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Workshop on Climate Change Education for the Public and Decision-Makers
v Implications of audience segmentation strategies/reports

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ABSTRACT
This paper applies a broad definition of education to a focus on self-defined groups, as one way of engaging diverse audiences in climate change education. The goal is to construct a method for creating a sustainable impact of education about climate change. It recommends attention to how people learn as they participate in social systems, based on the understanding that a person's "learning" is strongly influenced by affective and motivational factors. A sustainable approach requires that people and their groups have the capacity to make decisions and to take responsibility to assure that they have the best knowledge that is available. Networks and boundary organizations have emerged as an important connector between science knowledge and group capacity. Enhancing skills for making the connection between climate science and society by these groups may be an important goal for improving climate education for target audiences. Implementing a community-based approach requires that educators can identify self-defined groups (communities of place/interest/identity/practice) whose shared concerns and practices form the basis for engagement with climate science and climate-related action; the development of new connections among educators and communities; implementation of strategies for building social capacity among groups; engaging the land-grant cooperative extension system; engaging scientists working in geographically-specific locations; promoting action-learning and knowledge-action strategies; and monitor group capacity to adapt over time.

> *Climate change is not simply an environmental problem that can be addressed by regulating greenhouse gas emissions. It is about human development, social justice, equity, and human rights. It is about human security and the capacity of individuals and communities to respond to threats to their social, environmental and human rights* (O'Brien, 2009).

Climate change education has various goals within and across audiences. This paper will focus on communities as one way of engaging diverse audiences in climate change education, and consider elements such as:

- How self-defined communities – neighbors, co-workers, or members of the same organization (communities of place, interest, identity, or practice) – can function to bring leadership and change in society as it grapples with climate change concerns.
- How scientists and educators can identify and access self-defined communities who want to become informed about what climate change could mean for them.
- What educational and engagement strategies can be effective in building climate change adaptive management capacity among self-defined communities.

While a focus on self-defined communities builds on understandings of how to communicate effectively with specific audiences (Grunig, 1989; McKenzie-Mohr & Smith, 1999), it presents a different emphasis – an emphasis on engaging people in the ongoing pattern of their lives, and on applying education strategies in a way that builds competency for attending to climate change factors in everyday decisions.

Education about climate change serves three primary purposes: to build understanding of why change is occurring, to help people learn how to reduce emissions of climate change gases, and to increase knowledge and skills to adapt to changing climate impacts (NRC 2009 & 2010; NSF 2009, pp. 3, 6).[1] Identification of target audiences and relevant education outreach strategies will vary depending on which of these goals is featured. But in terms of building capacity for social change, the three goals are interconnected. A focus on one without integrating elements of the other two may shortchange our capability to reduce or manage impacts. It is generally recognized, for example, that the best efforts to reduce climate change gas emissions will only lessen the impact of gases already present in the atmosphere, rather than eliminate the impact (IPCC 2007, figure 3.1). Specific sectors will need the knowledge and skills not only to reduce their contribution, but also to manage climate impacts, as well as to anticipate and plan for potential future impacts. In the quote introducing this paper, O'Brien (2009), focusing on change rather than climate, describes an analysis that epitomizes the complexity of the social and cultural transformation required for response to the climate change dynamic. How can education providers and scientists help to build the social and cultural resiliency required for this monumental task?

We know that many Americans are interested in making individual changes, such as an adjustment in their lives for the purpose of saving energy and reducing their own contributions to climate change, but confront critical obstacles such as up-front capital costs or lack of knowledge

[1] Learning topics include: climate change science, causes, potential impacts, and possible solutions; understanding of the level of the scientific consensus about the fundamentals of climate change; fostering an appreciation of the magnitude of the problem; the need for comprehensive risk management involving both mitigation and adaptation; and skills for critical thinking, ongoing situational assessment and analysis of options, and identifying flexible and sustainable approaches (AAAS 2007, NRC 2009).

about what actions to take (Leiserowitz, 2007). Some efforts focus on informing people about climate change (particularly the science of climate change) with the expectation that information will suffice to change beliefs and attitudes, which in turn would mobilize audiences for making changes. But the communication fails to address certain specific obstacles that are itemized by Moser (2010). Moser (p. 36) offers that while "further education and increases in scientific literacy are essential and welcome for many reasons, it is far too simplistic to assume that . . . if these knowledge gaps could be filled and lay individuals somehow could be forced to interpret the findings in a particular way, they would automatically act to reduce their energy consumption and carbon footprint." But certain traits of climate change, such as the invisibility of climate change causes, delayed or absent gratification for taking action, and insulation of modern humans from the environment, make it particularly difficult for educators to develop effective strategies (Moser 2010).

The 2010 climate change education panel is addressing the acknowledged mismatch between education needs and current methods, in part, by focusing on identifying audiences and their specific characteristics and needs. Gardner and Stern's ***Short List*** of the most effective actions households can take is an example of how panel recommendations can be actualized for a particular audience (2009). Clarifying the link between audiences and strategies will inform educator response to the so-called attitude-behavior gap (Moser 2010), which highlights a persistent disconnect between people's concerns and attitudes about climate change and the extent of their energy- and climate-relevant behaviors.

Yet to have a more sustainable impact, "we need to open up the communication process to a wider community, in which participants own the process and content of communication." An emphasis on more interactive forms of communication has a greater chance of supporting individual behavior change, change in organizations, and change in different sectors of society (Moser 2007; Press, 2002). In Fazey's (2010) vision, people need knowledge and skills for how to move beyond their ability to buffer or eliminate climate impacts through technology fixes (e.g. building houses on stilts to reduce flooding impacts rather than eliminating housing in flood plains); for how to build social capacity for maintaining or increasing diversity of future response options (e.g. policies to encourage biodiversity); and for how to enhance the values, skills, and

capacities for people to adapt to change. In Fazey's terms, the goal of education would be "to reduce vulnerability to environmental change by building resilience and improving the capacity of societies and communities to adapt flexibly to changing environmental conditions."

