

**Teachers' views, approaches and needs in relation to
'Darwin-inspired' science**

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Executive summary

- Teachers were enthused by the idea of celebrating Darwin's life and work in 2009, and replicating this enthusiasm across the UK will be fundamental to the success of the project.
- Shortage of time is the main challenge. Teachers are constrained by the curriculum pressures, with little room for manoeuvre even at KS1. This makes it essential that any ideas and associated continuing professional development (CPD) are linked explicitly to curriculum.
- There was a lack of detailed knowledge about Darwin at all levels (among teachers and their pupils). Many primary school teachers initially considered Darwin to be irrelevant to their pupils. At secondary and post-16 levels, there was much greater recognition of Darwin's significance in the curriculum.
- Participants contributed many ideas of activities or experiments, including ways of publicising the Darwin celebrations. Electronic access to information was important, including the provision of an umbrella website for information and materials.
- They were keen to develop cross-curricular programmes and strengthen relations with other schools.
- Some practical problems in terms of resourcing were anticipated: for example, lack of funding, inadequate school grounds for experiments, potential vandalism and health and safety issues.
- CPD would be necessary to address the lack of knowledge and confidence in teaching about Darwin-related topics.
- Teachers and senior managers must be convinced that such a CPD commitment is justified. The involvement of key figures such as headteachers, science consultants/local authority advisors might be beneficial, to help motivate teachers and their schools to engage with the CPD as well as the wider initiative.
- It is important to disseminate information and publicity as soon as possible so that schools have plenty of notice for incorporating activities into the 2009 calendar.

Background

As part of Darwin 200 in 2009, the Wellcome Trust is interested in highlighting for students of all ages the relationship between Darwin's work and contemporary science. These are the findings of a study commissioned by The Wellcome Trust to explore teachers' views and pedagogical approaches to evolution and other 'Darwin-inspired' science and their resource and training requirements to do so. The findings of the study will help develop a strategy for assisting teachers in promoting the continued significance of Darwin's work in contemporary science.

Methodology

Ten focus group meetings were held, five at the Institute of Education (IoE) and five at the University of Southampton. At each location there was a KS1 (5-7 year olds), KS2 (7-11 year olds), KS3 (11-14 year olds), KS4 (14-16 year olds) and post-16 group of teachers.

The teachers were asked to bring to the meeting a list of Darwin-related topics/activities they (or their colleagues) already teach. This enabled them to complete a brainstorming exercise based on the following questions:

- a. What do you perceive to be a Darwin-related topic?
- b. What were Darwin's main contributions to scientific thinking?
- c. Why is his work important?
- d. How did he work?
- e. What relevance do these questions have for children/students today at your KS?
- f. What more do you want to know about Darwin?

The discussion that followed allowed teachers to clarify their comments and drew out misconceptions and gaps in their knowledge and understanding of Darwin and his work. By asking how they acquired their knowledge (e.g. books, journals, the internet, TV programmes) it was hoped that a picture might emerge of how they were likely to acquire new knowledge.

The focus then moved to students' knowledge and understanding of Darwin. There was general discussion of how students at each key stage reacted in lessons that included mention of Darwin or Darwin-related topics. For secondary phase teachers there was a short discussion of controversies about evolution that had been raised in science lessons, for example, creationism.

To determine how Darwin was included in the curriculum there was discussion of what Darwin-related topics they covered and how they taught them. Given the background of the 2009 bicentenary, teachers were asked to respond to ideas for Darwin-related activities and to make suggestions of their own.

The discussion then moved on to the facilities and resources available in their school to carry out Darwin-related experiments, and any continuing professional development (CPD) requirements that might arise, including barriers to engaging in CPD.

Teachers' knowledge of Darwin and his work

Teachers at each key stage acknowledged Darwin's connection with each of the following topic areas:

- evolution, natural selection, inheritance
- adaptation, variation
- interdependence
- environment, habitats, ecology

At each focus group meeting, religion and ethics were generally regarded as subsidiary issues relating to Darwin's theory of evolution.

All groups generally acknowledged Darwin's contribution to scientific thinking, for example in relation to:

- systematic study of ecology
- species change over time
- explanations for the mechanisms that drive evolution
- lateral thinking to connect ideas
- challenging and opening gateways that defied mainstream thought
- having the courage to publish and to capture the popular imagination.

However, he was not necessarily explicitly linked with many of these, especially in the primary classroom.

Teachers also saw the overlap between his contribution to scientific thinking and the ways in which he worked including observation, identification, recording, collection, rigorous testing, reflection, lateral thinking, comparing. However, there was a general misconception that he worked alone, and there was limited acknowledgement of Darwin as an overall pioneer of biological sciences, in the same way as Newton or Einstein for physical sciences.

