Arts
Centre
Education

Information for your visit to Rutherford's Den

Making the Most out of Your Visit

At The Arts Centre we would like you and your class to get the most out of your visit. We suggest using this booklet to guide you through different aspects of your visit. We have found that the students enjoy the sessions more when they have some prior knowledge, and this booklet is designed to help you with this.

Before:

- Use the information in this booklet and the exercises to help familiarise your class with who Ernest Rutherford was and what he did
- Use our pre-visit quiz https://goo.gl/UQthap to test your class' knowledge (9 Questions)
- Discuss what students know about The Arts Centre and Ernest Rutherford already

During

- Take part in the different activities available at the Arts Centre
- Ask questions about the site and about Rutherford and his life
- Learn more deeply about Rutherford's science and present science
- Explore the Arts Centre and surrounding areas as well as Rutherford's Den exhibits

After (We love to hear about how the visit inspired you or what learnings you took away)

- Create a poster with all the information learnt during the visit
- Write about your experience
- Present your new understandings and learnings using a medium of your choice: digitally via an app, video form/documentary, PowerPoint, written, roleplay etc

Email us your work and feedback at education@artscentre.org.nz

Who was Ernest Rutherford?

Born in Brightwater, near Nelson, in 1871. He had 11 brothers and sisters

Liked asking questions and making things

Worked hard and won many scholarships for school and university

Failed many times, but persevered to get where he wanted

Won a Nobel prize for Splitting the Atom

Went to University at Canterbury College, McGill (Canada), Cambridge and Manchester (both England)

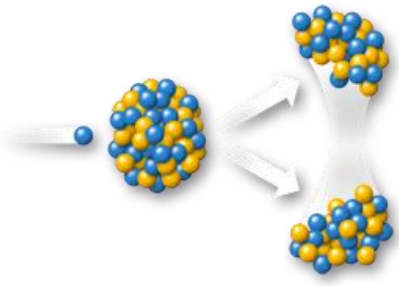
Worked out the structure of the atom we still use today with Hans Geiger and Ernest Marsden

Died in 1937 of a hernia

What did Rutherford do for Science?

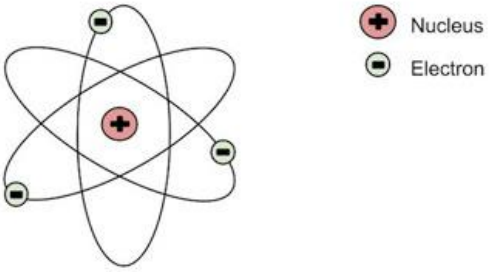
Explained how **radioactivity** was produced spontaneous breakdown of atoms

Managed to work out the age of the earth due to his **radioactivity** work (radiometric dating)



He split the atom and turned nitrogen into oxygen by bombarding it with alpha particles. He was the first **alchemist**. (He won a Nobel Prize for this)

He discovered the basic structure of the atom: that there was a dense positively charged **nucleus** and that **electrons** orbited it.



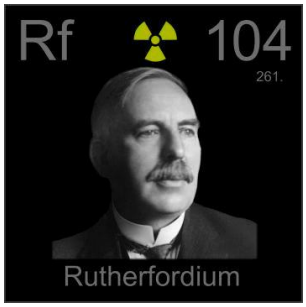
He predicted the existence of the **neutron**. This was later discovered by James Chadwick

Notable Prizes and Recognitions

1908 – Ernest wins the Nobel Prize

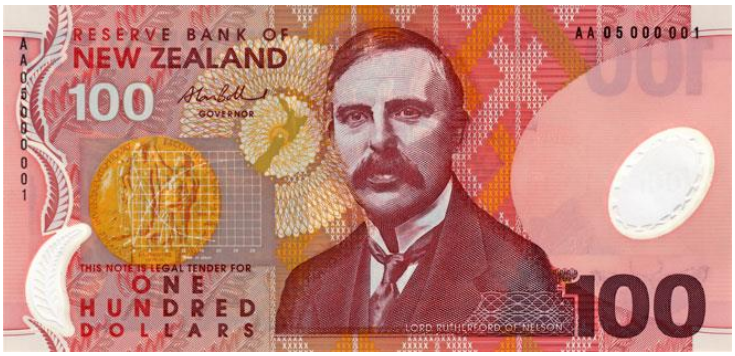
1914 – King George VI knights Ernest so he is now Sir Ernest Rutherford