Though likely a sound recommendation, enhancing resiliency and improving capacity are complex goals that are not readily addressed through existing education systems. "Communities" of place (e.g. neighborhoods), of interest (e.g. the Audubon Society), of identity (e.g. specific community faith group), and of practice (e.g. dairy farmers) can serve as bridges that connect individual responsibility, social capacity, and government policy. Self-defined communities have different interests with respect to climate change, but all communities share a concern for their futures. A significant climate change education goal is to ensure that scientists and educators can better understand the concerns and needs of communities and work with them toward effective solutions, and can help these self-defined groups to understand what climate change means for them. Emphasizing the potential in communities may provide the language needed for galvanizing education design efforts; that is, for effectively designing outreach or education that will help self-defined communities become "communities **for**" climate change learning and action.

The following sections of this paper indicate multiple entry points for the educator, from emphasis on the individual, to work with a group, to enhancing group function and capacity. Each self-defined community, for example, will know how best to protect its resources and can achieve conservation and health benefits in the short term from targeted actions. Sustainable solutions may be created when education leads to multiple benefits created by diverse actions at multiple scales – geographic scales (local/regional/national) as well as vertically or horizontally within social and economic endeavors" (Ostrum 2010).

At the individual scale, education can offer opportunities for learning knowledge and skills for making personal decisions such as those mentioned in the Gardner and Stern *Short List* (2009). Potential benefits can be generated, for example, by a household member who bikes rather than drives to work to achieve better health. And at the local scale, education can focus on helping people reduce investments in heating and electricity through better construction of buildings,

reconstruction of existing buildings, installation of solar panels, and many other efforts that families, agencies, and private firms can make that pay off in the long run (Ostrum 2010). But does a successful outcome of climate change education ultimately require that individuals or groups have a sense of participating in *collective* action to reduce global climate change impacts, or can mitigation goals be achieved by encouraging many self-defined communities to act *in their own interest* without emphasizing a broader societal goal? This paper suggests that there are multiple avenues to achieving desired education outcomes that may not rely on a sense of participating in a grander view, although achieving desired mitigation or adaptation outcomes may require multiple groups to move in the same direction.

At a minimum, potential education goals to help self-defined communities become "communities for" climate learning and action must:

- Identify communities of place/interest/identity/practice whose shared concerns and practices form the basis for engagement with climate science and climate-related action;
- Develop learning and action networks of communities and educational practitioners to share successful strategies and leverage progress across communities;
- Achieve some type and level of social engagement and action – behavioral (consumption or adaptive-related action) and/or political (civic action), such as actively supporting particular policies or programs (Moser 2009).

An addendum to this paper provides several examples of current climate change outreach efforts with self-identified communities in Wisconsin, the Great Lakes region, and nationally. Many do not focus specifically on climate change, but instead provide education and support for climate mitigation or adaptation activities. The Wisconsin Rural Energy Program focuses on farm energy education. The Wisconsin Focus on Energy program supports a state *Energy Independent Communities* initiative, coordinating Extension educators who work with communities as they develop strategic sustainable energy plans. The University of Wisconsin Extension Sustainability Team promotes energy-saving community management techniques through online resources and training for municipal officials and staff. The Wisconsin Initiative on Climate Change Impacts targets policy makers, bringing representatives of state agencies, business, nongovernmental

groups, and university experts together to analyze climate impacts in Wisconsin and recommend adaptation strategies.

At the regional level, the Great Lakes Regional Conservation Professional Training program meets the needs of conservation professionals, such as Natural Resources Conservation Service employees who work in agriculture. Training focuses on anticipating and managing ecosystem changes resulting from climate change. The Great Lakes Regional Water Program provides training on climate change education for land-grant university extension professionals who focus on water concerns. Wisconsin and national bioenergy projects are designing training for extension agriculture educators that addresses crop production, agricultural energy conservation and efficiency, and bioenergy and community economic development.

A. Self-defined groups – neighbors, co-workers, members of the same organization (communities of place, interest, identity, or practice) – can bring leadership and change in society as it grapples with climate change concerns.

Few self-defined and established communities are primarily organized around the issue of climate change. But many communities share interests and practices that will be deeply affected by impacts of the changing climate. These interests and practices provide significant entry points for shaping how communities and their individual members think, learn and act with regard to climate change.

Learning science research and behavior change theories are focused on individuals, but support the efficacy of a community-focused education approach, including the idea that people learn by participating in social systems that are structured by cultural tools and norms (Ajzen & Fishbein 2005; Bell et al., 2009, Bransford et al., 1999; Moll & Greenberg, 1990), and that learning involves affective and motivational factors (Ajzen & Fishbein 2005; Bell et al., 2009; Leiserowitz, 2007; Moser, 2007; Vygotsky, 1978). Behavior change theory suggests that when investigating the *likelihood* that a person will perform a behavior (intention to perform), it is necessary to consider a person's belief about what others believe about that behavior (social norms). A person's beliefs about a specific behavior (attitudes) and a person's belief about his or

her own ability to perform that behavior (behavioral control) may also be affected by social and cultural norms (Fishbein & Capella 2006). Wenger's (2000) framework describing different modes of belonging (engagement, identification, and alignment) highlights qualities of individuals and communities that can help connect an understanding of climate change with their personal and shared experience, boosting their collective competence to pursue climate change mitigation and adaptation (Shome & Marx 2009, p. 31, 36).

