

Primary BEST: outcomes of the pilot study



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What is BEST?

BEST Evidence Science Teaching (BEST) is being developed by the University of York Science Education Group (UYSEG) to help support secondary science teachers to use high quality research evidence in their teaching and improve young people's learning of key science ideas.

BEST has been funded from its start in 2015 by the Salters' Institute, and the Institute of Physics now co-funds the project. The BEST Team consists of Judith Bennett, Alistair Moore, Peter Fairhurst and Helen Harden in UYSEG.

BEST consists of resources for teachers to use in their lessons, supported by comprehensive teachers' notes. The BEST resources are published on the STEM Learning website (www.BestEvidenceScienceTeaching.org). A key indicator of levels of use is the number of downloads of the resources from the website.

Why Primary BEST?

Following the widespread success of the BEST developments for pupils in secondary schools, the Salters' Institute agreed in 2019 to fund a small-scale pilot study of BEST resources for use in primary schools. One reason for this was that 25% of the downloads of the secondary resources were by people in primary schools. The main purpose of the pilot study was to explore primary school teachers' responses to BEST resources and see how teachers used the resources in their lessons.

The Primary BEST pilot study

The pilot study involved adapting six activities from the BEST 11-14 resources to make them suitable for upper primary age pupils. The adaptations were undertaken by the BEST team in conjunction with Joy Parvin and Nicky Waller in the Centre for Industry Education Collaborations (CIEC) in the Department of Chemistry at the University of York.

The activities were then used by 21 teachers in six primary schools in Yorkshire, the North East of England, and Stoke-on-Trent.

To gather information on teachers' responses to the resources, teachers were asked to complete a questionnaire, and four of these teachers took part in interviews. The project had planned to observe at least one lesson in each school where teachers were using the resources, but the pandemic and school closures meant that fewer lessons were observed. In total, nineteen questionnaires, four interviews and three classroom observations were completed.

We want a high-quality teaching profession which embraces evidence-based practice to drive up standards in schools.

Department for Education white paper: Educational Excellence



21 primary teachers



6 adapted activities from the BEST resources

The BEST activities for the pilot study

Six activities were offered to teachers in the pilot study, two in each of the subject areas of biology (Living things and their habitats), chemistry (Properties of materials) and physics (Earth and space). Teachers were given a free choice of which ones they could use, and nine teachers used all six activities.

The six activities offered were:

1. Is it a bird?	Living things and their habitats
2. Seaside Sorting	
3. Axe	Properties of materials
4. Vase	
5. The Earth	Earth and space
6. Day and Night	



The most popular unit, used by sixteen teachers, was *Is it a Bird?*

What did teachers think of the resources?

Teachers expressed very positive views of the BEST resources, suggesting that they felt that the pupil materials were very suitable for use in lessons. This can be seen in both the responses in the teacher survey, and in comments made in the interviews with teachers.

Of the sixteen teachers who answered the survey questions about use of the BEST resources, by both themselves and their colleagues, the majority were positive about their usefulness, as illustrated by the following questionnaire responses:

<i>Statement</i>	<i>Number (%) of teachers in agreement</i>
The resources are useful	15 (79%)
The resources are easy to use	15 (79%)
The resources are useful for colleagues less confident in teaching primary science	15 (79%)
Similar resources would work well with my class over a whole year	14 (74%)

“The conversation around the axe is cleverly presented”

Primary teacher from School A,
North East of England

Teachers' comments in interviews provided further details about the characteristics they felt were particularly useful:

"Very good, and enjoyable because they are designed to make you think and to open up discussion. The conversation around the axe is cleverly presented and no one [in the 'talking heads' activity] is 100% correct." (Primary teacher from School B, North East of England)

"I thought some of them (the BEST resources) were really interesting. We do 'Space' in September, so I'd definitely like to have a go at some of them with the class just because I think the representations on the sheets were really good and thinking of it in different." (Primary teacher from School B, North East of England)

"In both activities it made it so much easier to kind of think about how I wanted the lesson to go and what sort of ideas I had." (Primary teacher from School A, North East of England)

How did teachers respond to using the BEST resources in their lessons?

The teachers were very positive about using BEST resources in their lessons, and about their pupils' responses. Sixteen teachers (84%) stated that pupils had responded positively to the BEST resources. In addition, eleven (58%) teachers reported that using BEST resources had already begun to change how they taught their science lessons. Twelve teachers (61%) reported that using the BEST resources had a positive impact on their planning and teaching, including how they responded to pupils' answers to questions in their lessons.

