

Wednesday, 4:15-6:45 pm, VMH 1203

This course examines technologies related to national security. Topics include the history, design, deployment, and effects of nuclear weapons; ballistic missiles and missile defenses; bombers, cruise missiles, hypersonic weapons, and air defenses; submarines and anti-submarine warfare; artificial intelligence and autonomous vehicles; satellites and antisatellite weapons; intelligence and verification technologies; and chemical and biological weapons.

Instructor. Prof. Steve Fetter, sfetter@umd.edu, 301.405.4758, 2222 Thurgood Marshall Hall. Office hours: Wednesday 10-12 and by appointment.

Grading. For students in 688P, the course grade will be determined as follows: problem sets, 40%; policy memo, 20%; final exam, 30%; class participation, 10%. For students in 488P, the policy memo will be optional, the problem sets will count for 50%, and the final exam for 40%.

- **Problem sets.** There will be ten problem sets. These will be assigned most weeks and are due before class the following week. Because solutions will be discussed in class, no late solutions will be accepted. You are encouraged to work in groups of up to four students, but you must prepare your own solution and it is important that you are able to reproduce the solutions on your own.
- **Policy memo.** You will be asked to provide an idea for a short paper or policy memo as part of PS 6. This should include some type of quantitative analysis or data collection and analysis or visualization. A first draft will be due on week 11. Final drafts are due the last week of class, during which you will give a brief presentation (not to exceed 5 minutes).
- **Final exam.** There will be an in-person closed-book final exam. Exam questions will be similar to problem set questions. You will be allowed to use one letter-sized “cheat sheet” and a calculator (or a calculator app on your phone with Internet access disabled). The exam will not be offered on alternative dates or times.

Week	Date	Topic	Due
1	Aug 28	Course introduction; history of the technology of warfare	—
2	Sep 4	Nuclear weapons	—
3	Sep 11	Effects of nuclear weapons	PS 1
4	Sep 18	Production of nuclear materials; nuclear power and safeguards	PS 2
5	Sep 25	Ballistic missiles and counterforce	PS 3
6	Oct 2	Ballistic-missile defense	PS 4
7	Oct 9	Submarines and anti-submarine warfare	PS 5
8	Oct 16	Bombers, cruise missiles, hypersonic weapons, and air defense	PS 6
9	Oct 23	Satellites and anti-satellite weapons	PS 7
10	Oct 30	Intelligence and verification technologies	PS 8
11	Nov 6	Artificial intelligence and autonomous vehicles	PM 1
12	Nov 13	Cyber warfare	PS 9
13	Nov 20	Chemical, biological, and radiological weapons	PS 10
—	Nov 27	Thanksgiving Break	—
14	Dec 4	Student briefings: policy memos	PM 2
—	Dec 11	Final exam	—

Learning outcomes. Demonstrate an understanding of various national security technologies (how they work, their effects and limitations); understand the history of these technologies (when they were developed, by whom, and for what purposes); and apply this understanding to critically evaluate past, current, and proposed systems and related policies.

Readings. There is required reading almost every week. This is intentionally kept to a minimum and covers only the essentials, in the expectation that you will do the required reading before class. I also list recommended reading under “more to explore.” These are optional, but I hope you will scan several and read at least one per week.

Course-related policies. Students are subject to all graduate course-related policies, including those on academic integrity; student conduct; sexual misconduct; non-discrimination; accessibility; absences and accommodations; course and credit changes and withdrawal; arbitrary and capricious grading; incomplete grades and grading systems; good standing and academic probation and dismissal; leave of absence; and grievance. For a list of graduate policies, see <https://gradschool.umd.edu/faculty-and-staff/course-related-policies>; for a list of undergraduate policies, see <https://www.ugst.umd.edu/courserelatedpolicies.html>.

Warning. The study of national security involves the study of war. Many of the technologies discussed are instruments of death and destruction, sometimes on an enormous scale—millions of lives lost, cities destroyed, and the possible collapse of civilization. This course is being taught in a period of increased tension between nuclear-armed states, including US involvement in a war between Russia and Ukraine in which Russia has threatened to use nuclear weapons. The discussion of mass destruction and the possibility of large-scale death is likely to be disturbing for you, as it is for me. The class session and problem set on nuclear weapon effects may be particularly upsetting. Please reach out to me if you want to discuss any of these issues, and make use of Maryland’s counseling resources as appropriate.