People who potentially have an interest in climate change mitigation and adaptation are connected with each other in groups that climate educators might identify as primary and secondary audiences (Grunig 1989). Primary audiences are directly affected by, or can take direct action to mitigate or adapt to, climate change. Primary audiences that have the potential to take action about climate change include self-defined communities, such as those listed in Figure 1.

Figure 1. *Communities of place/interest/identity/practice who are directly affected by, or can take direct action to mitigate or adapt to, climate change:*

Agricultural co-ops (farm business and practice)
Citizen science (local volunteers)
Commodity interest groups (auto industry, steel industry, corn growers, distribution groups)
Corporate/association employee groups (engineers, managers, sales)
Emergency managers (local public system managers)
Faith groups
Government associations (towns associations, county associations, state governors associations)
Land use planners and consulting engineers
Outdoor sports enthusiasts (clubs, associations)
Professional associations (water utility associations, civil engineering associations)
Property owner associations
Public and private building managers
Retail suppliers
School or public transportation managers
Utility managers and consulting engineers

Secondary audiences are groups that influence primary audiences. For the purpose of climate change education, these include audiences such as taxpayers, service users, investors, customers, educator discipline groups (e.g. earth science educators), general news and science reporters for media outlets, groups that provide online information, and entertainment media programmers.

How well groups can inform and motivate their members – and ultimately how well groups can develop a learning and action network of communities and educational practitioners to share successful strategies and leverage progress across communities – depends on a wide variety of factors, including members' need for or interest in the group, the group's leadership structure and its effectiveness, and the group's communication efforts and effectiveness. Identifying climate change interests among groups involves assessing these qualities, and implementing group-specific education efforts that may involve building leadership or group management capacity and communication strategies.

Measures of change in group capacity include measures that mark changes in relationships, interaction patterns, linkages and networks, practices, policies, delivery of services, resource generation and use, and institutionalization to sustain changes (Taylor-Powell et al, 1998, p. 111). Taylor-Powell also cites measures of group functional qualities that can contribute to the groups' ability to make changes, including implementation of the organization's goals, leadership, cohesiveness, working procedures, and outcomes (p. 155). Taylor-Powell contrasts, for example, "members indifferent to goals" with "members involved with goals" and "clear working procedures exists" with "working procedures are unclear." The development of "socio-technical capital" (Resnick 2001), which describes benefits built by social interactions that are supported by technical tools – such as via Facebook or blogs or wikis – presents a immediately relevant opportunity to investigate how social interactions encountered in these experiences could be structured to enhance group climate change resiliency.

B. Scientists and educators can identify and access self-defined groups who want to become informed about what climate change could mean for them.

> *To improve public understanding, natural and social scientists must play an active role in the dissemination of their findings about climate change. At the same time, both formal and informal educators must develop new ways to translate this information.* (NAS panel: Informing an Effective Response, 2010)

Implementing outreach techniques that lead to measurable impacts requires a process of task-specific audience identification and assessment, paired with analysis of outreach techniques to identify those that are potentially relevant for that specific circumstance (UW Environmental Resources Center 2008). Identifying and accessing a self-defined group of people for educational purposes may sound simple, but to be effective this outreach step requires self confidence and sophisticated skills. Neither educators nor scientists are skilled or confident with this task. Educators working for public agencies and various nongovernmental groups are asked to implement outreach strategies that have a general impact (encourage the public to reduce their use of water), or are asked to accomplish a specific change (encourage four-wheel recreational drivers to use trails rather than driving off-trail), but educators often have few skills or resources to accomplish behavior change goals through their work. Scientists in higher education institutions have long been required to share their knowledge with the community, but more recently research dissemination has also been emphasized by funding agencies. But there is no parallel advice for how scientists can become effective at outreach or at teaching non-specialists. Many scientists view this public outreach requirement as auxiliary, and also may not feel confident about finding or responding to outreach opportunities (Andrews et al 2005).

Over the last decade, many groups have attempted to isolate procedures to improve the outreach process among environmental scientists and educators. These may serve as a foundation for enhancing the quality of climate change outreach and education. The National Science Foundation's Centers for Ocean Science Excellence (COSEE) promotes partnerships between research scientists and educators and provides tools to make the relationship work smoothly. The Ecological Society of America recently published a special issue of *Frontiers* (2010) summarizing recommendations about effective communication of science in environmental controversies, and providing guidelines for how to enhance the connection between science and society. The University of Wisconsin Changing Public Behavior Project has investigated how to improve educator skills in applying social assessment processes, to assure that their initiatives meet desired goals and to create data for measuring environmental management impacts (Andrews 2008). The National Oceanic and Atmospheric Administration has developed resources to support educators and scientists in investigating the human dimension of an environmental issue (NOAA Coastal Services Center). And a federal, multi-agency effort,

HD.gov, provides an online interactive resource for posting and discussing audience assessment and evaluation strategies.

Networks and boundary organizations have emerged as an important connector (NRC 2009, p. 88; Osmond et al 2010, p. 306). Among other functions, organizations can serve to engage scientists in an outreach initiative. Andrews et al (2005) indicate that most scientists who responded to their survey became involved in outreach through an ***institution-based outreach coordinator*** or through their ***connections with a colleague*** or professor. But these organizations are only as effective as the skills they bring to the task. Enhancing skills for making the connection between climate science and society among these groups may be an important intermediate goal for improving climate education for target audiences.

