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MAGNETIC TO THE CORE

Communicating paleomagnetism with hands-on activities

EGU General Assembly 2020 - #shareEGU

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DEEP Determining Earth Evolution from Palaeomagnetism

UNIVERSITY OF LIVERPOOL

LEVERHULME TRUST

Introduction

In July 2019, the geomagnetism lab of the University of Liverpool had a stand at the Royal Society Summer Science Exhibition. This week-long exhibition had almost 14,000 visitors of the general public, including many school groups. Visitors came from all educational backgrounds. Our stand consisted of 4 hands-on experiments, with an informative backdrop. These four activities allowed visitors to explore the range of tasks that a paleomagnetist does, from the collection and measurement of samples to understanding the behaviour of the Earth's magnetic field and its origin in the outer core.

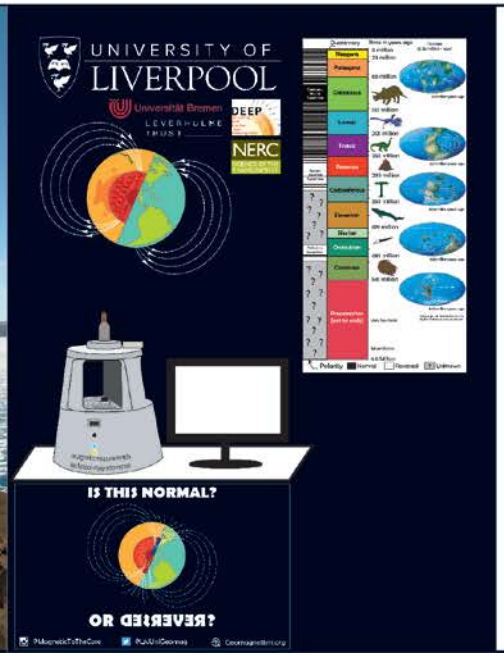
Click here to see an animated introduction (4 mins)

Click on the picture to explore the stand

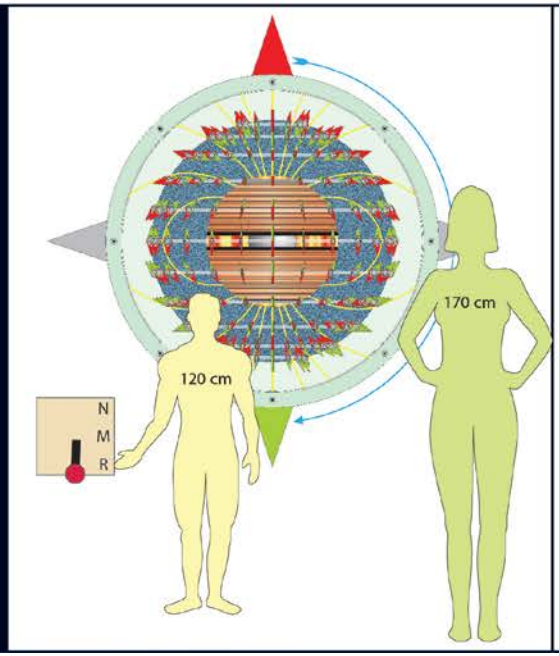
MAGNETIC TO THE CORE

Magnetic to the Core stand

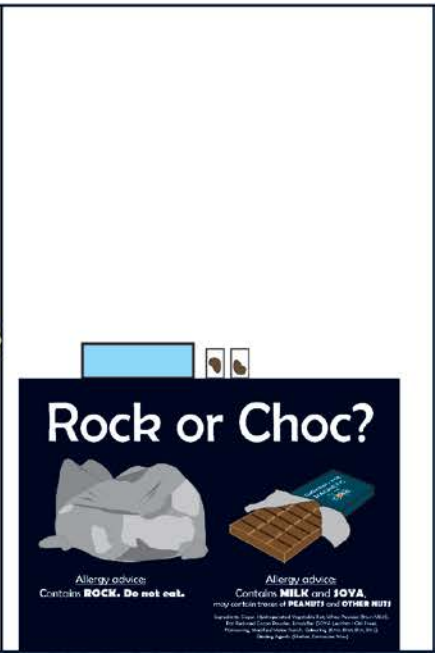
License to drill



Normal or Reversed?



