

# Connecting Classrooms to the Community

*A Guide for a Community-based Approach to Education*

Author contact information:

Jon Yoder

Northwest Center for Sustainable Resources  
Chemeketa Community College

Email: [wynn.cudmore@chemeketa.edu](mailto:wynn.cudmore@chemeketa.edu)

Phone: 503-399-6514

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## Guide Description

This is the last educator's guide in a series on community-based education produced by the Northwest Center for Sustainable Resources (NCSR). It is a compilation and summary of each of the previous manuals for schools and communities looking for specific ways of working together to educate our student-citizens. If you would like to delve into this work deeper you are encouraged to read these previous educator guides:

*Educator's Guide to Program Development in Natural Resources*

*Community as a Context for Learning*

*Community-based Natural Resource Activities for Biology*

*Community-based Education: Model Programs*

Previous educator guides describe a process that educators can follow to connect schools to their communities. They explain the philosophical basis for community-based education. The community-based approach engages students in the public domain, involves them in the information-gathering that is needed, and then provides feedback to enhance the community's policy and decision-making capacity. However, teachers who embrace this philosophy often struggle with how to implement the community-based approach into their classroom. So the previous guides also offer specific community-based lessons and activities that educators could use in a typical biology course to get students out in the community. They provide specific lessons for the information-gathering phase of their community-based efforts and address concerns regarding content and content standards as students participate in authentic educational opportunities in the community. There is also a showcasing of example programs so educators and partners can see how this may look in a variety of settings and schools. We hope these educator guides will help educators put the "community" into community-based programs.

This final publication pulls the key explanations, lessons, and resources from the previous NCSR educator guides so that educators and community partners will have all the key components at their disposal for designing and implementing a community-based project or program.

Those looking for ways to expand their work with natural resources or environmental education should also read *An Educator's Guide to American Indian Perspectives in Natural Resources*. This will provide information that can be used to expand field studies to incorporate historical or cultural aspects.

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Jon Yoder

NCSR Secondary Education Coordinator

Chemeketa Community College

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## INTRODUCTION

The need for educational reform is on the agenda of nearly every group that is in any way connected to public welfare in America.

Although education historically has been called upon to lead the way in dealing with change in our society, clearly the pressures on our communities from international competition, current economic issues, lack of skilled workers, need for highly skilled and technology literate citizens, and the incidence of serious social and environmental issues cannot be denied. Increasing day-to-day needs for citizens to be scientifically, technologically, ecologically, and socially literate underscores that there is reason to be concerned about the educational preparation of our student-citizen.

This background of concerns clearly illustrates that the task for reforming education is more than simply rearranging what is currently being offered in most schools throughout America. Changes cannot be achieved by attempts to simply revise, restructure, reorganize, or update the current school curricula. These courses and how they are currently taught are the very reasons for the demands for educational reform. The task, instead, is one of separating us from the past and developing new ways of thinking about a citizen's education. As educators, our responsibility is to provide leadership in creating programs that represent a system for student-citizens to engage in change that protects and enhances our natural and social worlds. Programs need to be more than single courses offered at the end of a students' high school experience, and instead should be comprehensive, coordinated series of experiences grades K-12.

Consider the analogy of baseball (i.e., the citizen's community-based educational program) where the young player may need some participation tees, the bases may be set closer, and more attention given to safety. However, when a young player (i.e., the citizen) observes major league baseball being played, it includes a bat and ball much like theirs, the rules are generally the same, and the concept of the game is understood. They have actually participated in and played the game although at a developmentally appropriate level. Schools need to provide a setting where our student-citizens have authentic opportunities to participate in the "games" played out in their communities so upon leaving the educational institution their entrance into the community is a known and practiced experience. These authentic opportunities are requested by the community and are the same experiences that are currently taking place there. An example would be a city agency asking students to assist them in completing their mission, which could be anything from conducting a tree inventory to educating community members about water quality.

It is to the communities' advantage to assure that young citizens have played the game for years and do not just begin when they graduate from high school. To have students become productive and participating members of the community, is the mission of education. Without years of experiences actually doing this would seem to lower the capacity for reaching or maintaining sustainable and vibrant communities. The current approach of sitting in a classroom, "learning" about math, English, science, and social studies, reading out of textbooks, and doing worksheets allows for little opportunity for the community engagement necessary for citizen participation. Connecting students to their own interests and lives is an important factor to consider in the education of the student-citizen.

As education attempts to meet the needs of society in the twenty-first century, the need for greater alignment between community goals and educational goals becomes critical. In the past there has been too large of a gap between what takes place in schools, what is important to a community and the resulting preparation and involvement that takes place within an educational system. Making real and authentic connections between schools and communities is essential if either is to fully realize their common mission of a productive citizenry. The request from both communities and schools to achieve this common mission is something that is already in place in every community. It becomes a matter of finding ways to link the two groups together.

The process best able to link schools and communities together and to achieve common goals is a community-based approach to education. This approach uses the needs and opportunities of the community to drive educational instruction. In every community there are agencies and public bodies with limited budgets that work and deliberate on public issues and policies. They have a need and often a requirement for citizen involvement. For too long students have not had the opportunity to take on their rightful role as a citizen and member in the community. Combining the needs of the community with corresponding educational opportunities and experiences for students is a central feature of community-based education. Students need to be engaged in the work of the community and thus there will be an authentic context to their learning.

The support for this approach to education is already in place and can be found in numerous agency, community, and school documents. A community-based approach to education is asked for in the *UN Decade of Education for Sustainable Development 2005-2014*, national teaching standards, state's goals, agencies goals, community goals, and school district mission statements. All of these documents mention the importance of citizenry and citizen involvement and so our educational system has an obligation to support these goals in intentional and direct ways.

There are many barriers that can deter communities and schools from undertaking this approach. From the community side there are concerns with staff time, effort, money and unfamiliarity with schools and what human resources they can provide. Where else do you have hundreds of citizens in one place with the ability to help community efforts to raise awareness and the capacity for decision-making? Students are an unused asset and resource and communities need to connect and tap in to this. Very few places in the community have citizens that have the working knowledge and skills that are taught and used every day in schools. This is a largely untapped human capital that could provide valuable support for a wide variety of community efforts as well as raise the awareness of other citizens regarding their community.

There are also barriers with schools that often lack the knowledge and information about community opportunities that fit their educational objectives. There are additional barriers, real or perceived, such as money and transportation issues. However, the biggest barrier that looms for most educational institutions is the emphasis on content standards and standardized testing. Many schools continue to focus on test scores and traditional methods of instruction. It is important to note that in a community-based approach, content standards are indeed addressed but now it is within the context of an authentic experience connecting to community needs. There is even some evidence that students will perform just as well or better on standardized tests from this contextual learning.

The benefits of a community-based approach for schools go beyond content standards and standardized tests. Student-citizens become connected to their communities rather than disconnected and alienated. There is a greater chance for continued involvement in years following their formal education. In addition, student motivation and engagement are high as they see a relevant connection to what they are learning. For communities there are both short-term and long-term benefits. More of the work of the community can be accomplished by engaging younger citizens and with educational products from their efforts, students can become more aware of what is occurring in their community and as a result have a greater capacity for making community decisions.

The community-based approach to education is not an easy one for either the schools or their communities, even with shared goals. It takes much patience and persistence over a number of years to build relationships and establish connections that bridge the gap between our communities and our schools. The work is difficult but very rewarding for students, teachers and members of the community. The result is often transformational for all who embrace and experience this approach.

The purpose of this educators guide is to in some small way facilitate these school-community connections and the resulting opportunities and experiences that are mutually beneficial. Although the examples used in this guide will be related to natural resources, any theme or subject area can use this same approach.

## **UNDERSTANDING COMMUNITY: LIFE-LONG LEARNING, THEMES AND ROLES**

Understanding the community around you is essential in the development of a community-based program. There are three areas that will be used to describe a community: *lifelong learning*, *community themes*, and *community life roles* of community members. The three areas that describe a community are all connected. All of these further support the notion that schools need to more closely interface with the community.

### ***Life-long learning***

The first area of community deals with life-long learning and the skills, knowledge, and attitudes necessary to function effectively in a community.

In this rapidly changing world, new skills are needed by broad segments of the public to maintain pace with community development, careers and jobs. Keeping up with these constant changes can often exceed the capacity of the average citizen. A community-based educational program could help bridge the gap between citizens and active participation in their communities.

Each member of the community brings a wide range of personal skills and knowledge to the public process: educational experience, personal life experience, diverse attitudes, and their own unique personality. The question for full participation is not so much how old the citizens are, but what is their personal entry-level skill for participation in the public arena? Although somewhat unclear for some, it is clear to the educational reform effort that students are and must be considered full participating citizens in our communities. The proposed framework ensures that developmentally appropriate access would be provided for the young citizens of our communities.

For citizens to be successful participants in the public process, they must be able to acquire basic public skills, such as being an effective communicator and team player. They must have an opportunity to develop additional specialized skills and knowledge, such as the application of specific technologies, if they are to contribute to the more specialized “themes” of the community.

If citizen skills and knowledge are not developed in the formal process during their schooling, then this opportunity should be available for development at any time. Although some will seek additional formal educational opportunities, most will go with what they have. This often limits their participation to “crisis” community issues where the motivation exceeds the concern about personal skills and knowledge; or that concern motivates the individuals to personally develop the skills and knowledge necessary to get through the crisis.



<b>Attributes for Student Development</b>		
<b>Skills</b>	<b>Knowledge</b>	<b>Attitudes</b>
<ul style="list-style-type: none"> <li>• Effective communications</li> <li>• Oral and written</li> <li>• Use of electronic communications</li> <li>• Problem-solving approaches for community actions</li> <li>• Techniques in being a "team player"</li> <li>• Organizational skills</li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of community processes</li> <li>• Opportunity to build a sense of place</li> <li>• Access to the community and regional history</li> <li>• Relationship of community in state, national and global context</li> <li>• Interactions of economic, social and ecological elements of community</li> <li>• Local geography</li> </ul>	<ul style="list-style-type: none"> <li>• A spirit of cooperation</li> <li>• Support for linkage between rights and responsibilities</li> <li>• Building a sense of ownership of community</li> <li>• Feeling for linkage between services and service</li> <li>• Confidence in actions to indentify, analyze and select</li> <li>• Actions to resolve issues</li> </ul>

***Community themes***

The actions of the community can be organized around community themes. The themes being proposed are useful organizers for our communities and can also be used to plan and focus asset inventories. These are the valued social, economic and ecological components of a community. The inventories would serve as the “common” resources of community members and be useful in planning and developing community action plans. None of these themes operates in isolation in the “real world”; thus, the community themes are only for the purpose of planning. The following is a list of proposed community organizing themes. Academic disciplines should be used to advance these themes.

Human Resources: A fundamental area of community study and participation that includes political and social systems. These may include, but need not be limited to, education, law and legal studies, law enforcement, public administration, child and family services, religion, and social services.

Health & Safety Services: A theme that is critical to groups and individuals in communities and fosters the promotion of health as well as the treatment of injuries, conditions, and disease. These may include, but need not be limited to, medicine, dentistry, nursing, therapy and rehabilitation, nutrition, fitness and hygiene.

Business and Management: The economic base of communities must be understood to ensure participation, and includes areas of study related to the business environment. These may include, but need not be limited to, entrepreneurship, sales, marketing, hospitality and tourism, computer/information systems, finance accounting, personnel, economy and management.

Arts & Communications: Often the base of community culture and community pride, this includes areas of study related to the humanities and to the performing, visual, literary and media arts. These may include, but need not be limited to, architecture, creative writing, film and cinema studies, fine arts, graphic design and production, journalism, foreign languages, radio and television broadcasting, advertising and public relations.

Infrastructure and Engineering Systems: Fundamental to current community infrastructure, this area of study is related to the necessity to design, develop, install, or maintain physical systems. These may include, but need not be limited to, engineering and related technologies, mechanics and repair, manufacturing technology, precision production and construction.

Natural Resource Systems: Often one of the limiting factors in community economics and development, this area of study is related to environment and natural resources systems. These may include, but need not be limited to, agriculture, earth sciences, environmental sciences, fisheries management, forestry, horticulture, and wildlife management. Ecosystem management is the standard for many public agencies and must include citizen participation. This theme also relates to citizens' stewardship and land use planning for communities and resource land.

### ***Community life roles***

A third area of community description is community life roles. These life roles of the community are the front line of action and play a significant role in determining the breadth and depth of capacity being added to the community. Linking actions to the life roles can help focus the work, both within the formal educational community and the broader community institutions. All citizens, including young citizen-students, should have the opportunity to function effectively in the following life roles of the community:

“Citizen”: to learn to act in a responsible manner; to learn of the rights and responsibilities of citizens of the community, state, nation, and world, and to learn to understand, respect, and interact with people of different cultures, generations, and races.

“Family Member”: to learn of the rights and responsibilities of family members and to acquire the skills and knowledge to strengthen and enjoy family life.

“Individual”: to develop the skills necessary for achieving fulfillment as a self-directed person; to acquire the knowledge necessary for achieving and maintaining physical and mental health and to develop the capacity for coping with change through an understanding of the arts, humanities, scientific processes, and the principles involved in making moral and ethical choices.

“Life-long Learner”: to develop the skills of reading, writing, mathematics, spelling, speaking, listening, and reasoning and apply them in a context that creates a positive attitude toward learning.

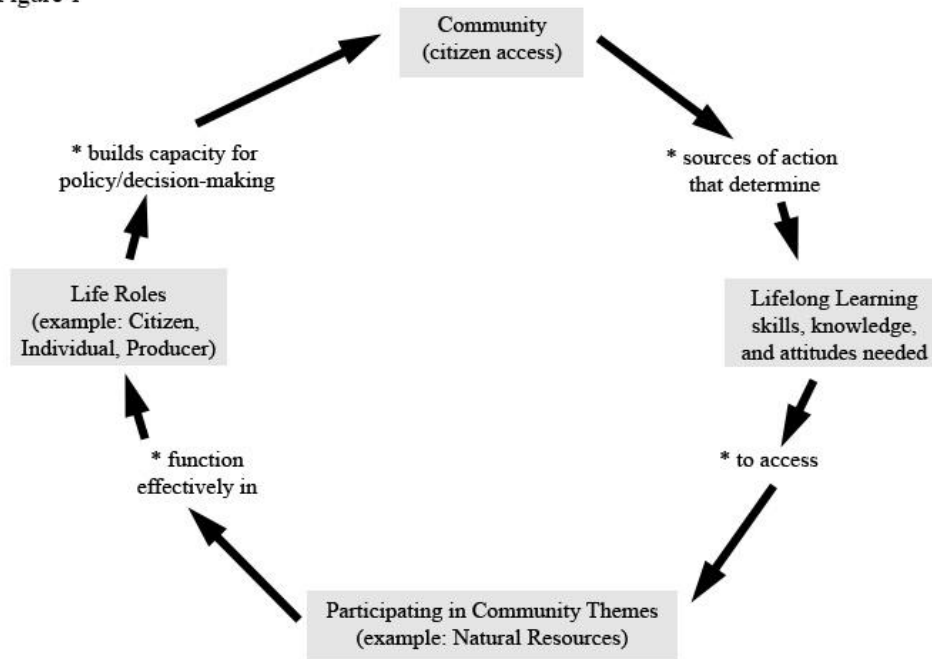
“Consumer”: to acquire knowledge and develop skills in the management of personal resources necessary for meeting obligations to self, family, and society.

Producer”: to learn of the variety of occupations; to learn to appreciate the dignity and value of work and the mutual responsibilities of employees and employers; and to learn to identify personal talents and interests, to make appropriate career choices, and develop career skills.

These life roles were taken from the Oregon State Education Goals, which attempt to provide every student citizen with the opportunity to learn to “function” effectively in six life roles. Public school should provide developmentally appropriate participation during the school experience to accomplish this.

The graphic below illustrates the community processes at play with lifelong learning, community themes and community life roles. It is important to note that although we are focusing on natural resources in this educator’s guide, this process can be used for all community themes. An example of the community process for the Natural Resource theme is shown below.

Figure 1



In Figure 1, citizens access and participate within a community in a variety of ways. Often this involvement serves as a source of action where life-long learning (skills, knowledge, and attitudes) is needed. This participation occurs within community organizations that can be categorized into broad themes such as natural resources. The interaction of community members within these themes allows for functioning in a number of life roles such as citizen, producer, and consumer. The result in this community process is to build a capacity for policy and decision-making among all members of the community.

Understanding how communities are organized and the way in which they operate will help educators as they connect students to their community. It will identify the knowledge and skills that will be developed, themes that will be addressed and what citizen roles will be focused on and practiced. This all provides an educational focus with the community at the heart of what we do.

## COMMUNITY-BASED EDUCATION

### *Relationship Between Schools and Communities*

The following series of graphic representations of possible relationships between school programs and community help highlight the notion of what community-based education can entail.

Figure 2

Figure 2 represents the typical relationship that exists between schools and communities. Students take a set of discrete courses in what often looks very little like the experiences taking place or needed in the community. Upon graduation students are assumed to know how to be a participating, contributing member of the community without really knowing what that means or having had previous experiences or opportunities within the community. This is the most common model and experience most of our students have as they move through the educational system.

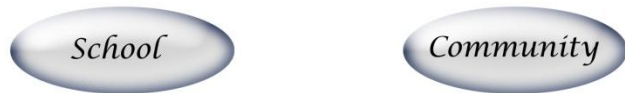


Figure 3

Figure 3 shows school activities taking place out in the community, but not interacting with the community processes. An example would be stream studies at a local site where there is no additional purpose other than to do stream studies. The school has not been asked to serve as a resource or to participate by the community. This is simply more school happening outside but there is no opportunity to understand the context of the work or have an opportunity to interact with the community. This may also include a field trip or guest speakers from the community who come in to school to talk about what may go on out in the community, but again students do not experience it in a citizen role.

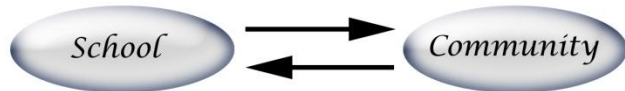


Figure 4

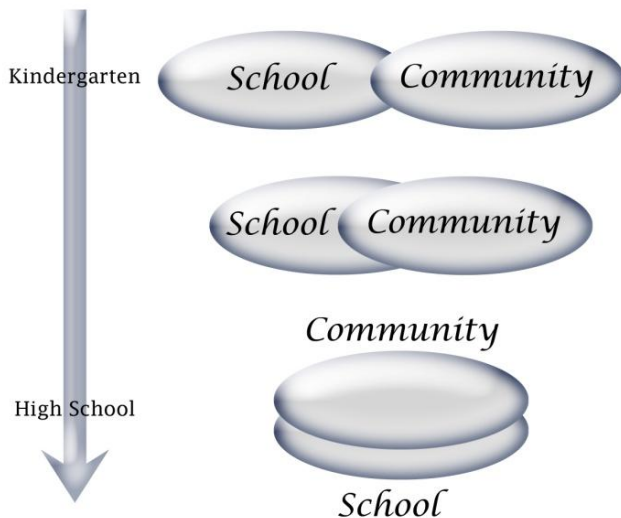


Figure 4 represents the relationship between schools and community advocated for by a community-based education program. In this model, schools are involved in serving as a resource for the community. The skills, knowledge, and attitudes are developed within authentic experiences in the community. Student-citizens are involved in the community processes and are considered a valuable resource by the community. Note that the amount of involvement may vary as you move from K-12.

Developmentally appropriate experiences in the community would likely occur less frequently in the primary years than as a 12th grader who may be in the community arena nearly full time. Elementary school students should have frequent exposure to ecosystem studies and can be powerful spokespeople when given the chance to be community participants.

It is important to note that this relationship between schools and communities is almost always mandated in documents intended to guide the educational process. For example, the mission statement from the Salem-Keizer school district reads:

*In partnership with the community, we ensure that each student will have the essential knowledge, skills and attitudes to be a life-long learner, a contributing citizen and a productive worker in a changing and increasingly diverse world.*

If we are to take this seriously, we need to design our programs in partnership with the community so the learning that takes place is within the context of the community. Most schools and districts across the country have similar mission statements, yet most learning that takes place is not within the community context, but rather in isolated classrooms. Establishing a community-based program is the fulfillment of the mission we have been given. Important knowledge, skills, and attitudes are still taught and content standards are addressed, but now it is within the context of a “partnership with the community.”

There are times during the instructional cycle when educators may be engaged in any one of the three graphic representations (Figures 2, 3, 4). This is to be expected; however, what is being advocated here is that whenever possible and appropriate, students and communities need to be more intentionally connected. Both schools and communities benefit directly from the approach shown in Figure 4.

This is a major paradigm shift and cannot be achieved by a single individual in a short period of time. What we are proposing will be a long and somewhat difficult task to accomplish. However, this approach will be rewarding enough for students, teachers and community members that, once implemented, it will be difficult to go back to a more traditional model of education.

## THE COMMUNITY-BASED EDUCATIONAL PROCESS

There are many ways that community-based education can be carried out in schools and in the community. The Northwest Center for Sustainable Resources (NCSR) has developed a framework that can help guide the implementation of a project or program. This can be helpful for those just starting out or for those who are looking to better organize and formalize their current work with the community. Each school and community will have unique characteristics and circumstances but the following process can guide the work in almost any school-community.

### Community Exploration

This section will describe a process to enter and explore the community. It is here where students learn what resources and needs are in their communities. This information can be used to identify student opportunities and to select student academic experiences. The focus is on the authentic participation of the student-citizen in the work of the community. Students and schools will then be viewed as a valuable resource for the community.



In this first step of the community-based educational process, students discover that the community uses and manages resources in a variety of ways. Numerous agencies—city, county, state and federal—are responsible for carrying out mandates and laws regarding the use and management of these resources. Businesses, industry, and other community groups are also interested and involved in the use and management of resources.

For the educator, here is the entry point in developing experiences and opportunities for students that are community-based. The goal is to find a task or project the students have been invited to participate in by the community.

However, as educators enter the community and participate in the public domain, they will need to form community partnerships since these are generally less familiar areas of study for them. A number of ways to have students explore the community are showcased in the lessons of this educator's guide found in Appendix A.

The lessons will connect students to their community. These are a collection of classroom activities intended as a springboard for beginning the process of exploring the community in which a project will take place. The goal of this curriculum is to empower teachers to identify student preconceptions about their community, to explore the assets within the community and to find opportunities for implementing change. In addition, these lessons help students identify the character of their community and conduct and tabulate public surveys to determine community attitudes and needs.

The lessons and tools found in the Appendix provide teachers and students with the opportunity to explore their community. The first step in the process for both teachers and students is to identify what makes up a community. As a result of this exploration of community needs, opportunities, and resources, potential community partners and projects can be identified. Involving community partners in the identification of real and authentic projects and involving students in selecting the work is a critical step along the way and at the core of what community-based education is all about. Lessons 1-12 in Appendix A of this manual are designed to facilitate this first step in accessing the community. These lessons are appropriate for all grade levels with necessary modifications as needed and should provide support for students and teachers as they start their community-based projects.

As young student-citizens engage in authentic educational experiences through community-based projects, it is important that they first understand the community around them. They should be able to place the community project within an understanding of what that community is. If we expect our students to be contributing members of the community (found in almost every educational mission statement in the country) then they will need to have opportunities to discover and participate as young citizens.

### **Information Gathering**

With the background and foundation of discovery and examination of community along with the identification of various needs and opportunities present from the previous section, students now are ready to take the next step.

The next step in the community-based process is to conduct the research, survey or inventory, monitoring, or other tasks necessary to complete their work. In this part of the instructional process the teacher can “show off” the educator skills they know so well.

It is within this arena that the educator is most comfortable and familiar. This is where the necessary skills, knowledge, and attitudes are developed within the context of community participation. This is also where the district, state, and national content standards are addressed. If these standards are important to our community, then schools should be able to find experiences in the community where these standards are needed or used. The selection of student experiences from the public domain needs to take these content standards into consideration. The content standards should be viewed as a means to an end and not the ends in themselves. Educators will need to use, modify, or create educational materials, activities, and labs that provide the information necessary to accomplish the task that has been selected. Traditional materials, texts, and labs may still be appropriate, but now are used in the context of solving a problem or completing a



task in the community. In addition, educators will need to access community resources and expertise. This means that the educator does not need to be the expert but is now truly a facilitator— lining up and arranging resources, materials, and experiences from a variety of sources. Forming partnerships with the experts in the community will help both the educator and the students develop the necessary skills and knowledge.

This section addresses the *information gathering* part of the instructional process and provides ideas and resources to help teachers and students carry out successful, authentic experiences outside of their classrooms. This can be a daunting task but if organized and planned well many hurdles can be overcome and problems avoided. The process of organizing a community-based project will be explored later in this section. In addition, in the Appendices you will find the “nuts and bolts” of how to develop and carry out community-based opportunities and experiences for your students that will help you in your work. These should help educators plan and organize their efforts in intentional ways.

In Appendix B you will find examples of how science standards and core content can be covered throughout an entire course using community-based principles. Biology is the subject area that has been chosen to show this, but other subject areas can certainly take this approach as well. Many educators are looking for more contextual and meaningful ways to make connections between the content they are required to teach and the natural world around them. There is no particular sequence that needs to be followed for these lessons; in fact, the sequence should be determined by the needs of the community and the priorities that have been set through the community mapping and surveys of section one. Although there is always concern by teachers regarding their course’s scope and sequence and their state standards and assessments, there has been research to show that using community and the environment as learning context can improve student learning. In a recent publication, *Closing the Achievement Gap* (Lieberman and Hoody, 1998; [www.seer.org](http://www.seer.org)), research has shown that students actually perform better when the environment is used as the integrating context.

It is now time to engage your students in authentic community projects that will allow them to serve as a resource for and raise the decision-making capacity of their community. This participation as a citizen of the community needs to occur throughout their education so upon exiting their formal academic pathway they are comfortable in the various roles and responsibilities of contributing members of the community. They have “been there and done that.”

The following process for conducting community projects is taken from the Community Mapping Program of The Orton Family Foundation (see appendix D). Additional tools and resources to explain and support this process have been pulled in from a variety of other sources. The general progression they are suggesting is:

- Organizing School and Community
- Planning a Community-based Project
- Conducting a Community-based Project
- Sharing with a Community (covered in the section on Community Participation)
- Evaluation and Assessment (covered in a separate chapter)



Each of the categories above is covered in the following sections, providing educators with ideas, a framework, and tools to conduct a community-based project. As in previous parts of this manual you can pick and choose those pieces that best fit your needs and setting. Lastly, it is critical that students and community partners are involved in some way with each step along the way. There are suggestions for how to do this in the sections that follow.

### ***Section 1 - Organizing a Collaborative Project***

This section assumes that you are an educator who is interested in starting one or more community projects and have completed an exploration of your community to provide the appropriate context for students. You either have a general idea of what you and your students want to accomplish by conducting a needs or opportunity assessment and a better idea of your timeframe, or a few prospective partners in mind, but no specific project ideas. The key is to identify people in the community and academia who share common interests and then bring them together to explore possibilities.