Boundary (or interface) organizations are defined as organizations that manage and facilitate the interaction between the scientists and the users or managers of a natural resource. Cooperative Extension, a system of scientists and educators coordinated by U.S. land-grant colleges that work closely with stakeholders, is a typical boundary organization. Other examples include foundations (such as the Recreational Boating and Fishing Foundation), topic-specific networks (such as the National Drinking Water Clearinghouse), member groups (such as Ducks Unlimited), and public media initiatives with a community based outreach network (KDKA San Francisco QUEST initiative for science literacy). Key functions include communication, translation, and mediation. Boundary organizations typically convene scientists and communities; target key audiences and encourage participatory learning; work with partners; facilitate the presentation of credible information; and bring benefits to both sides of the interface (Osmond, 2010, p. 307). To build effectiveness of boundary organizations, educators can help facilitate their own organization's ability to achieve ideal components listed in Figure 2.

Figure 2. *What is a boundary organization?* (Osmund 2010)

- A boundary organization is synergistic, and operates somewhere on a multi-dimensional continuum that tracks: purpose; scale (local, state, regional, national, multi-national); flow of information to and from scientists and audiences; and intensity of activity.
- The purpose for the organization may be to foster the use of science knowledge in

environmental policy, environmental management, behavior change, further learning, inquiry, discovery, or enjoyment.

- As they function, these organizations build a demand for science, at different levels of society, and for a variety of niches and contexts and scales, often by serving as a convener.
- They target key audiences, and encourage local research, participatory learning, and social learning through their work with partners and partnership organizations.
- They present credible information when using science to recommend policy or advocacy; present options; and "translate" science information so that it is "user-friendly".
- They provide benefits to both sides of the boundary and they direct, motivate, and enable inquiry, science synthesis, and monitoring.
- They educate partners (including scientists) about each other's knowledge, interests, needs, passions, concerns and learning styles.

Another type of opportunity for scientists to access communities arises because contemporary environmental research lends itself to cross-fertilization between scientists and geographic or self-defined communities. Environmental or ecosystem research is increasingly focused on places where people live and is more commonly featuring interdisciplinary approaches. Research principles that emphasize adaptive capacity and resilience "involving continuous interaction with stakeholders as well as ongoing reassessment and engagement in the policy process" have potential for building connections with individuals and groups (Pace 2010). In the spirit of this opportunity, Pace (2010, p. 294) recommends that scientists take advantage of many resources that provide guidance for how to communicate effectively in different forums (such as Moser 2009; Pike 2010; Shome & Marx, 2009). This advice applies equally to other climate educators.

In support of an organization or agency mission, researchers, technical professionals (conservation professionals, managers, engineers, planners, etc.) and educators work to improve environmental management by transferring information to relevant audiences, by providing tools and techniques, and by facilitating the decision process. To better identify and access relevant communities of interest is a challenging task, and professionals need resources, training, and support to tackle it. Some parameters that experts need to consider include:

- Defining the problem in*specific* terms.

- Understanding the *critical factors* that affect the likelihood that an individual will adopt an environmentally significant behavior.
- Identifying behavior goals that the targeted audience *can achieve.*
- Selecting outreach techniques most relevant for facilitating behavior change *by a particular audience.*
- Determining *how to measure* whether the individual (or group) achieved the behavior goal.

The Changing Public Behavior Project (UW ERC 2008) can shed some light on what work is needed to assure that scientists and educators can identify and access self-defined groups. The Changing Public Behavior Project is a national effort to improve citizen involvement in environmental stewardship, by building educator skills. National experts in social assessment and training identified specific skills that educators need in order to assess their audience and choose effective outreach techniques. Dissemination involved training participants – including natural resource professionals, educators, managers, and administrators from Extension, public agencies, and nongovernment organizations – who completed pre- and post- workshop questionnaires to assess their skills and confidence in using education techniques and social assessment tools when designing outreach efforts.

Professionals can improve their capacity to identify and access communities of interest and other self-defined groups by building educator and social assessment skills, such as those listed in Figures 3 and 4. These are independently described in order to isolate particular training goals. In the workshops, participants learn what questions to ask; what tools to use to gather social science information; how to use the tools and how to analyze results; and how to use results to select outreach techniques that satisfy audience needs. Self-report results from workshops held in 2008 revealed that natural resource professionals want additional training, especially related to initiating a dialog with target audiences and stakeholders; working with the target audience, stakeholders, and funders; developing and implementing a relevant outreach initiative; and monitoring and evaluating results (Andrews, 2009).

Figure 3. *Educator Skills*
(skills required to design and implement an outreach or training initiative)

A. Clarifying personal motives and interests related to an environmental concern, audiences, and stakeholders
B. Identifying an environmental management opportunity or concern
C. Assessing and describing an environmental management opportunity or concern
D. Identifying target audiences and stakeholders
E. Initiating a dialogue with target audiences and stakeholders
F. Describing an environmental practice that affects the environmental concern
G. Analyzing the environmental practice to identify single behaviors that make up the practice
H. Identifying target audience interests and skills
I. Using target audience information to assess the potential for behavior change
J. Prioritizing and agreeing on behaviors
K. Developing and implementing outreach activities that influence selected behaviors
L. Monitoring results
M. Evaluating results
N. Modifying description of the environmental concern or opportunity based on results

Figure 4. *Social Assessment Skills*
(skills required to develop and apply social assessment strategies)

A. Employing ethics in audience assessment processes
B. Working in collaboration with the audience
C. Selecting a data gathering or social assessment procedure
D. Applying a data gathering procedure
E. Recording oral and visual data
F. Analyzing and summarizing results
G. Applying results
H. Sharing results with stakeholders, funders, and target audience

C. Educational and engagement strategies can be effective in building climate change adaptive management capacity among self-defined groups.