1931 – Sir Ernest Rutherford is made Lord Rutherford of Nelson by King George VI



1964 – A new element is discovered and named after Ernest: Rutherfordium

1991 – New Zealand honour their greatest scientist by putting him on the $100 note



Ernest Rutherford – a history

1871	1871 Born in Spring Grove, Brightwater Southwest of Nelson
1877	Family moves to Foxhill
1883	Family moves to Havelock. Three brothers die during time there
1886	Wins Scholarship to Nelson College on second attempt
1887-1889	Attends Nelson College and in 1888 Family moves Taranaki
	Wins University Scholarship on second attempt
1889	
1890	Starts BA at Canterbury College
1894	Meets future wife May Newton
1895	Has completed BA, MA (hons) and BSc. Does original electromagnetic research. Awarded 1851 Exhibition Science Scholarship after original winner declines.Sail to England to begin research at Cambridge University
1898	Appointed to a professorship Physics at McGill University Montreal at age 27. Research started at McGill to explain radioactivity and the disintegration of atoms. Through to 1907
1900	Returns to New Zealand to marry Mary Newton
1901	Daughter Eileen Born
1907	Ernest became Head of Physics at University of Manchester, England until 1919
1908	Awarded Nobel Prize in Chemistry at age 37 for his work on explaining radioactivity.
1911	Develops nuclear model of the atom
1914	Knighted and visits Australia and New Zealand. Also did government research until 1917 during WW1
1919	Splits the atom by bombarding nitrogen with alpha particles. Heads Cavendish Laboratory at Cambridge University until 1937
1926	President of the Royal Society until 1930.
1930	Death of Eileen Rutherford, his daughter.
1931	Made Lord Rutherford of Nelson.
1932	Scientists working under Rutherford at Cavendish discover the neutron
1935	Dies suddenly at age of 66. Buried at Westminister Abbey, London. Lady Rutherford dies in 1954 in Christchurch.

Radioactive Decay

Rutherford worked with Frederick Soddy to work out that radioactive substances gave off a substance. When this touched another substance, the level of radioactivity dropped over time. This was how half-life of radioactive substances was discovered. Thorium atoms were breaking down and emanating radon.

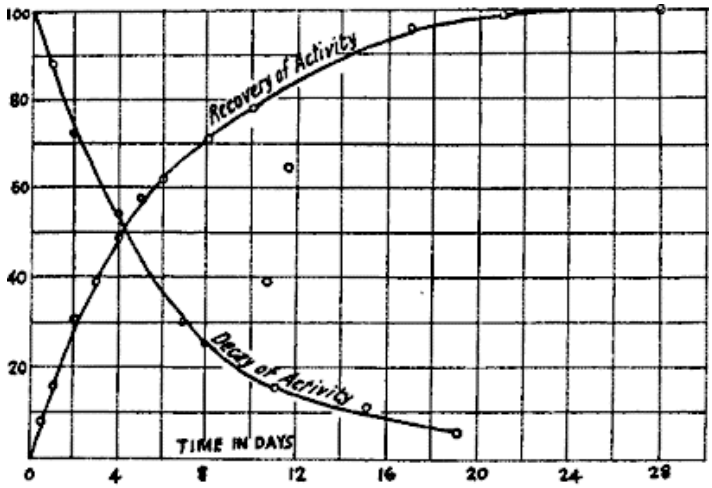


Fig. 3

After 18 months of working together, Rutherford and Soddy had:

- Discovered radioactivity is naturally emitted by all of the largest atoms in the Periodic Table
- Identified separate steps in each of the decay chains of thorium and radium
- Discovered that the rate of decay was always the same for a given element
- Established the concept of half-life (the time it takes for half the atoms of a radioactive substance to decay)
- Estimated the 'life' of radium to be only a few thousand years
- Developed an electrical method for detecting very small numbers of disintegrating atoms
- Begun to realise the huge energy stored inside the atom

A Modern Use – Smoke Alarms:

A small alpha emitter is used in modern smoke alarms.

