Complete this worksheet after you have modified your course, delivered it, and assessed it. Attach a syllabus/course outline, Activity Sheets for new activities, summary of your assessment, and essential copies of teaching materials to help the mentor team evaluate your achievement of workshop goals.

**Course Name:** ENVST 5559 – Air, Water, Health Capstone

**Instructor Name:** Jennifer Follstad Shah

*List learning goals for your course, lesson, or activity that highlight new sustainability elements.*

Learning goal 3 (from syllabus):

express ideas related to sustainability via oral and written means using language that encourages inclusion and collaboration

*Explain the new sustainability element(s) you incorporated into your course and how they related to the learning goals above (at course, lesson, or activity level). Describe how you see these elements relating to sustainability.*

I addressed the learning goal using three activities and two assigned readings.

**Assigned readings:**


**Activities:**

1. I invited Dr. Danya Rumore, Associate Director of the Center for Environmental Dispute Resolution, to facilitate a role-play simulation in my class. Students were assigned to different stakeholder roles, asked to read background information regarding stakeholder concerns, and given the challenge of trying to find a consensus approach towards dealing with rising sea levels in a coastal town in the northeastern US. The goal wasn’t really to find consensus in our limited class time, but to try to listen to and empathize with different stakeholder viewpoints. Students were asked to reflect orally and collectively upon the exercise after it was over.
2. Students engaged in the ‘Squaring the Circle’ exercise described in *The Climate Change Playbook* while on a four day retreat at the Bondermann Field Station at Rio Mesa. This
exercise asked students to arrange themselves, with their eyes closed, equidistantly around a 50 m length of rope, the ends of which were tied together to form a circle. The students were then asked to arrange themselves, still with their eyes closed, to form a square rather than a circle. The process was contentious, stressful, and exclusionary (to some), but the objective was attained. Students learned that communication is impeded when some cues are not available (i.e., sight) or ignored and when action is embarked upon prior to finding consensus on an approach. Students also learned that some individuals can be excluded from the process of problem solving when one or a few individuals assume a leadership role and put forth action without asking for input from others, resulting in resentment and lowered morale.

3. Students read 7 chapters from *Nonviolent Communication* prior to coming to the retreat. Together we reviewed the main points from each chapter. Then I facilitated another role play scenario, this time with students pretending to be two roommates. One roommate preferred the household to be tidy, the other did not mind an untidy abode. The students were asked to implement the techniques described in the book and then reflect verbally, as a class, on whether the techniques resulted in communication that was more clear and more inclusive than other ways of communicating similar ideas. It was my intention to then repeat the role play simulation introduced by Dr. Rumore, this time asking students to use the communication techniques outlined in the book and then compare the difference between the conversations. However, we ran out of time to conduct this part of the activity.

Students were asked to write a written reflection about the retreat and activities in which they participated while at the retreat, in addition to reflecting orally about activities just after they were completed.

*Provide a concise listing of sustainability lessons and activities and show their location in the course schedule. For selected new activities attach a completed Activity Sheet.*

Syllabus and activity sheets have been submitted.

*What motivated you to change your course?*

I had never taught this course before, but I wanted to focus on communication because many people representing many agencies with a diversity of interests are involved with the management of air and water resources and how they effect the health of organisms. I believe it effective communication is an important skill for our students to acquire in order to manage these resources more sustainably and less contentiously.
ENVST 5559: Air, Water, & Health Sustainability Capstone (Spring 2017)  
3 Credit Hours

Meeting Day/Time: Mondays 11:50 am - 1:10 pm
Location: William Stewart Hall (ST)214

Instructor: Dr. Jennifer Follstad Shah
Email: jennifer.shah@envst.utah.edu
Office: Building 73, Room 235
Office Phone: 801-585-5730
Office Hours: Thursdays 10:30-11:30am

Course Description: The Environmental and Sustainability Studies (ENVST) Program offers a broad, interdisciplinary education. The foci of the ENVST Air, Water, and Health capstone course are air and water resources and their influence on the health of humans and other biota. Students in this course will synthesize knowledge from previous coursework and experiences with new information presented in class to better understand concepts of sustainability. They will also reflect on their role as communicators and responsible citizens. Finally, students will complete a project intended to help the University of Utah campus progress towards greater sustainability.

Learning Outcomes: By the end of the course, students will be able to

1) identify approaches to sustainability, while considering the environment, social, and economic dimensions;
2) critique societal decisions that influence the relationship between humans and the larger environment, with a focus on air and water resources;
3) express ideas related to sustainability via oral and written means using language that encourages inclusion and collaboration;
4) plan and implement a project on campus requiring time management, team coordination, budget estimation, and professional communication.

Teaching Methods: This course will be conducted as a seminar, consisting of discussions based on guest lectures and assigned readings, group work resulting in a final project, and a student retreat that includes a service project and group exercises. The success of the class depends on all students completing the readings before class, coming prepared to engage in discussion, conducting independent research and tasks as dictated by the final project, and participating in the student retreat.

Readings: This course will use scientific articles and excerpts from the books listed below. These readings will be available in Canvas. Additional relevant readings may be included as the semester progresses.
Articles

Books
2. Sustainable Water: Challenges and Solutions from California (2015), Allison Lassiter (Editor), University of California Press.

IMPORTANT NOTES: Your instructor will provide you with digital copies of selected chapters from the listed texts, with two exceptions. First, Breathing Space chapters can be read online via Marriott Library. Second, we will read most, if not all, of Nonviolent Communication: A Language of Life. It must be read in full prior to attending the capstone retreat. Please buy a copy of this book. It is available at the University of Utah bookstore and online.

Management Plans/LegislativeProposals
1. Environmental quality legislative proposal(s) in 2017 session
3. University of Utah Sustainable Action Plan (SAP) component

Choices for Academic Success

Discussion Participation: 20% of grade

Learning outcomes 1-3 can only be achieved if students attend class meetings, have read all assigned readings, participate in discussion of the readings, and thoughtfully and respectfully engage with guest speakers.
Discussion Leadership: 10% of grade

All class discussions will be student-led, with one student responsible for each reading assigned each week. Discussion leaders will summarize the main points of the readings and pose 3-4 questions that link the readings to learning outcomes.

Citizen Letter: 10% of grade (letter and peer review of letter)

Each student will prepare a letter to communicate their stance on an issue related to air or water resources to one of the following audiences: (1) state legislator, (2) newspaper editorial team, (3) state or federal natural resource management agency, (4) University of Utah Board of Regents. This letter will be peer reviewed, using an established rubric as a guideline, and a portion of each student’s grade will be based on the quality of peer review within the framework of an established rubric.

Retreat: 20% of grade

All students must participate in a four-day field retreat at the Rio Mesa Center in Southern Utah (March 23-26, 2017). This retreat is designed to foster more in-depth discussion of issues related to sustainability than can be achieved in short weekly sessions and to focus on building better communication skills. Students also will conduct a service project during the retreat aimed at improving the quality of local air/water resources or reducing water use.

