Science Capital: Promoting social justice and engaging students with science

Dr Spela Godec

UCL Institute of Education

London, UK

@_sciencecapital #sciencecapital #SCteach

In this talk

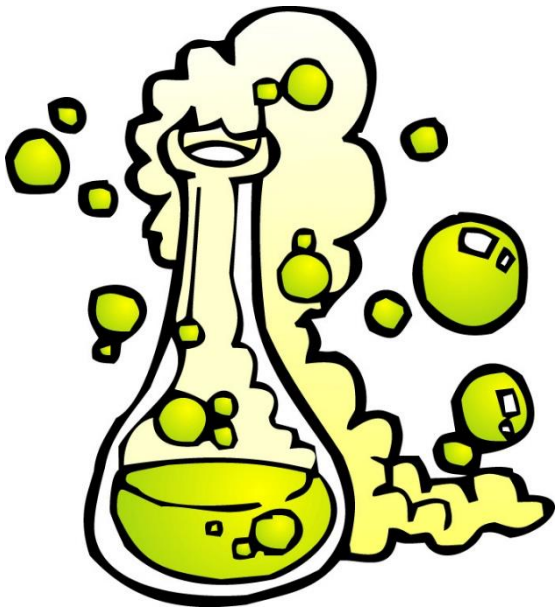
- Background – inequalities in science participation
- Science capital – what it is and why it matters
- The science capital teaching approach – engaging diverse students with science

In this talk

- **Background – inequalities in science participation**
- Science capital – what it is and why it matters
- The science capital teaching approach – engaging diverse students with science

Context (in the UK & internationally)

- Persistent inequalities in science participation
- Lots of time and money invested to broaden participation, but little change in participation rates and profile
- Efforts seek to make science more ‘fun’ and ‘interesting’

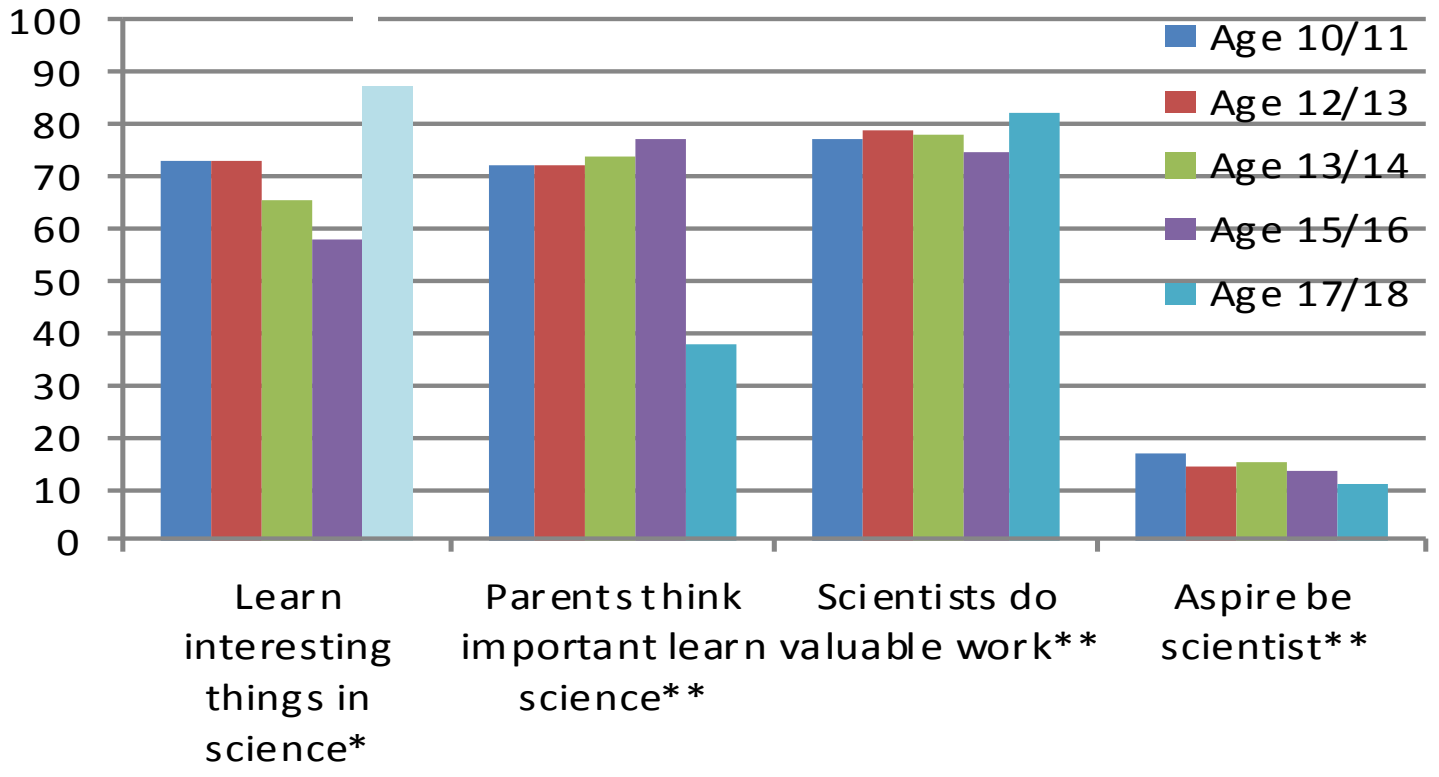


Aspires/Aspires2 research: 10-year study of young people's aspirations

- Large-scale surveys (40,000+ students) and in-depth tracking of students and their parents (age 10-18)
- Key findings:
  - Lack of interest is not the main issue
  - Aspirations are socially patterned
  - Trends are evident from primary (10/11 years old)

