BOSTON UNIVERSITY

College of General Studies

CAPSTONE 2017

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About the Capstone Project

The capstone project represents the culmination of your academic experience at CGS. This interdisciplinary, project-based assignment allows you to integrate what you have learned both at CGS and in other Boston University courses and apply it to real-world problems. Using a team oriented, project-based learning approach you will work together to address a specific scientific or technological issue from many different angles. You will incorporate material from different fields and look at the scientific, ethical, legal, social and economic issues that influence your topic. You and your team members will have different background and majors— this will make your final project more comprehensive and allow you to consider all of the challenges that your topic holds.

You will focus specifically on the local nature of the problem. In other words, what can be done in and around the Boston area to deal with these issues? The goal of this project is not just to read about and become experts on your specific topic (although, you will do that), but to engage with the topic and conduct your own research. This can include conducting lab experiments that your group designs to answer specific questions, interviewing experts that are leaders in the field, visiting relevant locations, conducting surveys, and other activities that take you beyond library and internet research.

As you begin this project, keep three thoughts in mind. First, the construction of a building is not an individual effort, but the culmination of labor undertaken by an organized group. You are expected to work together, to share ideas, and to collaborate for the success of your group. Second, successful capstone projects address relatively narrow topics and devise local solutions that may be applied to global problems. Finally, the Capstone paper is not a fifty-page term paper. Instead it should be a synthesis, combining separate elements to form a coherent whole. Background research is indispensable, but beyond research, your group is expected to analyze, synthesize, make proposals, and justify your conclusions. The most effective Capstone projects provide meaningful solutions to well-

defined problems. In your written product, your group will present a logical argument based on evidence, sound rhetorical practice, and well-documented sources of information.

Mechanics of the Capstone Project

Groups

The Capstone Project is a group project. You will be a member of the group during the entire project and each group will need to work out for itself some form of division of labor and responsibility. Each member of the group will be responsible not only to her or himself, but to the other members as well. We encourage you to use Google Documents or other sharing options as a way to easily add to, edit, and co-edit your Capstone paper. All students are required to document their specific contributions by posting their work to their E-portfolio. Your E-portfolio should be updated as the work is done and not only at the end of the project. Each student should create a specific Capstone tab in E-portfolio for his or her work.

Project Grades

You will receive one grade for the project. This grade will make up 25% of your semester grade in Natural Science, Social Science, and Humanities. There are three components to the Capstone grade: the paper itself, the oral defense, and peer evaluation of your participation in the activities of the group. You will be evaluated as a group on the written report (in other words, each member of the group will receive the same paper grade), but as individuals on the oral defense and participation. Your final Capstone grade will be a combination of these three components, and is determined by consultation among your three professors. We take this process seriously and discuss each student's performance at the conclusion of the oral defense and reconsider grades again at the end of the entire process of oral examinations before finally settling on a recorded grade. Be aware that your faculty do not look kindly on students who decide to travel for substantial periods of time during the project duration or who do only the minimum amount of work for the project.

Understand from the outset that our teaching and learning endeavor at CGS is a process, and the Capstone project is simply a part of that process. Faculty and students should come to the oral examination prepared to engage in discussion about both the Capstone process and the finished product. Rather than a “checklist” of strong and not-so-strong points about the finished product, faculty

will use this opportunity to engage with you one more time. Faculty will "share the floor" so that students may participate fully and so that each faculty examiner has an equal opportunity for engagement with students. The evaluation rubric that we present here addresses the evaluation process in greater detail, in order to provide guidelines for everyone's participation in the oral examinations. An individual team may require additional aspects to the projects, such as presentations involving videos, websites, E-portfolios, PowerPoints, or posters. Your faculty will discuss such additions with you at the beginning of the project.

Reporting of Grades

No Capstone grades will be released until all oral exams are completed. This is necessary because team faculty do not assign final Capstone grades until all student groups are evaluated. Your faculty will discuss the mechanics of reporting grades to you. Note that you will receive only **your individual Capstone grade**, as this is what constitutes 25% of your semester grade in each course. This grade is final since it involves substantial deliberation and discussion among the team faculty members. Do not expect the faculty to re-evaluate the grade, once given.

The Written Report

The length of the Capstone paper should be a *maximum* of 50 pages typed, double-spaced. This does not include preliminary pages (table of contents, etc.), endnotes, footnotes, works cited, bibliography, or appendices. Copies of the report must be provided for **each faculty member** and also each member of the group in order to prepare for the oral defense. Generally, faculty copies are provided by student teams as paper versions; however, some faculty and/or teams may request electronic copies of the Capstone Project on memory sticks. The form preferred by your team faculty will be discussed early in the process.

The Oral Defense

After the final report has been submitted to the faculty, your group will meet at an appointed time to defend its work before your team faculty. The oral defense can last up to two hours, though defenses of one to one-and-a-half hours are preferable. Each group member should have his or her own copy of the Capstone Project and should be prepared to answer questions on all aspects of the report. Do not expect to be questioned only on the section which you contributed – you must know the entire Capstone and be able to address any part of it to have a successful oral exam.

Statement on Plagiarism

To plagiarize is "to take (ideas, writings, etc.) from another and pass them off as one's own" (Webster's New World Dictionary, 3rd College Edition, New York: Simon and Schuster, 1988, p. 1031). You are expected to indicate sources using approved techniques. Since students are often confused about the use of quotation marks, the faculty has established the general rule that whenever five words are copied consecutively from another author, the material must be put in quotation marks; failure to do this is plagiarism. Students should note that the sources of ideas and thoughts, even though paraphrased in one's own words and expressed in what is commonly called an indirect quotation, must be credited.

