Suggested Project Themes for UPC2211/UGFN1000

Your team has to come up with a project topic from the suggested themes below or a self-initiated theme. In either case, it is subject to teacher approval. Moreover, the proposed topic should include a clear thesis, and no two teams can share the same topic. Sample topics are provided at the end of each theme. If you have any question about the theme, please contact the teacher concerned for more details.

In addition, each suggested project theme below is a broad subject. You better narrow down into a specific topic, and one way to prepare a presentation is to answer 3 related questions, each of which is at different levels of thinking complexity. To be more concrete,

Level 1 (understanding): Browse some websites, such as Google Scholar, to select an academic article related to one of the suggested project theme and summarize relevant arguments in the article.

Level 2 (analysis): Analyze or compare information by applying knowledge you have learnt in the course.

Level 3 (establishment): Establish your own views.

Theme 1: Consciousness and Dreams (Dr. Wing-hung, email: whwong@cuhk.edu.hk)

If you think it is stupid to say we are conscious when sleeping, you may find it nonsensical to believe one can learn when dreaming. Studies showed that there are on average 5 cycles in each sleep. In each cycle, there are 5 stages with the last one called REM sleep, where REM stands for "rapid eye movement". If someone opens your eyelids when you are in a REM sleep, s/he will see your eyeballs are rapidly rotating. Would you find it interesting to know that REM sleep is closely associated with dreaming? (https://en.wikipedia.org/wiki/Rapid_eye_movement_sleep) It was also found that the brain activities in a REM sleep show resemblances with those during wakefulness. In other words, while we are dreaming, to a certain extent, we are conscious. Lucid dreams might be evidence of consciousness during dreaming because we are aware of ourselves in a lucid dream.

Many interesting topics are worth investigation, for example, the relation between dreams and consciousness. In particular, lucid dreams during REM sleep may show some characteristics of consciousness. Another thought-provoking topic is whether dreams can assist learning. However, there seems no conclusive study on the topic. Some people took a slightly different approach that instead of the human brain, they studied artificial neural networks.

There are plenty of literatures on this theme:

1. Ursula Voss et al. 2013. "Measuring consciousness in dreams: The lucidity and consciousness in dreams scale," *Consciousness and Cognition*, Vol. 22, No.1, pp. 8-21. https://www.sciencedirect.com/science/article/pii/S1053810012002103?via%3Dihub
2. https://en.wikipedia.org/wiki/Rapid_eye_movement_sleep

3. James N Cousins et al. 2020. “Sleep after learning aids the consolidation of factual knowledge, but not relearning,” *Sleep*, zsaa210. DOI: https://doi.org/10.1093/sleep/zsaa210
4. https://www.nature.com/articles/304111a0
5. https://cnalifestyle.channelnewsasia.com/trending/singaporeans-world-sleep-day-survey-12533954
6. https://www.scmp.com/news/hong-kong/economy/article/1942608/sleep-deprived-and-internet-mad-hongkongers-place-last
7. https://www.who.int/mediacentre/commentaries/2016/health-sustainable-goals/en/
8. https://www.wellcertified.com/sdgs (see Sleep Support)

Note that all the references above are to provide you a general background. Students are required to do a systematic literature review on the discussion topic concerned.

Theme 2: Depression and Schizophrenia (Dr. Wong Wing-hung, email: whwong@cuhk.edu.hk)

There has long been the debate between nature and nurture: Which is the determining factor of the physiological and psychological conditions of an organism? In today’s language, this question can be rephrased to “How do environments and genes interact to determine the physiological and psychological conditions of an organism?” Some scientists addressed this question by studying schizophrenia and depression. There is evidence, from both humans and mice, that the onset of schizophrenia or depression is correlated to the attachment of methyl groups or acetyl groups, which are tiny molecules, to a specific gene. In the field of epigenetics, studies showed that the attachment of the tiny molecules can alter the expression of the gene. Such alterations, which we also call epigenetic changes, do not only occur in primitive cells but also in mature cells (https://www.scientificamerican.com/article/determining-nature-vs-nur/, *Scientific American Mind*, October 2006). An interesting discovery is that some epigenetic changes are correlated to environmental influences such as a hostile environment and maternal care. However, how the environment influences give rise to the epigenetic changes is still unknown.