As well as acknowledging the importance of his original work, teachers were aware of his impact on modern biology, including some controversial issues that could be investigated by students from upper KS2 onwards. Such Darwin-related topics included:

- biodiversity
- extinction
- genetics, DNA, mutation
- selective breeding
- climate change
- antibiotic resistance

Teachers across the key stages felt generally ill-informed about Darwin and wanted to know more about:

- the context of his life (a concise version)
- his travels
- areas of study and theories other than evolution
- interaction with other scientists, peers and contemporaries
- how Darwin links to the curriculum at all levels (but there was particular concern at KS1)
- activities and experiments to replicate
- places to visit especially to see collections he made.

Issues with teaching Darwin-related topics and activities

Primary school teachers tended not to define themselves as ‘scientists’, creating some lack of confidence when discussing Darwin. Bearing in mind that the participants in the focus groups were often the more ‘science-aware’ in their school (eg science co-ordinators), this suggests that such issues would be magnified for their colleagues.

There were inevitable differences in what was being taught about Darwin. KS1 pupils were not introduced to Darwin in any way, nor were many at KS2. Four particular difficulties were raised by KS1 and KS2 teachers in getting pupils engaged in Darwin-related topics and related investigative work:

1. understanding of evolutionary timescales (and even putting Darwin the man into historical context)
2. generating their own questions
3. making accurate observations and drawings (they tend to report and draw what they expect to see, not what they actually see)
4. fine motor skills.

Primary children’s questions about Darwin are often stimulated externally and they commonly ask about their descent from apes, but none of the primary teachers here mentioned religious issues without prompting. Secondary teachers had more problems with being asked to explain the juxtaposition between religion and Darwinism, often arising from children being taught in a creationist way in RE and about evolution in science. In this sample, post-16 students mostly followed Salters-Nuffield Advanced Biology (SNAB) which would encourage them to generate questions about Darwin’s work, and consider why the theory of evolution is difficult for some to accept. One teacher, finding Muslim students having problems acknowledging the evolution of humans, had designed a lesson specifically to debate the religion/science issue.

With regard to setting up experiments outside, one widespread problem was the difficulty of allocating space to set aside for experimentation. Others found that experiments were interfered with, either through vandalism or, more benignly, local authority’s regular maintenance schedules. This and the fact that some teachers lack confidence in teaching Darwin-related topics probably accounts for the popularity of outreach from museums, botanic gardens, wildlife groups, young champions (young science graduates), travelling theatre groups, or “Darwins” to visit schools.

The teachers often mentioned the value of cross-curricular approaches to make best use of time, resources and funding; but setting this up would require considerable organising across the school (especially at secondary level).

Resource requirements

Teachers reported that textbooks in use at secondary level are on the whole reductive and oversimplified, with objectives focused on examinations and not deeper understanding of Darwin’s experimental methods. Literature on Darwin available to primary aged children is very limited. An audit of relevant provision in school libraries is needed.

Teachers in the focus groups were strongly supportive of a single site (a ‘one-stop shop’) for all Darwin-related information and resources. Easy access for students would benefit case studies and data handling activities. There was also a request for a facility to share findings with other schools, and for an associated help-line.

Access to out of classroom learning facilities is of great relevance to this topic, given that many Darwin-related experiments need to be performed out-of-doors. Teachers would appreciate allocation of designated space for such investigations, and help with strategies and techniques for managing large groups during outside/off-site.

The majority of items teachers thought would be helpful to them in 2009 would need some financial input to provide:

- an ‘umbrella’ website with links to encompass Darwin related activity and organisation
- interactive whiteboard software and/or PowerPoint presentations with teachers’ notes
- time lapse DVDs (e.g. of growing experiments, worms underground, evolutionary time scales)
- list of plants to use and growing times for lifecycles (e.g. cabbages that Darwin grew)
- a booklet about Darwin’s life
- lesson plans including learning out-of-doors
- short videos of teachers using activities
- TV documentaries
- succinct press and magazine articles
- booklists
- role play ideas and the themes to follow
- touring theatre companies – Darwin plays/stories
- visiting ecologists, experts in wildlife, or ‘Darwins’

Any TV documentaries had to be short (half an hour maximum) and concentrate on the history of science, Darwin’s life, or something ‘thought provoking’, but most said they did not watch much TV. The teachers in the focus groups specifically mentioned some publications as popular sources of information, eg *The Guardian*, *Times Educational Supplement (TES)*, *New Scientist*. They preferred articles to take no more than 5-10 minutes to read and to contain not only facts but also ideas and creative suggestions for teaching. There was also some demand for articles appropriate for students in higher key stages to read for themselves. We took as fanciful subsidised trips for teachers to the Galapagos, but it was a topic raised at each of the focus groups!

