INTL 8288:
TECHNICAL BACKGROUND FOR WMD NON-PROLIFERATION POLICY PRACTITIONERS

Fall 2018
Mondays, 12:30-3:00PM, CITS 1st Floor Conference Room (Holmes/Hunter Academic Building)

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Office Hours: Mondays 11:00 AM – 12:30 PM; 3:00 PM -3:30 PM (Please email to schedule an appointment)

COURSE DESCRIPTION:
This class is designed to introduce MIP ISN students to the technology behind various types of WMDs and the associated technical requirements for an effective WMD non-proliferation policy. Specifically, it will explain why certain items are controlled and the challenges associated with maintaining such controls. The unique aspect of this course is that it will offer a STEM-based understanding of the issue area, an increasingly essential component in the competitive government/NGO job market.

After this course, students will have acquired an understanding of technical topics related to WMD technology, including:

1. An overview of basic science for nuclear, biological, and chemical processes for social scientists
2. The nuclear fuel cycle
3. Enrichment
4. Reprocessing
5. Chemical weapons agents and technology
6. Biological weapons agents and technology
7. Missile delivery systems
8. Multilateral Export Control Regimes and their application for preventing proliferation

TOPICAL OUTLINE FOR THE COURSE:
The course syllabus is a general plan for the course; deviations announced to the class by the professor may be necessary. A detailed course schedule and reading assignments can be found in the following pages, but a topical outline for the course includes lectures on the following:

1. Introduction of the course
2. Overview of WMD Technology
3. Overview of global WMD non-proliferation efforts
4. Nuclear Fuel Cycle
5. Nuclear Weapons Technology
6. Chemical and Biological Weapons Technology
7. Delivery Systems Technology
8. Emerging Technologies
9. International WMD organizations (including IAEA, OPCW, NSG, AG, etc.)
10. Multilateral Export Control Regimes

11. Controlling WMD technology

ATTENDANCE AND CLASS BEHAVIOUR POLICY:
This class will be highly interactive. As such, class attendance, punctuality, and participation are required in order to succeed. Therefore:

- **Regular attendance** is expected. 2 unexcused absences will be permitted, but the professor must be notified of each absence ahead of class. ½ final letter grade penalty will incur for each additional unexcused absence. Valid excuses include illness (doctor's note required) and family emergencies.

- **Punctuality** to class is a must. Late arrivals to class interrupt both your fellow students and your professor. If you have a situation where you will be habitually late, please notify the professor as soon as possible. Repeat latecomers will incur a ½ final letter grade penalty.

- **No computer use during class.** You must silence, and put away, any and all wireless devices you bring to class.

- **Each student is responsible for contributing to a positive learning environment**: students are expected to behave in a courteous, professional manner towards each other and towards the professor. While in class, students are expected not to fall asleep, use laptops unless permission is given by the professor, carry on personal conversations, read the paper, use cellular phones/text, or complete assignments other than what the class is working on. If you engage in any of these behaviors, you may incur a ½ final letter grade penalty for each occurrence.

ASSIGNMENTS:
The course is assessed by four modules – outlined below. **You are responsible for assignments whether or not you are in class the day they are due.** Should you miss class and wish to receive credit for an assignment due that day, you are required to turn in the assignment to the professor **before class.** I will use the 100-point grading system. Students will receive a letter grade for their final grade according to the following cutoffs:
A≥93; A- ≥90; B+ ≥87; B ≥83; B- ≥80; C+ ≥76; C ≥70; C- ≥68; D ≥60; F <60

1. Topical Quizzes (25%)
There will be 3-4 topical quizzes throughout the semester. These will not be announced ahead of time, which is why reading for every class is important, as well as mandatory attendance to each class. **If students are absent during any of these topical quizzes, they will receive a grade of zero for this assessment.**