Final Project: 30% of grade (proposal and presentation)

Students will work in small, self-organized groups on a project designed to reduce the University of Utah footprint in relation to air and water resources. Ideally, the project will be conceptualized and implemented within the timeframe of the semester. All groups will be required to submit a written proposal of their project within the few weeks of the semester (see syllabus). Students are encouraged to seek funding for their projects through the Sustainable Campus Initiative Fund (SCIF; http://sustainability.utah.edu/scif/) or Capstone Project Fund (http://capstone.ugs.utah.edu/undergraduate-capstone-experience/capstone_funding_opportunities.php). Groups will present their project orally, with the aid of powerpoint slides. The date and time of the presentation will be announced at the first class and posted on Canvas.

Retreat & Project Reflections: 10% of grade

Students will complete two reflection assignments consisting of some multiple choice/true or false questions and short essay responses. The multiple choice/true or false questions will allow students to indicate which aspects of the retreat and final project are most successful. The short essays will allow students to reflect upon lessons learned while participating in the final project and retreat activities.
Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94-100</td>
</tr>
<tr>
<td>A-</td>
<td>90-93</td>
</tr>
<tr>
<td>B</td>
<td>87-89</td>
</tr>
<tr>
<td>B+</td>
<td>84-86</td>
</tr>
<tr>
<td>B-</td>
<td>80-83</td>
</tr>
<tr>
<td>C</td>
<td>74-76</td>
</tr>
<tr>
<td>C+</td>
<td>77-79</td>
</tr>
<tr>
<td>C-</td>
<td>70-73</td>
</tr>
<tr>
<td>D</td>
<td>67-69</td>
</tr>
<tr>
<td>D+</td>
<td>64-66</td>
</tr>
<tr>
<td>D-</td>
<td>60-63</td>
</tr>
<tr>
<td>E</td>
<td>&lt;60</td>
</tr>
</tbody>
</table>

Academic Integrity: Violations, such as plagiarism (whether intentional or not), may result in a failing grade for the class. It is a violation of the Code of Academic Conduct to turn in a work that is not your own. This includes, turning in the work of another student, buying/copying a paper off the Internet, using the words or ideas of others without proper quotation and citation. University of Utah (Policy # 6-400): “A student who engages in academic misconduct,” as defined in Part I.B. and including, but not limited to, cheating, falsification, or plagiarism, “may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the student’s degree or certificate. Sanctions may also include community service, a written reprimand, and/or a written statement of misconduct that can be put into an appropriate record maintained for purposes of the profession or discipline for which the student is preparing.” See: [http://regulations.utah.edu/academics/6-400.php](http://regulations.utah.edu/academics/6-400.php).

Open Learning Environment: The intention and structure of university level courses are to provide open, thoughtful forums for a wide variety of topics and ideas. While discussing these topics, students shall not discriminate on the basis of “race, color, religion, creed, sex, national origin, age, disability or veteran status.” Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066.

For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677 (COPS).

Reasonable Accommodation: The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services. ([www.hr.utah.edu/oee/ada/guide/faculty/](http://www.hr.utah.edu/oee/ada/guide/faculty/))

Wellness: Personal concerns such as stress, anxiety, relationship difficulties, depression,
cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. There are excellent resources, often free and confidential, on campus. For more information, contact the Center for Student Wellness. (http://www.wellness.utah.edu; 801-581-7776)

The syllabus is not a binding legal contract. The instructor may modify it when the student is given reasonable notice of the modification.

Class Schedule:

*Book abbreviations: BS = Breathing Space: An Unnatural History of Air, EP = Environmental Politics, NC = Nonviolent Communication, SW = Sustainable Water: Challenges and Solutions from California, WES = Water Ecosystem Services: A Global Perspective

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic(s)</th>
<th>Reading(s)*</th>
<th>Guest Speaker(s) (Tentative)</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Jan 16</td>
<td>No class – MLK holiday</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Jan 23</td>
<td>Water Policy</td>
<td>EP Chapters 7 SW Chapter 4</td>
<td>Stephen Goldsmith, Lori Kaczka</td>
<td>Groups formed / Project idea(s) generated</td>
</tr>
<tr>
<td>4</td>
<td>Jan 30</td>
<td>Air Policy</td>
<td>EP Chapters 8 BS Chapter 5 Environmental quality legislation review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Feb 6</td>
<td>Ecosystem Services Approach</td>
<td>BS Chapters 3, Annex WES Chapters 2, 19</td>
<td>Sarah Hinn</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Feb 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feb 13</td>
<td>Integrated Resource</td>
<td>BS Chapter 6 WES Chapter 6</td>
<td>Carmen Gold</td>
<td></td>
</tr>
</tbody>
</table>

Comments:

- **Comment [1]:** Someone from Utah Physicians for a Healthy Environment
  - Ashley Miller <ashley@breatheutah.org>, Program and Policy Director
  - Laura Schmidt <laura@healutah.org>, Program Director

- **Comment [2]:** Invite Dave and Kimi from Friends of Red Butte Creek

-Jennifer Shah 1/12/2017 2:18 PM

-Jennifer Shah 1/12/2017 2:19 PM
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading Material</th>
<th>Instructor</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 20</td>
<td>No class – President’s Day holiday</td>
<td>Citizen letter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 6</td>
<td>Air Sustainability / Environmental Justice</td>
<td>Kelly et al. 2016 Science SW Chapter 11 WES Chapter 17</td>
<td>Mark Brunson</td>
<td>ENVST Assessment</td>
</tr>
<tr>
<td>Mar 11</td>
<td>No class – Spring Break</td>
<td></td>
<td></td>
<td>Medium &amp; large SCIF grant proposals due</td>
</tr>
<tr>
<td>Mar 13</td>
<td>No class – Spring Break</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 20</td>
<td>Climate Change</td>
<td>WES Chapter 3 SW Chapters 2 Rumore et al. 2016 Nature Climate Change</td>
<td>Danya Rumore</td>
<td></td>
</tr>
<tr>
<td>Mar 23-26</td>
<td>Communication &amp; Participation</td>
<td>NC Chapters #--</td>
<td>Rio Mesa retreat</td>
<td>MANDATORY</td>
</tr>
<tr>
<td>Mar 27</td>
<td>No class – day after retreat</td>
<td></td>
<td>Retreat reflection</td>
<td>(due Fri, Apr 1)</td>
</tr>
<tr>
<td>Apr 3</td>
<td>No class – Prof. Shah out of town</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr 10</td>
<td>Water Sustainability</td>
<td>Larsen et al. 2016 Science SW Chapters 7, 14</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Apr 17</td>
<td>Meta-Principles for Planning</td>
<td>BS Chapters 7, 8 Ramaswami et al. 2016 Science</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Apr 21</td>
<td>Project presentation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Complete one Activity Sheet for each activity you developed that incorporates sustainability into your course.

