Service Learning in the Geosciences: Opportunities for Innovation

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Many disciplines have begun to incorporate service learning into their undergraduate curricula. Disciplines are turning to service learning as a strategy for deepening student learning and opening students up to real world applications of what they learn while at the same time meeting the needs of others. The implementation of service learning in other disciplines is beginning to suggest how service learning achieves and maximizes its impacts. Much can be learned from becoming familiar with what has been done in other disciplines, and this paper is intended to highlight examples that could be helpful to the geosciences. The major emphasis throughout the paper will be on the need to innovate and customize rather than simply adopt what other disciplines have done. As the geosciences look to draw on the many examples of service learning as carried out in other disciplines, it will be important that geosciences service learning be designed in ways that meet the particular needs of geosciences students, use the content knowledge of the geosciences, and address the kinds of problems and situations that are of importance to the discipline. Customization will be crucial.

After an introduction that frames some of the issues in service learning and highlights some of the key points in the service learning literature, the heart of the paper will provide examples that illustrate frequent issues that have emerged when people from various disciplines have begun to initiate programs of service learning. Organized around fifteen challenges, the examples illustrate the kinds of issues that faculty confront and how they go about solving some of these problems. Each example will be followed by a brief set of questions to assist in thinking about how one might use this example to move service learning plans forward in particular contexts.

What Is Service Learning and Why Is It Valued?

One of the most succinct and instructive descriptions of service learning can be found on Purdue University's Physics website (http://www.physics.purdue.edu/outreach/service-learning.html):

> Service learning is a philosophy with which individuals are able to make meaningful contributions to the benefit of others while at the same time developing their own knowledge and expertise in an area of personal interest or commitment. Service learning is based on the principles that learning is most effective when contextualized in authentic applications. While providing authentic deliverables to the "customer," students enrolled in service learning courses learn from their experiences. That learning may involve leadership, the communication of science related ideas and principles to the public, experience in teaching in K-12 classrooms, the design and creation of instructional materials and assessment, and, above all learning relevant science too. A component of the service learning experience is personal reflection on the experience.

This description points out that service learning is about knowledge acquisition, about bringing this knowledge to bear in helping others solve real world problems, about customizing that knowledge so

that it is applicable in different contexts, and about tying action and application to cycles of reflection and revision. When service learning is done well and effectively, students and communities will benefit.

To fully understand the promise of service learning, it is important to move from the abstract to the concrete. An illustration from Denison University's Physics Department describes service learning through the example of their *Project Ignition* (https://denison.edu/files/offices/custom-landing-pages/servicelearning-physics_resources.pdf):

> Service-learning is education in action. Holding a mock crash on campus is service. Sitting in a science classroom analyzing velocity, the laws of physics including bodies in motion and bodies at rest, is learning. Taking lessons learned in a physics course regarding laws of motion, inertia, velocity, and energy, and using this knowledge to predict and understand the danger of auto accidents is service-learning. Exploring theories through a mock crash and sharing what is now understood about impact at varying speeds is service-learning. Sharing that information so others understand laws of physics and the dangers of auto accidents is service-learning.

Service learning fills a gap in the way we teach. It can cover what is missing in classroom textbook-only approaches. Consider some of the responses recently reported from a study involving many universities (Crawford et al, 2011). Alumni, employers, faculty, and students were surveyed about what was missing and whether the classroom education being offered is adequate to prepare students for the contexts they will encounter. The authors repeatedly heard themes about gaps. Consider some of the comments from alumni:

- "I did not learn in college that if you can't communicate, you're pretty worthless on many fronts regardless of your book smarts and degree held. That very much includes the ability to listen and learn other points of view."
- "Strategic thinking and problem solving are skills I did not receive training for while in college. In today's economy, it is critical to be a problem solver and evaluate problems strategically. While many who graduate from my alma mater are good at these skills, students in my degree program were not trained in these areas. Frankly, training in a classroom environment is difficult because most effective strategic thinking and problem solving comes in the moment and on the fly."
- "I wish there had been more interaction with Cross-Discipline majors—particularly in the last year or two of completing my degree—make students work together with their unique education background to solve a complicated problem that requires different education backgrounds."
- "The days of talking heads in classrooms need to be over…more real world team projects like the College of Business cohorts do; more exploratory experiences in related or outside fields that push learners to their edge where change can take place."

Service learning is being turned to as a way of filling important gaps such as helping students to link to important aspects of their world and their future. And service learning is important to the future of our disciplines in making the disciplines increasingly attractive to diverse students and retaining diverse students in college. Faculty are learning to design service learning in ways that do not undermine the

rigor of the content of the courses but rather increase it. The emphasis is increasingly on integrating "service" and "learning," thereby creating deep learning through the complex opportunities for service.

A Few Points on the Value of Service Learning for the Student: Much research is confirming that service learning has a variety of positive impacts on students. Major work such as a meta-analysis of 62 studies involving over 11,000 students investigated the impact of service learning on academic performance, attitudes toward school and learning, attitudes toward self, social skills, and civic engagement (Celio, Durlak and Dymnicki, 2011). Such studies indicate that service learning has a range of positive impacts, and is most impactful when it links curriculum, students have input in its form, and students regularly reflect on what they learned.

Service learning is also increasingly being turned to as a means of assisting students to arrive at a deeper understanding of how the content knowledge in their discipline can be used, how that content can be combined with that from other disciplines, and how that body of work can be important to solving difficult, urgent problems. The adoption of service learning as a key part of undergraduate teaching is being emphasized in many disciplines as a means of increasing depth of student content knowledge, increasing student capacity to retain content knowledge, increasing transferability and flexibility in using that content knowledge, and increasing student understanding of the complexity of contexts where their content knowledge is needed.

And there may be ways of doing service learning that are especially prone to increasing service learning's positive impacts on students. Data are increasingly pointing to various possibilities including that ensuring that students assist in the selection of the issues that will be addressed in their service learning projects. Such involvement has been found to result in stronger impacts of the service learning experience (Billig et al, 2005).

A Few Points on The Value of Service Learning to the Community: In studies of service learning programs, positive impacts on the community have frequently been found (e.g., Billig, 2009; Conway, Amel, & Gerwien, 2009). But concerns continue to be raised about the importance of avoiding arrogance (Werner, Voce, Openshaw, and Simons, 2002):

> Although many educators and social commentators have been optimistic about the potential of service-learning to improve education and solve social problems, others have expressed caution about the arrogance of charity work, the condescension of rich people taking care of poor people, the emphasis on community members' needs rather than their competencies, and the potential for exacerbating rather than ameliorating cross-cultural conflicts. (p. 574)

Increasingly it is being recognized that strong community partnerships are important if the positive effects of service learning are to be achieved (Ammon, Furco, Chi, & Middaugh, 2002; Billig, 2002; Kramer, 2000). Many report that the partnerships lead to greater benefits to and deeper impact on the communities involved, and greater reciprocity in the campus-community relationships (Sandy, 2007; Stoecker, Tryon, and Hilgendorf, 2009).

But the role of partners is changing. The authors of *Cultivating Community Beyond the Classroom* (Prentice, Robinson, & Patton, 2012) note that:

> Partners need to be seen as more than just placement sites for service learning. Agency directors, staff, and elementary and secondary school teachers must be co-facilitators of learning, as they have much to teach from the community perspective. ..Many community partners prefer long-term relationships with individual faculty to develop mutually beneficial agendas, joint project planning, and continual assessment.

