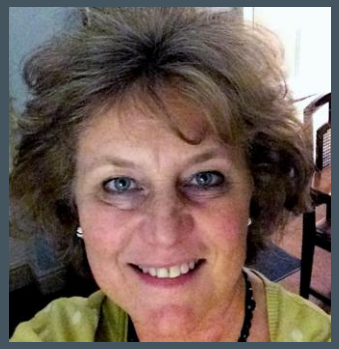
Transition concerns: Exploring and contrasting understanding about science enquiry in upper primary (KS 2) and lower Secondary (KS3)



Sally Howard

Sally.howard-2015@brookes.ac.uk

Friday 9th June 2016
session 3: 3:15 – 4:15
Assessment/ **STEM**/ Early Years workshop strand

Schooling!

My background experiences underpin my interest in enquiry coupled with transition challenges

SESSION OVERVIEW

- Why is there a call for more enquiry based science education? (IBSE)
- What are the characteristics of an enquiry based science teaching/lesson?
- What are the challenges associated with transition phase?

ENQUIRY BASED SCIENCE EDUCATION (IBSE) IS AN INTERNATIONALLY PREFERRED PEDAGOGY

OXFORD BROOKES UNIVERSITY

The importance of enquiry based science education has been firmly established in both primary and secondary settings (Gray, 2016; Rocard, 2007, Wellcome, 2011) …

yet, there still appears little change in the way science is taught in many classrooms (Crawford, 2014)

resulting in significant numbers of secondary pupils still not choosing to continue with science post 16

and there remains a **limited understanding as to why this might be the case.**

WHY ENQUIRY BASED SCIENCE EDUCATION (IBSE)? BECAUSE:

OXFORD BROOKES UNIVERSITY

A lack of learner engagement with science - starting in the primary phase and dipping rapidly in KS3.

Dip is associated with the way that school science is taught, as it fails to engage learners.

This disconnection contributes to a poor sense of ***science identity***, and poor attitude to science education, which ultimately is restricting future opportunities for too many young people.

see: Archer et al, 2012; Crawford, 2014; DeWitt & Archer, 2015; European Commission Report, 2015; Osborne, J., Simon, S., Collins, S, 2003; Rocard report, 2007 …

TRANSITION:
STRENGTHS & OPPORTUNITIES FOR DEVELOPMENT

OXFORD BROOKES UNIVERSITY

- A lot of good focus on the pastoral side of transition

- but there is insufficient focus on the academic aspects of the pupil intake…the gains made by pupils at primary school were not embedded and developed at Key Stage 3 (Ofsted;2013)

- too many secondary schools do not work effectively with partner primary schools to understand pupils' prior learning and ensure that they build on this during Key Stage 3. (Ofsted report (2015) Key Stage 3: The wasted years?

WHY FOCUS ON ENQUIRY & TRANSITION ?

OXFORD BROOKES UNIVERSITY

- The development of scientific ideas, skills and attitudes begins in the earliest years and is well advanced by the time students leave primary school.
- Children form their own scientific ideas about science, regardless of what is taught.
- The longer alternative ideas remain unchallenged, the more resistant to change they become, even in the light of conflicting evidence.
- Continuity of enquiry based pedagogy across phases is beneficial and motivating.
- 'Science identity' is still flexible between ages 10 – 14 years.

ENQUIRY REFERS TO AT LEAST THREE DISTINCT CATEGORIES OF ACTIVITIES:

OXFORD BROOKES UNIVERSITY

1. **what scientists do** (e.g., conducting investigations using scientific methods),

2. **how students learn** (e.g., actively inquiring through thinking and doing into a phenomenon or problem, often mirroring the processes used by scientists),

3. **a pedagogical approach** that teachers employ (e.g., designing or using curricula that allow for extended investigations)

Minner, D., Levy, A., Century, J. (2009)Inquiry-Based Science Instruction—What Is It and Does It Matter? Results from a Research Synthesis Years 1984 to 2002. Journal of Research in Science Teaching.

WHAT DOES THE NATIONAL CURRICULUM (ENGLAND) SAY ABOUT SCIENCE ENQUIRY IN PRIMARY SCHOOLS?

OXFORD BROOKES UNIVERSITY

‘’Working scientifically’ …embedded… focusing on the key features of scientific enquiry, so that pupils **learn to use a variety of approaches** to **answer** relevant scientific questions. These types of scientific enquiry should include:

- observing over time
- pattern seeking
- identifying, classifying and grouping
- comparative and fair testing (controlled investigations)
- researching using secondary sources

Pupils should seek answers to questions through collecting, analysing and presenting data DfE (2013) (scientific process)….

see ‘Maintaining curiosity A survey into science education in schools’ (2013)

WHAT IS MEANT BY 'ENQUIRY' BASED SCIENCE EDUCATION?