**Activity Name:** Launton Town Role Play Simulation

**Instructor Name:** Jennifer Follstad Shah

*State the activity learning goal(s).*

Learning goal 3 (from syllabus):

express ideas related to sustainability via oral and written means using language that encourages inclusion and collaboration

*Summarize activity.*

I invited Dr. Danya Rumore, Associate Director of the Center for Environmental Dispute Resolution, to facilitate a role-play simulation in my class. Students were assigned to different stakeholder roles, asked to read background information regarding stakeholder concerns, and given the challenge of trying to find a consensus approach towards dealing with rising sealevels in a coastal town in the northeastern US. The goal wasn’t really to find consensus in our limited class time, but to try to listen to and empathize with different stakeholder viewpoints. Students were asked to reflect orally and collectively upon the exercise after it was over.

*At what point in your course is this activity delivered?*

Mid-semester (just after spring break)

*Provide teaching tips to help other instructors implement your activity in their courses.*

1. Give a short quiz prior to the simulation to ensure that the students have read the assigned materials that provide background.
2. Allow for more time. We conducted this exercise in 1 hour. Realistically, at least 2 hours are needed.
3. Use a scenario to which students can relate. We used a situation based on the east coast of the US.
Describe your assessment strategy and instruments for student learning and attitudes. Attach grading rubric and/or assessment instruments.

Assessment was conducted through oral reflection as a class. In the future, I will ask for students to provide a survey-based evaluation as well.

How effective was the activity? What are your ideas for improvement in the future?

The activity was not very effective, in part due to time constraints and in part because some students were not prepared. I noted ideas for addressing these ideas in my teaching tips. I also will ask students to assume more than one stakeholder role in the future to try to better teach empathy for diverse perspectives.
COASTAL FLOODING AND CLIMATE-RELATED RISKS IN LAUNTON

General Instructions

In the small, coastal New England Town of Launton, the risks from storms are becoming increasingly dangerous. The town has had three major “100-year storms” in just the past decade that have destroyed homes and businesses. Luckily, no lives have been lost, but local officials and residents are increasingly worried about the fate of the neighborhoods close to the water. If climate change predictions turn out to be right and these recent storms indicate a trend rather than “freak” occurrences, these neighborhoods could be in a precarious situation.

This isn’t just a problem in Launton. Residents in neighboring communities as well as Launton are becoming increasingly concerned because no town can afford to keep rebuilding if the storms they have seen in recent years become the “new normal.” This problem is urgent, but no community in the area has figured out how to solve it yet. Launton has the opportunity to become a forward-thinking town model for how to reduce risks from climate change.

Launton is home to about 10,000 people year-round, but another 30,000 residents come to Launton in the summer to enjoy its beautiful beaches, New England landscapes, and recreational opportunities. Tourism is a big part of the economy. The eastern part of town along the coast is heavily built up with homes and businesses, while the western part of town is relatively undeveloped.

Launton has three main rivers that drain into the ocean. At the mouths of these rivers are coastal estuaries lined with marshes. Much of the land along the marshes has been protected as the Launton Nature Preserve, which is famous for its beautiful trails and wildlife viewing opportunities.

Launton’s coastal areas are some of the most valuable properties in town because of scenic views and easy access to beaches and parks. There are two neighborhoods along the coast in Launton: Plover Beach and Brewer’s Cove. Many of the properties in these neighborhoods are summer homes, but other year-round residents have owned homes in these neighborhoods for generations. They love this special place, but high tax rates and flood insurance premiums are making it hard for them to stay.

A map of Launton is provided in Appendix A.

---

1 A 100-year storm refers to rainfall totals that have a 1% chance of occurring in any given year.
Launton’s Climate Change Adaptation Strategy

The town is currently in the process of preparing an adaptation strategy to minimize the risks associated with climate change. In light of limited resources and a desire to ensure that the strategy gets implemented, town officials have decided to include ideas about adaptation in the updated Comprehensive Plan due out next year. The town’s Comprehensive Plan typically addresses zoning, development regulation, future infrastructure, and growth management. This time, though, the update will also include risk reduction, so that Launton can avoid further storm damage and bounce back more easily when severe storms and other climate impacts occur.

Launton has been working with science advisors from nearby Woodson University. The Woodson Science Advisory Team produced a climate risk assessment that charts likely changes in temperature, precipitation, and sea level rise in the years ahead (Appendix B). One of the major risks they have identified is increased flooding vulnerability in Launton’s coastal neighborhoods caused by:

1. sea level rise
2. increased frequency and intensity of storms, which cause storm surges and river flooding
3. additional residential and commercial development in vulnerable coastal neighborhoods

The town has appointed an official Coastal Resiliency Task Force to figure out the best way to protect coastal neighborhoods from flooding. The Task Force has seven members: Six leaders from the civic, government, and business sectors, and a trained facilitator. The group is looking at the possibility of controlling new development, building new flood protection infrastructure (like seawalls), and requiring vulnerable buildings to be flood-proofed in various ways to address coastal climate-related risks.

Local Politics

The Town Manager has been under increasing pressure to find ways to reduce Launton’s vulnerability to major storms. When catastrophic Hurricane Paul recently hit states farther south, many people were left wondering what would happen if that type of storm hit Launton.

The Town Manager is known for sound environmental and fiscal management, but storm impacts and climate change risks threaten that legacy. Launton’s finances are tight, so any new public projects will require tax increases or new fees. On the other hand, not preparing properly for flooding and storm damage could impose catastrophic costs down the line.

The Federal Emergency Management Agency (FEMA) and the Environmental Protection Agency (EPA) recently indicated they might be able to provide financial support to communities undertaking risk management efforts. Grants would cover some but not all of the costs of implementing climate adaptation strategies. Town officials are confident that, if they can agree on ways to reduce Launton’s vulnerability to climate change, they will be in a good position to secure future FEMA or EPA funding.
About Today’s Meeting

This is the third—and a very important—meeting of the Coastal Resiliency Task Force. At its first meeting the group arranged for a professional facilitator, established ground rules, and was briefed on Woodson University’s climate change risk assessment (Appendix B). In the second meeting, with the help of the facilitator, the group discussed different ways of managing coastal storm surges and flooding and produced a number of potential options (Appendix C). At today’s meeting, the Task Force must decide on what strategies they will recommend to the Town Manager regarding how to:

1. reduce the risks facing existing neighborhoods (such as through building seawalls, flood-proofing buildings, or buying back at-risk homes and businesses).
2. reduce risks associated with new construction and development as Launton grows.

The group should keep in mind that the Town Manager is asking for policy advice and doesn’t need all the particulars right now. Don’t get lost in the details; you don’t have a lot of time. To reach agreement the Task Force must have the support of at least five out of six participants.

Members of the Task Force

Town Planner: The Town Planner oversees all planning efforts in Launton including zoning code revisions and updates to the Comprehensive Plan. S/he is knowledgeable about climate risks to the community and the environment and is focused on Launton’s long-term environmental and fiscal health. The Town Planner wants to reach an agreement that allows Launton to begin to reduce risks now, before the consequences of inaction get worse.

