Online Ethics Center
FOR ENGINEERING AND SCIENCE

Emerging Technologies Bibliography

Author(s)

Kelly Laas

Year

2011

Description

A set of partially-annotated bibliographies including biotechnology, brain implants, geoengineering, nanotechnology, robotics, and synthetic biology.

Body

General

Budinger, Thomas F. and Miriam D. Budinger. 2006. Ethics of emerging technologies: Scientific facts and moral challenges. Hoboken, N.J. : John Wiley & Sons.

Discusses ethical issues raised by emerging technologies such as assisted reproductive technologies, enhancement technologies, information technology, and issues raised in the fields of business, the environment, and scientific research ethics as a whole.

Coeckelbergh, Mark. Human Being @ Risk. Enhancement, Technology, and the Evaluation of Vulnerability Transformations
Series: Philosophy of Engineering and Technology, Vol. 12. 2013, XIV, 218 p.

Hart, John. 1997. Ethics and technology :Innovations and transformation in community contexts. Cleveland: Pilgrim Press.

Miller S. and Selgelid, M. 2006. Ethical and philosophical consideration of the dual-use dilemma in the biological sciences. Centre for Applied Philosophy and Public Ethics, Australian National University and Charles Stuart University, Canberra, Australia.

Moor, James H. 2004. Why we need better ethics for emerging technologies. Ethics and Information Technology. 7(3): 111-119.
The author discusses the three stages of technological revolutions, the introduction stage, the permeation stage, and the power stage. He then goes on to propose a hypothesis that ethical problems increase as technological revolutions progress toward and into the power stage, and discusses how we need a better ethical response to cope with these ethical issues.

National Academy of Engineering. 2004. Emerging technologies and ethical issues in engineering: Papers from a workshop. Washington D.C.: National Academies Press.
Collection of papers from a workshop held in 2003 that brought together engineers and ethicists to discuss the responsible development of new technologies. Papers focus on the ethical issues presented in four main areas - sustainability, nanotechnology, neurotechnology, and energy.

Winston, Morton, and Ralph Edelbach (eds). 2003. Society, ethics, and technology. Belmont, C.A.: Thompson/Wadsworth.
A collection of essays discussing philosophical perspectives on emerging technologies in the areas of computers, robotics, information technology, biotechnology and genetic engineering, the environment, and emerging

technologies and human rights.

Back to top

Biotechnology

Baille, Harold W. and Timothy K. Casey. 2005. Is human nature obsolete?: Genetics, bioengineering, and the future of the human condition. Cambridge, M.A.: MIT Press.

Beyond therapy: Biotechnology and the pursuit of happiness. 2006. United States: President's Council on Bioethics.
This report, commissioned by the U.S. President's Council of Bioethics, explores the moral propriety of using biotechnologies such as genetic engineering, stem cell research, not simply to cure diseases, but also to enhance the lives of the healthy and to perfect man's body and prolong his life.

Bioethics Research Library at Georgetown University
This is the best source for anyone interested in looking at the field of bioethics, including the ethics of emerging medical technologies. Allows you to search a wide range of databases covering journal articles, books, and conference proceedings.

Borenstein, Jason. 2009. The wisdom of caution: Genetic enhancement and future children. Science and Engineering Ethics. 15(4): 517-530.

Brody, Baruch A. 2007. Intellectual property and biotechnology: The European debate. Kennedy Institute of Ethics Journal. 69-110.

Carter, Adrian, Parry Bartlett, and Wayne, Hall. 2009. Scare-mongering and the anticipatory ethics of experimental technologies. American Journal of Bioethics. 9(5): 47-48.
Examines the potentially adverse consequences of emerging technologies, and the ethics of stem cell-based interventions.

Degrazia, David. 2005. Enhancement technologies and human identity. Journal of Medicine and Philosophy. 30(3): 261-283.

Derksen, Mechteld-Hanna G. and Klasien Horstman. 2008. Engineering flesh: Towards an ethics of lived integrity. Medicine, Health Care, and

Philosophy: A European Journal. 11(3): 269-283.
Discusses the ethics of tissue engineering.

Fox, Dov. 2010. Retracing liberalism and remaking nature: Designer children, research embryos, and featherless chickens. Bioethics. 24(4): 170-178.