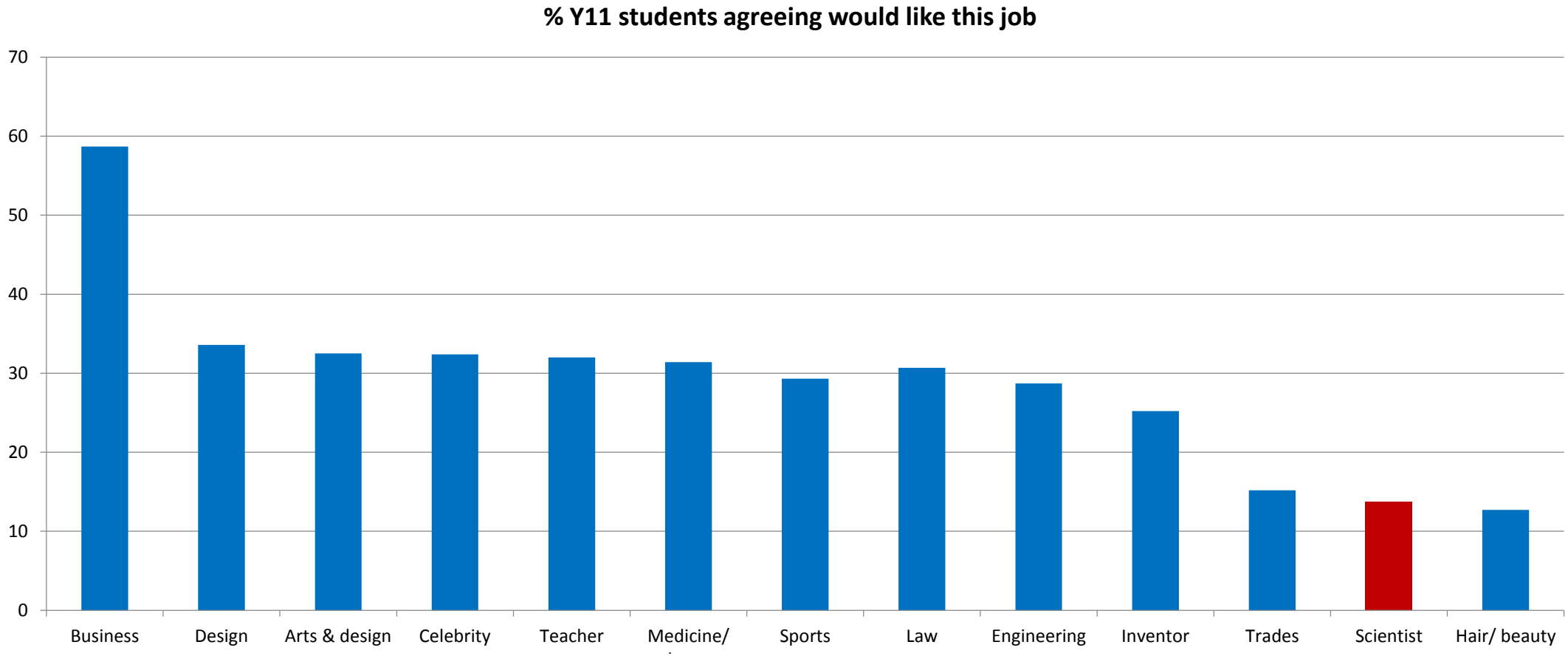
Young people like science – but few aspire to be scientists

Comparison of survey responses from Y6, Y8, Y9, Y11, Y13 students
(% strongly/ agreeing)



* Only asked of Y13 students studying at least one science A level
** Y13 data is weighted to national A level science entries

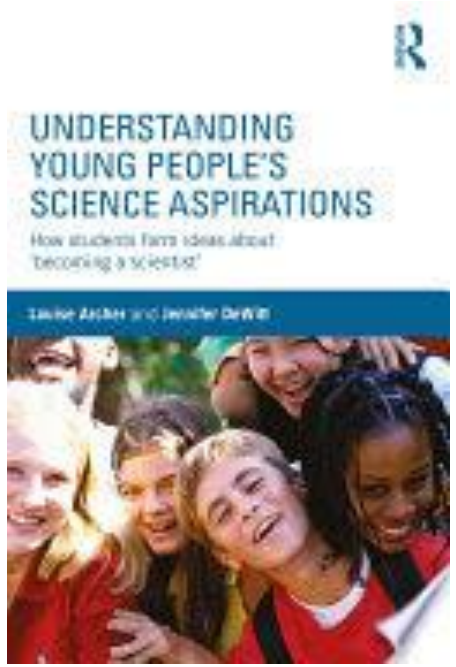
What careers do students aspire to?

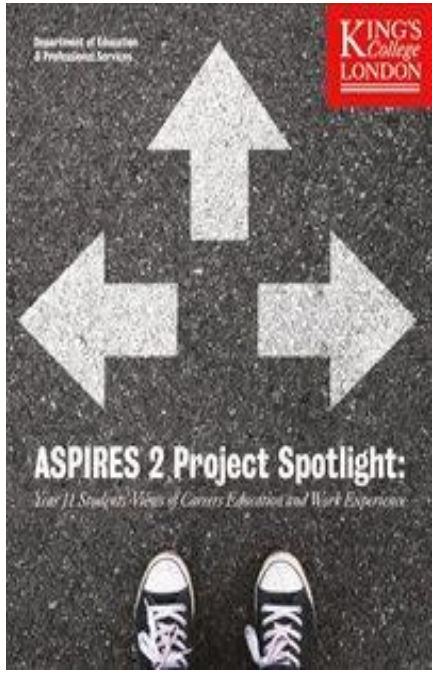


@_sciencecapital #sciencecapital #SCteach

What shapes the patterns in science aspirations and participation?