The interesting interaction between environments and genes is still a hot topic. Are there any new results in the field of epigenetics? Below are some useful literatures for further investigation:

1. Giacomo Cavalli and Edith Heard. 2019. “Advances in epigenetics link genetics to the environment and disease,” *Nature* volume 571, pages 489–499. (https://www.nature.com/articles/s41586-019-1411-0)
2. https://pubmed.ncbi.nlm.nih.gov/12823168/
3. https://www.fhb.gov.hk/download/press_and_publications/otherinfo/180500_mhr/e_mhr_full_report.pdf
4. https://www.who.int/mental_health/suicide-prevention/SDGs/en/

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Theme 3: Cupping Therapy (*Hijama*) (Dr. Wong Wing-hung, email: whwong@cuhk.edu.hk)

It is said that when Michael Phelps was swimming in the Olympics, the most eye-catching was not his skills but those circular marks located symmetrically over his body. These marks were caused by cupping (https://theconversation.com/cupping-at-the-olympics-what-is-it-and-why-do-athletes-use-it-63729). Cupping has a long history but its origin is unclear. (*Wikipedia*: "Cupping Therapy" and https://www.sciencedirect.com/science/article/pii/S2005290117302042#:~:text=Cupping%20therapy%20is%20an%20ancient%20technique%20of%20healing%20%5B1%5D.,texts%20to%20mention%20cupping%20therapy.) We only know it was practiced long time ago in different places including ancient Greece and China. Now it is practised nearly all over the world, usually as a form of alternative medicine.

Are there any geographical factors which determined its spread? How about cultural factors? It seems that people in the East welcome this therapy more than Western people do. Is there any relation to the underlying worldview of cupping? Below are some useful reading materials on this theme.

1. https://en.wikipedia.org/wiki/Alternative_medicine
2. Naseem Akhtar Qureshi et al. 2017. "History of cupping (Hijama): a narrative review of literature," *Journal of Integrative Medicine*, 15(3): 172–181. (https://www.sciencedirect.com/science/article/pii/S209549641760339X?via%3Dihub)
3. Anna Marie Dinall. 2019. "A reflection on cupping therapy and historical medical dominance," *International Journal of Complementary & Alternative Medicine*, Volume 12 Issue 2, pp. 66-68. (https://medcraveonline.com/IJCAM/a-reflection-on-cupping-therapy-and-historical-medical-dominance.html).

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Theme 4: Values of genetic technology (Dr. Pang Kam-moon, email: kmpang@cuhk.edu.hk)

A piece of news in *The Washington Post* reports that a Jordanian couple had lost six babies to Leigh syndrome, a heritable neurological disorder. Dr. John Zhang and his research team applied techniques of genetic editing and successfully help the couple give birth of a healthy baby.[1] Yet, the opponents regarded his act is pushing the boundaries of religion, as well as moral and ethical acceptance. Thus, this inspires us to ponder on how we make a decision when encountering a situation where science meets some unquantifiable values such as morality or human rights.

Science and technology can detect in the early stage of embryonic development whether an embryo has a congenital genetic disease, hence the babies with serious congenital diseases can be identified and thus be provided with suitable supports. Yet, no matter whether an embryo is healthy or has a congenital genetic disease, genetic testing of the embryo (an individual) will bring about ethical and moral issues such as privacy. Every person is entitled to privacy; however, genetic testing discloses the genetic characteristics of the individual.