The project organization phase can be the most creative and least restrictive process involved in undertaking a community project. This phase should focus primarily on identifying and organizing the interests of key community partners, specialists and educators who might have a stake in the issue or problem that has been identified through a needs or opportunities assessment. It should involve creating a project coordination team that can further define, assist and support the project to completion.

Consider initially assembling a cross section of interested individuals from the community and school system to discuss either a single project or a program that will have a series of projects over a longer period of time. Besides educators involved in related disciplines (English, Social Studies, and Technology), your invitation list might also include city and county managers, interested community members, business and industry representatives, appropriate government agency representatives, and of course, students. Organizations with resources that may be needed to carry out the project(s) should all be invited to participate in the initial coordination meeting and then be sent regular updates of progress, regardless of whether they actually showed up. Because community projects often depend on the guidance and leadership of a community mentor(s), it is very important to find solid candidates for this critical role early on. Not all community members relate well to students and academic settings. Hence, project coordination groups should try hard to enlist community partners who can be effective, professional mentors and have both the time and experience to work closely with the students.

A possible course of action is as follows:

- Identify issue of interest (refer to lessons from Community Explorations)
- Identify coordination group
- Hold coordination meeting
  - Recruit support
  - Expand awareness
  - Identify mutual benefits
- Turn issue into project

A *Basic Project Timeline* was developed to guide project teams through a chronology of steps typically involved in carrying out a successful project and to help them anticipate when various events might occur. The timeline is presented in Appendix C as a preview of the processes to follow, as it is always helpful to have the big picture in mind when launching a new effort.

It is also important for students to be involved in the selection of community projects. The following tools (available in Appendix C) can be used to determine the order of implementation of community projects according to project importance and resource availability. These tools may be completed by individual students or by a group of people on a project team. It is helpful to have a list of possible projects that have been requested by the community available before filling out the worksheets.

The *Problem Identification and Analysis Form* is designed to help select a community project is. Much of the information needed for this will come from the community exploration done previously.

The *Stoplight Importance and Resource Availability Worksheet* allows for the rating of each project. You will need to have the goals of the community projects you are considering and the resources needed to complete the project before using this worksheet. For each project, circle one number describing the project's importance towards accomplishing community goals, and one number describing the availability of resources. Average the scores of the students or groups for each project.

The *Stoplight Worksheet* will take the averages of the community projects from the previous worksheet and list them in descending order. You can now select the projects you can begin now by checking the "start" circle, check the "wait" circle for those projects you can take on later, and the "stop" circle for projects that are not important and you do not have resources to complete.

As a result of this process students and project teams can narrow down the community-based opportunities into a single project that you, the class and community partners can begin planning.

## ***Section 2 - Planning a Community-based Project***

As in the previous section there may be some overlap with this process of project development and the lessons in the manual on community needs and opportunities assessments. However, this section goes into greater detail on how to specifically plan to conduct the project and provides tables and flow charts to help in completing this step.

The planning phase is generally the most crucial part of carrying out a community project because this is when goals are set and products are defined. This phase can happen as part of an organizing school and community phase or separately if an appropriate group is ready to tackle a specific issue or topic. If compelling needs are not clearly articulated at the outset, the project may not ultimately address the right academic and community goals. If the goals and products turn out to be too ambitious, the project will fail to meet expectations. In this section we will examine a number of ways to define realistic scopes of work for projects, with the common objective of keeping projects small and simple.

### Step 1:

The first step in the planning phase involves collecting initial information to help assess both the level of readiness to tackle a specific project and the level of commitment each partner has toward making this effort a success. It involves collaborations among community partners, students and the teacher to establish goals, identify school and community resources that are available (both people and materials), and to identify roles and responsibilities. It is critical to define the roles, tasks, and responsibilities of each member of the project team. The relationship between the community partner and the school partner is, in effect, that of client to consultant. The community partner is “hiring” the school partner to do a job, but also providing the guidance necessary to successfully complete it. This is a new relationship for students and many teachers. The other part of the relationship is the mentoring role that the community partner plays with the students. This may be a new relationship for the partner. Discuss and clarify these roles well ahead of time – for the project as a whole and for the activities and tasks involved in carrying it out. *The Partner-School Expectations* list found in Appendix C can provide a starting point of discussion for building the school-community relationship.

One way to make the community partnership more intentional is to sign a memorandum of understanding (MOU) with the community partner or organization. This document should identify common goals and objectives as well as expectations and products. It may be possible to include materials and supplies that the partner can provide for the project in exchange for student involvement saving the school valuable resources. At a larger scale, agreements can even be reached between city councils and schools that provide proclamations about the importance and value of city partnerships with schools. One example, entitled *Formalizing Connections to the Community* is provided in Appendix C.

### Step 2:

The design and scope of community projects are highly dependent on how much time educators, students, and community members feel they will have to plan and carry them out. Time commitments must be made relatively early in the project design process as these will directly affect the final nature and outcome of the project. One approach to address the time issue is to provide time for team meetings during the summer months after educators have teamed up with a community partner and they have both agreed to move forward in planning a project for the next school year. Although students may not be involved in this initial planning you can bring them on board once the school year begins.

Project team meetings can address curriculum development. Some meetings may focus on the introduction of new technology, while others deal with project management and how to build effective community-school relationships that maximize the effect on student learning, achievement and self-esteem.

During the planning phase it is important to clearly document the academic standards and goals that will be met by the community project. Documentation may take the form of listing academic standards that will be met and constructing rubrics for assessing student work. It is also paramount to keep school administrators advised of and even involved in the various phases of project development and deployment and to demonstrate how your students are meeting academic standards and goals throughout the process. Most school administrators also value the

life skills and workplace experience students realize as a result of working with community mentors.

Many project teams adopt more of a client-contractor approach, in which students (the contractors) continue to refine their products until the community partner (the client) is satisfied. Otherwise, students would be able to turn in “C” work and be done with their assignment, leaving the partner’s expectations quite unfulfilled and their interest in future projects quite diminished. Memorandums of understanding, official contracts or other forms of agreement will help to formalize relationships and secure funding and equipment in return for services provided.

Depending on class size, it may make sense for all students to be involved in each of the identified tasks - research, data collection, technology applications, and oral presentations, for example. Another approach may have students working on specific tasks they are most passionate about, such as: conducting public surveys, doing historical research, or writing press releases as part of a publicity campaign. Encouraging students to take responsibility for shaping their teams and then working together to accomplish a common mission can result in extraordinary life lessons.

The *Project Planning Outline Form* and the *Project Resource Planner* found in Appendix C provide an outline and structure to support this planning.

#### Step 3:

Initial information-gathering objectives are vital to the design of a viable, successful project. Community members and educators must supply the majority of details together as a team that will lay the groundwork for project planning and design. Where missing resources are identified, additional community support is often instrumental in tracking these down locally or constructing alternative or interim measures to keep an acceptable form of the project moving forward. This stage of the process may also be referred to as the, “*Who – Why – What – Where – When & How*” stage of project development. The forms in the Appendix from the previous step will aid in this as well.

#### Step 4: Pulling It All Together

You, your class and your community partners have gathered information, collected ideas, recruited available resources, drafted a project and curriculum plan, and weighed the pros and cons of proceeding with a well-defined scope of work for your community project. Your planning process may not have advanced in a linear or straightforward manner, but rather with multiple concerns being investigated simultaneously by different participants and sub-groups. This is an effective approach as long as everyone comes back together to assimilate all the elements into a cohesive plan.

The *Checklist for Establishing a Field Study Site* and *Project and Field Site Considerations* found in Appendix C will help to frame these discussions and will help identify and outline important considerations as you plan for classroom excursions out in the community to a “field site.” This planning is essential for the safety and success of the project.

### ***Section 3 Conducting a Community-based Project***

Once the school-community is organized and a community project has been planned out, then it is time to carry out the project. In this section ideas are presented to assist educators in carrying out the project. Communication is the key to help keep ongoing dialogue occurring with those people in the community involved in the project and to help structure classrooms out in the community. These “nuts and bolts” considerations are absolutely necessary to consider as you plan to take students out in the community.

If the implementation phase of a community project had to be characterized by one key word, it would be “communication.” Ongoing communication – and lots of it, at all levels – is paramount to successfully carrying out a community-based project. Communication must get off on the right foot at the beginning of project implementation, as this is often where students are first brought into the process and the commitments are cast in stone.

Communication channels must be consciously kept open throughout the project. Otherwise, you may be tempted to revert back to your old ways of doing things if you are not used to working in collaborative community-school partnerships. Many project teams have judiciously elected to have the students stay directly in touch with their community mentors, knowing that the educators and mentors would need to coach them on the expectations involved. These types of student-mentor relationships may be new to everyone, so be prepared to spend a little class time reviewing the communication plan, ideally with the project mentor and other community experts present.

Undoubtedly, the most rewarding experience that students express about their community project is the opportunity to work directly with community members, particularly the primary project mentor. On the other hand, the most challenging aspect of project work for students is working with community members in general. These are skills and behaviors that need to be stressed for the students as they interact in the public domain. Expectations also need to be made clear for the community partner to operate most effectively. An exhaustive list of expectations and guidelines can be found in Appendix C entitled *Partner-school expectations*.

As the community project is carried out students, teachers, and community mentors need to adhere to the responsibilities and timelines that were originally agreed upon, making necessary corrections along the way to stay on track. The mentor needs to clearly define the quality of acceptable work and become actively involved in reviewing the students’ work and products throughout the project. The goal is to ensure that the mentor feels confident in the value and quality of final products developed by the students and is comfortable putting those products to use.

An essential goal in a community project that fully engages students is to incite a sense of ownership in the project. One method for doing this is to encourage the students to become actively involved in solving problems and determining how the project will enlighten or help others care for and appreciate their community.

When individuals’ ideas are recognized, they will generally want to see their proposals materialize and will help make that happen. Another way to foster ownership is to have students

who are already familiar with technology help demonstrate its capabilities or assist fellow students, acting much like a teaching assistant. Project teams can lend experienced students to lower grade levels – both the younger students and upper classmen like this arrangement and it certainly contributes to student learning on all sides. The upper classmen develop confidence, critical thinking skills, leadership skills, and professional ethics as a bonus to their academic achievement. The challenge is to guide students toward a vision without providing step-by-step instructions.

The next steps in a community project are the sharing with the community (covered below in the section on Community Participation) and evaluation and assessment (covered in the next chapter).

### **Community Participation**

Upon completing the information gathering phase, the next step is for students to participate and produce products useful at the community level. Participation by the student/citizen in the community is most often the piece missing from educational programs. If projects are selected



from community documents, then the policy and decision-making bodies of agencies, businesses, industries and the community should want to know how things are going. The school, serving as a resource, can raise the awareness and capacity of the community by sharing their findings and information. This may take the form of presentations to policy and decision-making bodies as well as a variety of other community groups and educational institutions. Having students consider social, economic and ecological factors is an important part of this information dissemination and community renewal. Developing public products allow students to develop a deeper and stronger connection to their community.

Products generated by students in collaboration with their project mentor will take many forms, so the best way to disseminate them will vary between projects. Whether the end product is intended to reside on an agency computer, a public web site or town hall wall, the young creators certainly need to learn to communicate their findings to their partner and the public in a coherent, relevant way. This is the ultimate test of how well the students understood their mission and how successful they were in meeting the expectations of their teachers and mentors. The community project recognizes the value of having all participants share their experiences and results with each other and with the public. The bottom line is to require that students present their projects to the public or to other groups outside their immediate project team.

Although a wide variety of student products can be completed, sometimes the community need or request that generated the project may also determine a specific product. However, in addition to the community partner's product, having students provide an educational product to the larger community expands the dissemination of important information to the community.

At every project presentation event, opportunities should be made for acknowledging the work of all team members – students, educators and community partners – and for recognizing the special contributions of selected individuals who truly deserve to be singled out as a role model, leader, troubleshooter or risk-taker. Our experience has also impelled us to save time for the students to express their gratitude to mentors, fellow students, teachers and community specialists for their support. The students will frequently offer words of appreciation if given the opportunity.

Community projects often require students to interact with the public to either collect or disseminate information about their project. This situation can offer yet another means of creating ownership in the project by allowing students to take the initiative to design, publicize and co-lead (with their project mentor) facilitated meetings, informational meetings or dedicated surveys. Of course, educators will need to match initiatives like this with the age and capabilities of the students – the younger grades may only be capable of planning and carrying out their own final presentations, for example, and not actually organizing or leading key events. One group of high school students in Colorado formed a special task team around the publicity needs of their project and recruited a local journalist to mentor them. They had to communicate and coordinate with the other project task teams to correctly reflect the message their entire project team needed them to deliver. The guidelines below resulted from the publicity team's journey into the kingdom of public affairs.

#### Publicity Strategy Guidelines for Public Events

- Research other events that may be planned for the same time as early as possible (6-8 weeks in advance is not too early).
- Let others know the date and general purpose of the presentation as soon as possible.
- Decide who should be informed and invited.
- At least four weeks prior to your event, contact your reporter to coordinate the press release. Record or FAX your own Public Service Announcement (PSA) to a local radio station and develop flyers to distribute and post in strategic locations around the community.

Another strong recommendation on sharing information beyond the “walls” of your community project is to keep the media aware of project meetings, workshops, field trips and presentations on an ongoing, consistent basis. An adult project team member should make a concerted effort to always keep the local reporters informed of opportunities to cover project activities and developments, throughout the course of the project. Reporters love to catch students working with their mentors, both in the classroom and in the field, and demonstrating their newly acquired skills to others. Many project teams elect to present their projects to city and county officials on their own – reporters will often jump to cover these events since student citizenry is a noteworthy concept. Community awareness of students' new role in shaping perspectives is definitely worth cultivating.

A recent approach has been to have participating schools and partnering organizations post representative products on their own web sites. The commitment to share results not only gives other project teams access to a valuable knowledge base, but also validates the students' work and contributions to the community.

The Community Participation step in the instructional process is essential if young citizens are going to be authentic contributors and resources for their community. In this way, young citizens raise the awareness of the community and its capacity to make informed decisions. Think what a resource schools and students could be for educating their communities while engaging in their own education.



## EVALUATION AND ASSESSMENT

Evaluation is the last and very critical step in carrying out a community project. However, it is the one most often ignored or overlooked. To help you measure the success of the students and of the project we have included some ideas and tools to assist in this process. There are also communication and “thank you” opportunities that need to be attended to with the community to maintain a positive atmosphere in the future.

Without adequate evaluation of both students and projects, success is difficult to measure accurately and without adequate closure, community members will remain unaware of the success of the project and their role in that success.

Finishing community projects each year takes on special meaning regardless of whether you plan to build on your current project in future years or tackle an entirely new issue. It is a time to reflect on what you might do the same or what you may want to change next time. Evaluations and assessments can measure what was learned from the community experience as well as how you might better utilize available resources more effectively. The evaluative process can indicate whether goals and objectives have been met and what knowledge, skills, and attitudes have been acquired by the students.

This section will briefly address three levels of evaluation from the standpoint of identifying and applying lessons learned to future projects - individual student achievement, overall project success, and assessing the level of community in the classroom.

### *Individual student achievement*

Educators often feel best equipped to handle substantive, formative assessment. This should be done periodically throughout the project and may take a variety of forms such as informal interviews, self-assessment, group assessment, mentor assessment, journaling, final products, and even more formal exams. Scoring guides and rubrics can be developed to make this a more objective evaluation.

The project team and community partners may want to assist in the development of evaluation criteria. Group discussions could generate assessments with such questions as:

- What does success look like?
- Where are we on the road to success?
- What do we each need to do to get to success?
- What do you understand about your project?
- What don't you understand?

In addition, the team and partners may want to:

- Review interim products and provide feedback to each task team and/or individual.
- Develop progress report formats that can be administered by the educators and turned in to their partners for review, with consequences for missing deadlines. The *Student Progress Report Example* could be used for this and can be found in Appendix C
- For projects that are divided up into task teams, look for evidence of inter-task team communication and coordination; have students determine how team interactions can be improved to positively affect the integrity of the final product.

Part of the evaluative process is to also get feedback from the community partner. This is especially important when there may be more of a one-on-one internship experience for the student. For this situation there are two forms in Appendix C, *Internship Evaluation Partner* and *Internship Evaluation Student* that should provide evaluative feedback from both the partner perspective as well as the student perspective.

### *Overall Project Success*

The second evaluation method involves a formal process of evaluating the overall project and not the individuals involved with the project. This can be done in any number of ways including interviewing key participants (i.e., educators and the primary project mentor) and having them fill out a standardized evaluation form. Alerting those participating at the beginning of each project that certain materials will be requested certainly allows them to plan the documentation and evaluation processes more efficiently. Generally the materials are collected and assimilated by a project team, although for single projects, the exercise is also strongly advised as a way to document your efforts and grow your program at a comfortable pace, based on timely and relevant feedback.

There is a *Final Project Evaluation* form in Appendix C that can be used as a project evaluation and assessment.

As you conclude the project, make sure that the students, educators, and community members that have been involved with the project not only receive the assessment feedback, but also a very big thank you. As always students should be an important part of this process.

### *Assessing the Level of Community in the Classroom*

Assessing the level of community in the classroom is an outstanding way to assess the level at which a project or program is community-based and provide opportunity for reflection and redirection.

What are the key components of inquiry-based, community-based education activities, and how can attainment of these key skills be identified in individuals? As part of the Urban Ecosystems Project (UEP), staff members of the Center for Science Education (CSE) at Portland State University set out to answer this question as they began to work with middle school teachers participating in grant activities. Responses were collected from teachers over the course of two

years. Results indicated that the set tool, a rubric, was instrumental not only in identifying key components, but also in assisting teachers in the process of self-reflection and better understanding the goals and strategies involved in community-based education. The *Community-based Education Development Continuum, (C-BED)*, is a tool (rubric) designed to explore the development of teachers to facilitate community-based educational activities within their classrooms, schools and communities.

The C-BED:

- Establishes a base of prior knowledge in participating teachers
- Tracks professional growth and development
- Determines the effectiveness of teacher training and intervention strategies
- Provides a common vocabulary, set of goals and strategies for developing projects and partnerships among participants
- Switches emphasis among participating teachers from a focus on project development to a focus on professional development, to ensure sustainability of ideas and practices
- Provides assessment data for reports
- Communicates goals, strategies and other information to participants and other interested parties
- Helps teachers clearly see the “big picture” of community-based education

The *Community-based Education Development Continuum* can be found in Appendix C and can help educators and community partners examine their work and their relationships. It is often difficult to find the time and energy to be this reflective. It may help to ask community partners and students to assist in this process. It is yet another way to involve all the stakeholders in this process and help others see the key characteristics of community-based education.

# EXAMPLE PROGRAM

## STRAUB ENVIRONMENTAL LEARNING CENTER

### **Background**

Community-based programs vary dramatically depending on the participating community and schools and the community theme that becomes the focus. The following example program takes place within a natural resources theme and evolved over a fifteen-year period of time. It is not meant to show one particular way of conducting a community-based program, but simply to highlight how one could look as you cycle through the three educational processes of community exploration, information gathering and community participation.

This example highlights the work of Jon Yoder. Jon is an award winning science teacher who taught at North Salem High School in Salem, Oregon for over twenty years and is currently the Science Specialist for the Salem-Keizer School District. Jon is also the Secondary Education Coordinator for the Northwest Center for Sustainable Resources (NCSR). It is in this capacity that Jon has written this and other educator guides to help schools and communities work towards meaningful and long-lasting educational partnerships. Jon also has presented at numerous state and national conferences and conducts summer workshops for teachers and community partners across the country. The following is an example of his work.

North Salem High School is an urban school of 2000 students with over 70 percent of students on free and reduced lunch. The Straub Environmental Learning Center (SELC) is a facility built on school property that is a direct result of a community-based approach to education and the resulting partnerships and value seen by the community. The SELC is host to North Salem High School students who take *Field Biology* and an independent study *Community Applications* courses there, as well host to a nonprofit community-group that designs and conducts community programs.

### **Introduction**

Community-based education has been defined and implemented differently in many classrooms throughout the country. However, one common thread is the notion that students should be connected to the community outside their classrooms in real and authentic ways. This methodology is also explicitly stated as a goal in the national teaching standards and can be found imbedded in most school district mission statements that refer to developing students into citizens. This support can be used to further justify the value of this approach.

For me, there are significant components and a process to community-based education that need to be present in order for it to provide students with the full experience of being immersed in and understanding the role of a student-citizen. I tried to follow this particular framework or process of instruction whenever possible. This work with students occurred in three domains: exploring the community, conducting the work of the community, and producing products for the community. The details of each of these will be described later as I discuss my work. Teachers and students find a variety of benefits and value in each of these domains and it is there I would like to begin.

As students are exposed to their community through explorations, mapping, surveys, needs and opportunity assessments and more, they begin to gain an awareness of their community and the agencies and organizations involved in supporting it. Unfortunately for many, this is the first time they have had the opportunity to actually get out in the community and gain an understanding of how a community looks and how one operates. If I am to call my program or instructional approach “community-based” it seems that the students should gain a clear understanding of what their community is and how it functions. This goal is at the center of my work with students, many of whom have been disconnected from their communities, from adults who surround them, and even from each other. Community-based education can reconnect them, and to me, that is the great value of this work.

Once the community context has been identified and described and a project selected, the “school” work begins. The value for students is that they rarely ask, “Why do we need to know this?” since the work they do is directly related to the work of the community. In addition, often students will have a role in selecting their work or projects. For most, this is the first time they have control and ownership in constructing and determining their learning. The teacher’s role becomes one of a facilitator and also coordinator of the content and concepts connected to the projects that students need to know. Often a community partner is involved as well. Student motivation and connection to their learning is high and they are deeply engaged in the work of the school-community.



Students work on an interpretive trail as part of an Oregon Department of Fish and Wildlife project. Photo by Jon Yoder

In the next step of the educational process, students produce products not only for the teacher but also for the community partner who has requested they do work for them. Students are also required to do a second product either individually or as a class that involves educating the larger community. Since the work goes out to the community at large, the quality of the work needs to meet a higher standard. This raises the benchmark for students and they find that they are more capable and proficient than they previously thought. I have seen many students who have been unsuccessful in the regular classroom produce top quality work and take great pride in knowing what they can achieve. To see them come alive in the learning process is a great reward for both teacher and student.

Lastly, I see great value in community-based education through the development of community within the classroom. It is not just about connecting students to the community outside the classroom but also creating that sense of community inside the classroom. Students from a

variety of academic and cultural backgrounds working together in this unique way, create a classroom culture and environment that is dynamic for both the teacher and students.

### **Exploring the community**

If community-based education is to indeed be “community-based,” then what is done in the classroom needs to be based on what is out there in the community. For too long, schools and the communities have operated as separate entities. Schools should be viewed as an integral part and serve as a resource for the community. The question then becomes, how can schools and communities form these critical partnerships? It is the school’s responsibility to help students become aware of and engaged in the work of the community. The goal is to become a resource for the community.

There are a variety of activities that teachers can engage their students in to raise awareness, understanding and involvement in the work of the community. In my classes, we often start with the development of a natural resources directory. Students create and then divide up a list of all the agencies (state, county and city), nonprofits, businesses, and other groups that are connected to natural resource use and management. They find contact information, what the group does – its mission, what projects they have in the area, and if there are ways for students to be involved. We then begin to develop a clear understanding of the roles of the various community groups and how this plays out in the area of natural resource use and management. It also provides a list of possible projects and a directory for future reference on questions that develop from projects throughout the year. From this list of possible projects we often invite potential partners in who then present their request for work to the students. The students can then decide if and when we can do the work for them. We have even signed informal memorandums of understanding where we state what we need and they state what their needs are in order to complete the work.

There are, of course, many other ways teachers can connect students to their communities. Early on in my work I would examine public documents from agencies, such as a county comprehensive plan, and find the citizen involvement component that was almost always there. I would call and tell them I had a class full of citizens waiting to be involved. The long pause at the other end was always amusing. Often the community is not very well equipped or prepared to partner with young citizens. As our students’ work became more widely known, we began to have agencies and groups come to us and ask for our assistance. Community needs and opportunities assessment surveys are yet another way to solicit community project ideas and gain an understanding of what community is.

### **Conducting community-based projects**

#### *Getting students out*

Once a project has been selected and students understand the purpose of the project, then the work begins. This also means that the teacher will need to organize a variety of instructional materials and activities related to the work. Over the years, I put together numerous notebooks and information folders with reading materials and activities on a variety of projects we undertook. Most projects we selected in later years were supported by previously collected curriculum materials. Many resource agencies have materials and the Internet can be a good source as well to add to project files. The content part of the instruction is important so students

know it is not time to just go out and play. The content is based on the projects that are selected and what students need to know in order to complete their work.

There are many factors to consider when engaging students in this way. This is especially true as you take them out of the classroom. I would like to address some of those issues and how I handled them in my classroom. Not all will apply to your situations, but they may provide you with some ideas to consider when doing community-based work.

### **Pre-site visit:**

- ✓ Selecting a project (Described in the previous section)
- ✓ Content and curriculum (Described above)
- ✓ Planning work with a partner

This is a critical piece if you are to do this long term. It is necessary to develop positive relationships with community partners who feel that you and your students are capable of delivering work of high quality in a timely manner. This was central to any success we had in our program. You will want to discuss some of the following in your interaction with a partner, both in and out of the classroom:

- Define the purpose of the partnership
  - Share the content to be covered
  - Exchange teacher and partner daily schedule and availability
  - Explain school rules regarding dress, language, etc. – partner is a role model
  - Describe how to access the school building – parking, reporting in, and finding the classroom (not between classes and students should escort guests to class).
  - Provide support and suggestions for any partner presentations to students.
    - Business and agency personnel are not always adept at classroom presentations or student interactions and may need guidance and suggestions.
  - Explain the background of the students –academic, cultural, etc.
  - Discuss student behavior - the teacher must supervise at all times
  - Visit study site with partner beforehand – where will you be meeting
  - List the equipment needs
  - Determine protocols to be used
  - Arrange any training necessary – do before going to the study site, if possible
  - Research liability issues – Are students covered as a class activity?
  - Contingency plans – ideas for a plan B and phone information
- ✓ Transportation
    - Make sure you have made arrangements ahead of time for transporting students and you have notified the school office when you will be gone.
  - ✓ Paperwork
    - Complete all the necessary paperwork that is needed when taking students off campus. Medical forms and permission slips with emergency contacts are important to take along with you each time you are out of the classroom (I do one at the beginning of the year). In addition, schools sometimes require paperwork each time you are gone or at least notification anytime you are not in your classroom.