Magnetic Globe



Rock or Choc?

Click on the different parts of the stand to explore the activities

Click the Instagram icon for a tour of our stand during the exhibition

Take me to the evaluation

Take me to the conclusions

License to drill

On the left side of our stand, visitors could start with collecting samples. We took our visitors on a 'fieldtrip' which involved getting them into a high-visibility vest and a hardhat (safety first!). They could then pose for a picture in front of a backdrop with a picture of a field location while holding the drill that we use in the field, or 'pumping water' to cool the drill. For privacy reasons, we let visitors take pictures with their own phones or cameras.

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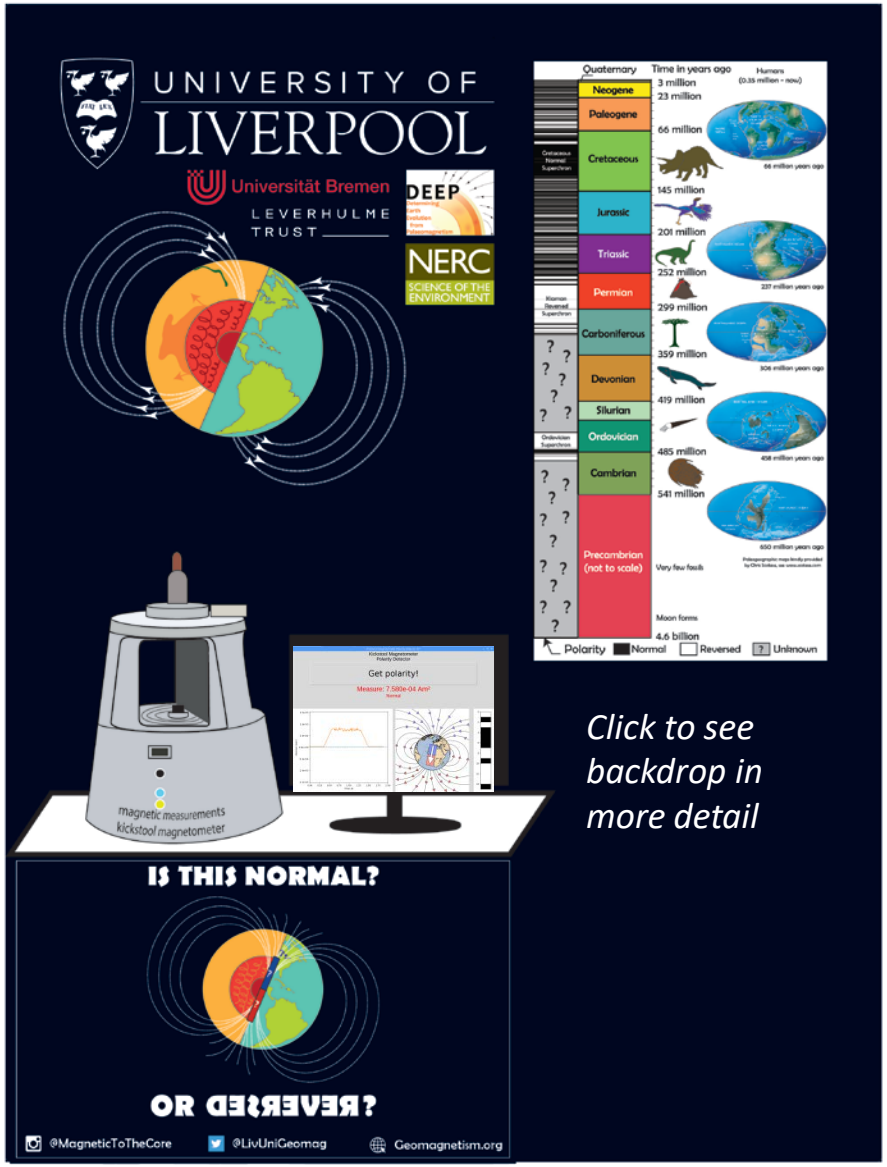
Measure samples!