Following the same line of thought, a couple in the future can even assign expected talents to their children by presetting relevant genes, so that the choice of their future career becomes more apparent. Selecting appropriate genes for embryos according to parents' preferences, babies can get, for example, better musical talents. Under the principle of resource optimization, the resources for cultivating musicians are given to those gifted children. The chance of becoming an outstanding musician in the future becomes higher than those who have not been genetically selected. However, the opponents regard those who have being genetically selected will lose their autonomy and are allowed to follow their own interests to choose their career.

In addition, this topic brings about discussions on the nature of science. Vaccination is an example. Vaccination campaigns helped eradicate smallpox, and scientific evidence for the effectiveness of large-scale campaigns has been well established. Yet, advocators of anti-vaccination refuse to have themselves or their children vaccinated against contagious diseases despite the availability of vaccination services. The World Health Organization identified this as one of the top ten global health threats of 2019.[2] Anti-vaccination primarily results from public debates in social media around the medical, religious and ethical issues related to vaccines. Another news that was

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[1] Ariana Eunjung Cha, "This fertility doctor is pushing the boundaries of human reproduction, with little regulation", *The Washington Post*, May 14, 2018. https://www.washingtonpost.com/national/health-science/this-fertility-doctor-is-pushing-the-boundaries-of-human-reproduction-with-little-regulation/2018/05/11/ea9105dc-1831-11e8-8b08-027a6ccb38eb_story.html.

[2] World Health Organization, "Ten threats to global health in 2019". http://www.who.int/emergencies/ten-threats-to-global-health-in-2019.

spread widely is the "resurrection" of the woolly mammoth. The woolly mammoth is a species of mammoth that lived during the Pleistocene until its extinction in the Holocene epoch. Some social media reported that the Harvard geneticist George Church would produce elephant embryos with woolly mammoth genes within two years.[3] However, John Hawks in his blog said that Prof. Church verified that these are just a fake news.[4] Is John's announcement another fake news? It leads us contemplate how the public comes to have scientific knowledge, and how we can distinguish it from inauthentic science presented as scientific by various political or economic interests.

Sample topics include "Under what circumstances genetic testing is advisable", "Discuss if your host country favors the concept of dream babies", and "Investigate why anti-vaccination is spread over the public successfully".

References:

1. "Prenatal Diagnosis & Testing: There's been a lot of talk about genetic testing. What is it? Are there any ethical and religious issues associated with it?" Saint Joseph's University, October 21, 2009. https://sites.sju.edu/icb/prenatal-diagnosis-testing-theres-been-a-lot-of-talk-about-genetic-testing-what-is-it-are-there-any-ethical-and-religious-issues-associated-with-it/.
2. Kelli Swan, "Genetic Testing and the Christian Faith: Navigating the Tension Responsibly". https://biologos.org/articles/genetic-testing-and-the-christian-faith-navigating-the-tension-responsibly.
3. Bryan Galvan, "The future of gene editing: ending disease or creating super-soldiers or a master race? Why rules are needed," *South China Morning Post* (Dec 30, 2018), https://www.scmp.com/lifestyle/health-wellness/article/2179853/future-gene-editing-ending-disease-or-creating-super.
4. Clive Cookson, "Gene-edited babies: From red light to orange... and then green?", *The Straits Times* (Feb 20, 2017), https://www.straitstimes.com/opinion/gene-edited-babies-from-red-light-to-orange-and-then-green.
5. "Michael Sandel on the values of being a human being". https://www.youtube.com/watch?v=tK3GyjnA3Yc.
6. Hopf H, Krief A, Mehta G, Matlin SA, "Fake science and the knowledge crisis: ignorance can be fatal", *R. Soc. open sci.*, **6**: 190161. (2019). http://dx.doi.org/10.1098/rsos.190161.

[3] "Woolly mammoth on verge of resurrection, scientists reveal", *The Guardian*. https://www.theguardian.com/science/2017/feb/16/woolly-mammoth-resurrection-scientists; "Woolly mammoth could be 'de-extinct' in 2 years, scientist says", *Weird News*. https://www.huffpost.com/entry/woolly-mammoth-elephant_n_58a62fa7e4b037d17d264477.