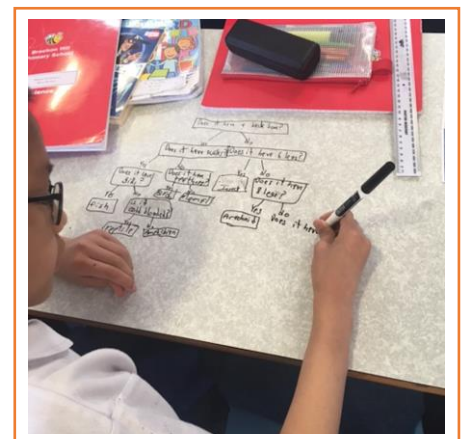
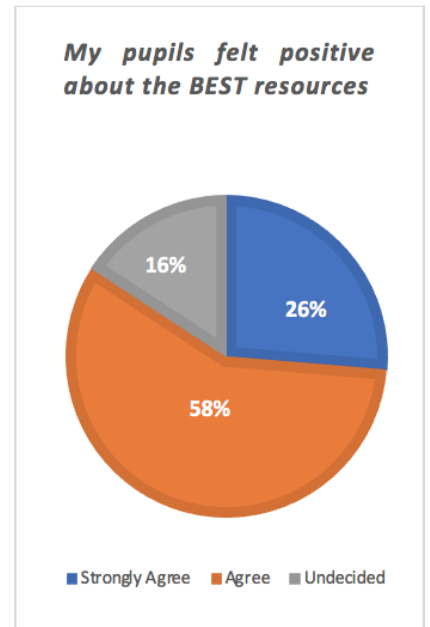
Comments from the interviews with teachers included:

"Some children took the ideas much further than the question, e.g. some metals can be flexible (foil) or liquid (mercury), and not all are hard." (Primary teacher from School A, North East of England)

"It was a really nice activity (Topic: Seaside Sorting and Is it a bird?) ... so, I definitely wouldn't change that one, I'm quite happy." (Primary teacher from School C, North East of England)

"I will use all of the other resources that were provided for the BEST pilot, when I teach the other topics next year." (Primary teacher from School B, North East of England)

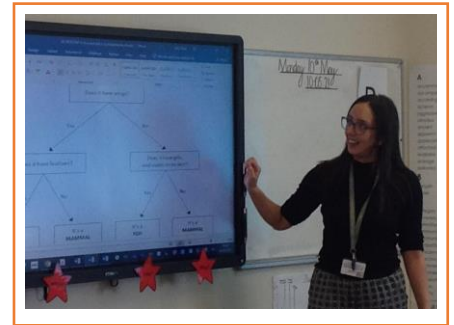
"Really easy ... I've already looked at the other one with the fish and the seaside... I think I'll probably start next lesson with that." (Primary teacher School D, North East of England)



Teachers were also asked about the Teachers' Notes in the BEST resources, as these are key to helping teachers understand *how* to use the pupils' resources in lessons and *why* the resource take the form they do. Teachers were very positive about the Teachers' Notes.

Teachers particularly valued the *Common Misconceptions and Misunderstandings* section, which 88% of teachers reported using. This was followed by the *Expected Answers* section (used by 75% of the teachers) then the *How to Respond – What Next?* section (used by 69% of the teachers).

The teacher interviews also indicated that BEST resources were seen as useful aids for planning. Teachers highlighted using the BEST resources to address pupils' misconceptions about science ideas and to improve their own knowledge of pupils' misunderstandings. Additionally, they felt that they were provided with the resources to help pupils move towards more scientifically accepted thinking.



Just under half of the teacher (42%) reported that using the BEST resources had changed how they planned their science lessons. For example, one teacher commented:

“All of it was useful. The notes about how to engage the children in discussion were particularly useful for enabling me to lead more open-ended discussion.” (Primary teacher from School B, North East of England)

Another noted:

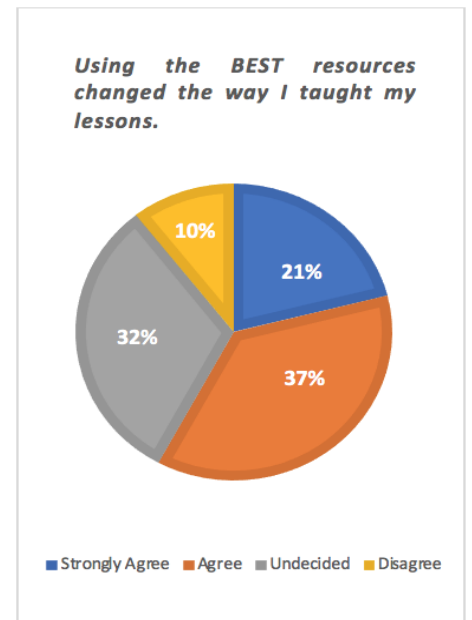
“It made my lesson much more ‘formal’ and structured - and I made a point of including the proper/prescribed vocabulary.” (Primary teacher from School A, North East of England)

Have the BEST resources changed what teachers know about pupils' misunderstandings of key science ideas?