Community and education

To assess which educational and engagement strategies can be effective in building climate change adaptive management capacity among self-defined groups requires an understanding of what we mean by educating communities, and how that might differ from traditional education. Community education is thought of as "the process and result of an effort to include a broad cross section of people in educational activities to enable them to work together to solve organizational or community problems that have usually entailed consciousness raising,

empowerment, and structural transformation" (Knox, 1993). When education is developed in collaboration with a community of place, interest, identity, or practice, it usually has multiple purposes, by necessity.

Beyond a goal of climate change learning or action, education of a self-defined community (Andrews 2002) will have multiple purposes, such as to:

- Assure equitable access to information by "publics": Public participation in policy development requires equal access to information (Lynn and Kartez, 1995; Dienel and Renn, 1995).
- Build individual capacity, that is to help people develop the capacity to make decisions and take responsibility (Horton and Freire, 1990; Ostrom, 1994) including knowledge of resource conservation and use, to help in correct and timely diagnosis of problems and to assure they have the best knowledge they can have, because resource decisions are usually made based on "best available" knowledge (e.g., nutrient best management practices).
- Build leadership capacity: Communities need a source of leadership in environmental management (Kellogg, 1999), and natural resources are more likely to be managed sustainably when decision making is decentralized (Wondolleck and Yaffee, 2000).
- Integrate education into the context of managing the community (Andrews 2002).
- Build capacity among policymakers: Policymakers need to understand the nature and causes of problems, as well as the tools for management (Singh, 1994).

Community education is described using unique terms, such as community of interest (CoI), community of practice (CoP), and social learning. For example, a national drinking water CoP leadership group includes experts from a number of land-grant universities.[2] The CoI consists of extension educators who need access to information that they can use for teaching, as well as people who want to make decisions about the quality or quantity of their drinking water. Social learning may occur as CoP members work together towards a common objective. As described earlier, goals for education of a self-defined community may relate most closely to building capacity, such as by focusing on one or more *capitals* characterizing that community: human,

[2] http://www.extension.org/

social, financial, or political capital. In developing an effective strategy for facilitating learning by self-defined communities it is helpful to understand terms such as: communities of interest, communities of practice, social learning, and capitals. These are further described in Figure 5.

Figure 5. *Concepts that inform the design and goals for educating self-defined communities.*

Community of interest may reference a discrete collection of persons who have a common interest, yet they may be located in different places and may not be aware of their shared interest. A community of interest need not be made up of similar perspectives. Indeed, it is made up of diverse perspectives surrounding a common issue (Wise, 1998). A "community of interest" is that form of community whose commonality lies in the benefits received from a resource or the costs imposed on it (Wondolleck and Yaffee, 2000).

Communities of practice: People who share cultural practices reflecting their collective learning (a group of nurses in a ward, a street gang, a community of engineers interested in brake design) (Wenger, 2000). As an example, the University of Wisconsin Cooperative Extension is leading or is involved in developing content and engagement for several Communities of Practice (CoP), such as a Drinking Water and Human Health CoP, for the national e-Extension initiative (known as eXtension; http://www.extension.org/). There is no eXtension climate change CoP to date, however.

Social learning: Social learning takes place when divergent interests, norms, values and constructions of reality meet in an environment that is conducive to learning. Learning can take place at multiple levels: at the level of the individual, the level of a group or organization, or at the level of networks of actors and stakeholders (Wals, ed. 2007). Every social learning system involves engagement, imagination, and alignment modes of belonging, to some degree and in some combination, but one can dominate and thus give a different quality to a social structure (Wenger, 2000).

Capitals are resources invested to create new resources in a community over a long time horizon. Educators can link climate change initiatives to building capacity in one or more of these areas, and potentially enhance the likelihood that climate considerations will be incorporated in community efforts. Capitals include natural, cultural, human, social, political, financial, and built capital. (Flora 2004.)

- *Human capital* – Educators assist people who want to do the right thing, but don't know how (knowledge and technology transfer).
- *Social capital* – Educators organize groups that share the values to create the necessary social pressure to change structures and behavior.
- *Financial capital* – Educators build knowledge and skills related to opportunities: positive sanctions, such as cost sharing, payments for ecosystem services, and earning more for ecological products; negative sanctions such as fines and lack of access to premium markets.
- *Political capital* – Educators build *environmental policy capacity* by facilitating a community's ability to engage in collective action that secures environmental public goods and services. In a community with strong environmental policy capacity, the social norm is to expect a high level of environmentally sound individual behavior and institutional performance. Strong community support for certain environmental protection measures translates into further support from local leaders, and generates the political, economic, and technical resources necessary for sustaining and implementing environmental programs (Press 2002, p. 187, 188).

Education and effective community engagement

Community education has broad applicability as an educational approach for achieving flexibility and responsiveness to climate issues (Andrews 2002; Andrews 1998). The community-based approach differs from traditional education design in that it recommends a process that not only builds individual knowledge and skills, but also helps to build an infrastructure for change that is sustainable, equitable, and empowering. In community-based education, a self-defined community has or establishes a *vision and goals*; inspires an *instigator* who, stimulated by these goals, enlists or gathers a group or coalition to start an *initiative* and to keep it going; supports group activities to *gather and analyze information*; and finally, through the group, *engages the larger community* in carrying out what it has learned through policy changes, new regulations, and/or education. This strategy emphasizes qualities of equity, empowerment, and sustainability as part of environmental management decision processes. Community-based education incorporates organization development, public participation, social marketing, environmental education, and right-to-know strategies. Measures that contribute to the effectiveness of volunteer activities also are encompassed in this model.

