Nuclear Physics Outreach

Christian Aa. Diget, Katherine Leech, Joel Richardson, Sophie Abrahams
University of York

Your ten-hundred words

Explain something about your science, making it as accessible as possible.

- Send us your ten-hundred words: https://tinyurl.com/stfc-ten-hundred

Make your own slide

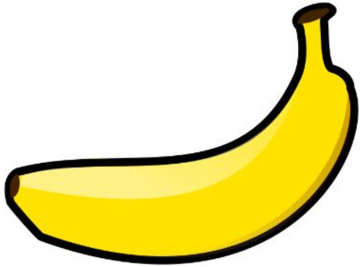
We want you to produce a slide (maximum of 2 slides) on your own research.

- Email your slide (and text) to physics-bindingblocks@york.ac.uk
  - Don't forget to include your name(s)
  - Please email it by the end of Wednesday this week (the 21st)
  - Best slide will receive a LEGO trophy

Binding Blocks
Building the Universe one nucleus at a time

Any questions?

UNIVERSITY of York



10	Having an X-ray of your arm gives you a radiation dose equivalent to eating 10 bananas.
800	A transatlantic flight is the same as eating 800 bananas.
27k	The typical annual dose of a person living in the UK is equivalent to 27,000 bananas (eaten over a year – that's 74 a day!).
66k	A chest CT scan would be the equivalent of eating 66,000 bananas.
80k	A six month trip to the International Space Station is equivalent to 80,000 bananas.
40M	Very high doses of radiation can cause burns, cancer, radiation poisoning and even death. A fatal dose of radiation is 4 Sv or 40,000,000 bananas.

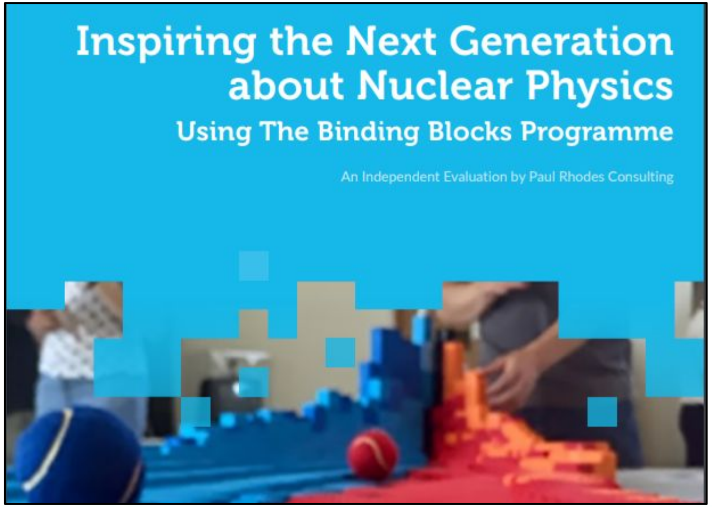
Binding Blocks

National Outreach

- 30,000+ young people and members of public
- 3,000+ masterclass participants
- 56,000+ views online
- 375+ UGs, PGs, and researchers trained
- 390+ teachers engaged
- 20+ partnerships with the nuclear physics community

Evaluation

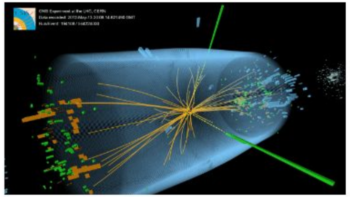
Independent consulting, based on masterclass participation, feedback, and focus groups



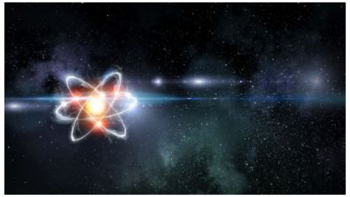
1. Does Binding Blocks inspire, and contribute to students wanting to study physics in the future?
2. Does Binding Blocks play an effective part in teaching the concepts of nuclear physics and developing confidence to talk about the subject?
3. Does Binding Blocks help to change people's views on nuclear physics?