Furger, Franco, and Francis Fukuyama. 2007. A proposal for modernizing the regulation of human biotechnologies. Hastings Center Report. 37(4): 16-20.

Griesse, Margaret Ann. 2007. Developing social responsibility: Biotechnology and the case of DuPont in Brazil. Journal of Business Ethics. 73(1): 103-118.
After discussing the progressive stages of social responsibility that scholars have outlined as they examine the history of business, the author discusses the activities of the DuPont corporation in Brazil and examines how the debate on genetically modified organisms is unfolding in this region, highlighting the need to develop means for providing open collaborative efforts in evaluating new technologies.

Harmon, Shawn. H.E. 2008. Emerging technologies and developing countries: Stem cell research regulation and Argentina. Developing World Bioethics. 8(2): 138-150.
Discusses the ethical concerns raised by biotechnologies such as stem cell research, and the issues raised by attempts to govern this kind of research. The author looks at the regulation of stem cell research in Argentina, and how well this country's regulations deal with these ethical concerns.

Kuzma, Jennifer, Pouya Najmaie, and Joel Larson. 2009. Evaluating oversight systems for emerging technologies: A case study of genetically engineered organisms. Journal of Law, Medicine, & Ethics. 37(4): 546-586.
This article reviews the U.S. oversight system for genetically engineered organisms to develop hypotheses and derive lessons for the oversight of other emerging technologies, such as nanotechnology.

Kakuk, Peter. 2009. The legacy of the Hwang case: Research misconduct in biosciences. Science and Engineering Ethics. 15(4): 545-562.

Knoepffler, Nikolaus (ed) et al. 2007. Human biotechnology as social change: An interdisciplinary introduction to bioethics. Aldershot: Ashgate Publishing.

Lea, Randall, D. 2009. Ethical considerations of biotechnologies used for performance enhancement. Journal of Bone & Joint Surgery, American Volume. 91-A(B): 2048-2050.

Mameli, M. 2007. Reproductive cloning, genetic engineering and the anatomy of the child: The moral agent and the open future. Journal of Medical Ethics: The Journal of the Institute of Medical Ethics. 33(2): 87-93.

Martin, Taylor and Karen Raynee. 2005. Teaching for adaptive expertise in biomedical engineering ethics. Science and Engineering Ethics. 11(2): 257-276.

Meghani, Zahra. The U.S. Food and Drug Administration, normatively of risk assessment, GMOs and American democracy. Journal of Agriculture and Environmental Ethics. 22(2): 125-139.

Merryman, W. David. 2008. Development of a tissue engineered heart valve for pediatrics: a case study in bioengineering ethics. Science and Engineering Ethics. 14(1): 93-101.

Mitchell, C. Ben. Biotechnology and the human good. Washington, D.C.: Georgetown University Press.
Explores questions about human dignity, human enhancement, and building a regulatory framework for the ethical development of biotechnologies.

Paula, Lino, and Frans Birrer. 2006. Including public perspectives in industrial biotechnology and the biobased economy. Journal of Agricultural and Environmental Ethics. 19(3): 253-267.
Discusses the opposition to genetically modified organisms in Europe, and asks the question, is it ethically justifiability to release large amounts of GM organism into the environment for the purpose of protecting that environment and to sustain the current affluent way of life in that region, especially when little is known about the potential adverse affects GM organisms could have to society and the environment.

Räikkä, Juha. 2009. The ethical and political evaluation of biotechnology strategies. Medicine, Health Care and Philosophy: A European Journal. 12(3): 273-280.
Discusses the role ethical advising bodies should have in decisions made about biotechnology strategies in national and regional government decision-making, especially in the role of promoting public debate that forms the basis for political decision-making.

Streiffer, Robert. 2006. Academic freedom and academic-industry relationships in biotechnology. Kennedy Institute of Ethics. 16(2): 129-149.
Examines the widespread development of commercial academic-industry relationships in the field of biotechnology, the restrictions often placed on academic research in these relationships, and their effect on academic freedom.

Wickins, Jeremy. 2007. The ethics of biometrics: the risk of social exclusion from the widespread use of electric identification. Science and Engineering Ethics. 13(1): 45-54.
Discusses the ways in which social exclusion might arise from the use of biometrics data in application such as identity cards, and introduces a model of balancing individual interests with which to analyze whether it is justified to run the risk of excluding some members of society for the benefit of others.

