JONATHAN WOODWARD

GRADUATE SCHOOL OF ARTS AND SCIENCES

RESEARCH AT UTOKYO: LETTING THE WORLD KNOW

GOALS

1. MY EXPERIENCE OF PROMOTING MY WORK USING UTOKYORESEARCH

2. PAST OUTREACH EXPERIENCES FROM THE UK AND FUTURE POSSIBILITIES

BACKGROUND

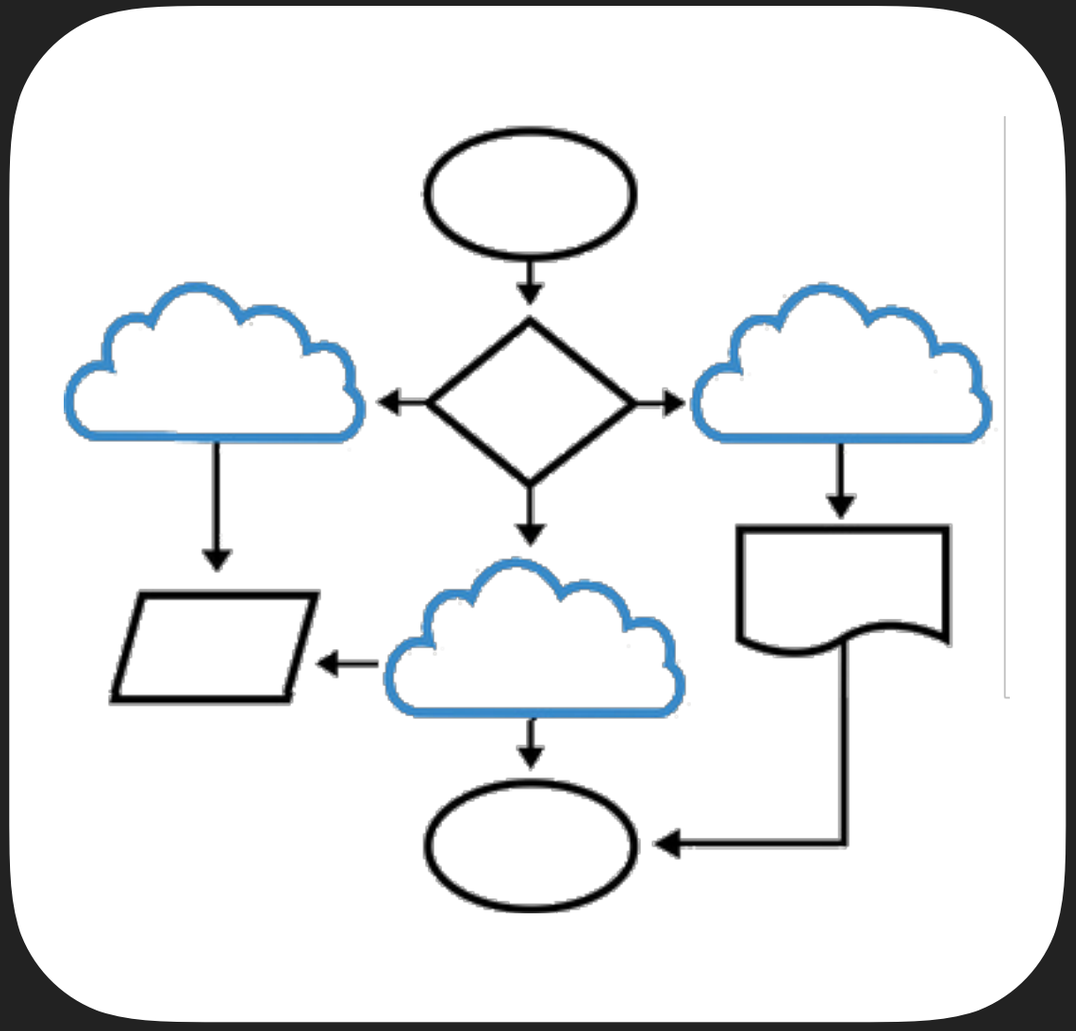
- From Rossendale in England (near Manchester)
- Studied for undergraduate and doctoral degrees at the University of Oxford
- 2 Years Postdoctoral Research at RIKEN (Wako)
- Independent research group at University of Leicester for >7 years
- Tokyo Institute of Technology for 3 years
- University of Tokyo since April 2011
  - PEAK, GPES
- Research
  - Spin- and Photo-chemistry
  - Instrument development and application