Students will be required to submit their own individual portions of the project to an online plagiarism checker. BU has a contract with Turnitin and team faculty will set up a Capstone Turnitin project via their Blackboard Learn sites. This service not only checks your writing for originality by comparing it to thousands of other websites, both internal to BU and external, but also provides a grammar and spelling checking service to improve writing. Both faculty members and students can learn more about this service via: http://www.bu.edu/tech/support/desktop/distribution/turnitin/blackboard/. Students may submit multiple revisions of their writing to this service and faculty will be able to access reports on all students. Students should submit their portions of the Capstone prior to the final editing of the project to ensure that all group members have properly attributed sourced material and have eliminated all spelling and grammatical errors. Failure to submit your own portion of writing to this service will have an impact your individual grade on the Capstone Project.

Use of the Internet

The internet can be a valuable resource for you during this project, but most information available on the internet is not checked or regulated, and therefore is not necessarily accurate. However, you can find authentic research sources through the internet by carefully reading a website. Often, a helpful bibliography is posted at the end of a web site. Use of Google Scholar can often point you to helpful primary sources. But note that the BU Library website and its physical building will provide you with the greatest and most useful sources. In addition, the BU librarians will have set up a special site for the Capstone topics that will greatly help you find sources—you should use this site as much as possible when getting started on your topic. Finally, you will note that under each topic listed in this year's syllabus, a set of links has been provided to help you better understand each issue. Prior to choosing a

specific topic, you should examine and read the material found at these links. You should consult with your team faculty regarding other types of information that they consider acceptable for use in the Capstone, and for guidance in proper methods of citing internet sources.

Original research

During the capstone project you are encouraged to conduct your own research. As mentioned in the introduction this may include laboratory experiments or surveys. Any experiments or surveys your group would like to conduct need to be discussed with a faculty member. The faculty member can help you design and obtain the necessary supplies for your experiments or surveys.

You are also encouraged to interview experts in the field or visit locations that specialize in the area of your topic. Always be courteous and respectful of people's time. If you do interview someone, have specific questions prepared ahead of time. Do not ask questions that are general in nature to the topic, but use this as an opportunity to get specialized information that might not be available from a written or internet source.

Capstone Format

The Group's Identity

Each Capstone group is charged with the task of formulating a policy recommendation on an issue that is related to their topic. For that purpose, each group will constitute itself as a panel of experts that has been charged with the responsibility of surveying the history and scope of a particular problem in the Boston metropolitan area. The group must consider many possible solutions before recommending what it determines to be the best solution for the local area. The group may be a special commission of inquiry, bureaucrats in a government agency, or an independent panel of scientists, scholars or citizens. The group will consider the scientific, ethical, philosophical, sociological, political and technological implications of the chosen problem and of the policy. The research necessary to formulate such policy recommendations should reflect data-driven research rather than opinion.

Format for the Written Report

Your group will develop a recommendation that is presented to a government agency or another appropriate group. Your paper should follow these general guidelines. Note that the percent breakdown is general and your professors will guide you on the specific breakdown of your paper. The breakdown does not include appendices, tables, figures, maps or other supplementary material:

A. <u>Background</u>: You will include an introduction that puts your topic into a context that is understandable to general readers. Clearly state the problem you are investigating, why it is important to investigate this problem, and to whom you will be presenting your recommendation. Your work on this section will be evaluated for clarity, brevity, and how effectively you describe the topic. *This section should occupy approximately 10% of your final written work*.

B. <u>Discussion and Development of the Problem:</u> Here you will pinpoint an issue from your background section. The problem you identify will be a contemporary issue, so you will use contemporary sources (newspapers, etc.) to shape this section of your work. By using contemporary sources, you will be able to uncover the "experts" or other crucial players who provide ideas, act on, consult, legislate, oppose, etc. the problem you identify. It is these people and their work that you will want to research more to shape your solution. Your work on this section will be evaluated for its

clarity, focus, and connection with a real contemporary problem. *This section should occupy approximately 30% of your final written work*.

C. <u>The Recommended Solution:</u> Your recommendation should be a logical outcome of the data and background you presented in sections A and B. You will propose a solution to the problem you have identified. You may draw from many sources for this section but it is logical that you will want to rely heavily on the work of key players you identified in the problem section. In order for your solution to be effective, you **must** have the following components**.** (1) The group must have a persona: who are you and to whom are you presenting your solution? (2) Your solutions must consider opposing viewpoints, potential opposition, and barriers. "Magic bullet" solutions are not acceptable for this project. (3) You should base your solution on the background you provided and the problem you identified. Your project must represent a unified, logical idea. Your work on this section will be evaluated based on the points above as well as clarity, accuracy, focus, and effective writing. *This section should occupy approximately 60% of your final written work.*

D. <u>Citations:</u> Citations occur within the text and are done in an author/year format. Unlike Humanities or Social Sciences, page numbers are not normally included in the citation unless you are using a direct quote. However, direct quotes are RARELY used in scientific writings, so learn to properly paraphrase the information being presented by the authors of works you are using. Also be aware that if you mention specific species, you MUST properly format the species name – the genus name is capitalized and both the genus and species name are italicized (ex. *Homo sapiens*). The following citation example should help you understand how you appropriately cite using the Council of Scientific Editors (http://writing.wisc.edu/Handbook/DocCSE.html). The preferred version of citations is the name-year system rather than the citation-name or citation-sequence systems. An example of the name-year citation system follows below.