Back to top

Brain Implants

Berg, Abby. Alice Herb, and Marsha Hurst. 2005. Cochlear implants in children: Ethics, informed consent, and parental decision making. Journal of Clinical Ethics 16(3): 239-250.

Bramstedt, Katrina A. 2005. When microchip implants do more than drug delivery: Blending, blurring, and bundling of protected health information and patient monitoring. Technology and Health Care 13(3): 193-198.

Drum, Bruce. 2006. Federal regulation of vision enhancement devices for normal and abnormal vision. Journal of Modern Optics 53(9): 1215-28.

European Commission. 2004. The ethical aspects of ICT implants in the human body: Proceedings of the roundtable debate. European Group on Ethics in Science and New Technologies. Amsterdam.

Farah, Martha J and Paul Root Wolpe. 2004. Monitoring and manipulating brain function: New neuroscience technologies and their ethical implications. Hastings Center Report. 34(3): 35-45.

Ford, Paul J. 2007. Neurosurgical implants: Clinical protocol considerations. Cambridge Quarterly of Healthcare Ethics 16(3): 308-311.

Ford, Paul et al. 2007. A patient revoking consent during awake craniotomy: An ethical challenge. Neuromodulation 10(4): 329-332.

Foster, Kenneth R., Paul R. Wolpe and Arthur L. Caplan. 2003. Bioethics and the brain. IEEE Spectrum 40(6): 34-39.

Gillet, G. 2006. Cyborgs and moral identity. Journal of Medical Ethics 32(2): 79-83.

Hansson, Sven-Ove. 2005. Implant ethics. Journal of Medical Ethics 31(9): 519-525.

Keiper, Adam, 2006. The age of neuroelectonics. New Atlantis 11: 4-41.

Komesaroff, Linda R. 2007. Surgical consent: Bioethics and cochlear implantation. Washington D.C.: Gallaudet University Press.

Kubu, Cynthia. S. and Paul J. Ford. 2007. Ethics in the clinical application of neural implants. Cambridge Quarterly of Healthcare Ethics 16(3): 317-321.

Maguire, G. Q., Jr., and Ellen M. McGee. 1998. Ethical assessment of implantable brain chips. Twentieth World Congress of Philosophy. Boston University. Boston, MA, 10-15 August, 1998. 19 pars.

---. Implantable brain chips? Time for debate. The Hastings Center Report 29(1): 7-13.

McGee, Ellen M. and Gerald Q. Maguire. Becoming a Borg to become immortal: Regulating brain implant technologies. Cambridge Quarterly of Healthcare Ethics 16(3): 291-302.

Nsanze, Fabienne. 2005. Ethical aspects of ICT implants in the human body. Opinion Number 20. Brussels, Belgium: European Group on Ethics in Science and New Technologies, European Commission.

Roco, Mihail and William Sims (eds). 2002. Converging technologies for improving human performance: Nanotechnology, biotechnology, information technology and cognitive science. Arlington, VA:

World Technology Evaluation Center (WTEC). URL Available: http://www.wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf

Rosahl, Steffen. 2004. Vanishing senses- Restoration of sensory functions by electronic implants. Poiesis & Praxis 2(4): 285-295.

Warwick, Kevin and Verginie Ruiz. 2008. On linking human and machine brains. Neurocomputing. 71(13-15): 2619-2624.
Discusses the current use of implant technologies in diminishing the effects of certain neural illnesses and the possibilities – and ethical aspects – of the potential for using these implant technologies to link the human nervous system bi-directionally with the internet.

Back to top

Geoengineering

Caldeira, Ken and David W. Keith 2010. The need for climate engineering research. Issues in Science and Technology Studies. 27(1):57-52.
The authors argue that geoengineering may be the only affordable and fast-acting solution to mitigate climate change. Though for the moment, the risk of catastrophic damage is slight, a day may come in the near future where the risk is sufficient that we will need to intervene in the earth's climate system on a grand scale. Research must be done sooner rather than later to see what kind of geoengineering options exist, and which of these options will cause the least amount of harm to people and the environment.

Corner, Adam and Nick Pidgeon. Geoengineering the climate: The social and ethical implications. Environment. 52(1): 24-37.