REASONS FOR PROMOTING MY RESEARCH

- Little previous promotion in UK
- Landscape has changed with social media and ubiquitous connectivity
- Long absence from my independent research field
  - Need to re-establish reputation
- Exciting new developments
  - Enthusiastic to share
- Reporting to Kakenhi

THE PROCESS

- Paper accepted by journal
- Sent e-mail to UTokyoResearch staff
- Need to complete form in both English and Japanese
- Asked my colleague to help with Japanese translation
- Four components
  - UTokyoResearch page
  - Japanese press release
  - International press release
  - UTokyo repository



HELPFUL, KNOWLEDGEABLE AND FRIENDLY STAFF

- The process was made straightforward thanks to the UTokyoResearch staff
  - Clear guidance throughout the process and rapid response to inquiries
- Communicated with others in Japanese
- Gave excellent advice / editing on the article in both Japanese and English
- Genuine expertise in producing content suitable for the public

UTOKYORESEARCH CONTENT

- Nice, clean design
- Convenient links in Japanese and English (equivalent pages)
- Continuous access (persistent links)
- Facebook posts
- E-mail distribution
- Links on front of UTokyo website

A microscopic approach to the magnetic sensitivity of animals

Research News

Watching photochemical reactions respond to magnetic fields in tiny spaces

TAG animal navigation biological magnetoreception cryptochrome TOAD microscopy MIM microscopy

Graduate School of Arts and Sciences / College of Arts and Sciences
2015/06/05

Researchers at the University of Tokyo have succeeded in developing a new microscope capable of observing the magnetic sensitivity of photochemical reactions believed to be responsible for the ability of some animals to navigate in the Earth's magnetic field, on a scale small enough to follow these reactions taking place inside sub-cellular structures.

Several species of insects, fish, birds and mammals are believed to be able to detect magnetic fields – an ability known as magnetoreception. For example, birds are able to sense the Earth's magnetic field and use it to help navigate when migrating. Recent research suggests that a group of proteins called cryptochromes and particularly the molecule flavin adenine dinucleotide (FAD) that forms part of the cryptochrome, are implicated in magnetoreception. When cryptochromes absorb blue light, they can form what are known as radical pairs. The magnetic field around the cryptochromes determines the spins of these radical pairs, altering their reactivity. However, to date there has been no way to measure the effect of magnetic fields on radical pairs in living cells.

A cartoon representing the two new microscopy techniques have been developed in this work
TOAD (transient optical absorption detection) imaging and MIM (magnetic intensity modulation) imaging.
© 2015 Jonathan R. Woodward.

The research group of Associate Professor Jonathan Woodward at the Graduate School of Arts and Sciences are specialists in radical pair chemistry and investigating the magnetic sensitivity of biological systems. In this latest research, PhD student Lewis Antill made measurements using a special microscope to detect radical pairs formed from FAD, and the influence of very weak magnetic fields on their reactivity, in volumes less than 4 millionths of a billionth of a liter (4 femtoliters). This was possible using a technique the group developed called TOAD (transient optical absorption detection) imaging, employing a microscope built by postdoctoral research associate Dr. Joshua Beardmore based on a design by Beardmore and Woodward.