2. Seminar Presentation (30%)
On the last day of class, students will present their end of semester presentations to the rest of the class and all instructors. Presentations should be no more than 30 minutes long and should outline which of the issues discussed in class pose the biggest threat to U.S. and international security, and why. Specific issues areas will be assigned to the students at the beginning of the

semester to avoid any repetition. **Powerpoint presentations need to be emailed to Mr. Sansot by 9AM on December 3. Late submissions will result in a grade of zero for this assessment.**

3. Policy Briefs (30%)

Brief 1: Students will prepare a brief that addresses a historical WMD policy and technical challenge – there are many from which to choose. Students may select any WMD-related policy issue that has an international dimension, but it must discuss both the policy and technical challenges. Additionally, students should address whether the policy approach used by said organization was correct and what they would have recommended for improved implementation. These double-spaced 10-page (at least, no more than 12) briefs are to be written for persons that will be briefing the NSC Chairman. You will be expected to (1) outline the technical and policy scope of the issue, (2) assess international implications, and (3) offer policy recommendations with justification.

- Policy brief 1 is due in class on Monday, October 8th.

Brief #2: Students will prepare a two-page policy brief that will be utilized the brief the POTUS on a recommended course of action pertaining to an emerging technology that poses new proliferation threat.

- Policy brief 2 is due in class on Monday, November 5th.

These assignments will be collected in class at the beginning of the class – 12:30PM. None of them will be accepted electronically. Late submissions will result in a grade of zero for this assessment.

4. Weekly Question and Class Participation (15%)

Active class participation is required. Students who are not presenting will be expected to keep up with the readings and to participate actively in the discussions. **Participation is based on class behavior, preparedness, and engagement with the material presented in class.**

All students will be required to come to class each week with one question to pose to the rest of the group about the week's topic. These questions will be collected in class at the beginning of the class – 12:30PM. They will not be accepted electronically. Additionally, the professor will pose one question each week via email. Students are expected to respond by the next classroom session. Failure to do so will result in a grade of zero for this assessment.

DEADLINES:

These deadlines are absolute – **NO EXTENSIONS ARE GIVEN**. Failure to turn in any of the assignments by the due date will result in a grade of zero for that particular assignment. In order to avoid a penalty for late submission of a paper, you must have evidence of extenuating circumstances (e.g., a doctor's note for illness). This must be submitted to the professor prior to the time of the deadline.

ACADEMIC HONESTY POLICY:

As a University of Georgia student, you have agreed to follow the University's academic honesty policy, "A Culture of Honesty," and the Student Honor Code. All academic work must meet the standards contained in "A Culture of Honesty" found at: http://ovpi.uga.edu/academic-

honesty/academic-honesty-policy. Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the professor.

All students are responsible for maintaining the highest standards of honesty and integrity in every phase of their academic careers. The penalties for academic dishonesty are severe and ignorance is not an acceptable defense. "Academic Honesty" means performing all academic work without plagiarism, cheating, lying, tampering, stealing, receiving unauthorized or illegitimate assistance from any other person, or using any source of information that is not common knowledge. "Academic Dishonesty" means performing any academic work that does not meet this standard of academic honesty. Assistance by another, when authorized by the Faculty Member, will not be considered academically dishonest, nor will using information that is fairly attributed to the source.

RETURN OF GRADED BRIEFS

The aim is to return graded briefs within 2 weeks after the submission date. Papers will be returned to you with an indicative letter grade, ranging from A-F. **ONCE A GRADE IS AWARDED, UNDER NO CIRCUMSTANCE WILL IT BE CHANGED.**

FERPA

The Family Educational Rights and Privacy Act (FERPA) protects the privacy of your educational record. Please e-mail me to make an appointment during my office hours to discuss your grades should you have any questions or concerns. I will not discuss your grades in class.

