The Johns Hopkins University  
Advanced Academic Programs  
Environmental Earth Sciences and Policy  

Syllabus  
Spring 2017  
420.629.81, Drinking Water, Sanitation and Health  

Instructor: Glenn Patterson, gpatter5@jhu.edu, 303-747-2089 (9 am – 9 pm Mountain Time). Expect a response to emails within 24 hours.

Course Goals

Course goals: The goal of this course is to explore ten dilemmas related to drinking water, sanitation, and public health, and examine the scientific and public-policy issues that frame each dilemma. The ten dilemmas, one for each lesson, are listed in the Course Content section below. By the end of the course you should be familiar with the how drinking water is provided and treated, who is responsible for ensuring its safety, what health threats are commonly associated with drinking water, and how the public policy sector has acted to reduce those threats. The geographic scope of the course ranges from your own local water supply, to other local examples from around the U.S., as well as some issues of global concern.

Course Information

Course description: Drinking-water health threats and the public-policy responses to them are examined in ten lessons. The first two cover the basics of drinking-water supply and treatment, and who is responsible for ensuring its safety. The remaining lessons examine eight dilemmas that involve vexing issues of both science and public policy. Each lesson has a presentation, some short readings, and a quiz of 6 questions. Seven of the lessons have roundtable discussion topics, some involving minor research assignments. At the end of the course students will be asked to respond to one essay question. The textbook, a 32-page EPA publication, can be ordered at no charge from EPA, but is also available on BlackBoard.

Policies

Introduction: As your instructor, I am committed to being a frequent and helpful presence during the course, logging in on average once a day to participate in discussions and respond to email. I expect you to dedicate the same level of interest and effort you would give to a classroom course, and stay current with the schedule of lessons, averaging one per week.

Additional Course information: Grading will be based on 500 points, distributed as follows:

- 10 quizzes, 24 points each (240 points)
- 7 discussions, 20 points each, (140 points)
- 1 research proposal, 20 points
- 1 non-technical summary of your research (see below), 40 points
- 1 final essay, 60 points,

for a total of 500 points.

The grading scale for students enrolled for credit is A+, A, A-, B+, B, B-, C, and F. Point values for each grade are:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>490-500</td>
<td>98-100%</td>
</tr>
<tr>
<td>A</td>
<td>465-489</td>
<td>93-97.9%</td>
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<tr>
<td>A-</td>
<td>450-464</td>
<td>90-92.9%</td>
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<tr>
<td>B+</td>
<td>435-449</td>
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<td>84-86.9%</td>
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<tr>
<td>B-</td>
<td>405-419</td>
<td>80-83.9%</td>
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<tr>
<td>C</td>
<td>390-404</td>
<td>77-79.9%</td>
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<td>C-</td>
<td>375-389</td>
<td>74-76.9%</td>
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<tr>
<td>D</td>
<td>360-374</td>
<td>71-73.9%</td>
</tr>
<tr>
<td>F</td>
<td>0-355</td>
<td>0-70%</td>
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</table>
B  415-434  83-86.9%
B-  400-414  80-82.9%
*Fail  0-399  0-79.9%

More details on the grading policy are available at [http://advanced.jhu.edu/current-students/policies/grading-policy/](http://advanced.jhu.edu/current-students/policies/grading-policy/).

Assessments:

**Quizzes** are open-book, with no set time limit, but you may take each quiz only once.

The **discussion forums** are the heart of the course, and you will be expected to participate on a regular basis. Discussion postings are due by one week after the suggested completion date for each lesson, as noted in the course calendar. Late discussion postings without prior consent of the instructor will be discounted by 10% in the grade book. To earn a full score, a discussion post must be written with good grammar, and must demonstrate both a good grasp of some aspects of the subject matter from the lesson, and some critical thinking as to your interpretation of the subject matter in the context of that lesson’s drinking-water dilemma. The goal of the discussions is to let you share the insight you have gained about how science and public policy have come together to help solve drinking-water dilemmas. The dilemmas do not have easy answers, and there is room for varying opinions in the discussions, as long as the opinions are supported.