"In the future, using another mode of the new microscope called MIM (magnetic intensity modulation), also introduced in this work, it may be possible to directly image only the magnetically sensitive regions of living cells," says Woodward. "The new imaging microscope developed in this research will enable the study of the magnetic sensitivity of photochemical reactions in a variety of important biological and other contexts, and hopefully help to unlock the secrets of animals' miraculous magnetic sense."

Lewis Antill is a student on the new GPES (Graduate Program on Environmental Sciences) program, supported by a GPES specific MEXT scholarship. The research was supported by JSPS KAKENHI Grant Number 24350002.

Paper

Joshua P. Beardmore, Lewis M. Antill, and Jonathan R. Woodward, "Optical Absorption and Magnetic Field Effect Based Imaging of Transient Radicals", *Angewandte Chemie International Edition*: 2015/6/3 (Japan time), doi: 10.1002/anie.201502591.
Article link (Publication, UTokyo Repository)

Links

Graduate School of Arts and Sciences

Organization for Programs on Environmental Sciences (OPES), Graduate School of Arts and Sciences

Woodward Laboratory, Organization for Programs on Environmental Sciences (OPES), Graduate School of Arts and Sciences

EurekAlert! The Global Source for Science News | AAAS

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PUBLIC RELEASE: 4-JUN-2015

A microscopic approach to the magnetic sensitivity of animals

Watching photochemical reactions respond to magnetic fields in tiny spaces

UNIVERSITY OF TOKYO

SHARE PRINT E-MAIL

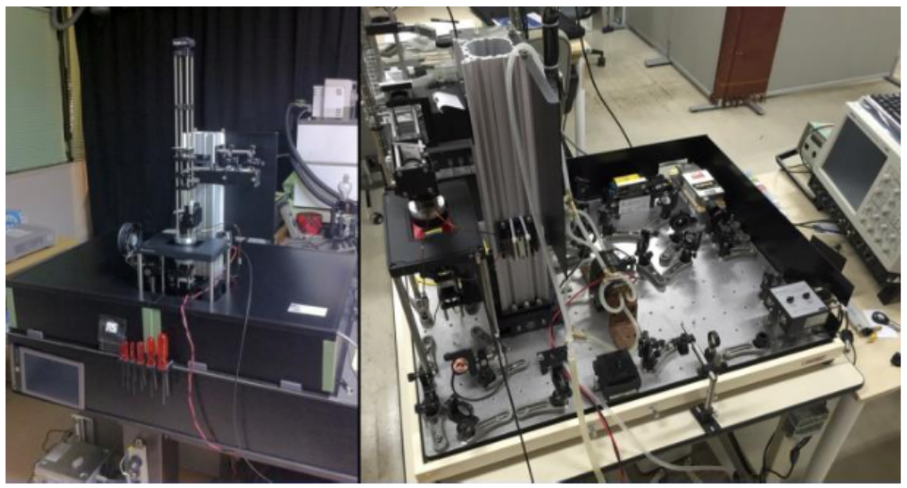

IMAGE: THESE ARE PICTURES OF THE NEW MICROSCOPE DESIGNED AND BUILT IN THE WOODWARD LABORATORY AS PART OF THIS RESEARCH. view more ›

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This news release is available in Japanese.

Researchers at the University of Tokyo have succeeded in developing a new microscope capable of observing the magnetic sensitivity of photochemical reactions believed to be responsible for the ability of some animals to navigate in the Earth's magnetic field, on a scale small enough to follow these reactions taking place inside sub-cellular structures.