As partnerships are increasingly recognized as important to service learning sustainability, increasing attention is being paid to the bodies of work that have explicitly focused on how to build such partnerships. This has drawn attention to the literatures on community-university research partnerships and on the scholarship of engagement. One of the leaders of scholarship of engagement, Ernest Boyer, eloquently pointed to the shift that engagement leads to in how scholars do their work: "The application of knowledge moves toward engagement as the scholar asks 'How can knowledge be responsibly applied to consequential problems? How can it be helpful to individuals as well as institutions?'" (Boyer, 1990, p. 21). As Fontaine (2006) notes, "the researcher's orientation shifts from conducting research on individuals or communities to conducting research in collaboration with individuals and communities" (p. 47). And strategies for collaboration become central. As McTaggart (1997) notes, these new forms of collaboration are distinctive in that rather than making individuals or organizations the objects of research, partners engage in a collaborative endeavor to improve a practice or situation (McTaggart, 1997). These bodies of work are increasingly serving as resources for strengthening service learning.

Learning from What Others have Done: Innovation as Essential

Service learning is not a "drop in" course component whereby one can take exactly what someone else has done and use it unchanged with one's own students. Instead you will need to reconfigure it to make it work for your discipline, your context, your students, and your community. Fortunately, one is not confronted with starting from scratch: many examples exist of what faculty have tried in the ways of service learning. What will be important is developing practices for finding a range of examples and learning to customize them. Throughout this paper I offer examples that capture the basic issues in service learning. The examples will vary in their fit with your context. Again and again, it will be suggested that there will be the need to adapt and innovate.

Keep in mind that there are many such examples. Where can they be found? Becoming familiar with the service learning literature is helpful, but what appears in the literature under the phrase "service learning" should be treated as a starting point only. Much that is useful will not be found under the term "service learning." Useful information will be discovered under such phrases such as 'community-university partnerships,' 'student engagement,' 'cooperative extension,' 'science shops,' 'democratization of science,' and 'citizen science.' Many will located within disciplinary sources or problem areas.

It is not enough to provide people with abstract, overarching rules (i.e., find the right partner, find the right topic). These rules fall short in capturing the actual complexities likely to be encountered under real world conditions. Abstract rules do not provide pathways for developing effective service learning in complex contexts. Throughout the bulk of this paper we thus will rely on in depth examples to illustrate the challenges and complexities of implementing the abstract rules or goals.

And we will emphasize the need for innovation. Innovation will be essential as you go forward in designing the forms that service-learning could take in the geosciences. While there are many examples of service learning in other disciplines, these examples will rarely be a perfect fit for your context, your students, your discipline, your course, your community, and your partner. People often say "I can't have my students do that type of service learning because…". The existing examples are best used as sources of ideas rather than exact modules that can be slotted into your course.

The innovation literature is replete with information on how, keeping an eye on overarching goals, to draw on examples of what others have done in order to envision how you might craft a service learning approach for use in your courses and your discipline. Recently, we published an issue of the journal *Maine Policy Review* (Silka, 2014) focused on how innovation concepts are being used throughout Maine to take ideas and practices that were developed elsewhere and reconfigure them for the very different contexts and problems of Maine. The result has been important progress that avoids starting from scratch but also avoids trying to do something that is not well suited to your context.

What you will encounter throughout the next section are illustrations from the service learning field of how people have innovated around fifteen common challenges that stand in the way of effective service learning (for example, course content that seemingly does not lend itself to service learning). These examples provide guidance by, on the one hand, acknowledging the challenges to implementing service learning but, on the other hand, pointing to what other disciplines have done that can serve as starting points for your own innovations. These examples give a sense of the issues you need to be thinking about as you move toward incorporating service learning into your curriculum.

Many of the examples are drawn from my personal experiences in academia in New England as a faculty member, center director, and administrator responsible for community outreach and partnership; from consulting around the country and internationally; and from serving on funding review panels for grants on service learning and on selection committees for awarding honors to those involved in service learning and engaged research. I have drawn from these examples because they provide rich details into how faculty are wrestling with the challenges and dilemmas in service learning that all too rarely are described in the final products that appear in the literature.

Fifteen Common Service Learning Challenges

Challenge 1	Lack of Training in Service Learning and the Challenges of Getting Starting
Challenge 2	Identifying Appropriate Topics for Service Learning
Challenge 3	Finding Community Partners
Challenge 4	Getting Students Interested
Challenge 5	Tapping into Ongoing Streams of Activities
Challenge 6	Identifying What Novice Students Have to Offer
Challenge 7	Ensuring that Service Learning Topics Help Students Develop Deep Disciplinary Knowledge
Challenge 8	Students have Busy Lives and Little Time for Service Learning
Challenge 9	Dealing with Large Classes
Challenge 10	Dealing with Online Classes
Challenge 11	Fearing that Problems are Bigger than What the Discipline Can Offer

Challenge 12	Finding, or Creating, Support for Service Learning
Challenge 13	Ensuring that Habits of Service Learning Remain with Students in their Post-Graduate Lives
Challenge 14	Bringing All the Parts Together
Challenge 15	Linking to High Profile Events that Matter to Partners

Fifteen Common Challenges, Ways that Faculty Have Found to Overcome Them, and Questions to Ask About Using These Examples to Envision Service Learning in the Geosciences

CHALLENGE 1: 'I wasn't trained to do service learning and I don't know where to start'

Few of us are fortunate enough to receive explicit training in service learning as a part of our graduate education. This is changing a bit as some programs are beginning to provide training for teaching that includes service learning. For most of us, however, service learning is something that has not been a part of our training. We come to service learning through a variety of paths, and knowing a bit about how others have begun to include service learning can be instructive as one begins to get started with adding service learning to one's own courses.

Art and evolutionary biology are the two disciplines I would like to describe. Dr. Peter Precourt, an art faculty member in the UMaine system, and Dr. Jordan Korubian, an evolutionary biologist at Tulane University, have each come to include service learning as an important part of their teaching. Peter describes himself as having been traditional art faculty member teaching studio art and related courses while a faculty member in New Orleans. He was there when Hurricane Karina devastated the city. Peter reports that as he watched the city lose so much and people struggling each day just to find basic resources, he began to wonder what purpose was served in college students learning to perfect their artistic skills while so much was in chaos and so many people were uprooted. He began to seek ways to link art to the community through service learning. He continued this after he moved to Maine. After he became a faculty member in Maine he began to work with faculty in other disciplines to link with a homeless shelter in the community. Students, for example, worked with staff at the shelter, looking at ways to enliven the public spaces with art. Together they created pedestals throughout the space: some held art and other held blankets that people in need could come and take. As a public space infused with art (including murals and the like created by art students), no one would know if people were arriving to go to the "art gallery" or to get resources that they might need. The students remained committed to strengthening their art skills but doing so in a reflective context that repeatedly caused them to consider the place and purpose of art. At a Newfoundland convention of CUExpo—the Canadian Community Engagement Conference held every other year—Peter described how little he would have expected this focus in his academic teaching but how effective it has been to include service learning as an additional path for assisting art students to learn their craft.

Dr. Jordan Korubian is a recent winner of the Lynton Award, the national award given annually to the pretenure faculty member in the United States who best models the most innovative and creative engaged scholarship. In his award address, Jordan describes himself as having been a traditional academic researcher, one whose research focus was on species and habitat loss. He was carrying out his research in a vulnerable habitat in Ecuador. He would go to his field site, rigorously investigate the

losses, and report the results in highly cited peer-reviewed publications with the goal that the research would contribute to policy changes that would reduce the loss of habitat and species. Key species were in grave danger. Jordan reports that a turning point for him was in one of his periods of study, an Ecuadorian boy excitedly walked up to him and showed Jordan his trophy: the boy had just shot one of the animals whose loss Jordan was studying with the aim of curtailing loss. Jordan did not give up his research or see its importance as diminished but he did begin to reflect on the need to link research with what he learned was called service learning. He began to involve the community in his research, looking together for ways that habitat and species protection could serve community needs for good jobs and a sustainable economy. He began to involve his students in envisioning strategies for using the science in ways that helped to meet community goals and which were consistent with the resources that communities have for creating changes that they want to make. The students have been involved not only in Ecuador but in neighborhoods near their Louisiana campus. Jordan reports that what he is now doing in terms of his teaching not only better connects his teaching to his research, but his students report that they can see more links between the science they are learning and broader cultural goals.

