

Stage 2 Physics

Science as a Human Endeavour

Sample question 3 and possible answers

(Refer to the exemplar examination, <https://www.sace.sa.edu.au/web/physics/stage-2-in-2018/support-materials/assessment-task-exemplars>, Question 16 (c))

Students must learn to identify the four SHE key concepts in articles, videos, talks etc. Students must then be taught how to write short explanations that explicitly show how recent innovations, developments or events illustrate particular SHE key concepts.

Information

In 2011 scientists working on the Oscillation Project with Emission-tRacking Apparatus (OPERA) published results of an experiment showing the speed of muon neutrinos to be 0.002% faster than the speed of light. The controversial results were reported by the media to be one of the biggest scientific discoveries of the century.

OPERA scientists recognised the possibility of an error, but they were unable to find its source. Their results were published online so that other scientists could analyse the data to find the possible source of error. In 2012 it was discovered that the error was due to a loose cable.

The research director Sergio Bertolucci noted at the time:

[al]though this result isn't as exciting as some would have liked, it is what we all expected deep down. The story captured the public imagination, and has given people the opportunity to see the scientific method in action – an unexpected result was put up for scrutiny, thoroughly investigated and resolved in part thanks to collaboration between normally competing experiments. That's how science moves forward.

Using the information above, explain how science relies on clear communication and on review and verification of results.

Question requires an answer relating specifically to the Communication and Collaboration SHE key concept.

Possible answer 1

The above example shows the importance of the review and verification of results. The OPERA group claimed that they had found an example of a particle moving faster than light – something that was thought impossible and contradicting the theory of special relativity. If true, much of what is understood would be incorrect. However, before findings are accepted by the scientific community as a scientific 'fact', they must be tested and re-tested by other groups to ensure that the claims are valid, as physical laws and phenomena are assumed to be replicable. This was important in this example, as an error was found in their equipment, showing their claims were incorrect.

Review

Verification

This example also shows how important clear communication is in science. Not only so that other scientists can understand methods, theory, data and analysis but also so that general public can understand scientific research, especially if they are publically funded. In the example above, other scientists around the world needed to understand the OPERA group's data so it could be analysed appropriately.

Interaction between science and society

Explanation of the communication and collaboration SHE key concept. Detailed and well-considered connection to how this study highlights the interaction between science and society.

Possible answer 2

For scientists to confirm results, they must use a universal language, where terminology, data representation and analysis of data etc. are performed using agreed upon understandings and techniques. Without this standardised communication, results could be interpreted differently and therefore making meaning of data would be difficult and confusing, leading to errors in interpretation of data and incorrect conclusions being drawn. This could fundamentally alter what we know to be scientific truths in relation to theories and models.

Communication

Review

Collaboration

Communication

Scientists, the media and others in society used the publication of results in a format that would enable analysis by those not involved in the original study. This led to an error being identified, enabling the results, in a format that would enable analysis by those not involved in the original study. This led to an error being identified, enabling the results to be more accurately analysed, giving more credibility to this 'one of the biggest scientific discoveries of the century'.

Verification

Explanation of the communication and collaboration SHE Key concept. Detailed and well-considered connection to how this study highlights the interaction between science and society.

Possible answer 3

Communication and Collaboration

If the scientists working on the project had not communicated with each other clearly, the project would have not got anywhere. If they had not communicated clearly by publishing their results online, no one would have discovered that there had been a mistake and lots of money would have been spent on other projects based on flawed theory of these fast muon neutrinos. It is important that results like these can be reviewed by other scientists so that everyone can be confident that the conclusions are valid and reliable. Ideas in science are not just built on one person saying that something is so. There has to be a lot of independent supporting evidence.

Verification

Review

Explanation of the communication and collaboration SHE Key concept. Detailed and well-considered connection to how this study highlights the interaction between science and society.