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More on this News Release

A microscopic approach to the magnetic sensitivity of animals
UNIVERSITY OF TOKYO

JOURNAL
Angewandte Chemie International Edition

FUNDER
Japan Society for the Promotion of Science

KEYWORDS

BIOCHEMISTRY BIOLOGY BIOMEDICAL/ENVIRONMENTAL/CHEMICAL ENGINEERING BIOTECHNOLOGY

TRANSLATIONS

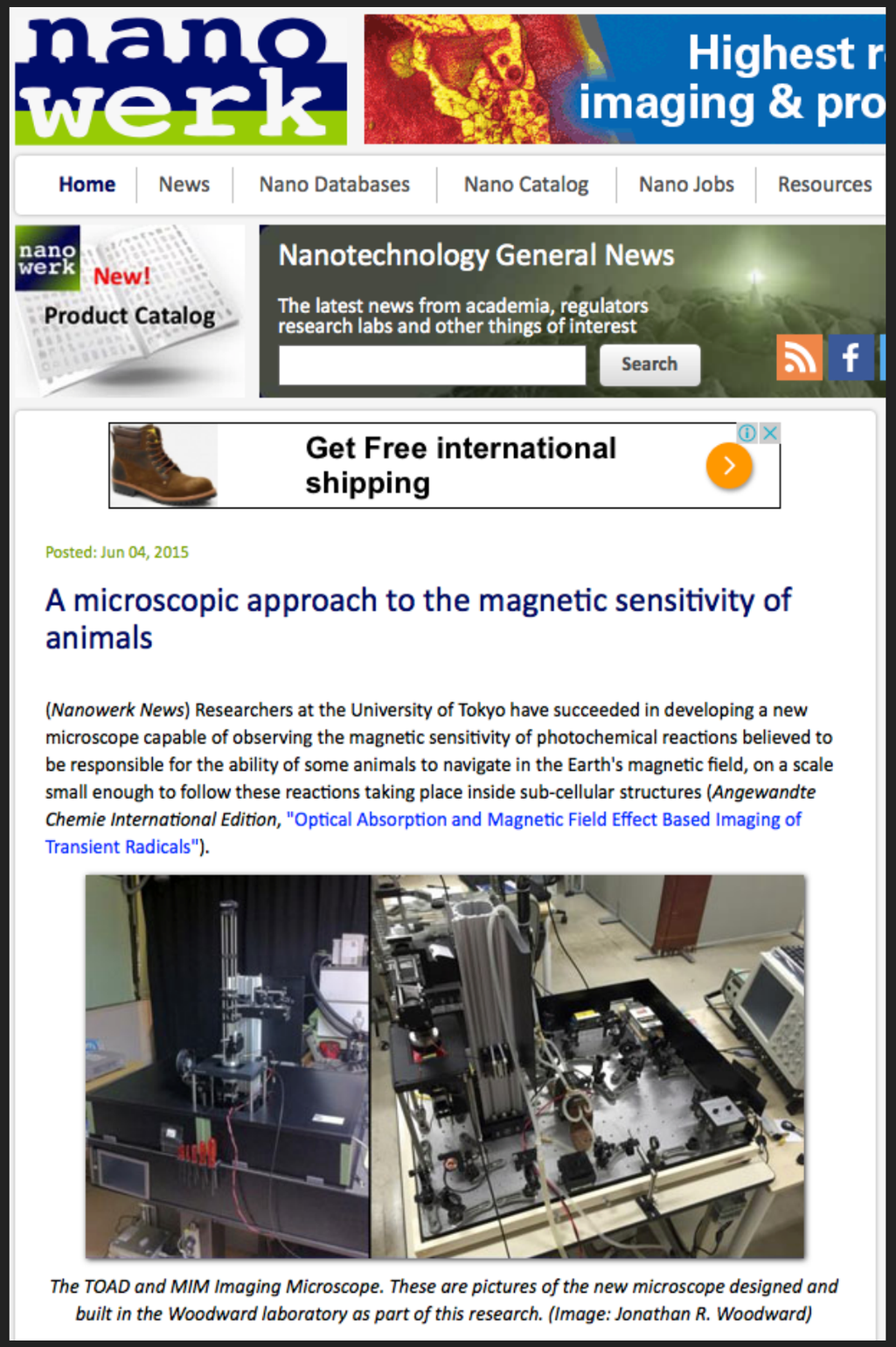
日本のニュース ›

PRESS RELEASES

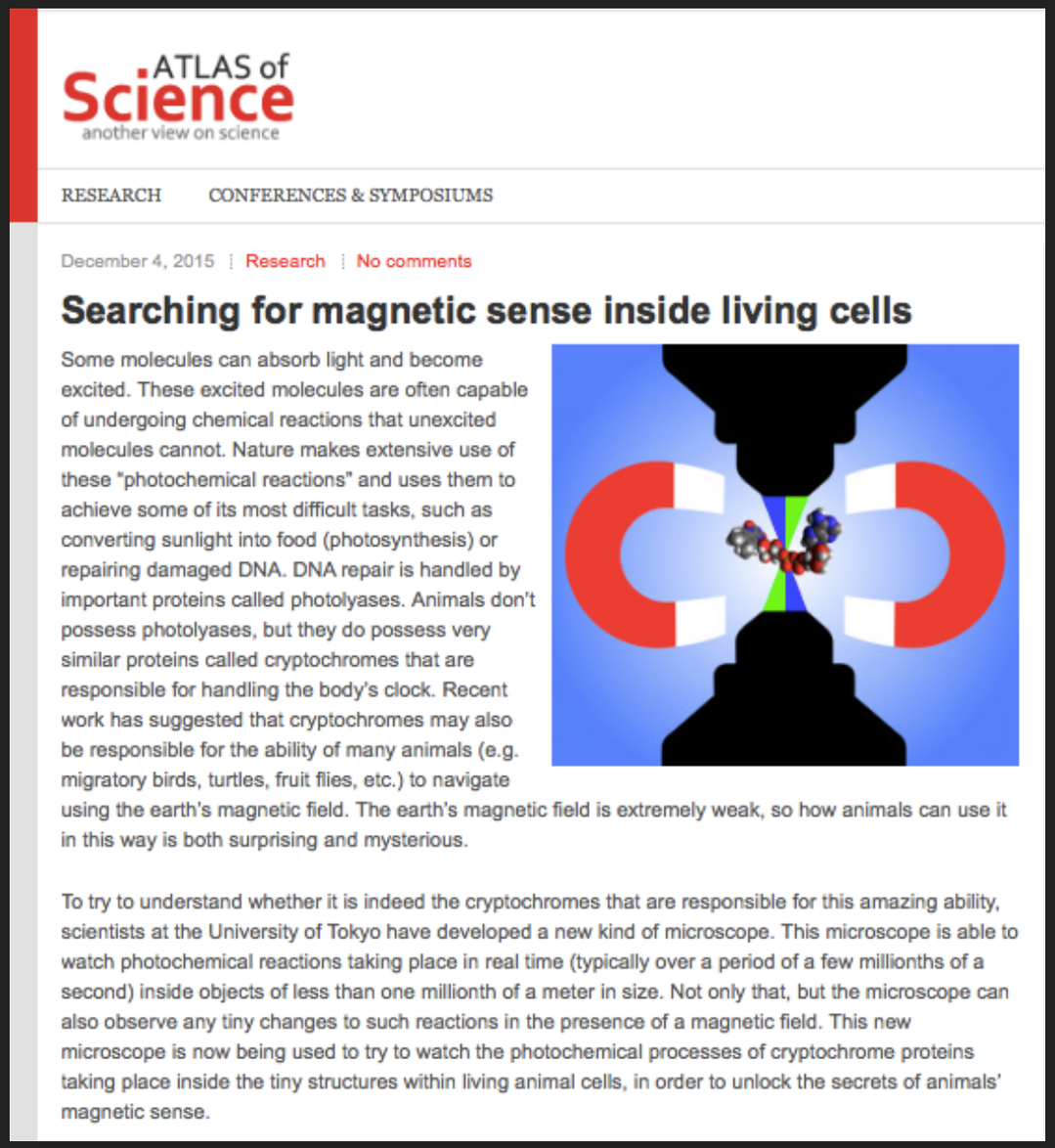
- No Japanese press release
  - Questions from Japanese journalists
  - Main target was international researchers / news outlets
- International press release was with EurekAlert