Keith, David W. 2000. Geoengineering the climate: History and prospect. Annual Review of Energy & the Environment. 25(1): 245.
This 40-page review discusses the concept of geoengineering as the intentional large-scale manipulation of the environment, particularly manipulation that is intended to reduce undesired anthropogenic climate change. The author discusses the roots of the problem, recent developments in the field, and the ethical, economic, societal, and environmental questions that geoengineering raises.

Ralston, Shane. 2009. Engineering an artful and ethical solution to the problem of global warming. Review of Policy Research 26(6): 821-837.
Discusses some proposed geoengineering projects that are aimed and helping to solve the problem of climate change, and discusses six ethical quandaries that emerge in global climate change debates and how they complicate any attempts to ameliorate or resolve the problem.

Royal Society. 2009. Geoengineering the climate: science, governance and uncertainty. London: The Royal Society.
This study, led by twelve leading academics in the fields of science, economics and the social sciences, looks at the range of geoengineering techniques currently available for large-scale manipulation of the planetary environment to counteract anthropogenic climate change. It looks at the potential efficacy and risks attached to each technique, and draws conclusions on where geoengineering should fit into a wider, international plan for reducing the effects of global warming.

Verlaan, Philomene. 2009. Geo-engineering, the law of the sea, and climate change. Carbon & Climate Law Review. 3(4): 446-458.
Author argues that geo-engineering project proposals should receive detailed, precautionary scrutiny by the international community, and argues that geo-engineering projects must satisfy a suite of mandatory international legal requirements that are dedicated to protect and preserve the marine environment, or they cannot legally proceed.

Back to top

Nanotechnology

NanoEthicsBank http://ethics.iit.edu/NanoEthicsBank
A database of journal articles, reports, and guidelines looking at the societal and ethical implications of nanotechnology. Developed by the Center for the Study of Ethics in the Professions, Illinois Institute of Technology

Allhoff, Fritz , Patrick Lin, James Moore, and James Weckert. 2007. Nanoethics: The ethical and social implications of nanotechnology. Hoboken, N.J.: Wiley Interscience.

Berne, RW. 2008. Towards the conscientious development of ethical nanotechnology. Science and Engineering Ethics 10(4): 627-638.

Choi, Kyungchee. 2003. Ethical issues of nanotechnology development in the Asia-Pacific region. Paper presented at Regional Meeting on Ethics of Science and Technology, 5-7 November 2003, Bangkok.

Colvin, Vicki L. 2003. The potential environmental impact of engineered nanomaterials. Nature Biotechnology 21(10): 1166-1170.

Davies, J. Clarence. 2006. Managing the effects of nanotechnology: Project on emerging nanotechnologies. Woodrow Wilson International Center for Scholars & Pew Charitable Trusts.

Dobson, P. J. 2000. Nanotechnology: Opportunities missed. Contemporary Physics. 41(3): 159-161.

---Exploratory Engineering. 1988. Foresight Background 3, Rev. 1: Dialog, Exploratory Engineering, Bioarchive. Foresight Institute. 15 December 2000.

Einsiedel, Edna, and Linda Goldenberg. 2004. Dwarfing the social? : Nanotechnology lessons from the biotechnology front. Science Communication. 24(1):28-33.

Elliott, Carl. 2005. Adventure! Comedy! Tragedy! Robots! How bioethicists learned to stop worrying and embrace their inner cyborg. Journal of Bioethical Inquiry. 2(1:) 18-23.

Galembeck, Fernando. Ethical issues of nanotechnology: Proceedings of the United Nations Educational, Scientific and Cultural Organization World

Commission on the Ethics of Scientific Knowledge and Technology (COMEST) 3rd Session. 1-4 December 2003. Rio de Janeiro, Brazil. 128-132.

Goldman, Lynn and Christine Coussens (eds.). 2005. Implications of nanotechnology for environmental health research: Roundtable on environmental health sciences, research, and medicine. Board on Health Sciences Policy. Institute of Medicine. Washington, D.C.: National Academies Press.

Gordijn, Bert. 2003. Nanoethics: From utopian dreams and apocalyptic nightmares towards a more balanced view. Paper on ethics related to nanotechnology, presented at the Third Session of COMEST.

Gorman, M. E., J. F. Groves and R. K. Catalano. 2004. Societal dimensions of nanotechnology. IEEE Technology and Society Magazine 23(4): 55-62.