OXFORD BROOKES UNIVERSITY

- There is not a universally agreed definition BUT there is a consensus on the key principles of enquiry based teaching
- It is not the same as: discovery learning, experiential learning, practical experiments, hands-on, problem - solving
- There are a range of inquiry skills and competencies that are considered as key '21 Century' skills and these need nurturing

WHILE LACKING A UNIFIED DEFINITION, THESE ARE THE COMMONLY AGREED PRINCIPLES:

OXFORD BROOKES UNIVERSITY

(1) Learners are engaged by scientifically oriented questions.

(2) Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.

(3) Learners formulate explanations from evidence to address scientifically oriented questions.

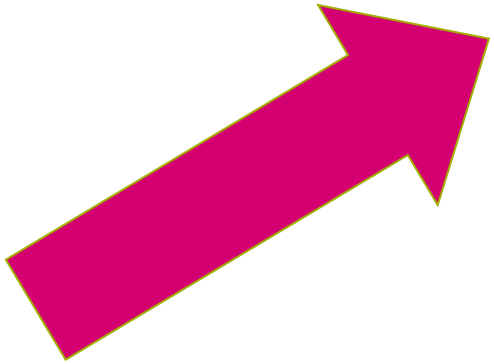
(4) Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.

(5) Learners communicate and justify their proposed explanations

(NRC, 2000, p. 25)

IS THERE A PROGRESSION IN INQUIRY SKILLS?

OXFORD BROOKES UNIVERSITY



Secondary

- controlling variables,
- formulating hypothesis, (students raising own questions is a precursor to this)
- experimenting/investigating.

Primary

- observing
- measuring
- using numbers
- grouping / classifying (a precursor to understanding variables)

TAKE NOTE

Enquiry is not just limited to students doing practical work or ‘investigations’ but also include discussion and the use of secondary sources.

Students need to learn **through inquiry** so they can develop scientific knowledge and they can also learn **about inquiry**, including the process of science and how to construct reliable, valid and accurate investigations. Both are required! Tendency to just ‘**do an inquiry**’.

Yeoman's, E. (2011) Perspectives on Education: Inquiry based learning. Wellcome Trust.

WHAT TYPES OF ENQUIRY ARE THERE?

DEPENDING ON THE DEGREE OF DECISION MAKING / ENACTMENT GIVEN OVER TO THE LEARNERS:

OXFORD BROOKES UNIVERSITY

Level 4 Open enquiry			
Level 3 Guided enquiry	Teacher given		
Level 2 Structured enquiry	Teacher given	Teacher given	
Level 1 Closed enquiry	Teacher given	Teacher given	Teacher given
	Questions	**Procedure / methods**	**Solution/ findings**

Adapted from Bell et al 2005 cited in Bunterm, T et al 204 Do different levels of inquiry lead to different learning outcomes? A comparison between guided and structured inquiry. International Journal of Science Education Routledge

WHAT IS ARGUMENTATION? – IS IT AN UNDER DEVELOPED ENQUIRY SKILL?

OXFORD BROOKES UNIVERSITY

Progression	Argumentation features to recognise progression
Emerging	**Defends** own view because it is 'their view'. Reacts to challenge in an emotional way.
	Understands the idea of **trying to convince** by making some sort of persuasive appeal based on how well they thinks it fits the **evidence**.
	Understands use of **evidence is required** to persuade. **Grasps the need to provide evidence and reasons** that are directly relevant to the main point.
	Understands the role of critique and rebuttal **and is able to reason about and respond to counterevidence and critical questions.** Successfully analysis unstated assumptions, biases, and other subjective elements to develop own position more clearly
Advanced	Understands how to **use others' arguments to develop own understanding. Can re-frame own position** in terms the current "state of discussion" . Demonstrates metacognitive understanding of 'persuasion'

WHAT COULD IMPROVE STUDENTS ATTITUDES TOWARDS SCIENCE EDUCATION BEYOND AGE 16?

OXFORD BROOKES UNIVERSITY

We know that the age 10-14 is critical in shaping students science identity. (eg DeWitt & Archer, 2015, ASPIRES project)

1) **School science experience**: IBSE is inclusive, engaging, motivating for teacher & learners, improves knowledge and process skills. Enhances students science identities and attitudes to science education

2)**Parental attitudes** (parents with high science capital have the most favourable impact on their child's science identity): run IBSE parents evening led by students. Work cross phase with parents on academic understanding not just pastoral.

OXFORD BROOKES UNIVERSITY

PERSONAL REFLECTIONS:

What are the characteristics of an enquiry based lesson?

What would you see / hear/touch?