THE IMMEDIATE CONSEQUENCES

- Easy to share my research through my own social networks
- Article rapidly picked up by many science news sites and blogs.
  - e.g. phys.org, nanowerk, sciencenewsline, healthmedicinet.com, 15 minute news…
- Statistics on *Angewandte Chemie* site using Altmetric
  - Top 1.6% of outputs from AC
  - Top 5% of all outputs tracked by Altimetric
- Paper requests (direct and on researchgate highest experienced)



THE LONGER TERM CONSEQUENCES



ATLAS of Science
another view on science

RESEARCH CONFERENCES & SYMPOSIUMS

December 4, 2015 | Research | No comments

Searching for magnetic sense inside living cells

Some molecules can absorb light and become excited. These excited molecules are often capable of undergoing chemical reactions that unexcited molecules cannot. Nature makes extensive use of these "photochemical reactions" and uses them to achieve some of its most difficult tasks, such as converting sunlight into food (photosynthesis) or repairing damaged DNA. DNA repair is handled by important proteins called photolyases. Animals don't possess photolyases, but they do possess very similar proteins called cryptochromes that are responsible for handling the body's clock. Recent work has suggested that cryptochromes may also be responsible for the ability of many animals (e.g. migratory birds, turtles, fruit flies, etc.) to navigate using the earth's magnetic field. The earth's magnetic field is extremely weak, so how animals can use it in this way is both surprising and mysterious.

To try to understand whether it is indeed the cryptochromes that are responsible for this amazing ability, scientists at the University of Tokyo have developed a new kind of microscope. This microscope is able to watch photochemical reactions taking place in real time (typically over a period of a few millionths of a second) inside objects of less than one millionth of a meter in size. Not only that, but the microscope can also observe any tiny changes to such reactions in the presence of a magnetic field. This new microscope is now being used to try to watch the photochemical processes of cryptochrome proteins taking place inside the tiny structures within living animal cells, in order to unlock the secrets of animals' magnetic sense.

- Invited to submit to a video journal based on our article (JOVE - journal of visualised experiments)
- Invited to submit an entry to Atlas of Science (accepted)
- Invited lecture arranged by a physics professor at Hongo - joined a collaborative research program
- Invited to write an article for the magazine of the Japan Society of Applied Physics (Oyo Buturi) (accepted)
- To be featured as a “Key Scientific Article” in “Advances in Engineering”

UTOKYO REPOSITORY

- At the time of preparing the UTokyoResearch article and press release, all repository arrangements completed.
- 6 months later, article appeared in the repository and I was informed by e-mail
- UTokyoResearch pages updated
- Convenient download link to use on own website / Researchgate / social media etc

ARTICLE IS NOW OPENLY ACCESSIBLE!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著者: Beardmore, Joshua P.
Antill, Lewis M.
Woodward, Jonathan R.

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photochemistry
radicals
reactive intermediates

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Relation URI: http://www.u-tokyo.ac.jp/ja/utokyo-research/research-news/a-microscopic-approach-to-the-magnetic-sensitivity-of-animals.html
http://www.u-tokyo.ac.jp/en/utokyo-research/research-news/a-microscopic-approach-to-the-magnetic-sensitivity-of-animals.html
http://onlinelibrary.wiley.com/doi/10.1002/anie.201502591/abstract

SUMMARY

- Smooth and very useful process
- Very convenient resource for sharing in a variety of contexts
- Large increase in exposure and readership
- Follow on opportunities for further exposure
- Non-paywall link to original article from repository

MY OUTREACH EXPERIENCES

- Worked extensively in public outreach of science in the UK
- Typically ran 20-30 events per year
- Worked with the general public, schoolteachers and children aged 10 - 18
- Developed a Nationwide programme called “Chemistry : The Next Generation”
  - Interactive activities across the UK