[4] John Hawks, "How mammoth cloning became fake news". https://medium.com/@johnhawks/how-mammoth-cloning-became-fake-news-1e3a80e54d42.

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Theme 5: Gender difference (Dr. Pang Kam-moon, email: kmpang@cuhk.edu.hk)

Traditional view on a man is that he knows the virtue of silence, throws a ball with accuracy, parks a vehicle with perfection, and take offence over trivial issues. In contrast, the view on a woman is that she is the mistress of grammar and superior at reading, capable of judging the moods and intentions of others with finesse and running a web of complex social relationships. “What makes the gender difference?” This question has been studied in a variety of fields, including medicine, physiology, psychology, as well as sociology.

Scientifically, evolution has come into play. The gender difference starts in the womb with a great rinsing of hormones that trigger the diverging of ways;[5] recent study on brain connectivity further reveals that there are indeed some striking differences in the neural wiring of men and women. The researchers further explain some beliefs those are commonly held about their behavior, for example, females outperformed males on attention, word and face memory.[6] Though the evolutionary difference between males and females are fascinating topic, it has been argued that the scientific understanding of the differences between men and women will reinforce the traditional views on sexes, thus boosting sexual stereotype or even discrimination.

In contrast, feminists argue that the differences might be solely due to cultural and social construction. For instance, MIT researchers reports that that the percentage of women who go to college intending to become engineers stay in the profession less than that of men. It is due to the fact that women often feel marginalized during team-based activities or internships; consequently, those experiences make the profession less appealing.[7] Thus, it has been a controversial issue that social or other barriers to women’s achievement in the field of science and engineering do exist.

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[5] Janet Radcliffe Richards, “How are men and women different” in *Big questions in science* (London: Vintage, 2003), pp. 103 – 115.

[6] Perelman School of Medicine at the University of Pennsylvania. "Brain connectivity study reveals striking differences between men and women." *ScienceDaily*. www.sciencedaily.com/releases/2013/12/131202161935.htm.

[7] MIT. "Study offers explanation for why women leave engineering: Group dynamics of teamwork, internships deter many women in the profession." *ScienceDaily*. www.sciencedaily.com/releases/2016/06/160615135205.htm.

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This controversial topic further inspires us to contemplate the cultural influences in science education and whether science education today has favored a particular gender and how to improve the science education in your host country so as to embody gender equality.

Sample topics include “Investigate if scientific understanding of gender difference boosts sexual stereotype”, “Justify if there is any social or other barriers to women’s achievement in the field of science and engineering”, and “Determine if science educations in Hong Kong and in Singapore advocate pragmatism”.

References:

1. Student Enrolment Statistics, NUS. http://www.nus.edu.sg/registrar/student-records/student-statistics.
2. “Why women are poor at science, by Harvard president,” *Guardian* (Jan 18, 2005), https://www.theguardian.com/science/2005/jan/18/educationsgendergap.genderissues.
3. Sam Dillon, “Harvard Chief Defends His Talk on Women,” *The New York Times* (Jan 18, 2005). https://www.nytimes.com/2005/01/18/us/harvard-chief-defends-his-talk-on-women.html.
4. Kaili Rimfeld and Margherita Malanchini, “How much is academic achievement shaped by genes?”, *BBC*, 7th September 2018. https://www.bbc.com/future/article/20180905-how-genes-influence-achievement-and-success-in-school.
5. Thomas Breda and Clotilde Napp, “Girls’ comparative advantage in reading can largely explain the gender gap in math-related fields”, *PNAS*, July 30, 2019. https://www.pnas.org/content/116/31/15435.
6. Eva Krugly-Smolska, “Cultural influences in science education”, *International Journal of Science Education*, Volume 17, 1995 – Issue 1. https://www.tandfonline.com/doi/pdf/10.1080/0950069950170104.
7. Lee Yew-Jin, “Primary Science Education in Singapore” (https://gocuhk-my.sharepoint.com/:b:/g/personal/tszchunchoy_cuhk_edu_hk/EUuQKMzGDHRKoin0x1AHw9QBtBMQKOZ52AjU7MtDMwUhzQ?e=aqPGoI); So Wing Mui Winnie, Wan Zhi Hong & Chen Yu, “Primary Science Education in Hong Kong” (https://gocuhk-my.sharepoint.com/:b:/g/personal/tszchunchoy_cuhk_edu_hk/ERXe6YfWdLJClZpOpn5C5VQBt7j4yKMLerK1EW0JHdpUMA?e=9MxZlm). in *Primary Science Education in East Asia: A Critical Comparison of Systems and Strategies*, ed. Yew-Jin Lee and Jason Tan, (Springer, 2018).
8. Yu Chong Ho & Lee Hyun Seo, *Creating Change to Improve Science and Mathematics Education: Lessons from Hong Kong*, (Singapore: Springer, 2020), Introduction (https://gocuhk-my.sharepoint.com/:b:/g/personal/tszchunchoy_cuhk_edu_hk/Ee196rVwX0tIrFrFXFO_5egBVVLoJTERJajPtbhEFKFO3g?e=epxVgA)

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Theme 6: A Scientist Predicts the Future (Dr. Pang Kam-moon, email: kmpang@cuhk.edu.hk)

Michio Kaku, an American theoretical physicist and popular science communicator, interviewed 300 of the world's top scientists and visited their laboratories for frontier sciences. Afterwards, Kaku predicted 10 significant changes in the world in coming decades. Reference: Michio Kaku, "A Scientist Predicts the Future" *The New York Times*, November 28, 2013. https://www.nytimes.com/2013/11/28/opinion/kaku-a-scientist-predicts-the-future.html. Most of them involved the development of science and technology. Among these technological projects, some have brought progress and development to mankind, and however some might have brought regression.

The future world depends on today. Sustainable development, which can be defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs, is a hot topic in recent years. The idea of the Sustainable Development Goals (SDGs) emerged in 2011, and the SDGs are a set of global goals for fair and sustainable health at every level: from planetary biosphere to local community.[8] The aim is to end poverty, protect the planet and ensure that all people enjoy peace and prosperity, now and in the future. Among the science and technological projects involved in the 10 significant changes, some of them align with the SDGs, and the others might not.

Hong Kong and Singapore have a different cultural background and their own strengths to develop some particular fields of science and technology. In Hong Kong, leading infectious diseases research and advancing the frontier in the study of human and animal influenzas, and other emerging viruses can be traced back to the discovery of and the fight against the SARS coronavirus in 2003. Among the science and technological projects involved in the 10 significant changes, which is the most suitable for Hong Kong to work on and which for Singapore?

Sample topics include "In the Kaku's article, which technological project has brought positive impacts on humans and nature and one has brought regression?", "Which technological project has aligned with the SDGs and which does not?", and "Choose one technological project which is the most suitable for Hong Kong to work on and one for Singapore".

[8] United Nations, "The 17 goals". https://sdgs.un.org/goals; "Sustainable Development Goals (SDGs), and their implementation: A national global framework for health, development and equity needs a systems approach at every level". https://pubmed.ncbi.nlm.nih.gov/29069332/.