Grunwald, Armin. 2005. Nanotechnology—A new field of ethical inquiry? Science and Engineering Ethics 11: 187-201.

Gutierrez, Eva. 2004. Privacy implications of nanotechnology. Electronic Privacy Information Center.

Guston, David H. and Daniel Sarewitz. 2002. Real-time technology assessment. Technology in Society 24(1-2): 93-109.

Hett, Annabelle et al. 2005. Nanotechnology: Small matter, many unknowns. Zurich: Swiss Reinsurance Company.

Kimbrell, George. 2009. Governance of nanotechnology and nanomaterials: Principles, regulation, and renegotiating the social contract. Journal of Law, Medicine, & Ethics 37(4): 706-723.

Lenk, Christian, Biller-Andorno, Nikola. Nanomedicine: Emerging or re-emerging ethical issues? A discussion of four ethical themes. Medicine, Health Care and Philosophy: A European Journal, 10(2): 173-184.

Lewenstein, Bruce V. 2005. What counts as a 'social and ethical issue' in nanotechnology? Hyle: International Journal for the Philosophy of Chemistry 11(1): 5-18.

Macnaghten, Phil, Mathew Kearnes and Brian Wynne. 2005. Nanotechnology, governance, and public deliberation: What role for the social sciences? Science Communication 27(2): 268-291.

Macoubrie, Jane. 2005. Informed public perceptions of nanotechnology and trust in government: Project on emerging nanotechnologies. Washington, D.C.: Woodrow Wilson International Center for Scholars & Pew Charitable Trusts.

National Academy of Engineering of the National Academies. 2004. Emerging technologies and ethical issues in engineering: Papers from a workshop, October 14-15, 2003. Washington, D.C.: National Academies Press.

National Research Council. 2002. Implications of emerging micro and nanotechnology. Committee on Implications of Emerging Micro- and Nanotechnologies: Air Force Science and Technology Board. Division on Engineering and Physical Sciences. Washington, D.C.: National Academies Press.

Roco, Mihail and William Sims (eds). 2001. Societal implications of nanoscience and nanotechnology : NSET workshop report, March 2001, Arlington, Virginia. Arlington, VA: National Science Foundation.

Roco, Mihail and Renzo Tomellini (eds). 2002. Nanotechnology: Revolutionary opportunities & societal implications: Lecce (Italy), 31 January-1 February 2002. Report of the 3rd Joint EC - NSF Workshop on Nanotechnology. Luxembourg : Office for official publication of the European Communities.

Rotman, David. 2003. Measuring the risks of nanotechnology: Chemist Vicki Colvin on the safety of nanotechnology. Technology Review 106(3): 71-73.

Royal Society and the Royal Academy of Engineering. 2004. Nanoscience and nanotechnologies: Opportunities and uncertainties.

Salvarezza, R.C. 2003. Why is nanotechnology important for developing countries? Proceedings of the United Nations Educational, Scientific and

Cultural Organization World Commission on the Ethics of Scientific Knowledge and Technology. 3rd Session. 1-4 December 2003. Rio de Janeiro, Brazil: 133-136.

Schummer, J. and D. Baird. 2006. Nanotechnology challenges: Implications for philosophy, ethics, and society. New York: World Scientific Publishing.

Sweeney, Aldrin E. 2006. Social and ethical dimensions of nanoscale science and engineering research. Science and Engineering Ethics. 12(3): 435-464.

Sweeney, Aldrin E., Sudipta Seal, and Pallavoor Vaidyanathan. 2003. The promises and perils of nanoscience and nanotechnology: Exploring emerging social and ethical issues. Bulletin of Science, Technology & Society 23(4): 236-245.

UNESCO. Nanotechnology and ethics expert group: Report of the first meeting. Paris 5-6 July 2005.

Wardak, Ahson. 2003. Nanotechnology and regulation discussion pape.r 2003-6 Washington D.C. Foresight and Governance Project. Woodrow Wilson International Center for Scholars.

Weil, Vivian. 2001. Ethical issues in nanotechnology: Societal implications of nanoscience and nanotechnology : NSET workshop report, March 2001, Arlington, Virginia. Mihail Roco and William Sims (eds). Arlington, VA: National Science Foundation: 193-198.