- ✓ Rules and expectations
 

These need to be established immediately and referred to frequently. I often reviewed these before each class outing and even provided examples of what the expected behaviors look like. All students signed an agreement that allowed for dismissal from class if they violated these expectations. I dismissed only two students in over ten years of this program.
- ✓ Safety
 

Safety needs should be paramount in the teacher's mind at all times. Working with your community partner, you should try to anticipate tasks and duties that may need extra precautions and directions to ensure safety. I always had students working in groups, never alone. I circulated among the groups frequently. Take a first aid kit along with medical records and emergency contact numbers. In today's world, cell phones can provide an important link to help when needed.
- ✓ Publicity
 

Notify the newspaper as often as you can when going out. They are often looking for stories featuring students doing good work. I built a close relationship with our paper and it has helped to publicize the program in the community. This is linked to funding that can follow this community recognition.
- ✓ Documentation
 

Teachers and students need digital cameras to document the work they do. Photos are used to document the projects they complete as well as show a study site over time when a number of classes work on the same project each year. Those baseline data are important to collect and store. Any documenting done can also be used in presentations that students give as part of their work.
- ✓ Equipment
 

Equipment must be cleaned, labeled and organized. I often assigned students to specific pieces of equipment they were responsible for. They were to make sure everything was ready to go. Students also need practice in the use of some equipment before they go out in the field. We used spectrophotometers, a Colilert machine (for fecal bacteria), GPS units, and other equipment that took special care and practice.
- ✓ Student roles/practice
 

Assign tasks and duties before heading out in the field. Make sure students all know their groups and roles so when they get to the site they are ready to go. Practicing helps.

**On-site:**

- ✓ Organizing work site
 

Visiting the site ahead of time with your community partner will help immeasurably. Also, go over procedures and tasks with students ahead of time.
- ✓ Monitoring behavior
 

Circulate frequently and give positive reinforcement pointing out good work. You are in charge of supervision and behavior; student management is not your community partner's responsibility.



- ✓ Teachable moments
 

Find opportunities to point out the community and content connections to students whenever possible. Students need to see their work in the context of the community and in the context of the content they are to learn. I sometimes verbally quizzed them to see at what level they understood.
- ✓ Equipment check
 

Before leaving the site double check that everyone has their assigned equipment and everyone is accounted for.

**Post-site:**

- ✓ Check in equipment
 

Once back at school make sure all equipment is cleaned and checked in. It makes it so much easier the next time out.
- ✓ Reflection and feedback
 

This is the time to review how things went, debrief about the information collected, field questions, make connections to community, make connections to content, and review next steps for either more field work or producing a product. These debriefing sessions help shape future outings and direct the next steps in the project. It is also important for your students to send a thank-you note to your community partner and for you to arrange feedback from your partner when the entire project is completed.

*Content components and instructional approach*

A common challenge in providing authentic educational experiences in the community is connecting this work to standards and content. However, this is often what teachers have been best prepared to do. It is a matter of deciding what content and standards best fit the community



Students work on a naturescaping project at their school.  
Photo by Rich Swartzentruber

experience, finding appropriate curriculum materials, weaving this throughout their work, and providing meaningful assessments along the way. There are numerous curricula materials available produced by public agencies and other organizations that can be used to teach the concepts of the work being done. These are often tied to state or national standards as well. You should also consider a variety of materials that expand the learning into cultural, historical, and social features of your community work. A

piece of this should be for students to know the community context of the work they are involved in. Other

school disciplines can also be reinforced with journaling as a key feature for many of the projects my students were involved in. Assessment continues to be an important feature of the educational process. The products students develop and all traditional forms of assessment can

be used to measure student learning. Once again, there needs to be some assessment component that reflects their understanding of the community context of their work.

Instructional approaches and strategies tend to take on creative and flexible features as this approach often requires a wide variety of instructional skills and practices. The classroom can be characterized by organized chaos at times and the instructor becomes a facilitator, guide, mentor, parent, and motivator. After an initial set of announcements and reminders, my students often worked independently on particular community projects and content assignments in the classroom, or traveled on their own around campus to complete their work. I had a process and a system of accountability and expectations for this and would constantly monitor their work and their location. I rarely had any issues. They embraced this role of student as the determiner of the time and effort spent on their learning.

### *Challenges*

I have tried to include a number of steps to consider when taking students out in the community to a study site with a community partner. This may serve as a checklist as you engage in this work. In addition, there are some broad categories of need that programs sometimes face as barriers when doing community-based work. I consider many of these as hurdles rather than barriers to getting students out in the community. I have included the hurdles most mentioned by teachers as preventing them from getting out. Be persistent, patient, and positive as you find ways to make community-based education happen. It is well worth it in the end for you, your students, your school, and your community.

- *Transportation*  
This is often the number one issue preventing teachers from getting their students out of the classroom. There is no easy way to work around this, but there are some ways that my classes crossed this hurdle. Our high school has athletic mini-buses that are used to transport sports teams to games after school, but sit unused during the day. I got certified to drive and was then able to use them whenever I wanted during the school day. When there were too many students to fit in one vehicle, I would arrange another teacher on prep that period to drive as well. If there was another teacher who needed a driver during my prep, I helped them out in exchange for their help. I had an English teacher that enjoyed driving to study sites where they could enjoy the outdoors and do their school work while we were off doing our work. Don't allow transportation to be a barrier in getting students out. Be creative.
- *Funding*  
Money was needed for equipment. I started the funding search by writing grants for the first five years. I was able to secure a variety of top-of-the-line equipment, but drew weary of the grant writing grind. So I found several other ways to secure funds. First, a partner asking students to do work can sometimes provide or even donate tools or needed equipment. I was able to get many of my field tools and gloves and other supplies in this way. Once we were viewed as a valuable asset for the community, this became even easier. One example is a state-of-the-art gauging station built on our campus by our State Water Resources Department that feeds a variety of water quality data to a website every 15 minutes. The city of Salem now operates this and students use the data for studies

asked of them. The fact that nearly one million dollars was spent by the school district, the city, and the community to build a LEED-certified Environmental Learning Center next to a creek on campus for community-based classes speaks to the funding potential when the school and community see value in this type of programming.

- *Time*

Your school schedule may be limiting, but again there are always ways that teachers find to get beyond these limitations. Our school is on a block schedule and has 85 minutes per class. I usually limit our selection of community work to a 20-minute distance. That gives us at least 40 minutes at the site to do our work. Finding partners with opportunities closer to your school may help with time issues. We did all of our work during the class period, but some teachers extend this to after-school hours.

*Partners and projects*

It may be helpful to provide examples of community projects that were accomplished through the processes above. Just as important, the community partner we did the work for is listed with the project.

City of Salem: Water quality monitoring

Mill Creek Watershed Council: Stream channel profiling

Oregon Department of Fish and Wildlife: Invasive crayfish study

Audubon Society: Naturescaping project (design, implementation, monitoring)

Willamette Mission State Park: Streamside buffer zone study

Salem 4-H Center: Interpretive trail and platform construction with educational materials

U.S. Fish and Wildlife: Wetlands assay

Marion Soil and Water Conservation District: Invasive species study (Japanese Knotweed)

Kettle Foods: Wetland mitigation monitoring

Private landowner: Species survey connected to city annexation

**Products**

Once students have explored their community, have taken on a community project, and completed their investigation, it is time for them to produce products and to be assessed. For my students, this would be two larger projects, classroom activities, readings and writings, and formal assessments.

Larger projects were dependent on what the community partner wanted from our work and could take a variety of forms. It could be a formal report with data that were collected, a presentation to the partner, interpretive materials, curriculum materials for others to use, or the completion of work projects related to invasive species, restoration work, naturescaping and more. These would be presented to our partner who asked us to work for them. A second type of larger project was an educational project, targeting some part of the larger community. This may take the form of working with an elementary school, creating brochures for the neighborhood, presentations to community groups, or signage for the public. These were most often done as a class with students being responsible for various parts. This student product can raise the awareness of the community on particular resource issues and raise the capacity of the community to make more informed decisions.

There are other ways that students showcase their learning that follow a more traditional route. I expected students to read and write about topics we were engaged in, complete short activities related to the study, and take periodic exams (final exams were orally taken) testing their content knowledge, components of the project, and the community connections or context. My goal was to have students possess a clear understanding of the learning targets and the expectations in the activities to get them there.

### Case study

It may help to have an example that showcases this work to better explain how all of this fits together. A project on Mill Creek provides an idea of how community-based instruction can be applied to a real classroom experience. Remember this differs in every classroom with every teacher.

#### *Mill Creek Watershed Council – stream channel profiling*

Bob Roth, the coordinator for the Mill Creek Watershed Council, contacted me and asked if my students would be interested in conducting a stream channeling study for the watershed council as they had few funds or personnel to do so. I gave my standard answer, “You will have to come in and ask my students.”

I made arrangements to meet with Bob before he came to my class and went over ideas for his pitch to the students. I gave him details of the class, expectations of both of us for the class and the project, and a time and process for coming to my class. I explained he needed to describe his work in the community and the reason he needed the data the students would be collecting. We decided on the particular information that needed to be gathered, the format for the end product



Students collect invertebrates to study stream health for Opal Creek. Photo by Gale Hann.

from students, the field sites we would access (I went with him to look at these at a later date), and the training and protocols he needed to teach the students. He had no access to equipment, so the students needed to design any equipment that was required.

Bob made his presentation to the class asking for student assistance in the project. Students followed-up with the decision to help out within a few weeks as they were in the middle of another project. Sometimes students could be engaged with several projects simultaneously. Bob provided

training on the protocols needed and several students designed some measuring devices out of

PVC pipe that Bob was able to secure. These were used to measure water depth in Mill Creek when the depth was greater than they could access wearing waders. I organized the students into groups with various tasks and responsibilities from those measuring, to those entering data, and others assisting those in the water.

I made arrangements for transportation over a two-week period of time with weather determining some of our outings. I had students practice the protocol in the stream behind our classroom with Bob's help and I gathered the first aid kit, medical and emergency forms and we were ready to go. The next day they met me at the mini-buses with materials and equipment they were assigned and off we went. The trips to the site were filled with last minute task and behavioral reminders.

We spent four class periods over the next two weeks gathering data on stream depth and width at a number of sites. Students completed the forms and prepared the data in the forms that Bob provided. During the two weeks students also read about the significance of stream morphology and did curriculum activities related to streamflow and hydrology. The work went well and students completed the tasks easily.

When students were finished collecting the data, we called Bob and the students presented their work orally and handed him the forms he requested. They thanked Bob for allowing us to partner with him and fielded questions he had. I followed up later with him to provide feedback on the experience, and he thought it went very well and sent a thank-you to the class.

Students struggled with a community project for this, but settled on providing neighboring residents with information on impervious surfaces and flooding. They felt this was connected enough to the study on streamflow and so I let them move forward. They developed some information that was then included in a community publication. Students had a variety of roles from writing, to illustrating, to arranging the publication. At the end of all of this work, students were assessed on their two projects, the classroom activities, and questions on an essay exam.

Not all projects flow the same way. I start some with a journaling activity to connect them to a particular study site. They are required to write at least one journal entry per month. In other projects I sometimes like to bring in an American Indian component. No one project contains all the same elements, but most projects follow the same general processes described earlier.

### **Sustainability of program**

One of the most difficult things about community-based instruction is that it is not a part of mainstream educational practice and instead an approach practiced by a few dedicated, passionate teachers. Very few schools or districts have made this a central and supported approach at the school or district level. They have not institutionalized it. That means that most often when a practitioner of community-based education leaves a school, the course or program they established disappears.

I would like to suggest several ways to increase the chances of program sustainability rather than being teacher dependent. The first is to develop an identity for the class or program. This can be accomplished by giving it a name, as a separate name begins to build that identity separate from the teacher's name. The next step is to make sure there is recognition of the work and the

program in the community. This comes from media coverage of student work so there is real awareness of the value of the program. Greater support from the community can come from a community committee to help with the school programming or even establishing a nonprofit group to do the same. The last step for me was to have a facility built specifically for the program. There are others who have sought sustainability of a program by developing a “school within a school” program or establishing a charter school. All of this is an attempt to maintain a community-based effort after the program developer leaves.

The establishment of a named and recognized program embedded in the school system will go far in providing long term lasting power, but even that is no guarantee. Perhaps the most effective feature of program sustainability is an actual physical presence such as a separate facility specially built for program use. If this can also be leveraged with community support and use, then the program is set for long term effectiveness long after instructors come and go.

The Straub Environmental Learning Center is such a facility.

The Center was built in 2004 after a seven-year effort I led. It was built only after I had engaged students over a number of years in community-based studies and established many relationships upon which this vision was built. Funding for the one million dollar, LEED-certified building came from the school district, which owns the property, the City of Salem, and the community-at-large. It sits on the south end of the high school campus next to a stream and a restored riparian area that serves as a training and study site. The facility houses a large classroom, mud room, large community room, chemical and storage area, restrooms and an office. I was the only teacher housed here and students made the 5-minute trek from the main building each class period.

Simultaneously to the building of the SELC, I established a nonprofit organization called the Friends of the Straub Environmental Learning Center ([www.fselc.org](http://www.fselc.org)) to begin community-wide educational programming. After several years we now have a Board of Directors, an Advisory Board, Education Committee, and paid staff. Our programs target citizens of all ages and include: Nature Kids, Family Nature Night, Family Nature Retreat, summer nature camps, Green Awards Dinner, Amateur Naturalist classes, Issues Forum, Climate Masters class, Sustainable Holiday Fair, and an excellent Lecture Series that features well-known speakers from around the Northwest and beyond.

In my time at North Salem High School, I was able to have a facility built for my classes and establish a nonprofit only because of the school and community relationships built over a long period of time. The courses continue to be taught even after I left the school. I continue my work at the SELC with the nonprofit even though I no longer teach in the classroom. The current teacher has his own spin on natural resource education and new courses have been added, but there are components of community-based education that remain. None of this would have occurred without the support of the school, district, media, and community, who saw great value in what students were involved in doing. I can't imagine a more rewarding way to teach and work with our student-citizens.

## Summary

If you are beginning the process of trying out community-based education, you should know that it is always a work in progress. No one ever reaches a place where they have it all understood and under control. The best piece of advice is to start small with a single activity or experience and a foray into the community to find a partner. It will grow on you.

Perhaps a top ten list of advice for those starting out on this journey will help challenge and guide you on your way.

1. Start small and find other teachers interested in doing a community project. Support and collaboration are critical for success as you begin this work.
2. Don't let issues such as transportation and funding stand in your way. Be creative and persistent and employ the resources of your community.
3. Getting to know community partners is a must, so be prepared to make calls and meet with potential partners. They are often more than willing to work with you and may have resources you can use.
4. Make sure that your class does not become a work crew. The work you do should be the work of your partner. This is not a field trip or guest presentation, but joining the authentic work of your partner.
5. Be organized and plan ahead. You can never foresee all possibilities, but being organized helps you become more successful with students and partners.
6. Promote the program. It is not about you, but about the students and their capacity to serve as a resource for their community.
7. Involve students in the selection of their work and in designing their products. This may be the first time they have some control over their learning. It can be empowering for them.
8. As your work expands, think of ways that the program can sustain itself when you are no longer there.
9. Do not worry about having to know the content or being in charge of direct instruction. You will become a facilitator and instruction comes from the community partner and the curriculum resources you organize. One of the great joys of this approach is that you often get to learn along with your students. Sometimes they can even teach you. The teacher is no longer the "sage on the stage," but instead is the "guide on the side."
10. Remember it is about community! The work students do needs to have a context to it. They should come out of their study with a clear understanding of what their community is, how it can function, and possible roles for them to participate. Do not forget that this approach also fosters community building within the classroom and students become reconnected to themselves and to each other.



## **Appendix A – Community Exploration: Lessons 1-12**

*The lessons in this appendix are designed to support the class in accessing the community and should be completed in preparation for the Information Gathering phase of the community-based education process.*

LESSON 1 – COMMUNITY BRAINSTORMING

LESSON 2 – MENTAL MAPPING

LESSON 3 – COMMUNITY PROFILING

LESSON 4 – COMMUNITY INVESTIGATION

LESSON 5 – COMMUNITY ASSETS MAPPING

LESSON 6 – WEB OF INTERDEPENDENCE

LESSON 7 – FANTASY COMMUNITY

LESSON 8 – GOVERNANCE IN THE COMMUNITY

LESSON 9 – CONDUCTING AND COMPILING A COMMUNITY SURVEY

LESSON 10 – BRAINSTORMING COMMUNITY OPPORTUNITIES

LESSON 11 – COMMUNITY OPPORTUNITIES ASSESSMENT

LESSON 12 – BRAINSTORMING AN ACTION PLAN





## LESSON 1 – COMMUNITY BRAINSTORMING

### Objectives

*Students will be able to:*

- Demonstrate the ability to brainstorm effectively.
- Define the term “community.”
- Employ group skills to gather ideas.



### Time needed

One 45-minute class

### Materials

Blank butcher paper and two markers per group of four

### Procedure

In this activity, students will work in small groups to discuss and record their responses to the following prompts and questions. It is important to present this activity to the students as a brainstorming session; there are no “right” or “wrong” answers. The objective is for the students to talk about and record their first ideas about the communities to which they belong.

Ask students to divide into groups of four and give each group a large piece of blank butcher paper (or blank 11” x 17” paper) and two markers. Focus the class attention by delivering the discussion prompts and then allow the students to talk about and record their answers in their small groups. The primary prompt for this activity is: *“What is your community?”*

After the students have had time to provide as many ideas as they can, some ideas for additional prompts might include:

How are the community members similar and/or different?

How are they connected?

What are the habits of the citizens?

Are all of our school's students from the same community?

When you think of your community, do you think of your family, friends, classmates, things you do or places around you?

After students talk about their preconceptions of their community, they can apply this information to a discussion of the broader concept: *“What defines a community?”*

Post these papers on the wall and as a class use their contents to create a working definition for the concept of "community." Students can decide if they believe a person's community to be based on the location he/she lives, works and plays, the things that he/she does, cultural background or other characteristics. Putting this definition in a visible place, the students can use it as a reference point when discovering the resources that make their community unique.

## LESSON 2 – MENTAL MAPPING

### Objectives

*Students will be able to:*

- Visually represent a community.
- Identify and map community resources within a given area.

### Time needed

One 45-minute class

### Materials

Large paper (11 x 17) for each student

### Procedure

This activity will be enriched if it is presented to the students at least one day before using it. Ask students to be highly aware of sights, sounds, smells and interactions they encounter on the way home and to school, as they will be recording these items the next day.

Ask students to close their eyes and envision leaving their house and walking, riding or driving to school. Students should record the route they follow and the community resources (things, people and places) they pass en route. Provide students with large pieces of paper (11x17 or 11x14 work well) and ask them to draw an aerial map of their daily route. To allow for a more extensive map, encourage students to use symbols and a legend to identify key points (e.g., X= school, O= tree, += store) instead of elaborate drawings. Discuss with the class the cardinal directions in relation to the school (e.g., the front door of the building faces North) so that students may use this information in their maps as well.

After students finish drawing their maps, discuss the activity and create a class list of all of the community resources on the students' maps. Some ideas for discussion include:

- How did you select what resources to put on your map?
- What resources do we use that are not on the class list of resources? Why are they not there?
- If the class did the "Community Brainstorming" activity in Lesson 1, compare the two lists. Which is more extensive? Why?
- Ask students to pair up and exchange maps with their partner. Can the students use the partner's map to follow his/her route?

This activity can be used as a baseline assessment of student awareness of their community. Allow the students to create another mental map after completing a project in the community and compare it to the first one. Has the students' community awareness changed? What new community resources and characteristics are now included?



## LESSON 3 – COMMUNITY PROFILING

### Objectives

*Students will be able to:*

- Identify preconceptions.
- Identify specific characteristics of a community.
- Use various strategies to gather and record data.
- Use various strategies to organize and explain data.
- Compare preconceptions to current beliefs, based on new information.



### Time needed

Two or three 45-minute classes

### Materials

None

### Procedure

This activity allows the teacher and his/her students to review their preconceptions of their community and compare these perceptions with actual data about the community. Through the gathering of information, students will produce a community profile to describe the place they live. Students can create a vibrant, visual display of their profile to share with their school and other community members. First, the class should make a list of six questions they would like to answer about their community. Examples might include:

- What is the population of your community? Describe the demographic information of the people, such as their cultural background, age, socio-economic status, education and gender.
- Describe the geographic characteristics of your community. How do nearby mountains, lakes, plains, rivers, etc. influence the community?
- What is the history of your community? How was it named?
- Does your community produce any goods? What industries, corporations or groups employ many of your neighbors?
- What types of recreation are important to your community?
- What do you like about your community? What do other people (tourists, university students, other communities) like about it?
- Is your community urban, rural or suburban? Is it part of a larger group?

After the students decide what information they want, they should divide into groups of six to begin collecting it, one question per group member. Depending on the total number of students, each question may have a few students who focus on it. To find these data, students can consult materials from regional government offices, the local library and on the Internet. Local demographic information can be obtained from the Census Bureau or a local Historical Society. Reading the city charter or contacting local leaders, political representatives and long-time residents could also provide answers.

With the entire class, combine each group's information to create a community profile, and display it in a creative way. Using pictures, graphs or text, a visual or oral presentation of the community profile could be formed. As students compare this profile to earlier preconceptions of their community, they should determine if they would now describe their community in different ways. In addition, students may now be able to describe some of the community's assets, which are useful or valuable characteristics of a place.

## LESSON 4 – COMMUNITY INVESTIGATION

### Objectives

*Students will be able to:*

- Access and utilize a variety of non-traditional reference materials and local resources.
- Contact community members using effective communication skills.



### Time needed

One 45-minute class

### Materials:

Community maps, phone books, and various publications

### Procedure

The main goals of this activity are to familiarize students and teacher with facets of the community and to empower students to use different resource materials to discover these aspects. As a facilitator, the teacher should provide students with an adequate supply of maps, phone books and other publications of the community and surrounding area. Regional governments, tourist offices, the Internet, public transportation offices, auto clubs, neighborhood associations and public libraries are good places to collect a class set of maps and resources about your community. It may be beneficial to discuss/review topics such as how to use a book's index or how to orient oneself on a map before beginning the investigation. The class and teacher then decide on questions for students to answer individually or in small groups.

Another option is to split the class into teams and present this activity as a scavenger hunt. This can build class enthusiasm for the challenge. The examples of *Community Scavenger Hunt* and *How Well Do You Know Your Place* that can support this are included in the lesson.

After students are done answering questions, discuss the activity and answers with the class. Some possible prompts include:

- Did the whole class get the same answer for any one question?
- Which resource was most helpful?
- What new things did we learn about our community?
- What was the team strategy of the group that finished the investigation first?

A possible extension for this lesson includes presenting the activity to the class ahead of time and allowing students to contact community organizations to find phone books, maps and other resources to use.

## Lesson 4: Activity 1 - Community Scavenger Hunt

Your mission is to use the resources available in your classroom to find answers to the following questions. Think of the people, places and things in your community when you answer the questions. Many of the questions have more than one answer possible. Add two questions you are interested in finding out about your community. Good luck.

Name two places where students can play outdoor sports:

1.

2.

What is the address of city hall?

3.

List three natural areas in the community (lakes, parks, forests, etc.)

4.

5.

6.

Where can you find several new houses being built?

7.

What is the address of the closest recycling center?

8.

Name the location of a large area covered with asphalt.

9.

Where does your wastewater go when it leaves your home?

10.

Class question:

11.

12.

## Lesson 4: Activity 2 - How Well Do You Know Your Place?

Want to get to know your home better? Then this is the quiz for you. If you can answer all these questions, you deserve a prize for awareness of your local environment and community. And if you are not sure, some sources of information are suggested below each set of questions.

### BUILDINGS

- What building materials commonly used in your region are from local sources?
- What color are the bricks and stone that are quarried in your region?

*Sources of information: Local builders' association*

### ENERGY

- What portion of your electricity is generated using nuclear power? Hydroelectricity? Fossil fuels? Wind? Solar?

*Sources of information: Local utility or fuel supplier*

### FOOD

- How long is the growing season in your area?
- Where did the food on your dinner plate last night come from?
- How far is this from where you live?
- What are your local sources of organic food?

*Sources of information: Food co-op, local grocer, conservation district or Natural Resources Conservation Service office*

### COMMUNITY

- What are some important local issues where you live?
- Name the decision-making body in your community?
- List one or more "contributions to the common good of the community" in the past year?
- Can you name an organization in your community that helps those in need by providing food, comfort, transportation, or companionship?

*Sources of information: Local city/town offices, newspaper, phone book*

### WASTE

- Where does your garbage go?
- What materials can be recycled in your community?
- Where does hazardous waste in your community go?

*Sources of information: Municipal public works offices, Department of Natural Resources offices.*

### WILDLIFE

- Can you name 25 species of birds, mammals, reptiles, amphibians, trees, and flowers in your area?
- Which birds stay in your area year-round?

*Sources of information: Department of Natural Resources offices, local Audubon chapter, sportsmens' clubs*

## LOCAL HISTORY

- Which Native American tribe lived in your area prior to Europeans?
- Why was your town or city established?
- Why was the location important?
- What was on the land where you live one hundred years ago?
- When did Europeans first come to the area and why?

*Sources of information: Public libraries, native people, older residents, historical museum or archives*

## WATER

- In which watershed do you live?
- When you turn on the tap, where does the water come from - a lake, river, groundwater?
- When you flush the toilet, where does the water go?

*Sources of information: Conservation district or Natural Resources Conservation Service office, Municipal public works offices, EPA Surf Your Watershed website <http://www.epa.gov/surf/>*

## POLLUTION & THE ENVIRONMENT

- What are the major sources of industrial pollution?
- What organizations in your area are working to protect and enhance the environment?
- What state and federal agencies regulate pollution of air, water and land in your community?

*Sources of information: Department of Natural Resources offices, phone book, public library, Internet*



## LESSON 5 – COMMUNITY ASSETS MAPPING

### Objectives

*Students will be able to:*

- Produce a community map.
- Articulate relationships between community resources.
- Demonstrate careful data collection techniques.



### Time needed

Three 45-minute class periods

### Materials

Large butcher paper for wall map, community maps

### Procedure

This activity can be used as an indicator of student awareness of their community. Students will create or obtain a large map of the community to put on the classroom wall or another visible location. Students can contact regional government offices, neighborhood groups or local tourist offices to seek out map donations. This map should not only include streets and schools but natural boundaries, commercial sites, green spaces and demographic information; it might be easiest to make something that resembles a diagram more than a traditional map (see following examples). As students learn of new resources in their community, add them to or label them on the large map.

Relationships that the students discover between different community resources should be noted on the map as well. Students can use arrows and description boxes to illustrate the web of connections between the economic, environmental and social assets within the community.

Keep a tally of the number and nature of the entries added to the map each day/week/month. Some discussion questions may include:

- How did you discover the resources put on your map?
- Is there a map in the community that looks like the one that we have created? Why or why not?
- As time has gone on, does the class fill in more blanks on community assets or add more of the relationships between community assets?

Another way of documenting community assets is through photography. Using disposable cameras or digital cameras, each student can be given 24 hours to shoot pictures of what she/he sees in the community, including physical assets and the habits and behaviors of the people that live there. Local retailers might be willing to help defray the cost of cameras and a local publication might be able to use some of the pictures produced. Together, these pictures will create a collage of what life is like in your community.