Emergency Management Director: The Town’s Emergency Management Director is very concerned about the impact of extreme weather events on coastal neighborhoods and infrastructure – not just flooding but also heat waves and power outages from storms. The Director wants to ensure that evacuation procedures are in place to protect residents and visitors in an emergency. There has been increasing pressure on the emergency management budget because Launton has recently experienced so many serious storms.

Town Councilor: The Town Council representative is especially concerned about protecting the town’s economy and way of life. The Councilor is acutely aware that the majority of the town’s year-round, voting residents do not live near the coast and are reluctant to spend money protecting expensive vacation homes. However, s/he understands how important coastal businesses and tourism are to the town’s economy and tax base.

Executive Director of the Great Coast Regional Land Trust: A non-profit that has been operating in Launton for over ten years, the Land Trust is dedicated to preserving undeveloped land and helping monitor beach and water quality. The Executive Director of the Land Trust is particularly concerned about the health of the marsh ecosystem and wants to stop sprawling development in inland watersheds. S/he is on the Task Force because the Land Trust has been a valuable partner in helping the town with land conservation and environmental monitoring.
Executive Director of the Launton Chamber of Commerce: The Chamber’s mission is to advance business interests in Launton. Many of the Chamber’s members do not believe that climate change is a serious threat. They are more concerned with the day-to-day challenges of running their businesses and do not support new regulations on new development or tax increases.

Chairperson of the Brewer’s Cove Neighbors Association: The Association is comprised of homeowners who live along the coast. Some members are skeptical about climate change, but they all know that some parts of the neighborhood are now at risk from storms. Many of the Association’s members are not year-round residents and do not vote in the town. They do have political clout, though, because they pay so much in taxes. Other Association member families have lived in Brewer’s Cove for generations and are deeply attached to the neighborhood.

Facilitator: The Task Force invited a trained, neutral facilitator to help move the discussion along and keep the parties engaged. Everyone has agreed to work with this facilitator.
Appendix A: Map of Launton
Appendix B: Risk Assessment Memo

From: Scientific Advisory Committee
To: Launton Coastal Resiliency Task Force
Re: Climate Change Risk Assessment

This memo provides key information from the risk assessment prepared by Woodson University. Task Force members may want to consider these forecasts when developing a coastal risk management strategy.

The following potential impacts are especially relevant:

- **Sea level rise** may:
  - increase beach erosion
  - submerge low-lying land and marshes
  - increase flooding due to higher storm surges during severe storms

- **There may be more extreme precipitation events**, resulting in:
  - heavier coastal and river flooding
  - increased hazards from erosion of beaches and stream banks

**Sea Level Rise**
Climate models project that the sea level will rise by approximately:
- 0.5 ft - 0.8 ft in the short term (2010-2039)
- 1 ft - 1.7 ft in the medium term (2040-2069)
- 2 ft - 4.7 in the long term (2070-2099)

**Extreme Precipitation Events**
Historically, Launton has experienced an average of 8.5 extreme precipitation events (defined as four inches of rain in 48 hours) per decade. Because these events are often highly destructive, there is great concern about them increasing in frequency. The best estimates are that these events are likely to change as follows:
- One to two additional events per decade in the medium term (2040-2069). This represents an increase of 12% to 24% from today
- Two to four additional events per decade in the long term (2070-2099), or an increase of 24% to 48% from today

Given the combined effects of the increased frequency of extreme precipitation events and sea level rise, the boundaries of Launton’s floodplains will likely shift in the future. By 2050, it’s likely that the 500-year floodplain will become the new 100-year floodplain, meaning the risk of flooding will increase from a predicted once per 500 years to once per 100 years in this area. The increase in risk to properties within today’s 100-year floodplain is even more dramatic.
## Appendix C: Summary of Coastal Hazard Risk Management Options

### Options for Reducing Risks to Existing Coastal Development

<table>
<thead>
<tr>
<th>Option</th>
<th>Costs to Town</th>
<th>Who Pays?</th>
<th>Future Benefits</th>
<th>Future Costs</th>
</tr>
</thead>
</table>
| **Option A: Protect**  
Pursue Seawall Strategy | $ - $$$  
Public expense depends on private vs. public construction of seawalls | Individual property owners pay for seawalls on their property.  
The town would pay for a municipal seawall. | Seawalls can provide a high level of protection to homes and businesses if flood conditions do not exceed the design capacity of the walls. However, seawalls built today would have to function under changing precipitation patterns and sea levels for at least the next 50 years. | Building and maintaining seawalls will be expensive.  
If a seawall fails, the damage to properties that relied on it can be extremely high.  
Seawalls increase beach erosion and reduce beach access. They also increase flooding and erosion risks to neighboring areas. |
| **Option B: Accommodate**  
Expand Flood-proofing Ordinance to the 500-Year Flood Plain | $ - $$  
Costs will depend on the property | Property owners pay to flood-proof their homes.  
If the town subsidizes flood-proofing, the cost of subsidies will be paid by the town. | A flood-proofing ordinance would require new and remodeled homes to accommodate flooding in their design, making them more likely to survive storm surges and flooding.  
An expanded flood-proofing ordinance could also help property owners stay ahead of changing flood insurance requirements, which would help residents secure lower insurance rates. | Flood-proofing increases the cost of building and remodeling buildings in coastal neighborhoods.  
Flood-proofing will also not prevent all damage to homes, although it will greatly reduce damage in most flooding incidences. |
| **Option C: Retreat**  
Buyback Program for At-Risk Development | $$$  
The town pays for the buy-back program. | This would help home and business owners move out of the most vulnerable areas and could provide green spaces to act as buffers against future storms. | The town would no longer collect property tax on the properties it buys back.  
Buyback participants would need to move and may leave the town. |
### Options for Reducing Risk Associated with Future Coastal Development

<table>
<thead>
<tr>
<th>Option</th>
<th>Costs</th>
<th>Who Pays?</th>
<th>Future Benefits</th>
<th>Future Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option A: Protect Focus on Upgrading Coastal Infrastructure</strong></td>
<td>$$$-$$$$</td>
<td>The town pays through higher fees and taxes.</td>
<td>This would protect coastal roads and water infrastructure from the impacts of climate change, which would reduce the neighborhood’s vulnerability to big storms. It would also reduce erosion and pollution due to culvert failures or sewage overflows.</td>
<td>High costs would be incurred if future storms exceed design capacity of infrastructure upgrades.</td>
</tr>
</tbody>
</table>

The town would raise or re-route coastal roads, increase road drainage, and build a more robust sewer and water infrastructure to handle sea level rise and bigger storms in coastal neighborhoods. The public expense would vary based on the level of upgrades the town pursues.

| Option B: Retreat Encourage New Development Inland | $ | The town pays through tax incentives on inland development. | New economic development. | Increased sprawl could increase costs of town infrastructure, and development in watersheds could increase flooding from runoff. |

The town would adopt new economic development incentives to encourage future development away from the coast. The town could also increase zoning densities in inland areas.