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1. Google Arts & Culture, “How machine learning is changing everything: tech's big watchword explained”. https://www.youtube.com/watch?v=xUhlpfewemY.
2. DeepMind, https://deepmind.com/impact. This website introduces some real-world projects built on our breakthroughs in fundamental AI research.
3. Jeremy Rifkin, “The Internet of Things: Monopoly Capitalism vs. Collaborative Commons,” *The Huff Post* (Dec 06, 2017), https://www.huffpost.com/entry/internet-of-things_b_5104072.
4. Terence Yuk Ping Lam, Kwok Chi Lau, “Examining Factors Affecting Science Achievement of Hong Kong in PISA 2006 Using Hierarchical Linear Modeling”, *International Journal of Science Education*, Volume 36, 2014 - Issue 15. https://www.tandfonline.com/doi/full/10.1080/09500693.2013.879223.
5. *Singapore’s Voluntary National Review of the Implementation of the 2030 Agenda and the Sustainable Development Goals* (2018). https://gocuhk-my.sharepoint.com/:b:/g/personal/tszchunchoy_cuhk_edu_hk/ETOUmbEw-qhEuIKJmoCJ_nUBwsxU3tJxBzSi8J3ariEKBw?e=uNCn1N.
6. UN Sustainable Development Goals under New Urban Agenda Principles in Hong Kong (2020). https://gocuhk-my.sharepoint.com/:b:/g/personal/tszchunchoy_cuhk_edu_hk/EQuTztwaaL5FnVDMGSrb2ewBOz9rj1ag5bzaeBv8fm_x4w?e=PEbLSQ).

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Theme 7: Living with Eugenics (Dr. Chan Chi-wang, email: cwchan@nus.edu.sg)

Eugenics has long been a controversial topic in humanity for its associations with scientific racism and discrimination. However, modern life science keeps accumulating more hints on how genetic information is being stored in our DNA (See James Watson’s DNA: The Secret of Life), and how good traits are correlating with genes (See Robert Plomin’s Blueprint). This will lead to necessary re-evaluation of our answers to the question of “Nature or Nurture?” beyond the scope of psychologists.

The topic of eugenics has become more controversial along with the growth in the studies of genome analysis. The opponent of eugenics suggested that their counterparts were actually promoting the idea of “genetic determinism”, while their counterparts said no. Such dispute was not only taking place at the level of academic discussion. It is observed that the public attitude towards eugenics in different societies could lead to difference in their social norms and policies.

For the topic of eugenics, there will be several meaningful questions to answer: Is eugenics good or bad to build a sustainable future for human beings? Were the findings from genetic science being abused? Was determinism a suitable lens to analyse eugenics?

Theme 8: Fighting Dengue (Dr. Chan Chi-wang, email: cwchan@nus.edu.sg)

Dengue used to disturb many southeast Asian countries and huge social effort is making to minimize its damage to our society. Besides the traditional chemical control of disease-carrying mosquitoes, news innovations that involve genetic-modified (GM) mosquitoes are widely being studied. (https://www.sciencemag.org/news/2019/09/study-dna-spread-genetically-modified-mosquitoes-prompts-backlash)

The working principle of the genetic-modified mosquitoes in controlling Dengue is mostly about gene editing. The experimentations of GM control had also been put into practice in some countries. Results are coming out.

Some possible questions to ask could be: Are we ready to fully impose the genetic-modified mosquitoes' control of disease? How would you advise the public about the major considerations when we were about to introduce genetic means of insects control? Is GM-control a sustainable way to protect human beings from diseases?

Theme 9: On technological determinism

The idea of technological determinism argues that the technological advancements would determine the nature of societies. Such reductionist's idea is giving us a large convenience in understanding human history. For example, the absence of the scientific and industrial revolution in ancient China might be an explanation to its weakness in the 19th and 20th century. (The discussion for such absence was also known as the "Joseph Needham Question".)

Jared Diamond's book "Guns, Germs & Steel" was somehow echoing the idea of technological determinism in explaining the difference in the strength of civilisation. However, some critics would say that technological determinism was not a good idea in understanding history, and it should not be the basic principle to predict human's future.

There are some basic questions to ask: What is the appropriateness of technological determinism in the understanding of history? Should the discussion of "sustainable future" be largely dominated by technological development?