## LESSON 6 – WEB OF INTERDEPENDENCE

### Objectives

*Students will be able to:*

- Identify economic, ecological and social components within a community.
- Explain the concept of interdependence in natural systems.
- Apply the concept of interdependence to the surrounding community.



### Time needed

One 45-minute class

### Materials

None

### Procedure

Every urban community can be viewed as a collection of the economic, ecological, and social components of the area. The community includes the systems in each of these three areas and the interactions between them. Allowing students to explore the extensiveness of this web of interdependence will help to highlight its significance.

In the same way that a community is a web of inter-connections, the elements of a natural ecosystem are interdependent as well. The changes that affect one part of the ecosystem will either directly or indirectly affect other parts of the ecosystem. A quick look at a food chain will help to illustrate this. Hand out the following student handout, *Ideas on Interdependence*, to discuss the food chain diagram and to record student answers for the following activity.

To examine interdependence in the community, allow each student to select a resource within the community. This can be an individual, a business, or a natural system for example. Each student should find three changes in the community (one social/civic change, one economic change and one natural/environmental change) that would affect his/her selected resource. For example:

*A student would be affected if:*

1. A new law changed school hours [social/civic]
2. A charge was imposed to use the Internet [economic]
3. The local water source was contaminated (no drinking water) [environmental]

*A local playground would be affected if:*

1. The average age of residents went up [social/civic]
2. Funding for the park was increased [economic]
3. A flood caused mudslides in the area [environmental]

*A popular chain restaurant would be affected if:*

1. The population changed (that type of food became less popular) [social/civic]
2. A competitor of the restaurant closed down [economic]
3. A drought caused less food production/ higher food prices [environmental]

If students are struggling to come up with economic, environmental or social changes, challenge the rest of the class to create scenarios that would affect those resources. If needed, encourage students to contact someone involved with the selected resource to discuss consequences of possible changes.

Discussion questions after this activity include:

- Was it difficult to find a change of each of the three types (economic, social and environmental)? Which type was most difficult? Did this depend on the resource selected?
- How is interdependence visible in the communities in which we live?
- Are citizens aware of the different impacts that community changes cause? Why or why not?
- Can you think of one change that was made in or by the community that has affected you?

## Lesson 6: Activity - Ideas on Interdependence

Parts of our community, just like parts of nature, are connected to each other in many different ways. If we look at a food chain that includes:

*Willow Tree → Leaf Beetle → Frog → Fish → Human*

We know that a drastic change in the population of any member will affect the populations of all of the other members of the chain. A natural event that decreases the number of leaf beetles would hurt the frog population by limiting their food source but would help the willow trees keep their leaves from getting eaten.

In order to think about interdependence in our community, you will select one part of your community and describe three different things that would change it. You can choose a person, place, business, a feature of nature, a school, or any other part of your community. An example of this is:

- Community resource: A student
- Social change: A new law that changed school hours would affect a student
- Economic change: A charge to use the Internet would affect a student
- Environmental change: Contamination of the town's drinking water would affect a student

Now, you need to select a different resource to complete the following:

1. Community resource I have chosen:
2. One social or civic change that would affect my resource:
3. One economic change that would affect my resource:
4. One natural or environmental change that would affect my resource:

## LESSON 7 – FANTASY COMMUNITY

### Objectives

*Students will be able to:*

- Identify and list characteristics necessary to a community.
- Create a visual representation of an ideal community.
- Make a presentation to an audience.
- Contrast ideal and actual community plans.



### Time needed

One or two 45-minute class periods

### Materials

Large pieces of butcher paper for each group

### Procedure

In this activity, students are asked to create plans for a "fantasy community," an imaginary place that includes any characteristics they desire. Students will work in groups to discuss what resources should be present in their ideal community, how to arrange them and map the results. As a class, students should think about typical community resources and create a list of facilities that are required in each group's "fantasy community." These can include hospitals, housing (single and multi-family), a town center, public transportation, fire department, library, schools, cultural centers, grocery stores, police station, parks, post office, trees, etc.

Students should be divided into groups of 4-5 and given large pieces of butcher paper or other writing surface to record ideas and map their finished product. Each group should also receive a copy of the *Facts of Your Fantasy Community* handout sheet that follows. Outside of the list of required facilities, encourage students to put whatever they want in the community, keeping in mind that they get to select the climate, geography and recreation points of their choice.

After students have had ample time to map their ideal communities, allow each group to:

- Present to the class the map of their "Fantasy Community"
- Explain important features and the significance of their location
- Share the answers their group wrote on the recording sheet.

A possible extension of this activity would be to invite a speaker from your community's planning or land use department to learn about real projects and issues. Have the students view natural resource and/or planning documents to see how these impact the "fantasy communities" created by the class.

## Lesson 7: Activity - Facts of Your Fantasy Community

Names of group members:

What is the name of your community?

What is the climate of your community? How does this affect the choices you made while creating your community?

Describe the population of the neighborhood: (Is it a rural, urban or suburban community?)

How does the geography of your community influence the way in which it would be built? (For example, think of hills, lakes, bays, location of the town center, etc.)

How do people get around your community? Are there sidewalks, buses, and bicycle lanes?

What types of work does the population have?

Do the citizens of your community produce food or other goods? What are some examples?

List two ways your "Fantasy Community" is different from your real community:

## LESSON 8 – GOVERNANCE IN THE COMMUNITY

### Objectives

*Students will be able to:*

- Describe the structure of local government particularly as it applies to natural resources.
- Identify federal, state, county, and city agencies and organizations that are involved in the use and management of natural resources.



### Grade Level

All ages (appropriate modifications needed for primary students)

### Time needed

Three 45-minute class periods

### Materials:

Phone books, Internet

### Procedure

Understanding how local governments are organized is important to understanding how communities function. City agencies and citizen advisory groups have a major impact on determining what occurs throughout the local community. Knowing these entities and the role(s) they play will help students understand the larger picture of policy and decision-making that occurs in their neighborhood. In addition, it provides a great pool of resources for students to contact for information or to form partnerships for future community-based projects. This can help provide the community context or umbrella needed within which they carry out their student-citizen participation.

There are numerous activities students can engage in to document the governmental organization in their community. Depending on the part of the country and the community they live, these organizations will vary with names such as neighborhoods, villages, towns, or boroughs. In addition to describing the city governmental organization students can also examine the organizational structure of county, state and federal agencies and organizations that impact their community. Focusing on those agencies and organizations that have a particular role with the environment or with natural resource use and management will help students narrow their efforts and make it a more manageable project.

The following two activities are examples of what could be undertaken by students to describe how their local government is organized. Teachers in various parts of the country will have different structures in their communities and can modify these lessons to fit their needs. Contacting someone in city government will be a critical piece in organizing and focusing your efforts and to reduce some of the frustration students may feel as they begin to explore the community in this way.

## Lesson 8: Activity 1 - What is the Structure of Your Local Government?

Teachers can use all or part of the following outline and information to guide students to describe their local government. Students can be given an assignment to collect the information on the various parts of this outline or develop their own.

### *What is Local Government?*

- Local government is generally defined as town, village, city, or county government.
- Members of the local government can be divided into elected officials, employees, and appointed officials.
- Local government is divided into various departments, boards, and commissions. County governance has boards and agencies that often receive some funding from local governments.
- The structure of local government varies due to who is “in charge.” For example, an elected mayor leads some cities. Others have a “strong city manager” who is hired by the elected city council to run the day-to-day operations of the city.

### *Elected officials (describe their primary duties and responsibilities)*

- Mayor
- City Council
- County Boards
- Other

### *City departments (with land use and environmental responsibilities)*

- Public Works
- Parks and Recreation
- Planning and Development
- General Services
- Other

### *Appointed boards and commissions (with land use and environmental responsibilities)*

- Planning
- Parks
- Other City Documents (that affect the use and management of natural resources)
- Comprehensive plan
- Adopted city code
- Other

This outline serves only as an example template for investigating the organizational structure of a local community. Each community has different governance configurations, so teachers will need to modify this outline to fit the community they examine.

The student products for this lesson can be varied. However, teachers should have the students deliver their work to the community in some meaningful way. This may be in the form of a poster or a *PowerPoint* presentation to interested parent or community groups, flow charts or brochures handed out in the neighborhood, or a booklet to be used by community groups and organizations that need to access city government.



## Lesson 8: Activity 2 - Resource Directory

This activity is similar to the previous lesson, but has a greater focus on gathering contact information and more detailed descriptions on city, county, state, federal, and local organizations, business, and industries that are involved or interested in the environment and the use and management of natural resources. Students produce a directory that can be used by the class for future projects and other interested groups involved in conducting community projects or needing information on specific issues.

The information that students may collect is listed below. Teachers can edit or add other pieces of information they would like the students to collect as well. Divide the students into groups and have them use the phone book, Internet, and other available resources to find out the necessary information.

- Name of agency, organization or business
- Description of the mission or purpose of the group
- Examples of past or ongoing efforts in the community
- Contact information
  - Address
  - Phone
  - Web Site

<b>Community Agencies and Organizations</b>		
<u>City Agencies</u> Public Works Parks and Recreation Planning General Services	<u>County Agencies</u> Public Works Parks Planning Development Soil/Water Conservation District	<u>State Agencies</u> Water Resources Agriculture Parks Forestry Fish and Wildlife State Lands Dept. of Environmental Quality
<u>Federal Agencies</u> Corps of Engineers Agriculture National Parks Natural Resource Conservation Service Forest Service Environmental Protection Agency Fish and Wildlife Service Bureau of Land Management	<u>Organizations</u> Audubon Society Nature Conservancy Native Plant Society "Friends" groups Ducks Unlimited / Fishing Groups Neighborhood Associations	<u>Business and Industry</u> Water labs Forest industries Landscape designers Environmental services Wetlands consultants Agricultural industries

## LESSON 9 – CONDUCTING AND COMPILING A COMMUNITY SURVEY

Conducting a survey is one way that people gather information about the characteristics, beliefs and habits of others who share the community. Surveys are an important tool used by scientists and other experts to collect information, including both facts and opinions. Surveys are usually quicker than conducting an interview, so feedback from many different people can be easily collected. Since it is not possible to find out how an entire community feels or behaves, surveys done well represent how others will respond based on the small sample group. Surveys can be delivered orally, such as in person or over the phone. They also can be delivered in a written format, such as in a letter or electronically.



### Activity 1 - The Importance of Surveys

#### Objectives

*Students will be able to:*

- Describe some of the characteristics of surveys used by scientists and other experts to gather information
- List the purpose, targeted population and method of survey to be conducted by their group

#### Time needed

Up to 40-minute class period

#### Materials

None

#### Procedure

Students involved in a community-based project may use a survey to find out something about the community that is not already known. With this information, it is easier to make community decisions or effect change in an area of interest. Examples may include how students spend money in the community, whether or not citizens eat fish from a contaminated river or the percent of time middle school students spend in a local park. Discuss this idea with the class and ask students to think of one characteristic about their community for which they would like more information.

#### *Part I*

Hand out copies of student handout, directing students to work independently or in pairs. The handout asks students to identify:

- A reason to conduct a hypothetical survey.
- The appropriate method for asking questions.
- The population targeted.

### *Student Handout*

Conducting a survey is one way that we can gather information about the characteristics, beliefs and habits of other people who share our community. Surveys are an important tool used by scientists and other experts to collect information, including both facts and opinions. Think of something that you would like to know, such as:

- What is the top environmental concern in your community?
  - How many people use the city parks?
  - How is land used in your community?
1. List one thing you would like to know about your community that a survey could help you find out.
  
  2. Who would you ask to find out this information?
  
  3. How many people would you ask to complete your survey?
  
  4. How would you distribute your survey questions? Door-to-door? Over the phone? In a letter? Another way?
  
  5. After asking the people you survey, would you know how everyone in the community feels? Explain.
  
  6. Instead of using a survey, is there another way you could find out this information? Would this method take more or less time?
  
  7. What could you do with the information that you find out about this issue? Who might be interested in your findings?

## *Part II*

You are now ready to select and discuss your specific survey topic. After the students complete the student handout, encourage them to think about the same questions in relation to the community research question to be addressed by the class. With the entire class, brainstorm answers to the following questions and record the responses on an overhead or easel paper:

- What is the population we will target?
- How will we administer our surveys?
- How much time do we have to complete the surveys?
- Why are we using a survey as a tool?
- What information will we have after we complete this survey?

Remember, it is important for students to understand the importance of the population sampled when using surveys. For example, if students only distribute a survey to fellow classmates, the results can't be generalized to represent the feelings of the entire community. Also, the number of participants involved is critical to discuss as well. The more people surveyed, the closer the results will reflect the population sampled. Now that the answers have been explored as a large group, you are ready to think about specific survey questions! Move on to Activity 2 for help with this step.

## Lesson 9: Activity 2 - Writing Survey Questions

### Objectives

*Students will be able to:*

- Identify three characteristics of successful survey questions
- Demonstrate the ability to brainstorm effectively

### Time needed

Up to 60-minute class period

### Materials

None

### Procedure

Writing survey questions that successfully get the information one is looking for can be a difficult and complex task. However, keeping a few pointers in mind when writing your survey questions will facilitate the process of collecting data. The design of the survey questions will determine what information you will have at the end of the data collection process, and what kinds of claims can be made based on this data. Remember that you will be writing the questions as well as the answers for participants to choose from.

A few characteristics to keep in mind include:

- Write simple but clear questions: ask only one question at a time and use simple language.
  - Keep it short. Ten minutes is the recommended length for a survey; make it longer only if the respondent has an incentive to complete the survey (grade, coupon, etc.)
  - Provide clear answers. Decide whether you will use open-ended questions, a yes/no format or a “numbered” scale to gauge responses (i.e., strongly agree, agree, disagree, strongly disagree).
  - You can group possible answers only if you don’t need exact numbers. For example, providing participants’ age ranges (10-15, 16-21, 22 and over) will simplify the process, though it means that you will not know exactly how many respondents were 18 years old. If you ask for exact answers, data can always be grouped when reporting or graphing.
  - Include on the survey a way to track who is responding (age, gender, county of residence, etc.). Remember to discuss with your students who your target participants are and different strategies for conducting surveys (on the phone, in person, etc).
1. Have a discussion to review or explain the following:
    - The type of information desired (i.e. the focus of the survey)
    - The target population
    - How your survey will be delivered
  2. Keep the overall focus of the survey in mind. Brainstorm a list of possible question topics to be included in the class survey. Record ideas on an over-head or easel paper.

3. Explain how to write good questions (using the *Activity 2 Overhead* form provided), discussing the major characteristics to keep in mind.
4. Select a question topic and provide the students with two or three different ways to write or phrase the question. An example follows below and on the following student handout.
  - Question #1: Do you believe that it is safe to eat fish from our local waterway?  
Yes/No
  - Question #2: I think that fish from our local waterway are safe to eat.  
Strongly Agree/ Agree/Neutral/ Disagree/ Strongly Disagree
5. Hand out *Activity 2 Student Handout*. Have pairs of students write a question topic down on their worksheet (or assign a topic to each pair) and explore two to three ways to ask a question (and related answers) about a topic.
6. When finished, have student pairs share their questions with the class, then have students vote on the most useful phrasing of a question for each topic. Record the number of votes.
7. Combine these best efforts into a draft version of the survey. Allow the community partner and yourself to revise the draft, adjusting phrasing of questions if needed.

**Extension:**

Students should take a copy of the draft survey home for homework and ask someone unfamiliar with the survey to complete it. The students' assignment is to time how long it takes for this person to finish the survey and to record any difficulties this person has with the survey questions. Averaging all the recorded times will give a general idea of how long the survey should take to complete. Allow students to share their notes on parts of the survey others found difficult and make changes accordingly.

## Activity 2 Overhead

Writing good questions for a survey can be a tough job! Even if you do know exactly what information you are interested in, asking the questions in a way that can be easily interpreted may take some practice. Some points to keep in mind include:

1. Keep it simple!
  - a. Confusing example: What are colors of cars in which you have ridden in the past?
  - b. Good example: What color is your car?
  
2. Get them to give you a clear and simple answer!
  - a. Confusing example: Tell us what you think about our drinking water: \_\_\_\_\_
  - b. Good example: I think the water in our community is safe to drink.  
*Strongly Agree / Agree / Neutral / Disagree / Strongly Disagree*
  
3. Write questions whose answers can be easily graphed!
  - a. Confusing example: For what purpose do you use a computer?
  - b. Good example: Do you use a computer to do homework?  
*Yes / No*

Example of different ways to write a question:

Question #1: Do you believe that it is safe to eat fish from our local waterway?  
*Yes/No*

Question #2: I think that fish from our local waterway are safe to eat.  
*Strongly Agree/ Agree Neutral/ Disagree/ Strongly Disagree*

Question # 3: I think that eating fish from our local waterway is:  
*Very safe / somewhat safe / somewhat unsafe / very unsafe*

*Activity 2 Student Handout*

We will now write, then vote on, specific phrasing to use for our class survey questions.

Topic: \_\_\_\_\_ # of Votes

Two or three ways to write a question and possible answers for this topic:

1. Q: \_\_\_\_\_

A: \_\_\_\_\_

2. Q: \_\_\_\_\_

A: \_\_\_\_\_

3. Q: \_\_\_\_\_

A: \_\_\_\_\_

Topic: \_\_\_\_\_ # of Votes

Two or three ways to write a question and possible answers for this topic:

1. Q: \_\_\_\_\_

A: \_\_\_\_\_

2. Q: \_\_\_\_\_

A: \_\_\_\_\_

3. Q: \_\_\_\_\_

A: \_\_\_\_\_



## Lesson 9: Activity 3 - Creating an Introduction: Explaining the Survey to Participants

### Objectives

*Students will be able to:*

- Recognize target audience
- Develop introduction to survey
- Meet public speaking benchmarks

### Time Required

45 minutes, plus additional time to administer survey (depending on survey length and number of respondents)

### Materials

None

### Procedure

After the questions for a survey are written, a few important steps to consider remain before approaching people to complete your survey. During this activity students will create an explanatory introduction to the survey, and then practice with delivery. Encourage the students through discussion to keep the following in mind:

- Completing a survey is voluntary and you are asking people to participate.
- It is necessary to think about who your intended audience is.
- Where will you be accessing these people?
- How long will it take to complete the survey?
- How will you record responses (create a form or use a tape recorder)?
- Will you offer “incentives” to encourage people to complete the survey?

Give students a copy of the survey questions that the group has drafted, or display them for all students to view. Tell students they will each be writing an introduction to the survey, to tell possible participants who the students are, what the survey is about and why they should invest their time in completing this survey. Students will use copies of the student handout to record their written introduction. However, review the following points with students before giving the written assignment:

- If using a written survey, everyone involved needs to keep track of how many are given out (mailed or sent home at school) and how many are returned. The percent of how many were returned is called your “return rate.” People hearing of your survey results may want to know this percent, which is not generally very high (55% is good).
- If using an oral survey, remember to record the time, place, age and gender of each survey participant. Make a recording form for this, or incorporate these questions into the survey.
- Students should only administer their survey in a safe environment, within sight of a trusted adult.
- If using a tape recorder, ask respondents’ permission to record the conversation.

Ask students to think of a time they have completed a survey or watched another person doing so. Ask them to consider what information they would want to know before participating. Then, ask them to complete the *student handout* individually or in groups. After writing their introduction paragraph, ask students to pair up to time how long it takes them to recite this introduction (as well as the survey questions themselves, if necessary). Reconvene as a large group to see how close the students' times were and to assure they are within the amount of time the group had in mind for the survey. After assuring that students' written introductions are appropriate and complete, move onto the process of administering the survey!

### **Assessment**

Completion of the student handout can be used to gauge participation in the class. How well do the written introductions give appropriate information to respondents? Can students list the purpose of the class survey to be completed? Do the students feel ready to approach people to complete the survey?

*Activity 3 Student Handout*

Approaching people to ask them to complete a survey can be intimidating at first. Writing an introduction and practicing your delivery beforehand will help you feel more comfortable and will help people understand what exactly you are trying to accomplish. Some points to keep in mind include:

1. Introduce yourself! Share the purpose of your survey and be proud of what you are doing.
2. Ask for participation! Not everybody will want to speak with you, don't be pushy.
3. Describe any incentives. Will participants help you to learn more about your community get a free ice cream cone or receive extra credit from a teacher? If so, let them know about it.
4. Be consistent and neutral if delivered orally! Try to ask the same questions in the same way to each person.
5. Say thank you! You are asking people to give up some of their time so be sure to thank them.

Below, write a paragraph that will serve as an introduction to your survey. Be sure to include everything you want a person to know before he or she agrees to participate. My introduction:

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Now, ask a classmate to time how long it takes you to deliver your introduction: \_\_\_\_ sec.

*Remind students that in the introduction and delivery of surveys they should speak at an appropriate speed and clarity – if they rush through to make the time needed, they won't successfully communicate their questions or much of anything else. Using the following forms on phoning and interviews may help support their work as well.*

## PHONE GUIDE

*You should fill out this information before picking up the phone:*

Your name \_\_\_\_\_ Date \_\_\_\_\_

Your school or organization \_\_\_\_\_

Your school or organization's address \_\_\_\_\_

Your school or organization's phone number \_\_\_\_\_

Name of person you are calling \_\_\_\_\_

His or Her title \_\_\_\_\_ Phone number to call \_\_\_\_\_

Organization you are calling \_\_\_\_\_

Ideas for your conversation:

"Hello. My name is \_\_\_\_\_ and I am from \_\_\_\_\_ (your school or organization). May I please speak with \_\_\_\_\_ (person you are calling) or someone in public relations?"

Things that you are going to say or ask:

Answers or information that you are given:

"Thank you very much for your time."

## INTERVIEW GUIDE

*You should fill out this information before the interview*

Date of Interview \_\_\_\_\_ Time of Interview From: \_\_\_\_\_ To: \_\_\_\_\_

Name of Person Interviewed \_\_\_\_\_

Organization or Company \_\_\_\_\_

Organization or Company Address \_\_\_\_\_

Phone Number \_\_\_\_\_

Interview to be completed by (circle one): Phone In Person Email Survey Monkey?

Ideas for the interview:

Question you plan to ask:

Response:

Question you plan to ask:

Response:

Question you plan to ask:

Response:

Notes:

"Thank you very much for your time."

## Lesson 9: Activity 4 - After the Survey: Managing Survey Results

### Objectives

*Students will be able to:*

- Organize collected data
- Interpret results

### Time Required

Will vary according to number of responses.

### Materials

None

### Procedure

Before tallying the answers received, a tally sheet or other way of recording answers is necessary. A blank tally sheet is attached as a student handout or students can create their own paper version of a tally sheet or use spreadsheet software to record data. One easy way to create a tally sheet is to simply add lines to a paper version of the original survey, provide room to tally answers.

Here is one way to tally:

1. Based on the number of survey questions to be analyzed, split students into working groups. Assign each group a question to analyze. Provide groups with a copy of the tally sheet, or cut the tally sheet and give each group their section only.
2. Divide the returned surveys into stacks, based on the number of groups determined above. Hand out one batch to each group. Ask students to mark each survey result that is recorded, but only once! Students will then go through each survey in their batch and record the answer to their assigned question on their tally sheet. Students within a group will need to organize themselves to accomplish this, based on the number of students in their group. Assigning specific roles should be an effective strategy.
3. After all groups are done recording the answers from their batch of surveys, ask groups to pass the batch on to the next group. Continue recording answers and rotating survey batches until the groups again see the batch they first recorded. Next, ask students to total the number of answers they got for each possible response for their question and record this on the tally sheet in the space marked “total.”
4. With the entire class, allow groups to report the “totals” for their question. Record all the totals on a master sheet or overhead.

*Activity 4 Student Handout*

Group Members: \_\_\_\_\_

Use this form or create one like it to record the data you collected with your survey. Fill in the questions from the survey and each of the possible answers. Then, put a hash mark next to the appropriate response for each survey. After you record the answer to every survey, count the hash marks for each answer and put the number on the total line.

1. Question: \_\_\_\_\_

Answer options	Tally marks	Total
_____	_____	_____
_____	_____	_____
_____	_____	_____

2. Question: \_\_\_\_\_

Answer options	Tally marks	Total
_____	_____	_____
_____	_____	_____
_____	_____	_____

3. Question: \_\_\_\_\_

Answer options	Tally marks	Total
_____	_____	_____
_____	_____	_____
_____	_____	_____

## Lesson 9: Activity 5 - Interpreting Survey Results

### Objectives

*Students will be able to:*

- Graph data
- Write a claim based on information from a graph

### Time Required

1 hour

### Materials

None

Note: For this activity you will need to reserve a computer room.

### Procedure

Analyzing the survey results will allow you to make sense of all the information you gathered. How you explore the data will be determined by the type of information you want to communicate. This lesson describes several statistical methods and how to create graphs. Depending on how the group plans to share the information gathered from the survey conducted, creating graphs, charts or other visual representations might be a necessary step. For this activity, a computer with spreadsheet or graphing software may be helpful. However, many adults and students use software to create sharp-looking graphs that communicate little. Be sure to reinforce the importance of making sure the most appropriate type of graph is used to communicate the information.

#### *Part I: Explaining the results*

After recording the totals in the student handout from Activity 4, you are ready to explore various ways to report the results. With the students, you will determine how the information can be presented in the most meaningful way and do the appropriate calculations as a class or in small groups.

The following methods can be explained using the example provided below: Five students were asked if they believe they should get dessert as part of their lunch.

They were given the following options:

- 1 = Agree
- 2 = Neutral
- 3 = Disagree

Results:

- 3 students said 1 (or agreed)
- 1 student said 2 (or neutral)
- 1 student said 3 (or disagreed)



- Have the students calculate the percent of the people who selected the different responses to their question. To calculate the percent of responses, use the total number of a certain response, divide by the total number of respondents, then multiply by 100. For example:

$$(1 + 1 + 1) / 5 * 100 = 60\% \text{ of respondents answered "1"}$$

Agree responses = 3, Total number = 5

- Have the students calculate the mean, or average number of responses to their question. To calculate the mean, sum all the responses and divide by the number of responses. For example:

$$(1 + 1 + 1 + 3 + 2) / 5 \text{ answers} = \text{mean of } 1.6$$

- This function can be used for answers on a scale as well, by assigning a numeric value to each possible answer (e.g., if 1=Agree, 2=Neutral and 3=Disagree, then a mean of 1.6 translates into respondents sort of agreeing but remaining somewhat neutral).
- Have the students calculate the median, or middle value, of the responses to their question. To calculate the median, line up all of the numbers in increasing order. It is the entry in the middle of the list. The median is "1" in the following example:

1 1 1 2 3

- Have the students calculate the mode, the most frequent value of a set, or the number that occurs most often. To calculate the mode response, count how many times each response is given. For example:

Responses: 1, 1, 1, 2, 3 (Since 1 occurs more times than 2 or 3, 1 is the mode)

Use the results from these calculations to interpret what the data is saying and have the students discuss which is the most useful for their survey and purpose. At this point students may make graphs, charts or other visual representations.

