Program Information

Name of Program: Can I, or Should I? Science and Ethics

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Target Audience: All students

Strategy for Implementation: Large group discussion

Time of Year to Implement: Any

Relevant Learning Goal: Goal 1: Social Responsibility - As a member of the IMSA community, it is essential that students understand how their actions affect others and impact the world around them/globally. We challenge our students to develop sustainable skills which include being mindful, accountable, virtuous members of the IMSA community and society at large.

Specific Lesson Outcomes:

- Students will promote an equitable environment
- Students will foster respect for self, others, and the community
- Students will engage in interactions outside of their comfort zone
- Students will recognize, develop, and apply sustainable practices

Purpose: Students will engage in a group discussion about the important relationship that exists between scientific advancement and ethical considerations. Optionally, students learn about an amusing historical example of ethics going unchecked in the face of scientific progress, with what could have been glaringly obvious and disastrous effects, as an illustration of why such advancements must be checked by ethics.

Planning and Preparation:

- This program has an accompanying presentation: https://docs.google.com/presentation/d/12AYjce3f4q6cisazyZfziFf3abwbPAs9ezDDBmlQYaY/edit?usp=sharing
- As always, feel free to tailor this program to your own wing and their interests.

Program Agenda

- **Slide 1: Welcome/Title**
    - [Introduce students to the day's program, discussing the interplay of ethics and scientific advancement, along with an amusing (albeit concerning) historical example of why the two must be connected.]
- **Slide 2: Question 1**
    - [Open the discussion with the question if any of your students have come across any ethical questions in any of the STEM learning they have done so far (inside or outside the classroom).]
    - [Slide 3 contains suggestions.]
- **Slide 3: Question 1 answers**
    - [This slide is just a non-exhaustive list of answers to the question in slide 2]
    - Use/storage of personal data (electronic, geographic, genetic, etc.)
    - Driverless vehicles
    - 3D printing (creation of harmful materials: 3D printed zip guns, etc.)
    - Responses /adaptation to climate change
    - Quality/counterfeit pharmaceuticals
    - Application of Artificial Intelligence (AI)
    - MANY more
- **Slide 4: Question 2**
    - What happens if scientific advancement goes unchecked?
    - [This next question leads the discussion in to the historical trivia example of WHY considering ethics is important]

Author's note: You may decide that Slides 5-9 are a non-sequitur and not relevant/needed for the discussion. They are presented and included to serve as an amusing example of the subject matter (scientific advancement done without ethical consideration). By all means, feel free to scrap them/replace them in your own version of the program

- **Slide 5: Project Plowshare**
    - [Introduce the historical anecdote of Project Plowshare, marketed as "atoms for peace," running from 1957 to 1977 in the U.S. under the Atomic Energy Commission]
- **Slide 6: Project Plowshare and PNEs**
    - The plan of this project, conceived as the Cold War was ramping up: to dedicate the U.S.'s growing nuclear arsenal towards what were identified as peaceful civil projects meant to benefit mankind.
    - What were some of these ideas? Among others, Project Plowshare

suggested using nuclear bombs for
        - Earth removal for interstate highways
        - Mining and natural gas extraction (fracking)
        - Widening the Panama Canal
        - Artificial harbors along coastlines
        - Energy generation (steam from underground detonations)
    - **Do we see any problems with any of these?**
- **Slide 7: Storax Sedan test detonation**
    - However foolish they seemed, tests still happened for this project
    - Storax Sedan, for example, was the name given to a proof-of-concept nuclear test detonation in the Yucca Flat, Nevada in 1962.
    - The test was meant to test the viability of using nuclear weapons to expedite mining and extraction of natural resources (such as natural gas) from deep underground as well as to assess the viability of nuclear weapons for large-scale landscaping projects (such as to build highways across the Mojave Desert)
    - "The 104 kiloton detonation displaced 12 million tons of soil and resulted in a radioactive dust cloud that rose 12,000 feet [3,700 m] and plumed toward the Mississippi River." - Sovacool, Benjamin K (2011), "Contesting the Future of Nuclear Power: A Critical Global Assessment of Atomic Energy," World Scientific, pp. 171–2
    - **Surely nothing wrong there, yes? (this is sarcastic)**
- **Slide 8: Storax Sedan test detonation effects**
    - As it turns out, there are actually many reasons not to test detonate nuclear weapons, in general, but also in your own country.
    - Subsequent analysis of the radioactive fallout from the test detonation showed that not-negligible doses of radiation were carried across the American Midwest, mainly settling throughout the state of Iowa.
    - So there we have a clear example of people who had nothing to do with a scientific project being harmfully exposed because ethics weren't considered.
- **Slide 9: Project Plowshare Termination**
    - [Read the excerpt]
    - And so ends perhaps one of history's most egregious examples of unchecked scientific ideation ignoring the vital aspects of ethics.