In both of Peter and Jordan's cases, they did not receive training in graduate school in service learning but they report that adding service learning has strengthened their teaching. Their disciplines are very different as are their contexts, yet both created innovative service learning opportunities that are linked to central themes in their particular disciplines.

Going Forward Considering These Examples:

- What steps have you considered taking to incorporate service learning in your courses? Are there details of these examples that prompt ideas for you about how you might begin to develop service learning?
- Have you had the opportunity to receive any training in service learning and, if not, do these examples suggest any strategies you might consider for initiating service learning?
- Which parts of what they did could work for you in your courses, context, or situation?
- What obstacles and barriers might you encounter or need to overcome to learn a service learning approach that would work in the geosciences?
- What next steps might you take?

CHALLENGE 2: 'But How Would I Find a Topic for Service Learning?'

On the face of it, it is not always clear which topics might be effective ones for service learning experiences. Consider solid waste (aka: trash!). Trash would seem like one of those unlikely problems to open up opportunities for service learning across a range of disciplines. To a surprising extent it has. So this should raise the possibility that as we search for service learning topics that deepen course content, link to many disciplines, and link to community interest, we may want to look far afield and in different ways.

In the case of solid waste, many communities are devoting a significant percentage of the municipal dollars to addressing their solid waste problems: the growing amounts of waste being created, waste that is increasingly toxic, the stalling of recycling efforts, the shifting value of those recycled materials,

and limited land that is appropriate for landfills where runoff will not contaminate groundwater, rivers, and lakes. Cities and towns are struggling with all of these issues and most communities of small size do not have the means to investigate how to solve them.

In Maine, faculty and students from many disciplines (anthropology, economics, ecology, engineering, community psychology, communication, and water resources) came together to identify opportunities for universities to be involved as partners in identifying strategies to address solid waste problems. Students were involved in hosting meetings around the state to identify common goals and opportunities. Students were involved in gathering information about reuse and composting. Students were involved in analyzing how waste problems are framed in the press which gives a sense of the information landscape that must be worked with. The service learning opportunities becoming available are abundant. Towns are saying that they would like assistance in finding out how other towns have framed policy and practices (policies like "pay as you throw"). Towns are saying that they would like to know how to better understand the toxic waste in the waste stream and how it might be diverted. Towns are saying that they would like to understand how to increase recycling rates. Schools in local cities and towns are asking what would be involved in composting and how they can involve their students in waste issues and connect the study of waste issues to the school curriculum.

To a surprising extent, waste is on the minds of many people and is a timely topic for involving students from many disciplinary backgrounds. It is also a topic that is 'graduated enough' that students from first year to fourth year can contribute with their varying levels of knowledge and experience. For example, a recent statewide event, the Maine Science Festival, students were involved in offering hands-on solid waste sorting experiences for middle school youth. The middle school youth dressed in hazmat suits and safety glasses and confronted a boat filled with waste of many sorts. In front of the waste were four signs and four buckets to which the waste was to be allocated. The signs said: "Recycle Me," "Compost Me," "Reuse Me," and "Throw Me Away." Students grabbed paper and recycled it. They puzzled over books and pieces of felt. They threw food scraps into the composting bin. And they stared at the Styrofoam and were taught an on-the-spot lesson about items that represent waste challenges. College students could be involved in designing the exercise, learning and translating the relevant literature into fun age-appropriate handouts, and teaching the participants what goes where and why. Teachers accompanying the students wanted to talk about composting and recycling and how they can develop programs at their schools. College students had a chance to expose hundreds of middle schoolers in age appropriate ways to the latest ideas about waste and waste issues and to do so in ways that were linked to their disciplines and courses.

The presentations our diverse team has given on the above work have taken the title: "Talking Trash: The Sustainability Challenge Hiding in Plain Sight." The phrase "talking trash" has also come up in Massachusetts. Contexts may differ in terms of which part of this problem may be of concern. In Massachusetts, the concern in many cities and towns was the stalled recycling rate. Many items were ending up in the limited landfill space that could be recycled. Authorities in towns like Lowell, Massachusetts, with rapidly growing immigrant and refugee populations, were concerned that new community members were not getting the message about the importance and value of recycling. The city came to the local university and asked that they involve faculty and students in findings ways to

address this problem. Through our environmental justice work with the large Cambodian and Laotian communities, we were able to involve students in designing a community convening called "Talking Trash." People were asked to bring an item that they had trouble recycling to the event where we could learn from each other what to do. The result was a wonderful hours-long discussion and learning session that gave everyone new ideas and greater understanding of the resources in the community to address this problem. Students learned from hearing diverse residents share ideas from their home countries. Residents learned from seeing what students had to offer. The planning for solid waste moved forward.

The point of course is that it may not be initially apparent which topics might be available and generative. It may take some innovation and problem solving to find them. And the form they take in different settings and contexts will vary. Handled well, students will learn about the complexity of the problems and the opportunities to devise solutions that will draw on their disciplinary skills and make a difference.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for your courses, context, and community?
- What obstacles and barriers would you need to overcome and how would you go about doing so?
- What would be your next steps?

CHALLENGE 3: 'I have no idea how to find community partners or where to even start'

As the literature indicates, effective service learning is impossible without service learning partners who see benefits in being involved. Many institutions of higher education have a checkered history with their surrounding community that can make it difficult to find partners that come to the relationship without suspicion and distrust. Universities too frequently have not been good neighbors and students have not been seen as an asset to the community at large.

Effective service learning is attentive to the need to recognize these obstacles and this history. Many communities report their frustration at having university faculty simply assume that the communities will want to serve as hosts for service learning initiatives. Astute, creative faculty look for opportunities that neither shortchange the student academic experience nor make assumptions about what the community wants, values, or needs.

Many different disciplines develop ways to find partners that look for common ground and shared concerns. Dr. Aram Calhoun, an internationally renowned ecologist, involved her ecology students in investigating the importance of temporal seasonal pools (i.e., vernal pools) in the lifecycle of key amphibian species in Maine. The research demonstrated the impact of land use practices near vernal pools on the successful migration of these key species. New development on private lands near vernal pools can directly impact these species. Dr. Calhoun created effective partnerships with town planners and community leaders to take on this issue of how to design land use regulations that would be responsive to the environmental issues while also being respectful of the needs for land development and community growth. Students were involved in many aspects that reflect service and learning: doing

research that not only met community needs but also reflected the latest evidence in the discipline. Students were able to see the complexity of the multiple and conflicting aims and goals of maintaining the natural environment and achieving appropriate growth.

Dr. Karen Bieluch (2015) has shown how to move the analysis of partner expectations beyond conjecture and into empirical work. In her work, Bieluch studied communities throughout Maine, surveying them about when and how they would prefer to work with higher education on projects where university research and student involvement could be helpful. Bieluch uncovered complex views of under what circumstances and at what stages communities prefer to partner with higher education to solve problems.

Going Forward Considering These Examples:

- In the geosciences, are there topics that might be of particular interest to partners or potentially beneficial to students and partners as service learning projects?
- Are there aspects of the vernal pool example and its links to research and policy that prompt for you service learning possibilities in the geosciences?
- Using this example as an illustration, what obstacles and barriers would you need to overcome in identifying possible partners for geosciences service learning?
- What would be your next steps in finding possible service learning partners?

CHALLENGE 4: 'But How Do I Interest Students in Service Learning?'

The literature shows that student interest greatly contributes to the impact of service learning for students. Service learning is most successful when students are engaged with the topic. This does not mean that the students prefer to be given an entirely free slate where they must pick a topic and find a partner. On the contrary, the absence of a structure can be very problematic if the goal is to create a service learning experience that heightens the knowledge learned, shows its applicability, and meets community needs. How can all of this be done?