Assignments:

As mentioned above under “Grading”, in addition to the quizzes and discussions, there are three assignments in this course. The three assignments build on each other. Assignment 1 is a **research proposal**, in which you will identify a problem pertaining to drinking water, and discuss how you plan to research the topic. You will also make a guess as to the format of the non-technical summary that is Assignment 2. Submit the assignment using the "submit" option in Assignment 1. Assignment 1 is worth 20 points.

Assignment 2 is a **non-technical summary** of your research topic, which is designed for an audience of interested lay people; people who care about drinking water and know something about it, but have not specialized in water in an academic setting. The assignment may take the form of a slide show, brochure, poster, web site, video, podcast, news article or opinion piece, letter to an elected official, or other similar format. Submit the assignment using the "submit" option in Assignment 2. Assignment 2 is worth 40 points.

Assignment 3 is your **final essay**, similar to a brief term paper. You are expected to write 3-4 pages about the drinking-water threat or problem of your choice (identified in the research proposal and described in the non-technical summary), and how it is or should be mitigated. I am asking you to identify a threat to safe drinking water in this country or abroad, do some independent research on the topic, and present your thoughts about possible solutions in 3-4 pages. Your final essay is due by midnight on Tuesday, May 10, 2016. To submit your essay, use the "submit" option in Assignment 3.

Here are some potential topics, but you are also free to select your own.

- Perchlorate—how much of a threat is it?
- Contrast European and American approaches to source water protection
- Contrast source-water protection measures among various states or cities
- How consistent are source-water assessments among the various states?
- Riverbank filtration as a pre-treatment alternative—how effective is it in reducing health risks from pathogens, and how much pre-treatment credit should be granted to those utilities that use it?
- Use of GIS to correlate drinking water quality and human health
- Issues in water re-use
- Issues in water conservation
- Balkan endemic nephropathy and water supplies
• New technology for monitoring source-water quality
• New treatment technologies for water or wastewater
• Federal water policy—is there one? How much of a role should the Federal government play in setting water policy? How is vulnerability of source waters determined?
• Effectiveness of best-management practices in controlling non-point-source pollution
• Success stories in source-water protection
• Case histories of major source-water pollution episodes—Rhine River, Ohio River, Milwaukee, Chernobyl, etc.
• Drinking-water supply and source-water protection in foreign countries: China, Russia, South Africa, Israel, Iraq, Egypt, etc.
• Relative health risks from bottled water and tap water
• Which cities have the cleanest and dirtiest water?
• History of drinking-water regulation in the Environmental Protection Agency
• Drinking-water supply and health problems in ancient, medieval, and other historical periods
• Desalination
• MTBE
• Artificial recharge
• Water-borne diseases
• Lead

If you use material written by someone else, keep it short, enclose it in quotes, and provide a reference for it. Also please provide references for facts you cite in your essay. The essay will be graded in this way:

<table>
<thead>
<tr>
<th>Category</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>20</td>
</tr>
<tr>
<td>Organization</td>
<td>15</td>
</tr>
<tr>
<td>Readability</td>
<td>15</td>
</tr>
<tr>
<td>References</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
</tr>
</tbody>
</table>

In all your writing for this course, text that is not enclosed in quotes is expected to be your original writing. Text that you copy directly from web sites or other documents should be enclosed in quotes and attributed to a source.

The course is designed for a pace of about one lesson per week, as indicated by the suggested lesson completion dates on the course calendar. Lessons 4, 5, and 7 are designed for 2 weeks each. It is especially recommended that you work on Lesson 2 during the week suggested on the calendar, so that the entire class may share the exercise. The rest of the lesson completion dates are more flexible, but you should still strive to complete each lesson within one week of its suggested completion date. If you have a schedule conflict that requires an extension, please notify the instructor in advance.