Three Main Areas

Module 1: Energy and Decay

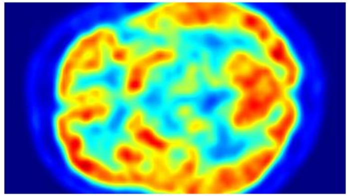


Module 2: Experimental Nuclear Physics

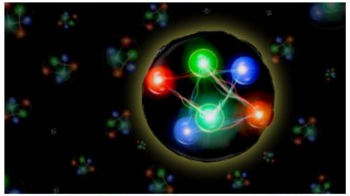


Module 3: Nuclear Astrophysics

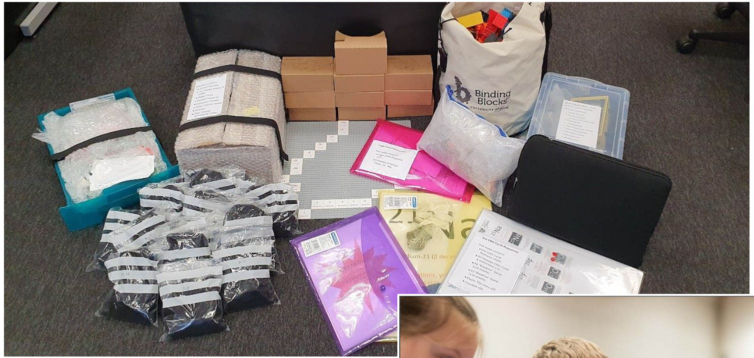
Module 4: Fusion Technology

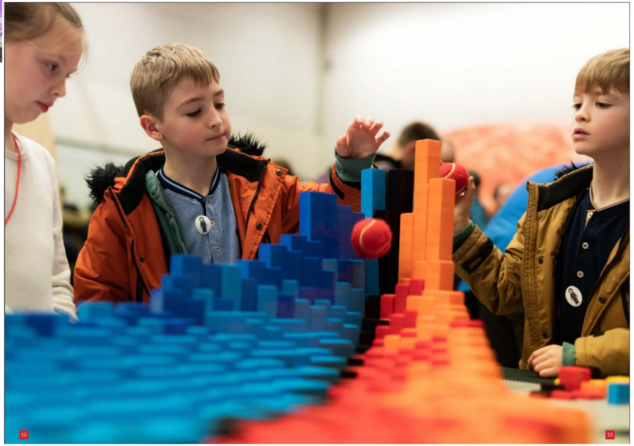


Module 5: Medical Physics



Module 6: Particle Physics meets Nuclear Physics

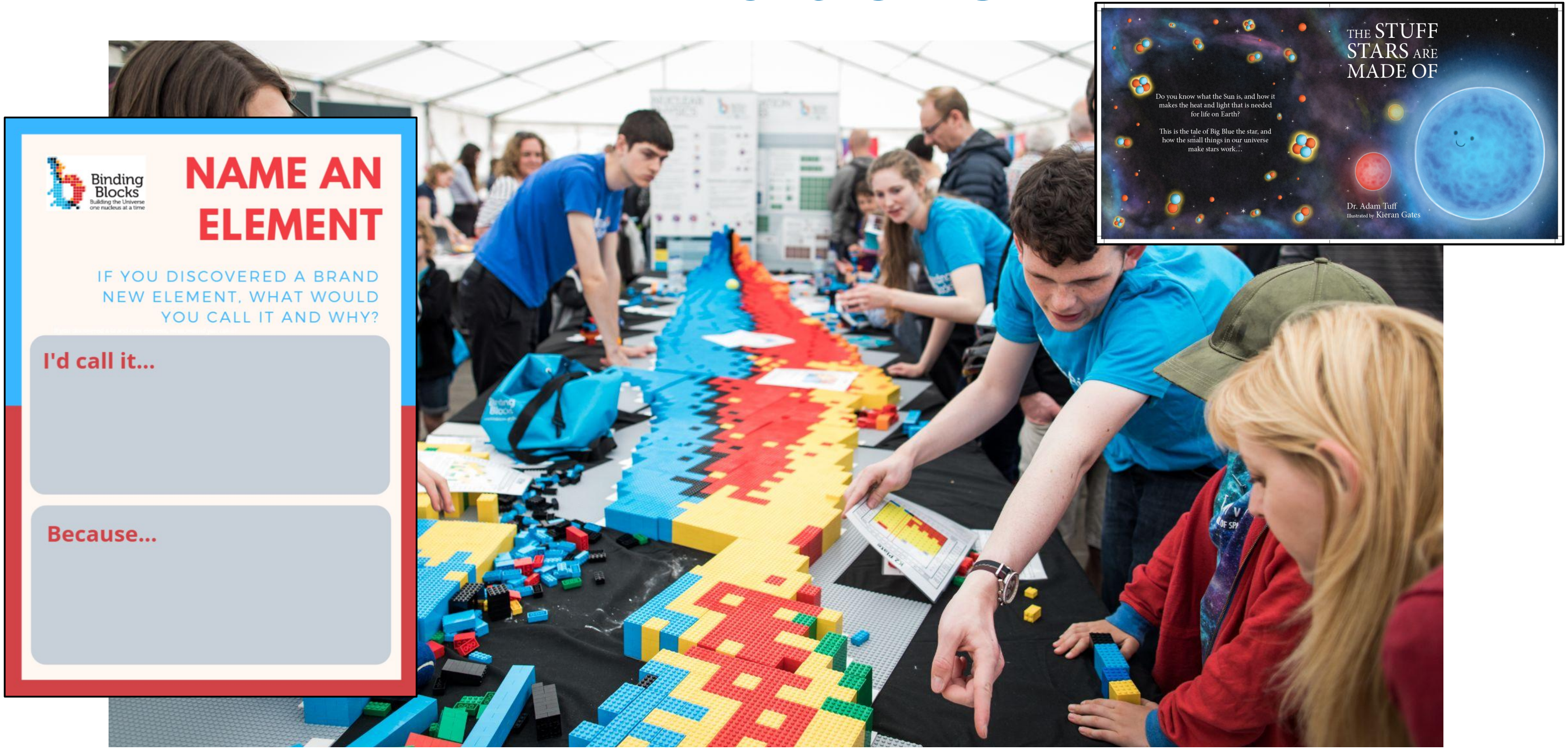




Binding Blocks
Building the Universe one nucleus at a time

Exhibitions

UNIVERSITY of York



Nuclear Masterclass

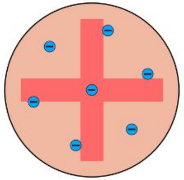
The Structure of the Atom

The idea of the atom originated in Ancient Greece, where philosophers named the smallest building blocks of matter **atoms**. They believed that these were indivisible, solid particles and that differences in atomic shape and size gave rise to the different properties of matter.

Modern atomic theory then began in the early 1800s with chemist and physicist John Dalton. His idea of atoms was very similar to that of the ancient Greeks - tiny, solid balls that could not be broken down into anything simpler. However, as experiments advanced, our understanding of the atom also developed.

Following the discovery of the negative electron, and knowing that atoms were neutral overall, JJ Thompson proposed the **Plum Pudding** atomic model. This saw the atom as a positively charged 'pudding', with negative electrons embedded as 'plums' throughout. This model of the atom was disproved by an experiment completed by physicists Rutherford, Geiger, and Marsden.

In the video below, Kayleigh Gates and Abby-Rhian Powell from the University of Glasgow explain more about the famous Rutherford experiment, and how the same technique of **scattering** is still used in cutting-edge experiments today.

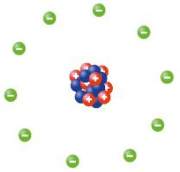


The plum pudding model of the atom, which was later disproved by Rutherford's experiment.
Kurzon, CC BY-SA 4.0, via Wikimedia Commons

Rutherford Model

We now understand atoms to be made of **protons** (positively charged particles), **neutrons** (neutral particles) and **electrons** (negatively charged particles). The protons and neutrons are at the centre of the atom in the nucleus, and the electrons surround the nucleus.