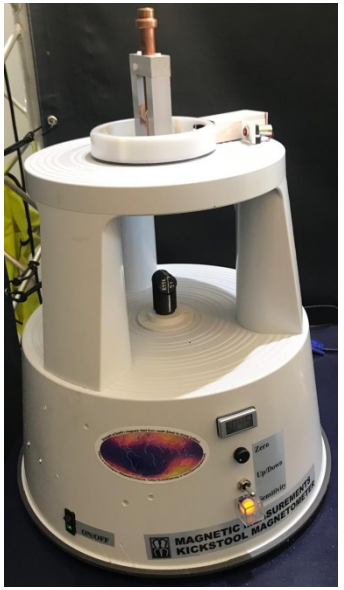
Normal or Reversed?



Click to see backdrop in more detail

After samples were 'collected', visitors could measure samples on a custom-built kick stool magnetometer that was designed especially for outreach. We had samples of Icelandic lavas, and people could measure if the polarity of these samples was Normal or Reverse. If the sample had a reverse polarity, this meant that the sample was at least 780,000 years old, which is the last time that Earth's magnetic field was reversed. For geologists, 780,000 years old is not very old, but members of the public were astonished by how old the rocks were.

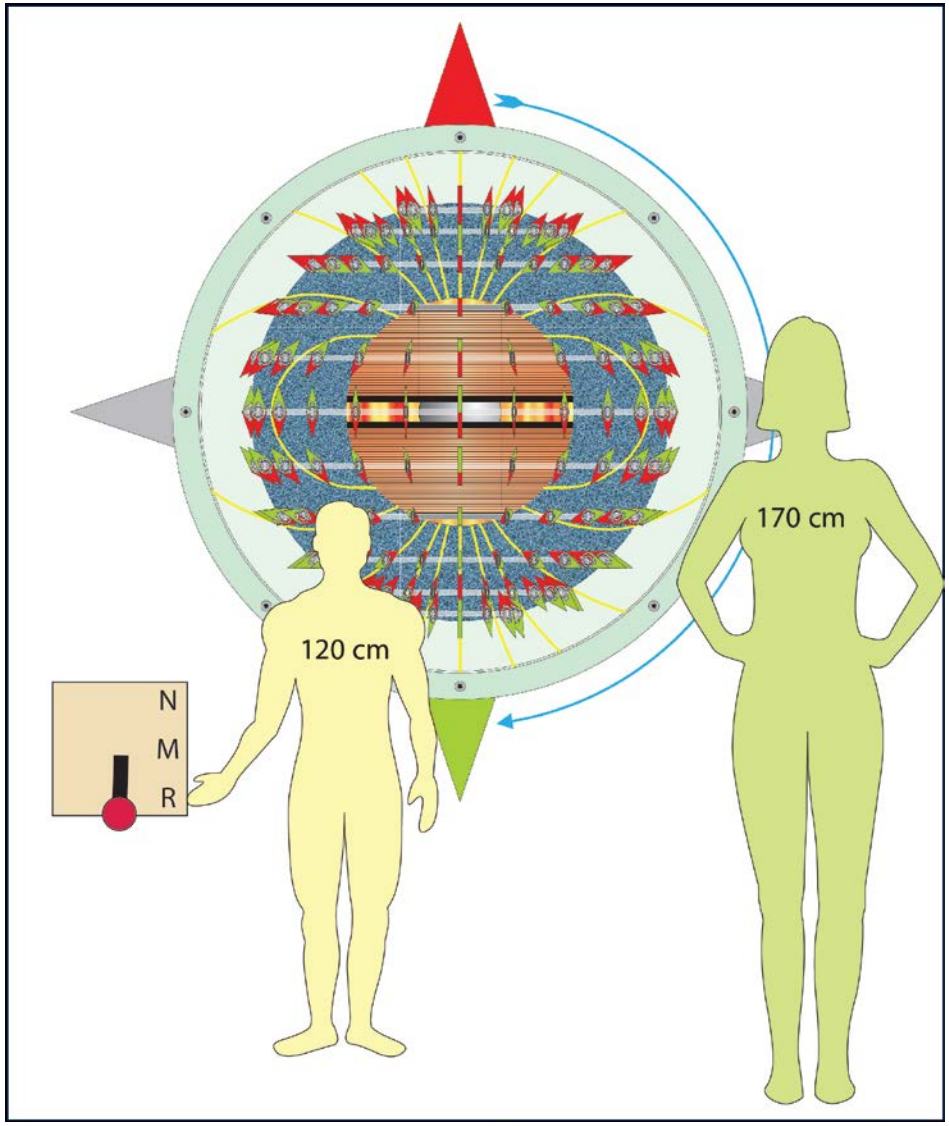
>1000 measurements were collected with the magnetometer during the week