Course Schedule and Deadlines:

DATE	TOPIC	DEADLINES
August 13	Introduction and class overview	
August 20	Overview of WMD Technology and Global WMD non-proliferation efforts	**Weekly question**
August 27	Overview of Nuclear Technology	**Weekly question**
September 3	**NO CLASS – LABOR DAY**	
September 10	Nuclear Fuel Cycle	**Weekly question**
September 17	Nuclear Weapons Technology	**Weekly question**
September 24	Chemical Weapons Technology	**Weekly question**
October 1	Biological Weapons Technology	**Weekly question**
October 8	Missile Delivery Systems	**Policy brief #1 AND Weekly question**
October 15	Emerging Technologies	**Weekly question**
October 22	International WMD organizations (including IAEA, OPCW, NSG, AG, etc.)	**Weekly question**
October 29	Multilateral Export Control Regimes	**Weekly question**
November 5	Controlling WMD Technology	**Policy brief #2 AND weekly question**
November 12	Controlling WMD Technology	**Weekly question**
THANKSGIVING BREAK: November 19-23		

November 26	**CLASS DISCUSSION:** Current WMD Proliferation Challenges	**Weekly question**
December 3	**SEMINAR PRESENTATIONS**	

REQUIRED READINGS:
A list of readings has been provided for each week. Students are expected to read everything on the list since the readings will facilitate class discussion and enhance understanding of the topics covered in class. Students are expected to come prepared to class each week to discuss the issues raised from what they have read with their fellow students and instructor(s).

Books:

1. Peddling Peril: How the Secret Nuclear Trade Arms America's Enemies – David Albright, ISBN-13: 978-1476745763; ISBN-10: 1476745765

2. The Challenges of Nuclear Non-Proliferation - RICHARD DEAN BURNS AND HON. PHILIP E. COYLE III, ISBN-13: 978-1442223752, ISBN-10: 1442223758

3. Illicit: How Smugglers, Traffickers and Copycats Are Hijacking the Global Economy – Moises Naim, ISBN-13: 978-1400078844; ISBN-10: 1400078849

CLASS OVERVIEW AND READING ASSIGNMENTS:

Week 1 (August 13): Introduction and class overview

- Overview of class, grading, expectations, etc.

Readings:

- Please read the syllabus and come to week 1's class with any questions you may have about the syllabus and the class

Week 2 (August 20): Overview of WMD Technology and Global WMD non-proliferation efforts –

- What is a WMD?
- Why is an understanding of this topic important?
- Definitions/differences
- History
- Use
- Proliferation methodology
- WMD Conventions
    - NPT
    - CWC
    - BTWC
- Convention Implementing Organizations
    - IAEA (including a discussion on the AP)
    - OPCW (including a discussion on the OPCW-UN Joint Mission)
- UNSCR 1540

Readings:

- Video: "Nuclear Tipping Point" (54 minutes): https://vimeo.com/20532059

- "Weapons of Mass Destruction": https://www.hampshire.edu/pawss/weapons-of-mass-destruction
- NRC Fact Sheet on Dirty Bombs, December 2012: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-dirty-bombs.html
- 26 Countries' WMD Programs; A Global History of WMD Use: http://usiraq.procon.org/view.resource.php?resourceID=000678
- Text of the NPT: http://www.armscontrol.org/documents/npt
- Text of the BWC: http://www.armscontrol.org/treaties/bwc
- Text of the CWC: http://www.armscontrol.org/act/1997_04/cwctext
- Eric R. Terzuolo, "How the Iran Deal Erodes the Nonproliferation Treaty," *The National Interest*, August 5, 2015: http://nationalinterest.org/feature/how-the-iran-deal-erodes-the-nonproliferation-treaty-13492
- IAEA Safeguards Serving Nuclear Non-Proliferation, June 2015: https://www.iaea.org/sites/default/files/safeguards_web_june_2015_1.pdf
- Fact Sheets: Treaty Membership and Signatory Status of NPT, CWC, BWC: http://www.armscontrol.org/factsheets/treatymembership

Additional Reading:

- Kenneth Katzman and Paul K. Kerr, "Iran Nuclear Agreement," Congressional Research Service, May 31, 2016: http://fas.org/sgp/crs/nuke/R43333.pdf
- Text of the JCPOA: http://www.iaea.org/sites/default/files/gov-2015-72-derestricted.pdf
- George Perkovich, Mark Hibbs, James M. Acton, and Toby Dalton, "Parsing the Iran Deal": http://carnegieendowment.org/2015/08/06/parsing-iran-deal/iec5
- Ramesh Thakur, Jane Boulden, and Thomas G. Weiss, "Can the NPT Regime be fixed or should it be abandoned?", *Dialogue on Globalization*, Occasional Papers No. 40, October 2008: http://library.fes.de/pdf-files/iez/global/05760.pdf
- IAEA Safeguards in Practice: https://www.iaea.org/safeguards/safeguards-in-practice

Week 3 (August 27): Overview of Nuclear Technology

- Radiological and Nuclear Principles
- Intro to the Nuclear Fuel Cycle

Readings:

- The Nuclear Fuel Cycle Overview – World Nuclear Association: http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/nuclear-fuel-cycle-overview.aspx
- Stages of the Nuclear Fuel Cycle, NRC: http://www.nrc.gov/materials/fuel-cycle-fac/stages-fuel-cycle.html
- Radiation Protection, NRC: http://www.nrc.gov/about-nrc/radiation.html
- Plutonium Manufacturing and Fabrication: http://nuclearweaponarchive.org/Library/Plutonium/

Additional Reading:

- Technical Description of Fuel Cycle Facilities and Evaluation of Diversion Potential: http://www.princeton.edu/~ota/disk3/1977/9586/958607.PDF

- Kelsey Hartigan, Corey Hinderstein, Andrew Newman, Sharon Squassoni, "A New Approach to the Nuclear Fuel Cycle: Best Practices for Security, Nonproliferation, and Sustainable Nuclear Energy," CSIS/NTI, February 2015: http://www.nti.org/media/pdfs/150320_Squassoni_NuclearFuelCycle_Web_final.pdf?_=1426863720

Week 4 (September 3): No class

Week 5 (September 10): Nuclear Fuel Cycle

- Nuclear Material Production
  - Nuclear Reactors
  - Uranium Enrichment
  - Reprocessing

Readings:

- Uranium Enrichment, NRC: http://www.nrc.gov/materials/fuel-cycle-fac/ur-enrichment.html
- Uranium Enrichment, World Nuclear Association: http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/conversion-enrichment-and-fabrication/uranium-enrichment.aspx
- How uranium ore is made into nuclear fuel, World Nuclear Association: http://www.world-nuclear.org/nuclear-basics/how-is-uranium-ore-made-into-nuclear-fuel.aspx
- Processing of Used Nuclear Fuel. World Nuclear Association: http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/fuel-recycling/processing-of-used-nuclear-fuel.aspx
- Nuclear Proliferation and Safeguards, Office of Technology Assessment, June 1977: http://www.princeton.edu/~ota/disk3/1977/7705/7705.PDF

Additional Reading:

- Civilian HEU Reduction and Elimination Resource Collection, NTI: http://www.nti.org/analysis/reports/civilian-heu-reduction-and-elimination/
- William F. Shughart II, "Why Doesn't U.S. Recycle Nuclear Fuel?" *Forbes*, October 1, 2014: http://www.forbes.com/sites/realspin/2014/10/01/why-doesnt-u-s-recycle-nuclear-fuel/#3691456c7db4
- Nuclear Reprocessing: Dangerous, Dirty, and Expensive, Union of Concerned Scientists: http://www.ucsusa.org/nuclear-power/nuclear-plant-security/nuclear-reprocessing#.V3K41Vfw8RF
- George Perkovich, Jessica T. Mathews, Joseph Cirincione, Rose Gottemoeller, Jon B. Wolfsthal, *Universal Compliance: A Strategy for Nuclear Security*, March 2005: http://www.nti.org/media/pdfs/analysis_carnegie_universalcompliance_2005.pdf?_=1316466791

Week 6 (September 17): Nuclear Weapons Technology

- Nuclear Weaponization
  - Process

    - Testing
- Detection Technologies
    - Nuclear testing
    - Radiation Detection

Readings:

- Detecting Radiation, NRC: http://www.nrc.gov/about-nrc/radiation/health-effects/detection-radiation.html
- Radiation Detection and Measurement: http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/rdtec.html
- How Can You Detect Radiation? Health Physics Society: http://hps.org/publicinformation/ate/faqs/radiationdetection.html
- Detecting Radioactivity: http://www.darvill.clara.net/nucrad/detect.htm

Additional Reading:

- "CTBT at 15: Status and Prospects," Arms Control Association, October 2012: http://www.armscontrol.org/files/ACA_CTBT_Report_Vienna_2012.pdf
- Text of the CTBT: http://www.armscontrol.org/node/2491
- Nuclear Testing Fact Sheets: http://www.armscontrol.org/factsheets/nucleartesting
- How to Detect a Secret Nuclear Test (<4 minute video): https://www.youtube.com/watch?v=daZ7IQFqPyA

Week 7 (September 24): Chemical Weapons Technology

- Intro to chemical weapons
    - History
        - WWI Use
        - WWII Use (Germany and China)
        - Iran-Iraq War – impetus for CW nonproliferation
        - International response: CWC and AG
        - Syria
    - Physiological Effects
    - CW vs Explosives
    - CW vs TICs
- Chemical precursors
- Chemical process to make chemical agents
- DU Equipment
- OPCW Facilities declarations
- Controlled chemical DU equipment and industry

Readings:

- Sarah Everts, "When Chemicals Became Weapons of War": http://chemicalweapons.cenmag.org/when-chemicals-became-weapons-of-war/
- Sarah Everts, "Who was the Father of Chemical Weapons?": http://chemicalweapons.cenmag.org/who-was-the-father-of-chemical-weapons/
- Chemical Weapons Then and Now: http://cen.acs.org/content/dam/cen/93/8/09308-cover3timeline.pdf

- Elaine Seward and Sarah Everts, "How Chemistry Changed WWI": http://chemicalweapons.cenmag.org/how-chemistry-changed-wwi/
- Controlled Chemicals, OPCW: https://www.opcw.org/our-work/non-proliferation/controlled-chemicals/
- OPCW Scheduled Chemicals: https://www.opcw.org/chemical-weapons-convention/annexes/annex-on-chemicals/
- Australia Group Chemical Equipment Control List: Chemical Weapons Precursors: http://www.australiagroup.net/en/precursors.html
- World Customs Organization Strategic Trade Control Enforcement Implementation Guide – **p.41-42**: www.wcoomd.org/en/topics/enforcement-and-compliance/instruments-and-tools/guidelines/wco-strategic-trade-control-enforcement-implementation-guide.aspx
- Australia Group Chemical Equipment Control List: http://www.australiagroup.net/en/dual_chemicals.html
- Jannis Brühl, "Where Did Syria's Chemical Weapons Come From?" *ProPublica*, September 25, 2013: https://www.propublica.org/article/where-did-syrias-chemical-weapons-come-from
- Iraq Survey Group: Comprehensive Report of the Special Advisor to the DCI on Iraq's WMD, 30 September 2004, Volume III of III: https://www.gpo.gov/fdsys/pkg/GPO-DUELFERREPORT/pdf/GPO-DUELFERREPORT-3.pdf

Additional Reading:

- First-hand Accounts of the First Chlorine Gas Attack: http://chemicalweapons.cenmag.org/first-hand-accounts-of-the-first-chlorine-gas-attack/
- Jonathan B. Tucker, "Trafficking Networks for Chemical Weapons Precursors: Lessons from the Iran-Iraq War of the 1980s," CNS Occasional Paper No. 13, November 2008: http://cns.miis.edu/opapers/pdfs/op13_tucker_edited.pdf
- Mary Beth D. Nikitin, Paul K. Kerr, Andrew Feickert, "Syria's Chemical Weapons: Issues for Congress," Congressional Research Service, September 30, 2013: http://www.fas.org/sgp/crs/nuke/R42848.pdf
- Christopher M. Blanchard, Carla E. Humud, Mary Beth D. Nikitin, "Armed Conflict in Syria: Overview and U.S. Response," Congressional Research Service, October 9, 2015: http://www.fas.org/sgp/crs/mideast/RL33487.pdf (p.25-27)