An important structural characteristic of many outstanding service learning experiences is that they are carefully designed to find and tap overlap between partner needs, student interests, and course content. That is, they can be likened to a Venn diagram in which the goal is to find the area of overlap.

The political scientist Dr. Rob Glover teaches political science courses that include a focus on community-based political decision making. In the community which houses the University of Maine, a topic of contention is student rentals in family neighborhoods. The city was attempting to devise a set of guidelines for what would be allowable in the way of rental housing for groups of unrelated adults. This issue was of great importance to community residents. It had equal interest to students. And the problem reflected many of the characteristics of local policy making: need for data, need to be familiar with what other communities have done, and need to know what various policy options might be.

Dr. Glover designed with community planners a set of service learning activities that would align with the content of the course, would meet the needs of the community for data which could otherwise not

be met, and would greatly interest students. The final presentations to the city council demonstrated to councilors the breadth and depth of the student understanding of the problem and possible solutions.

What this example reflects is the importance of the faculty member, in effect, being able to think in terms of a Venn diagram: what do the students need to learn, what would interest them, and what does the community have as a pressing concern. The skill of the faculty member is not to be underestimated. As an aside, Dr. Glover was recently honors as a Lynton Award finalist for an untenured faculty member doing the most creative work in the scholarship of engagement.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 5: 'I know it can be helpful to tap into ongoing streams of activities but I can't imagine how to do this'

Service learning can be most effective when it is not 'stand alone' but is embedded in ongoing significant large scale problems that have drawn the attention and interest of an institution and its partners. Students then see firsthand that the service learning is not "make work" and that their discipline has important resources that can be brought to bear in solving complex problems. Finding such topics can be challenging for faculty but the rewards can be great. Streams of opportunity for service learning may result.

Universities in three New England states have identified one such emerging, timely problem: what to do about the dams on the region's many rivers? Dams have held a prominent place throughout the region's history. Many of the major rivers were dammed in order to provide power for the mills that would become central to the region's economic growth. At the time the dams were built, little was known about the ecological impacts these dams would have: how they might disrupt the migrations of fish and in other ways impact the ecology of the region. Now many of these dams are up for licensing renewal and policy decisions must be made about how to weigh the complex issues related to their future. Together, faculty in a host of disciplines (i.e., ecology, engineering, economics, communication, geographic information systems) are coming together across the three states to envision how different disciplines can contribute to an integrated approach to working with stakeholders to assess the viability and present and future impact of dams.

The service learning opportunities are rich: students from different disciplines are able to work on a project that combines stakeholder engagement, interdisciplinary exposure, and problem solving that is of great importance to the region. By integrating students into such projects through service learning, students can be given the opportunity to see all the elements but are able to experience them in a graduated way that aids in their learning while also assisting the community.

Such service learning opportunities can be especially valuable to students. Consider another New England example of complex problems that could serve as important service learning opportunities. New England faculty who specialize in the study of infrastructure (roads, bridges, culverts and the like) are coming together with faculty who study climate change to identify ways that together their disciplines can build models that have greater value for stakeholders such as those who design roads and bridges and who must do planning for New England's infrastructure under a variety of climate change scenarios. Service learning opportunities for students in a variety of disciplines are being envisioned that would increase the reach of the project while at the same time providing students with complex learning opportunities that would otherwise not be available to them.

Going Forward:

- Are there ways that you might adapt some of these ideas for the geosciences?
- Which parts could work for you?
- What opportunities exist in your area or region?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 6: 'But My Students are Just Starting to Learn. What do They Have to Contribute? And How Do I Find a Topic that is Right Sized for Where My Students are in the Learning Process?'

As in all teaching, there are challenges in teaching service learning. We have previously mentioned some of these challenges: finding the right partner, ensuring that the service learning deepens the learning rather than distracting students from course content, and matching course content with partner need. It is also important to ensure that tasks are at a level that can be completed by students in the time available and with their level of knowledge and skill and that partners understand this.

Let's consider the latter. This issue is at the heart of the paradox of service learning. We want students to be able to contribute to problem solving but yet they may be early in the process of learning and not yet have all the skills and knowledge in place. Indeed, that is often why they are enrolled in a course. Yet in service learning contexts, partners might expect that the students can do things they can't do and are prepared with a knowledge base they don't yet have. At the same time, community partners rightly object to serving as a laboratory where they are training our students but getting little out of this for their community. Service learning can founder on these mismatched expectations if efforts are not taken to prepare for them and address them.

One strategy we have used to address these problems is to develop what we call a 'Request for Partnership.' This is a form that we send out to potential partners well before the course to solicit partnership interest. This brief form, sent to targeted groups, describes the focus of the course, what students will be learning, what skills base they will be acquiring, and what level of involvement the students could bring to tasks. Our expectations are stated for what students could do for partners and what partners would be responsible for doing. Potential partners send this back with ideas for projects for which they would like student involvement.

An example of where we have used this approach is for a course on geographic information systems (GIS). Students begin the course with no knowledge of GIS. At the end of the course (but not until the end), they are expected to be fully conversant with using GIS. Prior to the start of the course, we sent out "Requests for Partnership" in which we described the focus of the course, what students would learn throughout the course, and how the students might work with partners in the urban community surrounding the campus. The 'Request for Partnership' was sent to housing agencies, police and fire departments, planning agencies, and the like. Many of the agencies had great need to be able to map their data and relevant public data but had not yet had an opportunity to learn GIS and identify ways it could be useful. The 'Request for Partnership' alerted them to what students were learning, why the students—many of whom would remain in the community after graduation—were important assets, and how the agencies might move forward in learning about contexts in which they work.

Over time we have found that this 'Request for Partnership' approach serves many unexpected goals. It helps us as instructors to do the reflective practice we expect of our students: we ask ourselves what we hope they will get out of the service learning, how should the service learning deepen student learning of the materials, what is an appropriate level of participation to expect and how do we engage appropriate partners. The approach is also designed on the platform of 'Request for Proposals' used by granting agencies such as foundations and federal agencies so that the instructor and partners obtain experience in thinking in grant terms that may be useful as the work goes forward and funding is needed to support it. This approach helped partners see that they were getting a resource (just like with grants) and that there were expectations on both sides. This approach, we have found, helps students see that this is a serious endeavor and that they are entering into a contract of sorts for bringing their learning to bear on problems that make a difference for the community. The students reported that they learned the importance of the skill, the complexities of using the skill, and the community of partners interested in strengthening their approaches to accomplishing their goals. This approach also helped students see that the delivery of a product and a final report (just as with a grant) is important.

Going Forward:

- How might you draw on these ideas for a service learning project in the geosciences for students in the early, middle, and late stages of their educational training?
- Which parts could work for you and your context?
- What content in your discipline might lend itself to such an approach?
- What obstacles and barriers would you foresee and need to overcome?
- What would be your next steps to innovate around this example so that something similar could work for the geosciences?

CHALLENGE 7: 'My Goal to Ensure My Students Develop Deep Knowledge of the Discipline. How Do I Keep Service Learning from Watering Down The Development of Complex Knowledge?'

Service learning faces the danger of being superficial and short-lived when it is not embedded in complex ongoing activities and continuing initiatives. The startup costs can be high and impact from the effort can be low. Successful efforts look for ongoing opportunities that are not created just for the

purposes of service learning and bring a depth of opportunity. What these look like will vary by discipline, institution, and community. They can be tied to cutting edge work.

Consider an example from New England. New England is a watery place: this includes the ocean, of course, but also many lakes and many rivers and streams. Water resources are in abundance. Many campuses have been working individually and together on water problems: pollution to coastal beaches; heightened pollution of lakes from pesticides and other runoff; declines of fishing populations resulting from the damming of major rivers in the region.