Incentives would mean reduced property taxes collected from inland businesses.

| Option C: Retreat Encourage New Development Inland, Combined with a Town Conservation Plan | $$$ | The town and property owners pay in the form of potentially increased development, regulatory, and administrative costs. | New economic development. An economy and tax base that is less vulnerable to coastal storms. Environmental and tourism benefits from land conservation. | Development regulations could increase the cost of future development. Conservation through land acquisition would involve additional costs for land purchase and maintenance. |

Similar to Option B, the town would encourage new development inland through tax and zoning incentives. It would also adopt a conservation plan to prevent inland sprawl.

Elements of the conservation plan could include land purchase or low impact development (LID) regulations to reduce storm water runoff on new inland developments.
Appendix D: Glossary of Relevant Terms

Climate Change Adaptation
Climate change adaptation is a phrase that is used to broadly describe ways of planning or preparing for changes in the climate and related consequences. Adaptation can refer to physical changes, such as raising roads to withstand stronger storm surges, as well as policy and planning changes, such as using all public buildings as cooling centers during heat waves. Adaptation is different from climate change mitigation, which refers to efforts to reduce greenhouse gas emissions, such as through driving electric vehicles or using renewable energy.

100-year Storm
A 100-year storm is a storm that produces so much precipitation in such a short period of time that it is expected to occur only once every 100 years. The “100-year storm” has a 1% chance of occurring in any given year.

Seawalls
Seawalls are structures built along the coast to protect land and buildings on the shore from erosion and flooding. Like dikes or levees, they are often higher or taller than the land would be naturally. The term seawall may refer to a small structure built to protect an individual property or much larger structures that are built to protect sizeable sections of towns and cities. Below are two examples of what seawalls might look like.

Flood-proofing Ordinance
A flood-proofing ordinance is a local law requiring buildings in areas with a certain level of flooding risk to either be elevated above a certain flood level or be built to withstand a flood without suffering too much damage.

Buyback or Buyout Program
Towns and cities may use a buyback or buyout program to purchase private land that is at high risk of flooding or that has experienced severe flooding in the past, and then to convert this land to a condition that can withstand flooding and provide some measure of flood protection to other nearby properties.
Transfer of Development Rights (TDR)
Transfer of Development Rights is a zoning procedure that allows a property owner to sell his/her right to develop a parcel of property to another owner with property in an area that is more amenable to development. By constraining development in one area and promoting more it in another, TDR provides property owners of restricted areas the opportunity to realize their property’s financial value by selling the development rights. Below are two examples:

This case was prepared with funding from the University of New Hampshire under Cooperative Agreement No. NA09NOS4190153 (CFDA No. 11.419) from the National Oceanic and Atmospheric Administration. The opinions and recommendations in this case are those of the authors and do not necessarily reflect those of the University of New Hampshire or the National Oceanic and Atmospheric Administration.
Complete one Activity Sheet for each activity you developed that incorporates sustainability into your course.

**Activity Name:** Squaring the Circle Exercise

**Instructor Name:** Jennifer Follstad Shah

*State the activity learning goal(s).*

Learning goal 3 (from syllabus):

express ideas related to sustainability via oral and written means using language that encourages inclusion and collaboration

*Summarize activity.*

Students engaged in the ‘Squaring the Circle’ exercise described in *The Climate Change Playbook* while on a four day retreat at the Bondermann Field Station at Rio Mesa. This exercise asked students to arrange themselves, with their eyes closed, equidistantly around a 50 m length of rope, the ends of which were tied together to form a circle. The students were then asked to arrange themselves, still with their eyes closed, to form a square rather than a circle. The process was contentious, stressful, and exclusionary (to some), but the objective was attained. Students learned that communication is impeded when some cues are not available (i.e., sight) or ignored and when action is embarked upon prior to finding consensus on an approach. Students also learned that some individuals can be excluded from the process of problem solving when one or a few individuals assume a leadership role and put forth action without asking for input from others, resulting in resentment and lowered morale.

*At what point in your course is this activity delivered?*

At class retreat (1 month before class ended)

*Provide teaching tips to help other instructors implement your activity in their courses.*

1. Follow the instructions given in *The Climate Change Playbook*, but be sure to provide a general description of the exercise and outline the rules before allowing students to line up along the length of rope.
2. Perhaps divide the class into two teams engaged in the same exercise.
3. Include a ‘cool-down’ exercise (something fun, positive, morale boosting) after the initial exercise is complete.
Describe your assessment strategy and instruments for student learning and attitudes. Attach grading rubric and/or assessment instruments.

Assessment was conducted through oral reflection as a class. Students also included feedback about the exercise via survey responses to open ended questions about what worked well at the retreat and what could be improved.

*How effective was the activity? What are your ideas for improvement in the future?*

The activity was very effective, but emotionally draining. Ideas for improvement are listed in the list of teaching tips.
Complete one Activity Sheet for each activity you developed that incorporates sustainability into your course.

**Activity Name:** Nonviolent Communication Discussion & Simulation

**Instructor Name:** Jennifer Follstad Shah

*State the activity learning goal(s).*

Learning goal 3 (from syllabus):

express ideas related to sustainability via oral and written means using language that encourages inclusion and collaboration

*Summarize activity.*

Students read 7 chapters from *Nonviolent Communication* prior to coming to the retreat. Together we reviewed the main points from each chapter. Then I facilitated another role play scenario, this time with students pretending to be two roommates. One roommate preferred the household to be tidy, the other did not mind an untidy abode. The students were asked to implement the techniques described in the book and then reflect verbally, as a class, on whether the techniques resulted in communication that was more clear and more inclusive than other ways of communicating similar ideas. It was my intention to then repeat the role play simulation introduced by Dr. Rumore, this time asking students to use the communication techniques outlined in the book and then compare the difference between the conversations. However, we ran out of time to conduct this part of the activity.

*At what point in your course is this activity delivered?*

At class retreat (1 month before class ended)

*Provide teaching tips to help other instructors implement your activity in their courses.*

See answer to activity effectiveness.

*Describe your assessment strategy and instruments for student learning and attitudes. Attach grading rubric and/or assessment instruments.*

Assessment was conducted through oral reflection as a class. Students also included feedback about the exercise via survey responses to open ended questions about what worked well at the retreat and what could be improved and a question asking the students to rank the exercise on a scale from 1-5.
The majority of students (74%) thought the readings and exercises were good to excellent. Only 13% thought the exercises were sub-average to poor.

How effective was the activity? What are your ideas for improvement in the future?