Education strategies that reflect this approach, and which would be appropriate for promoting climate change literacy, mitigation, and adaptation goals among self-defined communities, are outlined in Figure 6.

Figure 6. *Education strategies effective in a community-based approach*

- Action learning, also known as participatory action learning (Adnan 1992; Park 1993; Pretty 1995; Williams 1996; Israel 1998; Chambers 2002; VeneKlasen et al. 2007).
- Action research, a more rigorous type of action learning, involves the student in generating new information to improve understanding of how knowledge content is developed, using critical thinking skills, and creating a sense of ownership of the knowledge. Action research has been used extensively in training and development in corporations, and in adult education in environmental, agricultural, and health settings (Quigley, 1997).
- Adaptive planning models (Colfer 2005; Folke 2005);
- Civic empowerment models (Sirianni 2001 and 2005; Reid 2008);
- Civic engagement and public participation models (Renn 1995; National Research Council 2008);
- Community organizing models, e.g. Saul Alinsky;

- Community problem-solving education – education that aims at community and organizational development and social change, in contrast to traditional education, which is aimed at development and change of the individual;
- Creating change -- the role of communications theory (Fishbein 2006; Moser 2009; and Getting in Step, US EPA 2010); or implementing behavior change theories (Ajzen 2005; Fishbein 2006; Gardner 1996; Prochaska & Velicer 1997);
- Deliberation with analysis; application of decision support systems/ knowledge-action systems (NRC 2009, p.78);
- Diffusion of innovation (Rogers 2003) and "influentials" theories (Keller 2003[3]);
- Free-choice learning – such as learning that occurs while watching TV, reading a newspaper, attending a zoo or museum (Falk & Dierking, 2002);
- Information reporting services that monitor, report and verify emissions, report climate trends, and report other information relevant to a self-defined community;
- Scenario planning (Holmgren 2009);
- Social communications theories and research (Ellison 2009);
- Social learning systems, including performance of "interface organizations" (Wenger 2000; Cash 2003; Ellison 2009; Osmond 2010; Wals 2007, and others).

The sheer length of the list in Figure 5 should illustrate that the opportunities are many and varied. Community education techniques may also incorporate use of archives and asynchronous communication. These self-directing resources can help people interact in ways they could not in face-to-face environments (Hollan & Stornetta 1992). For example, an online community of practice (CoP) can foster learning among groups of individuals with a shared interest (Cox, 2005). Just as with other self-defined groups and boundary organizations, the capacity for a CoP to function as an education resource depends on the quality of its governance, including choosing organizational structures and mechanisms that can influence the processes of using, sharing, integrating, and creating knowledge in preferred directions or applications (Foss et al, 2010). Online community building platforms, such as Wikis and online CoPs, are helpful to community members and can build trust among the group, which is key to community success (Chiu 2006; Fang & Chui, 2010). Despite known challenges for development, a virtual Community of

[3] Keller and Berry define "influentials" as people who are experienced in life; are more likely to be well educated; have an active orientation toward life (attend meetings, write to politicians, serve on committees and as officers of an organization, write and talk about their opinions, participate in groups trying to influence public policy); are connected (have ties to a larger number of groups than average); have impact or who have influence (others look to them for advice and opinion); have active minds; like to learn through people and experiences; are trendsetters (interested in, experiment with, and use new techniques, tools, and brands).

Practice is an excellent platform for knowledge development and delivery, in which learning includes stages of creation, mobilization, diffusion, and commoditization (Birkinshaw & Sheehan, 2002).

Evaluating education in partnership with self-defined communities

If we promote the idea of providing education and outreach in collaboration with self-defined communities, how will we know if the work is effective? Ultimately we can observe changes in group goals, aspirations, policies, actions, financial commitment, etc. as described by Taylor-Powell (1998; pp. 111 and 155 offer an example of potential measures). As an intermediate step, we can measure individual capacity and self-confidence to apply strategies described earlier in this paper. Sample criteria are identified in Figure 7.

Figure 7. *Measures of educator effectiveness when working with self-defined groups to promote climate learning and action*

- Assess the professional's likely involvement in climate outreach with self-defined groups. Does the person know how to be involved?
    - Helping or speaking with formal or nonformal educators; talking about his or her work with youth or adults; answering questions; working to solve a problem with an individual; making a conference presentation; leading a group; facilitating a group; providing internet resources.
- Knowledge of components of educator and social assessment skills listed in Figures 3 and 4
- Confidence in assessing when to use educator and social assessment skills listed in Figures 3 and 4
- Confidence in applying educator and social assessment skills listed in Figures 3 and 4
- Confidence in finding social assessment resources or experts, as needed.
- Degree to which the professional is applying planning steps recommended for developing an education or outreach initiative:
    - Describe climate concern or opportunity
    - Identify primary target audience(s)
    - Determine specific actions people need to take to accomplish the climate-related management goal
    - Collect audience information relevant to the climate-related practice and specific behaviors (What does the audience already do relative to the preferred behavior? Are there barriers? What are audience skills/ interests/ needs? Does it meet an audience need or address an interest? Does it have an impact on the problem? Does it provide users with an observable consequence? Is it similar to what the user does already? Is it simple for the user to do? Is it low cost in $, time and energy for the user?)
    - Assess potential for adoption of single behaviors that lead to the climate-related practice
    - Use audience information to isolate concrete actions of interest to the audience, that will help accomplish the climate-related management goal.

