

Science case study and lesson plan

Science

Science aims to teach students the critical literacy skills and foundational knowledge to assess by themselves: whether scientific/medical claims are based on evidence, and whether an individual (or groups of individuals) making such claims are reputable.

Critical literacy link to Key Stage 3 programme of study

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience

Analysis and evaluation

- evaluate data, showing awareness of potential sources of random and systematic error

Case study – Year 8 science lessons at Grey Court School, Richmond

Two year 8 classes were assessed on their ability to critically assess if scientific articles were fake or reputable.

Both sessions began with a peer discussion: ‘How do scientists find out if something is true about the world?’ The majority of all students were able to say that scientists conduct experiments. A sizeable minority of lower attaining students claimed that one could find out true information simply if it was on Google or Wikipedia.

Students were then given a handout containing one fake and one real article. Students had to circle the information within the article (or webpage) that they used to determine the hoax from the true article. Higher attaining students were able to identify that the heavy use of advertisements was an indication: nearly all circled the name of the webpage, mentioned if it “looked click baity” and circled whether the webpage was ‘secure’. The majority of students demonstrated digital skills and an understanding of web safety. However, they were less confident in challenging the content of the articles.

“A critical mindset is of the utmost importance in order to be successful in science. A successful scientist will verify existing knowledge through observable and repeatable experimentation, challenge dogma with new evidence, and attempt to engineer better solutions to various problems

after critically analysing how processes could be more efficient.”
(Christopher Pegg, science teacher)

After the task the students had explained to them the criteria of what specifically to look out for in articles, in terms of both how the content itself is presented and how to analyse the content contained. Using a grid containing those criteria to help them, the class had to annotate articles dotted around the room and tally on the back of them whether they thought it was real or fake. An analysis of the tallied results suggested that lower attaining students were less able to identify fake news than their higher attaining peers.

Following a class discussion, students had to annotate their original two articles with a different colour pen. At the end of the lesson, lower attaining students claimed generically via Post-it Notes that they were now “able to tell if something is fake news” but only a minority had proved they could: nearly all the higher attaining students however could explain in detail the specific things they now recognised when looking at science articles. They frequently mentioned the importance referenced evidence in articles and identifying the authorship.

The lesson suggested that many students could be fooled by disingenuous content if it was presented in a way that appeared reputable. The converse was true; nearly all true content (articles taken from *New Scientist*) was perceived as false if it had any adverts on their webpage.

How to Critically Analyse a Science Article

When looking at any science, look out for these things:

- The **aim (objective)** of the study and author
- Who is funding (giving money) and reporting the study?
- Is there a **conflict of interest?** (Is someone wanting it to work because their friend’s job needs it to work?)
- **Balanced** article- are both possible sides of the argument being talked about?
- Does the journalist understand the research paper properly?
- Is the discovery based on good evidence? (**Repeatable** data using a **large sample size**)
- Has the scientists made the correct **conclusions?**

Objectives :

C - Explain how Scientists determine (find out) if something is true (a fact) or not by using experiments and collecting data.

B - Critically analyse scientific and medical articles for their scientific validity.

A - Evaluate the extent to which the autism and vaccine scandal spread so far and wide because it was hard to know if it was fake or the truth.

Contributed by Christopher Pegg, KS3-4 Science Teacher and KS5 Biology Teacher at Grey Court School.

Science example lesson plan

Topic	Do vaccines cause autism?	KS3 and KS4 appropriate
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By the end of the lesson students will....	<p>C - Explain how Scientists determine (find out) if something is true (a fact) or not by using experiments and collecting data.</p> <p>B - Critically analyse scientific and medical articles for their scientific validity.</p> <p>A - Evaluate the extent to which the autism and vaccine scandal spread so far and wide because it was hard to know if it was fake or the truth.</p>
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What will the teacher do?	What will the learner do?
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Starter

<p>Starter slide up for students.</p> <p>Task: list all the ways that scientists can find out if a fact is true or not?</p> <p>Hint: how do you find out information about the world?</p> <p>Extension: If facts are the truth, then why do scientific theories about the world change over time?</p>	<p>Students to draw on own knowledge of how they find out knowledge and apply to scientists. How might scientists do it differently to them?</p> <p>Students write list and add to it following class discussion and feedback.</p>
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Main part of the lesson

<p>1) How do we know if a story in the news about science or medicine is true and not fake?</p> <p>2) Class discussion based on what the students circled: Students are then introduced to the concept of critically analysing a science article in the news by looking out for the following criteria:</p> <ul style="list-style-type: none"> • the aim of the study • who is funding and reporting on the study • if there is a conflict of interest in the study • balanced article - are the potential limitations and criticisms of the study discussed? 	<p>Students will be given a handout with one half of the page containing examples of miracle cure anti balding medicine, miracle cures, healing rituals etc. and an example of an accessible science journal.</p> <p>Task: Student to identify and circle the parts of the page that they use to determine if an article is valid (validity as a concept will be explained) or not. They must explain at the bottom why specifically and which one they think is more likely to be the truth.</p> <p>Students participating in class discussion and giving feedback on what they circled. Students self-assess if they circled all the possible relevant things.</p>
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- if the headline has understood the research paper properly
- if the research paper is based on repeatable data using a large sample size
- if the scientists have interpreted the results properly.

3) **Analysing homeopathy: Why is homeopathy not used in hospitals?**

Extension: Joke: What do you call alternative medicine that works?.... Medicine. Question: Using your grid, Why are many alternative medicines not accepted in most scientific communities (by conventional medicine/ Doctors in hospitals)?

Task: Students are given a tick box grid containing the above criteria. Students to critically engage with the claims made by homeopaths. Students watch a video on homeopathy and identify using the above criteria if homeopathy is valid science.

Plenary

TASK: Do vaccines cause autism?

Students given an article from the contemporary period claiming that vaccines cause autism.

Reveal and Post-it Note results:

Students told that there is **no evidence** for the claim that autism is caused by vaccines; they are shown a video that reveals the doctor based his study on a small sample size, was paid by a vested interest and has since had his medical degree suspended. The terrible harm the fake news has had on children and families around the world is referenced.

Students to outline and explain two ways that the article suggests the claim is true , and two ways that the article might not be true (using the grid)

Students to answer the question: Why was it so hard for people at the time to determine (find out) if the article was true (published by a doctor in a reputable medical journal) or not (small sample size; doctor was paid by vested interests; biased statistical model used)?

Students write down what they have learnt today on a Post-it Note and explain how/if the lesson has changed the way they read science articles in the future.