Learn about reversals

Go back

Magnetic globe



This hands-on activity was aimed at understanding a reversal of Earth's magnetic field. We borrowed a magnetic globe from the paleomagnetism lab of the University of Bremen. It shows a scaled model of the Earth, with the solid inner core as an iron ball, the outer core (which generates the magnetic field) as a coil, and compasses to show what happens during a reversal of the field. Visitors could switch the polarity of the field from normal (N), via a multipolar state (M; which is thought to occur during a reversal), to a reverse (R) polarity. Visitors could then see the compasses flip orientation.

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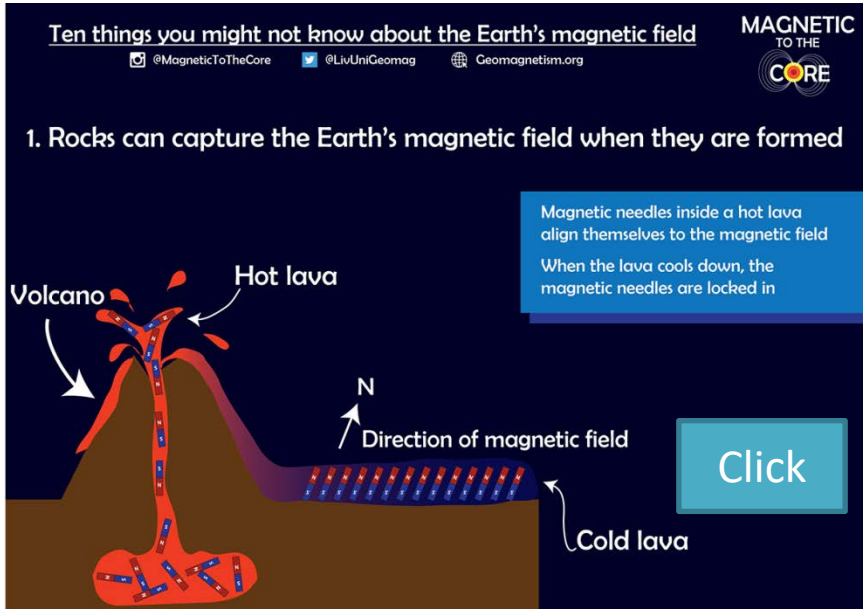
Rock or Choc?

Rock or Choc?

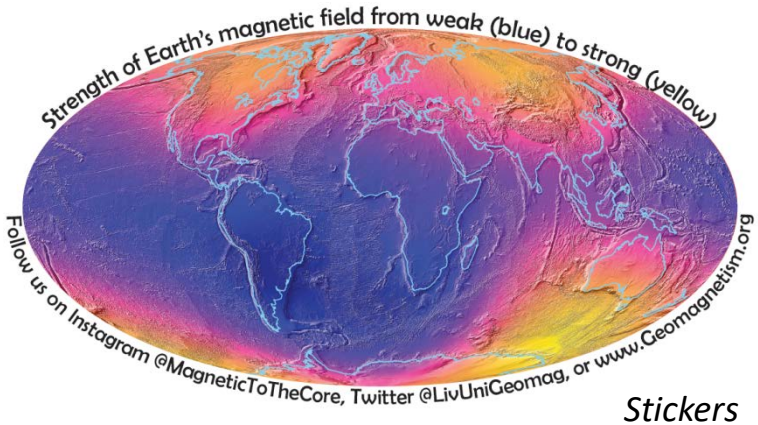
At ‘Rock or Choc’, visitors could determine whether pebbles were real rocks, or made of chocolate. The chocolate pebbles looked so real that even for geologists they were difficult to tell apart. By measuring the magnetic susceptibility, visitors could find out if they had guessed correctly which were rocks and which were chocolates. As a reward, they got a chocolate pebble that they could eat. This was our most popular activity, as the experiment was clear even to the youngest kids. Many people came back to guess again, and eat more chocolates.

