**ES/GT 361 SCIENCE AND SOCIETY: A EUROPEAN PERSPECTIVE**
IES Abroad Barcelona

**DESCRIPTION:**
We live in a world where science is an intricate part of human societies: Whether it is a new pandemic, a genome editing, advances in space exploration or in artificial intelligence, our lives are inevitably affected by scientific and technological advances. The relationship between science and the public has been the subject of intense scrutiny and mockery: Scientists are both loved by the public as saviours and heroes and hated as designers of military weapons, chemical pollutants and GMOs. Beyond the ramifications of this duality, the relationship between Science and Society is far more complex and fuller of nuances than any judgement can convey, and carries a strong geographical, historical and cultural influence, which can be studied through its different manifestations in different societies. This course aims to explore the intricacies of this relationship through relevant topics that are changing the very fabric of society. The course will look at how social, political and cultural forces in Europe and the rest of the world influence scientific practice and technological innovation, and how these two, in turn, are driving social changes at large. Students will examine how science operates and how it is disseminated to the wider public; identify the past and current roles of science in Europe and its role in innovation; explore the historical context and social environment surrounding scientific research; analyze contemporary ethical issues surrounding science and technology and; learn how to communicate scientific information to a wider public. It will focus on developing analytical skills and a problem-based approach to learning throughout the different topics reviewed. The theoretical element will be complemented by case studies, practical exercises and field trips. Exercises will provide an opportunity to formulate hypotheses derived from an understanding of how science works, while the field elements will provide a platform to apply and analyze the knowledge gained through the course and offer a local perspective of science dissemination while also promoting student-student interaction and active learning.

**CREDITS:** 3 credits

**CONTACT HOURS:** 45 hours

**LANGUAGE OF INSTRUCTION:** English

**INSTRUCTOR:**

**PREREQUISITES:** None

**ADDITIONAL COST:** None

**METHOD OF PRESENTATION:**
Information is presented in a variety of forms, providing different learning platforms aimed at developing different skills.

- **Lectures:** provide the platform to introduce each topic, set core concepts and analyse the different elements involved in each session while promoting discussions to share different points of view through student participation.
- **Readings**: selected texts consist of either an overview of the relevant subject and background information, or a case study that illustrates the main ideas to be discussed during class.
- **Class activities:** are designed to apply the information learned and help the student assimilate it in a more personal way. These consist of group activities, debates, topic analysis and student presentations among others.
- **Documentary analysis**: offer a different perspective from the academic literature and will address specific aspects of the course to highlight elements of effective science communication.
- **Self-course-related trips**: provide a hands-on experience of some of the topics through visits to selected science centres and promote and support active learning.
- **Structured debates:** promote research, analysis, synthesis of information and allow the students to use Rhetoric in the elaboration of discourse, presenting their arguments on selected current issues in a structured manner.

**REQUIRED WORK AND FORM OF ASSESSMENT:**

- Class participation - 10%
- Self-course-related trips - 15%

- Midterm exam - 20%
- Final exam - 20%
- Science documentary production and presentation - 20%
- Structured debates - 15%

**Class participation**
Class participation is essential for the effective dynamic of lectures. This will be evaluated through a carefully prepared rubric and through in-class activities.

**Self-guided course-related trips**
Attendance on fieldtrips is mandatory; this activity is essential to gain a deeper insight into some of the topics covered by the course. There will be specific assignments for these activities that will need to be completed during and after the visits.

**Midterm exam and Final exam**
**T**hese will examine the student's knowledge on the course topics through short-answer, multiple-choice, and open-ended questions elaborated in a participatory process.

**Science documentary production and presentation**
Students will engage in designing and preparing a 10-minute science documentary to present in class. This will help them apply some of the concepts reviewed throughout the course and immerse themselves in the role of the science communicator. The purpose of this exercise is to assess the capacity of students to research, compile, integrate, analyse, synthesize and present information to a specific audience. This assignment will be done in groups of 3-4 students and the topics will be selected by the students. Evaluation will be based on a rubric that will look at (1) the research and synthesis, (2) the quality of the scientific element, (3) the effectiveness of the dissemination element and (4) the language used throughout the documentary.