Week 8 (October 1): Biological Weapons Technology

- Intro to Biological Weapons
- Historical Overview of Biological Weapons
    - WWI through WWII
    - Cold War era
    - Bioterrorism
- Bioagents of weapons concern
    - Agents targeting humans
    - Agents targeting agriculture
- Processes for bioagent to bioweapon
    - Dual Use Equipment

- Bioweapon concepts
    - Biotechnology
    - Biological research fueled by bioterrorism concerns
    - Ethical considerations

Readings:

- V. Barras, G. Greub, "History of Biological Warfare and Bioterrorism," *Clinical Microbiology and Infection*, Vol. 20, Issue 6, June 2014: 497-502: http://www.sciencedirect.com/science/article/pii/S1198743X14641744
- Australia Group Common Control Lists: Human and Animal Pathogens and Toxins: http://www.australiagroup.net/en/human_animal_pathogens.html
- Australia Group Common Control Lists: Plant Pathogens: http://www.australiagroup.net/en/plants.html
- Mary Beth D. Nikitin, Amy F. Woolf, "The Evolution of Cooperative Threat Reduction: Issues for Congress," Congressional Research Service, June 13, 2014: http://fas.org/sgp/crs/nuke/R43143.pdf (p.1-6; 37-42)
- "Lugar applauds opening of Nunn-Lugar Bio-Threat Laboratory in Tbilisi, Georgia," US Senate Committee on Foreign Relations, March 17, 2011: http://www.foreign.senate.gov/press/ranking/release/lugar-applauds-opening-of-nunn-lugar-bio-threat-laboratory-in-tbilisi-georgia
- Patrick Goodenough, "Russian Official Accuses U.S. of Using Lab in Caucasus for Bio-Warfare," CNS News, October 15, 2013: http://www.cnsnews.com/news/article/patrick-goodenough/russian-official-accuses-us-using-lab-caucasus-bio-warfare
- Mike Wheatley, "Russia Accuses U.S. of Placing Bio-Weapons Labs on its Borders," Russia Insider, June 17, 2015: http://russia-insider.com/en/politics/russia-accuses-us-placing-bio-weapons-labs-its-borders/ri8082
- Puccinia graminis (stem rust of cereals), Invasive Species Compendium: http://www.cabi.org/isc/datasheet/45797
- Cyrille Saintenac, Wenjun Zhang, Andres Salcedo, Mathhew N. Rouse, Harold N. Trick, Eduard Akhunov, Jorge Dubcokvsky, "Identification of Wheat Gene Sr35 That Confers Resistance to Ug99 Stem Rust Race Group," *SCIENCE*, Vol. 341, Issue 6147, 16 August 2013: 783-786: http://science.sciencemag.org/content/341/6147/783.full
- Pathotype Tracker - Where is Ug99? http://rusttracker.cimmyt.org/?page_id=22
- Wheat Stem Rust – Ug99: http://www.fao.org/agriculture/crops/rust/stem/rust-report/stem-ug99racettksk/en/
- Kerry Grens, "Putting Up Resistance," *The Scientist*, June 1, 2014: http://www.the-scientist.com/?articles.view/articleNo/40085/title/Putting-Up-Resistance/
- Australia Group Common Control Lists: Control List of Dual-Use Biological Equipment and Related Technology and Software: http://www.australiagroup.net/en/dual_biological.html
- Hilary Rodham Clinton, Remarks at the 7th Biological and Toxin Weapons Convention Review Conference, Geneva, Switzerland, December 7, 2011: http://www.state.gov/secretary/20092013clinton/rm/2011/12/178409.htm
- Capabilities Analysis of Bioterrorism: Roadblocks Facing Non-State Actors' Use of Bioweapons, *Global Biodefense*, May 20, 2014: http://globalbiodefense.com/2014/05/20/bioterrorism-roadblocks-facing-non-state-actors-use-of-bioweapons/

