

24" X 36" "BAKING A BATTERY"

A novel educational resource to explain battery manufacturing



Sophia Constantinou^{1,2}, Elizabeth Driscoll³, Emma Kendrick⁴ and Peter Slater³

¹ School of Chemistry, The University of Edinburgh, EH9 3FJ

² The Faraday Institution, OX11 0RA

³ School of Chemistry, The University of Birmingham, B15 2TT

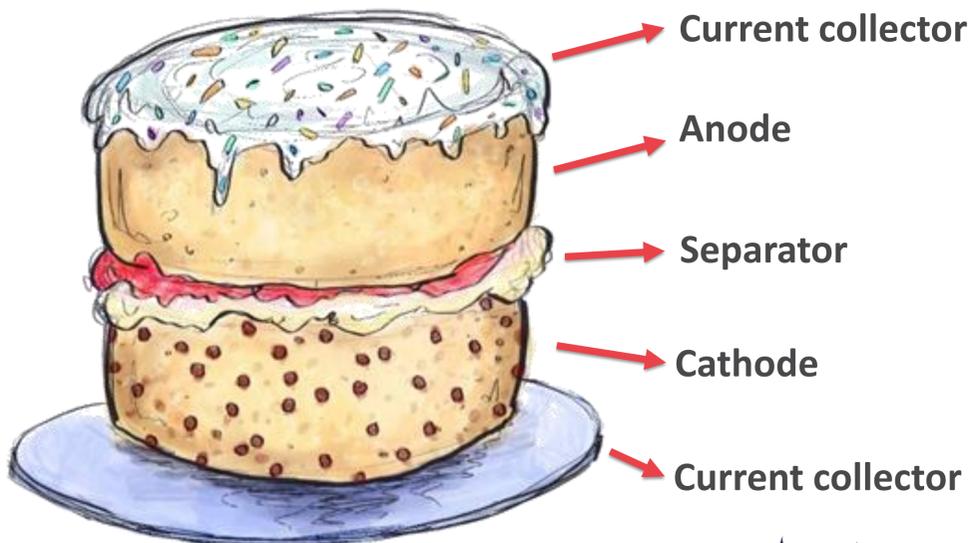
⁴ School of Metallurgy and Materials, The University of Birmingham B15 2TT

ABSTRACT

The aims for this project were to inspire the next generation of battery scientists and make the science of battery manufacturing more accessible to science students and non-scientific audiences. Two educational resources were produced:

- A series of infographics, using the analogy of a cake to represent a battery. Ten were produced in total and feedback was collected in the form of a survey for two of them. These were aimed at GCSE, A-level, and undergraduate students with some scientific knowledge.
- A podcast, consisting of four episodes, to bring the battery manufacturing content of the infographics into a wider context. This was aimed at non-scientific audiences interested in electrification, as well as science students.

Novak's theory of education, known as Human Constructivism, states that "meaningful learning underlies the constructive integration of thinking, feeling, and acting, leading to human empowerment for commitment and responsibility." ¹ The educational resources were designed to fit in with these principles: bringing battery science into the context of our everyday lives and using an analogy to relate an unfamiliar concept to a familiar one.



Chocolate chips are used to represent the lithium ions. In a charged state, these would be in the anode. A syrup soaking into the cake is used as an analogy for the electrolyte.



PODCAST

A podcast was created to go alongside the infographics, with the aim of this resource to be accessible to people of a non-scientific background.

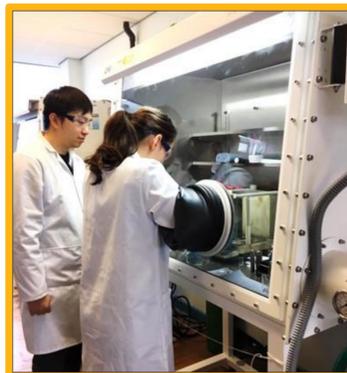
Each episode relates battery manufacturing to a different field: science education, outreach, ethics, and patent law.

[Click to access the podcast](#)



MOTIVATION

- Creating resources to build upon the game created by E. H. Driscoll et al. to explain how a battery works. ²
- Educational literature details the importance of meaningful, rather than rote learning.



Some of the images used in the series of infographics



RESULTS AND CONCLUSIONS

A survey was used to determine the usefulness of two infographics designed as an introduction to lithium ion batteries, their components and their manufacturing process. There were 20 responses to the survey.

Five-point Likert scales were used to determine how visually appealing the infographics were and the usefulness of the infographics.

100 % found the infographics to be either visually appealing or extremely visual appealing.

90 % thought the 'Baking a Battery infographic' to be a useful or a extremely useful prop in explaining the components of a battery.

75 % thought the 'Lithium ion batteries : Why they're important' infographic to be a useful or extremely useful prop in explaining the importance of lithium ion batteries.

Of the Secondary school teachers, 100 % put that the Baking a Battery was either useful or extremely useful, indicating that the cake analogy could be useful as a resource for secondary school students.

When asked what could be improved in both infographics, several respondents mentioned that some definitions needed to be explained. Thus, rather than putting more words into the infographics (detracting from the visual impact), a key terms infographic should be created. Other respondents commented that it would be useful to have the manufacturing processes covered in more depth. Both of these suggestions are covered in the rest of the infographics produced but were awaiting publication at the time of the survey.



The 'Lithium ion batteries : Why they're important' infographic. The 'Baking a Battery' infographic describes the components of a battery using the cake image.

IMPACT / NEXT STEPS

- Developing Primary School resources using the cake analogy.
- Developing additional resources with greater links to the GCSE and A-Level chemistry curriculum.
- Collecting survey responses to analyse the usefulness of the other infographics, and for the series of infographics as a whole
- Collecting feedback from the podcast.
- Creating more resources with a focus on the positive environmental impact of batteries, as the survey results indicated that this was an interesting topic that should be discussed in more depth.

REFERENCES

1 S. Lowery Bretz, *Novak's Theory of Education: Human Constructivism and Meaningful Learning*, 2001, vol. 78.

2 E. H. Driscoll, E. C. Hayward, R. Patchett, P. A. Anderson and P. R. Slater, *Journal of Chemical Education*, DOI:10.1021/acs.jchemed.0c00282.

ACKNOWLEDGEMENTS

Thank you for contributing to my podcast Emily Hanover, Elizabeth Driscoll, Ellie Bibby and Hannah Faulkner.

INTERN BIO

Sophia Constantinou is studying Chemistry at The University of Edinburgh. I aspire to have a career in science communication and education. As Undergraduate School of Chemistry Representative for my university, I am working to create educational resources to consolidate first year chemistry. I am also extremely passionate about art, having served as the President of my university Art Society and helped found the Animation Society.