- Gender, ethnicity, social class, geographic location
- Careers education
- Education system
- ‘Science capital’

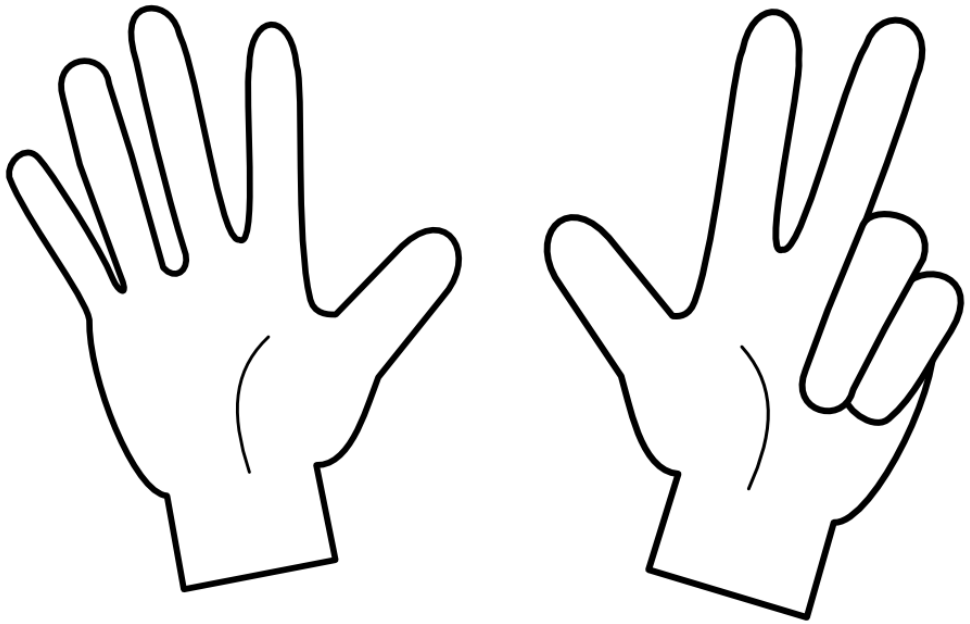




In this talk

- Background – inequalities in science participation
- **Science capital – what it is and why it matters**
- The science capital teaching approach – engaging diverse students with science

How much science capital do you have?



@_sciencecapital #sciencecapital #SCteach

Do you have a Science or Maths post-compulsory qualification?

(1 point per qualification)

Does your partner have a Science or Maths post-compulsory qualification?

(1 point per qualification)

Do your parents have a Science or Maths post-compulsory qualification?

(1 point per person per qualification)

Is anyone in your close family studying for a STEM (science, technology, engineering and mathematics) degree?

(1 point per person)

Do any of your close family or friends work in a science/STEM job?

(1 point per person)

Do you often talk to close family or friends about science/science-related issues?

(yes = 1 point)

When you were growing up, did anyone specifically encourage you over time to continue with science?

(1 point per person)

When you were growing up, did anyone specifically explain the value of science qualifications to you?

(1 point per person)

Are you up to date with recent major scientific developments?

(yes = 1 point)

Do you regularly read about science in magazines or newspapers?

(yes = 1 point)

Do you think science is boring?

(no = 1 point)

Do you have more than 100 books at home?

(yes = 1 point)

Do you often watch science programmes on TV?

(yes = 1 point)

Do you often visit science museums or science centres?

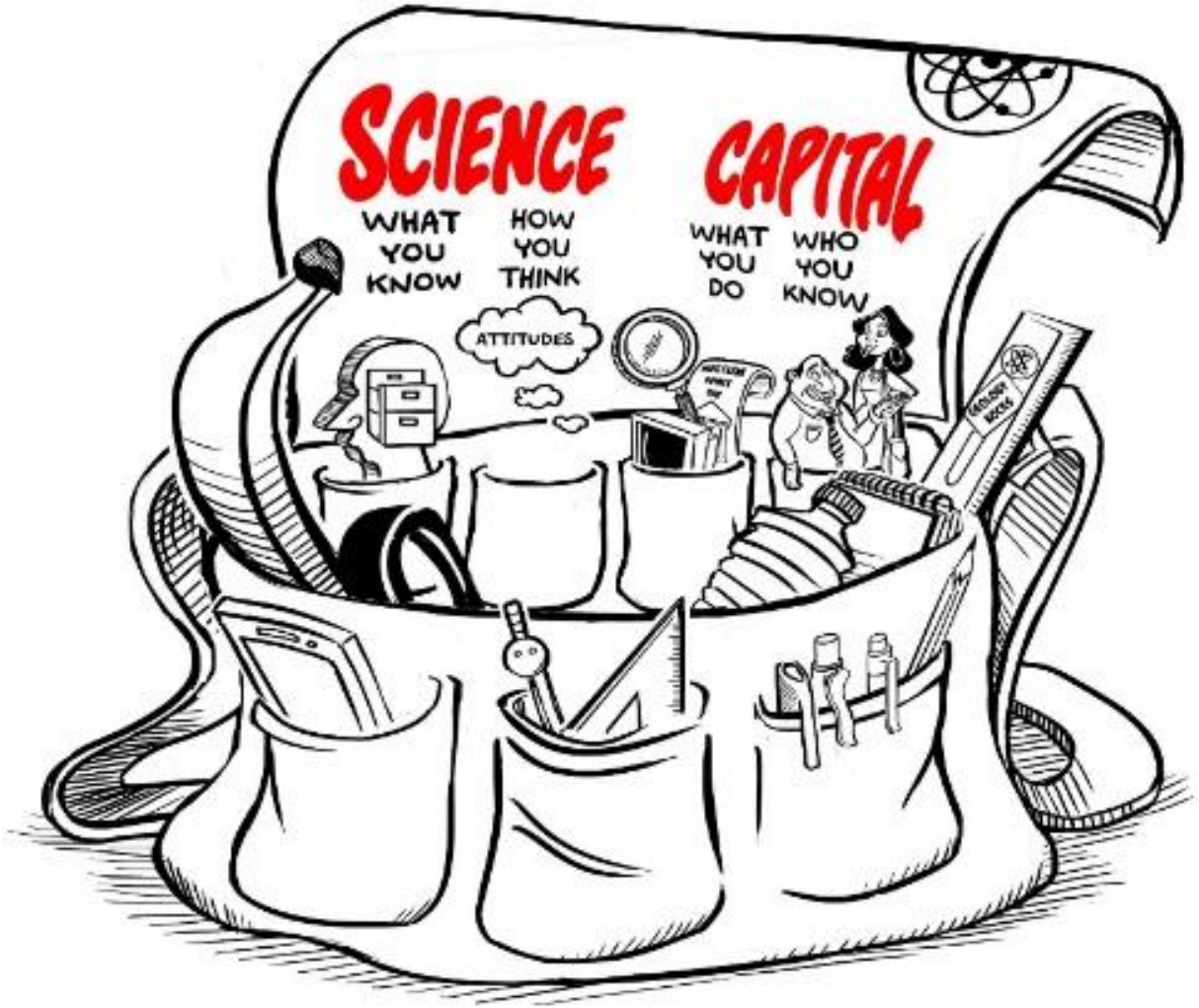
(yes = 1 point)

Do you know how to test a hypothesis?