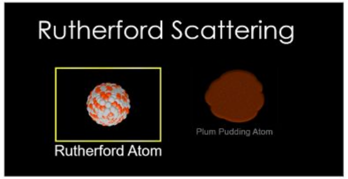
Most of the mass of an atom is concentrated in its nucleus: protons and neutrons make up most of the atomic mass. The mass of an electron is so tiny that it is often considered to be insignificant.



Activity 1.3
Models of the Atom

Use the PHET interactive simulation of Rutherford Scattering to investigate the plum pudding and Rutherford models of the atom:

1. Start by looking at the plum pudding model of the atom. What do you notice about the path of the alpha particles through the atom? Is this what was observed in Rutherford's experiment?
2. Now look at Rutherford's model of the atom. What do you notice about the paths of the alpha particles in this case? You can change between a single nucleus and multiple atoms using the icons in the top right corner of the screen.
3. What do you notice about the alpha particle's behaviour if you vary the number of protons in the nucleus?
4. What do you notice about the alpha particle's behaviour if you vary the number of neutrons in the nucleus?



PhET Simulation of Rutherford Scattering, University of Colorado Boulder

Activity 1.4
The Atomic Model and Scattering

Log in to Isaac Physics and answer the question:

- Scattering and the Structure of the Atom

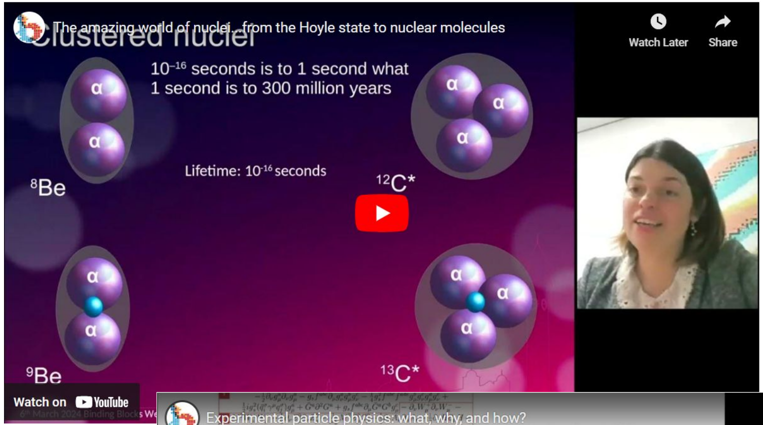
Don't forget to log in to Isaac Physics!

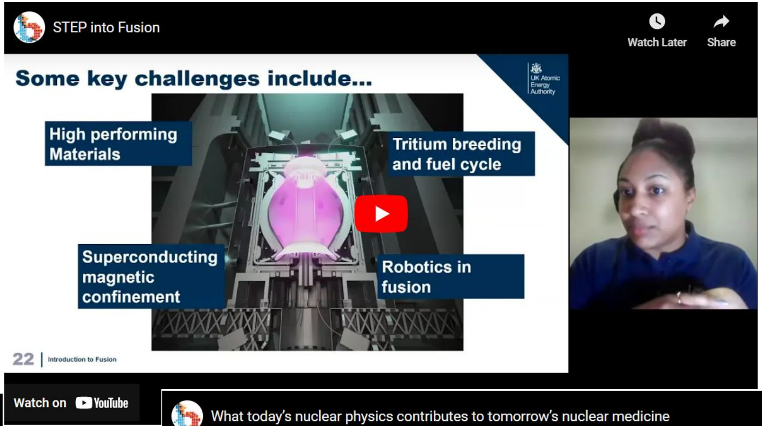
isaac Physics. You work it out.