Remember to analyze the demographics as well (e.g., 53 % of respondents were female and the average respondent age was 42.3 years)! Knowing the demographics of the population surveyed will help to articulate who your data represents, which will impact claims that can be made on behalf of the information gathered.

*Part II: Graphing the results and making claims*

Ask students to use three minutes to draw a graph that communicates the following information: Students were asked if they owned a bike.

- 20 replied yes
- 10 replied no

Ask students to each draw another type of graph to show the same information, using an additional three minutes. After students have drawn two graphs, compare the types of graphs used. Discuss the appropriateness of each type (pie graph shows one variable, bar graph shows multiple variables, line graph shows change over time).

Discuss with students what makes a good graph, handing out examples if possible from the local newspaper or other sources. Be sure to touch on specific ideas such as:

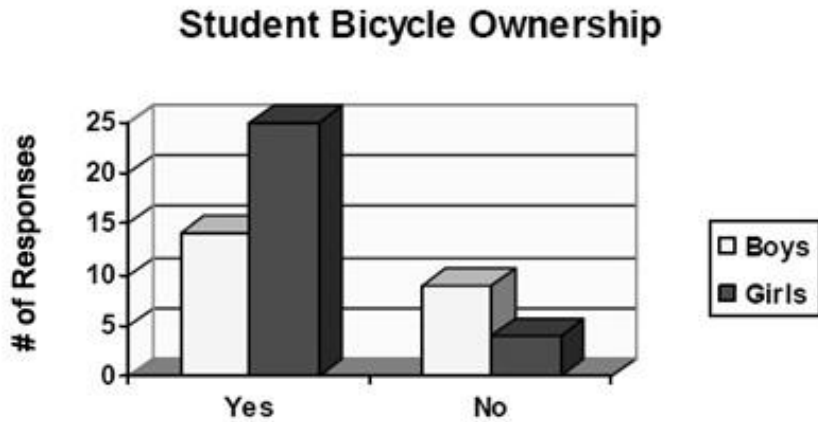
- Where do we see graphs and charts?
- Why do we use them?
- What parts do all or most graphs have?

After students seem comfortable with the reasons for creating graphs, pass out copies of the student handout. Individually or in pairs, ask students to complete the handout, creating a graph to represent one question from the information gathered during the survey process.

If using a computer to create graphs, do not try to take students through the graphing process step by step. Instead, require students' full attention (in groups if necessary) as you demonstrate the process and discuss the best way to display the data. Allow each student in the pair time to create a graph, with ample time to explore the software options. Have students save their work in the spreadsheet view and again with a different name in the word processing document or draw document. (If graphs or spreadsheets will be distributed among groups, discuss naming conventions so that all names are consistent.)

Activity 5 Student Handout

Graphs are often used as a way to visually tell others about the data you have collected. By looking at a graph, you can usually identify a number of “claims” about the information contained in the graph. Below is an example of a graph based on the results of a survey that asked students if they owned a bike. Two examples of claims the graph tells us are also listed.



Claim # 1: Most Students surveyed owned a bike.

Claim # 2: More girls than boys were surveyed.

Below, draw or paste a graph that illustrates the data found in your survey. Be sure to include all of the important pieces, such as a title and key. Next to your graph, write two claims which you think your graph communicates to another person.

My graph:

Claim # 1:

Claim # 2

## LESSON 10 – BRAINSTORMING COMMUNITY OPPORTUNITIES

### Objectives

*Students will be able to:*

- Demonstrate the ability to brainstorm effectively.
- Identify and list opportunities for change in the local community.
- Identify the main idea of a written article.



### Time needed

One or two 45-minute class periods.

### Materials

Local newspaper, magazines, or neighborhood publications

### Procedures

Recall the results of looking at the assets within the classroom and the larger community. Community opportunities can include places and methods in which these assets could be explored, enhanced or shared. The assets of a community member or organization can be used to improve or develop other parts of the community. Students will now focus on how their assets can be used.

In this activity, students will read articles in the local section of the newspaper, a community newsletter or other neighborhood publications. Each student should be asked to review two articles and answer the following questions for each article:

- What is the community issue described in the article?
- How do you feel about this issue? Why?

After students have had time to describe the articles, as a class they should list community issues about which they read. When the teacher is done listing these issues, the class should brainstorm other ideas of issues the students could see themselves addressing in their community.

Remember-this is just a list of ideas! The primary prompt for this activity is:

- Which issues could our class impact in our community? How?

After the students have had time to provide as many ideas as they can, some additional prompts might include:

- What would you like to see changed in your community?
- Are there natural assets such as vacant lots or neglected community gardens that are in need of improvement?
- Are there current policies/rules in your community that you would like to see changed?
- Are there parts of the local economy that could use enhancement?
- Are there members of the community whose assets are not being shared (such as the cultural knowledge of senior citizens)?

Keep this list in a visible location so students can think of strategies they can use to bring improvements to their community.

## LESSON 11 – COMMUNITY OPPORTUNITIES ASSESSMENT

### Objectives

*Students will be able to:*

- Use local reference materials and resources to identify issues of interest.
- Demonstrate public speaking skills.
- Use established criteria to make a choice or decision.
- Assess the feasibility of creating change.



### Time needed

One 45-minute class

### Materials

Local newspapers, community publications, Internet

### Procedure

After exploring the resources, opportunities and assets of their community and after thinking of community ideals, students are now better prepared to assess ways in which they can create change in their community. This activity is a chance for students to build upon the list of opportunities they created in the "Brainstorming Community Opportunities" (Lesson 10) activity or to examine a few of them more in depth. Students should examine newspapers, news broadcasts, local publications and the Internet to find more information about areas of concern in their community. Students could create a survey, interview local experts or attend a public meeting to find out what issues other citizens want to see addressed. Comparing the assets of the students' "Fantasy Community" (Lesson 7) to those of their real community might highlight new resources students would like to see in their area.

At this point, students can determine if they are ready to act on one of the opportunities they have listed. If there are two or more opportunities that interest the students, the following questions can serve as criteria to decide which issue to address. Having a class vote or hearing persuasive speeches regarding each issue will allow for student ownership in the decision-making process. Also, these questions may be used to help examine the likelihood of a successful action plan:

- How does this situation affect our lives? How does it affect other people in the neighborhood?
- Are we, as students, capable of taking advantage of this opportunity to better our community?
- What assets are held within this classroom that we can use?
- What assets /resources outside of our classroom will help?
- Are the students in this class excited about this opportunity? Why does it or why does it not interest us?
- How does this issue affect the environmental, social and economic aspects of our community?

## LESSON 12 – BRAINSTORMING AN ACTION PLAN

### Objectives

*Students will be able to:*

- Demonstrate the ability to brainstorm effectively.
- Identify options to a course of action to address a specific community issue.
- Formulate steps toward a specific goal.
- Translate ideas into a written plan.

### Time needed

One 45-minute class period

### Materials

Large pieces of butcher paper

### Procedure

In this activity, the teacher is the facilitator, providing prompts and questions for the students in order for their ideas to be recorded. It might be easiest to begin with a few large pieces of blank paper on the wall or another spot visible throughout the planning process. A few guidelines for brainstorming include:

- This is an activity to record our first ideas and answers to questions so we will suspend the need to raise hands or talk in turn and every response will be recorded. We can then develop finished thoughts from our list.

Students should be asked to review the outcomes of the "Community Opportunities Assessment" activity (Lesson 11) and restate the issue in their neighborhood that they have decided as a class to address. The objective of this work session is to record ideas of how the class can begin to work on the chosen issue.

The primary prompt for this activity is:

- What do our steps to address the community issue look like?

After the students have had time to provide as many ideas as they can, some prompts that will help include:

- Have other people tried to address this opportunity? How?
- Could the assets/resources we have help to create other strategies?
- What will we do in the short term and over a longer period of time?

When ideas have been collected, the class should review them and formulate a course of action. A written plan should clearly state the community issue to be addressed, the planned strategy, community partners and the following:

- What tasks are included in our plan? Who will complete each one?
- What types of support will we need (work space, supplies, money, professional help, permission from the school, transportation, etc.)?
- What is the timeline that we have?
- What obstacles do we foresee in our way?



## Appendix B – Information Gathering: Lessons 13-24

*These lessons are designed to facilitate the Information Gathering phase of the community-based education process. Those lessons chosen to be used will depend on the project. Most likely, not all lessons will be used for any given project.*

LESSON 13 - BIOSPHERE

LESSON 14 - ECOSYSTEMS

LESSON 15 - POPULATIONS

LESSON 16 - CELLS

LESSON 17 - GENETICS

LESSON 18 - EVOLUTION

LESSON 19 - CLASSIFICATION

LESSON 20 - BACTERIA

LESSON 21 - FUNGI

LESSON 22 - PLANTS

LESSON 23 - ANIMALS

LESSON 24 - HUMAN IMPACT



## LESSON 13 - BIOSPHERE

### Activity: Depletion of Stratospheric Ozone

#### Abstract:

This unit is designed to have students apply the topic of stratospheric ozone depletion to a community context.

#### Age Group:

Grades 9-12

#### Time Needed:

If all five activities are completed 6-10 days may be required. Refer to individual activities for the time needed for each one.

#### Major Concepts:

Biosphere

Human Impact

#### Objectives:

*Students will be able to:*

- Differentiate between tropospheric and stratospheric ozone
- Understand natural ozone balance and the effect of halides
- Determine the awareness of the ozone problem in the school community by developing and conducting a survey
- Understand the alternatives to ozone-depleting chemicals
- Create an outreach product for the benefit of and in partnership with the broader community

#### National Standards Addressed:

*Science in Personal and Social Perspectives:* Students should develop an understanding of personal and community health, natural resources, environmental quality, natural and human-induced hazards, and science and technology in local, national, and global challenges

*Physical Science:* Students should develop an understanding of structure and properties of matter, chemical reactions, and interactions of energy and matter

#### Teacher Background:

This unit is designed to take the conventional topic of stratospheric ozone depletion and have the students apply it practically in a community context. The students will go through the entire process of learning new information and then use that information to make a valuable difference in the community around them. Through this process students will not only learn the factual content of the topic but will also develop a number of analysis and assessment skills through applications. Students will be serving their peers as well as their broader community while working in partnership with established community organizations. The Environmental Protection





Agency (EPA) as well as state and local agencies and organizations are involved in monitoring our air quality; partnering with these groups would be an opportunity for students to be involved as citizens.

There are five activities included in this lesson. You are welcome to try all or select individual activities. Whatever is chosen it is important to note that forming partnerships with the community and reporting back to the community are essential elements of this lesson.

The activities and appropriate resources are listed below. More detailed descriptions of student activities follow.

### **Activity 1: Atmosphere Composition**

Students learn the difference between tropospheric and stratospheric ozone by referring to the EPA publication listed below. This should provide a thorough background. A variety of student products can be generated from this information.

<http://www.epa.gov/ozone/science/index.html>

<http://www.epa.gov/airtrends/aqtrnd95/stratoz.html>

<http://www.epa.gov/ozone/basicinfo.html>

<http://www.epa.gov/ozone/defns.html>

### **Activity 2: Decomposition of Ozone - The Ozone Game**

#### **Activity 3: Public Survey – The Effects of Increased UV Radiation**

Refer to web pages listed below for background on UV radiation effects.

Background information on health related issues comes from the web sites listed below:

<http://www.epa.gov/o3healthtraining/what.html>

<http://www.epa.gov/o3healthtraining/population.html>

<http://www.epa.gov/o3healthtraining/effects.html>

[http://www.nsc.org/safety\\_work/NSCAwards/Documents/USPS%20Delivering%20Safety%20Newsletter/Here%20comes%20the%20sun.pdf](http://www.nsc.org/safety_work/NSCAwards/Documents/USPS%20Delivering%20Safety%20Newsletter/Here%20comes%20the%20sun.pdf)

[www.earthfiles.com/earth191.htm](http://www.earthfiles.com/earth191.htm)

Student activity: “Public Survey: Who Knew?”

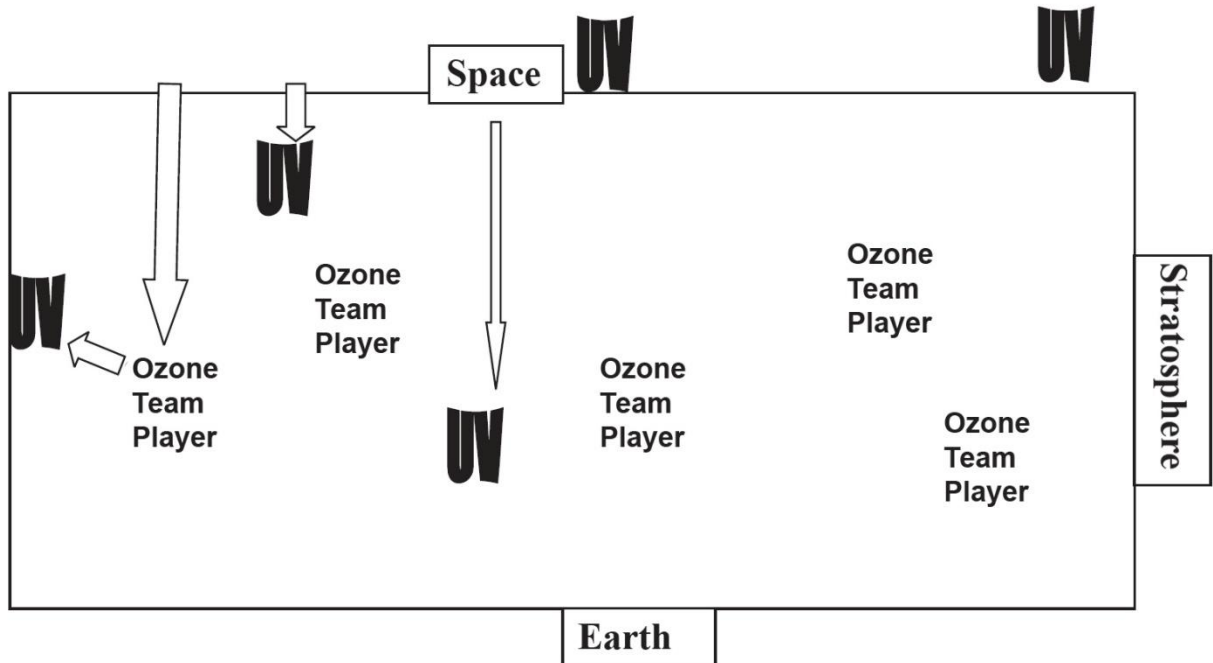
#### **Activity 4: Finding Alternatives – The Sources of Halides**

#### **Activity 5: UV Health and Ozone Action Publication**

## Lesson 13: Activity 2 - The Ozone Game

### Introduction:

The objective of this activity is to understand natural ozone balance and the effect of halides on the ozone layer. This interactive game is designed to help students visualize an invisible process. The natural interaction of ultraviolet (UV) radiation and ozone, as well as chlorofluorocarbons (CFC's) and ozone are clearly illustrated by this game. It is best to provide the students with the basics of how the ozone and UV light and CFC's interact, play the game, and then discuss the implications of CFC use and sustainable industry.



### Time Needed:

50 minutes

### Materials:

Gym or playing field access  
Flag belts  
Signs for "Earth" and "Sun"  
Dry erase board for scoring

### Procedure:

To begin playing the game, students are divided into two teams of equal numbers. One is selected to be the UV team first. These wear flag belts. Their goal is to cross from space to earth without losing a flag from their belt. The ozone team occupies the "stratosphere" playing field. Their goal is to prevent any UV players from reaching the earth by taking one of the flags from their belt. The UV team scores based on how many reach the earth with both flags intact. Both teams may use the entire playing area.

After several runs, switch the roles so that the teams are playing the opposite roles. Switch the flag belts and run three more times. Allow teams to strategize to reach their goal.

Call students' attention and announce the score after three runs each. Describe the natural balance of ozone and UV with some getting through but most being absorbed.

At this point the CFC effect should be introduced. The UV team selects a fast member to be a CFC molecule for them. The CFC player has 30 seconds to tag as many ozone players as possible. These must leave the stratosphere. Then the game is begun again. Repeat this process two or three times so a majority of the ozone players is tagged out. Reverse the teams so all players have an opportunity for each role. Add up the scores and emphasize the effect of CFC's on the amount of UV radiation on Earth.

Safety concerns should be addressed. If there are enough flags, then each team should have their own to wear to save time and prevent physical contact. If there are not enough flags then tagging can be used by the CFC person to eliminate ozone players. Students should be prepared in advance to have appropriate footwear for vigorous activity. Students with unsafe footwear should not participate.

## **Lesson 13: Activity 3 - Public Survey – The Effects of Increased UV Radiation**

### **Introduction:**

The objective of this activity is to determine the awareness of the ozone problem in the school community. The foundational element of individual safety with UV radiation is awareness. Does an individual know what is happening to them when they are exposed? Do they know what the risks are? Do they know what to do about it? These questions are important to answer affirmatively if a person is going to make conscientious decisions about appropriate exposure to the sun.

Since the students, after their lessons on stratospheric ozone and UV radiation exposure, are now informed citizens, what is the next thing to be done? To inform their peers and community about healthy living is the goal, but the first step is to assess what the general understanding is already. If the public is already informed, there is no need for an educational step. To assess the need for ozone and UV education, a survey must be created, administered, and assessed.

### **Time Needed:**

2 50-minute periods

### **Materials:**

Word processing and spreadsheet applications

Computer access

Candy or other token incentive

### **Procedure:**

Develop the survey (45 – 60 minutes)

Record on the board as the students brainstorm a list of all the things they think are important for people to know about the atmosphere, ozone, and UV radiation. The list should be exhaustive. Refine the list so there is minimal overlap between items. You should end up with between 15 and 30 “things to know.” Assign each item to a student or group of students and have them create one or more questions that would assess a person’s understanding of that item. When drafts of questions are complete, groups should review each others’ questions to look for ways to improve. The goal is to create a question that cannot be answered correctly without knowing the answer. Once the students have finished their survey questions, they should be compiled into one form and copied.

Administer the survey (homework)

During the following day after developing the survey the students will each receive 5 copies of the survey and 5 pieces of candy. They each are responsible for finding five people who will complete the survey (taking only a few minutes). The candy is an incentive for those taking the survey. It is important that the students giving the survey do not prompt or assist them in answering the questions. A sample of more than 100 students can be made in a short time.

Assess the survey results (45 – 60 minutes)

It is ideal to do this piece in a computer lab where students have access to spreadsheet software.

It can also be done on graph paper or simply in a data table if materials are limiting. The goal is to create a bar graph comparing the number or percent of times each question was missed.

Divide the students into small groups to create the graphs. Students then compare the graph to the survey to identify the topics that are the least and most understood. Have them create a list of the top ten topics that were missed. These are the target topics for the community outreach component.

## Lesson 13: Activity 4 - Finding Alternatives – The Sources of Halides

### **Introduction:**

The objective of this activity is to understand that although alternatives to ozone-depleting chemicals are available; these alternatives usually present challenges of their own.

### **Time Needed:**

50 minutes

### **Materials Needed:**

Samples of common packaging material types (e.g., polystyrene foam, inflated plastic, folded paper, cellulose, and shrink wrapped cellulose)

Beakers of water

Bricks (or other heavy object)

### **Procedure:**

Group the students and give them samples of polystyrene foam, inflated plastic, folded paper and cellulose packing materials. (Any other available varieties will be useful as well). Give each group a beaker of water, and a brick. Have them list the potential problems of each kind of packing material and then choose which material they think is the best alternative to polystyrene.

When the students investigate they will eventually find that paper and cellulose are vulnerable to water damage, inflated plastic is non-renewable and is vulnerable to sharp object punctures.

After the students have listed the problems with each of the materials, have them suggest what they think is the best way to overcome the problems of the alternatives to polystyrene. “If some can’t handle water, and some can’t handle sharp things, what can we do to create packing material that will replace Styrofoam?” Groups brainstorm for 5 minutes and record their best solution.

Each group then presents their solution to the class. After all have presented, bring out a sample of shrink-wrapped cellulose packaging (typically used in shipping computers) as one of the more attractive alternatives to polystyrene. Why?

**Concluding Emphasis** – Alternatives are available, but challenges must be overcome to make them as successful as possible.

## Lesson 13: Activity 5 - UV Health and Ozone Action Publication

### Introduction:

The objective of this activity is to create an outreach product for the benefit of and in partnership with the broader community. The survey conducted by the students has identified the information that their peers are lacking regarding UV radiation, the ozone layer and their relationship to human health. Since your students are now informed citizens, the final step of citizenship is outreach. This means extending the valuable resource that you have (information in this case) and helping improve the quality of life for those in the community.

One way to extend information to the community is through published brochures/pamphlets that can be distributed. The students will be the designers of the published material. The critical step at this point is to secure a partnership that will take the effort of the students and guide it into the mainstream community. This will maximize the effectiveness of the outreach, taking it from the realm of a “token activity” into the real world of participating citizens. A community partner can also help with the publishing component.

There are numerous potential partners who already have an established mission that is aligned with the purpose of your students’ publication efforts. Below are a few examples with some excerpts from their mission statements that reveal their purpose as it affects the students.

### County Health and Human Services Department

“The mission of Lane County Health & Human Services is to promote and protect the health and well-being of individuals, families, and our communities. Health & Human Services (H&HS) is a broad-based organization which oversees health, mental health, social services, and offender programs in a largely subcontracted system. The subcontract providers are our community partners in a complex service delivery system.”

<http://www.co.lane.or.us/HHS/default.htm>

### American Cancer Society for Teens

“The American Cancer Society Teens is a network of teen volunteers working to meet The Society’s mission: eliminating cancer as a major health problem by preventing cancer, saving lives and diminishing suffering from cancer, through research, education, advocacy, and service.”

<http://www.cancer.org/Treatment/SupportProgramsServices/look-good-feel-better-for-teens>

### Local Clinics and Hospitals

“At McKenzie-Willamette Hospital, we believe that the community should have access to current health and medical information in order to gain more control over the quality of their own lives.

<http://mckweb.staywellsolutionsonline.com/>

### Time Needed:

Varies depending on depth of project.

**Materials:** Varies with projects.

**Procedure:**

Before the students design their publication it is essential to arrange the partnership. You need to establish an understanding of the desired outcomes or products of the partnership and more importantly, both parties must have an understanding of their respective responsibilities. In this situation you are looking for the community partner to assist in the publication and distribution of an informational piece designed by the students. The community partner may have specific media in mind. The students can design the product according to the needs of the community partner. A hospital may prefer a poster series, pamphlets, billboard, radio or TV ad. The media is not what is important. The critical goal is to have the students designing content for a particular media to inform the public about their health and ozone issues.

Once the media and approximate format are agreed upon with the community partner, the students need to create the actual layout and content of the publication. Not every student's work can be published. It is possible that more than one would be published, but generally the partner will be looking for one design. This means we need a way for all students to contribute to the design. If a student doesn't have some personal ownership in the final design, they will have no ownership in the outreach process either. A competition will not achieve this since only one or a few will be vested in the final product. There are a few ways to improve on this. One option is to divide portions of a designated design to groups and then assemble them into one feature. This is particularly effective for pamphlets, which have numerous components such as a cover layout and varying internal sections. Another method for broad investment in one final product is peer editing and critiquing. Several drafts allow for comment and assistance from others. If one particular design is chosen, even those who did other designs had a part in helping shape the one that was selected. The selection process should be a democratic event with nominations and arguments for and against nominated designs. It is essential to frame the arguments in the context of what will best communicate the message to the audience, not just the most aesthetic. When a final design is selected, commend the entire contributing class for their part in shaping and driving the final product and reinforce how they will have a positive impact on many lives as a result of their efforts. The internal rewards of outreach far outweigh any external efforts we could apply. This is what will continue to influence students as they take their knowledge beyond the walls of their school.



**Assessments:**

Activity 1: Report, flyer, brochure or other student product. Information can be included in final publication as well.

Activity 2: Summary of game results with ideas learned. Again, this could be part of the final publication.

Activity 3: Design of the survey, data analysis, and presentation of results.

Activity 4: Presentations of solutions

Activity 5: Published materials and community education efforts.

**Resources:**

<http://www.epa.gov>

[www.earthfiles.com/earth191.htm](http://www.earthfiles.com/earth191.htm)

**Author/Affiliation:**

Dustin Beck  
Mohawk High School  
Marcola, OR

## LESSON 14 - ECOSYSTEMS

### Activity: The Effect of Change on Ecosystems

#### Abstract:

Changes in ecosystems are studied through the analysis of two adjoining sites, one recently disturbed and one untouched. Comparisons of a variety of biotic and abiotic factors will highlight changes that have occurred in the disturbed area.



#### Age Group:

Grade levels 6-12

#### Time Needed:

This project will take place over a few months and may continue over a number of years. One day a week or one day every other week should be used to collect data from the chosen outdoor site. At the beginning of the lab, two or three days should be devoted to describe the project and review data collection methods. Data should be taken monthly and logged until enough data have been collected to complete the final documents.

#### Major Concepts:

Ecosystems  
Succession

#### Objectives:

*Students will be able to:*

- Analyze past maps, aerial photos, and/or GIS layers
- Collect data by conducting soil testing, monitoring various abiotic factors, and inventorying plant and animal life.
- Develop an environmental impact statement
- Keep a field journal of their data and answers to questions posed.

#### National Science Standards Addressed

*Science as Inquiry:* Abilities necessary to do scientific inquiry

*Life Science:* Interdependence of organisms

*Science and Technology:* Understandings about science and technology

*Science in Personal and Social Perspectives:* Science and technology in local, national, and global challenges

#### Teacher Background:

Students will understand how environments that have been altered are changed through the analysis of abiotic and biotic factors of a recently disturbed area and a more natural and untouched area. Abiotic characteristics such as humidity, rainfall, temperature and sunlight can

be monitored and compared between the two sites. Biotic factors such as vegetation and inhabitant species can be monitored as well. Organisms that once preferred a cooler, moister ecosystem are now subjected to changes in temperature, humidity and sunlight.

The location of this activity is important to the end result of the project. A site should be chosen that has undergone changes recently such as clear cutting, clearing for a new school, fire, landslides or logging. Choosing a site, which has an edge, will allow the students to make comparisons between the untouched ecosystem and the newly altered site. Try to find two sites that are similar in geography such as slope and sun exposure. If there is an edge near this site, this will be the best location to collect data. The more fragmented the area has become, the more edges that will exist.

By comparing recent and past aerial photographs of the chosen sites students will be comparing and contrasting factors such as vegetation type and coverage as well as other events such as erosion. By examining aerial photographs or using Geographic Information Systems (GIS), students will be able to identify areas which have lost trees or foliage due to the disturbance (logging, clear cutting, fires, landslides and volcanoes).