**Structured debates**
Groups of students will introduce and debate some of the current controversies in Science and Society. Topics will be selected from a list prepared by the instructor (students may add to this list) and students will research the relevant literature, prepare and present carefully selected arguments and defend their position during a structured debate in class.

**LEARNING OUTCOMES:**
By the end of the course, students will be able to:
- Explain the role that science has played in the history of humankind, its influence in shaping European societies, and its current role in society as a whole.
- Identify the driving forces of scientific research and the process of generating scientific knowledge.
- Compare and contrast science communication in Europe and the rest of the world.
- Develop and express an informed, personal point of view on issues concerning science and technology, and engage in debate with an informed and well-rounded approach.
- Process and analyze scientific information and communicate it to the appropriate audience

**ATTENDANCE POLICY:**
As a member of our class community, you are expected to be present and on time every day. Attending class has an impact on your learning and academic success. For this reason, attendance is required for all IES Barcelona classes, including course-related excursions. If a student misses more than three classes in any course without justification, 3 percentage points will be deducted from the final grade for every additional absence. Seven unjustified absences in any course will result in a failing grade. Absences will only be justified, and assessed work, including exams, tests and presentations rescheduled, in cases of documented medical or family emergencies.

**CONTENT:**

| Session | Content | Assignments |
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| **Session 1** | **Introduction to the course** | |
| **Session 2** | **Why understanding science matters.**<br>• Definitions of science, understanding and the public<br>• The importance of promoting and understanding science<br>• The coming of age of popular science | • Gregory, J., & Miller, S. (1998). *Science in public: Communication, culture, and credibility* (pp 10-19). Plenum Press.<br>• Stilgoe, J. and S. Lack. (2014). "Why should we promote public engagement with Science?" *Public Understanding of Science*, 23 (1), 4-15.<br>• Gawande, A. (2016, June 10). The Mistrust of Science. *The New Yorker*. https://www.newyorker.com/news/news-desk/the-mistrust-of-science |
| **Session 3** | **3: The methodology of science and scientific literacy**<br>• Problem-based thinking and the scientific method.<br>• Empirical observations, field experiments and laboratory experiments.<br>• How scientific peer-review works.<br>• The consolidation of scientific theories | • Beall, H., & Trimbur, J. (1999). How to read a scientific article. *Communicating science*, 1, 72.<br>• Bauer. H. (1992). *Scientific Literacy and the Myth of the Scientific method*. University of Illinois Press. Pp. 19-42.<br>• Munafò, M. R., & Davey Smith, G. (2018). Repeating experiments in not enough. *Nature, 553*, 399. |
| **Session 4** | **Communicating Science I**<br>• Making news out of science<br>• News language in Europe: does region matter?<br>• The main European institutions.<br>• What science and how much of it? | • Bower, M.W., Bucci, M. (Eds) 2008. *Journalism, Science and Society: Communication Between Newsmaking and Public Relations.* Routledge, New York. Pp. 11-21, 21-33, 93-109.<br>• Weigold, M.F. 2001. "Communicating Science: A review of the literature". *Science Communication*, 23 (2), 164-193. |
| **Session 5** | **Communicating Science II**<br>• Science on TV: The influence of documentaries in public lives in Europe.<br>• Making documentaries: a comparative approach between European and American styles.<br>• Public fascination with unorthodox science. | • Avraamidou, L. & J. Osborne. (2009). The role of narrative in communicating science. *International Journal of Science Education*, *31* (12), 1683-1702. |
| **Session 6** | **Science in Museums I**<br>• The origin of science museums in Europe.<br>• The role of museums as learning centres<br>• Assessing the impact of science museums | • Samper, R.J. (1990). Science museums as environments for learning. *Physics Today*, *48* (11), 50-56.<br>• Allen, S. and J. Gutwill. (2004). Designing with multiple interactives: Five common pitfalls. *Curator*, 47 (2), 199-212. |