Education for all

Bringing science to the whole of society

Chemistry the next generation
part of Chemistry for our future

Primary school (4–10)

Magical chemical energy
The science of ice cream

Secondary school (11–16)

Salters' Festival
kNOw Chemistry
Spring School
Summer School
What do chemists do?
A day in the life of a chemistry student

Sixth form (17–18)

Activities day
Chemistry Masterclass
Hands free & Hands on Chemistry Careers
Spectroscopy afternoons
Revision conference
Visual revision
Amazing chemical technology

Science
LEARNING CENTRES

Schoolteachers

Teachers' Spectroscopy Workshop
Practical and Creative Chemistry
Inspiring with IT

The Public

Pylons : Friend or Foe?
Chemistry of the mobile phone

Chemistry : Hands free & Hands on

University of Leicester

Display technology

Make your own electrochromic polymer

The University of Nottingham

Circuit nanotechnology

Photolithography - Make your own circuit board

Loughborough University

Energy technology

Dye-sensitized Solar Cells

AstraZeneca

Green technology

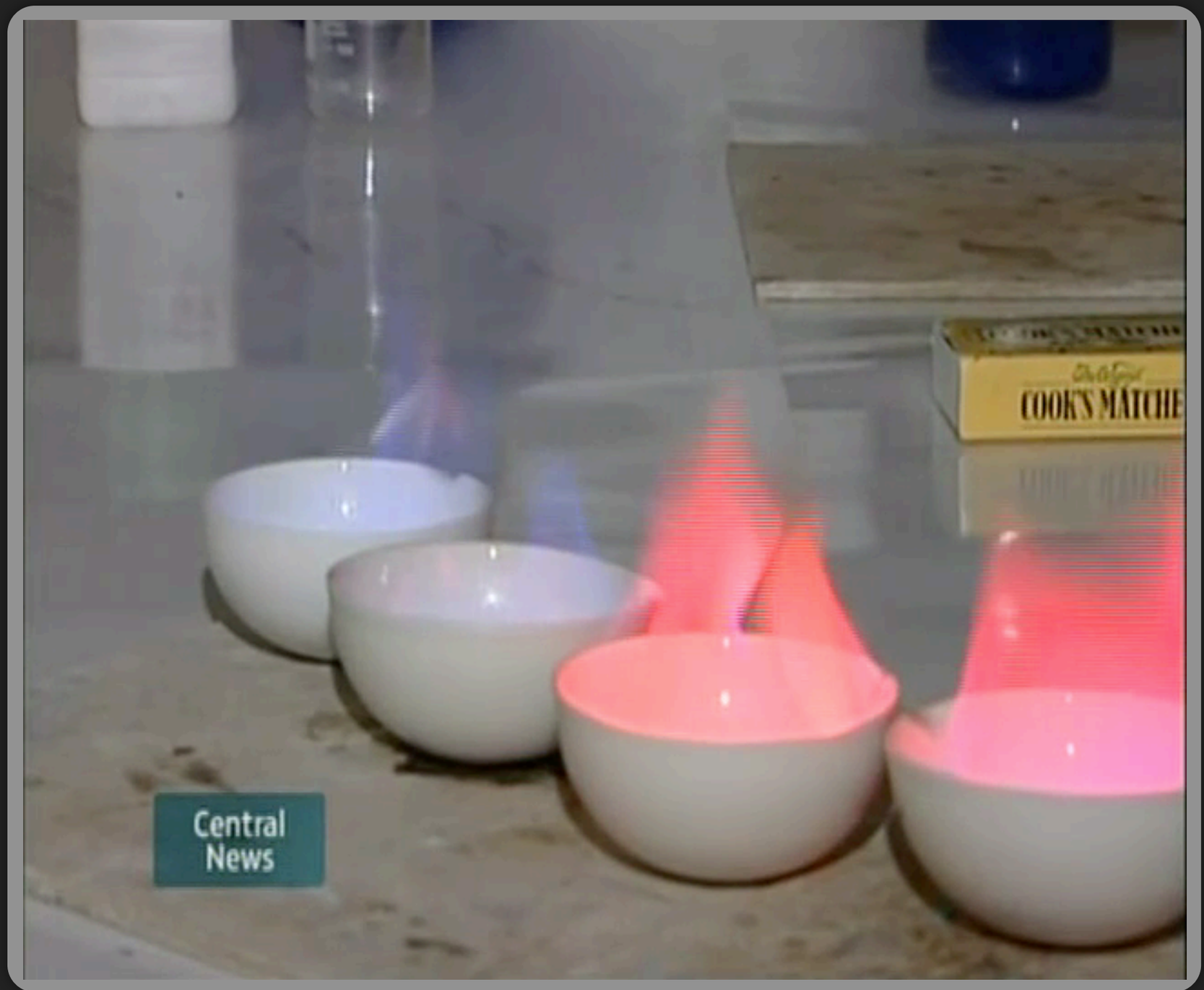
Biodegradeable Polymers

NOTTINGHAM TRENT UNIVERSITY

Display technology

Light emitting chemicals - chemiluminescence

Magical Chemical Energy



PICTURE: MAX EWEN/ 152245-00

MAGICAL: Dr Jonny Woodward as Harry Potter, and pupils Amber Robinson, nine, and David Millar, 10

Even us muggles can understand!

Leicester University has been transformed into Hogwarts to help put a bit of magic back into science.

BY LYNDSAY EMMETT
EDUCATION CORRESPONDENT

About 1,200 youngsters from primary schools around the city will be learning about the secrets of chemistry from Harry Potter and Dumbledore this week.

The pair are making it so much fun that even ordinary muggles can understand what is going on.

Prof Paul Jenkins donned a grey wig and long beard to play the head of the magical school, while Dr Jonny Woodward put on glasses to perform the part of everyone's favourite boy wizard.

Aided by an assistant dressed as Professor McGonagal, they are wowing classes of 10 and 11-year-olds by creating different coloured flames, making crystals and turning solids into liquid and then into ice.