    - Base selection of education/communication strategies based on what has been learned to be effective from audience information
- Degree to which educator is applying effective communication strategies
- Degree to which the professional has experienced *effectiveness* in their education/outreach efforts
- Degree to which the professional has experienced *satisfaction* with their education/outreach efforts

Criteria for evaluating boundary organization effectiveness can be derived from qualities outlined in Figure 2 (Osmond 2010) and related avenues of thinking. Criteria could include effectiveness of how to engage stakeholders in a collaborative decision-making process with scientists and policy-makers (For example: Andersson, 2004; Bacic, Rossiter & Bregt, 2005; NRC 2008; Olsson, 2007; Rinaudo & Garin, 2004; Roth et al, 2008). Elements which ensure authentic participation include a gradual and continuous process; an audit of stakeholder viewpoints; user relevance and friendliness; a context that is legitimate to all involved; and dialogue that ensures awareness of and preparedness to handle constraints, transparency, and mutual respect (Olsson, 2007; Rinaudo & Garin, 2004).

Evaluation criteria could also recognize key factors important to the function and organization of what Cash (2003) calls "boundary management" activities. Functions include communication, translation, and mediation (convening groups, as well as resolving differences). The most significant criterion appears to be the fact that the interface organization makes a serious commitment to managing the interface; institutionalizes accountability to key actors on both sides of the knowledge action boundary, and creates jointly produced efforts or outputs such as models, scenarios, or reports. Individual scientists working in "boundary" situations are more likely to have an effective impact if the interface organization systematically addresses these elements. Boundary organizations can strive to link scientists to stakeholders and decision-makers through an experience which incorporates these qualities.

Another important factor is that the interaction proposed in these models does not stop once the information is conveyed, but continues, to allow monitoring, interpretation, and adjustment related to the application of a recommendation. Social learning is a term which has been used to describe this type of ongoing dialogue among stakeholders, scientists, planners, managers, and

their environment. The interchange goes beyond the role of scientists helping policy makers to understand how humans affect ecosystems and vice versa, to investigating the role of human activities in causing problems and facilitating collective responsibility for an "ecological society" (Röling & Jiggins, 2001. p. 150).

D. Potential approaches for next steps

In summary, the apparently staggering challenge of educating geographic and self-directed communities to assess, understand, and respond to climate change is at least partly matched by a diverse, and well developed, array of learning tools and strategies. Next steps include:

1) **Facilitate new connections among educators and communities.** Link together existing research, practitioner and community networks. Promote adoption of effective outreach systems among boundary organizations. Provide resources, training, and support to enable educators to identify the sense in which each self-identified community has the potential to become a community for climate learning and action, to discover effective interaction opportunities, and to ensure authentic participation.
2) **Investigate, enumerate, and implement strategies for building social capacity** to attend to and respond to conditions resulting from a changing climate. Individuals and self-defined groups can function in a way that encourages thinking about maintaining or increasing diversity of response options to future conditions. Groups can enhance the capacity of their members to adapt to change. Train educators and boundary organizations to build leadership, group management capacity, and communication skills as a component of their current efforts. Identify and disseminate criteria for evaluating the success of building group and individual capacity for creating response options and adapting to change.
3) **Engage county Extension faculty** in investigating and implementing processes that build understanding of which geographic or self-directed communities to approach to learn their interest in climate change education, and to investigate implementation opportunities, as well as systems for connecting scientists with self-defined communities.
4) **Engage scientists working in geographically-specific locations**. Facilitate scientist communication capacity and effective engagement with stakeholders.

5) **Promote the use of action learning** in collaboration with "communities of interest" and "communities of practice" as a way both to develop understanding of community assets, needs, and opportunities, and to build ownership among community members. Engage self-defined groups in applying adaptive planning, community problem solving, and knowledge-actions systems. Investigate volunteer/citizen science models for disseminating information and empowering individuals and groups.
6) **Monitor**. The challenges of climate change education are dynamic, just as climate science is dynamic. To serve the needs of the future as well as the present, there is a need to provide constant feedback information about public engagement with climate change across many communities (Ostrum 2010; NAS 2009).

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Addendum. University of Wisconsin Cooperative Extension
Sample of programs addressing climate change

Wisconsin Rural Energy Program Activities
The mission of the Rural Energy Program is to provide education and tools to help people understand how they use energy, how they can reduce their use and renewable energy production alternatives. Indirectly this program's activities help reduce greenhouse gas emissions, as energy efficiency measures and alternative energy sources are implemented. For the past seven years the program has provided technical support to the Wisconsin Focus on Energy Agricultural Program in the form of developing fact sheets, auditing tools, and training personnel on how to do audits. We also provide speakers for workshops and presentations to agricultural audiences on energy use topics for dairy farms, irrigation, grain drying, greenhouse production, lighting, ventilation, wind energy, solar energy, biogas production and biomass usage. We have developed a toolbox of Energy Self Assessment tools (www.ruralenergy.wisc.edu) for the USDA-NRCS targeted at agricultural producers in the previously mentioned areas. These tools provide site specific energy efficiency information based on the user's operation. We have also authored 15 extension publications and many white papers on energy subjects.

Energy Independent Communities (EIC). Wisconsin communities that have passed resolutions to work toward generating 25% of electricity and transportation fuels from renewables locally by 2025 are an excellent model of communities of practice that are highly suited to climate change education. Of the 135 municipalities that have passed EIC resolutions, there are 19 community groups, comprising 44 municipalities and a few school districts, that received state grants to do the measurement and planning necessary to accomplish the Governor's goal. EI communities are located in all seven regions of the state and range from a single small village, to a county, up to a network of 11 municipalities in a region.