> Made naturally, antibiotics are designed to interfere with or kill other microorganisms (Ambile-Cuevas et al., Ludgar, 1995; Levy, 1998). Microbes that make the antibiotics have devised ways to protect themselves from their self-manufactured toxins (Ambile-Cuevas et al., 1995). This resistance can also be passed on to other bacteria, even those of different species. When a population of bacteria is exposed to an antibiotic (which occurs, for example, when we take

antibiotics), those bacteria NOT resistant to the drug die first. The resistant ones are left behind to produce more resistant bacteria (Ambile-Cuevas et al., 1995; Levy, 1998). Some bacteria acquire the DNA of other bacteria, and therefore gain antibiotic resistance genes more readily than others (Grady, 1996). This has produced particularly pathogenic strains of some food borne bacteria, such as *E. coli* and *Salmonella*, which no longer respond to antibiotic treatment (Holmberg et al., 1987).

Please use the electronic *The Writer's Handbook* provided by the Council of Scientific Editors to aid you in citing various types of publication sources (http://writing.wisc.edu/Handbook/DocCSE_NameYear.html).

Alternative Format for the Written Report (Adversary Format):

In this format your group presents alternative solutions and acts as the arbitrator of a dispute (e.g., for or against new Internet privacy regulation). Two petitioners argue their respective positions on the controversy and the arbitrator makes a final ruling in favor of one of the petitioners. Your paper will develop competing arguments for each side of the controversy in an orderly, logical manner, render a judgment, and explain the reasons for favoring one position over the other. Your paper should be organized as follows:

A. Introduction: Clearly state the controversy, and why it is a controversy. It may help to provide a brief history of the controversy in this section. Indicate who the two petitioners are and what positions they will be representing.

B. Petitioner I - Arguments: State the controversy that is being argued and what judgment is desired. Develop the history behind the controversy that will support this petitioner's arguments. Present, in a logical, clear manner, the data that support this petitioner's position. For example, if you were arguing against the use of property taxes to fund public education you might want to present data showing that such funding leads to inadequate resources for schools in poor districts. Any evidence that will support the petitioner's position and sway the judgment towards their side should be presented.

C. Petitioner II - Arguments: Follow the same approach as above. It is advisable to present counter-arguments and evidence that opposes the other petitioner's position. These arguments can be developed as in a point-counterpoint debate; for example, if you were arguing in favor of the current use of property taxes to fund public education you might want to provide data that shows that it does provide adequate resources. Petitioner II should present evidence that will support their position and sway the judgment towards their side.

D. Judgment by the Arbitrator: State what the ruling of the arbitrator is, then logically develop the rationale for the ruling. Data presented by both petitioners should be used to support the ruling. You should strive for a realistic ruling and one that is consistent with the arguments presented. Be careful not to rule against a strong argument, or if you do, be able to justify your ruling. Try to be realistic in the ruling and consider such points as implementation of the favored position, cost to both society and the individual of the ruling, and what values were important in arriving at your ruling.

General Points: Be careful to present opposing positions objectively. Do not weaken one petitioner's arguments just to arrive at a ruling favored by the group. It strengthens this type of paper to present arguments as near to equally strong as possible.

Deadlines

The Capstone Project begins immediately after final exams. Your Team Faculty will do all scheduling of meetings and your oral defense. Below is an outline of the expected progress of your Capstone.

Dates	**Capstone Progress**
March 31st	Capstone Kickoff with Team Faculty MANDATORY ATTENDANCE
April 3rd- April 14th	Attend scheduled meetings with faculty, Capstone group meetings Conduct Research
April 17th- April 28th	Additional conferences with faculty Completing research Writing the paper
April 28th	**All sophomores are required to be present in Jacob Sleeper Auditorium FRIDAY APRIL 28TH, at 12 pm at which time all Capstone Projects will be collected by faculty teams.** **THERE WILL BE NO EXTENSIONS.**
May 1st – May 12th	Capstone Oral Defenses
May 16th	Final grades will be posted

Your Meetings With Professors

Your group will meet with your team of professors a minimum of two times during the first two weeks of the Capstone project. The following represents a three-meeting schedule. Details of the schedule will be provided by the faculty members.

Meeting 1: (15-20 minutes)

1. Your topic and the focus of your topic
2. Your group coordinator and the schedules of all your group members

Meeting 2: During this meeting (20-30 minutes) you should bring:

1. Three copies of a 1-2 page outline of the work you propose based on the "Background, Problem, Solution" format. *Your outline must be in formal outline style.*
2. Three copies of a 1-2 page bibliography in CSE (Council of Scientific Editors) name-year style. *All of your citations throughout the project must be done in this style—no exceptions and no other styles accepted*. See http://writing.wisc.edu/Handbook/DocCSE_NameYear.html.
3. A peer-review/evaluation rubric clearly indicating how each group member will be evaluated on their participation in the project.

Meeting 3: This may be the last formal meeting with your professors before you deliver the project to your professors. During this meeting, your professors will comment on your final outline and the status of your project. Your group will be assigned a final meeting time (oral examination) at this meeting. You must bring:

1. Three copies of a revised and expanded outline of your project (4-5 pages). You should be ready to write directly from this outline. You must include your persona and your audience persona in this outline. *The outline must be in formal outline style.*
2. Three copies of an expanded bibliography **in the appropriate citation style**.
3. A list of all group members' class schedules and final exam times.

The Oral Examination

Your professors will have read your written work and agreed on a provisional grade for the work. The oral examination then takes the form of a discussion between you and your professors. It will be in two parts.

1. Your group will be invited to engage in a discussion about the Capstone process and your approach to the final project.
2. Your professors will ask general and specific questions about your final project. Your answers will help the professors understand your work on the project and it will help them evaluate the work based on the criteria previously outlined.
3. When necessary, your professors will also point out problems in grammatical constructions and inconsistencies in argumentation. Please remember that a clear and effective argument is one that is clearly written.

At the end of the oral examination, which will take approximately one hour to one-and-a-half hours but no more than two hours, you will be asked to evaluate your own performance as well as that of your fellow team members on the Capstone project. Your evaluations will be strictly confidential. Your evaluation will be based on the participation rubric your team developed.