Volunteers from the audience get to play the parts of Harry's best friends, Ron and Hermione.

Dr Woodward said: "The children don't know we're dressed as Harry and Dumbledore until they get here so it is a nice surprise, but there is also a serious message.

"They love magic and what we are trying to say to them is that they can do things that are just as magical using science."

Prof Jenkins said: "Children at this age are fascinated by science and what we are trying to do is to show them how much fun it can be."

Dr Woodward said: "Often when children are 10 and 11, they often say science is their favourite subject. But, when they get to 14, 15 or 16, something happens and they lose interest. What we are trying to do is to keep that spark of interest going before they get to secondary school."

"What we are trying to say to them is that they can do things that are just as magical using science."
Dr Jonny Woodward

The youngsters have responded well to the experiments.

"We did one using different salts and that produces different coloured flames. We got a very good reception from the children for that," said Prof Jenkins.

Pupils from Dovelands Primary School were impressed. Harriet Lee, 10, said: "My favourite experiment was when they froze a beaker to a piece of wood."

Charlotte Sanderford, 10, said: "It was excellent and because it is science it will be good for us at school."

Dylan Ifield, 11, said: "I liked the experiment when they made the flames change colour."

SOME IDEAS

- What aspects of your studies / research fascinate you most?
  - Could you excite others with these things?
  - Don’t wait for someone to ask you - just do it!
- Running science outreach events with the public / schoolchildren in both English and Japanese
  - Combine the efforts of home and international students
  - Wide variety of subjects / disciplines
  - Hands on and interactive is best if possible
- I can provide suggestions, advice and support
  - Contact with PEAK and GPES students

IF YOU WANT TO GET IN TOUCH

WOODWARD@GLOBAL.C.U-TOKYO.AC.JP

THANK YOU FOR YOUR ATTENTION!