The alpha particles ionise the air particles causing a small electric current to flow

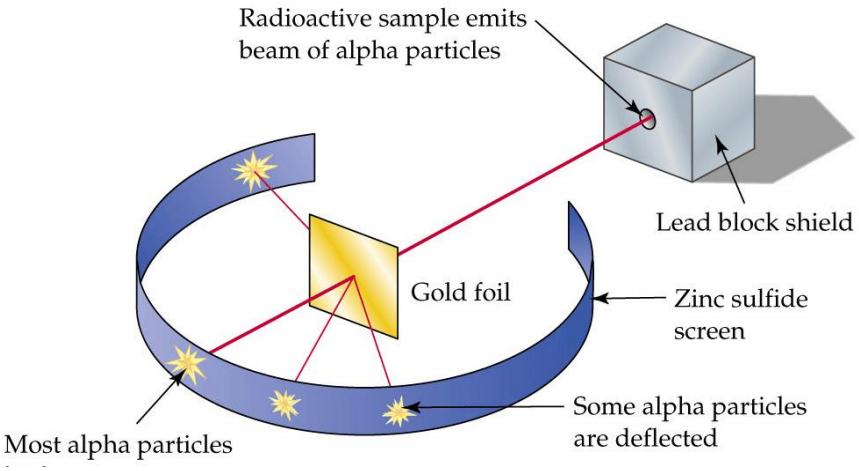
When smoke enters, the alpha particles hit the smoke particles instead of the air. The electric current drops

The drop in current is detected and the alarm will sound

Atomic Structure

Rutherford noticed that a beam of alpha particles was narrower in a vacuum than in air. This indicated that the air particles may be scattering the alpha particles.

He began to study this with Hans Geiger and Ernest Marsden by firing alpha particles at very thin foil pieces. He wanted to know whether any alpha particles were reflected back.



J. J. Thomson's Plum Pudding structure of the atom was widely accepted at the time Rutherford started his investigations.

He found that:

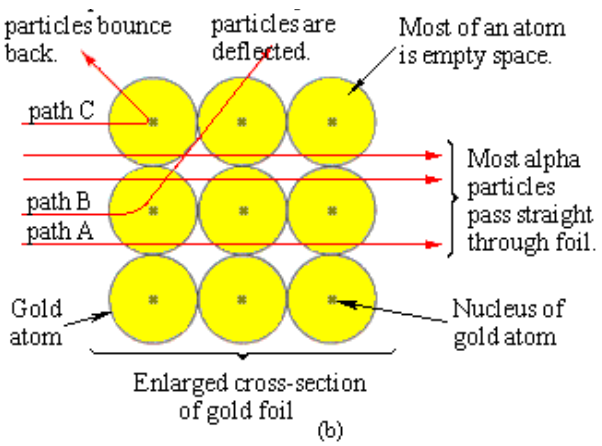
-Most alpha particles travelled straight through

- Some alpha particles were deflected at strong angles

- Few (1/8000) were deflected back to the source

This lead to a new structure where there was a small dense positively charged nucleus. Rutherford worked out that the nucleus was 10,000 times smaller than the atom overall – the atom was mainly empty space

He described his discovery '…as incredible as if you had fired a fifteen-inch shell at a piece of tissue-paper and it came back and hit you'



Ernest Rutherford

A E Z I R P L E B O N H Y I G
E R P U T C N H O A K R R A F
I C S C I S Y H P T B A T Z B
W X C E Y H K P D O R D S H T
R L E R K X E E C M I I I R I
A V D U E U G R F S G O M U L
N Q T T R R D S G M H A E T P
P J D C N C I E J A T C H H S
I F K U E I R V M C W T C E F
R I I R S X B E D G A I V R Q
D T J T T E M R Z I T V P F F
G R N S O E A A W L E I K O A
V A O H W W C N O L R T G R S
M V K L K P V C X L W Y Q D W
R L O U Q I X E G N W M S G O

RADIOACTIVITY
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ERNEST
NOBELPRIZE
PHYSICS
CHEMISTRY
PERSEVERANCE
BRIGHTWATER
MACGILL
CAMBRIDGE
SPLIT
STRUCTURE
LORD
RUTHERFORD

Ernest Rutherford

A E Z I R P L E B O N H Y I G
E R P U T C N H O A K R R A F
I C S C I S Y H P T B A T Z B
W X C E Y H K P D O R D S H T
R L E R K X E E C M I I I R I
A V D U E U G R F S G O M U L
N Q T T R R D S G M H A E T P
P J D C N C I E J A T C H H S
I F K U E I R V M C W T C E F
R I I R S X B E D G A I V R Q
D T J T T E M R Z I T V P F F
G R N S O E A A W L E I K O A
V A O H W W C N O L R T G R S
M V K L K P V C X L W Y Q D W
R L O U Q I X E G N W M S G O