The activity was effective, but I would make the following improvements in the future:

1. Have students do the readings, 1-2 chapters at a time, at the start of the semester, with in-class discussions to ensure main points have been understood.
2. Ask the students to try to implement the techniques in their daily lives and keep a journal on their successes and challenges (new graded assignment).
3. Have students analyze scripts of the roommate scenario to distinguish between different types of communication before asking them to engage in the role play scenario.
4. Plan for more time to apply the techniques to the Launton Town climate change scenario.
Role-play simulations for climate change adaptation education and engagement

Danya Rumore1,2*, Todd Schenk3 and Lawrence Susskind4

In order to effectively adapt to climate change, public officials and other stakeholders need to rapidly enhance their understanding of local risks and their ability to collaboratively and adaptively respond to them. We argue that science-based role-play simulation exercises—a type of ‘serious game’ involving face-to-face mock decision-making—have considerable potential as education and engagement tools for enhancing readiness to adapt. Prior research suggests role-play simulations and other serious games can foster public learning and encourage collective action in public policy-making contexts. However, the effectiveness of such exercises in the context of climate change adaptation education and engagement has heretofore been underexplored. We share results from two research projects that demonstrate the effectiveness of role-play simulations in cultivating climate change adaptation literacy, enhancing collaborative capacity and facilitating social learning. Based on our findings, we suggest such exercises should be more widely embraced as part of adaptation professionals’ education and engagement toolkits.

Climate change poses serious threats to communities worldwide. Although public officials in many towns and cities recognize the dangers they face, efforts to adapt are often limited by real and perceived uncertainty, capacity limitations and competition among interests and priorities. For example, imagine the town of Launton. Over the past decade, the coastal New England community has been hit repeatedly by intense storms, which have caused significant damage to waterfront homes and business. Local officials are very concerned about the prospects for their small beachfront town, particularly as climate change projections indicate Launton will become increasingly vulnerable as the sea rises and more extreme storms occur. Unfortunately, they feel hamstrung by uncertainty about the nature and severity of climate change risks; already stretched resources; lack of public support for major investments and policy changes; and the absence of a clear roadmap for how to adapt to a changing climate.

Launton is a fabricated town in a role-play simulation (RPS) exercise designed for the town of Wells, Maine—one of many RPSs being used to bring stakeholders together to learn about and discuss climate change adaptation. Although Launton itself is imaginary, this scenario is all too real for many coastal towns and cities in the United States, and elsewhere. As with Launton, many communities face widespread impacts from climate change, which—if not prepared for and effectively managed—could have devastating effects within the century1. To help communities prepare for climate change risks, we need to find ways to enhance readiness to adapt.

There is a long history of using RPSs and other serious games as education and engagement tools for tackling public policy challenges, including, increasingly, to advance climate change mitigation and adaptation action2–7. Although RPSs have been identified as particularly promising education and engagement tools for climate change adaptation, this potential had not been previously tested. We draw on the findings from our research to demonstrate that RPSs do indeed have considerable potential for helping stakeholders and communities adapt to climate change by educating them about climate change risks and building their capacity to collaboratively respond. Based on our findings, we conclude that RPSs should be more widely used as an adaptation education and engagement approach. We also discuss some of the limitations of this approach and lay out possible paths for future research and practice.

The need to enhance readiness to adapt

Stakeholders around the world are increasingly concerned about the need to prepare for and manage climate change impacts8–11. Yet, despite this growing recognition and a continually improving technical understanding of climate-related risks, adaptation in practice remains limited10. The lack of adaptation action is by no means surprising. Preparing for and managing climate change risks is a collective risk management challenge. Stakeholders will have to work together over time to respond to risks as they emerge, despite differing ideas about the extent to which climate change is a problem and what (if anything) should be done about it11. Adaptation is greatly complicated by a wide variety of challenges, ranging from scientific uncertainty, complexity and limited resources to competing priorities and differences in risk perception11–16. Such barriers underscore the need to consider underlying governance processes and socio-political concerns, rather than focusing on adaptation as solely a technical challenge8,11.

Adaptation is further complicated by the fact that it is a moving target, requiring continuous learning, monitoring, adjustment and renegotiation of objectives11,18. Thus, effectively managing climate change risks will require a high level of ‘response-ability,’ or the ability to collectively respond to changing conditions as they emerge19.

Most communities—including municipalities, regions, nations and organizations—are not ready to undertake the kinds of collective risk management that adaptation will require11,18,20,22. This may explain why few communities have moved beyond the understanding phase of adaptation to the planning phase, and even fewer have moved on to implementation16. Enhancing individual and collective readiness to prepare for and respond to climate change will...
require increasing literacy about climate change adaptation; people need to understand and accept climate-related risks and potential adaptation responses. Furthermore, effectively responding to climate change risks will require coordination among diverse stakeholders within communities and across scales of governance in the face of uncertainty and complex science. Adaptation literacy must therefore be thought about at both the individual and community levels, and readiness to adapt will require a high level of collaborative capacity, or ability to work together to solve collective problems despite differing interests, perspectives and areas of responsibility.

To achieve these goals, stakeholders and communities need to develop a shared sense of the risks that they collectively face, how they might prepare for and manage these risks, and the kinds of decision-making approaches that will allow them to respond collaboratively and adaptively to emerging threats. This, in turn, will demand a certain amount of social learning, a process by which stakeholders learn together and from each other to create a collective intelligence and shared understanding.

Reconciling participants to new games and levels, thereforere be thought about at both the individual and community perspectives and areas of responsibility.

Research suggests that stakeholder negotiation RPSs also

Research suggests that multi-stakeholder negotiation RPSs also

Using role-play simulations to advance adaptation action

Recognizing this potential, we have been experimenting with RPSs as a way to help advance climate adaptation for almost a decade. Each RPS participant is provided with the same set of general instructions describing the problem to be addressed during the exercise, and each individual is given confidential role-specific instructions with information about the character he or she will play during the simulation. Participants then assume their assigned roles and engage in mock group decision-making for a set period of time. The period of game play is followed by a debriefing session, in which the full group of participants are brought together to reflect on and process the experience, and to explore how what they learned relates to their real-world situations.

The idea behind RPSs is to create a realistic but simplified setting in which participants can engage in group dialogue and negotiated decision-making, experiment with possible solutions and learn to appreciate the perspectives of others — all while in a safe space. The game setting enables participants to deeply explore complex and often controversial issues and relationships, without direct political, financial, relational, or other consequences.

It is up to the participants to make their own determinations about what actions, if any, are appropriate for the scenario laid out. The facilitated debriefing conversation after each simulation run provides an opportunity for participants to make sense of their experience and what they take away from it.

Our work with stakeholders grappling with climate change adaptation has consistently suggested that RPSs hold great promise for helping participants better understand the risks they face and devise collaborative approaches for addressing those risks. Although the promise of the approach was clear, however, the effectiveness of RPSs as an adaptation education and engagement tool had heretofore not been rigorously tested. Recognizing this, we undertook two separate projects to systemically test the effectiveness of RPSs.