(yes = 1 point)

Do science qualifications predominantly lead to jobs in science and medicine?

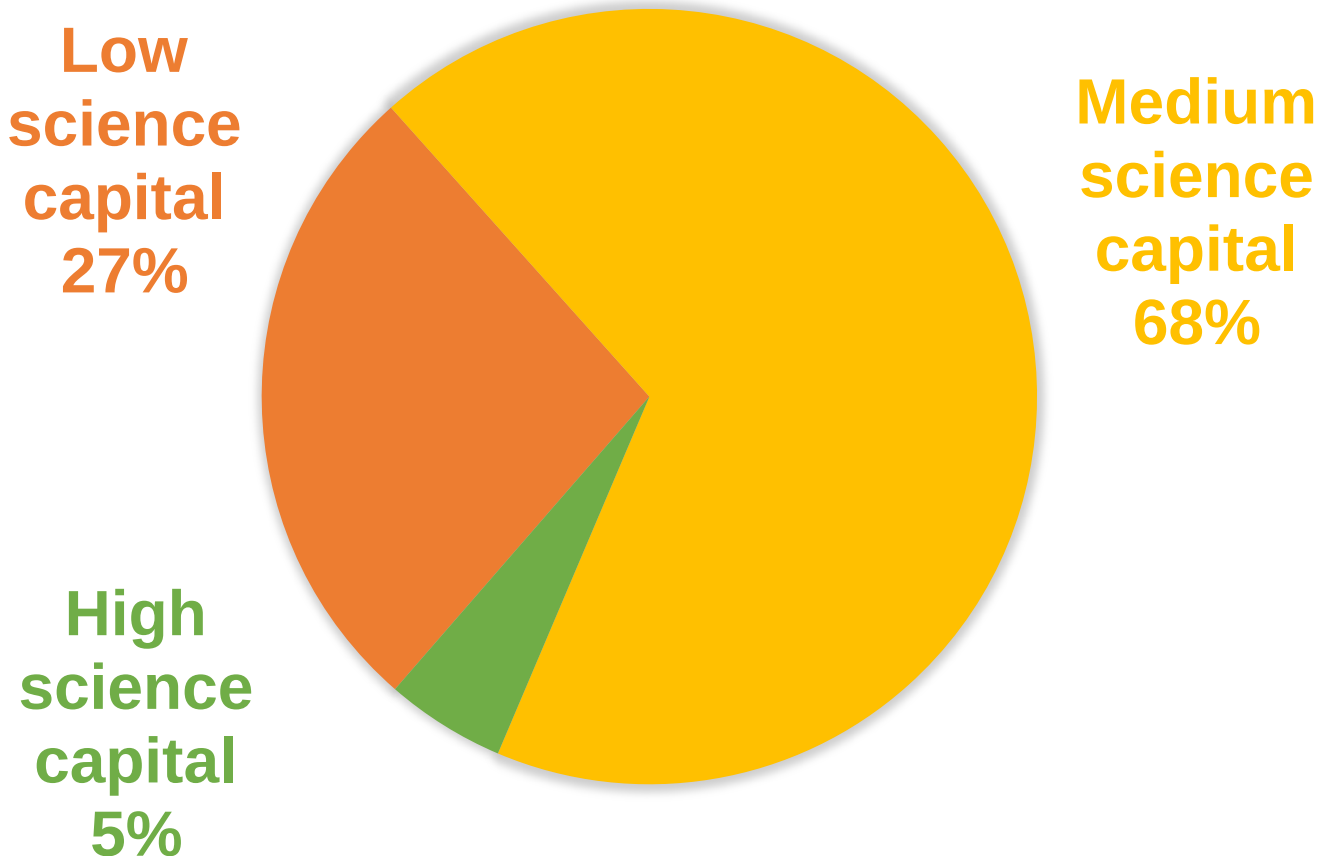
(no = 1 point, yes = MINUS 2 points)



@_sciencecapital #sciencecapital #SCteach

WHAT IS SCIENCE CAPITAL?

Science capital distribution (11-15 year olds)



Why does science capital matter?

A young person with high science capital is *significantly* more likely to plan to continue with science after the age of 16 and see science as being 'for me'.

	Young people with HIGH science capital	Young people with LOW science capital
'I would like to study a science subject at University.'	50%	6%
'Other people think of me as a science person.'	80%	3%

Joshua, 11: high science capital

Joshua's mum works as a laboratory technician and his dad is an engineer. They have high aspirations for Joshua to study at university and get a good job. Joshua thinks science is important for everyday life and hopes to become an inventor. He regularly reads science books and watches science-related videos on YouTube, and the family often visit museums during the weekends and holidays.

The other day in the car we were laughing about chemical symbols and things, so I guess it does come into the discussion quite subliminally really. (parent)

Tracey, 12: low science capital

Tracey's mum works as a cleaner and her dad is a car mechanic. No one from her immediate or extended family has ever attended university and Tracey remarks that her mum often warns her that university could be a difficult experience. Tracey hopes to become a celebrity, although she also talks about maybe working with animals, perhaps as a veterinary nurse. When asked about her knowledge of animals and animal health, she says that this does not 'count' as science. Despite some science interest, Tracey's science capital score is relatively low.

‘Celebrated performances’ in the science classroom

- Findings from a year-long study of nine London secondary science classrooms
- Expected and ‘celebrated’ behaviours:
  - muscular intellect
  - behavioural compliance
  - tick-box learning

You’ve just got to have general knowledge and, like, you’ve just got to be the one that always puts their hand up. (student)

What can ‘science capital’ offer?

