

# EXPERIMENTAL METALLURGY WITH DR ALEXANDER (SANDY) KNOWLES

## TALKING POINTS

### KNOWLEDGE:

1. What is the temperature of the Sun's core?
2. What is used to keep the plasma in place in a fusion reactor?
3. What causes damage to tungsten if it is used in a fusion reactor?

### COMPREHENSION:

4. How would you describe the difference between fusion and fission?
5. What two problems make nuclear fission less desirable than fusion as an energy source?
6. What does a transmission electron microscope enable researchers to do?

### APPLICATION:

7. Would steel be a good material to use in a nuclear reactor? Why/why not?

### ANALYSIS:

8. Thinking of the cake analogy, what is the benefit of mixing elements together into an alloy?
9. Why is cake not a superalloy? What differences are there?

### EVALUATION

10. To what extent do you think nuclear power is a better option than renewables?
11. Do you think we should spend more money on building fission power plants or developing fusion? Why?

## ACTIVITY

### PRICE COMPARE – IS NUCLEAR BETTER VALUE THAN RENEWABLES?

For this exercise, make a comparison between France and Germany – two European countries that both generate a lot of low-carbon electricity but have very different policies towards nuclear.

Use Our World in Data ([ourworldindata.org/grapher/electric-fossil-nuclear-renewables?country=~OWID\\_WRL](https://ourworldindata.org/grapher/electric-fossil-nuclear-renewables?country=~OWID_WRL)) to find out what percentage of each country's electricity comes from:

(a) fossil fuels (b) nuclear (c) renewables.

If you can, use a spreadsheet program like Excel to turn this information into a pie chart for each country. Then, look up what the cost of electricity is in France and Germany:

[ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity\\_price\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics)

How does the share of nuclear affect electricity cost?

What are the implications of this for the type of research being conducted by Sandy and his team?

As recommended by Sandy, read this article from MIT Energy Initiative to find out more about "The Future of Nuclear Energy in a Carbon-Constrained World":

[energy.mit.edu/research/future-nuclear-energy-carbon-constrained-world](https://energy.mit.edu/research/future-nuclear-energy-carbon-constrained-world)

## MORE RESOURCES

Watch this video of Sandy explaining his work in fusion energy:

[www.youtube.com/watch?v=Od0vPHbddBE](https://www.youtube.com/watch?v=Od0vPHbddBE)

Visit the Culham Centre for Fusion Energy website to find out about the latest developments in fusion energy: [www.ccf.ukaea.ac.uk](http://www.ccf.ukaea.ac.uk)

Sandy is looking at zirconium and tungsten and researching how to make alloys that could make these elements even more useful by increasing durability and resilience. Read this article that explores this very issue: [www.azom.com/news.aspx?newsID=57575](https://www.azom.com/news.aspx?newsID=57575)

Sandy suggests reading the book 'Stuff Matters: Exploring the Marvellous Materials that Shape our Man-Made World', by Professor Mark Miodownik, which offers a great introduction to metallurgy and materials. Professor Miodownik has produced numerous articles, videos and podcasts: [twitter.com/markmiodownik](https://twitter.com/markmiodownik)

Learn about the High Flux Accelerator-Driven Neutron Facility at the University of Birmingham that Sandy uses in his work: [www.nnuf.ac.uk/high-flux-accelerator-driven-neutron-facility](http://www.nnuf.ac.uk/high-flux-accelerator-driven-neutron-facility)

The School of Metallurgy and Materials at the University of Birmingham has regular open days showcasing their degree programmes in Materials, Aerospace and Nuclear Engineering: [www.birmingham.ac.uk/schools/metallurgy-materials/index.aspx](http://www.birmingham.ac.uk/schools/metallurgy-materials/index.aspx)

Birmingham also hosts The Big Bang Fair, celebrating STEM and opportunities for young people: [www.thebigbang.org.uk](http://www.thebigbang.org.uk)

The Institute of Materials, Minerals and Mining has range of school outreach resources: [www.iom3.org](http://www.iom3.org)