Many ongoing projects have been undertaken as a part of the New England Sustainability Consortium's (N.E.S.T) multiyear initiatives on The Future of Dams, and Safe Beaches and Shellfish. A key aspect that these stakeholder-engaged, solutions-focused initiatives share in common is a focus on development and use of decision support tools. The projects work with stakeholders to look at the kinds of decisions they are need to make (the need to integrate economic, environmental, and engineering data, for example) and work to devise strategies for data to be combined to help in making these decisions. Teams that include students are then involved in devising ways to create information tools that help stakeholders in their decision making contexts.

Such an approach provides highly useful tools for partners facing complex information contexts, and through service learning projects students can able to be a part of the development and implementation of such information tools. Students are working as part of a team and can experience first-hand where the disciplinary knowledge fits in and the importance of the disciplinary research. And the tools do not just "sit on the shelf." Students can see the gap between researchers and stakeholders reduced. Students can even envision jobs they might fill upon graduation as they see the various roles being played in problem solving.

The development of decision support tools is far from being limited to a single discipline or a single project. Students have become involved in the development of decision support tools for assessing the viability of community solar projects, as a part of a beekeeper mapping project integrating pollinator information with landscape features, and as a part of an alternative futures project that puts together complex information about land use alternatives so that the information can be used by a broad range of decision makers seeking to envision the future consequences of various types of contemporary land use decisions. The opportunities across disciplines have been broad.

Instead of service learning moving away from the difficult questions and creating superficial and simplified approaches to disciplinary questions, service learning can point out many gaps that need to be bridged: how to bring together different kinds of information, how to bridge gaps between knowledge and application, how to bridge gaps between the perspectives of people working on the problem. Students can even better understand the gap between what they currently know and what they will need to know for the kinds of jobs and roles they see might be available upon graduation and that they could aspire to fill.

Going Forward:

- How might you use these ideas in the geosciences?

- Which parts could work for you?
- What opportunities exist in your discipline for decision support tools?
- What obstacles and barriers would you need to overcome to create service learning opportunities on this topic?
- What might be your next steps?

CHALLENGE 8: 'But My Students Have Busy Lives and Don't Have Time for Service Learning'

Some have assumed that service learning is viable only for students who have substantial spare time, have few family or work responsibilities, and have assets such as vehicles that can be used to get them to service learning sites that are some distance from campus. One faculty member teaching at a campus that drew mostly mid-life low income adults with many family responsibilities told me that one of her students taking part in service learning with high school students lamented that she was unable to devote the same time helping her own children develop the academic skills she was working to bring to the youth in the school that was the focus of the service learning initiative. The very college students who have much life and work experience to bring to service learning may struggle with classes with service learning expectations that aren't as fixed in time as a simple lecture course might be.

There are opportunities for being innovative in ensuring that as we move service learning forward the practices work for all students. Might the students be able to do the work closer to home? Might face time requirements be reduced? Can out of class time responsibilities be reduced? Can work in groups be designed in innovative ways that reduce students' additional time responsibilities? Are there innovative ways to more closely link the service learning to the content of course in order to reduce the time needed? Could work across courses make service learning more time efficient?

In a course on community problem solving, we focused on efforts on problems with the availability of child care because we knew that this issue was important to our nontraditional students and to the community. The students did a host of service learning investigating assets and barriers to service provision and led a public forum on strategies in a diverse community for arriving at child care resources that meet the needs for diverse families. Courses in electrical and mechanical engineering sought to include service learning that were more closely aligned to course content: students worked with housing agencies to identify how low income apartments could easily be retrofitted so that all aspects of the apartment could be monitored by voice commands by wheelchair using residents. Transportation engineering students investigated how streets and sidewalks could be made wheelchair accessible and what kinds of engineering changes would be needed. Faculty in engineering were innovative problem solvers imagining how the problems in the community might be approached in ways that would call on what students were learning in all of its complexity.

What works for other disciplines will not be the same as for the geosciences. The overall example is relevant: Faculty in particular disciplines can seek out service learning opportunity that link directly to course content and stretch students to use/apply the content in ways map onto community needs and concerns.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 9: 'But My Classes are Too Large. I can't see how I can possibly do Service Learning'

One assumption that many people make is that the kind of hands on teaching that service learning represents can only be done in small classes and thus is rate limiting. Under this assumption many classes would not be ones that could include service learning. They are simply too large for a high quality service learning experience to happen: too many students, too many partners, and too many moving parts.

We have witnessed service learning be a successful part of large courses. Innovative faculty problem solvers are needed to develop such courses but the result—in part because so many students are reached—can be high impact and high visibility for service learning.

An example is work done through the Campuses for Environmental Stewardship Program that has initiated a program in which faculty teaching a range of undergraduate courses in disciplines as varied as anthropology, communication, economics, media studies, and nature-based tourism work together to incorporate into their individual courses service learning on themes related to sustainability. Dr. Bridie McGreavy, UMaine Assistant Professor in Communication and Journalism, used this as an opportunity to take an introductory level communication class with over 200 students and engage them in service learning initiatives all linked to Maine's Penobscot River Restoration Project. This high visibility, high importance project involved many different groups engaged in communicating about many different issues regarding the Penobscot River. Speakers to the class—including representatives of the Penobscot Nation and the National Oceanic and Atmospheric Administration—helped to inform the class of the issues. Students then worked in groups with stakeholders to develop rich, detailed, complex communication materials (including print and social media) in ways that called for using all of the skills and intellectual knowledge they were learning in the course.

Dr. McGreavy was creative throughout: looking for ways to manage the size of the tasks, having students work in carefully constructed teams, and having them work with known partners. This all built on existing partnerships so there was a base to build on and not everything had to be created anew. Much innovative thinking was still needed but the results were powerful: partners reported how useful this was to them and the students reported that the experience deeply impacted how they think about their discipline and their future. Among the student responses regarding the impact of this course:

> "I learned a lot about dams and the Penobscot: risk communication, science communication, public speaking and applying science theories to communication."
>
> "I can speak for all of my group members when I say that we all learned to collaborate more effectively through this project. We were able to focus all of our attention collectively to take a

smaller part of what we have been learning in class and magnify it to show how all aspects of our project were related."

"I had no idea that the campus was even on the Penobscot, so to learn about how far the river has come and how it's still improving is awesome to know about and see."

"The most fulfilling part of the service learning project was the knowledge that I gained about an environmental issue within my community. I have lived in Maine my entire life, and I had not heard about this project until now."

And the collaborating faculty in the UMaine Campuses for Environmental Stewardship project are now working on a cross-case comparison of their various service learning models and how these different models connect with student learning outcomes. They report that sharing models, curriculum strategies and insights across their courses and learning from each other's experiences has been a very valuable.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 10: 'But My Courses are Online: I Guess I can't do Service Learning'

Service learning is generally promoted as a face-to-face activity, as something that is linked to place and placed-based contexts. As an increasing number of courses are taught online, we have opportunities to think about how service learning can be brought into this arena and not seen as something that only takes place in face-to-face courses. This is important not merely because courses are going online but because the problems best linked to particular disciplines may not be nearby. Many are doing this in other arenas. 'Meet the Scientist' programs are examples in which young people through the internet are able to meet scientists working in the Antarctica, for example. The National Science Foundation wanted STEM students to learn from astronauts but found, of course, that there were too few astronauts to go around (and some weren't particularly good at this mentoring). NSF supported programs to create, in effect, online astronaut avatars, for students to interact with and the evaluations indicated that this strategy that reached many more students were able to have 90% of the impact of interactions with real astronauts. The lesson NSF learned is that we shouldn't try to get to 100% if we can get nearly then at much less cost. Can we take lessons from this for service learning in online courses?