- Michael J. Selgelid, "Governance of Dual-Use Research: An Ethical Dilemma," *Bulletin of the World Health Organization* 2009, 87: 720-723: http://www.who.int/bulletin/volumes/87/9/08-051383/en/
- Stephen Strauss, "Ebola Research Fueled by Bioterrorism Threat," *Canadian Medical Association Journal*, November 4, 2014; 186 (16): 1206: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4216251/
- Crystal Boddie, "Federal Funding in Support of Ebola Medical Countermeasures R&D," *Health Security*, February 1, 2015; 13 (1): 3-8: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4389695/

Week 9 (October 8): Missile Delivery Systems

- Ballistic and Cruise Missile Technology
- Unmanned Aerial Vehicles
- Missile subsystems
- Missile Technology Control Regime

Readings:

- Karl Tate, "How Intercontinental Ballistic Missiles Work (Infographic)", Space.com, February 1, 2013: http://www.space.com/19601-how-intercontinental-ballistic-missiles-work-infographic.html
- Trajectories: http://hyperphysics.phy-astr.gsu.edu/hbase/traj.html
- HyperPhysics Concepts: http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html#mechcon
- The Materials Ballistic Missiles are Made of: http://missilethreat.com/the-materials-ballistic-missiles-are-made-of/
- Missiles of the World (Ballistic, Cruise, All): http://missilethreat.com/missiles-of-the-world/

Additional Reading:

- Kelsey Davenport, "Iran's Missile Tests Raise Concerns," *Arms Control Association*, April 2016: http://www.armscontrol.org/ACT/2016_04/News/Irans-Missile-Tests-Raise-Concerns
- Kelsey Davenport, "Worldwide Ballistic Missile Inventories," *Arms Control Association*, July 2014: http://www.armscontrol.org/factsheets/missiles

Week 10 (October 15): Emerging Technologies –

- A discussion on emerging technologies and their impact on nonproliferation

Readings:

- "3D Printing may lead to export control crackdown," The Export Compliance Journal, November 27, 2013: https://www.ecustoms.com/blog/?p=67&p=67
- "Peril and Promise: Emerging Technologies and WMD; Natasha E. Bajema and Diane DiEuliis; https://www.hsdl.org/?abstract&did=800906

- Which Emerging Technologies are "Weapons of Mass Destruction"?, Adam Thierer, https://techliberation.com/2016/08/26/which-emerging-technologies-are-weapons-of-mass-destruction/

Week 11 (October 22): International WMD organizations Main WMD multilateral regimes:
    - Nuclear Suppliers Group
    - Missile Technology Control Regime
    - Australia Group
    - Wassenaar Arrangement – Basis of Control List Structure used for Dual-Use Items
- Other programs:
    - Proliferation Security Initiative
    - Container Security Initiative
    - World Customs Organization
    - Interpol

Readings:
- The Missile Technology Regime: http://www.mtcr.info/english/public.html
- Multilateral Export Control Policy: The Coordinating Committee: http://www.princeton.edu/~ota/disk3/1979/7918/791810.PDF
- Nuclear Suppliers Group: http://www.nuclearsuppliersgroup.org/en/
- Australia Group: http://australiagroup.net/en/
- Mark Hibbs, "Toward a Nuclear Suppliers Group Policy for States Not Party to the NPT," Carnegie Endowment for International Peace, February 12, 2016: http://carnegieendowment.org/2016/02/12/toward-nuclear-suppliers-group-policy-for-states-not-party-to-npt/itxg
- World Customs Organization: http://www.wcoomd.org/en/topics/enforcement-and-compliance/instruments-and-tools/guidelines/wco-strategic-trade-control-enforcement-implementation-guide.aspx
- Proliferation Security Initiative: http://www.state.gov/t/isn/c10390.htm
- Container Security Initiative: https://www.cbp.gov/border-security/ports-entry/cargo-security/csi/csi-brief
- Container Security Initiative in Summary, May 2011: https://www.cbp.gov/sites/default/files/documents/csi_brochure_2011_3.pdf
- Interpol: http://www.interpol.int/Crime-areas/CBRNE/CBRNE
- Jeffrey Muller, "Shields up!" *CBRNe World*, April 2015: http://www.cbrneworld.com/_uploads/download_magazines/Shields_up.pdf