Rubric for Success

The most successful Capstone projects will take into account the following.

Written Portion:

1. Clarity, Clarity, Clarity. Make sure your paper is as free as possible of grammatical errors and awkward writing. Taking the time to edit the paper as a group is one method that has been effective in creating a clear, cohesive Capstone Project.
2. Did your background section sufficiently introduce the contemporary issues with which the Capstone was concerned and identify appropriate stakeholders and players?

3. Was your research of the issue sufficient in scope and detail to provide the reader with a good working knowledge of the extent of the problem at hand? Did you use appropriate examples and infer from those examples the kinds of solutions that had been tried in other local areas? Did you assess the success or failure of similar solutions elsewhere and analyze the reasons for those successes or failures? Did you extrapolate how solutions would work in the region or locality on which you focused your attention in the Boston area?
4. Did you provide data (tabular, graphical) demonstrating why this topic is an important issue facing the Boston region?
5. Did you locate appropriate local resources (via interviews, visits, surveys, etc.) that would help you better understand the problem, current local responses, and potential solutions (and/or previously attempted solutions)?
6. Did you account for how local implementation of your solutions would occur (what were the responsible agencies, councils, governmental bodies that would be involved)? Did you account for how local populations would be impacted by your solutions? Did you account for the likely reactions of local populations to your solutions?
7. Is your solution based on logic and driven by available data?

Oral Portion:

1. Could each of you, individually, define the problem on which you focused?
2. Could each of you, individually, describe to the faculty the background of the problem and the solution you propose?
3. Could each of you, individually, defend your entire position?

TOPICS

Today there is a rapid pace of change the likes of which we have never seen before in human history. The impact of human activity (especially rapid urbanization) on the Earth has encouraged many to call the current geological epoch the **Anthropocene**. This change is multi-faceted and touches on many different areas of our lives. Some of these changes have vastly improved the lives of people around the world. However, rapid change brings with it risk and unforeseen consequences. Many of the topics below look at environmental change and the corresponding consequences on infrastructure, human health and food/water security. Others look at new technologies, including technologies that enable rapid global movement and gene editing, and the challenges these new developments present.

Remember that the goal in addressing any of these topics is to look at them from a local standpoint. What can a Boston-based group do to address the issue? It can be difficult to implement ideas at a federal or global level. Many of these problems represent global issues, but local solutions can have significant impacts. Your group will pick one of the topics below and use the information in the description as a starting point for developing a specific focus. Think globally, Act Locally is the way solutions to most large-scale problems have been and can be addressed.

1. **Hazards of Climate Change in an Urban Environment: Sea Level Rise in Boston**

   Boston, like other urban areas faces hazards due to climate change, such as rising sea levels. The Intergovernmental Panel on Climate Change (IPCC) estimated in 2007 that climate change may result in an increase of sea level of 18 to 59 centimeters by the end of the twenty-first century. Since significant fractions of the cities of Boston and Cambridge were built on landfill and have relatively low elevations, will these sections be threatened by the rising sea level? What can be done to ameliorate this problem? Should there be increased construction of sea walls for protection of parts of Boston or the New England coastline? Moratoriums or other limits on future construction along the Florida, New Jersey, and New York coastlines have been seriously discussed or even implemented in some cases. Should there be a moratorium on building permits and construction of new buildings in low elevation sections of Boston or along the New England coastline? How would such a moratorium affect the future economic development of the Boston metropolitan area? How can the city protect the economic centers it already has? How might the income level of neighborhoods affect these decisions?

2. **The Impact of Extreme Weather Events in an Urban Setting**

Scientists believe that climate change will increase the odds of extreme weather events occurring. Extreme events include heat waves, droughts, fires, heavy rain, winter weather, storm surges, hurricanes, and floods. In urban areas, these events present unique challenges. High population density increases the impact of these events. Heat waves represent a public health threat and can be intensified in urban environments due to the urban heat island effect. Energy usage during heat events can lead to blackouts and brownouts. Storms can cause damage to infrastructure, affect public transportation and affect city water and wastewater services. Winter storms, such as the ice storms in 2015, can cause power outages and other structural problems for urban areas like Boston. For this topic, select one of these areas and focus on what Boston has done to prepare for this eventuality. What needs to happen to improve the preparedness of the city? How can steps be taken to ensure that the city will be able to cope with extreme weather events? In your research, consider economic, social, and political realities in implementing these measures.

3. **Water Runoff and Sewer Overflows**

Modern sewerage systems convey sewage from houses and commercial buildings and rainwater through separate pipes under normal conditions, but the system of separate pipes for sewage and rainwater sometimes proves inadequate for Boston because of its geography and weather patterns. During periods of very heavy precipitation, combined sewer overflows act as relief valves and allow overflow water to be released into nearby bodies of water. The immediate advantage of the combined sewer overflows is that they prevent rainwater mixed with untreated sewage from backing up in houses or flooding the many low lying streets in the Boston metropolitan area. The disadvantage is that in times of heavy rainfall the sewage-rainwater overflow is discharged into the Charles River, Mystic River, Neponset River, or Boston Harbor, and thus the water quality of these bodies of water is degraded. The Massachusetts Water Resources Authority has eliminated many uncontrolled combined sewer overflows in recent years, but should this program be expanded and improved? What financial costs will these improvements entail?