- Framework for understanding issues of differential engagement
- A reflection framework for devising action
- An evidence-based, pedagogical framework for building student science capital and supporting more students to engage with science

In this talk

- Background – inequalities in science participation
- Science capital – what it is and why it matters
- **The science capital teaching approach – engaging diverse students with science**

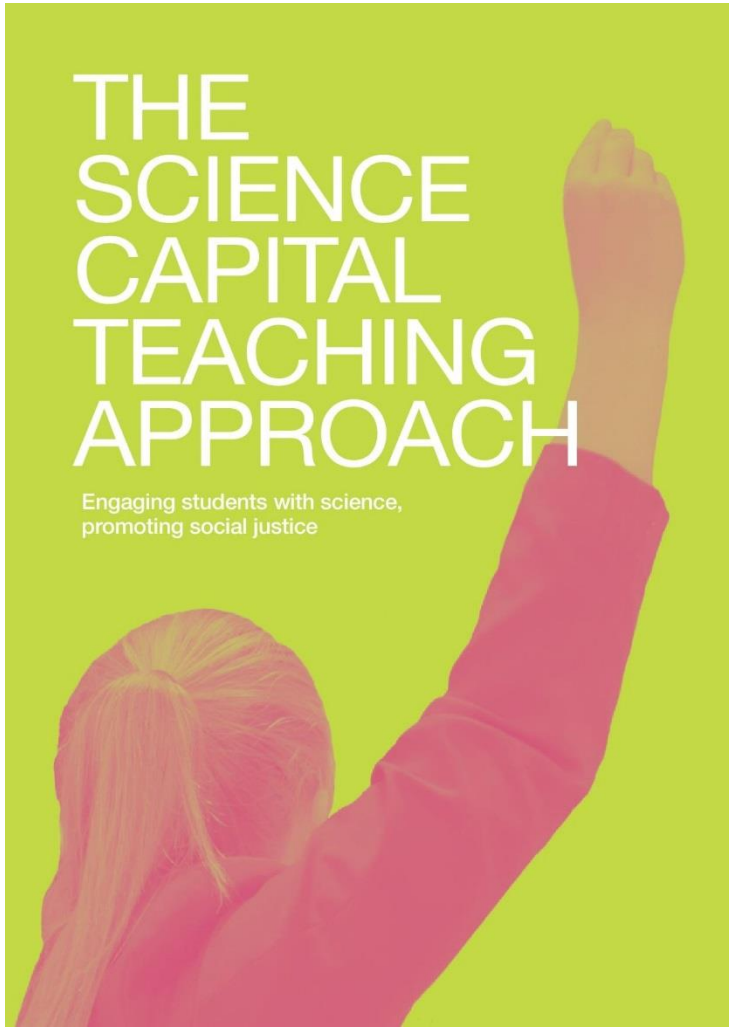
Putting research into practice to better engage diverse students with science

What could be done to change the teaching practice to help more students engage with science?

- 4 years, 43 secondary science teachers
- Tweaking lesson plans
- Professional development sessions, classroom observations and reflections

The Science Capital Teaching Approach

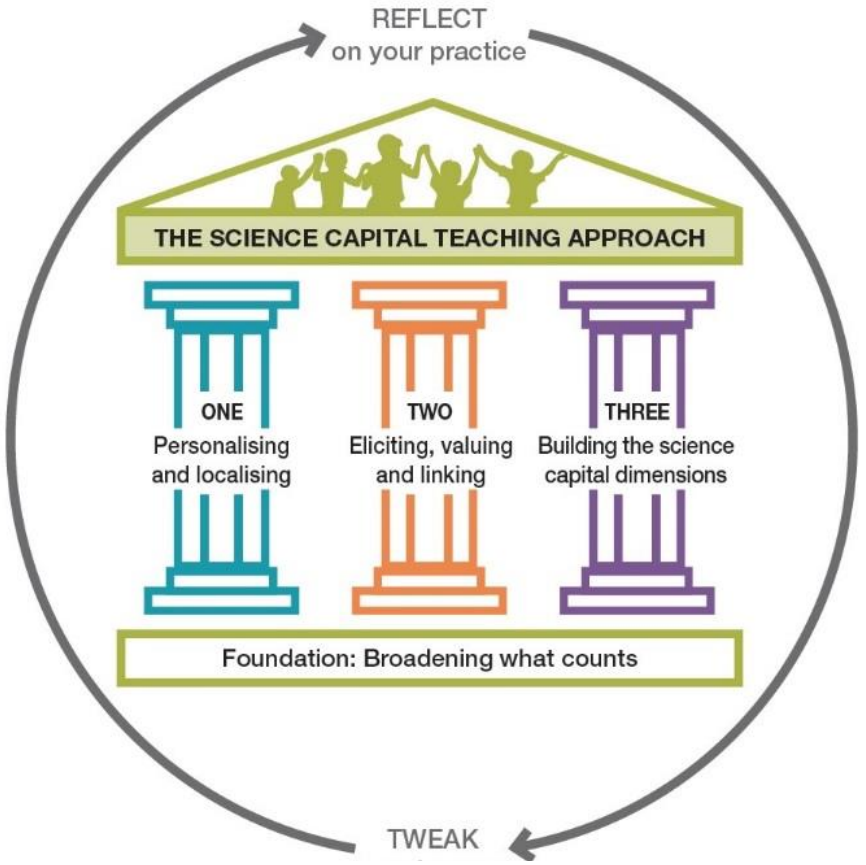
(a free online resource for teachers)



@_sciencecapital #sciencecapital #SCteach

The Science Capital Teaching Approach

- Builds on existing good teaching practice
- Mind-set and tweaks to existing lessons



Foundation: Broadening what counts

- Students do not just find science concepts difficult – some struggle to identify and engage with science
  - Open up more ways that children can be recognised by others as being scientific
  - Recognise broader range of experiences, skills and behaviours as legitimate
  - Challenge stereotypes

Think about your class. How important are the following characteristics in determining if someone is a 'science person'?

	Very important	A bit important	Not important
1. Being naturally clever	☐	☐	☐
2. Getting the answer right	☐	☐	☐
3. Using scientific language and terms	☐	☐	☐
4. Shouting out the answer	☐	☐	☐
5. Being curious	☐	☐	☐
6. Working hard	☐	☐	☐
7. Discussing ideas with others	☐	☐	☐
8. Sharing views and experiences	☐	☐	☐
9. Being creative	☐	☐	☐

Pillar One: Personalise and Localise

Reduce the distance between science and students' lives to make science more meaningful and relevant to them.