The Institutionalizing Uncertainty project (IUP) engaged transportation infrastructure planners, decision-makers and other stakeholders in the coastal cities of Rotterdam, Singapore and Boston in exploring how they can effectively recognize and assess the dynamic and uncertain climate change risks they face, and how they can work together across traditional organizational, institutional and interest-based boundaries to mitigate those risks. The goal was to advance our collective understanding of how complex and uncertain risks such as climate change can best be handled, exploring questions of effective collaboration, the use of decision support tools (scenarios in particular), institutional change and differences between governance regimes. An RPS was run with 76 participants across the three cities, placing them in a fictitious yet realistic situation in
which they had to directly wrestle with whether (and how) to revise plans to construct a new highway in light of potentially significant, yet uncertain, climate risks. Participants completed pre- and post-exercise questionnaires, participated in a post-exercise debriefing, and were interviewed in the days following the exercise. The game play and debriefings were video recorded and coded for analysis.

The New England Climate Adaptation Project (NECAP) was a two-year participatory action research project that tested the effectiveness of RPSs as a public education and engagement tool, while simultaneously enhancing the readiness of four coastal New England communities to adapt to climate change. Project staff worked with local partners to develop a tailored RPS for each of the four municipalities. Each simulation was based on and included real-world downscaled climate change projections. The simulations also drew on the findings from in-depth interviews with local stakeholders, modelling realistic local political tensions. Over the course of six months, 110 to 170 people in each community were engaged in playing the simulation designed for their town. The project intentionally sought to engage local public officials with local residents in workshops to help generate shared understanding among the public and decision-makers. All NECAP workshop participants completed a questionnaire before and after the simulation and participated in debriefing conversations directly after the simulation. In-depth interviews were conducted with 20 to 30 percent of participants from each workshop four to six weeks after the event. Before- and after-workshop questionnaires were collected from a total of 510 participants. A total of 140 workshop participants participated in follow-up interviews. Quantitative and qualitative data were analysed to evaluate the effect of the simulation workshops on: individual and group perspectives about local climate change risks and adaptation responses; the need for (and importance of) local action; confidence in the prospects of local action; and the importance of collective action and stakeholder engagement in adaptation planning.

For both projects, shifts in participants’ perspectives were analysed for statistical significance using the Wilcoxon matched pairs signed-rank test (see Supplementary Information).

**Evidence of the effectiveness of role-play simulations**

Our findings from these two projects provide strong evidence that participation in RPSs can increase readiness to adapt by cultivating literacy about climate change adaptation, enhancing collaborative capacity, and facilitating social learning. Furthermore, our findings suggest that when used as part of a broader engagement strategy, they can help catalyse climate change adaptation action.

**Cultivating adaptation literacy.**

Many participants indicated that the simulation brought climate change risks and the need for collective adaptation action “home” for them, helping them appreciate that climate change is a local issue and grasp how their town might be impacted. As one City of Dover resident explained in a representative quote, he had not realized that “the vast amount of different areas that can be affected due to climate change”. Moreover, he reported that the simulation showed him “how climate change can have such an effect on even a small place like Dover”. Survey and interview findings from NECAP also show that the exercise helped the majority of participants better understand the kinds of local actions that will be necessary to prepare for and respond to climate-related risks. Many participants noted that the simulation helped them understand that adaptation needs to be mainstreamed into everyday local planning, rather than done separately or on top of day-to-day decision-making.

Some emphasized the value of exercises as a delivery mechanism. In the words of a participant in Singapore: “Just telling people that climate change is important, they might not be convinced, but when they do a simulation, being in the role, actually [helps] them to appreciate the fact that climate change is [an] important considering factor.”

Based on the large dataset from NECAP, we also have reason to believe RPSs may be particularly effective for shifting opinions among those who are, to use the Yale Project on Climate Change Communication’s Six Americas categorization, in the “concerned” and “cautious” categories in terms of their perspectives on climate change (Supplementary Table 4).

Our research also shows that RPSs can help stakeholders and community members better understand what will be involved in adapting to climate change and the challenges they are likely to face in doing so.

“Before the game, I didn’t think [uncertainty] was really that much of a problem because it was coming from my own point of view, and after the game, Reflecting on what they learned, participants were surprised to find that many of the significant challenges and sources of uncertainty inhibiting effective adaptation are not scientific, but rather governance issues that require robust institutional responses.

Along similar lines, the strong majority of NECAP participants showed signs of significantly enriched understanding about the complexity of climate change and what adaptation will entail. As a Town of Wells interviewee remarked while reflecting on the simulation: “Even though I think of myself as knowledgeable about the basics of climate change, I hadn’t really considered the process of actual decision-making in communities and figuring out what to do.” A city councilwoman and coastal property owner in the City of Cranston said that the simulation helped her “prioritize and see the whole picture of what the city is grappling with”.

In NECAP, there was a statistically significant increase in participants’ confidence that their town could take meaningful adaptation action (p < 0.05, Supplementary Table 6). Participants attributed their increased confidence to the fact that the simulation demonstrated pathways their town might take to adapt and helped them realize that others in their community, including public officials, are taking the issue seriously. However, these participants noted that the simulation made them realize how truly challenging climate change adaptation will be.

As with the NECAP participants, however, some felt less confident and many stayed the same. Participants whose confidence decreased
as a result of the exercise cited barriers to adaptation — including deficient professional capacity, inflexible institutional norms and standards, and persistent uncertainty (which the exercise highlighted) — as the reason for their increased scepticism.

Enhancing collaborative capacity. Our results also suggest that RPSs can help lay the foundation for collaborative risk management by highlighting the interdependency of stakeholders, increasing empathy for different perspectives, building support for collaborative decision-making, and introducing complementary tools and approaches.

In the IUP, participants were asked both before and after the exercise how important it is that they engage with other decision-makers and stakeholders as they plan and make decisions about adaptation.

The importance of broad engagement was universal across the three cities, although there was notable variation in opinions about who should be engaged, which seemed to directly reflect cultural norms about governance. In Boston, non-governmental actors are playing key roles in the region’s nascent adaptation efforts and participants praised their prominence. In contrast, participants in Singapore agreed on the importance of cross-governmental collaboration, but many were wary of extensively involving external stakeholders.

Participation in the NECAP simulations also resulted in a notable increase in participants’ sense of how important it is to engage diverse stakeholders in adaptation decision-making. As one participant explained: “The workshop made me more aware of the fact that more citizens — all citizens — should be taking a look at what’s going on and taking a role in it.”

In addition to increasing participants’ belief in the importance of engaging diverse stakeholders in adaptation decision-making, interview findings suggest there were two main reasons for this.

People commonly said it was very eye opening to “walk in someone else’s shoes.” In a comment that was reflective of sentiments expressed by others, one workshop participant said of his experience: “You had to sit down and say: maybe this guy has a point. I never thought about it.”