4. **Coastal waterways and eutrophication**

In recent decades' scientists have recognized "dead zones," coastal waters with depleted amounts of oxygen. The presence of excessive amounts of nitrates or phosphates in the water, which is called eutrophication, can occur because of sewage effluence or agricultural runoff containing fertilizers

and can result in dense "blooms" of algae. When the algae die and sink to the bottom, they decompose. The decomposition process uses oxygen and thus reduces the concentration of oxygen in the deeper levels of the waters, which, in turn, may kill fish and other aquatic organisms and create a dead zone. Scientists have measured decreased concentrations of oxygen in the coastal waters of Massachusetts. What can be done to remedy this problem? Should septic systems in eastern Massachusetts be monitored and controlled more closely so that sewage does not enter the coastal waters? Should the application of fertilizers on farms, lawns, and golf courses be more tightly regulated to lessen the amount of nitrates and phosphates in rainwater runoff? Maryland has instituted some of the most stringent environmental regulations in the nation in an effort to try to return the Chesapeake Bay to a healthier state and has even instituted a rainwater runoff tax. Should Massachusetts adopt similar measures to protect and improve its coastal waters?

5. **Local Water Access**

The landscape of the Charles, Merrimac, Mystic, and Muddy Rivers is dynamic. Likewise, the landscape of coastal beaches surrounding the city of Boston, as well as north and south of Boston, is highly dynamic. From tidal swamps to polluted industrial and transportation loci, to today's mixed-use capabilities, our riverways and coastal beaches reflect the communities that surround them. How can we preserve these environments and, in particular, how can we rebuild the natural plant and animal communities they once hosted to make them more resilient to storms and changing climate? How can we continue to use them for commercial purposes, while ensuring their health and keeping them clean from pollution sources? How much money should surrounding communities be required to pay for restoration purposes? Should we continue to allow community growth around these waterways or should we establish "zones" of undeveloped tracks along the banks of these rivers? What should we do when flood events damage current structures along shorelines (i.e., should we allow rebuilding of structures)? Think about what happened to the urban centers in NY and NJ during Hurricane Sandy. What should be the policy for similar shorelines in and around the Boston area that are already impacted by hurricanes and nor'easters via storm surge? Should we allow rebuilding of structures along barrier beaches or should the state take that beach by way of eminent domain and prohibit re-building?

6. **Fisheries**

In September 2012, the Commerce Department declared that the New England Fisheries were in a

state of disaster. This declaration opened the door for federal monies to be used for relief for struggling fishermen and the ports that relied on fishing activity. While the fisheries have been managed for decades, and fishermen have been catching certain species at the rate mandated by regulators, stock models have not been reliable for determining overfishing levels. As a result, the regulations haven't been stringent enough and stocks have not been given sufficient time to rebuild properly. In 2010, many new regulations were enacted that cut fishing levels by 70% on some species and this has endangered the fishing industry. Gulf of Maine shrimp fisheries were closed in December 2013. Those fisheries have remained closed since (aside from a few scientific studies) and will remain closed for the 2017 season. Regulators argue that the Southern New England lobster fishery should have been closed in 2011 as it was both depleted and overfished and, in September 2013, regulators closed the nearby Long Island Sound lobster fishery. New England historically has been considered a rich fishing region for a number of species of fish and crustaceans, yet we have seriously depleted these once-rich grounds via the heavy mechanization and commercialization of fishing post-1950. With an ever-increasing demand by consumers for seafood, more and more species of fish are overexploited. How do we solve the problem of supplying seafood products for consumer demand while, at the same time, ensuring that the wild fish and crustacean stocks remain sustainable populations? Some possibilities for projects include considering the management of marine protected areas, fish farming and sustainability in the fishing industry, or economic impact of restrictions on fishing communities, but students should feel free to develop their own projects for this broad topic.

7. Urban Gardens and Food Pantries

Should Boston advocate the use of locally grown and raised food for use in neighborhoods and on college campuses? The "slow food" movement is a real force in many communities. Could Boston become more environmentally friendly if it actively embraced this movement? Could Boston become more sustainable if we relied on locally grown and raised foods? Is it realistic to feed people in the area largely on local food considering the population density and environment surrounding Boston? How could the limitations imposed by the environment be overcome? Should Boston invest in local farms so they will provide foods to more neighborhoods in Boston? Should Boston invest in rooftop farming efforts? How can local food pantries provide more locally-grown produce to families and individuals at risk for malnutrition and obesity?

8. **Managing Human Interactions with Local Wildlife**

Have you ever watched people interacting with wildlife in an urban setting? For example, in many urban parks humans seem entranced and attracted to the activities of eastern grey and fox squirrels – even opting for interspecies communication through feeding and taking pictures. Edward O. Wilson, the internationally known Harvard evolutionary biologist, calls this Biophilia or love of life/other living organisms. Yet there are many risks both to humans and to the wildlife that arise from these interactions. There are also costs and benefits that should be considered. For this topic, you can explore both the specific aspects of how humans co-exist with urban wildlife (from squirrels, skunks, raccoons, and coyotes to hawks, owls, and wild turkeys) in Boston and the issues that wildlife interactions impose on the community. What is the esthetic value of contact with other species? How can the needs of humans be balanced with those of other species? Or should they?

9. **Biodiversity as an Urban Goal**

In the past 50 years (since the start of the "new" conservation movement in the 1960s), a great deal of information on the biological diversity of our planet has been generated. Most famous is the loss of biological diversity in the tropical rainforests. However, a topic that is much less discussed is the potential role urban areas may play in maintaining and enhancing biodiversity. While the view of urbanization is one of a reduction of biodiversity, does this have to be the case? Do we even know what the biodiversity of an urban area is? How could we and should we assess biodiversity in Boston? Is diversity restricted to larger green spaces like parks or does it occur across the urban environment? This is a challenging and potentially sticky problem since many organisms that may make up urban biodiversity are not "sexy" in the public relations sense. For example, could there be rare or endangered species that thrive in urban settings and live well with humans? What about species that are considered undesirable? How can biodiversity be preserved while still considering the needs and desires of humans living in Boston?