It will be absolutely essential that you find partners in the community to assist in this effort. A number of city, county, state, and federal agencies and organizations will have this expertise and equipment and are usually eager to help out. Contact them at the beginning of the project, as they will have a variety of suggestions on how to proceed and carry out your work. They can also assist students in completing the environmental impact statements, and the other abiotic and biotic monitoring and inventorying you will be doing.

The study site should be divided into areas for sampling so that as much as 5-10 acres is represented by the study. Students will be broken up into groups and assigned a section to sample. Samples should be taken from an edge between the two areas and in 10 yard increments moving directly away from the disturbed site as well as into the natural area.

Students will produce a groundwork EIS (Environmental Impact Statement) at the end of their extensive study. It will include specific measures designed to minimize the environmental, economic and cultural impacts of the changes on the ecosystem. This document ensures that all environmental impacts of the change to the ecosystem will be recorded and documented. The document that the students will produce will prove to be useful in many ways to the community in which the study is conducted. In many cases, schools are altering land to build new schools. These studies will be a useful tool for the school board, planning commission, local soil and water conservation districts, maintenance departments and/or to present at township or city council/rotary club meetings. There will be a rubric included that the students can follow to be as thorough as possible in their study.

Students should be expected to keep some type of a field notebook or journal of their work. You may have them answer a variety of content type of questions in this as well to check to see if they understand the scientific process or content material you want them to know.

The end result of all this work should be student products that provide some type of feedback to the community. These can take a variety of forms from presentations with *PowerPoint* to brochures and posters. In addition, the class may want to take on the restoration of their site or another like it to reestablish the natural diversity. This will produce a more aware and informed citizenry for future decision-making.

As a caution, this project may seem overwhelming to anyone undertaking field studies and community involvement. You may want to pick out individual pieces of this activity to pursue. Small successful steps can build into a larger continuing project.

### **Introduction:**

Ecosystem transformations are inevitable. They define and change the way that we all live. Human activity is changing the ecological role of Earth's ecosystems at a faster rate than at any time in the last 65 million years. As an example, forest ecosystems provide habitats for more species of flora and fauna than any of the earth's ecosystems. A well-grown forest is Earth's primary biodiversity reservoir. They are a key component in global biogeochemical cycling. The economic consequence of cutting one tree down equates to \$200,000 worth of oxygen production, air and water cleansing, habitat provision, soil fertility and erosion control. That same tree will be sold as timber on the commercial market for no more than \$600. Through this activity you will become aware of the impact that our human activities are having on local ecosystems.

Since most species cannot generate their own nitrogen or obtain it from the atmosphere, they must rely on nitrogen compounds from soils. Organisms require nitrogen to make proteins, DNA, RNA, and other organic compounds. Multi-cellular organisms cannot directly use the nitrogen in the troposphere. Cyanobacteria in soils and water are required to turn nitrogen into a water-soluble ionic compound, which can then be absorbed through root systems and made available to consumer organisms. Nitrogen, soluble nutrients, and minerals are quickly lost through altered ecosystems. Mosses, lichen, and ferns when exposed to the sun decay and enrich the soil with nitrogen they fixed from the air. When these are present, it is a conclusive indicator that an ecosystem is nourishing its components. Nitrogen is one of the most important nutrients for regeneration. This nutrient availability will directly affect abiotic and biotic factors and in turn the inhabitant species.

Minerals and nutrients dissolve in rainwater and many times are carried away by runoff. This newly exposed soil is now filling creeks, rivers and bays with silt and increases river sedimentation. New plant communities cannot reestablish themselves easily in areas where land has been depleted of soil nutrients. The loss of this vegetation and extensive root systems are no longer slowing erosion of soil and nutrients. This can be identified through analysis of aerial photographs or through GIS.

**Materials Needed:**

Aerial photographs or GIS info on the chosen areas (two maps will be needed, the most recent published and one published at least 20 years earlier)

Maps of your area are available through:

<http://www.usgs.gov/pubprod/>  
[http://eros.usgs.gov/#/Find\\_Data](http://eros.usgs.gov/#/Find_Data)  
<http://earthexplorer.usgs.gov/>

Soil probe or auger (spade or a shovel)

Clean plastic containers

Overhead grids (graph paper copied onto a clear overhead)

Soil Test Kit (LaMotte)

Internet access (to monitor humidity and rainfall from local weather stations, NOAA or local and regional weather bureaus) <http://www.nws.noaa.gov>

Thermometers

Field guides <http://www.enature.com>

**Procedures for Activity:**

- 1) Examine the two sites.
  - a) Describe how one ecosystem has been disturbed.
  - b) Show in a web diagram or in writing what you think happened to the organisms that were once there
- 2) Compare and contrast GIS or aerial photographs of the area that you have chosen to study. If you are using aerial photographs lay down the overhead grid over the photograph from at least 20 years ago. Trace the area of foliage and the river systems. Lay the same grid over the most recent aerial photograph, trying to align geographical features. Trace the newly cut areas (newly cut areas appear lightest in color and new growth appears light gray with well-grown forests being the darkest spots on the map). Count the boxes that were once dark in color, but have now been altered.
  - a) Evaluate river systems, waterways and stream banks to show any changes between them on the two maps. Have the streams, rivers, lakes and banks changed in anyway? If yes, how might this affect the nutrients in the soil of the areas that you are studying?
  - b) How do vegetation and extensive root systems slow erosion? How can a man-made structure slow erosion rates?
- 3) Data Collection. Gather soil samples and examine abiotic and biotic data.
- 4) Produce a product or project that can be delivered to the community, such as an environmental impact statement.

## DATA COLLECTION

### Soil collection procedures:

- Atypical areas should be avoided when collecting soil samples, such as old fence lines, old lime or old manure piles, windbreaks, snow fences, wet sites, dead and back furrows, regions near lime-rock roads and borders between bottomland and gradients.
- When collecting soil samples, use a soil probe or auger, when possible. These tools facilitate sampling uniform depths and quantities of soil. If these tools are unavailable, a spade or shovel may be used.
- Soil sub-samples should be combined thoroughly to make up a representative sample for each area.
- Samples should be placed in a clean plastic container and labeled, as metal receptacles may lead to erroneous results and paper bags may contaminate the soil.
- Soil test kits may be purchased from a variety of science suppliers. (LaMotte)
- Standard soil tests will provide analysis of nitrate-nitrogen (NO<sub>3</sub>-N), phosphorous (P), potassium (K), soil moisture, and soil pH.

### Abiotic Data:

- Keep data on the humidity and rainfall of the area over the extended duration of the study ([www.nws.noaa.gov](http://www.nws.noaa.gov) )
- Keep data on temperature (readings taken at ground level, one meter above ground level and two meters above ground level)
- Keep data on the sunlight recorded: sunny, partly sunny and not sunny

\* *How did the soil compare at each of the sites?*

### Biotic Data:

- Keep data on plant and animal species
  - Keep data on low grass, high grass, forested or scrub grass populations
  - Keep data on what organisms were observed over the period of the study
- Report your data to the class in an informal presentation yet, one that includes data and graphs of your findings.
- List all of the environmental characteristics that you think would be most suitable for a healthy ecosystem in your chosen location?
- If a developer constructed a paved road straight through this site, what impact might the road have on the site's suitability for its inhabitant species and ecosystem?
- When visiting new construction sites, what erosion control methods are they using? Evaluate the methods effectiveness.
- In what ways do light and nutrients determine the course of succession?
- How long do you estimate that it takes an ecosystem such as the one that you are studying to return to its natural state, taking climate conditions and plant species into account?

## ENVIRONMENTAL IMPACT STATEMENT

Write a groundwork environmental impact statement by following the rubric and the following guidelines.

### Site description:

- Topography, geology and description of superficial deposits
- Climatology of area
- Vegetation of area
- Fauna of area

### Project Description:

- Possible impact on fresh water, superficial and groundwater
- Plans for minimizing negative environmental impacts
- Plans for site restoration
- Report on public consultation
- Environmental follow-up and monitoring

\*Present EIS to community partners

**Assessment:**

A variety of assessments can be given from the field work and data that is collected to community products and presentations. Below are some rubrics that can be used for questions and data collected for the Field Journal and for the EIS.

Rubric for assessment

Questions	6 points	4 points	2 points	Zero points
Describe how the ecosystem has been disturbed? (Procedure 1a)	You clearly explained your hypothesis to how the ecosystem has been disturbed.	You roughly explained your hypothesis to how the ecosystem has been disturbed.	You weakly explained your hypothesis to how the ecosystem has been disturbed.	You did not meet the requirements of this question.
Show in a web diagram or in writing the probable fate of the ecosystem's organisms and what you think has happened to the soil. (Procedure 1b)	You expressed your thoughts clearly in your web or writing about the probable fate of the ecosystem and what has happened to the soil.	You expressed your thoughts clearly in your web or writing about the probable fate of the ecosystem and what has happened to the soil.	You expressed your thoughts clearly in your web or writing about the probable fate of the ecosystem and what has happened to the soil	You did not meet the requirements of this question.
Procedure 2a	You clearly explained how streams, rivers, lakes, and banks have changed and how this affected the nutrients in the soil of the areas that you are studying.	You roughly explained how streams, rivers, lakes and banks have changed and how this affected the nutrients in the soil of the areas that you are studying	You weakly explained how streams, rivers lakes and banks have changed and how this affected the nutrients in the soil of the areas that you are studying.	You did not meet the requirements of this question.
Procedure 2b	You explained clearly how vegetation and extensive root systems slow erosion and how a man made structure can slow erosion rates.	You explained roughly how vegetation and extensive root systems slow erosion and how a man made structure can slow erosion rates.	You explained weakly how vegetation and extensive root systems slow erosion and how a man made structure can slow erosion rates.	You did not meet the requirements of this question.
Data Logged of both sites	Your group used good lab technique, kept accurate records and logged findings of the biotic or abiotic factors.	Your group used acceptable lab technique, kept accurate records and logged findings of the biotic or abiotic factors.	Your group used deficient lab technique, kept accurate records and logged findings of the biotic or abiotic factors	You did not meet the requirements of this question.
Soil comparisons	You accurately compared the soil at each site.	You compared the soil at each site.	You inaccurately compared the soil at each site.	You did not meet the requirements of this question.



Questions	6 points	4 points	2 points	Zero points
Report data to the rest of the class in an informal presentation. Include data and graphs	Your report included adequate data to help the class determine what would make the ecosystem suitable for the native organisms by showing graphs of your findings.	Your report included moderate data to help the class determine what would make the ecosystem suitable for the native organisms by showing graphs of your findings.	Your report included deficient data to help the class determine what would make the ecosystem suitable for the native organisms by showing graphs of your findings.	You did not meet the requirements of this question.
List environmental characteristics suitable to healthy ecosystem	You thoroughly listed all the environmental characteristics that you think would be most suitable for a healthy ecosystem in your chosen locations	You listed most the environmental characteristics that you think would be most suitable for a healthy ecosystem in your chosen locations	You listed some of the environmental characteristics that you think would be most suitable for a healthy ecosystem in your chosen locations	You did not meet the requirements of this question.
Impact of a paved road	You described clearly what impact a paved road might have on the sites suitability for its inhabitant species and ecosystem.	You described what impact a paved road might have on the sites suitability for its inhabitant species and ecosystem.	You tried to describe clearly what impact a paved road might have on the sites suitability for its inhabitant species and ecosystem.	You did not meet the requirements of this question.
New construction erosion control methods	You explained clearly what erosion control methods new construction is using.	You explained what erosion control methods new construction is using.	You either explained the erosion methods focused or their effectiveness	You did not meet the requirements of this question.
Light and nutrients affect on succession	You described clearly ways that light and nutrients determine the course of succession	You described ways that light and nutrients determine the course of succession	You described poorly ways that light and nutrients determine the course of succession	You did not meet the requirements of this question.
Estimate time for ecosystem restoration	You estimated how long it takes an ecosystem such as the one that you are studying to restore itself by providing evidence.	You estimated how long it takes an ecosystem such as the one that you are studying to restore itself by providing some evidence.	You estimated how long it takes an ecosystem such as the one that you are studying to restore itself but did not provide evidence.	You did not meet the requirements of this question.

Rubric for EIS

Description of objective	6 points	4 points	2 points	Zero points
Topography	You provided a visual or a great description of the topography of the site.	You provided a short description of the topography of the site.	You provided minimal information about the topography of the site.	You did not meet this requirement.
Geology	You provided clear information on the formation of the area of your study.	You provided information on the formation of the area of your study.	You provided minimal information on the formation of the area of your study.	You did not meet this requirement.
Rock, minerals, bedrock	You provided extensive information on the soil and bedrock of the area.	You provided information on the soil and bedrock of the area.	You provided minimal information on the soil and bedrock of the area.	You did not meet this requirement.
Climatology	You provided extensive data and trends of the climate of your area during your study.	You provided data and trends of the climate of your area during your study.	You provided minimal data and trends of the climate of your area during your study.	You did not meet this requirement.
Vegetation	You provided extensive information from the study on low grass, high grass, forested or scrub grass populations	You provided information from the study on low grass, high grass, forested or scrub grass populations	You provided minimal information from the study on low grass, high grass, forested or scrub grass populations	You did not meet this requirement.
Impact of surrounding water sources	You included a hypothesis and extensive data on the state of the water supply at your study site.	You included a hypothesis and data on the state of the water supply at your study site.	You included a hypothesis and minimal data on the state of the water supply at your study site.	You did not meet this requirement.
Minimizing negative effects	You included an extensive plan on minimizing the negative effects of the disaster on the ecosystem and soil.	You included a plan on minimizing the negative effects of the disaster on the ecosystem and soil.	You included a minimal plan on minimizing the negative effects of the disaster on the ecosystem and soil.	You did not meet this requirement.
Plans for reconstruction	You included significant evidence and a plan to aid in the native species returning to your test site.	You included evidence and a plan to aid in the native species returning to your test site.	You included minimal evidence and a plan to aid in the native species returning to your test site.	You did not meet this requirement.
Public Consultation	You have an extensive plan to share your information with your community partners and have included visuals with data.	You have a plan to share your information with your community partners and have included visuals with data.	You have a minimal plan to share your information with your community partners and have included visuals with data.	You did not meet this requirement.

**Extensions:**

- There are a variety of community products that could be produced such as developing a web site, a video, and brochures.
- Establish the sites as long term ecological study sites. Document changes over a number of years. Develop a photo record of the sites throughout the year and from year to year.
- Develop a restoration project at a disturbed site that can restore it more quickly to its natural state.

**Resources**

Bureau of Land Management. [www.blm.gov](http://www.blm.gov)

Golley, Frank B. (ed.) 1977. "Ecological Succession," in *Benchmark Papers in Ecology*. Stroudsburg, PA; Dowden, Hutchinson; Ross

Leopold, Aldo. 1966. *A Sand County Almanac*. New York; Oxford University and Press.

National Resources Conservation Service.  
[www.nrcs.usda.gov/wps/portal/nrcs/main/national/home](http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/home)

National Science Teachers Association, 1997, *Deforestation*. 64pp., PB138X02

U.S. Environmental Protection Agency. [www.epa.gov](http://www.epa.gov)

U.S. Forest Service. [www.fs.fed.us](http://www.fs.fed.us)

U.S. Geological Survey. [www.usgs.gov](http://www.usgs.gov)

**Author/Affiliation:**

Kerin Carlson  
Lincoln High School  
Ypsilanti, MI

## LESSON 15 - POPULATIONS

### Activity: Aliens Among Us

#### Abstract:

The study of populations and related concepts is central to a unit on ecology. Exploring these ecological principles in the context of real life environmental issues can further promote student understanding. Invasive plants represent a real and present threat to our natural areas. Providing students with authentic learning experiences dealing with such species can serve to enhance student comprehension of ecological concepts, while providing opportunities for them to function as members of their community.



#### Age Group:

Grades 9-12

#### Time Needed:

1 – 4 periods, or longer, as part of an ongoing research partnership

#### Major Concepts:

Competition

Predation

Biomass

Crowding

Exponential and logistic growth

#### Objectives:

*Students will be able to:*

- Conduct an authentic scientific investigation and develop an understanding of the process of science
- Convey their findings to the community
- Describe factors that limit population growth
- Describe the ecological impact of invasive plants

#### National Standards Addressed:

*Science as Inquiry:* Abilities necessary to do scientific inquiry, Understandings about scientific inquiry

*Science in Personal and Social Perspectives:* Natural resources, Environmental Quality

*Life Science:* Interdependence of Organisms

#### Teacher Background:

The study of populations is a traditional piece of a unit on ecology. Hands-on field experiences examining populations in a given environment can provide students with an opportunity to

observe and learn essential concepts in population studies, such as: density-dependent limiting factors (competition, predation, parasitism, and crowding), trophic levels, roles and niches, demographics (birth/death/growth rates), biomass and community interactions while allowing them to utilize basic scientific research procedures to observe common living plants and animals. Having students collect, organize, summarize and, report such information to an interested audience can make the learning experience more meaningful. Research has shown students to be more attentive to protocols and detail when the data collected are being used in an authentic manner.

### **Introduction:**

Limiting factors are environmental factors that stabilize populations and keep species from reaching their biotic potential. Limiting factors that come into play as population density increases are called density-dependent factors. Such factors for plants may include sunlight, space, water, and soil temperature and nutrients. Invasive plants are often successful in outcompeting natives for these factors.

Although public awareness lags behind, invasive plants have been identified as major contributing factors for decline and endangerment of many species in North America and around the world. As introduced plants expand their range and increase in abundance they are able to out-compete native plants. Associated with these changes in plant communities are changes in ecosystem processes, species diversity and abundance.

The loss of natural habitats to settlements and modern agriculture in combination with the range expansion of invasive species and associated changes in plant communities are the largest threat to the integrity of our natural ecosystems. It is estimated that in the U.S. alone, invasive plants infest over 100 million acres and continue to expand their range by 8-20% annually (twice the size of the state of Delaware).

### **Materials:**

1-meter square frames (PVC piping or meter sticks)  
Clipboards  
Pencils  
Data sheets

### **Procedure:**

Before hand, make contact with your local natural resource management agencies (e.g., Wildlife/ Forest preserves, Public Works Departments, Soil and Water Conservation Districts, Department of Natural Resources, U.S. Fish and Wildlife Service) and inquire about ongoing invasive plant programs. Such organizations may be interested in having your students assist with data collection, conducting a survey or plant removal, particularly if a new invasive plant has been spotted. Partnering with such agencies will give your fieldwork more relevance and purpose. It may also provide you and your students with access to experts, equipment and, established protocols. If such partnerships are not available or, are logistically impossible, check with your local public library, garden club and/or elementary schools for an audience interested in having your students report back to. Your students can then produce products (brochures, posters, *PowerPoint* presentations) that summarize their findings while educating others.

## **Preliminary Research**

You may wish to have students begin by conducting some preliminary research on the topic. You might assign the following questions to individuals or groups of students. Information can then be shared, discussed and studied before moving ahead.

Possible research questions:

- Why is biodiversity an integral component of a healthy functioning ecosystem?
- What invasive species are found locally?
- How can invasive species alter fire, hydrologic, carbon or nutrient cycles?
- How can native plants prevent erosion, improve water quality or provide for animals?
- What limiting factors can be imposed by invasive species?
- What are some means of controlling invasive plants? What are the pros and cons of such techniques? (Fire, cutting, mowing, flooding, herbicide, biological control)
- What are protocols? Sampling methods? Data collection? Why is standardization important?

## **Data Collection**

Select a site that is feasible and of interest to you and your students and/or partners. Unless guided by protocols and requests from a partnering agency, have students construct their own protocols (consistency and documentation are important). If possible, select four distinct areas (sunny, shady, dry, wet, slope...) within your site, to place the 1-meter square frames. Data collected may include: Date, time, location, temperature, weather conditions, type of area (wetland, meadow, forest, or ditch), plant species present and their counts (when stem density is low enough to count) or percent ground cover of each species (when stem density is too great to count). Students may also check for patterns in distribution and abundance of given plant species, whether the soil is virgin or disturbed, animal species present, and percent cover of rocks, soil and, organic debris (wood and leaf litter).

## **Data Analysis**

Using the data collected, students can generate a variety of maps and graphs such as habitat type/percent cover invasive plant species, number of different native species in areas with and without invasive species, percent cover of invasive species in disturbed areas and undisturbed areas to summarize their findings. Frequency tables and other simple statistical calculations can also be computed. Students may wish to look for strong correlations between areas with high invasive plant densities and other specific environmental factors (disturbed soil, proximity to other invasive species). Conversely, one may wish to examine which environmental factors have stronger correlations with native plant communities as compared to those plant communities dominated by invasive species. Such analysis techniques will assist in data interpretation and, may stimulate students to make their own hypotheses and, consequently, develop their own experiments or studies to address those questions.

**Assessment:**

If partnering with a natural resource agency or organization, your students will be collecting, summarizing and presenting authentic and needed data. You may also wish to have students share their findings at school/town board meetings, or other public hearings. Such presentations may include poster exhibits, *PowerPoint* presentations, slide shows, pamphlets and such. Letters to the editor can also be sent to local newspapers and/or to a district newsletter if one exists.

In addition to the presentation of data collected, emphasis should be made to educate the given audience regarding the threat invasive species pose to biological diversity in general and, to local native communities specifically. The limiting factors involved in the decline of native species should also be addressed. Finally, possible efforts to remove, eradicate, or prevent the spread of local invasive plant species should be discussed.

**Extensions:**

- Have students write letters to the editor, give public presentations, or create informational brochures that describe their findings
- Have students conduct additional research and conduct community workshops on the issue of local invasive plants and potential solutions
- Have students organize and conduct local invasive plant removal efforts
- Have students keep a journal that documents how the community interacts with the invasive plant population they have
- Discuss the concept of carrying capacity and limiting factors in the context of conservation

**Extended Collaboration**

Student-teacher-scientist partnerships are unique collaborations that offer a win-win opportunity for research scientists, teachers and their students. Student collected data on the distribution and abundance of a particular invasive species can be of value to research scientists studying their population dynamics. Locally collected data can be shared with such partners, increasing the significance of the student's efforts.

**Resources**

Cornell University. 2002. Ecology and Management of Invasive Plants Program.  
<http://www.invasiveplants.net/>

**Author/Affiliation:**

Linda Tompkins  
Mynderse Academy  
Seneca, Falls, NY

## LESSON 16 - CELLS

### Activity: Effects of Increased Atmospheric CO<sub>2</sub> on Photosynthesis and Cellular Respiration in Plants

#### Abstract:

Atmospheric CO<sub>2</sub> is produced by processes as diverse as the decomposition of organic materials in wetlands, volcanic eruptions and the burning of fossil fuels. This activity examines the effect of increased atmospheric CO<sub>2</sub> on photosynthesis and cellular respiration.

#### Age Group:

Grades 9-12

#### Time Needed:

Five 1-hour lab periods. If you are not using grass plots that have already been established, this lab requires approximately 3 weeks total time to allow for plant growth.

#### Major Concepts:

Photosynthesis

Cellular respiration

Regulation of cell functions by outside stimuli

#### Objectives:

*Students will be able to:*

- Identify the chemical equations for photosynthesis and cellular respiration
- Describe the correlation between CO<sub>2</sub> and rate of photosynthesis
- Measure CO<sub>2</sub> levels
- Measure net primary productivity
- Understand the mathematical relationship between net primary productivity, gross primary productivity and cellular respiration

#### National Standards:

*Life Science:* The Cell; Photosynthesis and cellular respiration; Regulation of cell functions by external stimuli

#### Teacher Background:

This is an ideal project to partner with government agencies (e.g., EPA, state agriculture departments, county soil and water conservation districts) interested in atmospheric CO<sub>2</sub> levels.

Atmospheric CO<sub>2</sub> is produced by both natural and human-driven processes. The decomposition of organic materials, volcanic eruptions, forest fires and the burning of fossil fuels all contribute to the concentration of CO<sub>2</sub> in the Earth's atmosphere. The relationship between global temperature and atmospheric levels of CO<sub>2</sub> has been well-studied and debates continue about the





consequences of human-induced climate change as a result of elevated CO<sub>2</sub> levels. Rising sea levels, increased extinction rates and more devastating storms have all been proposed as potential impacts. Some consequences, however, could be beneficial. For example, since CO<sub>2</sub> is a raw material for photosynthesis, higher CO<sub>2</sub> concentrations may result in enhanced growth for some plants including agricultural crops. As a result, fewer fertilizers may be needed to achieve the same amount of production. This may result in an environmental benefit since runoff of commercial fertilizers from agricultural lands has been shown to be a major source of water pollution.

Informing the community of areas of high atmospheric CO<sub>2</sub> would allow them to reduce their fertilizer use and reach the same desired result. For example, a golf course near a high traffic area could reduce the amount of fertilizer applied due to the additional atmospheric CO<sub>2</sub> from combustion of fossil fuels. This could reduce the amount of nitrates and phosphates reaching the watershed from runoff.

**Introduction:**

The gross primary productivity (GPP) of an ecosystem is the rate at which solar energy is captured during photosynthesis and is stored in the form of carbohydrates. GPP is typically measured in units such as the amount of carbohydrate produced per unit area per unit time (e.g., grams/square meter/week). We also know that plants, like other living organisms, must carry on respiration (R) to provide energy for life processes such as growth, reproduction and metabolism. This uses some of the energy originally produced by photosynthesis. The energy that remains in plant tissues after respiration has occurred is called net primary productivity (NPP). NPP therefore represents the rate at which organic matter (biomass) is actually incorporated into plant tissues to produce growth. The relationship can be expressed as follows:

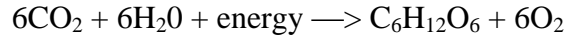
$$\begin{array}{rcl} \text{net primary productivity} & = & \text{gross primary productivity} - \text{plant respiration} \\ \text{(plant growth)} & & \text{(total photosynthesis)} \end{array}$$

Only the energy represented by NPP is available for consumers, and of that energy only a small portion is actually used by them. Both GPP and NPP can be measured as either “energy per unit area per unit time” (e.g., kilocalories/m<sup>2</sup>/week) or “dry mass per unit area per unit time” (e.g., grams/m<sup>2</sup>/week).

In this lab you will determine what impact, if any, elevated atmospheric CO<sub>2</sub> levels, have on NPP (plant growth) and cellular respiration (R). This will be done by growing plots of grass under different CO<sub>2</sub> levels and comparing their productivity.

**Background for calculations:**

The process of photosynthesis uses solar energy to convert carbon dioxide and water into carbohydrates. Oxygen gas is produced as a byproduct. The reaction is summarized by the reaction:



Photosynthesis provides the fuel (carbohydrate) for cellular respiration which is nearly the reverse of photosynthesis. The energy resulting from respiration is used to drive all life processes such as growth and metabolism. Cellular respiration may be summarized by the reaction:



Note that  $\text{CO}_2$  is *consumed* by photosynthesis and *produced* by respiration.