Go back
Freebies

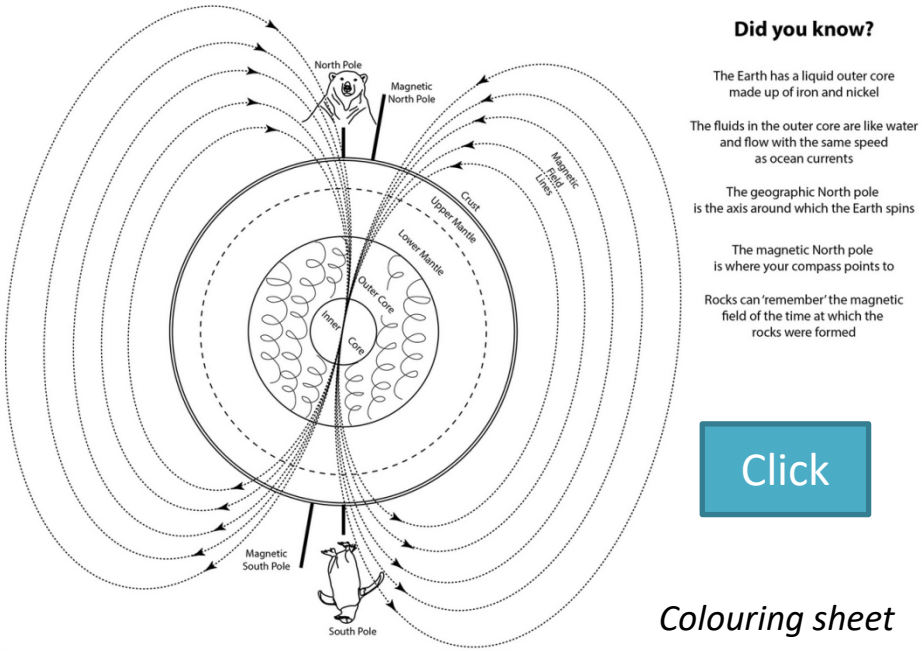
Extra materials and giveaways



For people who were really interested, we made a little booklet with '10 things you might not know about Earth's magnetic field'. After the exhibition, it was also uploaded to ResearchGate, and proved very popular also with scientists. We had a screen with slides about our research up which we used to continue the conversation when guests were interested in the more in-depth science. We also made a colouring sheet, stickers and magnets.



Stickers



Colouring sheet

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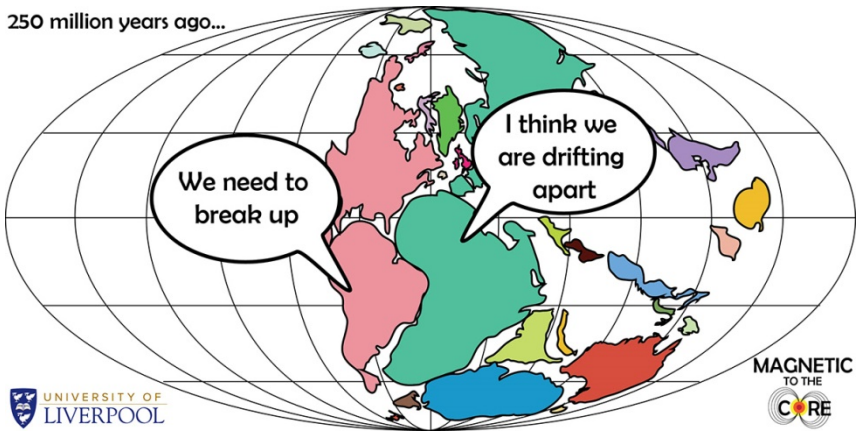
Evaluation

Evaluation



Fridge magnet

In order to evaluate our stand, and measure whether visitors' knowledge on the Earth's magnetic field had actually increased by visiting our stand, we created a quiz with 10 questions. For many visitors, it was fun to take the quiz, but we also rewarded anyone who took the quiz with a fridge magnet. Our results show that especially for school kids, our stand had a significant impact on their knowledge of the Earth's magnetic field.