--- World Technology Evaluation Center (WTEC).Converging technologies for improving human performance: Nanotechnology, biotechnology, information technology and cognitive science. Arlington, VA.

Zebroski, Robin. 2006. Altering the body: Nanotechnology and human nature. International Journal of Applied Philosophy. 20(2): 229-246.

---2002. Responsible Nanotechnology: Looking Beyond the Good News. Eurekalert.com.

--- 2003. Zeroing in on ethical issues in nanotechnology. Proceedings of the IEEE 91(11): 1976-1979.

Special journal issues focusing on nanotechnology:

- Journal of Law, Medicine & Ethics, 37(4): (Winter 2009)
- Science Communication 27(2): December 2005
- Issues in Science and Technology 21(4): (Summer 2005)
- Science 290.5496: (2000)
- Technology Review. 102(2): (1998)

Back to top

Robotics

Arkin, Ronald C. 2009. Ethical robots in warfare. IEEE Technology and Society Magazine: 30-33.

Arkin: Robert. 2009. Governing lethal behavior in autonomous robots. Boca rattan: CRC Press.

Asaro, Peter. Modeling the moral user. IEEE Technology & Society Magazine 28(1): 20-24.
Discusses the ethical design and regulation of autonomous lethal robots amid global concerns, interests, and justifications in the U.S.

Coeckelbergh, Mark. 2009. Virtual moral agency, virtual moral responsibility: on the moral significance of the appearance, perception, and performance of artificial agents. AI & Society 24(2): 181-189.

Davies, S. 2009. It's war – but not as we know it [autonomous military robotics] Engineering & Technology 4(9): 40-43.

Krishman, Armin. 2009. Killer robots: Legality and ethicality of autonomous weapons. Burlington, V.T.: Ashgate.

Nagenborg, Michael, Rafael Capurro, Jutta Weber and Christoph Pingel. 2009. Ethical regulations on robotics in Europe. AI & Society 22(3):349-366.

Pearson, Yvette, and Jason Borenstein. 2012. Creating "Companions" for Children: The Ethics of Designing Esthetic Features for Robots. AI &

Society. Published online on August 21, 2012.

Santoro, Matteo, Dante Marino, and Guglielmo Tamburrini. Learning robots interacting with humans: From epistemic risk to responsibility. AI & Society 22(2): 301-314.
Discusses the theoretical and practical limitations in humans' ability to predict and control the behavior of learning robots in their interactions with humans, and the responsibility we have for harm caused by learning robot actions.

Singer, P.W. 2009. Wired for war: The robotics revolution and conflict in the 21st century. New York: Penguin.

Sparrow, Robert. 2009. Building a better warbot: ethical issues in the design of unmanned systems for military applications. Science and Engineering Ethics 15(2): 169-187.

--. 2007. Killer robots. Journal of Applied Philosophy 24(1): 62-77.

Tonkins, Ryan. 2009. A challenge for machine ethics. Minds & Machines 19(3): 421-438.

Wallach, Wendell. 2008. Implementing moral decision-making facilities in computers and robots. AI & Society 22(4): 463-475.

Wallach, Wendell. 2009. Moral machines. Teaching robots right from wrong. New York, Oxford University Press.

Back to top

Synthetic Biology

Bolt, Joachim, and Oliver Muller. 2008. Newtons of the leaves of grass. Nature Biotechnology 26(4): 387-389.
Certain ethical implications of synthetic biology research go beyond those of genetic engineering.

De Vriend, H. 2006. Constructing life: Early social reflections on the emerging field of synthetic biology. The Hague: Rathenau Institute; Working Document 97.

Edwards, C. 2009. Ethics and synthetics. Engineering & Technology 4(11): 36-37.

Herrera. Stephen. 2005. Preparing the world for synthetic biology. Technology Review.

Preston, Christopher. 2008. Synthetic biology: Drawing a line in Darwin's sand. Environmental Values 17(1): 23-39.

Schmidt, Markus. 2009. Synthetic biology: The technosciences and its societal consequences. Dordrecht: Springer.

Back to top

Notes

Last updated by author Kelly Laas, April 2010.

Rights

Use of Materials on the OEC

Resource Type

Bibliography

Parent Collection

OEC Bibliographies

Topics

Artificial Intelligence and Robotics
Controversies
Emerging Technologies
Geoengineering

Publisher

Online Ethics Center