One strategy that met with much success was developed in an online course (this one happened to be on stakeholder-researchers partnerships with students from 15 different programs). The course was designed to teach all of the literature on research partnerships and how they are conducted in different disciplines. When the course is taught face-to-face, students typically work with partners to develop an understanding of their needs for research and collaborations with higher education institutions and

practice providing this information. The question was how to transform this service learning when the course was taken online. Keeping in mind the goals of service learning of having students learn and serve and reflect back, what was done in this course was to create a free online workshop available to anyone on a certain date. The students had to do nearly all of what they would have done face-to-face: integrate recommendations from the literature with what potential partners were indicating as important. Design inviting exercises that would meet workshop participants' needs and show that the students deeply understood what they had learned and how it might be useful. In the evaluations students reported that putting together the workshop very much helped them understand the complexity of the information, see how it could be used, and understand strategies for make the information useful.

We have used similar approaches in specialized courses that are offered online because their content is such that relatively few students in any one location will be likely to enroll. A course "Research Ethics with Underserved Groups" is an example of one such course in which students from throughout the United States enrolled. The service learning portion again was organized around a workshop offered near the end of the course and designed to meet the needs of partners while enabling the students to use all of the information they learned in the course. Participants signed up from around the world and included participants from Australia and various other countries. The students reported that they worked harder and integrated the information much more thoroughly than if they had simply been learning the information just for themselves.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 11: 'But Many Problems Are Bigger than my Discipline and Need Interdisciplinary Approaches and I Don't Know Where to Start'

Many problems--what are increasingly termed 'wicked problems'—can be addressed only through bringing together perspectives from multiple disciplines. Such problems benefit from a service learning approach. Yet having disciplines come together is challenging. One approach that is increasingly being considered is one that looks for programs on campuses that already have an interdisciplinary structure to which service learning could be added.

One such example is Honors. Many campuses offer undergraduate Honors programs that bring together students from many disciplines in cross learning opportunities. Many Honors programs also require that their students complete Honors theses which can be opportunity for incorporating service learning. Some Honors programs are investigating how to build service learning into their rigorous academic programs.

At University of Maine, for example, faculty members from across the university were hearing from community partners that a whole host of food issues were becoming pronounced problems in Maine: hunger, food costs, pesticides in food, and collapse of marine fisheries. At the same time, new food related opportunities were emerging: a rapid increase in young people choosing to make a lifestyle of organic farming and seeking out other food-related careers. Partners began seeking out the university to assist in analyzing and thinking about strategies for addressing these problems and exploiting these opportunities.

The Honors program is becoming a place for developing service learning opportunities that take on the tough challenge of connecting student research with partner needs. This has been far from easy for a program that prides itself on the rigor of its' academic training. The worry was that 'the tail was wagging the dog', which is to say that, in the effort to meet the needs of the partners, the academic goals might be undercut. There have been continuing efforts to test out different ways of achieving an appropriate balance.

Honors students in the past have done individual projects but through this effort, called the Sustainable Food Systems Research Collaborative, faculty and students are working together to connect individual projects and problems so that there is continuity across the different projects and disciplines often with common partners. They are modeling ways to build a systematic, rigorous interdisciplinary approach to connecting service learning with demanding intellectual content.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts of what the Honors program is doing could work for you in your context?
- What opportunities do you see for such interdisciplinary collaborations that would involve the geosciences?
- What obstacles and barriers might you encounter and need to overcome?
- What would be your next steps?

CHALLENGE 12: 'But This All Seems Overwhelming to Do This by Myself. What Kinds of Support Structures Do Campuses Have?

The challenges mentioned with regard to service learning frequently concern startup barriers: how does a single faculty member find partners, how does the faculty member begin to learn about community interests, how does the faculty begin to start to build a relationship with identified partners, how does faculty member learn about everything that has already been done so as not to duplicate past efforts. The challenges can seem insurmountable.

One strategy that has sometimes been used—either with deliberate forethought or as a gradual development—is to have one or more persons within a department, a college, or a center become the facilitator of service learning efforts and partnerships.

Consider Bowdoin College's Environmental Studies Department. The department has a long tradition of involving students in environmental projects that have service learning elements. Many of these

projects are focused on the Kennebec River that is near the campus and has long suffered the impacts of environmental damage resulting from a long history of industrial development in the form of mills and dams designed to power industrial sites. Many different aspects of the Merrymeeting Bay estuarine area can serve as the locus for work on various environmental issues. Bowdoin's Environmental Studies Department had the resources to create a position where the responsibilities included linking students and courses to projects and opportunities related to the Kennebec and other regional sites.

The benefits of a central person are significant: such a person can facilitate and coordinate efforts, can assist in a campus not overwhelming partners through uncoordinated research, and such a partner can enable projects over time to build on each other. Large scale issues can be broken into manageable pieces that can be addressed across a set of semesters. But this role, best imagined as some combination of facilitator, innovator, and inventor, is far from a familiar one on most campuses. Eileen Johnson served as a staff person in Bowdoin's Environmental Studies Department assisting students in developing service learning projects in their courses. Eileen Johnson is now Dr. Johnson after having completed her dissertation as a part of the University of Maine Sustainability Solutions Initiative investigating how stakeholders and researchers could be brought together to collaborative around the problems of two of Maine's rivers including the Kennebec. Her dissertation work has served as the backbone for the approach now used to involve students with partners, doing so in ways the involve students in real problems that matter to the community, that link to the deep structure of the curricular content, and that engage student interest.

Many campuses are not fortunate enough to have resources to have a dedicated person whose role is to support and facilitate service learning and partnership development within or across disciplines. A body of work is now emerging that looks at organizations that have been labeled 'boundary spanning' organizations that can assist to bring groups—such as universities and community partners—together to solve problems. Boundary spanners can be groups or they can be individuals, but the basic characteristic is that they are adept at working across differences and creating and using opportunities to bring diverse groups together. For those of us at under resourced campuses and who work with under resourced regions, investing in learning about boundary spanning organizations can be an important step.

Going Forward:

- Are there ways you might you apply these ideas in the geosciences?
- Which parts might be relevant to service learning in the geosciences?
- What opportunities exist in your discipline for preparing individuals to fill a role of strengthening and linking service learning opportunities?
- What obstacles and barriers would you need to overcome to have such an approach be workable?
- What would be your next steps?

CHALLENGE 13: 'But My Students Won't be Staying in the Area—Can They Use What They Learn?'

Much of what we do in teaching comes down to assisting students to learn general principles but also to arrive at a firm understanding of the complexities of individual contexts. We want students to engage in place-based activities but to understand that places differ. For many students, they will not spend their

lives where they carry out their college service learning. For many, they attend college in one locale and then they graduate and move elsewhere to some place that could be vastly different from where their college is located. How then can service learning be an aid to helping students master the key concept of contextualizing knowledge?

The reflection practices in service learning can focus on this. We have discussed how important reflection practices are to effective service learning. Here is should be noted that faculty who are successful at designing effective service learning are often themselves engaged in reflective practice. They become reflective practitioners, looking at what worked and what did not and designing the service learning to take into account the multiple goals of service learning. Reflective practice will be fundamental to success.

Some very interesting work on wind power that involves service learning is being done on islands in Maine by Dr. Anna Demeo, a faculty member at College of the Atlantic. Dr. Demeo's mechanical engineering doctorate at the University of Maine focused on wind power issues and she is now able to involve her students on projects related to the viability of wind power for island communities struggling with very high electrical costs. Students in her courses are unlikely to live on Atlantic islands when they finish their degree. What they learn must be tied to the dynamics of the coastal communities; at the same time what they learn must be transferable to contexts and situations that differ in many ways from what would be found in isolated communities in the upper Atlantic.