Additional Reading:
- MTCR Annex and Annex Handbook: http://www.mtcr.info/english/annex.html
- "What the Missile Technology Control Regime is All About," News18.com, June 8, 2016: http://www.news18.com/news/tech/what-the-missile-technology-control-regime-is-all-about-1253600.html
- NSG Documents: http://www.nuclearsuppliersgroup.org/en/nsg-documents
- NSG Guidelines: http://www.nuclearsuppliersgroup.org/en/guidelines
- Australia Group Common Control Lists: http://australiagroup.net/en/controllists.html

Week 12 (October 29): Multilateral Export Control Regimes in practice

- In depth look at the implementation of the Multilateral Export Control Regimes

Readings:

- TBD

Week 13 (November 13): Controlling WMD Technology

- Dual Use goods – historically controlled based on control lists created by supplier states
- How to effectively engage industry
    - In light of other pressing international security measures, can we expect governments and companies to focus on DU goods like corrosion resistant valves for example?
- In an age of expanding international trade and production, what does controlling Dual Use goods mean? Idea of supplier states may be becoming obsolete.
- How is new technology affecting idea of "controlling DU goods"? E.g. 3-D printing? Micro chemistry? Interface of bio and chemistry?

- Sybille Bauer and Mark Bromley, "The Dual-Use Export Control Policy Review: Balancing Security, Trade, and Academic Freedom in a Changing World," EU Non-Proliferation Consortium Non-Proliferation Papers, No. 48, March 2016: https://www.sipri.org/sites/default/files/EUNPC_no-48.pdf
- Renaud Chatelus, "The Role of Customs in Strategic Trade Controls: Challenges and Potential. Taking a States' Enforcement Perspective," CITS/UGA: http://cits.uga.edu/uploads/documents/chatelus_customs.pdf
- David Ivey, "Perspectives on Challenges/Problems in Export Control Compliance," October 29, 2015: http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_169005.pdf
- Stephanie Lieggi and Diana Lee, "Tracking Growth in Dual Use Commodities in Southeast Asia: Keeping Ahead of Proliferation Networks," May 20, 2015: http://www.nonproliferation.org/tracking-growth-dual-use-commodities/
- Jonathan B. Tucker, ed., *Innovation, Dual Use, and Security: Managing the Risks of Emerging Biological and Chemical Technologies*, Cambridge, MA: MIT Press, 2012: 235-248.

Week 14 (**November 12)**: Controlling WMD Technology in Practice

- A look at the process for trading in strategic goods

Readings: TBD

Week 15 (November 26): Class Discussion

Possible issues for consideration, but students are welcome to raise other topics:

- Nuclear
    - Declared NWS – Modernization and increasing arsenals and stockpiles
        - China, US, Russia, UK, France

    - India, Pakistan
    - DPRK, Iran
- Biological
    - Technology advances
    - Lack of verification mechanism
- Chemical
    - Incomplete CW stockpile destruction
    - Continued use of CW in Syria and Iraq
    - Prevalence of chemical industry throughout the world and need for dual-use equipment
- Non-state actors
- Role/responsibility of scientists in non-proliferation
- Controlling technology – is it even possible?

Week 16 (December 3): Student end of semester seminar presentations
Students will present their end of semester presentations to the rest of the class and all instructors. Presentations should be no more than 30 minutes long and should outline which of the issues discussed in class pose the biggest threat to U.S. and international security, and why. Specific issues areas will be assigned to the students at the beginning of the semester to avoid any repetition. **Powerpoint presentations need to be emailed to Mr. Sansot by 9AM on December 3. Late submissions will result in a grade of zero for this assessment.**