Take the Quiz and test your knowlegde!

Our stand aimed at providing the following learning outcomes to visitors:

- Understanding that rocks can record the Earth's magnetic field
- The poles of the Earth's magnetic field can switch polarity
- Different materials have different magnetic properties
- Paleomagnetism is the study of Earth's magnetic field using rocks, and anyone can do it

Go back

Impact and significance

Evaluation

Correctly Answered Percentage Scores									
	All participants					School-age participants			
	Not yet visited stand	visited <10 mins	visited ≥ 10 mins	visited total		Not yet visited stand	visited <10 mins	visited ≥ 10 mins	visited total
N	216	77	89	166		66	36	24	60
Mean percentage correct answers	59.7	66.5	78.8	73.1		49.7	62.3	77.8	68.5
95% norm	2.5	4.6	3.8	3.1		4.4	7.2	7.6	5.6
Median	55.6	66.7	77.8	77.8		44.4	66.7	77.8	66.7
Standard Deviation	18.8	20.7	18.2	20.3		18.1	21.9	19.1	22.0

We randomly approached people near our stand and asked them to participate in the quiz. At all times, one member of the team was tasked with the quiz, this task rotated so everyone in the team did a roughly equal number of hours on the quiz. The questions were asked by the team-member, who filled in the answers on a tablet. One of the caveats of doing the quiz this way is that sometimes groups of 2 or more people would take the quiz collectively, although participants seemed to enjoy the quiz a lot more when they took it in teams.

We were not allowed to collect sensitive data at the event, so we asked people whether they were in school as a means of discriminating between kids and adults. This also meant that we were not able to collect more specific data on the background of participants.