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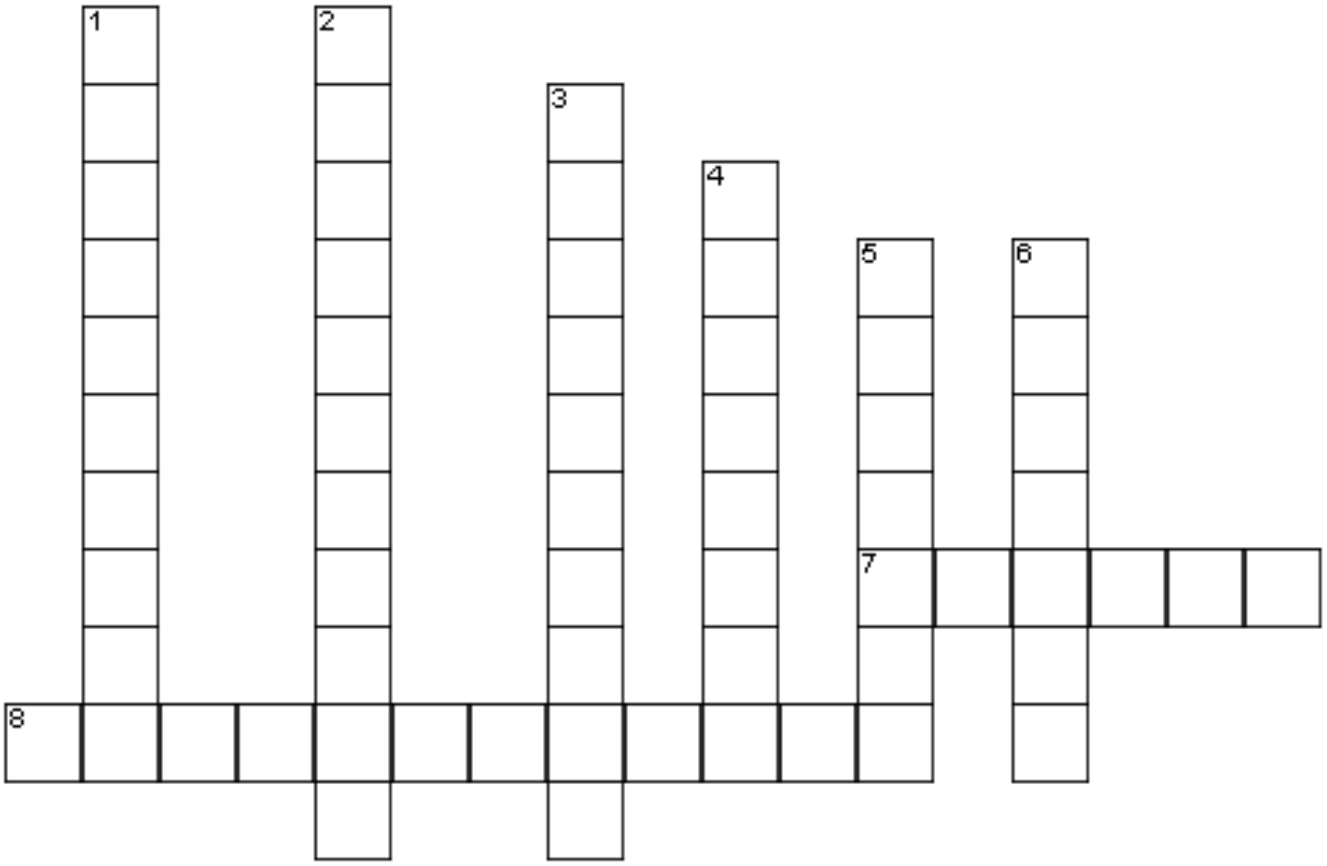
Ernest Rutherford's Life



ACROSS
7 The number of brothers and sisters Ernest had
8 A character trait of Rutherford

DOWN
1 The name of the prize Ernest won in 1908
2 Where Ernest Rutherford was born
3 The first word of the University Ernest went to in New Zealand
4 What orbits the centre of an atom
5 The second word of the University Ernest went to in New Zealand
6 The centre of an atom