- **Slide 10: Question 3**
    - [Resume the large group discussion by asking the recap question of why being ethical is important in any scientific exploration or research.]
- **Slide 11: Question 3 answers**

    - Promote goals of research - knowledge, truth, avoiding error
    - Ethical practices facilitate better cooperation and coordination
    - Ensures work is accountable
    - Builds public support for research
    - Promotion of moral and social values
- **Slide 12: Question 4**
    - [Test if your students know the kinds of safeguards and agencies that are in place to uphold ethics in the scientific community.]
- **Slide 13: Question 4 answers**
    - Professional societies/codes of conduct
    - Peer-review processes in journals and publications
    - Regular education/training for professionals centered around ethical conduct
    - Third-party oversight of research conduct
- **Slide 14: Codes of conduct**
    - [Illustrate how seriously the world's scientific agencies take matters of ethics by showing their webpages on ethics.] (Click any of them!)
    - National Institutes of Health (NIH)
    - National Science Foundation (NSF)
    - Food and Drug Administration (FDA)
    - Environmental Protection Agency (EPA)
    - US Department of Agriculture (USDA)
    - Singapore Statement on Research Integrity
    - American Chemical Society, The Chemist Professional's Code of Conduct
    - Code of Ethics (American Society for Clinical Laboratory Science)
    - American Psychological Association, Ethical Principles of Psychologists and Code of Conduct
    - Statement on Professional Ethics (American Association of University Professors)

    - Nuremberg Code
    - World Medical Association's Declaration of Helsinki
- **Slide 15: United Nations Sustainable Development Goals**
    - A final note worth mentioning is how IMSA has made it a matter of academic and operational policy to abide by and work towards the 17 identified United Nations Sustainable Development Goals.
    - Skimming the list of all 17 goals shows a clear human-centered approach to being ethical in all matters of policy and research

Canvas Assessment Questions

1. Has your STEM education (in the classroom or outside of it) thus far exposed you to any ethical grey areas?
2. Can you think of any modern examples of scientific breakthroughs currently going unchecked by human considerations?
3. What is one way you can be more ethical in your pursuit of science?

Supplemental Available Material

Project Plowshare

Kaufman, Scott (2012) “Project Plowshare: The Peaceful Use of Nuclear Explosives in Cold War America”

Office of Scientific and Technical Information Executive summary on Project Plowshare (https://www.osti.gov/opennet/reports/plowshar.pdf)

Sovacool, Benjamin K (2011), Contesting the Future of Nuclear Power: A Critical Global Assessment of Atomic Energy, World Scientific, pp. 171–2

Science and Ethics

Resnik, David (2020), “What is Ethics in Research & Why is it Important?”, National Institute of Environmental Health Sciences (https://www.niehs.nih.gov/research/resources/bioethics/whatis/)

Sharma, Om P. (2015), “Ethics in Science,” Indian Journal of Microbiology (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4456506/)

University of Notre Dame. "Emerging ethical dilemmas in science and technology." ScienceDaily. ScienceDaily, 17 December 2012. (www.sciencedaily.com/releases/2012/12/121217162440.htm)