Continuing Professional Development (CPD) requirements

CPD to local clusters of schools was favoured. Most teachers wanted twilight sessions but variations on day-long CPD were thought helpful for specific Key stages (e.g. KS1 and 2 would join for Darwin’s life history and ways of working in the morning and divide for specific experiments in the afternoon). KS3 and 4 teachers reported that there is usually only the possibility for a single day, or half day, for CPD because of time pressures, and they thought head teachers are only likely to sanction such teacher involvement if it can be shown to have ongoing relevance to the curriculum. The desire for cross-curricular activities and skill development relating to *How Science Works* were emphasised in the focus groups. To implement integration on this scale successfully will require full involvement of senior management/leadership teams, and have broader implications for Science CPD programmes.

Nature reserves, gardens, museums, parks, or places with Darwin connections would be appropriate sites for hosting CPD days for teachers in a locality. Co-operation and

collaboration with CPD outreach and Science Learning Centres would be needed if this option was offered and co-ordinated effectively.

CPD will still be necessary even if a 'toolkit' that included all the instructions for Darwin experiments was sent to schools. Again, this is because of the lack of knowledge and confidence expressed by teachers about themselves and colleagues. CPD will need funding, particularly for subjects outside the current priorities of individual schools or national initiatives.

Teachers thought there should be a holistic approach to CPD and outreach. They wanted a feedback mechanism/evaluation that they could see to reinforce uptake and implementation of activities. They had ideas about working with other schools, particularly developing links between feeder (KS2) and secondary schools (KS3). There was uncertainty about a toolkit to enable schools to take part in a 'national experiment'. The thought of activities at museums or botanic gardens was well received by half the participants, but would need funding for the sites to develop activities (requiring CPD for the educators there) and for transport of children to sites. Teachers had little time to watch TV, but felt that a short downloadable programme on Darwin's life and work, and background to the Wellcome Trust's Darwin experiments for 2009 would be useful. It was felt that there was no substitute for hands-on experience of how to do ecology in the school ground or making a 'thinking path'.

Marketing and promotion of Darwin's anniversary

Teachers recognised that it will be crucial to build up a momentum to encourage and sustain interest so that schools will engage in the celebration and with the Darwin experiments in 2009. Based on national campaigns that had worked successfully in their schools, they suggested the following ways of marketing 2009:

- a Launch Day when all schools do a relevant activity
- a week of cross-curricular activities
- specific resources for Science Clubs
- a postcard with updated information each month
- posters
- a database of resources
- 'travelling specialists'
- a bag or kit with sufficient resources for a lesson or activity with 30 children
- a science pack
- CD-ROMS with several games
- a helpline - particularly in Science Week
- a children's online archive.

Specifically for Darwin, suggestions included:

- a 'Darwin Day' to launch when all schools do a Darwin related activity
- a 'Darwin Week' with cross-curricular activities
- 'Darwin Clubs' to replace science clubs for 2009
- a postcard from Galapagos each month
- a Darwin pack
- CD-ROMS e.g. extinction games, Beagle voyage, pollen allergies
- online archive about Darwin's life.

There was a desire for involvement and collaboration, e.g. a forum in which to share achievements and gain feedback, secondary students having opportunities to present to primary feeder schools, competitions with stickers or certificates for participants.

Suggested creative ways of working included:

- Adaptation/natural selection: selecting clothing for climate (e.g. a fur coat); match finches to foods (e.g. picking up various foods with different implements); survival simulation games; predator and prey models;
- Evolution (classification): sorting fossil sequences; making own fossils; sorting photos or models of organisms;
- Seasonal change/long term recording: using ICT – digital cameras for photographs and time lapse;
- Antibiotic resistance/immunity: molten agar culture, MRSA scenario, head-lice card sort;
- Over-production of offspring: seed experiments; seed dispersal experiments; birds' egg counting;
- Inheritance/sexual selection in humans: e.g. breeding of various organisms known to children (e.g. *Mr Men* and *Little Misses*)
- Origin of species: board game on evolution, extinction; interactive voyage/Beagle voyage software; card game on imaginary animals, environmental conditions, mutations, timescale top trumps, collectable cards; time travel game, going forward and backward;
- Argumentation/ decision-making: concept cartoons;
- Inductive reasoning: investigative journalism/CSI-style.
- Expression of the emotions: pet behaviour;
- at break time, a rota of pupils to make a paper or digital diary (eg recording seasonal changes in school grounds)

More feedback

We would welcome feedback from any teachers who already include Darwin or Darwin-related activities in their teaching - in class and out-of-doors.