10. **Managing Zoonotic Diseases**

Interaction with animals involves a public health risk. Diseases such as rabies can be spread through contact with other mammals. Although this is not common in the US, rabies is often cited as a neglected disease worldwide. In Boston and the surrounding areas, bats carry rabies and can enter into homes. In 2012, a man died in the Boston area after contracting rabies from a bat. Other diseases that come from interactions with animals and are present in Boston include vector-borne

diseases caused by mosquitos (for example, West Nile encephalitis and eastern equine encephalitis) or ticks (Lyme Disease). For this topic, you can select one of these diseases or a group of diseases that are related (e.g. mosquito-borne diseases) and think about how Boston and the surrounding areas can deal with minimizing the risk, dealing with infections and alerting the public about risks. Think about how to alert the public without causing undue panic (and possibility undermining your credibility). How would you fund programs to deal with animal populations that harbor disease? How would changing the population of the animals in question affect the local ecosystem? What concerns might the public have about these programs?

11. Public Health Responses to Epidemics and Outbreaks

In the last few years, we have seen a number of outbreaks that have caught the attention of the new media and the imagination of the public. Ebola, SARS and now Zika virus have all caused concern and forced policy makers to consider the effectiveness of current protocols. Today, most experts believe that the question is not whether there will be a pandemic (an outbreak that spreads across the world), but when this pandemic will happen. Various suggestions have been made about how to predict and control this pandemic when it does occur. Suggestions include limiting travel, increasing funding for research into emerging disease, and revitalizing the response protocol for the health care system. None of these suggestions come without cost or with a guarantee that they will be effective. Analyze which courses of action would be most effective in preventing or limiting the effect of the next outbreak. Consider in your analysis the cost, the feasibility of applying any policy that extends beyond US borders, and the public response to the implementation of these policies.

12. Emerging Diseases

Emerging diseases are defined as new diseases or diseases that are increasing in frequency. Emerging diseases represent a public health threat. New diseases appear in human populations all the time. Older diseases might be increasing due to various environmental factors including an expansion of the range of certain vectors due to climate change. What can be done to monitor and deal with a disease that has not been seen before? Particularly in Boston, an urban environment, where a new disease might spread quickly, what protocols exist to detect and alert public health officials about emerging diseases? If an 'old' disease (such as tuberculosis) is suddenly on the rise, how should Boston deal with this? How can Boston determine which populations are most at risk and act to

protect them? Consider the social, political and economic realities that might make it difficult to reach communities at risk. For this topic, select either a general plan for dealing with emerging diseases, or select a currently emerging disease and investigate how the response in Boston might be improved.

13. Green Construction: Green Roofs and Catchment Basins

The relatively high population density of the Boston metropolitan area and the presence of buildings, pavement, and asphalt for streets and parking lots have contributed to Boston as an "urban heat island." In other words, these structures and their associated activities and emissions seemingly have elevated the temperatures of the city relative to those of the surrounding rural areas; this is an effect that is especially unwelcome in the heat of the summer. The buildings, highways, streets, and parking lots of Boston also have been significant elements in rainfall runoff during times of high precipitation. Boston University recently constructed the Center for Student Services building with a green roof or living roof, a roof with a significant amount of vegetation growing on it. Such green roofs or living roofs decrease rainfall runoff and thus lessen the contamination of bodies of water because of uncontrolled combined sewer overflows. Green roofs also lower the urban heat island effect. Should there be tax credits or other incentives that encourage industries, universities, and schools to construct more buildings with green roofs or living roofs? Should there be incentives to create catchment basins with vegetation around the perimeters of large parking lots?

14. Urban Green Spaces

In a city like Boston, space for human activities is limited. Yet, a major initiative of the Boston city government has been and continues to be access to and management of green spaces. While Boston University is not known for its green spaces, try to image what it would be like with no trees lining Commonwealth Avenue, no BU beach, no Charles River Esplanade, no small parks/sitting areas scattered around campus. Now expand this view to the entire city. Clearly green spaces have value on many levels. For example, a study conducted in Germany in 2010 found that any exposure (even looking out the window at trees) had a calming and healthful impact on city dwellers. Examine the value and role of green spaces in an urban environment. Is Boston a "green" city compared to other cities? How are green spaces distributed across city neighborhoods? How can the need for economic and living space for humans be balanced with the need for green spaces when space is limited? This topic can be focused in many ways from a re-examination of what we mean by green spaces to being

able to quantify the quantity and quality of open green spaces in an urban environment.

15. Energy Use and Development

The American Council for an Energy-Efficient Economy recently ranked Boston in the top tier of cities doing the most to save energy (www.aceee.org/press/2013/09/report-ranks-us-cities- efforts-save-). Based on data from 2015, Massachusetts was generating 64% of its electricity from natural gas, 7% from coal, and 9.4% from renewable energy sources (about 2/3 from solar, wind and biomass and another 1/3 from hydroelectricity). In terms of energy consumed per capita, Massachusetts ranks 44, with only Arizona, Connecticut, Florida, Hawaii, California, Rhode Island and New York consuming less energy per capita per person (https://www.eia.gov/state/rankings/). Massachusetts has instituted a number of programs that focus on further reducing the energy footprint and "going green." However, there is clearly more work to be done. Examine what is currently being done in Massachusetts to encourage green energy growth. What further efforts could be taken? In what ways and by using what technologies does the state expect to reduce emissions? How should the state incentivize energy consumers to reduce their emissions footprint? What should businesses expect to have to do to reduce their footprints? What energy resources should the state develop? Avoid? This topic is rich for exploring how local governments might attempt to ameliorate climate change in the absence of federal action.