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| | | • Perry, D.L. (1992). Designing exhibits that motivate *Association of Science-Technology Newsletter*, March-April 1992. |
| **Session 7** | **Science in Museums II**<br><br>**Student Presentations** | |
| **Session 8** | **Student presentations of science museum exhibits**. | |
| **Session 9** | **Health topics I: Health in the modern world**<br>• Social Determinants of Health<br>• The Global Burden of Disease<br>• Current approaches to Health | • Lerner, H., & Berg, C. (2017). A comparison of three holistic approaches to health: One Health, EcoHealth, and Planetary Health. *Frontiers in veterinary science, 4*, 163.<br>• Marmot, M. (2005). Social determinants of health inequalities. The *lancet, 365*(9464), 1099-1104. |
| **Session 10** | **Midterm Exam** | |
| **Session 11** | **Health topics II: Ethical issues in medicine**<br>• The Ethics of Stem cell research<br>• Animal testing<br>• Cloning | • Pound, P., & Bracken, M. B. (2014). Is animal research sufficiently evidence based to be a cornerstone of biomedical research? *BMJ*, 348.<br>• Grimm, D. (2018, November 2). Record number of monkeys being used in US Research. *Science.* https://www.science.org/content/article/record-number-monkeys-being-used-us-research |
| **Session 12** | **Health topics III: Genome editing**<br>• CRISPR Gene editing<br>• Ethical issues withing Genome editing<br>• Gene drives | • Owen, R., Macnaghten, P., & Stilgoe, J. (2020). Responsible research and innovation: From science in society to science for society, with society. In Emerging technologies: ethics, law and governance (pp. 117-126). Routledge.<br>• Fine Maron, D. (2015, December 3). "Improving" Humans with customized genes sparks debate among scientists. *Scientific American*. https://www.scientificamerican.com/article/improving-humans-with-customized-genes-sparks-debate-among-scientists1/ |
| **Session 13** | **What does Science tell us about Society?**<br>• The social structure of humankind<br>• The evolution of morality | • Chapais, B. (2011). The deep social structure of humankind. *Science* 331: 1276-1277<br>• Haidt, J. (2003). The moral emotions. In Davidson R.J., Sherer, K. R., and Goldsmith, H. |

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| | • Moral Emotions | H. (Eds) Handbook of effective sciences. Oxford University Press, Oxford. (pp 852-870). |
| **Session 14** | **Documentary presentations** | |
| **Session 15** | **Documentary Presentations** | |
| **Session 16** | **Technology and Culture**<br>• The Exponential nature of Technology<br>• The Duality of technological progress | • Bostrom, N. (2006). Welcome to a world of exponential change. *Demos Collection*, 21, 40.<br>• Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (2018). The limits to growth. In *Green planet blues* (pp. 25-29). Routledge. |
| **Session 17** | **Artificial Intelligence**<br>• The Different Calibers of AI<br>• Visions of the Singularity | • Brundage, M. (2015). Taking superintelligence seriously: Superintelligence: Paths, dangers, strategies by Nick Bostrom (Oxford University Press, 2014). *Futures*, 72, 32-35.<br>• Bostrom, N. (2020). Ethical issues in advanced artificial intelligence. *Machine Ethics and Robot Ethics*, 69-75. |
| **Session 18** | **Robots and Biometrics** | • Gelb, A., & Clark, J. (2013). Identification for development: The biometrics revolution. *Center for Global Development Working Paper*, (315).<br>• Liang, Y., Samtani, S., Guo, B., & Yu, Z. (2020). Behavioral biometrics for continuous authentication in the internet-of-things era: An artificial intelligence perspective. *IEEE Internet of Things Journal*, *7*(9), 9128-9143. |
| **Session 19** | **Race/Gender and Technology** | • Benjamin, R. (2019). Race after technology: Abolitionist tools for the new jim code. Social forces. |
| **Session 20** | **The Technology of Sustainability**<br>• The Great acceleration<br>• Technological development for sustainable development | - DellaSala, D. A., Goldstein, M. I., Elias, S., Jennings, B., Lacher, T. E., Mineau, P., & Pyare, S. (2018). The Anthropocene: how the great acceleration is transforming the planet at unprecedented levels. *Encyclopedia of the Anthropocene*, *1*, 1-7.<br>- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: the great acceleration. *The Anthropocene Review*, *2*(1), 81-98. |