In other places the problems may be unique to a confluence of things which may not be replicated elsewhere. For students involved in service learning a challenge is to help these students became deeply immersed in the specific context but be able to attend to the general principles and thing about how they would apply elsewhere. A number of years ago, the town of Portland Maine suffered a devastating fire of a paint factory. At that time the paint was lead-based. A tremendous amount of lead-contaminated ash was the result. Because of the large volume that needed to be dealt with, community leaders followed standard practices then in effect. They spread the ash throughout the community on all of the soil. Look ahead decades and residents are now being encouraged to do community gardening in their urban neighborhoods and backyards. One of the areas for community gardens is adjacent to low income housing, many residents of which are new immigrants to Maine and who are eager to garden. Faculty and students from the University of Southern Maine have become involved in soil remediation and community education programs to assist people in understanding soil contamination and what to do about these situations. The confluence of events in the Portland case are unlikely to be exactly replicated elsewhere and the specifics of the service learning are unlikely to directly transfer.

The challenges of urban soil contamination in immigrant communities or island power are not ones that every place will have. What becomes important in service learning is finding ways to teach students to bring to bear general principles they are learning in classes but apply them to specific situations. And it is important to help them learn to consider how they would use these ideas in other contexts having different characteristics. Many faculty have found service learning well suited to making salient these questions of context, discipline, and shared learning. Service learning is useful in part because it provides a window into the complexities of taking the general principles articulated in the classroom and

applying them in real world situations. In the end, service learning can help students move back and forth between the general and the specific.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 14: 'But How Do All These Parts Come Together?': Bringing It All Together in Team-Based Approaches

Ultimately it is important that students learn to see how all of the pieces fit together: different courses, different bodies of research, different disciplines, and activities across semesters. It is important that students come to understand that what they are doing is part of larger set of activities and issues. They need to learn that a part of work is "handing off the baton"—understanding that one will be carrying out activities for a while and then one will need to help with the transition so that others can pick up what one has done and continue and expand the effort. Course by course learning rarely provides undergraduate students with experiences that develop this understanding. Service learning can be important to the emergence of this understanding.

Some projects can be particularly well suited to opening up vistas for seeing the need to bring all pieces together. The lakes of Maine are under considerable stress. Lake quality is declining as a likely consequence of multiple stressors: rapid shore development, changing land use practices in the watershed, and changing climate. But not all lakes are showing equal degradation even under relatively similar stressors. The chemical composition of the soil and rock conditions of the lake basins vary considerably and need to be well understood to assess likely impacts of increasingly prevalent stressors. The Lakes Environmental Association (LEA) in Maine is building partnerships with many local universities to strengthen the knowledge base about Maine lakes and involve students in this work. LEA is taking the step of hiring a Research Director whose responsibilities will include linking different efforts, identifying needs for research, and finding ways to ensure that the research is done in done in ways that are useful to maintaining the quality of the lakes. An important focus is creating new lake monitoring systems and new sensor systems that will provide information that can be made available to a broad array of partners: those who live near the lakes, those who use the land in the watersheds near the lakes, and city and state officials who have responsibilities for monitoring the lakes and implementing various rules and regulations. Students have been involved in much of this work through service learning projects and active attempts are being made to ensure that students see the larger picture and the ongoing issues.

These efforts are spawning a host of opportunities for student involvement and as the questions continue to change there are new opportunities for students to see the ongoing nature of the work and the ways that their disciplinary service learning is contributing to a larger picture and the building of knowledge across time and disciplines.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What opportunities exist in your discipline?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

CHALLENGE 15: 'How Do I Bring All of The Goals Together and Do So In A Way That Calls Attention to this Important Service Learning Work?'

The ultimate struggle in service learning is that of locating a focus that matters to the community, that links to the content of the course, that is at an appropriate scale, and that comes at a time when students could be involved (not too early in the semester and not at the end). Often it will take innovation and problem solving to identify and connect to such opportunities. The possibilities are not always self-evident.

An important approach that some faculty have found to hold promise is tapping large scale community events, festivals, and convenings. These often have high visibility and are flexible enough to provide opportunities for multiple forms of service learning from different disciplinary perspective. And they often matter to the community and have community ownership. As an additional benefit, festivals and similar sorts of events are often magnets for publicity and so can be a way to bring visibility to the important service learning efforts of students. Consider, for example, the Southeast Asian Water Festival that recreates along the Merrimack River in Lowell, Massachusetts the celebration that has long been central to communities along the Mekong River in Southeast Asia. Lowell is now home to the second largest Cambodian community in the U.S. This annual event brings together diverse groups to highlight important issues. The planning for the event occurs year round and has served as occasion to raise questions about water quality on this highly industrialized river and involve students in projects related to water quality. The occasion has been an opportunity to investigate history and bring students into investigating and sharing information about the history of the two areas. The occasion has been an opportunity to investigate traditions of fish consumption and to involve students from health programs to consider how to gather and share information about fish consumption and fish advisories. And these are just a few of the many examples of how different classes and disciplines have been involved. Faculty in philosophy, music, and education have all found opportunities to involve their students and create service learning opportunities.

Knowing enough about the community to be aware of such opportunities can be challenge, particularly for new faculty. Some faculty are fortunate to be a higher education institutions that have an office that supports such work. Many are not. Some universities are trying out innovative strategies for jumpstarting the knowledge, doing so in ways that can contribute to partnerships and service learning. University of Massachusetts Lowell started a process early in the academic year in which new faculty were invited to meet potential community partners by coming on an around town bus trip. The bus stopped at partner location, faculty visited the potential partner and learned about opportunities. The partner then came on the bus with the faculty. Each stop was an opportunity to meet new partners who then joined the faculty on the bus. The end of the tour was a hosted meal together at a downtown

location where discussions of service learning opportunities and partnership opportunities were the focus of the discussion. Most new UML faculty do not live in the community, are not originally from the area, and have limited knowledge of the downtown and thus the event helps to begin build understanding and knowledge. UML is not alone in doing things like this. University of New England, which is on the Saco River Estuary and the Atlantic Ocean, has engaged in a similar effort tied to place that bring faculty and potential partners together. Their "We Are All in the Same Boat" has taken faculty and community leaders out on the Estuary and up the river to show firsthand the kinds of challenges to the river that are arising from development, industrialization, and recreation. The facilitated boat ride has served as a way for faculty and community partners to see how they might come together to address problems such as involving students through service learning.

Going Forward:

- How might you use these ideas in the geosciences?
- Which parts could work for you?
- What obstacles and barriers would you need to overcome?
- What would be your next steps?

A Few Additional Comments about Using the Examples: The fifteen challenges have been used to highlight some of the complexities you might encounter as you undertake the work of building effective service learning into your geosciences courses and curriculum. The discussion of each challenge outlines a strategy people have used to meet that challenge and to create effective service learning. The 'Going Forward' questions are intended as aids for using these examples to innovate in ways that will work for the geosciences.

As these examples suggest, these challenges will often require resetting of expectations: yours', the partners' and the students'. This might include resetting your expectations for how learning can be organized when you move beyond the traditional lecture approach, resetting student expectations about what happens in a course when it extends beyond the confines of the classroom, and resetting partner expectations for ways students can be involved and contribute. When things are changing fairly rapidly, people often come to the situation with expectations from earlier experiences that may no longer hold. Reflecting on the change can be important. We have pointed to the importance of the reflection process on the part of students as a key part of the learning. It is also useful to note that the reflection piece can be equally important for the faculty member and the community partners. Such reflection might be less formal for those others than for the students, but becoming what Donald Schon (2008) has termed "The Reflective Practitioner" will be central to the continuing growth and refinement of service learning approaches and initiatives.

As these examples also illustrate, it will be useful to learn how to seek out unexpected and emerging opportunities. Sometimes the opportunities will come out of the blue. In the Gulf area Hurricane Karina and the BP Deepwater Horizon oil spill led to the rapid need for problem solving from many disciplinary perspectives. In Maine, the rapid, dramatic, and largely unexpected collapse of the fishing and forestry industries is creating much need for new problem solving. New opportunities for service learning may emerge in unexpected ways that provide important disciplinary opportunities. Researchers will not

automatically think about what kinds of service learning opportunities might be available in their research work that has built collaborative potential with many partners. Community partners won't automatically think about how the kinds of complex projects they are immersed in could be important opportunities to bring student skills and energy to the task. It will often take you as the faculty member who is aware of what you are trying to achieve in the classroom to envision innovative ways that the different goals of the partners and the learning experiences of the students might be brought together.

