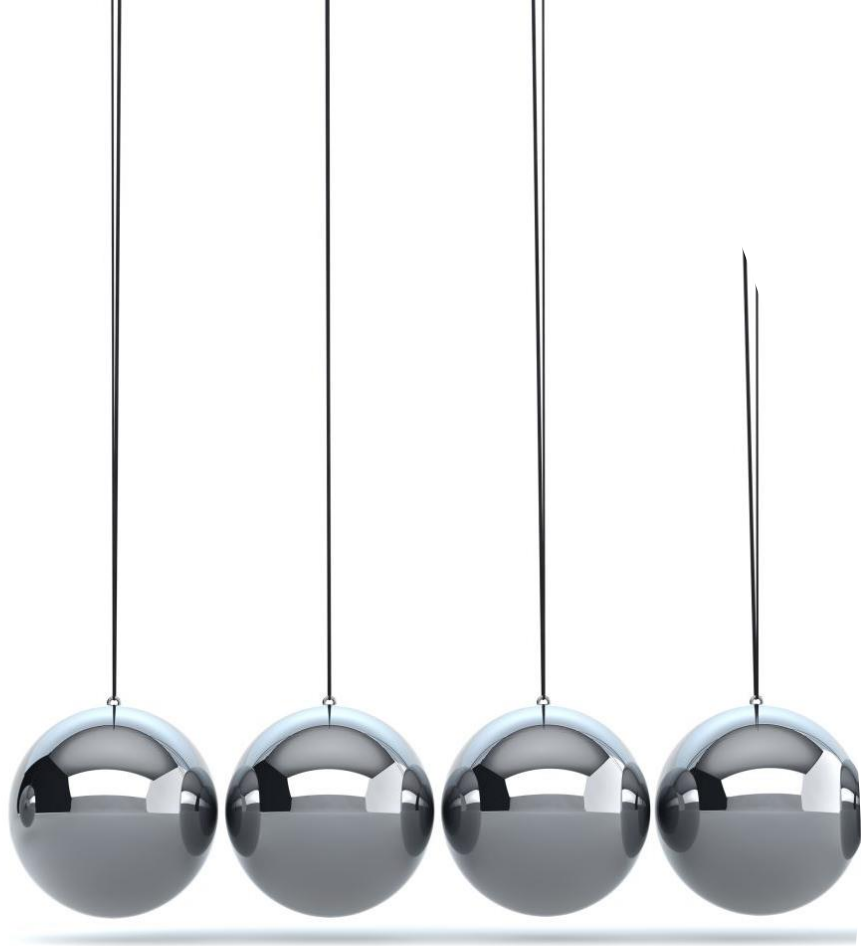
# DOES NEWTON'S FIRST LAW MAKE ANY SENSE?

---



# DOES NEWTON'S FIRST LAW MAKE ANY SENSE?

---



- Newton: "Einstein is being acted on by an external force"
- Einstein: "Newton and the box are being acted on by an external force"
- Who is right?

# How to get involved with outreach

- Queen Mary University
- STEM ambassadors
- Start your own thing!
- Apply for funding for projects

The Talk – My Research – Outreach

Questions?