To Summarize:

**Net primary productivity (NPP)** – the amount of carbohydrate that accumulates as plant growth after respiration

**Gross primary productivity (GPP)** – the total amount of carbohydrate produced as a result of photosynthesis

**Plant respiration (R)** – the amount of carbohydrate that is used during cellular respiration to produce energy

$$\text{NPP} = \text{GPP} - \text{R}$$

Photosynthetic rates, and thus GPP, are highly dependent upon the amount of solar energy available. Tropical areas are generally more productive than temperate areas and GPP is higher on clear, sunny days than on cloudy days. Not *all* solar radiation, however, is used by plants to drive photosynthesis. That portion of solar radiation that *is* used in photosynthesis is referred to as **photosynthetically active radiation (PAR)**. PAR can be used as an approximation for GPP.

Total Photosynthesis Calculation:

The solar radiation constant is  $2.0 \text{ cal/cm}^2/\text{minute}$  or  $28800 \text{ kcal/m}^2/\text{day}$ . Not all of this reaches the Earth's surface, however. The atmosphere absorbs approximately 18% of this energy and about 21% is reflected back into space by clouds.

**Calculating weekly photosynthetically active radiation (PAR) available:**

- Measure daily PAR
- Account for percent of reflected and absorbed light by multiplying the daily PAR by the percents above for solar energy absorbed (18%) and reflected (21%) and subtract these from the total daily value. This is your actual PAR for the day.
- Repeat the process for each day and add the seven values for the week together to obtain your weekly PAR.
- As indicated above, PAR can then be used as an approximation for GPP

**Sample Calculation to Determine Respiration (R):**

Weekly PAR is estimated to be 544320 kcal/m<sup>2</sup>/week. This value can then be plugged into the mathematical relationship between GPP, NPP and R:

$$\text{GPP} - \text{R} = \text{NPP}$$

resulting in:

$$544320 \text{ kcal/m}^2/\text{week} - \text{R} = \text{NPP}$$

If we have an estimate of NPP, then R can be determined by solving the simple equation above. Recall that both GPP and NPP can be measured either as energy (kilocalories/m<sup>2</sup>/week) or dry mass (grams/m<sup>2</sup>/week). NPP will be determined by direct measurement of the biomass that accumulates over time on a sample plot and will be expressed as “grams/m<sup>2</sup>/week.”

**Materials**

For measuring atmospheric CO<sub>2</sub> levels:

Containers for water reservoirs (the more surface area the better) 2 per plot. The water reservoirs need to be at least 10 cm X 10 cm X 10 cm, plastic milk jugs work well.

30 ml test tubes-1 per CO<sub>2</sub> sample

Phenolphthalein indicator solution

Sodium hydroxide (NaOH needs to be pure and free of carbonates that would interfere with accurate results)

**For Measuring Net Primary Productivity:**

Digital or triple beam balance

Drying oven or other means of drying samples

Drying paper or large beakers

Grass seed of several different species

Lightweight potting soil

Drying paper or large beakers

Materials to make flats for sample plots (if flats are used)

**Procedures:***Overview:*

At least two study sites with different CO<sub>2</sub> levels will be selected. Net primary productivity will be estimated by measuring the amount of grass biomass that accumulates over one week at each site. Two grass plots are established at each study site. The grass biomass (dry weight) of the first plot is determined and then, one week later, the second plot is harvested and weighed. The difference between these two dry weights is an estimate of plant growth or net primary production. If PAR is used as an estimate of gross primary productivity (GPP), two of the three terms in the equation, GPP – R = NPP are known and respiration (R) can be determined by subtraction.

### *Selection of Study Sites:*

Two study sites should be selected - one near a high traffic area and another more remote and isolated from heavy traffic. You could also select sites that your community partner has an interest in monitoring for CO<sub>2</sub> levels.

### *Establishing plots:*

Two plots of planted grass must be established for each study site. Plots may either be established in the field or in “planting flats” which are then placed in the field. Flats may be constructed from a variety of materials (10 cm X 10 cm, works well) or commercial flats can be used. Be sure to measure the area of the flats and make appropriate adjustments in your calculations.

- Mark off 1 meter x 1 meter plots, two at each study site.
- Prepare plots for planting grass seed.
- Count out the number of seeds you wish to plant, for each sample plot. Use planting guidelines provided with the seeds to estimate the appropriate seed density for your plot size. All plots must have the same number of seeds planted.
- Record your plot size (in m<sup>2</sup>) and number of seeds used per plot.
- Spread the seeds evenly over the plot and cover with a thin layer of potting soil.
- Water the plots as needed with identical amounts of water for the next two weeks. The grass should be 7-10 cm tall before the actual experiment begins.

### *Measuring atmospheric CO<sub>2</sub>:*

Carbon dioxide levels at each test site must be estimated to determine which sites have “elevated CO<sub>2</sub>” and which do not. If available, a CO<sub>2</sub> monitoring device may be used to measure CO<sub>2</sub> directly. Otherwise, atmospheric CO<sub>2</sub> levels may be estimated as follows:

- At the time of planting, place water reservoirs in or next to plots. Reservoirs can be submerged to ground level.
- After one week, siphon 25 ml water from just below the surface of the water reservoirs.
- Place water sample in test tube and add one drop of phenolphthalein indicator solution to sample.
- Add the sodium hydroxide solution drop by drop to the sample. Count each drop as it is added. Swirl the test tube to mix after each drop is added. Continue adding drops until a light pink color forms, and persists for at least 30 seconds.
- Each drop of sodium hydroxide solution used equals 1.25 mg/l carbon dioxide.
- Multiply number of drops by 1.25 mg/l to determine CO<sub>2</sub> concentration in mg/l.

### *Measuring net primary productivity:*

- Calculate weekly PAR at each plot. (See data table)
- From one plot (we’ll call these “#1 plots”) at each sample site carefully remove the entire grass plants from the soil. Remove as much of the soil from the plants as possible trying to keep all roots intact.

- Carefully rinse off any remaining soil from the roots and gently shake off the excess water. Place the plants on drying paper or in a large beaker, and label with plot number and grass species.
- Place all samples in the drying oven for seventy-two hours (3 days). Continue to water the second plots (we'll call these "#2 plots") at each site as before. These will be pulled and dried after an additional week of growth.
- After the 3-day drying time, remove the samples from the drying oven and let them cool. When cool, weigh each sample and record these weights as **starting dry weight** in the appropriate place in TABLE A.
- One week after you removed the #1 plots, repeat steps 2 through 5 above for the #2 plots.
- Record these weights as **final dry weight** in the appropriate place in TABLE A.

#### CALCULATIONS

- Determine PAR and use as an approximation for GPP. Enter these values in TABLE B.
- Determine NPP by subtracting "starting dry weight" from "final dry weight" for each grass plot. Enter value for NPP in TABLE B
- Determine R using the known mathematical relationship between GPP, NPP and R. Enter value for R in TABLE B.

### SAMPLE CALCULATION

An experiment is conducted as described above at two sites. Site A is a “high CO<sub>2</sub> site” and Site B is a “low CO<sub>2</sub> site”. Weather was clear and sunny throughout the experiment and photosynthetically active radiation (PAR) is determined to be 544,320 kcal/m<sup>2</sup>/week. This value would be reduced by 10% if partially cloudy and by 20% if cloudy. This value will be used as an approximation for GPP.

Net primary productivity (NPP) will be determined by measuring the amount of biomass that accumulates over one week in plots that have been planted at each of the two sites. Two 1 m<sup>2</sup> plots have been planted at each site. Two weeks after planting, the #1 plots have grown sufficiently to harvest and **starting dry weights** are obtained. One week later, the #2 plots are harvested and **final dry weights** are obtained. Data are recorded as follows:

Site Identification	Final dry weight (g)	Starting dry weight (g)	* NPP (g/m <sup>2</sup> /week)
Site A	60,000	20,000	40,000
Site B	55,000	18,000	37,000

\* NPP is obtained by subtracting the starting dry weight from the final dry weight as illustrated in the table

Since both GPP and NPP are now known for each site, respiration (R) can be determined by solving for R in the equation  $GPP - R = NPP$

**For Site A:**

$$544,320 - RA = 40,000$$

$$RA = 504,320 \text{ g/m}^2/\text{week}$$

**For Site B:**

$$544,320 - RB = 37,000$$

$$RB = 507,320 \text{ g/m}^2/\text{week}$$

**TABLE A (for calculation of NPP)**

Site Identification	Final dry weight (g)	Starting dry weight(g)	* NPP (g/m <sup>2</sup> /week)

\* NPP is obtained by subtracting the starting dry weight from the final dry weight

**TABLE B (for calculation of R)**

Site Identification	PAR (kcal m <sup>2</sup> /week)	GPP (g/m <sup>2</sup> /week)	NPP (g/m <sup>2</sup> /week)	*R (g/m <sup>2</sup> /week)

\* Respiration (R) is determined by subtracting NPP from GPP

**Analysis:**

Answer the following questions by examining Tables A and B.

Did plants at the “high CO<sub>2</sub> site” exhibit higher net primary productivity (NPP) when compared to the “low CO<sub>2</sub> site”? What explanation can you offer?

Did plants at the “high CO<sub>2</sub> site” exhibit higher respiration (R) when compared to the “low CO<sub>2</sub> site”? What explanation can you offer?

Briefly discuss the relevance of your findings to agricultural production.

Briefly discuss the relevance of your findings to other impacts of global warming.

**Assessment:**

Prepare the information you have gathered for a presentation to the agencies involved. The presentation should include graphs that illustrate the relationship between CO<sub>2</sub> levels and net primary productivity and respiration. Technical terms that the public may not understand (e.g., net primary productivity) should be defined and discussed early in the presentation. The significance of your findings to community members should also be included.

**Extensions:**

Previous studies have shown that when atmospheric CO<sub>2</sub> increases, plant growth also increases. It has also been observed that as soil nitrate increases, plant growth increases. When both were elevated, net productivity was enhanced more than the sum of their individual contributions. One possible extension would be to measure nitrate levels to determine the level of nitrates that would yield optimum growth for the CO<sub>2</sub> level of a particular area. In this way, the use of nitrate fertilizers could be minimized thus reducing the harmful effects of nitrate runoff into water supplies.

Government agencies and community members who may be able to provide information and/or be interested in the results include:

- U.S. Fish and Wildlife
- U.S. Forest Service
- U.S. Environmental Protection Agency
- Local Native American tribes
- Water management agencies
- County Parks and Recreation
- Ranchers and farmers

**Resources:**

Distributed Active Archive Center for Biogeochemical Dynamics

[http://daac.ornl.gov/NPP/npp\\_home.shtml](http://daac.ornl.gov/NPP/npp_home.shtml)

NASA Earth Observatory

[http://earthobservatory.nasa.gov/GlobalMaps/view.php?d1=MOD17A2\\_M\\_PSN](http://earthobservatory.nasa.gov/GlobalMaps/view.php?d1=MOD17A2_M_PSN)

E-How

[http://www.ehow.com/how\\_7371191\\_calculate-net-primary-productivity.html](http://www.ehow.com/how_7371191_calculate-net-primary-productivity.html)

University of Michigan. Introduction to Global Change.

<http://www.globalchange.umich.edu/globalchange1/current/lectures/kling/energyflow/energyflow.html>

**Author/Affiliation:**

Sonna Smith

Grant Union High School

John Day, OR



## LESSON 17 - GENETICS

### Activity - Natural Variation Within Species

#### Abstract:

The physical attributes (traits) of an organism are controlled by DNA, which is selected by the environment in which it lives. This activity will clarify the connection between traits, DNA and the environment via field studies and community interaction.



#### Age Group:

Grades 7-12 (although easily adapted to lower grades)

#### Time Needed:

50-minute class period to collect samples in the field

50-minute class period to classify and make observations of variations

Field study of area to inventory organisms may take 3-5 class periods depending on the size of area.

#### Major Concepts:

Genetics, variation, species, plant and/or animal external anatomy

#### Objectives:

*Students will be able to:*

- Understand that variations occur within a species
- Classify organisms based on physical features
- Observe life in a natural setting and gain an appreciation of life around us
- Identify species within an area
- Understand how genetic make-up is expressed through an organism's physical features

#### National Standards Addressed:

*Unifying concepts and processes:* Systems, order, and organization

*Science as inquiry:* Abilities necessary to do scientific inquiry

*Life sciences:* Molecular basis of heredity

Matter, energy and organization of living systems

Interdependence of organisms

*Science in Personal and Social Perspectives:* Environmental quality

#### Teacher Background:

Students and the general public often lose sight of the variation of living things around us.

Students in particular think that all plants are the same, or all snakes are the same, though when we look at people we can easily recognize the variety of sizes, skin color, nose shape, and eye

color, which are used for our individual identity. Animals are also able to tell themselves apart. Somehow the penguin always seems to find its baby after a day at sea though they are nesting with thousands of other penguins, which to most humans look exactly alike until we really start to observe them closely. This activity is meant to get students to look at living creatures in a natural setting, begin to create an inventory of species found in that setting, and to distinguish between individuals of a given species.

Contact local organizations and agencies to see if there are local sites that need to be inventoried for plants or animals. The local Audubon Society or natural resources agencies such as Bureau of Land Management, U.S. Fish and Wildlife Service, and Soil and Water Conservation Districts are good places to start looking for partnerships. Depending on your school district, it may be easy to arrange an all-day field trip for your class to inventory the plants and animals of a site and also to bring in specialists in plant identification and a wildlife biologist to train the students on how to sample the area for the organisms. If a field trip option is unavailable, try a Saturday and give the students some extra credit for taking time out of their schedule to learn this information. This adds community awareness and aids in the student connecting with the environment and feeling a part of the community, especially if they can publish this information or they can act as education specialists in some way to get their information out. Once an inventory is accomplished, this activity will bring greater depth to their understanding and can be used to tie in genetics and natural selection.

Plants can be easier than animals to work with as they don't move and can be easier to collect. There are many identification books and field guides with color pictures, so students can identify them based on their physical features. Animals are also great to work with and many kids love to find wriggling snakes, millipedes, bugs, and insects. It reduces the frustration level if the plants or animals selected to study are abundant, easy to identify, and have notable variations within the population.

In this activity, either you can direct students as to which traits you want them to observe and measure or you can make it more inquiry-based and have them pick their own trait to measure. Examples of traits you may wish to observe include leaf color, weight, length, width, vein pattern, surface area, leaf shape, and leaf margins. Working with specialists may help to identify traits and characteristics to focus on.

Notes:

- You may need to discuss random sampling techniques with your students before you get out in the field, or when you are in the field and ready to turn them loose. This will help set the stage and improve results after this discussion.
- Definitely take the time to debrief about problems/limitations by using this sampling protocol – some variations may be due to age of specimens, position in the stand, amount of shade/light, etc.
- Feel free to adapt this lab – other ideas which may be of interest to study is the number of stoma on the leaf surface, leaf color, amount of pigments, types of pigments, etc.

**Introduction:**

Variations among individuals in a population are caused by the interaction between DNA and the environment those individuals are exposed to. DNA is the heredity material that tells an organism what it is and how it works. There is enough variation within a species of organisms to allow for individual differences. For example all humans have 99% of the same DNA code, but the 1% difference among us results in the variation we observe such as height or eye color. This variation exists in all creatures and is the basis for **natural selection** - the idea that variations, which are desirable for an area, give the organism a better chance at using the resources and surviving to pass on its genetic material to the next generation. Therefore, the physical attributes (**phenotype**) of an organism are determined by its DNA, which in turn is “selected” by the environment in which it lives. We are going to connect these two concepts in this activity.

**Materials:**

Pencil and paper for sketching in the field

Plastic bags with wet paper towels to collect plant specimens

Screw-cap bottles

Nets to collect animal specimens

Hand lens or dissecting microscope

**Procedure:**

- Prior to going out to the field, students should select an organism (species) they would like to work on. You may want to provide them with a list to choose from that can be obtained from a variety of natural resource agencies. Once the selection of organism is completed, students need to gather the necessary materials they will need in the field and have them ready for the next day’s trek to the field.

*In the field*

- Students will collect information from at least 10 individuals of their chosen species. For example if you have chosen an oak tree, you would collect a leaf or two from each of 10 different oak trees. (You may also want them to collect other plant parts such as flowers or fruits) Store all of the collected plant material in a plastic bag with the specimens wrapped in a moist paper towel. Refrigerate samples when you get back in the lab to help preserve them.
- While in the field have students sketch and describe at least 4 entire individuals of their selected species. In this way you can note branching patterns in oak trees, for example, and possibly use this information for comparisons. Record your observations on Data Sheet 1.

*In the classroom*

- Students should make detailed observations of the individual organisms collected. A hand lens or dissecting microscope may be needed to observe the variations that you find. For example, with oak leaves pay close attention to leaf venation, color, leaf margin, and thickness. Then, discuss the possible reasons for these variations. Students should record their observations on Data Sheet 2.

## NATURAL VARIATION WITHIN SPECIES: DATA SHEET 1

Give the genus and species name of your organism.

Describe the general biology (where does it live, how does it get food and nutrients, etc) of the particular species which you have selected and indicate the source of your information.

Describe in detail your method of collection and identification.

Explain how you will ensure that all individuals collected or identified are members of the same species.

What are other sources of variation which your sampling may not have taken into account?

**Sketch of Individual 1:**

**Sketch of Individual 2:**

General location found:

General location found:

Specific identifying characteristic:

Specific identifying characteristic:

## NATURAL VARIATION WITHIN SPECIES: DATA SHEET 2

Describe the phenotypic traits you will be measuring and why they are biologically relevant.

Describe in detail your method of measuring the traits of interest.

Fill in the data table below.

Individual	Trait	Surface Area	Weight	Length	Width	Vein Pattern
# 1						
# 2						
# 3						
# 4						
# 5						
# 6						
# 7						
# 8						
# 9						
# 10						

**Analysis:**

From your data table, were all of the individuals the same or were there differences?

List the traits which show differences.

These differences are variations. Why is it biologically important for members within a species to show variations?

What part of the cell is responsible for these variations?

What molecule found in the nucleus controls the variations which we see in all beings?

**Conclusion:**

Based on your observations and data, what can you conclude about the role of DNA in the nucleus to control variations in leaf size and shape?

**Assessment:**

A number of products can be developed by students for the partnering organization and for the local community:

- Inventory chart of plants and animals in given area
- Sketches of plants/animals and their variations
- Pamphlet that lists the amount of varieties of organisms found in the area
- Poster showing community organization and energy flow

**Extensions:**

- Depending on the care of collecting and recording data, students could go back to the same tree the following year and see if the variation was consistent from year to year.
- Would this be expected based on its genetics? If you compared one area to another, would you find other variations of the same species?
- If historical data already exist for the site, the information the students get can be used to compare against the historical data and can determine how the site has changed and why.
- Research local legends about the uses of local plants and animals and how these uses have changed.
- Make a brochure of the plant and animal types in the area and address the city council with issues and concerns raised by doing this research.
- Use the site for vegetation sampling for population studies, monitoring health of the ecosystem based on biodiversity.

**Resources:**

Kozoloff, Eugene. 1995. Plants and Animals of the Pacific Northwest. 264 pp.

Gilkey, Helen and La Rea Dennis. 1992. Handbook of Northwestern Plants. 507 pp.

Oregon Department of Fish & Wildlife. 1993. Naturescaping.

Access excellence. 1996. Sampling variation in a natural population.

[www.accessexcellence.org/AE/AEC/AEF/1996/macphee\\_population.html](http://www.accessexcellence.org/AE/AEC/AEF/1996/macphee_population.html).

Theoretical Biochemistry Institute. 1996. Charles Darwin's Origin of Species.

[www.tbi.univie.ac.at/Origin/origin\\_toc.html](http://www.tbi.univie.ac.at/Origin/origin_toc.html).

Hands on the Land. 2000. Mammals of the Hanford Reach.

[www.handsontheland.org/classroom/04/index\\_eng.html](http://www.handsontheland.org/classroom/04/index_eng.html).

Microscopy of the United Kingdom. 1994. Pond life.

[www.microscopy-uk.org.uk/pond/x\\_index.html](http://www.microscopy-uk.org.uk/pond/x_index.html).

**Author/Affiliation:**

Terry Manning  
Silverton High School  
Silverton, OR

## LESSON 18 - EVOLUTION

### Activity - Invasive Plant Species and Your Community

#### Abstract:

This activity initiates the study of evolution through the context of a community project to manage a field site and educate the public on the identification and dangers of invasive plant species.

#### Age Group:

Grades 9-12

#### Time Needed:

8-10 days

#### Major Concepts:

Adaptation

Invasive vs. native species

Competition

#### Objectives:

*Students will be able to:*

- Define and research local invasive species and their effects on the community
- Study the adaptations of invasive species that allow them to out-compete native species
- Adopt a plot of land and remove invasive species
- Create an informational pamphlet to be distributed throughout the community
- Gain an appreciation for the local environment.

#### National Standards Addressed:

*Unifying concepts and processes:* Systems, order, and organization; Evolution and equilibrium

*Life Sciences:* Biological evolution, Interdependence of organisms

#### Teacher Background:

This activity is to be used as a bridge between studying ecology and evolution. It would best be used as a culminating activity at a field site that has been used to demonstrate the principles of ecology. From the study of how a specific environment functions, it will lead the students into a study of how species have traits and characteristics that allow them to adapt successfully to particular environments.

The first step is finding a possible field site to study. This site can be a schoolyard, community park, state park, nature center, or corporate site such as those managed by non-profit organizations. This activity is to be used in coordination with a community partner. Possible partners include the Department of Agriculture, the Bureau of Land Management, your local Parks and Recreation department, or other non-profit volunteer organizations. Many areas also





have local native plant societies. These organizations may be able to help in determining an appropriate field site, as well as supplying tools and materials for invasive plant removal and copy costs for the community informational pamphlets. Also, many counties employ a weed control agent who is usually quite willing to give presentations and offer assistance.

The “Community Action Survey” can be used as a pre- and post-assessment. It is designed to measure the students’ progress toward the lesson objectives. Valuable data can still be collected on the success of the lesson if it is used only as a post-assessment.

### **Introduction:**

Evolution shows us that natural selection works on variation within populations to allow species to adapt to their local environment. Usually, non-native species that are transplanted to new environments by human activities, are easily out-competed by native species, which are well adapted to the environment. A minority of introduced species however, have adaptations that allow them to out-compete the local native species. The ecological impacts of these invasions are extremely difficult to predict and take years to fully understand.

Invasive species can have negative impacts on native species in a variety of ways. They compete for food, water, nutrients, and space as well as altering ecosystem composition and processes. Introduced diseases and parasites can attack and eliminate dominant native plant species. For example, the chestnut blight fungus from Asia all but wiped out the American chestnut, thus changing the makeup of eastern forests (U.S.D.A.. Forestry Service, 2000). Invasive species impact nearly half of the species currently listed as Threatened or Endangered under the U.S Federal Endangered Species Act (National Invasive Species Council, 2001). They are second only to habitat loss as a cause for species decline and extinctions in modern times.

The best way to control invasive species is to prevent them from invading in the first place. Once they are established, however, there are several control methods including mechanical, chemical, biological, and ecological methods. On a small scale, direct physical removal of the invader gives the native species time to re-establish themselves, hopefully giving them the foothold they need to out-compete the invasive species in their environment.

### **Materials:**

Local plant field guides  
List of local invasive plant species  
Tools for clearing the study site  
Digital camera(s)  
Publishing software

### **Procedure:**

- Create a list of local invasive species by contacting local natural resource agencies, plant societies or accessing information on the Internet. A listing with pictures may be useful for the students to more easily recognize the plants.
- Lead students on a walk around the school grounds or the immediate neighborhood (such as a park or local wetland). Student pairs or small groups should all have the list of local

invasive plants and a field guide. Make a class list of all plant species that can be recognized and indicate which ones are introduced or invasive species.

- Have the students look up any invasive species they encounter and record their origin and known effects on the local ecosystem. Make special note of any adaptations that allow the invasive species to out-compete the native species. Internet sites are useful in quickly looking up the plants.
- Discuss adaptations and how they allow a species to better compete in their environment. As a class, first brainstorm a list of characteristics plants require to be competitive in an environment. Then, brainstorm a list of possible adaptations that would make a species more competitive. Was there any evidence of these adaptations in the invasive species seen on the walk?
- Assign each student a local invasive plant species to research. Have them research and answer the question on the “**Adaptations of Invasive Species**” worksheet dealing with their adaptations and native environment.
- Introduce the idea of developing a pamphlet to the students. The pamphlet will cover the local invasive species and will be an educational reference to be handed out throughout the community. Decide on a list of topics to include and a basic layout. Possible topics include a basic pictorial reference of common invasive species of the area, before and after photos of the study site with a brief description, and basic information and background on invasive species and their impact on the environment. Break the students into groups and assign each group one of these topics.
- With the help of local agencies and organizations, establish a community study site to visit. Discuss the role of the invasive species at this site and discuss the possible succession once they have been removed. If possible, find a nearby plot with little or no invasive species for comparison. Begin any research or photography needed to begin making the community pamphlet. Identify camera points for the “before” and “after” images.
- Once the pre-documentation and research is complete, plan a day or two to clear the site of invasive species. Tools and supplies need to be procured (perhaps by your community partner or school). Before beginning the clearing, once again point out the invasive species to make sure that native species are not cleared as well.
- After clearing the study site, finish documenting and researching the site for the community pamphlet. The longer the interval between the clearing and the final documentation the more obvious will be the “before” and “after” difference.
- To begin compiling the community pamphlet, each group will write and design their section in rough draft form. Complete the pamphlet in publishing software.
- Decide on the community groups you want to distribute to and distribute the pamphlets and/or provide presentations.
- Give the “**Community Action Survey**” to the students to measure their understanding and personal commitment to the role of invasive species in their community.
- Have a discussion on the effects of their work with the community

## Adaptations of Invasive Species

What is an adaptation?

What is an invasive species?

**Your invasive species to research:** \_\_\_\_\_

Where did your invasive species originate and when and how did it arrive? Describe the natural environment to which this species is native. If this information cannot be found, predict what the environment would look like.

What adaptation(s) does your invasive species have which helps it compete with the native species of your community?

What impact have these adaptations created in your community (or around the world)?

Create a diagram of your invasive species and the environment around it making special reference to the adaptations that allow it to out-compete its native neighbors.

## Community Action Survey

On a scale of 1 to 10 (10 being the highest), do you... (circle your answer)

1. Feel that invasive species have a major impact on your local environment?

1 2 3 4 5 6 7 8 9 10

2. Believe that educating the community about invasive species was a meaningful goal?

1 2 3 4 5 6 7 8 9 10

3. Feel that clearing your field site of invasive species was a worthwhile time commitment?

1 2 3 4 5 6 7 8 9 10

4. Think that your community pamphlet will have an impact on your community?

1 2 3 4 5 6 7 8 9 10

5. See your local environment as something that needs to be saved?

1 2 3 4 5 6 7 8 9 10

**Assessment:**

- The students will be assessed by their participation in producing and distributing the community pamphlet.
- Students can present their pamphlets to the city council or partner community organization.
- Success of the lesson will be assessed using the “Community Action Survey” which is designed to measure students’ involvement and understanding of the lesson.