Getting Help

You have a variety of methods to get help on Blackboard. Please consult the help resources listed in the online classroom for additional information. Important Note: If you encounter technical difficulty in completing or submitting any online assessment, immediately contact the 24-hour Help Desk listed under the "Blackboard Help" tab. Also, contact your instructor at the email address listed earlier in this syllabus.

University Policies

General

This course adheres to all University policies described in the academic catalog. A few to pay close attention to are noted below. JHU Ethics Statement: The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and
falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.

**Plagiarism**

Read and adhere to JHU's Notice on Plagiarism.

**Dropping the Course**

You are responsible for understanding the university's policies and procedures regarding withdrawing from courses found in the current catalog. You should be aware of the current deadlines according to the [Academic Calendar](#).

**Students with Disabilities**

Johns Hopkins University is committed to providing reasonable and appropriate accommodations to students with disabilities. Students with documented disabilities should contact the coordinator listed on the [Disability Accommodations](#) page. Further information and a link to the Student Request for Accommodation form can also be found on the [Disability Accommodations](#) page.

**Textbook**

**Required reading:**


**Required reading:**

*Water On Tap* is easily accessed online from the Welcome Page on the course menu.

**Course Content**

**Lesson 1--Drinking-Water Basics (Week 1, ending January 14, 2017)**

**Objectives or Goals:**

Provide basic information about the water cycle, where drinking water comes from, types of contaminants, and water treatment.

**Topics:**

- Water of the world
- History of drinking water treatment
- How is drinking water treated
- Virtual tour of drinking water plant

**Readings:**

- *Water On Tap* pages 7-8, 15-17
- *The History of Drinking Water Treatment*
- *Drinking Water Treatment*
- *Drinking Water Treatment on the Go*
- *EPA Local Drinking Water Information*

**Assignments:**

- Discussion 1: Where does my drinking water come from?
- Quiz 1

**Lesson 2--Drinking Water Institutions (Week 2, ending January 21, 2017)**

**Objectives or Goals:**

Discuss the variety of institutions, agencies, organizations, and other entities that bear some responsibility for ensuring the safety of our drinking water. Consider their perspectives, fields of expertise, contributions, and agendas.
Topics: What sectors of our society are involved in ensuring the safety of drinking water? What are some examples of relevant institutions in the various sectors? How do they interact or fail to interact? What barriers prevent effective interaction?

Readings: - Water On Tap, pages 21-22 and 29-30
- History of the Fairmount Water Works
- A Call to Action: A Recommitment to Assessing and Protecting Sources of Drinking Water

Assignments: - Discussion 2 -- Who is responsible for safe drinking water?
- Quiz 2

Lesson 3--Drinking Water Law (Week 3, ending January 28, 2017)

Objectives or Goals: Discuss what the law says about who has the right to use water and how its use and quality may be regulated. Compare different approaches in different parts of the country.

Topics: Water rights Safe Drinking Water Act Drinking Water Regulations Bottled Water Regulations

- Understanding the Safe Drinking Water Act
- Primary and Secondary Drinking Water Standards
- Drinking Water Issues—Corrosive Water
- CDC-Lead-Water
- Lead and Copper Rule
- When the Water Turned Brown
- Surface Water Treatment Rules
- Disinfectants and Disinfection By-Products Rules
- Unregulated Contaminant Monitoring Rule
- Source Water Protection Basics
- FDA Regulates the Safety of Bottled Water
- Bottled Water: Pure Drink or Pure Hype?
- Regulation of Bottled Water

Assignments: Quiz 3

Lesson 4--Drinking Water and Sanitation (Weeks 4 and 5, ending February 11, 2017)

Objectives or Goals: Discuss the connections between drinking water and disease, and efforts through the years to separate the two.

