Working together

Cooperation refers to the process of "working together towards the same end, purpose, or effect" (Oxford English Dictionary, 2019). This might be between teacher and student but can be even more effective between peers. Here I'll share five manifestations of cooperation through the lens of the nature of science: interdisciplinary projects; international mindedness; academic honesty; peer review; and public and political engagement.

Interdisciplinary projects

Contrary to layperson understanding, there is no single scientific method. Ecologists, geologists and astronomers favour observations and sampling leading to categorisation, and physicists and psychologists test hypotheses by controlling variables. All are valid, systematic and replicable, and scientists recognise the value of cooperation across disciplines. Significant conclusions cannot be made without statisticians, processes modelled without computer scientists, alternative explanations suggested without diverse thinking, or data logging probes manufactured without engineers.

The Human Genome Project involves geneticists, electrophoresis physicists (Dovichi, 1997) and software engineers in sequencing DNA. Like any project, imagination and flashes of intuition had their place, a nod to Watson and Crick's fabled double helix moment announced at The Eagle, Cambridge, in 1953.

International mindedness

To facilitate interdisciplinary cooperation, research locations (like universities, government organisations and defense agencies) require funding and may need to draw on a talent pool beyond their locality. In order to operate, therefore, scientists must be internationally minded. The exchange of information across borders is a centuries-old tradition, with science founded in Arabic, Indian and Chinese civilisations.

Today CERN presents an example of the irrelevance of religion, gender and nationality in its 2400 employee-strong mission to complete the Standard Model of particles. Scientific languages are developed to transcend discipline, such as mathematics and the Système Internationale d'Unités. The individual scientists' personalities, disappointments and triumphs create an intrinsically human environment in which to work with theoreticians and experimenters in symbiosis.

Academic honesty

While members of a research group and their funding are likely to be internationally derived, they may elect to work in isolation from other groups. Commercial advantages, academic promotions or increasing resources are often up for grabs if a group is the first to validate a theory or solve a problem. However, as with school experiments, efforts must still be made to repeat measurements, calculate the probability that a conclusion is correct, consider all sources of uncertainty and guard against bias.

With human lives at stake, no shortcuts can be taken by competing research groups in medicine or pharmaceuticals. New drugs and interventions must be tested through the strict clinical trials process before being put into use. Scientific research has a reputation built on the integrity and academic honesty of its claims. Scientists uphold these values by acknowledging their sources and avoiding plagiarism. They date their work and publish their findings, whether positive or negative in relation to the initial hypothesis.

Peer review

For research to be considered scientific, it should develop a common understanding of the independent, external reality of the universe. Peer review is undertaken before publication by experts in similar fields with ultimate approval by a journal editor to ensure that all scientists (from undergraduates to world-leading professors) are subjected to the same criteria. This initial skepticism is welcomed by researchers who reciprocate for others.

This process became key when, in September 2011 , we awoke to the news that neutrinos, a type of subatomic particle, had broken the speed of light (Istituto Nazionale di Fisica Nucleare, 2011). The OPERA research group held up their work to scrutiny among their community in a conference. Although later proved incorrect due to loose cabling (!), humankind has witnessed many such paradigm shifts in its history: wave-particle duality, evolution by natural selection and the Copernican model of the universe.

Public and political engagement

Scientific conclusions are not always unambiguous and recommendations are sometimes ignored. Many fields have ethical implications that must be communicated effectively with the public and political policy makers. Examples include genetic engineering, nuclear power and medical transplants (International Baccalaureate, 2014). The rapid availability of publications online can raise awareness of science, but risks being misunderstood if incomplete media reports reign in the public consciousness.

Political bias and the prevalence of lucrative pseudoscience can lead to a distrust of what scientists have to say or a reluctance to act by popular leaders. For example, mitigating against the effects of climate change may only become government policy if pressure is applied by the voting public. Dissemination of results should be planned from the outset of research design with due consideration of possible controversies and the likely emotional fallout.

Science is a human activity, a bringing together of minds and resources, to form a greater collective understanding of the universe. As with any endeavour, competition and professional pride have their place. However, it is only through cooperation that hypotheses can be tested, results verified, conclusions published and paradigms shifted.

Cooperation has its place at Whitgift too. Learning new ideas through classroom experiences, forging paths to excellence in co-curricular activities and even revision for external exams can be boosted by working together. You see, while we are often judged on our individual contribution or merits, the sum of our parts can produce a greater whole. I urge readers to look for opportunities to cooperate and invite others to do the same. Share your knowledge at PRISM and support your peers as they do likewise, celebrate and commiserate with friends, and make suggestions if you have an idea.

To find out more about the nature of science, ask at the Library for books on the theory of knowledge (I'd recommend the Very Short Introductions series) or, better still, aim for the breadth of the IB Diploma or the addition of an EPQ in the Sixth Form. W

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