- Get to know your students and what matters to them
- Go beyond contextualising science – personalise and localise it to make relevant to your particular students' everyday lives

Pillar One: Personalise and Localise

Mr Michaels shows a slide with heat transfer/loss through doors, windows and walls and asks ‘What could we do to reduce the heat loss? **Could you tell me of any examples of what your parents or someone you know has done to reduce the heat loss where you or they live?’** Students discuss in small groups and record their answers on mini white boards before reporting back to the whole class.

Pillar Two: Elicit, Value and Link

Make varied and diverse students' knowledge and experience count as valuable and legitimate.

- **Eliciting** not only content knowledge but also interests, skills and what matters to students
- **Valuing** these contributions
- **Linking** contributions to curriculum science – to recognise existing knowledge as science-related and build new knowledge

Pillar Two: Elicit, Value and Link

Julian suddenly asks: ‘Is insulin a protein?’ Mr Lloyd **asks Julian to say what he knows about insulin and what it is used for.** Julian says: ‘My grandma has diabetes. She has to inject herself in the tummy with insulin’.

Mr Lloyd asks Julian: **‘Do you know what the insulin does? Why does your grandma have to inject it?’** Julian replies with apparent **pride** that he knows the answer: ‘It sorts out her blood sugars. Most of us do it, like, naturally. But some people don’t have insulin, or they have too much, so something like that.’

Pillar Three: Building science capital

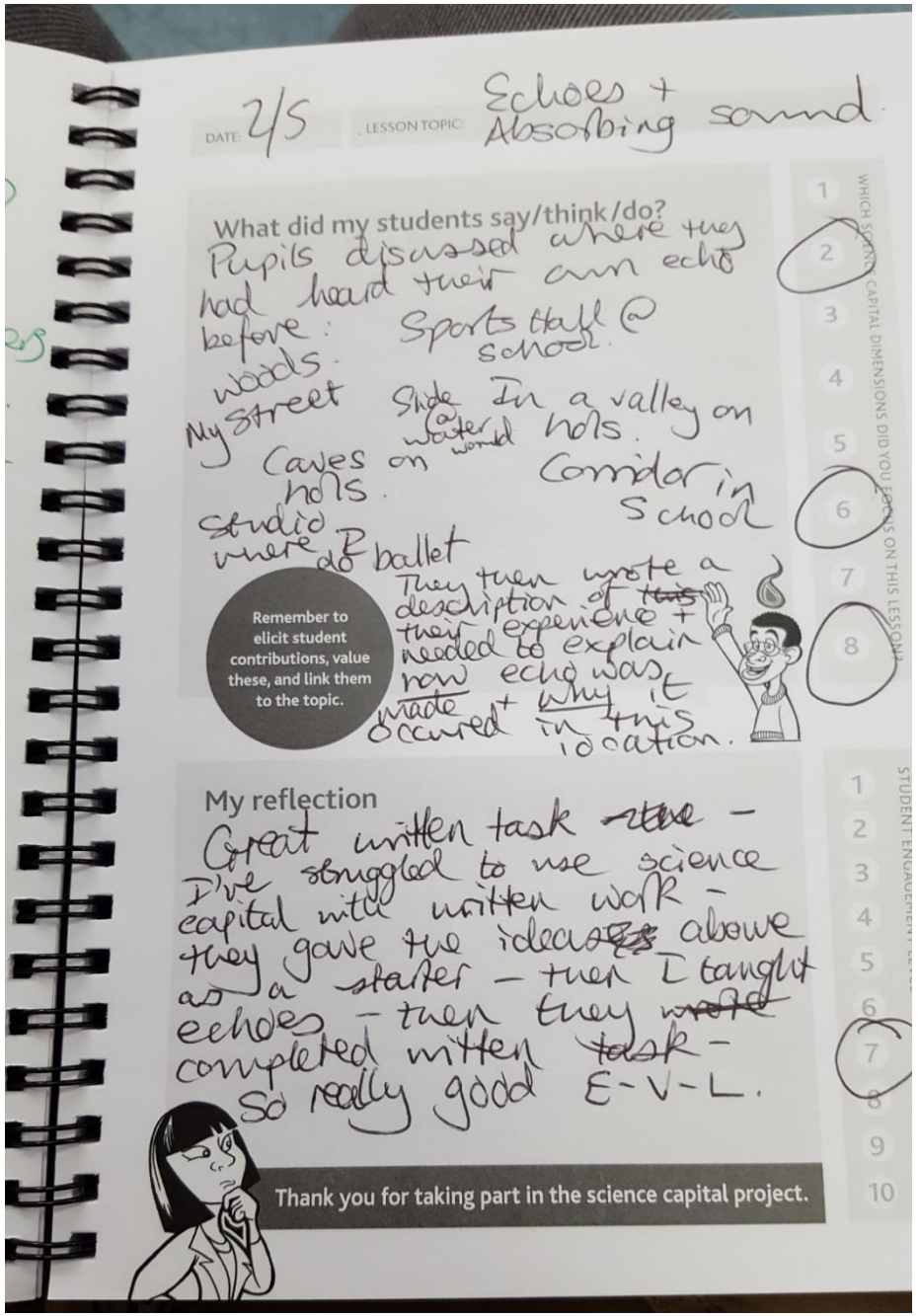
Cultivate, recognise and build students' science capital and support students who have fewer 'dominantly valued' resources.