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| | | - Bradley, C., Hirt, M., Hudson, S., Northcote, N., & Smit, S. (2020). The great acceleration. *McKinsey Quarterly*, 1-7. |
| **Session 21** | **Beyond Earth: Exploring the Universe** | • Iliopoulos, N., & Esteban, M. (2020). Sustainable space exploration and its relevance to the privatization of space ventures. *Acta Astronautica*, *167*, 85-92. |
| **Session 22** | **Science in warfa**<br>• The link between technological innovation and war: a historical review.<br>• The technology of weapons and priorities in public funding of science.<br>• The Future of Warfare | • Van Creveld, M.L. 1989. *Technology and war: from 2000BC to the present - A revised and expanded edition*. 1st Free Press ed. Macmillan, New York. Pp 37-51, 251-297. |
| **Session 23** | **Current controversies I: Student debates.** | • References to be researched by students. |
| **Session 24** | **Current controversies II: Student debates.** | • References to be researched by students. |

**COURSE-RELATED TRIPS: TBC**

**REQUIRED READINGS:**

- Allen, S. and J. Gutwill (2004). Designing with multiple interactives: Five common pitfalls. *Curator*, 47 (2), 199-212.
- Avraamidou, L. & J. Osborne. (2009). The role of narrative in communicating science. *International Journal of Science Education*, 31 (12), 1683-1702.
- Beall, H., & Trimbur, J. (1999). How to read a scientific article. *Communicating science*, 1, 72.
- Bauer. H. (1992). *Scientific Literacy and the Myth of the Scientific method*. University of Illinois Press. Pp. 19-42.
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- Bostrom, N. (2006). Welcome to a world of exponential change. *Demos Collection*, 21, 40.
- Bostrom, N. (2020). Ethical issues in advanced artificial intelligence. *Machine Ethics and Robot Ethics*, 69-75.
- Bradley, C., Hirt, M., Hudson, S., Northcote, N., & Smit, S. (2020). The great acceleration. *McKinsey Quarterly*, 1-7.
- Brundage, M. (2015). Taking superintelligence seriously: Superintelligence: Paths, dangers, strategies by Nick Bostrom (Oxford University Press, 2014). *Futures*, 72, 32-35.
- Chapais, B. (2011). The deep social structure of humankind. *Science* 331: 1276-1277
- DellaSala, D. A., Goldstein, M. I., Elias, S., Jennings, B., Lacher, T. E., Mineau, P., & Pyare, S. (2018). The Anthropocene: how the great acceleration is transforming the planet at unprecedented levels. *Encyclopedia of the Anthropocene*, *1*, 1-7.
- Ewald, P. 1994. Evolution of Infectious Disease. Oxford University Press, New York. Pp. 67-87, 109-119.
- Ewald, P. 1994. Evolution of Infectious Disease. Oxford University Press, New York. Pp. 119-159.
- Fine Maron, D. (2015, December 3). "Improving" Humans with customized genes sparks debate among scientists. *Scientific American*. https://www.scientificamerican.com/article/improving-humans-with-customized-genes-sparks-debate-among-scientists1/
- Gawande, A. (2016, June 10). The Mistrust of Science. *The New Yorker*.
- https://www.newyorker.com/news/news-desk/the-mistrust-of-science