Looking Forward and Next Steps

The overarching goal of this paper has been to highlight the importance of service learning, illustrate how other disciplines have undertaken service learning, and suggest some of next steps to be considered as you work to incorporate this approach into your discipline. Greater integration of service learning into the geosciences will ideally (a) bring more students into the geosciences, (b) bring diverse students into the discipline, (c) assist students in seeing and working with the complexity of problems, (d) integrate place-based approaches into service learning, and (e) effectively engage with and meet the needs of partners.

As we have seen, service learning is a means of moving beyond past approaches to campus volunteerism and service. The forms of engagement represented by service learning do not neglect giving back to the community (the community writ large, in all its varied forms), but the focus is on creating pathways for students to envision how what they are learning can contribute to solving problems, thereby enriching the community and strengthening student learning. The discipline and the content are not a happenstance but are central to what is undertaken. This approach moves beyond 'noblesse oblige' where the assumption has often been that higher education from its position of privilege can deem to give something back to others, yet often without any true ties to the central knowledge mission of higher education. The service learning approach requires us in academia to keep thinking about our knowledge function: what are the problems that matter to people, problems that are tied to our discipline and that, by having student tackle them with partners, will strengthen student learning and perhaps could even impact the discipline itself. And service learning, unlike service, is fundamentally bidirectional: students learn from the community and the community learns from students. Everyone gains when service learning is done well and with care.

Resources for Building on What Has Been Discussed Here: There are many resources that can be helpful as you move toward incorporating service learning into your teaching. It is useful to start with the literature that is specifically focused on service learning but it will also be important to tap into other resources. These may not speak directly to what should be done in geosciences service learning but they do provide overarching lessons and ideas that are likely to be helpful. Below are just a few suggestions of where one might start (please see the attached resource list for relevant article and website).

- **Relevant Literatures:** There are growing literatures such as on boundary spanning that investigate issues relevant to strengthening activities such as service learning. In the boundary spanning literature, for example, individuals and organizations that serve the role of bringing groups together and helping groups find common ground. This body of work is suggesting how

boundary spanners can help to strengthen partnerships that are solutions-focused and bridge research-action divides.

- **Campus Entities with Long Histories of Doing Work Bearing Some Similarities to Service Learning:** Many campuses have entities that have done outreach, engagement, and sharing research with broader communities. Although their work differs in important ways from service learning, an in depth look at some of their work can provide important ideas. Cooperative Extension offices at Land Grant Universities are examples. Cooperative Extension offices at land grant universities have long been in the business of bringing university research to the community. While one will not find the work couched in the terms of service learning, there is much to be learned here about strategies for involving students, building partnerships, and sharing knowledge with diverse groups.
- **Organizations and Movements Bringing Together Universities and Community Members:** Citizen Science is just one example of the movements emerging nationally and internationally which are focused on ways that scientists and citizens can come together to productively solve problems by doing research together. Many ideas for service learning projects could be developed from reviewing the rapidly growing literature on citizen science.
- **Toolkits:** Many toolkits are now available on service learning. They are intended to provide guidance and give faculty a head start and their begin their effective to develop effective service learning. One such example can be found at: http://www.eastfieldcollege.edu/Assets/ServiceLearning/faculty-toolkit-for-service-learning.pdf
- **Websites and Searching the Web:** There is a growing body of information on the web about service learning and related activities. Indeed, much of the most up-to-date information about service learning is appearing first on websites. A growing number of websites are devoted to or include service learning information, including the websites of Campus Compact and New England Higher Education Resource Center.
- **Conferences:** Increasingly national and international conferences are taking place that provide information on activities that relate to service learning. These include conferences by such groups as the Citizen Science Association, Canada's CUEpo, Community Campus Partnerships for Health, Engagement Scholarship Consortium. All host annual or biannual conferences that provide opportunities to learn about the newest activities related to service learning.
- **Journals:** There are new and existing journals devoted to service learning and related issues. Just a few examples include Journal of Community Service Learning, Michigan Journal of Community Service Learn, Journal of Experiential Education, Journal of Service Learning in Higher Education. Articles that include discussions of service learning are increasingly appearing in many disciplinary or topical journals.

And as we look to strengthen service learning, we should not overlook resources that might be hidden in plain sight: alumni, for example. When we are looking for boundary spanners, they might be graduates of our programs who went on to positions that involve the very complexity we hope our students will be prepared to address. Alumni might both provide entrée into intriguing problems and be aware of some of the ways that what they were taught might have been enriched with particular kinds of service learning. And you may find it helpful to look closer to home. Consider what your campus is doing that

might be turned toward service learning. Consider your campus's strategic plan. Are there indications in such planning efforts of how service learning might support the goals of the university? University of Maine's aspirational goal, for example, is that the campus will become the most community-engaged research university. In other words, look for opportunity points.

Resources can also include funding sources. Some of the examples used in this paper to illustrate service learning that grew out of opportunities created by grants aimed at investigating urgent and emergent problems. The grants themselves did not fund the service learning but often what the grant did was to create opportunities whereby service learning linked to undergraduate majors could be pursued in the context of a program of research or an ongoing partnership. Funding that provided the opportunities that led to some of the service learning projects described in this paper came from federal agencies as varied as the Housing and Human Services, National Science Foundation, National Institute of Health, National Institute of Environmental Health Sciences, Department of Education, and the Environmental Protection Agency.

And Keeping in Mind the Centrality of Innovation: Finally, in seeking diverse sources for advice, it can be helpful to be innovative in seeking out ways to find ideas. One of the strategies being explored by some who have begun to incorporate service learning into their teaching is to employ the online method of crowdsourcing to ask for advice on ways to solve service learning problems. The idea is this. At present faculty sometimes try service learning in their courses but then encounter problems of the sort discussed in this paper. The faculty then might turn to others around them and ask what they should do but their small network may not have an answer. Most people's networks tend to be small. With crowdsourcing that network can be greatly expanded. A service learning problem solving website could be created in which a "problem" (such as the challenges described in this paper) is put up on the web and people are invited to offer a solution. Such an approach might be an avenue for starting to generate new ideas about how to solve some of our service learning problems and continue to strengthen this important form of learning.

Ultimately, the emphasis will need to be on innovation if the full value of service learning is to be realized in ways that align with the aims of the discipline. While we know the basic dimensions of what service learning is intended to do, we also know that, like all teaching, much innovation will be needed to ensure that the service learning you implement is effective for *your* discipline, *your* courses, *your* campus, *your* students, *your* settings, and *your* partners. Every one of these element can vary from one place to the next so it will not work to simply adopt what worked elsewhere. Your service learning approach often must be transformed to work in your context and with your students. As with all of the most effective kinds of teaching, service learning must always be customized and adaptive.

If we succeed in making these changes, there will be many indicators that success has occurred and we have moved to a new era. Consider familiar short hand phrases that could disappear or become puzzling: people will wonder what is meant by phrases such as 'it is just academic,' or 'that's a part of the ever present town/gown problem.' And the importance of these changes cannot be overstated. President Ana Mari Cauce, University of Washington, is just one of many academic leaders pointing to the need for academic change to address large-scale challenges; Dr. Cauce noted that these challenges "cannot be solved by universities working in isolation. The need for engagement across multiple

disciplines and sectors requires universities to mobilize a wide range of faculty, staff, students, and, importantly, external partners in the search for solutions. This can only happen in a culture that supports risk-taking and embraces working across boundaries" (Hart et al., 2016). And in a public lecture, Canadian sociologist Mark Renaud (2004) pointed to the need for universities to welcome and engage in change: "Universities—Change is Mandatory, Survival is Optional; Choose Wisely."

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