16. Biological Accidents: Regulation and Response

Boston is an area that is known as a hub for biotech and other high tech fields. This research helps fuel the local economy, but it also carries perceived risks to the community. For example, there was a lot of opposition to the construction of Boston University NEID Laboratory. This laboratory is a Biohazard Level 4 facility- meaning that the researchers work on the most dangerous biological agents known, including Ebola and potential bioweapons, such as weaponized anthrax. What are the challenges in community outreach for the facility? How does a local community deal with having such a facility in their neighborhood, especially when the neighborhood is low income, as in the NEID case? What kind of emergency plans exist if an accident does happen? For this topic, think about both the value and the risks associated with these types of institutions.

17. Urban Waste

Waste is a serious issue for any community, but often presents greater issues in cities that lack the

open space in which to dump and bury their garbage. Some large cities export their waste to suburban or rural areas for disposal; some even send their waste out of the state. Boston is a moderately sized city (ranks 21st in size in the US) with a population estimated at 636,479 individuals, roughly 13,143 people per square mile. The population of the Greater Boston area (most of the eastern third of the state) is estimated to reach 4.6 million people. Waste produced by that many people must go somewhere. One can examine the broader issues of city landfills and their challenges, population numbers and the pollution they create, or one can focus on specific issues, each of which may help to reduce the waste stream. Some examples of these specific issues include the banning of plastic bags and plastic water bottles, dealing with the electronic trash stream, recycling and compost centers and dealing more effectively with gray wastewater.

18. The Impact of Pollution on Human Health; Endocrine Disrupters

An endocrine disruptor is a substance that is not produced in the body but mimics or antagonizes natural hormones. It is thought that endocrine disruptors may be responsible for some reproductive problems in both women and men, as well as for the increases in the frequency of certain types of cancer. Endocrine disruptors have also been linked to developmental deficiencies and learning disabilities in children. Because hormone receptor systems are similar in humans and animals, effects observed in wildlife species raise concerns of potential human health effects. Exposure to endocrine disruptors can occur through direct contact with pesticides and other chemicals or through ingestion of contaminated water, food, or air. Chemicals suspected of acting as endocrine disruptors are found in insecticides, herbicides, fumigants and fungicides that are used in agriculture as well as in the home. Industrial workers can be exposed to chemicals such as detergents, resins, and plasticizers with endocrine disrupting properties. Endocrine disruptors enter the air or water as a byproduct of many chemical and manufacturing processes and when plastics and other materials are burned. Endocrine disruptors can also leach out of plastics, including the type of plastic used to make hospital intravenous bags. Many endocrine disruptors are persistent in the environment and accumulate in fat, so the greatest exposures come from eating fatty foods and fish from contaminated waters. How can we ensure that our water supplies are adequately treated for these chemicals and how can we reduce our use of plastic containers that leach these compounds?

The water crisis in Flint, Michigan brought to light the fact that many of our cities have infrastructure problems that could cause lead to leach into our water supplies. A study in 2016 of 300 public school buildings in Massachusetts showed that more than half had a sample of lead levels above

recommended units. Furthermore, buildings built before 1940 are often fed by lead service lines that run from main municipal water lines into houses. As an example, 47% of Malden's service lines are lead, while 28% of Medford's, 22% of Somerville's, 19% of Marlborough's, and 11% of Winthrop's are also lead-lined. Generally speaking, the cost of replacing these service lines falls on the homeowner. How can we insure that our area children are drinking lead-free water? How can the state assist low-income families that are most vulnerable to lead hazards? What programs could be designed to more effectively deal with this infrastructure issue?

19. Food Production

The world population is projected to reach nearly 10 billion by 2050. In light of this figure, many are concerned about how to feed such a large population. Some ideas that have been put forward include genetic modification of food, cloning and production of lab meat. With these new technologies come risks. For this topic, develop a policy that would regulate new types of food sources. Be sure to take into account the willingness of people to consume these new food sources, potential costs (and how they could be brought down to make the food source reasonable), and health/environmental risks. You can choose to focus on a broader food/technology policy or focus on one area of development such as genetically modified foods, cloned meat or another type of technological advancement.

20. Gene Editing

Our greater understanding of genetics has led to a number of medical improvements. Most recently the development of CRISPR technology has opened the door for faster, more accurate and cheaper gene editing. However, it has also opened the door to a number of ethical questions. Perhaps one of the ones that makes us the most uncomfortable is the idea of designer babies. We now have the technology to potentially select certain traits in our offspring. This could be a very positive thing if it is used to eliminate genetic disorders and lower the risk of disease. However, there is the concern that this technology could be used for other choices that are opposed by many, such as selecting eye color, height, athletic ability, and even having a child with three parents. These choices raise concerns about unintended consequences, both genetic and societal. For instance, gene editing might exacerbate racial prejudice by emphasizing light skin color or blue eyes. Genes often control more than one aspect of a person; playing with these genes might result in less than desirable changes. There is also concern that this technology would be available only to the rich, exacerbating a gap between the rich and poor. Since this technology is so new, little legislation exists that would regulate how this technology is used. For

this topic, design a comprehensive piece of legislation that would outline regulations and justification for those regulations.

21. Urban Sustainability

In the past the majority of people lived in rural areas. However, since the Industrial Revolution, we have seen a shift with more and more people moving into urban environments. This rapid pace of urbanization has resulted in a change in the landscape and in human interactions with the environment. Mega-cities (cities of over 10 million) people- once unheard of- are growing in number with a predicted 41 mega-cities by 2030.

Boston and the Greater Boston area has seen its own form of substantial growth since the 1970s. For the Boston area, much of this growth has been in the form of urban sprawl. In fact, what today can be considered the "Greater Boston Area" encompasses a major area that stretches across three states (Massachusetts, Southern New Hampshire and Rhode Island). Urban sprawl has many negative environmental and lifestyle consequences. For example, areas with large urban sprawl rely heavily on car-based transportation. Cars are major emitters of greenhouse gases and pollutants. Long commute times reduce quality of life and have health consequences.