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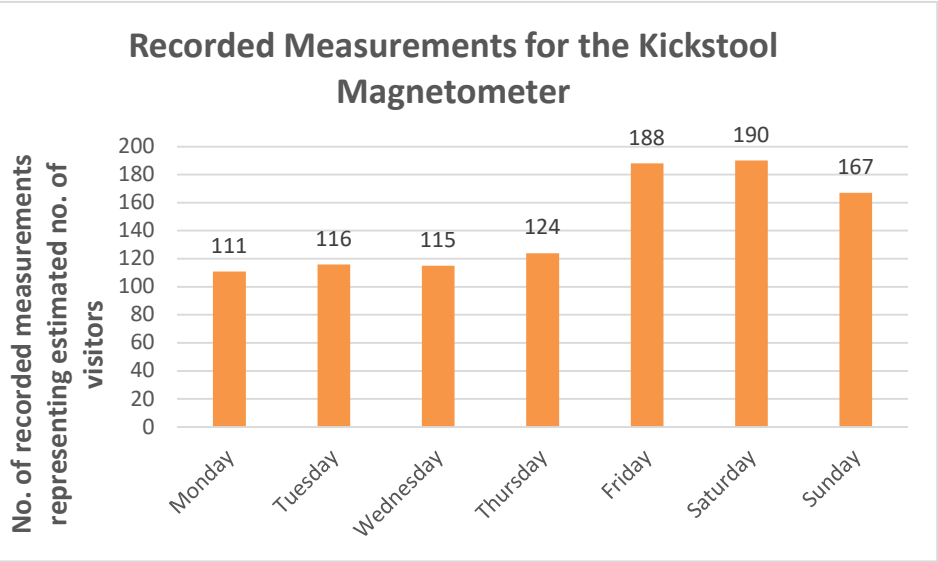
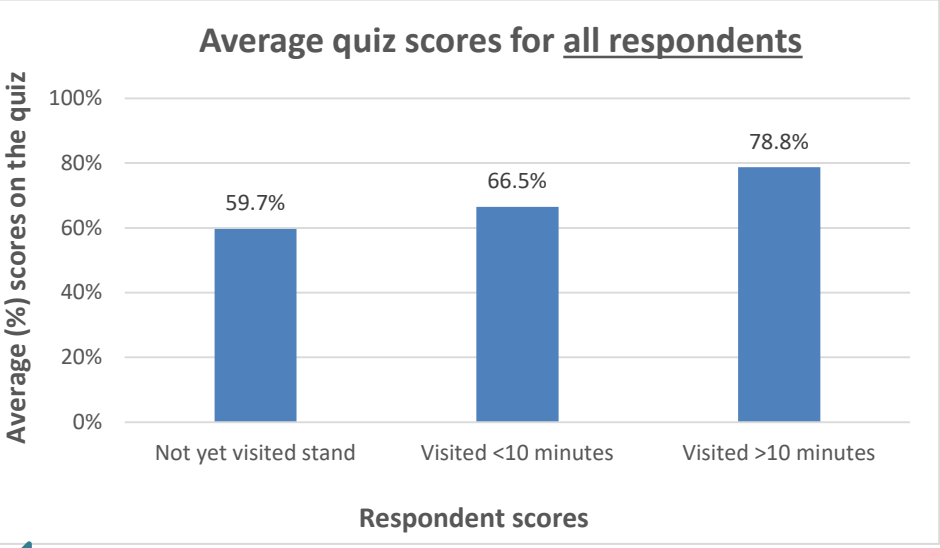
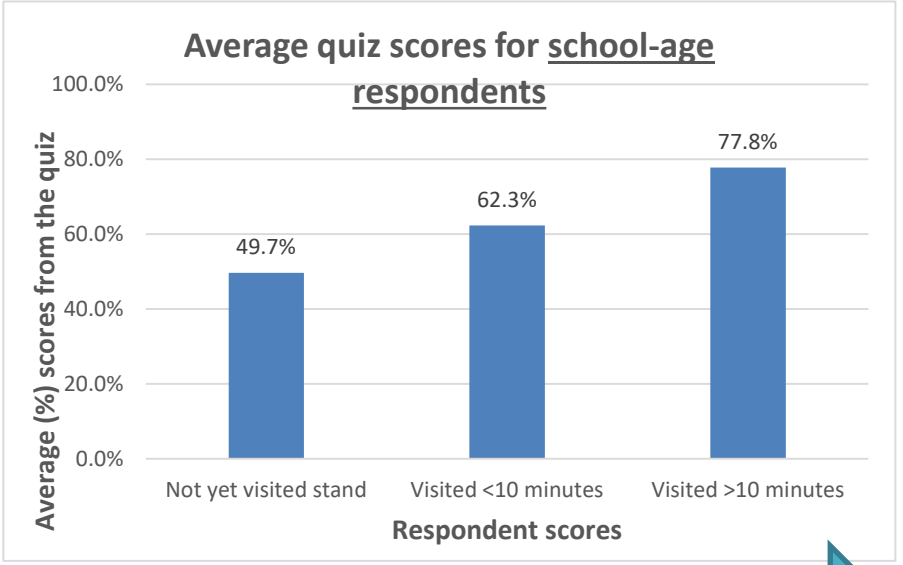
Impact and significance

Evaluation



Using recordings from the magnetometer, we estimated a minimum of 1011 visitors interacted with the stand. The impact of the stand on visitors' knowledge of the Earth's magnetic field was clearly demonstrated through the quiz scores. Quiz scores of all respondents, and scores of school-age respondents in particular, show clearly that more time spent at the stand increased the average quiz scores.





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Conclusions

Conclusions

We provide an example of a best practice for measuring the impact of an outreach event. Using the recordings from the kick stool magnetometer, we estimated that a minimum of 1011 visitors interacted with the stand. The impact of the stand on visitors' knowledge of the Earth's magnetic field was clearly demonstrated through quiz scores. The average score of all respondents, and in particular the average score of school-age respondents shows clearly that more time at the stand made them do better at the quiz. Visitors to the Royal Society Summer Science Exhibition may have had a more significant scientific background than the average population, and another data set in a different setting would be valuable to more thoroughly assess the impact of Magnetic to the Core.

Please get in touch if you have any questions!

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Massive thanks to everyone on our team: Daniele Thallner, Yael Engbers, Ben Handford, Simon Lloyd, Louise Hawkins, Courtney Sprain, Domenico Meduri, Richard Bono, Michael Grappone, Anouk Beniest, Elliot Hurst, Georgia Quinn, Joe Perkins, Mimi Hill, Jenny Schauroth and Tereza Kamenikova.