Detailed Course Outline		
Week	Date	Topic
1	Aug 28	<p>Course introduction; history of the technology of warfare</p> <p><u>Recommended:</u> Krepinevich, <i>Cavalry to Computer: The Pattern of Military Revolutions</i> Martin Van Creveld, War and Technology</p> <p><u>More to explore:</u> Alex Roland, War and Technology: A Very Short Introduction (Oxford: Oxford University Press, 2016) Martin van Creveld, Technology and War: From 2000 BC to the Present (New York: Free Press, 1989) Bernard Brodie and Fawn McKay Brodie, <i>From Crossbow to H-Bomb</i> (Bloomington: Indiana University Press, 1973)</p>

2	Sep 4	<p>Nuclear weapons</p> <p>Problem Set 1 due Sep 11</p> <p><u>Required:</u> Bruce Goodwin, Nuclear Weapons Technology for Policy Wonks, p. 3-34.</p> <p><u>More to explore:</u> Basic Nuclear Physics and Weapons Effects, 159-166 S. Glasstone and P. Dolan, Effects of Nuclear Weapons, 1.42-1.72 S. Glasstone and L.M. Redman, An Introduction to Nuclear Weapons Robert Serber, The Los Alamos Primer B. Cameron Read, A Physicist's Guide to The Los Alamos Primer</p>
3	Sep 11	<p>Effects of nuclear weapons and nuclear war</p> <p>Problem Set 1 due before class; Problem Set 2 due Sep 18</p> <p><u>Required:</u> S. Glasstone and P. Dolan, Effects of Nuclear Weapons, 1.01-1.41; 1.73-1.79 Basic Nuclear Physics and Weapons Effects, 167-182</p> <p><u>More to explore:</u> S. Glasstone and P. Dolan, Effects of Nuclear Weapons, esp. 2.01-2.150 John Hersey, "Hiroshima," The New Yorker, August 23, 1946. OTA, Effects of Nuclear War Owen B. Toon, Alan Robock, and Richard P. Turco, "Environmental Consequences of Nuclear War," Physics Today (December 2008) Videos and photos of nuclear tests at https://www.atomcentral.com/High-altitude Nuclear Weapon Effects, Part 1: Phenomenology (Defense Nuclear Agency, 1963)</p>
4	Sep 18	<p>Production of nuclear materials; nuclear power and safeguards</p> <p>Problem Set 2 due before class; Problem Set 3 due Sep 25</p> <p><u>Required:</u> Feiveson, et al., "Production, Uses, and Stocks of Fissile Materials" and "Fissile Materials, Nuclear Power, and Nuclear Proliferation," chapters 2 and 5 in Unmaking the Bomb</p> <p><u>More to explore:</u> "The History of Fissile Material Production for Weapons" and "The Global Stockpile of Fissile Material," chapters 3-4 in Unmaking the Bomb IAEA Safeguards: An Introduction Charles Ferguson, "Preventing Catastrophic Nuclear Terrorism"</p>