- Knowledge about the transferability of science
- Science media consumption
- Participation in out-of-school science learning
- Family science skills, knowledge and qualifications
- Knowing people in science-related roles
- Talking about science in everyday life

Pillar Three: Building science capital

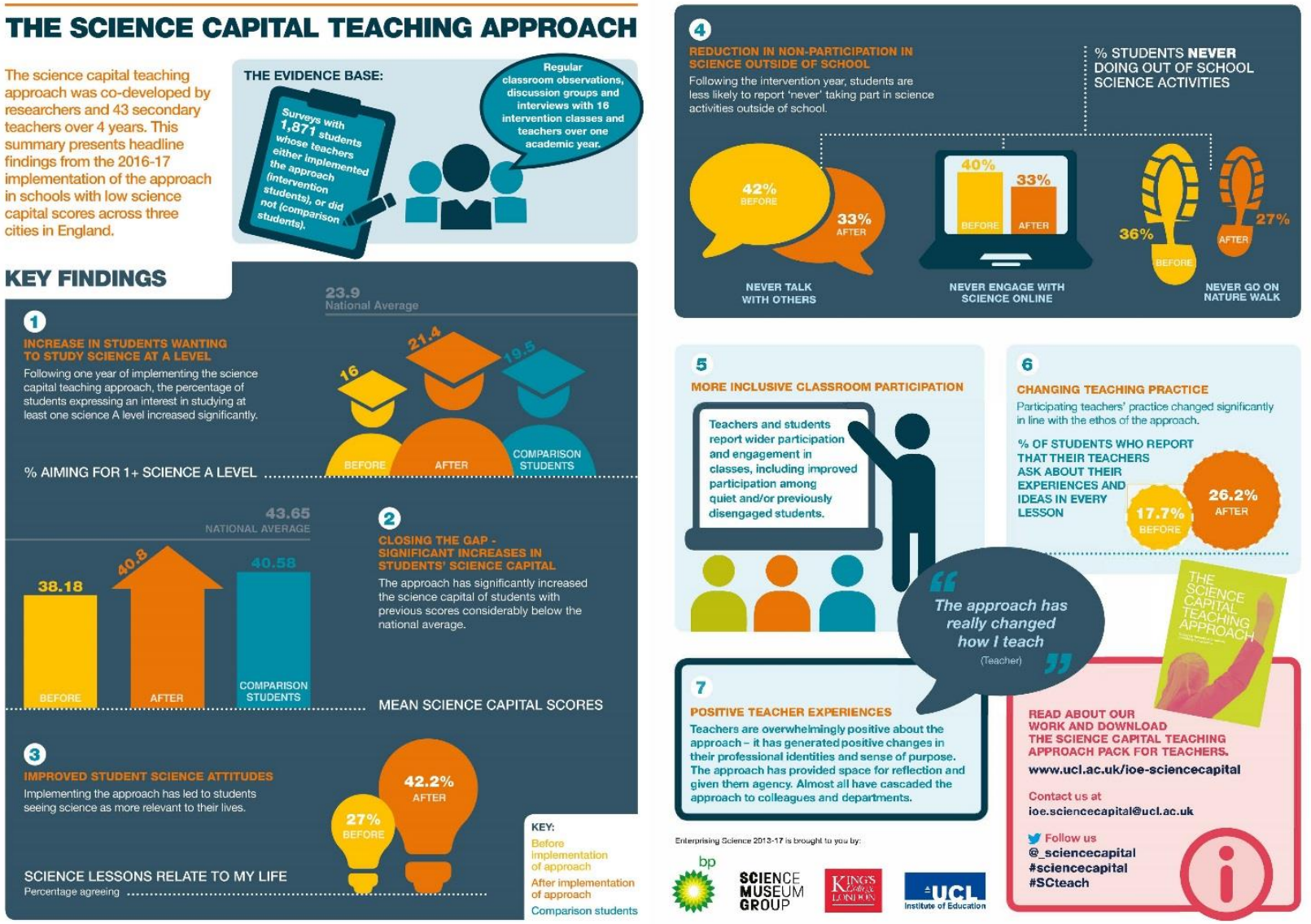
Ms Marquez: **'Can anyone tell me about any ads on TV for products that work to minimise microbes spreading?'** She asks students to discuss in pairs. Ralph mentions a 'Catch it, bin it, kill it' campaign he saw. A few other students are nodding – they remember this as well. Ms Marquez asks him to describe the advert and then says to the class: 'It's great that you are making these connections. **You could also ask your parents or grandparents what they know—or about ad campaigns they remember—on the importance of making sure microbes don't spread'.**

Teacher's reflective diary



@_sciencecapital #sciencecapital #SCteach

Outcomes


THE SCIENCE CAPITAL TEACHING APPROACH
The science capital teaching approach was co-developed by researchers and 43 secondary teachers over 4 years. This summary presents headline findings from the 2016-17 implementation of the approach in schools with low science capital scores across three cities in England.
THE EVIDENCE BASE:
Surveys with 1,871 students whose teachers either implemented the approach (intervention students), or did not (comparison students).
Regular classroom observations, discussion groups and interviews with 16 intervention classes and teachers over one academic year.
KEY FINDINGS
1
INCREASE IN STUDENTS WANTING TO STUDY SCIENCE AT A LEVEL
Following one year of implementing the science capital teaching approach, the percentage of students expressing an interest in studying at least one science A level increased significantly.
% AIMING FOR 1+ SCIENCE A LEVEL
23.9
National Average
16
21.4
19.5
BEFORE
AFTER
COMPARISON STUDENTS
2
CLOSING THE GAP - SIGNIFICANT INCREASES IN STUDENTS' SCIENCE CAPITAL
The approach has significantly increased the science capital of students with previous scores considerably below the national average.
MEAN SCIENCE CAPITAL SCORES
43.65
NATIONAL AVERAGE
38.18
40.8
40.58
BEFORE
AFTER
COMPARISON STUDENTS
3
IMPROVED STUDENT SCIENCE ATTITUDES
Implementing the approach has led to students seeing science as more relevant to their lives.
SCIENCE LESSONS RELATE TO MY LIFE
Percentage agreeing
27% BEFORE
42.2% AFTER
KEY:
Before implementation of approach
After implementation of approach
Comparison students
4
REDUCTION IN NON-PARTICIPATION IN SCIENCE OUTSIDE OF SCHOOL
Following the intervention year, students are less likely to report 'never' taking part in science activities outside of school.
% STUDENTS NEVER DOING OUT OF SCHOOL SCIENCE ACTIVITIES
42% BEFORE
33% AFTER
NEVER TALK WITH OTHERS
40%
33%
BEFORE
AFTER
NEVER ENGAGE WITH SCIENCE ONLINE
36%
27%
BEFORE
AFTER
NEVER GO ON NATURE WALK
5
MORE INCLUSIVE CLASSROOM PARTICIPATION
Teachers and students report wider participation and engagement in classes, including improved participation among quiet and/or previously disengaged students.
6
CHANGING TEACHING PRACTICE
Participating teachers' practice changed significantly in line with the ethos of the approach.
% OF STUDENTS WHO REPORT THAT THEIR TEACHERS ASK ABOUT THEIR EXPERIENCES AND IDEAS IN EVERY LESSON
17.7% BEFORE
26.2% AFTER
"The approach has really changed how I teach" (Teacher)
7
POSITIVE TEACHER EXPERIENCES
Teachers are overwhelmingly positive about the approach – it has generated positive changes in their professional identities and sense of purpose. The approach has provided space for reflection and given them agency. Almost all have cascaded the approach to colleagues and departments.
READ ABOUT OUR WORK AND DOWNLOAD THE SCIENCE CAPITAL TEACHING APPROACH PACK FOR TEACHERS.
www.ucl.ac.uk/ioe-sciencecapital
Contact us at
ioe.sciencecapital@ucl.ac.uk
Follow us
@_sciencecapital
#sciencecapital
#SCteach
Enterprising Science 2016-17 is brought to you by:
bp
SCIENCE MUSEUM GROUP
KING'S College LONDON
UCL Institute of Education

