

## Physics Enrichment program

### Nature of science commentary

The "Nature of Science" is an over-arching theme that is present in all science topics. It is about how science works and how we test and improve science. There are many small aspects and here are some key ones that you should be aware of as you are studying in the sciences.

Common terminology Observations Intuition Evidence through experimentation Imagination Competing theories Common reasoning process Modelling Models and visualization Observable universe Predictions	Insights Development of theories Curiosity Serendipity / Accidental discovery Improved technology/instrumentation Human understandings Long-term risks Risks and problem-solving Variety of perspectives Relationships Peer review	Collaboration Bias Theoretical advances and inspiration Modern computing power Using mathematics Theories Laws Paradigm shift Uncertainties Patterns, trends and discrepancies
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Please write a commentary about any recent discovery/innovation in the field of physics during last 50 years. Some suggested topics are shown below. Please write a minimum of about 4-5 paragraphs about this development. This commentary is partly persuasive as you are trying to persuade the reader about how these aspects of the nature of science have influenced the discovery.

The first paragraph is your introductory paragraph which describes the issue and the aspects you will explore. The next 2-3 paragraphs explore each aspect with examples. You can structure each of these supporting paragraphs using the PEE model. The opening sentences makes the **P**oint. The following sentence uses **E**xamples/ Evidence from your chosen discovery. Then conclude your paragraph with an **E**xplanation. The final paragraph will be a concluding paragraph. The introductory and concluding paragraphs may be a little smaller so the total length of the commentary is about 300 words. An example essay is attached using a Biological example..

Please mail the commentary by 15th July 2020.

#### Some possible topics

change to the definition of the mass	Quantum entanglement
Higgs Boson	Discovery of Extrasolar planets
discoveries by the Large Hadron Collider	Bose-Einstein Condensates
Gravitational waves	Proof that Neutrinos Have Mass
Cosmic Inflation	Room Temperature Superconductors

You can also check science news (Purch, 2018) for further articles and from Top 10 physics discoveries (Cham, 2015).

# Top 10 Physics DISCOVERIES of the last 10 Years



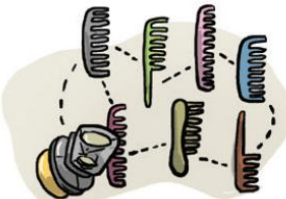
Majorana Fermions



Parity-Time Symmetry in Optics



Magnetic Monopoles  
...on (Spin) ICE!



Planck's Comb Map



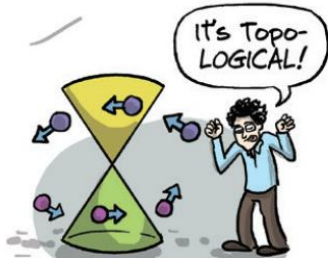
Scotch Tape, Nobel Prize Edition



The Higgs Bison



~~Faster Than Light Neutrinos~~  
oops!



Topographical Insulators



Measuring Quantum Effects

NOT Measuring Quantum Effects

In Superposition

## References

Cham, J. (2015). Top 10 physics discoveries of the last 10 years. *Nature Physics*, 11(10), 799–799. doi:10.1038/nphys3500

Purch (2019.). Live Science: The Most Interesting Articles, Mysteries & Discoveries. *Science News 2018 - Latest Scientific Discoveries*. Retrieved from <http://www.livescience.com/news>

## Example Commentary: The Human Genome Project

The Human Genome Project (HGP) was started in 1990 by the US Department of Energy, National Institute of Health and a number of other organisations both national and international (Smithsonian’s National Museum of Natural History & National Human Genome Research Institute, 2017). It had the then ambitious target of mapping the entire human genome with 15 years. It was able complete in even shorter time. I will outline 3 aspects that lead to the success of this project which includes collaboration, improved technology and consideration of ethics.

Firstly, large projects that require both capital and labour investment and also needing a range of expertise often benefit from collaboration. An example is the HGP which requires thousands of DNA sequencing machines in order to complete the task in the set timeline. In addition, to both run these machines and the databases storing the results also required of lot of experts. The collaboration means the initial costs can be shared amongst all the collaborators. Also, the collaborators, can contribute with their field of expertise meaning that further training is not as necessary. Hence collaboration was very useful for this project.

Secondly, new knowledge gained in science often comes from experiment and observation, however, we are sometimes limited by our equipment. In the HGP, the use of fluorescently tagged bases and capillary gel electrophoresis enabled much of the process to be automated and so up to 40 million bases could be read per day in one facility alone compared to slow manual method (Marzillier, 2013). Hence, without the improved technology, the project would have taken many decades instead of only one. When the technology improves, we can often make better and faster observations and design more precise experiments.

Thirdly, there was also an ethical issue to consider when making new discoveries. For example, in the HGP, there were some private companies also contributing but they were looking to patent part of the gene sequence. However, one of the fundamental principles driving the public institutions involved in the HGP was that “all data should be freely available and in the public domain to encourage research and development” (Fortun, 2006). Some scientists argue that patenting genes is a reasonable way to seek commercial returns for the time and money invested in genetic research. Others feel it is wrong to allow ownership of the building blocks of life. This ethical issue needs to be considered to allow this project to continue.

In summary, the HGP was a project that successfully mapped the human genome. There were many aspects that led to its success, three of which were outlined above. They were the collaboration, improved technology and consideration of ethical issues.

### References

Fortun, M. A. (2006). Celera Genomics: The Race for the Human Genome Sequence. Encyclopedia of Life Sciences.

Marzillier, J. (2013). DNA Sequencing & The Human Genome Project: An Endeavor Revolutionizing Modern Biology [PDF]. Retrieved from [https://www.lehigh.edu/~inbios21/PDF/Fall2013/Marzillier\\_11132013.pdf](https://www.lehigh.edu/~inbios21/PDF/Fall2013/Marzillier_11132013.pdf)

Smithsonian's National Museum of Natural History & National Human Genome Research Institute. (2017, December 27). Genome: Unlocking Life's Code. Retrieved from <https://unlockinglifescode.org>