Topics: Waterborne diseases
- Development of wastewater treatment
- Water-related health problems around the world

Readings: - Water on Tap, p. 5
- The History of Drinking Water Treatment

Assignments: - Discussion 4 (no discussion 3)-- Report on a disease
- Quiz 4

Lesson 5--Protecting Source Water from Urban and Agricultural Runoff (Weeks 6 and 7, ending February 25, 2017)

Objectives or Goals: Discuss contaminants that can enter water from urban and agricultural runoff, and measures taken to protect source water from them.

Topics: Pristine sources--Boulder, Portland Unfiltered sources--Boston, New York Animal wastes--Waco, Orange County Agricultural chemicals--Des Moines Urban runoff--Dayton

Readings: - Water on Tap, pp. 4-5, 21-22.
- What's a Watershed and Why does it Matter?
- A River Runs Through It—Waste Management at Center of Controversy
- Erath County’s Booming Dairy Industry Pollutes Texas' Waterways
- Mayors Meet in Waco to Discuss Watershed Protection and Animal Waste
- Agricultural Pollution—Dairies
- Keeping Manure in its Place
- Chino Dairies Facing Fines over Waste
- Nitrate: Finding Answers for the Santa Ana
- Orange County Water District: Groundwater Management
- Iowa Agriculture Water Alliance
- Conflict over Soil and Water Quality puts "Iowa Nice" to a Test
- Watershed Progress: New York City Watershed Agreement
- EPA Grants New York City a New Waiver
- New York City Watershed – Protection
- Massachusetts Office of Watershed Management
- Mass. Integrated Water Supply Improvement Program
- Dayton Well Field Protection Program
- Estimating Areas Contributing Recharge to Wells

Assignments: 
- Discussion 5--Does your utility have a source-water protection program?
- Quiz 5
- Assignment 1, Research Proposal

Lesson 6--Regulating Animal Feeding Operations (Week 8, ending March 4, 2017)

Objectives or Goals: Discuss impacts of animal feeding operations on human health, and various approaches being taken toward regulating AFO's.

Topics: 
- Impacts of AFO's on health
- Federal regulation of AFO's
- State regulation of AFO's
- Agricultural practices to avoid contamination--"RoboCow"

Readings: 
- Abstract: A Reconnaissance for Hormone Compounds in the Surface Waters of the United States
- Abstract: Occurrence of Antibiotics in Liquid Waste at Confined Animal Feeding Operations and in Surface and Ground Water
- Effects of Confined Animal Feeding Operations (CAFOs) on Hydrologic Resources and the Environment
- Playing by the Rules: Regulations and Animal Agriculture
- Pollution from Giant Livestock Farms Threatens Public Health
- Unified National Strategy for Animal Feeding Operations
- Managing Livestock, Poultry, and Horse Waste to Prevent Contamination of Drinking Water
- Concentrated Animal Feeding Operations: Final Rulemaking

Assignments: 
- Quiz 6

Lesson 7--The Contaminant Soup and Drinking Water Standards (Weeks 9 and 10, ending March 18, 2017)

Objectives or Goals: Discuss the occurrence of contaminants as mixtures instead of singly, and approaches to regulating contaminants as mixtures.

Topics: 
- Occurrence as mixtures
- Pesticides
- Volatile organic compounds
- Pharmaceuticals and hormonally active compounds
- Regulating contaminant mixtures

Readings: 
- Man-Made Chemicals Found in Drinking Water at Low Levels (USGS Podcast)
- Pesticides in the Nation’s Streams and Groundwater—Chapter 5, Complexities: Seasonality, Mixtures, and Degradates
- VOC’s, Pesticides, Nitrate, and their Mixtures in Ground Water used for Drinking Water in the United States
- Philadelphia Partnership for Pharmaceutical Pollution Prevention
- Our Stolen Future—Basics
- Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance, OR
- Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams (fact sheet)
- Combining Xenoestrogens at Levels below Individual No-Observed-Effect Concentrations Dramatically Enhances Steroid Hormone Action
- Evaluating Concurrent Exposures to Multiple Chemicals
- Drinking Water Strategy – Contaminants as a Group Process
Assignments: 
- Discussion 7 -- Should contaminants be regulated as mixtures? 
- Quiz 7 
- Assignment 2, Non-Technical Summary of Research Project.