EIC's that receive planning grants must create a team with local government, utility and stakeholder members; establish an energy baseline by creating an inventory of all government electric and fuel use in buildings, infrastructure and fleet; and create a plan to reduce energy use and to generate energy locally (or regionally---as opposed to buying green power on the open market). County-based UW-Extension educators work with these communities to guide them through the strategic sustainable energy planning process. They also assist with community energy outreach and education. Technical assistance on measurements and options analysis comes from the WI Focus on Energy public benefits program, the nonprofit Energy Center of Wisconsin, local utilities and UW-Extension. The state Office of Energy Independence organizes education of and information sharing among the EICs throughout the year-long process. Therefore, these 44 communities are already well connected with each other. This is providing scale and context to create State bids for purchasing items like LED street lights and to develop revolving loan fund pools for energy retrofits and renewable energy installations.

While these communities are pursuing "energy independence" based on a variety of motivations from commitment to sustainable community development, to saving money and energy, to creating local jobs, climate change is not a primary focus. In measuring energy savings, they are able to quantify their reductions in green house gas emissions, which they view as readiness for "cap and trade", should it occur; but they are not likely to take that to the next step of community education and engagement with climate change.

The University of Wisconsin Extension Sustainability Team. One of UWEX's many cross-discipline self-organizing "work teams," the Sustainability Team uses a place-based approach to sustainability and community development. Since its inception, the Sustainability Team has grown from 12 members to 39, including state specialists from many scientific disciplines as well as county-based UWEX faculty members, regional planning commissions, and local government groups. Together, the team created Toward a Sustainable Community: A Toolkit for Local Government (TASC). TASC includes resources on energy efficiency, ecological economics, life cycle assessment, green building, and many other topics. Recently, the Sustainability Team began to offer public policy forums to support community sustainability, and created a Sustainable Communities Capacity Center to make eco-municipality resources readily available on the Internet.

The Wisconsin Initiative on Climate Change Impacts (WICCI; http://www.wicci.wisc.edu/)is a statewide collaboration formed to help Wisconsin stakeholders adapt to climate change. WICCI began in 2007 as a partnership between the UW-Madison's Nelson Institute for Environmental Studies and Wisconsin's Department of Natural Resources. It has since grown to include a wide variety of participants. More than 40 scientists from Wisconsin universities and regional/state agencies are working with policy makers and diverse stakeholders to accurately assess climate trends and develop adaptation strategies. WICCI has formed 15 working groups made up of scientists, policy makers and stakeholders to develop an evidence-based review of climate trends in Wisconsin and explore the impact of those trends on such themes as agriculture, fisheries, wildlife, and water resources, and on communities such as Milwaukee and Green Bay. A vulnerability and adaptation assessment report will be shared with local, regional and state governments in December 2010, and outreach specialists are already exploring the best means of engaging policy makers in responding to the findings.

Conservation Professional Training

The Great Lakes Regional Conservation Professional Training Program provides continuing education training opportunities to a wide variety of Conservation Professionals working with farmers in the Great Lakes Region. Several courses were retooled, such as Conservation Planning, and new courses are being developed that will incorporate climate change as integral to the fabric of the training curriculum. Since even subtle changes in climate can lead to substantial changes to local ecosystems, we are proactively addressing management strategies that minimize ecological and economic impacts. A few course examples include: NRCS Energy CAP's (Conservation Activity Plan), and a series of Forestry courses that incorporate how climate change impacts invasive species management, sustainable forestry practices and Agroforestry. Due to the similar nature of forestry issues, three states (Minnesota, Wisconsin and Michigan) are working in partnership to learn ways to mitigate the impacts of drought stress and milder winters in colonization by invasive species such as the emerald ash borer, gypsy moth and a host of terrestrial plant invasives.

Climate Change Webinar Series

The Great Lakes Regional Water Program coordinated by the UW Environmental Resources Center is working in cooperation with The Ohio State University, Ohio Sea Grant, and NOAA to co-sponsor a webinar series on climate change, impacts, and adaptation strategies for communities in US-EPA Region 5. The purpose of the webinar series is to develop a common understanding of climate change and climate change impacts in Midwestern Great Lakes states, and to share adaptation strategies among federal and state agency staff, local governments, and university Extension educators. The series has attracted over 150 participants from across the Great Lakes region. The Ohio State University is also hosting a "Resources for Climate Change Education in the Great Lakes Regiõn website at

http://ohiowatersheds.osu.edu/climate/ This website is populated based on input from the webinar series as well as contributions from scientists, educators and practitioners from across the region.

Energy Independence, Bioenergy Generation and Environmental Sustainability National Facilitation Project

The UW Environmental Resources Center is working on two projects related to Bioenergy: the Biofuels and Community Participation Project, and the Energy Independence Project. The Biofuels and Community Participation Project has developed frameworks and protocols for extension agents to effectively engage community residents in planning and discussion regarding proposals to site new energy facilities within communities. The project team (with UW Extension personnel) is developing a 'Toolkit for community-based assessment of renewable energy development,' which includes guidelines to encourage community participation, tips for conducting analysis of community resources, and matrix assessment tables for various renewable energy options. The Energy Independence national facilitation project is a collaborative response by states within the North Central Region to develop training and professional development programs on bioenergy and sustainability for Extension professionals and public officials. The project has conducted an inventory of Extension personnel in two program areas: Agriculture and Natural Resources, and Community Resource Development. They created a Curriculum Design Team (CDT) comprised of content experts within Extension (29 members from North Central states) to work collaboratively on developing a web-based curriculum, and the team has begun work on four curriculum modules: Bioenergy crop production and handling, Water resource issues, Agricultural energy conservation and efficiency, and Bioenergy and community economic development. These modules are being developed within the eXtension Wordpress platform.