5	Sep 25	<p>Ballistic missiles and counterforce</p> <p>Problem Set 3 due before class; Problem Set 4 due Oct 2</p> <p><u>Required:</u> Davis and Schilling, "All You Ever Wanted to Know about MIRV and ICBM Calculations but Were Not Cleared to Ask," Journal of Conflict Resolution. Dietrich Schroerer, "Intercontinental Ballistic Missiles," Chapter 6 in Science, Technology and the Nuclear Arms Race, Wiley & Sons, New York, 1984.</p> <p><u>More to explore:</u> Kosta Tsipis, "Intercontinental Ballistic Missiles," chapter 5 in Arsenal: Understanding Weapons in the Nuclear Age (Simon and Shuster, 1983) Rosenberg, "The Origins of Overkill," International Security, Spring 1983. MacKenzie, "Missile Accuracy: A Case Study in Technological Change, 2012. Steve Fetter, Ballistic Missile Primer Steve Fetter, Ballistic Missiles and Weapons of Mass Destruction</p>
6	Oct 2	<p>Ballistic missile defense</p> <p>Problem Set 4 due before class; Problem Set 5 due Oct 9</p> <p><u>Required:</u> "Strategic Ballistic Missile Defense: Challenges to Defending the United States" (American Physical Society, 2024)</p> <p><u>More to explore:</u> Jaganath Sankaran and Steve Fetter, "Defending America: A Sensible Approach to National Missile Defense Against North Korea," International Security (Winter 2021/22), Charles L. Glaser and Steve Fetter, "National Missile Defense and the Future of U.S. Nuclear Weapons Policy," International Security (Summer 2001) "Missile Defense Countermeasures" (Union of Concerned Scientists, 2000) Richard L. Garwin and Hans A. Bethe, "Anti-Ballistic Missile ABM Systems," Scientific American (March 1968) High-altitude Nuclear Weapon Effects, Part 2: System Interference (Defense Nuclear Agency, 1963)</p>

7	Oct 9	<p>Submarines and anti-submarine warfare</p> <p>Problem Set 5 due before class; Problem Set 6 due Oct 16</p> <p><u>Required:</u> Tom A. Stefanick, "Undersea Nuclear Forces: Survivability of Chinese, Russian, and US SSBNS" (submitted to Journal of Strategic Studies) James R. Holmes, "Sea Changes: The future of nuclear deterrence," Bulletin of the Atomic Scientists (2016)</p> <p><u>More to Explore:</u> Richard L. Garwin, "Will Strategic Submarines Be Vulnerable?" International Security (Fall 1983)</p>
8	Oct 16	<p>Bombers, cruise missiles, hypersonic weapons, and air defense</p> <p>Problem Set 6 due before class; Problem Set 7 due Oct 23</p>
9	Oct 23	<p>Satellites and anti-satellite weapons</p> <p>Problem Set 7 due before class; Problem Set 8 due Oct 30</p> <p><u>Required:</u> David Wright, Laura Grego, and Lisbeth Gronlund, "The Physics of Space Security" (Cambridge, MA: American Academy of Arts and Sciences) Large Constellations of Low-altitude Satellites: A Primer (Washington, DC: Congressional Budget Office, 2023), pp. 2-17</p> <p><u>More to Explore:</u> Ivan Oelrich, Paul van Hooft & Stephen Biddle, "Anti-satellite warfare, proliferated satellites, and the future of space-based military surveillance," Journal of Strategic Studies (July 2024) Air and Command Staff College, Space Primer, Air University Press, 2009 Ashton Carter, "Current and Future Military Uses of Space." Annals of the New York Academy of Sciences, vol. 489. no. 1. (1986): 5-17 U.S. Space Force, "Spacepower: Doctrine for Space Forces," 2020</p>

10	Oct 30	<p>Intelligence and verification technologies</p> <p>Problem Set 8 due before class; Problem Set 9 due Nov 13</p> <p><u>Required:</u> "Defense Primer: Command and Control of Nuclear Forces" (Congressional Research Service, May 2024) Air and Command Staff College, Space Primer (Air University, 2009), chapters 13 and 17</p> <p><u>More to Explore:</u> Moreira, et al, "A Tutorial on Synthetic Aperture Radar," IEEE Geoscience and Remote Sensing (March 2013)</p>
11	Nov 6	<p>Smart weapons, artificial intelligence, and autonomous vehicles</p> <p>Policy memo first draft due before class</p> <p><u>Required:</u></p> <p><u>More to Explore:</u></p>
12	Nov 13	<p>Cyber warfare</p> <p>Problem Set 9 due before class; Problem Set 10 due Nov 27</p> <p><u>Required:</u></p> <p><u>More to Explore:</u></p>
13	Nov 20	<p>Chemical, biological, and radiological weapons</p> <p>Problem Set 10 due before class</p> <p><u>Required:</u></p> <p><u>More to Explore:</u></p>
—	Nov 27	Thanksgiving Break
14	Dec 4	Student briefings: policy memos
—	Dec 11	Final exam