For this topic, think about how the problem of urban sprawl might be addressed in Boston. Think about how to attract people to live closer to the city, what types of infrastructure improvements, land-use issues, housing costs and transportation issues might be feasible in the Greater Boston area. Consider social class influences on housing and transportation that affect urban sprawl. The goal of this topic is to come up with a plan for the Boston area to "retrofit" the city and reduce and/or stop the expansion of urban sprawl.

22. Human Urbanization and the Impact on Evolution

More than 50% of humans currently live in cities or urban centers. Cities provide many positive factors that have influenced both organic as well as cultural evolution. For example, shortly after Charles Darwin returned from his voyage on the HMS. Beagle, he moved to London, which allowed him to be closer to the center of English Scientific activity. It can be argued that his time in London stimulated him to begin his "Transformation Notebook" where he first outlined his thoughts on Evolution by natural selection.

Recently, an analysis of how urbanization affects evolution was published in the *Proceedings of the National Academy of Sciences*. In this review the authors found clear evidence of phenotypic change in

human urban environments compared to non-urban systems. Both plant and animal species were reported to have changes in body sizes, behavior and reproduction. Additionally, in many cases the pace of evolution in urban systems was extremely rapid compared to non-urban systems.

The impact of evolution on the organic components of the urban ecosystem may have significant impacts on ecosystem services and ultimately impact the sustainability of urban systems. The authors believe that urbanization (and its impact on the evolution of species living in these systems) will influence biodiversity, nutrient cycling and water purification.

There will continue to be an increase in urbanization and the role urbanization plays on evolution. What impact this will have on how sustainable urban centers are for humans is a serious question. This topic allows you to make clear connections between the process of evolution and the future of human sustainability. For this topic, think about how rapid evolution might change the natural landscape in and around Boston. What types of programs should monitor evolutionary change? What are the possible consequences of rapid evolutionary change and what should Boston do to deal with the impact of evolutionary changes in the natural population and maintain a sustainable local ecosystem?

We have presented you with a detailed syllabus designed to serve as a guideline for the Capstone Project. Remember, these pages are only a *syllabus*, nothing more. You are not expected simply to read this document and be able to go off and produce a Capstone report. Your team faculty are to serve as your ultimate directors. Each team may have slightly different expectations and may set slightly different guidelines to follow. In any case, your faculty are there to *guide* you through this venture in an attempt to make the Capstone a productive and profitable learning experience.

If you are feeling slightly overwhelmed at this point, relax. It may be helpful to take a moment to consider that the entire Capstone procedure can be condensed into four tasks:

1. State a problem.
2. Gather the pertinent facts about this problem, being careful to examine all sides of the issue.
3. Based on these facts, formulate a decision or recommendation.
4. Determine the implications of your recommendation.

E-PORTFOLIO ASSIGNMENT

As part of the Capstone project, you need to set up a "Capstone" tab on your Digication E-Portfolio site and keep a record of your work on the project. Your E-Portfolio can be a good tool for keeping track of your progress on the project, and it can also be useful in determining your participation.

E-Portfolio Requirements:

1. Keep a weekly log of your individual contributions to the project (discuss the books and articles you have read, discuss the drafts you have written, list the group meetings you have attended, etc.).
2. Cut and paste all drafts you have written into the Capstone tab of your E-Portfolio site. Include even the drafts that do not make the group's final cut.
3. Post an electronic copy of your group's final Capstone Paper on your E-Portfolio site.

Capstone self-assessment:

After your group's Capstone paper has been submitted please evaluate the Capstone project as the culmination of your two years at the College of General Studies. More specifically, the College's faculty and administration would like to know how this project drew upon and enhanced skills you have acquired in your CGS courses. (In this regard, see the goals articulated in our CGS rubric: www.bu.edu/cgs/citl/eportfolios-and-assessment.) This information will help the College better understand how the Capstone experience relates to your coursework and your intellectual development.

The Capstone self-assessment consists of three questions. Please respond thoughtfully to each question. The total length of your self-assessment should be approximately two double-spaced pages. You should post your self-assessment on the Capstone tab of your E-Portfolio site before your oral defense, and you also should bring a printed copy of your self-assessment to your oral defense for your professors.

Here are the three questions:

(1) How did the Capstone project contribute to the development of your research, writing, and editing skills?

(2) Did you learn anything new about how to use evidence to formulate a strong argument? Please provide specific examples.

(3) To what extent did your coursework at the College of General Studies prepare you for the interdisciplinary nature of the Capstone project? Again, please provide specific examples.

Posting to the Team Digication E-Portfolio Site:

Submit your whole E-Portfolio to the team's course site BEFORE your Capstone defense. (See instructions below):

1) Open your E-Portfolio. On the top right of the page you will see a box called "portfolio tools." Click on this pull-down menu and select "submit."

2) On the left-hand side, you will see a list of courses in which you have been automatically enrolled. Choose the one that corresponds to your team. (Example: CGS Team R Spring 2017.) A green check mark will appear next to your course once you select it.

3) Return to the top right of the page, where you will now see a "next step" button. Click this.

4) On the left, you should now see a title or description of the course assignment. (Titled "End-of-year Portfolio"). Click on this, and you will then see a green check mark appear next to it.

5) Go back to the top right and choose "next step."

6) Now on the box on the left you see "My Evidence." Click on that.

7) Go back to the top right and choose "Next Step."

8) Now on the left you should see your name with an empty box next to it and underneath it a list of all of the files in your portfolio. For the purposes of this end-of-year assignment, choose the first option, which is "all pages." Check marks should now appear in all boxes.

9) Return to the top right of the screen and choose the first box, "Save and Submit." You're done—thanks!