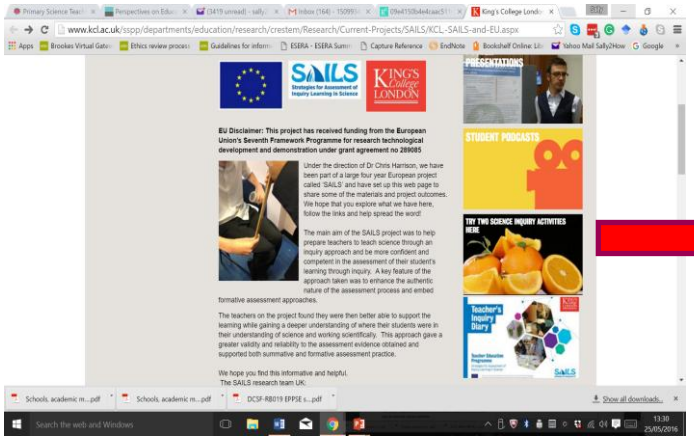
Are they the same for primary and secondary?

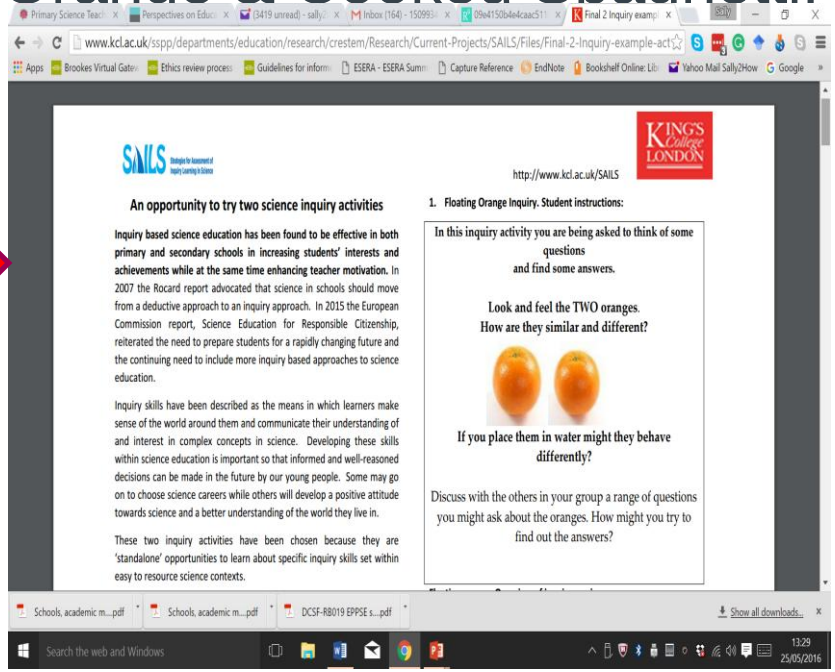
FREE SCIENCE ENQUIRY (INQUIRY) MATERIALS SUITABLE FOR A TRANSITION PROJECT 'PRIMARY TO SECONDARY' PUPILS AND TEACHER CPD ACROSS PHASES

OXFORD BROOKES UNIVERSITY

- Assessment dictates practice!
- SAILS project materials freely available from:

http://www.kcl.ac.uk/SAILS see Orange & Cooked Spaghetti:





Thank you ☺

REFERENCE

OXFORD BROOKES UNIVERSITY

- **Archer, DeWitt, Osborne, Dillon, Willis, Wong** (2010) Doing science versus being a scientists: examining 10,11 year old school children's constructions of science through the lenses of identity. Science Education. 94:4 p 607-639.

- **Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B.** (2012). *Science Aspirations, Capital, and Family Habitus: How Families Shape Children's Engagement and Identification With Science.* American Educational Research Journal, 49(5), 881–908. Retrieved from http://www.jstor.org.oxfordbrookes.idm.oclc.org/stable/23319630

- **European Commission report** (2015) Science education for responsible citizenship. http://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf Accessed 10/12/15

- **Crawford, B.** (2014) *From inquiry to scientific practices in the science classroom*. in Handbook of research on science education. Vol ii. Lederman, N.G & Abell, S.K (Eds) Routledge

- **Gray, P.,** (2016) An Inquiry into inquiry: EU projects and science education. http://instem.tibs.at/sites/instem.tibs.at/files/upload/WP2%20Final%20synthesis%20report%20D2.4%20finale.pdf accessed 29/1/16

- **Osborne, J., Simon, S., Collins, S. (2003)** Attitudes towards science: A review of the literature and its implication International Journal of Science Education., 25:9, 1049-1079 Routledge

- **Rocard, M**. (2007). *A renewed Pedagogy for the Future of Europe*. Brussels: European Commission. Directorate-General for Research. Accessed 18/5/15 http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf

- **Wellcome** Trust (2011) *Perspectives on Education: inquiry-based learning*. Wellcome Trust http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtvm055190.pdf accessed 14/11/15