Most teachers (79%) indicated that using the BEST resources helped them to learn more about their pupils' misunderstandings of key science ideas. This, in turn, helped them teach challenging science ideas more effectively using the BEST diagnostic questions, and to track the development of their pupils' understanding.

Teachers commented on how surprised they were by their pupils' responses. For example:

“I was surprised by how some of the children in the class responded to the diagnostic assessment question(s).” (Primary teacher from School A, North East of England)



"I would have made a lot of assumptions about their knowledge and understanding of different animals without doing this activity." (Primary teacher from School C, North East of England)

Teachers also commented on what they had learned about their pupils' misunderstandings. For example.

"Often, children have misconceptions in science, using the BEST resources changed my general understanding of what these are. (Primary teacher from School A, North East of England)

"I thought a little more deeply about how the children might struggle with the meaning of particular words, not just rush ahead to get to a quick answer and not really think about it." (Primary teacher from School B, North East of England)

What was observed in lessons?

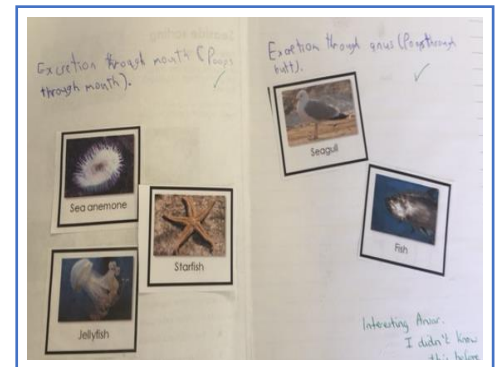
Lesson observations were undertaken to gather first-hand data on how teachers were using the BEST resources, and how pupils responded. Field notes were taken during the lessons to record observations.

The observations indicated that teachers drew on the BEST resources to engage pupils with the topics and to probe pupils' developing scientific understanding of the topics. High levels of pupil engagement were observed, with pupils being very keen to discuss and share their ideas, as shown in the following extracts from the field notes:

"Teacher encouraged children to work alone first and then work in their table group to explain their ideas to others and convince anyone with a different opinion why they might not be correct."

"Lots of examples of the teacher working very hard not to correct children but to encourage them to listen to others; the entire lesson was focussed on the children justifying and explaining."

"Children were encouraged to return to their original answers and reflect on whether their scientific ideas had changed and why. The teacher commented that she did not feel that she was 'at the end of this yet' and would definitely use a follow-up to resolve any outstanding misconceptions."



Primary teacher from School A,
North East of England

Teachers were observed providing class feedback throughout the discussions, checking pupils' understanding of both vocabulary and the science ideas being covered.

"All children were encouraged to use the correct scientific vocabulary during discussions."

"Key vocabulary was repeated throughout the lesson, the teacher even made reference to vocabulary they had learnt in Year 3. The seaside sorting activity uncovered some incredibly advanced vocabulary, such as bio luminous and hydrostatic skeleton."

"Teacher asked for definition of classification and children were able to answer correctly."



Did the teachers have any reservations about the BEST resources?

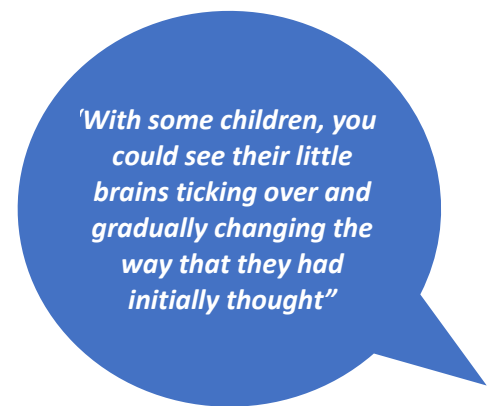
Two teachers raised concerns about time management, and the expectation that pupils would find solutions during the activity. In the words of one teacher:

*"Time doesn't always allow for this sort of discussion."
(Primary teacher from School B, North East of England)*

Conclusions

The Primary BEST pilot study suggests that primary school teachers are likely to value BEST resources in the same way as their secondary school counterparts. The resources were felt to be appropriate, engage pupils and allow teachers to diagnose and develop their pupils' understanding of key ideas in science. It was also clear that teachers were surprised by some of their pupils' ideas revealed by the diagnostic questions.

Although the Primary BEST pilot materials were not intended to provide a planned sequence of ideas similar to that provided in the much more extensive BEST 11-16 resources, there was also evidence that the Primary BEST resources were influencing how some teachers approached lesson planning more generally.



'With some children, you could see their little brains ticking over and gradually changing the way that they had initially thought'

Primary teacher from School B,
North East of England