Spring Break—March 20-24, 2017

Lesson 8--Arsenic in Ground Water (Week 11, ending April 1, 2017)

Objectives or Goals: 
Discuss the occurrence of arsenic in ground water in the US and abroad, health impacts, regulation, and mitigation.

Topics:  
- Sources of arsenic  
- Occurrence of arsenic in water  
- Health impacts  
- US and international standards  
- Regulation  
- Mitigation  
- Arsenic in Bangladesh -- the world's greatest drinking-water disaster

Readings:  
- Arsenic, drinking-water and health risk substitution in arsenic mitigation  
- Drinking Water Standard for Arsenic (EPA Fact Sheet)  
- Arsenic in Groundwater of the United States: Occurrence and Geochemistry  
- Treatment Technologies for Arsenic Removal  
- Arsenic Used in Chicken Feed May Pose Threat  
- Arsenic Contamination of Groundwater in Bangladesh  
- Arsenic-Poisoning Lawsuit Rejected by Britain

Assignments:  
- Quiz 8

Lesson 9--Disinfection By-Products (Week 12, ending April 8, 2017)

Lesson:  
Killing pathogens can create other problems

Objectives or Goals:  
Discuss the tradeoffs between killing pathogens and creating toxic disinfection by-products.

Topics:  
- The disinfection process  
- Disinfection by-products  
- Health effects of DBP's  
- Avoiding the dangers of DBP's Regulations to curb DBP's

Readings:  
- Water on Tap, page 9  
- Seeking Safe Drinking Water  
- EPA Drinking Water Guidance on Disinfection By-Products  
- USGS Studies on Disinfection By-Products and Drinking Water

Assignments:  
- Discussion 9--How can we kill pathogens and avoid the dangers of DBP's? -Quiz 9

Lesson 10--Drinking-Water Security (Week 13, ending April 15, 2017)

Objectives or Goals:  
Discuss the threats of intentional and accidental damage to water supplies, and how we can protect our drinking water.

Topics:  
- History of sabotage of water supplies  
- Notable accidental contaminant spills  
- Technology for early-warning monitoring  
- Institutional aspects of water security  
- Vulnerability assessments

Readings:  
- Water on Tap, pp. 13-14  
- Battle of Kirrha—the First Sacred War  
- History of Biological Warfare  
- A Chemical and Biological Warfare Threat: USAF Water Systems at Risk  
- The History of Germ Warfare: Very Long, Very Deadly  
- Historical Aspects of Biological Warfare Agents  
- Water Supply Terrorism  
- Nerve gas attack on Tokyo Subway  
- The History of Bioterrorism-tularemia (CDC video)  
- Bioterrorism Agents/Diseases  
- Presidential Decision Directive 63: Critical Infrastructure Protection  
- AWWA Guidelines for the Physical Security of Water Utilities  
- A Proud River Runs Red  
- The Tisza Cyanide Disaster and International Law  
- Floreffe, Pennsylvania Oil Spill  
- Oil Spills Prevention and Preparedness Regulations
- The Inez Coal Tailings Dam Failure
- Martin County Coal Slurry Spill
- Gold King Mine Background
- Early Warning Monitoring to Detect Hazardous Events in Water Supplies

Assignments:
- Discussion 10--Should early warning monitoring include source water?
- Quiz 10

**Essay (Week 14, ending April 22, 2017) (Essay due May 1, 2017.)**

Lesson:
Technical and institutional solutions for a drinking water problem

Objectives or Goals:
Research a drinking-water issue and report your findings.

Topics:
Any serious drinking-water threat in the US or abroad

Assignments:
- Assignment 3--Select one serious threat to drinking water in the US or abroad, do some independent research, and write 3-4 pages on possible solutions involving technology and institutions.