New EEF guidance report published: Improving Secondary Science

Seven practical recommendations focused on improving science teaching, particularly for disadvantaged pupils

Almost all pupils develop their own explanations for science concepts before they learn about them in lessons.

But their ideas about things like ‘how plants grow’ or ‘how we see things’ don’t always align with scientific understanding, according to new guidance for improving science teaching published today by the Education Endowment Foundation (EEF).

However, the report suggests that teachers can harness these common misconceptions to improve pupils’ learning.

According to the 'Improving Secondary Science' report, put together by a panel of teachers and leading experts, teachers should have a clear understanding of the common misconceptions in the area they’re teaching so that they know the issues that are likely to be problematic for their pupils. Teachers should also work to uncover the specific misconceptions their pupils hold through class and group discussion, before moving on to challenge these.

While these preconceptions can be hard to shift, presenting pupils with compelling evidence that contradicts them can be a good way to move thinking on. For example, many pupils find it hard to understand that the space between gas particles is empty and will often say it is filled with ‘air’, ‘dust’, or ‘bacteria’. However, showing that it is possible to compress a gas, for example by pushing down a syringe, is a good way of opening a discussion about what this means about the spaces between gas particles.

Building on pupils’ preconceptions is one of seven recommendations in today’s report designed to support secondary schools to provide every pupil - but particularly those from disadvantaged homes - with a high-quality and well-rounded grounding in science and an interest that may lead them to further study. Improving Secondary Science reviews the best available research to offer science teachers practical classroom suggestions.

Previous research by the EEF and the Royal Society found that there is a gap in science outcomes between disadvantaged pupils and their classmates at every stage in the education system. The gap first becomes apparent at Key Stage 1 (ages 5-7) and only gets wider throughout primary and secondary school and on to A-level.

This earlier research found that it is not lack of motivation to learn science that is contributing to the attainment gap between disadvantaged pupils and their better-off classmates. Analysis of attainment data found that the biggest predictors of pupils’ attainment in science are their levels of literacy and their scientific reasoning ability.

A second recommendation in today’s report focuses on developing pupils’ scientific vocabulary to support them to read and write about science. According to the report, “learning science involves learning a whole new language and it is important that you develop pupils’ fluency in that language.”

While pupils need to learn scientific words like photosynthesis or carbon dioxide, they struggle most with familiar words that have a different meaning in science. The report recommends that pupils are explicitly taught words that have a different meaning in science - like valid, random or spontaneous – so that they can understand and interpret scientific texts.
The other five recommendations focus on:

- Using models to develop understanding
- Developing children’s abilities to self-regulate aspects of their learning.
- Supporting pupils’ memory skills, so that they can retain and retrieve knowledge.
- Using experiments purposefully.
- Using structured feedback to move on pupils’ thinking.

Sir Kevan Collins, Chief Executive of the Education Endowment Foundation, said:

Many pupils come up with their own explanations for the science concepts they meet on a daily basis, before they learn about them school. While these misconceptions are often difficult to shift, teachers can use them to challenge their pupils. Giving them compelling evidence that contradicts their own ideas can be a great way of boosting learning.

This is one of seven practical recommendations in today’s report focused on improving science teaching, particularly for disadvantaged pupils. The attainment gap in science may not be as well-documented as the gap in English and maths, but our earlier research has shown that it’s just as pervasive.

Notes to editors

1. The Education Endowment Foundation (EEF) is a grant-making charity set up in 2011 by the Sutton Trust as lead foundation in partnership with Impetus Trust (now part of Impetus–The Private Equity Foundation), with a £125m founding grant from the Department for Education. The EEF is dedicated to breaking the link between family income and educational achievement. Since its launch the EEF has awarded £96 million to test the impact of 169 projects reaching over 10,000 schools, nurseries and colleges across England, and involving more than one million children and young people. The EEF and Sutton Trust are, together, the government-designated What Works Centre for Education.

2. The full report will be available here, from 0001 on Friday 21 September 2018.