The findings were similar in the IUP: “One thing I find very useful about this gaming exercise is that you force participants to put on different hats, and so they put themselves in the shoes of that role, and that helps to get them out of their own comfort zone, the role that they are playing in office,” said a participant in Singapore, reflecting broadly-held sentiments. She added: “They are [subsequently] able to see the other side of the argument, the other argument, the counter-arguments, and that … sensitizes them to certain issues. And when they return to their portfolio, they are better able to formulate plans or strategies for that particular issue. So it broadens their perspective.”

The simulations also seem to have effectively introduced the merits of more collaborative approaches to decision-making.

IUP participants also voiced high levels of support for a consensus building approach to adaptation decision-making following the RPS. As one participant lamented: “I wish that the approach to decision-making were more like that [followed in the exercise] in the real world; ultimately, decisions are made somewhat mysteriously, and I don’t think that they are made so openly as part of [this type of] consensus building group.”

Similarly, IUP participants reported that they learned about the importance of a well-designed and facilitated decision-making process, especially when tackling complex challenges such as climate adaptation. They also indicated that the experience underscored the impact stakeholder interactions and negotiation skills can have on the outcomes; those that were adept at seeking mutual gains and/or arguing their cases were more successful in getting what they wanted. In general, participants reflected that this kind of process is enhanced by good deliberative technique.

Fostering social learning. Our experience with NECAP strongly suggests that engaging diverse groups of stakeholders through RPSs creates a powerful forum for social learning. NECAP participants commonly reflected on the fact that the simulations created a safe space and a valuable opportunity for bringing local decision-makers and other diverse community members together to talk about local climate change risks. They suggested this community learning was a powerful influence on their perspectives. In the words of one Town of Wells interviewee, it is “nice to know that I’m not alone in this, that there are others who also want to keep things happening”. A City of Dover resident described the experience: “It gave me some confidence that the city officials and citizens were really trying to engage in this … It gave me some hope that Dover … Can actually do some good planning.”

Similarly, in the words of a Town of Barnstable participant: “It forces the communication to happen … If we sat down there without the role-playing, some ideas are thrown out there. But when we’re doing that role-playing, whether you agree with it or not, it forces the subject matter to be put on the table. And it works.”

The impacts of this social learning on adaptation action will take time to fully manifest and are hard to measure. However, there are strong initial signs from NECAP that this learning is translating into community decision-making. All four NECAP partner municipalities are beginning to integrate the climate change projections developed through the project into their planning and zoning updates, and many of the communities have pursued federal and other funding to enable them to do more in-depth vulnerability studies. Perhaps most importantly, climate change risks are now on the political docket in a way they definitely were not before the project. As a City of Cranston public official put it, the project had the effect of getting public officials “outside their comfort zones and talking about adaptation planning as a normal part of their duties — [that] wouldn’t have happened without this project”. Another project partner said the simulations “helped build dialogue that may have never happened without this project”. These effects must be understood as resulting from the broader NECAP effort and not just the role-play simulation workshops. However, they provide further evidence that social learning has occurred in these communities, and speak to the potential of RPSs to act as inflection points for broader adaptation education and engagement strategies.

Adding role-play simulations to the adaptation toolkit

The NECAP and IUP provide rigorous empirical evidence that science-based role-play simulations can indeed be powerful tools
for stakeholder education and engagement around climate change adaptation. They give us reason to believe such exercises can help stakeholders understand climate change risks and build support for adaptation action, enrich participants’ understanding of what climate change adaptation will entail and the challenges it will present, and increase support for collaboratively engaging diverse stakeholders in adaptation decision-making. Further, the NECAP experience demonstrates that such exercises, when nested in broader engagement processes, can serve as valuable conversation starters, fostering social learning and potentially acting as catalysts for action. In light of these findings, we feel confident that RPSs are a valuable addition to adaptation professionals’ toolkits, and we encourage others to experiment with them as an approach to adaptation education and engagement.

In considering the potential of these exercises as adaptation support tools, facilitated post-exercise dialogue allows participants to make sense of their simulation experience and tie their learning back to reality. Tailoring RPSs to specific contexts is not feasible, existing games can be used or modified to kick off important conversations. Although it is true that busy public officials may not want ‘waste time playing a game’ and the general public may be sceptical, we have found that participants almost always enjoy the experience and, in retrospect, say they found it valuable. Additionally many participants find the prospects of engaging in an experiential learning exercise more attractive than simply attending a town hall or public meeting. It is also important to note that the generalizability of these findings to other types of serious games is unclear. Our experience suggests that the face-to-face element of RPSs is key to the value they provide, although this hypothesis has not been verified. The efficacy of different kinds of serious games for social learning and engagement around adaptation merits further rigorous study.

The potential to build on the paper-based RPS model described here by integrating different technologies, such as computer game engines that provide feedback on the impacts of different decisions, merit further exploration and empirical study. Additional research is also needed to examine the extent to which RPSs are effective across different cultures and contexts. Finally, there is considerable potential to use RPSs as a research tool, such as to understand institutional and group dynamics in the context of making adaptation decisions. The IUP hints at their value in this respect, but more work is needed to clarify what we can and cannot learn by observing play and what other research methods can be paired with RPSs to generate information relevant to adaptation policy-making.

The seriousness of climate change and the urgent need for adaptation require that we become creative in our approaches to fostering support for action and building the capacity of stakeholders to effectively respond. Adapting to climate change is no game, but we have reason to believe role-play games can help.

Received 5 June 2014; accepted 15 June 2016; published online 27 July 2016

References

22. Adapting to the Impacts of Climate Change (National Research Council, 2010).
30. Informing an Effective Response to Climate Change (National Research Council, 2010).
32. Abt, C. C. Serious Games (University Press of America, 2002).
37. Najam, A. Getting Beyond the Least Common Denominator: Developing Countries in Global Environmental Negotiations (Massachusetts Institute of Technology, 2001).
51. Next Generation Planner (Tygron, 2016); http://www.tygron.com

**Acknowledgements**

The New England Climate Adaptation Project was supported with funding from the University of New Hampshire and the National Oceanic and Atmospheric Administration under Cooperative Agreement no. NA09NOS4190153 (CFDA no. 11.419). The IUP received support from the Dutch Knowledge for Climate Program, funded through TNO: the Program on Negotiation at Harvard Law School; and the Tufts-MIT Water Diplomacy Program. The authors also wish to acknowledge all of the NECAP research team members, partners, and workshop participants who made the project possible, as well as Ellen Czalka for her help in statistically analysing NECAP data. They also wish to thank the incredible local partners and participants in the three case cities in the IUP, and in particular project partners at TNO.

**Author contributions**

D.R. conceptualized the research questions and analysed data for NECAP. T.S. conceptualized the research questions and analysed data for Institutionalizing Uncertainty. L.S. provided mentoring and oversight for both projects. D.R. and T.S. contributed equally to the preparation of this manuscript, with input from L.S.

**Additional information**

Supplementary information is available in the online version of the paper. Reprints and permissions information is available online at www.nature.com/reprints. Correspondence and requests for materials should be addressed to D.R.

**Competing financial interests**

The authors declare no competing financial interests.