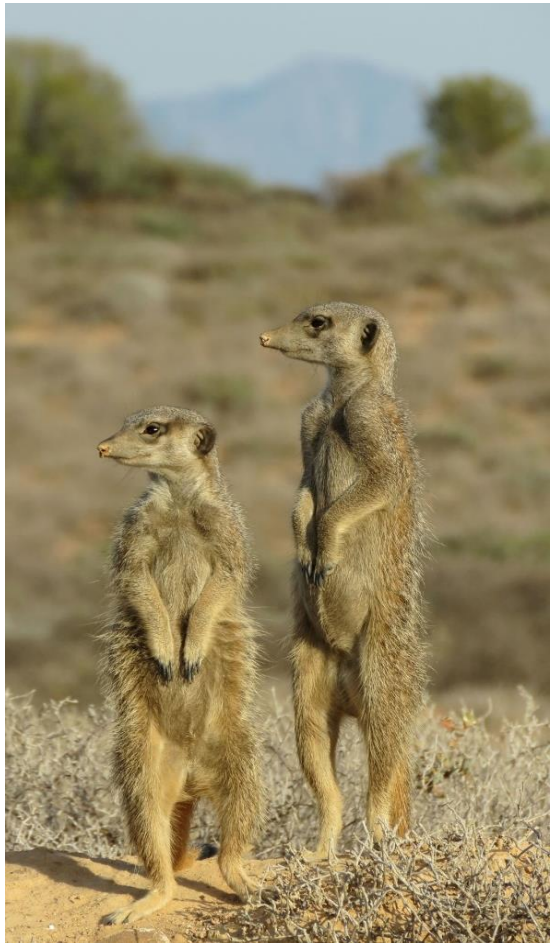
Positive outcomes for teachers & students

- Increased interest and enjoyment of lessons
- Improved engagement

  So [Y10 bottom set] are a very challenging group of students […] Through the year what I've noticed is when [I use the approach] I can see it their eyes … they kind of … like a meerkat, they pop up and you can see the engagement and you can see that they talk about it a bit more. (Teacher)

- Improved understanding

  Ms. Akwright teaches us more in a one-to-one kind of thing, like she teaches you based on what you know. (Student)



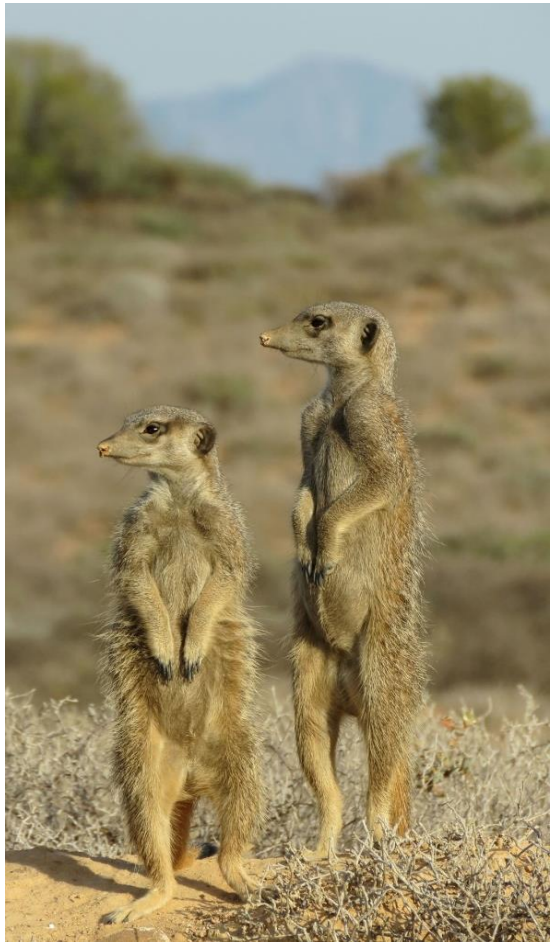
Positive outcomes for teachers & students

- Improved behaviour
- More inclusive classroom participation
- Attainment

  It's been better than the target …. I'm really surprised. (Teacher)

- 'Happier' teachers and shared practice

  It's making life a lot easier because you're not …you're not just like bombarding them with information, you're drawing things that they understand that is relevant to them, that makes their lessons a bit more interesting and a little bit more, you know, successful I think. (Teacher)



Summary thoughts for practice

- Share the Science Capital Teaching Approach principles
- Provide support and time for teachers to reflect
- Emphasise the transferability of STEM for any job – DON'T just focus on the value of STEM for STEM destinations
- Personalise, localise and link the science curriculum to what matters to your particular students
- Focus on diversity, representation and implicit messages that are conveyed within and by your classroom

Thank you! ¡Muchas gracias!

Website: www.ucl.ac.uk/ioe-sciencecapital
(for the handbook PDF and additional resources)

Twitter: @_**sciencecapital**
#sciencecapital
#Scteach

Email: ioe.sciencecapital@ucl.ac.uk
s.godec@ucl.ac.uk