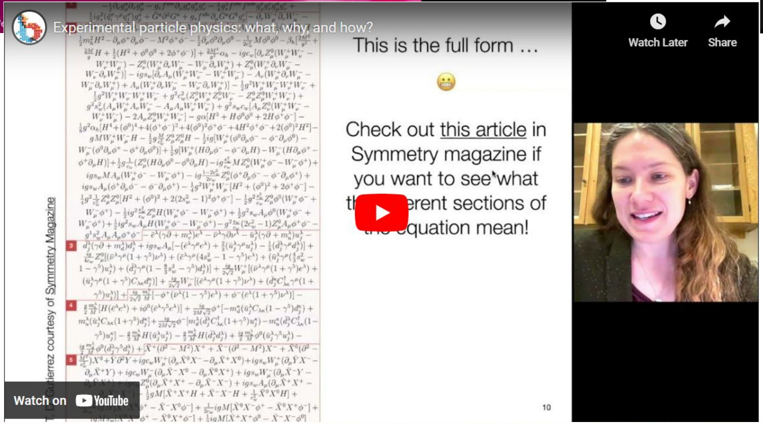
Masterclass Webinars

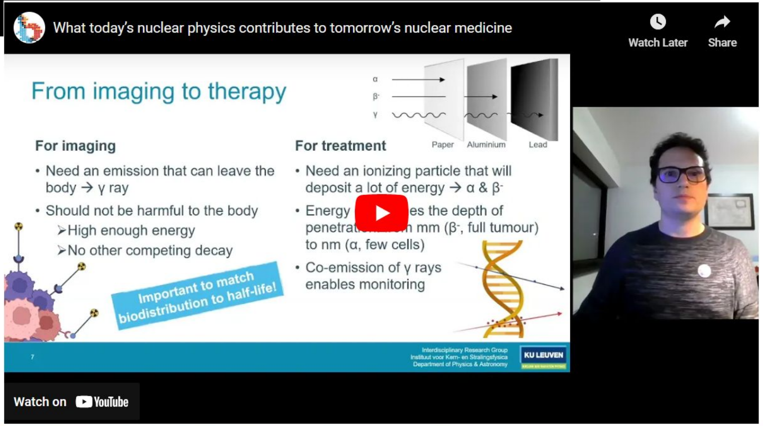
Binding Blocks
Building the Universe one nucleus at a time

UNIVERSITY of York









Binding Blocks
Building the Universe
one nucleus at a time

Teacher Loan Kit

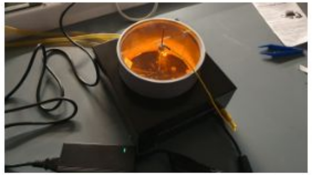
UNIVERSITY of York

LEGO Chart

Scatterer

Dice

Cloud Chamber



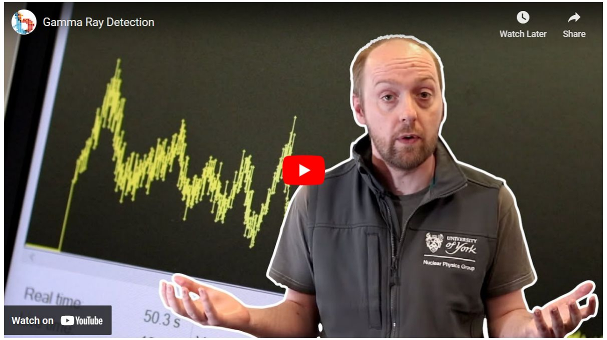
Geiger Counter

D3S Detector

Particle Zoo

VR Headsets

Hot CNO Cycle



Binding Blocks
Building the Universe one nucleus at a time

Get Involved

UNIVERSITY of York

Work in partnership and engage with training:

- Videos and online activities
- Physical resources
- Webinars
- Online forum
- **Mentoring**

Resources

bindingblocks.org.uk

Binding Blocks
Building the Universe one nucleus at a time

UNIVERSITY of York

Get Involved!

Sign up for mentoring:
Payment for time and expenses covered
https://tinyurl.com/stfc-mentoring-form

Get in touch: physics-bindingblocks@york.ac.uk