- Gelb, A., & Clark, J. (2013). Identification for development: The biometrics revolution. *Center for Global Development Working Paper*, (315).
- Gregory, J., & Miller, S. (1998). *Science in public: Communication, culture, and credibility* (pp 10-19). Plenum Press.
- Grimm, D. (2018, November 2). Record number of monkeys being used in US Research. *Science.* https://www.science.org/content/article/record-number-monkeys-being-used-us-research
- Haidt, J. (2003). The moral emotions. In Davidson R.J., Sherer, K. R., and Goldsmith, H. H. (Eds) Handbook of effective sciences. Oxford University Press, Oxford. (pp 852-870).
- Hard, M. and A. Jamison. (2013). Hubris and Hybrids: A Cultural History of Technology and Science. Routledge, London. Pp. 19-71.
- Healy, T. (2012). The Unanticipated Consequences of Technology. In: Khan, A.S. (Ed) Nanotechnology: Ethical and Social Implications. CRC Press, New York. P 155-174.
- Hoskin, M. 1999. The Cambridge Concise History of Astronomy. Cambridge University Press. Pp. 18-47, 68-93.
- Hunt, A. (2008). Science in Society. Heinemann, Edinburgh. Pp. 1-16
- Hunt, A. 2008. Science in Society. Heinemann, Edinburgh. Pp. 97-123.
- Iliopoulos, N., & Esteban, M. (2020). Sustainable space exploration and its relevance to the privatization of space ventures. *Acta Astronautica*, *167*, 85-92.
- Jarmul, D. (Ed). 1991. Headline news, Science views. National Academy Press, Washington, D.C. Pp 1-18.
- Khan, 2012. "Nanotechnology: The Size of the Cosmos Versus the Size of Human Knowledge." In: Khan, A.S. (Ed) Nanotechnology: Ethical and Social Implications. CRC Press, New York. Pp. 335-339.
- Lerner, H., & Berg, C. (2017). A comparison of three holistic approaches to health: One Health, EcoHealth, and Planetary Health. *Frontiers in veterinary science, 4*, 163.
- Liang, Y., Samtani, S., Guo, B., & Yu, Z. (2020). Behavioral biometrics for continuous authentication in the internet-of-things era: An artificial intelligence perspective. *IEEE Internet of Things Journal*, *7*(9), 9128-9143.
- Marmot, M. (2005). Social determinants of health inequalities. The *lancet, 365*(9464), 1099-1104.
- Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (2018). The limits to growth. In *Green planet blues* (pp. 25-29). Routledge.
- Munafò, M. R., & Davey Smith, G. (2018). Repeating experiments in not enough. *Nature, 553*, 399.
- Owen, R., Macnaghten, P., & Stilgoe, J. (2020). Responsible research and innovation: From science in society to science for society, with society. In *Emerging technologies: ethics, law and governance* (pp. 117-126). Routledge.
- Perry, D.L. (1992). Designing exhibits that motivate. Association of Science-Technology Newsletter, March-April 1992.
- Pound, P., & Bracken, M. B. (2014). Is animal research sufficiently evidence based to be a cornerstone of biomedical research? *Bmj*, 348.
- Samper, R.J. 1990. Science museums as environments for learning. *Physics Today, 48* (11), 50-56.
- Sandel, M.J. 2005. "The Ethical Implications of Human Cloning." Perspectives in Biology and Medicine, 48 (2), pp 241-247.
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: the great acceleration. *The Anthropocene Review*, *2*(1), 81-98.
- Stilgoe, J. and S. Lack. 2014. "Why should we promote public engagement with Science?" Public Understanding of Science, 23 (1), 4-15.
- Van Creveld, M.L. 1989. Technology and war: from 2000BC to the present - A revised and expanded edition. 1st Free Press ed. Macmillan, New York. Pp 37-51, 251-297.
- Weigold, M.F. (2001). Communicating Science: A review of the literature. *Science Communication*, *23* (2), 164-193.