**Extensions:**

- Conduct plant and animal inventories before and after the clearing.
- Conduct before and after measurements of different environmental factors.
- A community survey could be added to narrow the focus of the final pamphlet.
- Plan a community work day to help in the clearing of the study site and other areas around the community.
- Plant native species after removal of invasive species.
- Prepare a report that compares and contrasts biological and chemical control methods of invasive species.
- Distribute pamphlets to educate prison work groups who are commonly used to clear areas of invasive species.
- During the clearing process, partner with a middle school class and provide mentors.
- Distribute the pamphlets to local neighborhood associations.

**Resources:**

<http://www.invasivespecies.gov/>  
<http://www.nps.gov/plants/alien/factmain.htm>  
<http://plants.usda.gov/java/noxiousDriver>  
<http://www.enature.com>

**References:**

USDA Forest Service. 2000. Chestnut Blight.

<http://www.fs.fed.us/r8/foresthealth/idotis/diseases/chestnut.html>

National Invasive Species Council. 2001. What are the impacts of invasive species?

<http://www.invasivespecies.gov>

**Author/Affiliation:**

Ron Gray  
Waldo Middle School  
Salem, OR

## LESSON 19 - CLASSIFICATION

### Activity: Local Ethnobotanical Field Guides

#### Abstract:

The students will investigate native species of plants in their local area. Connections to Native American cultures will be encouraged as they produce a community oriented ethnobotanical field guide accompanied by an inquiry based research report.

#### Age Group:

Grades 8-12

#### Time Needed:

Several days for research question development  
1 class period for collection  
Several days of drying and plant pressing time  
2 class periods for identification and key development  
Several days for research group discussion and work  
Student homework/work outside class is expected

#### Major Concepts:

Science as a process  
Classification  
Diversity

#### Objectives:

*Students will be able to:*

- Analyze how human populations use resources in the environment to maintain and improve their lives
- Describe the roles of plants in Native American culture
- Understand the importance of biological diversity
- Understand the scientific basis for biological classifications
- Identify native plants and develop a dichotomous key using physical features
- Develop and conduct a research study that incorporates questions that interest them and are amenable to an investigation in ethnobotany

#### National Standards Addressed:

*Life Science:* Biological Evolution

*History and Nature of Science:* Science as a human endeavor

*Science in Personal and Social Perspectives:* Personal and Community Health, Natural Resources



**Materials:**

- Plant presses can be purchased through nearly any biological or scientific supply catalog although it is possible to do the activity without them. Heavy cardboard placed between two boards and tied tightly together works just as well. Even large, old, discarded hard covered books can be used to press plants.
- Sturdy, heavy cotton paper is best for mounting specimens, but drawing paper works fine.
- Professional herbarium specimens are sewn onto the paper with a needle and thread but if this is a safety concern for you, glue or tape may be used instead.
- Scissors and/or pruning shears.
- Clear contact paper for laminating specimens (optional).
- A collection of field guides for plants in your area such as weeds, wild flowers, trees or edible plants.
- A binder or folder for storing the finished specimens.
- Student-provided research notebooks.

**Teacher Background:**

Ethnobotanists are scientists who study the role of plants in a society. To better understand how a particular culture interacted with plants in the past, ethnobotanists look for clues in many places. They can learn a lot by finding out how an area's current society uses plants.

Botanists have devised a way to catalogue and keep track of all the known plant species with herbarium collections. An herbarium collection is an assortment of plant specimens. An herbarium specimen is a pressed, dried plant (or the important parts of a plant), which is glued or sewn onto a durable piece of paper. Also recorded on the sheet should be the name of the plant, where it was found and other important information.

Field guides are books that contain photographs or accurate illustrations along with clear descriptions of plants or other groups of organisms such as insects or birds. Field guides are used by scientists, students, and amateurs to help them identify species that are encountered.

In this activity students will become familiar with making herbarium specimens as well as using field guides and keys to help identify the species that they gather. They will use their herbarium collection to create local native plant field guides including a dichotomous key. The collection also serves as data for their inquiry-based research report.

There are a number of ways that this activity can connect students to authentic experiences and opportunities in the community. The students can make presentations to local community groups or organizations such as elementary school classrooms, elder care facilities, garden clubs, neighborhood associations, and youth clubs. After the presentation, some of the field guides can be donated. Consider suggesting alternative language versions to the students. Students could also develop brochures and/or plant displays based on their field guides for local/state parks, nature reserves, or wildlife refuges. The different agencies could choose a design from the submitted brochures/displays.

There is a lot of modern interest in “Native plant medicines” both from big drug companies and from people who want simple treatments. It would be helpful to remind students of two things about studying plants and ethnobotany:

1. Ingesting plants can be dangerous. If you are a person ignorant of plants, and go out hunting and trying to use “medicines” you can make yourself or others very sick, even die. Plants are not in and of themselves “healthy” or even necessarily safe. There are very powerful plant poisons, and some of the most powerful chemical poisons were originally developed from those of plants. There is also a consideration of how the plant parts must be processed or treated properly, what parts to use, what proportions, and what mixtures.
2. A sacred or religious aspect is involved in much Native plant medicine, of most kinds, and for most tribes. Native American Indian medicines tended to be complex mixtures of many kinds of different parts of plants, gathered and treated at different times of year, mixed in specific proportions, and administered in scheduled doses of particular size and dilution. This was never public knowledge, and much of it was learned only by apprenticing to a particular doctor to learn his or her particular medicines. Prayers and thanks are to be given to the “Great Mystery” who provides and reveals their proper uses by people. Usually an offering is made of tobacco or sometimes silver is buried by the “chief plant” of a group, representing the spirit of those particular plants. A prayer often accompanies this offering. All of this is part of an attitude, a culture, a religious outlook, a local society, and a history unique to each tribe. Contacting the cultural or education committees of local tribes could be a valuable experience.

### **Introduction and Concepts:**

#### *Native Plants and Ethnobotany*

Native plants are unique kinds of plants. The native plants of a given area are those that grew there prior to European contact. Native plants evolved in local areas over a very long period, and are the plants that the first humans knew and depended on for their livelihood. Native plants have co-evolved with animals, fungi and microbes, to form a complex network of relationships. These plants are the foundation of native ecosystems, or natural communities.

Specimens, seeds and drawings of New World plants were taken to Europe by early explorers over many years. Thus, American plants were included in ongoing botanical studies of the world’s flora. In modern times, the science of paleobotany allows scientists to carry out detailed studies of plant fossils. By comparing fossil records with modern plants, researchers can confirm their theories as to which plants are native to an area.

Before northern European people even set foot on the region now known as the Americas, Native American Indians had refined the use of plants for uses in their everyday lives. The study of such plant use is called ethnobotany. This project will give you the knowledge that was once essential to the survival of past American Indians, in an easy-to-use manner. It can be considered a field guide.



To begin with, Native American Indians had four basic uses for plants. Of most importance was food. From the woody trees to the swampy marshes, the grassy fields to the tidal shores, the Indians relied heavily on the food they collected for sustenance. Berries were dried, tubers were stored, and fresh greens were gathered so that vegetable matter was eaten all year round. Next in importance came the materials. The American Indians built their houses, sewed their clothing, caught their fish, and cooked their food in and with materials that they obtained from their environment. The third major use of the indigenous plants was medicine and charms. Many plants were made into poultices, teas, and concoctions, to cure or attempt to cure the illnesses that the American Indians faced. Lastly, the American Indians used plants for art and entertainment. Most importantly, American Indians relied heavily on plants for their survival.

Plants native to particular areas, having evolved here, are best suited to perform the tasks that plants do, such as manufacturing oxygen and filtering impurities from our water. These plants also do the best job of providing food and shelter for native wild animals. Maximum diversity in animal populations requires maximum diversity of plants. Biological diversity is vital to humans, because ultimately, we all live off the land, whether we admit it or not. Native plants continue to play a crucial role in the development of new foods, medicines and industrial products.

### *Biological Evolution, Diversity and Classification*

The general concept of biological evolution involves the idea that species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life and, (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring. The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms. Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent from common ancestors.

Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities, which reflect their evolutionary relationships. The species is the most fundamental unit of classification.

In general, a classification is a method for organizing information. Human beings classify things spontaneously. Classification groups similar things together. This definition is necessarily vague; there are many reasonable ways of defining similarity and hence many alternative classifications for the same things.

Taxonomy is that branch of biology dealing with the identification and naming of organisms. The ancient Greek philosopher Aristotle apparently began the discussion on taxonomy. British naturalist John Ray is credited with revising the concept of naming and describing organisms. During the 1700s, Swedish botanist Carolus Linnaeus classified all then-known organisms into two large groups: the kingdoms Plantae and Animalia. Robert Whittaker in 1969 proposed five kingdoms: Plantae, Animalia, Fungi, Protista, and Monera. Other schemes involving an even greater number of kingdoms have lately been proposed, however most biologists employ

Whittaker's five kingdoms. Recent studies suggest that three domains be employed: Archaea, Bacteria, and Eukarya. Phylogeny refers to the evolutionary relationships among species. In making a phylogenetic classification, taxonomists name groups of organisms that are all close relatives of one another.

Linnaean hierarchical classification was based on the premise that the *species* was the smallest unit, and that each species (or *taxon*) nested within a higher category. Linnaeus also developed the concept of binomial nomenclature, whereby scientists speaking and writing different languages could communicate clearly. For example "Man" in English is "Hombre" in Spanish, "Herr" in German, "Ren" in Chinese, and "Homo" in Latin. Linnaeus settled on Latin, which was the language of learned men at that time. If a scientist refers today to *Homo sapiens*, all scientists know what organism/taxon he or she means.

The naming of species and other taxa follows a set of rules, the International Code of Botanical Nomenclature (ICBN) for plants, the International Code of Zoological Nomenclature (ICZN) for animals.

Some general rules for nomenclature:

1. All taxa must belong to a higher taxonomic group. Often a newly discovered organism is the sole species in a single genus, within a single family...etc.
2. The first name to be validly and effectively published has priority. This rule has caused numerous name changes, especially with fossil organisms: *Brontosaurus* is invalid, and the correct name for the big sauropod dinosaur is *Apatosaurus*. *Eohippus* (the tiny "dawn horse") is invalid and should be referred to as *Hyracotherium*. Sometimes, however, names can be conserved if a group of systematists agrees.
3. All taxa must have an author. When you see a scientific name such as *Homo sapiens* L., the L stands for Linnaeus, who first described and named that organism. Most scientists must have their names spelled out, for example *Libopollis jarzenii* Farabee et al.

An example of classifying humans (*Homo sapiens* L.):

Kingdom Animalia  
Phylum (Division for plants) Chordata  
Class Mammalia  
Order Primates  
Family Hominidae  
Genus *Homo*  
Species *sapiens*

An example of classifying "moss rose" (*Rosa gallica* L.):

Kingdom Plantae  
Division Tracheophyta  
Class Angiospermae  
Order Rosales  
Family Rosaceae  
Genus *Rosa*  
Species *gallica*

After an introduction including background and concepts in this lesson, have the students develop some research questions that interest them about this topic. The research question(s) in their final form should incorporate most of the objectives for this lesson and may take multiple iterations and guidance from the teacher in the development of suitable questions. Students should record the questions and all aspects of a research plan into a student research notebook. Encourage them to work in groups of 2-4 students. Each student will be responsible for recording the group's preliminary plan for conducting the investigation and keeping extensive records of the work by the group.

The students will be required to go to their assigned area of the selected site and responsibly collect and press plant specimens. Back in school, they will dry and prepare herbarium specimens and utilize field guides to help them identify species. Laminated herbarium collections can then be organized to create field guides. A dichotomous key will be developed for the specimens in the field guide.

Be sure NOT to collect or disturb any species which may be endangered or at risk. The teacher should become informed of rare and endangered species within the selected site. Discuss safety issues with the students. Potentially poisonous plants are a concern. Poisonous plants can be separated into different groups based on their toxicities. Some plants will cause a systemic toxicity if ingested, resulting in a range of symptoms from mild abdominal cramping to serious cardiac arrest. The degree of toxicity depends on the quantity ingested or the part of the plant eaten. Other plants contain insoluble calcium oxalate salts. Contact dermatitis can result in a burning sensation due to the irritation of mucous membranes or skin layers. See more information at Cornell University Poisonous Plants Informational Database website: <http://www.ansci.cornell.edu/plants/index.html>

Each group of students is responsible for submitting ten (10) 5x7 index cards with the following information on the lined side of the card:

- Names of students on team
- Date
- Common name of plant
- Scientific name of plant (Family, Genus, Species)
- Description of how the plant was used by local cultures historically
- Other interesting information about this plant
- Reference / source of information

A plant drawing should be drawn on the unlined opposite side of the card. Draw in detail one or two leaves including leaf shape, margin, tip, base and venation pattern, and show the attachment to the stem.

**Plant Identification and Pressing Guidelines:**

1. Describe the location of the plant (wet, dry intermediate, disturbed area, slope, light conditions, aspect, etc.)
2. Describe the habit of the plant (vine, shrub, tree, forb, etc.)
3. Identify unique characteristics to help remember each plant (smell, color, fruit, etc.)
4. Gently place the plant or plant parts onto a page of the plant press and cover it with another page. Each specimen should be placed in-between a new page or piece of cardboard. Slip the 5x7 inch card, with as much information filled out as you can, in with the specimen. Then cover all of them with the cardboard and wooden boards and tie them tightly together. Keep the plants in the press in a dry, warm location for about a week until they dry out and get flattened.
5. When the specimens are ready, carefully place each species on an individual herbarium sheet and glue them onto the sheet.
6. Use your field guide(s) to help you identify the plants that you have collected. The field guide will have instructions on how to identify the plant. Some are easier to use than others. Find as much information as you can. Finish filling out the information for your card.
7. Laminate the herbarium specimens with clear contact paper. Real herbarium specimens are never laminated but this may make your collection more durable.
8. Punch holes in your herbarium specimens and put them in a 3-ring binder.
9. Distribute the plants in the collection into their respective families, genus and species. Develop a dichotomous key and place it at the beginning of the guide. This key can be used to help identify other plants in the field.
10. Give the book a name such as “Local Wetland Plants.” Now you have both a homemade herbarium collection and your own personal field guide customized for your area.

**Research Report Guidelines:**

Based on the notes of individuals from their student research notebooks, the group prepares a written report, describing the research. That report also includes data that have been collected and preliminary analysis. Students should be provided an outline of report requirements including: research question and rationale, data collection, analysis, and conclusions.

**Assessment:**

- The completed field guides and group research reports are the final products and can be used for evaluation.
- If the plants have been correctly identified, then the student has successfully used the keys from the professional field guides.
- There should be a sufficient amount of supplemental information showing that the student has learned a lot about the species, for example: plant brochures, plant displays, and presentations should contain cultural, historical, taxonomic, and phylogenetic information.
- Public presentations/brochures/displays can be evaluated using a rubric.
- Evidence for the quality of a student’s ability to reason scientifically comes from the rationale for the student’s own (or group’s) research question and from the line of reasoning used to progress from patterns in the collected data to the conclusions.

**Extensions:**

- Test plants for biological activity such as anti-bacterial studies.
- Test plants for nutritional content through starch analysis and comparison studies.
- Test plants with paper chromatography to separate various chlorophylls.
- Develop phylogenetic trees of collected specimens and related species.

**Resources:****Plant classification**

<http://plants.usda.gov/>

**Ethnobotany**

<http://www.sfu.ca/halk-ethnobiology/html/main.htm>

<http://www.ethnobiology.org/>

<http://www.kew.org/scihort/eblinks/>

**Indigenous knowledge**

<http://www.unesco.org/most/bpikreg.htm>

<http://www.unesco.org/most/bpindi.htm#definition>

<http://www.mcgill.ca/cine/>

**References:**

Altran, S. 1998. Folk biology and the anthropology of science: Cognitive universals and cultural particulars. *Behavioral and Brain Sciences* 21: 547—609.

Barber, Dick. 2002. Teaching People Plant Collecting.

<http://biology.arizona.edu/sciconn/lessons2/Barber/overview.htm>.

Giese, Paula. 1995. Native American Indian Resources: Teas, Herbs, Flavorings.

[http://www.kstrom.net/isk/food/r\\_teas.html#nutri](http://www.kstrom.net/isk/food/r_teas.html#nutri).

International Association for Plant Taxonomy. 2000. International Code of Botanical Nomenclature.

<http://www.bgbm.org/iapt/nomenclature/code/default.htm>.

Microsoft® Encarta® Online Encyclopedia 2000. Classification.

<http://www.101science.com/Taxonomy.htm>.

Mozley, Sam. 2002. How to Write Scientific Names of Animals.

<http://www.cals.ncsu.edu/course/zo150/mozley/nomencla.html>.

Weston, Peter & Crisp, Michael. 1998. Introduction to Phylogenetic Systematics.

<http://www.sasb.org.au/cladistics.html>.

**Author/Affiliation:**

Yuki Monteith

Portland State University

Portland, OR 97207-0751

## LESSON 20 - BACTERIA

### Activity: Bacteria and Water Quality

#### Abstract:

Water quality is determined by testing for the presence of fecal coliform bacteria.

#### Age Group:

Grades 8-12

#### Time Needed:

45-90 minutes (can be repeated over several weeks or months for a more detailed study)

#### Major Concepts:

Bacteria

Bacterial populations

Role of bacteria in the ecosystem

Correlation between fecal coliform levels and the presence of pathogens in water

#### Objectives:

*Students will be able to:*

- Correlate the number of fecal coliform bacteria present in a waterway to the probability of the presence of pathogens
- Conduct a fecal coliform survey of a local waterway
- Create a presentation based on their findings.

#### National Standards Addressed:

*Unifying Concepts and Processes:* Change, constancy, and measurement.

*Life Science:* The cell, Interdependence of organisms.

*Science in Personal and Social Perspectives:* Personal and community health, Environmental quality.

#### Teacher Background:

This activity may be used as a part of a unit on bacteria to demonstrate their role in ecosystems. This can be accomplished through a variety of community contexts: students may test fecal coliform levels immediately upstream and immediately downstream of a sewer treatment facility, a tertiary treatment area and agricultural runoff areas. Students might compare fecal coliform levels in a waterway before and after the development of a plant buffer zone. Students could also conduct fecal coliform tests on water samples and compare the water quality at tertiary treatment sites to areas with retention basins or to areas that do not have any wastewater diversion systems currently in place. Contact the local wastewater treatment facility, Environmental Protection Agency, or other agencies that could partner with you and identify sites for testing. They may also have equipment to assist in the collection and testing of samples.



**Introduction:**

Bacteria are found throughout the biosphere, with the Archaeobacteria living in the most extreme of environments (such as sulfur hot springs) and Eubacteria living in or on most other places on Earth.

Archaeobacteria are thought to resemble the earliest prokaryotes due to the extreme environment of early Earth, and of these, the methanogens (or “methane-producers”) are perhaps the most likely to be known to the general public. They live in anaerobic environments such as swamps, sewage treatment centers, and the guts of cattle, decomposing material and giving off “swamp gas” or methane gas as a byproduct of their metabolism.

The first eubacteria to appear in the fossil record are responsible for “poisoning” the atmosphere with oxygen, beginning a critical change in the geological record. This led to the appearance of more complex life forms on Earth. The eubacteria include cyanobacteria, *E. coli* and other bacteria found in the human intestines, and a wide variety of bacteria responsible for decomposing dead organisms and waste byproducts thereby releasing nitrogen, carbon and other elements back into the nutrient cycles. A breakdown of the organic molecules in the waste byproducts begins immediately as bacteria from the gut is released from the body in the feces.

Untreated sanitary (human waste) wastewater and storm runoff from urban and suburban areas may be diverted directly into local waterways rather than flood a wastewater treatment plant during a period of heavy rainfall. The raw sewage can lead to high levels of fecal coliform bacteria in the streams. Sources of fecal coliform include feces of humans or other animals, storm runoff and agricultural runoff. While fecal coliform bacteria is not necessarily pathogenic, the occurrence of abnormally high levels of colonies has been found to correlate to the presence of disease-causing organisms such as those that cause dysentery and typhoid fever. Viruses that cause hepatitis A and gastroenteritis are also more prevalent.

Two solutions have been developed to prevent untreated sewage and storm runoff from entering into waterways: retention basins and tertiary treatment systems. Retention basins serve to store excess wastewater and completely prevent it from entering waterways. Tertiary treatment systems are a fairly recent development, mimicking how wetlands act as natural filtering systems. Such systems result in filtered water that may be used for agricultural, urban and habitat use, or returned to a wastewater treatment center.

**Materials Needed:**

NOTE: Actual materials required for this activity will depend upon the community partnership and the particular protocols and supplies set forth by that partner. Local water labs and wastewater treatment plants are possible partners to contact for testing support. Scientific supply catalogs also have the following:

- Water Quality Kit (available from companies such as *Micrology Laboratories*)
- Liquid coliscan medium
- Sterile sample bottles (for water sample)
- Sterile droppers, calibrated
- Pre-treated *Easygel* Petri dishes

Sterile sample bottles (for coliscan-water mixture)  
Non-latex gloves  
Extended rod sampler  
Medium-sized cooler with ice (for transport of samples)  
Incubator

**Procedure:**

1. The students will contact a local wastewater treatment center and express their desire to form a school-community partnership. They will ask if they can be shown how to sample and test water for the presence of total fecal coliform bacteria, as well as *E. coli*.

NOTE: Students may make initial contact via phone or formal business letter, dependent upon the goals of the teacher. If experience in communicating via phone is desired, students might make a preliminary script to use as a guide when calling. If experience in formal business letter writing is preferred, it might be required that a rough draft be peer-edited first, with a final draft and stamp of approval done by the teacher prior to mailing the letter. In either case, a brainstorming session by the students would help in generating ideas.

2. In exchange for training by the partner, and the use of their facilities for processing samples, the students will agree to compile data for a particular site and report the results of their survey back to the community partner. Students should keep an accurate record of the data as it is collected.

3. The exact sampling sites, the frequency and the duration of the testing will depend greatly upon the needs of the community partner.

4. Students will write a thank-you note to the community partner upon completion of their research.

**Assessment:**

The students will compile the results of fecal coliform counts in a spreadsheet, using a program such as *Excel*. Graphs may then be generated using these data. Students should analyze the data, making sure to describe and explain any trends present in the graphs. The resulting product, such as a *PowerPoint* presentation, may then be taken to the community partner, other interested organizations, and the general public where the students will present their findings. A report with a cover letter might be included as well to serve as a permanent record.



**Extensions:**

- As the students take water samples they can also record other water quality parameters as well as the precipitation for previous days.
- Present findings to the city health department, the city council or watershed council.
- Invite a speaker from the local wastewater treatment center or from a local Soil and Water Conservation District office.
- Have a panel discussion with the community members living along the waterway, along with representatives from the wastewater treatment center, regarding ideas for improving water quality.
- Create a booklet to educate community members about the importance of water quality.

**Resources:**

U.S. Environmental Protection Agency. 18 June 2002. Drinking Water Pathogens and Their Indicators: A Reference Resource.

[http://www.epa.gov/enviro/html/icr/gloss\\_path.html](http://www.epa.gov/enviro/html/icr/gloss_path.html).

Fecal Coliform. <http://www.switzerland.k12.in.us/watershed/fecal.html>.

The Oregon Garden. <http://www.oregongarden.org>.

City of Salem (Oregon). Willow Lake Wastewater Treatment Plant and Demonstration Natural Reclamation System.

<http://www.cityofsalem.net/Departments/PublicWorks/WasteWaterTreatment/Natural%20Reclamation%20Services/Pages/default.aspx>.

**Author/Affiliation:**

Jessica Graham  
Regis High School  
Stayton, OR

## LESSON 21 - FUNGI

### Activity: Lichens as Indicators of Air Pollution

#### Abstract:

Air pollution levels are determined by identifying and comparing lichen populations in the field.

#### Age Group:

Grades 8-12

#### Time Needed:

45-90 min (can be repeated over several months for a more detailed study)

#### Major Concepts:

Symbiotic relationships

Lichens as indicators of air pollution

Impacts of air pollution on living organisms

#### Objectives:

*Students will be able to:*

- Identify the structures of lichens
- Identify lichens growing in their local area
- Determine air pollution levels using lichens as indicators

#### National Standards Addressed:

*Life Science:* Matter, Energy, and Organization in Ecosystems

The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism. The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials.

#### Teacher Background:

As nations have become industrialized, air quality has become an increasing concern. Air pollution monitoring instruments can only provide a picture of the air quality at the time of the sampling and so can have limited use in providing long-term observation of changes in air quality.

As early as the mid-1800's, scientists observed that lichens are sensitive to air pollution and can be used as a bio-indicator of air pollution changes. Since that time, many studies have been undertaken to monitor air pollution levels using lichens.

Your classroom can provide data on lichen populations in your region for several of the national and international organizations that track air pollution using lichens. These organizations can be accessed on the Internet using the addresses located under "Resources." On a local level, you



may partner with and provide data on air pollution levels to a number of agencies and community organizations.

These groups include:

- City Council/Mayor/City Manager
- City Planning Department
- State Department of Transportation
- Local and state agencies and environmental organizations
- Department of Environmental Quality

Your classroom could assist these groups by:

- Educating groups about the use of lichens to monitor pollution
- Developing a field guide to lichens that others can use to monitor air pollution
- Reporting on data of pollution levels in the area
- Detailing variation in pollution levels in different parts of city or region

### **Introduction:**

Organisms in the kingdom Fungi play an important role in ecosystems. Mushrooms, lichens, molds, slime molds, yeasts, rusts, smuts, and water molds are all members of this kingdom. Fungi are eukaryotic organisms; most species are multicellular. The cell walls of most fungi contain chitin, which is also found in the hard outer skeletons of insects.

Most fungi possess the following structures:

Hyphae: Many individual filaments that make up the body of a fungus. Each hypha contains cytoplasm and one or more nuclei. They secrete enzymes that digest food.

Mycelium: Intertwined hyphae that make up the body of a fungus. Most of the fungus lives under the substrate, or material in which the fungus is growing.

Fruiting Body: The visible part of the fungi that produces spores.

Sporangia: Specialized hyphae that produce tiny spores.

Fungi are decomposers, meaning that they use enzymes to break down organic matter and then digest this food. This process, of fungal decay, breaks down dead organisms and the wastes of living organisms thereby returning valuable nutrients to the soil. Living organisms can then use these nutrients for new growth. To survive, fungi need moisture, food, warmth, and darkness. Fungi are either saprophytic, feeding on dead matter, or parasitic, feeding on living organisms.

Fungi are an important food source for animals and people. People also use fungi to produce antibiotics such as penicillin. Fungi are used in making breads and cheese. Fungi can also cause serious diseases and destroy millions of dollars worth of crops such as corn and wheat.

Lichens:

Lichens are organisms that consist of an alga and a fungus living in a symbiotic relationship. Fungal hyphae give the lichen its internal structure and shape. Algal cells are imbedded within the fungal mycelium. This symbiotic relationship has benefits for both the alga and the fungus. The fungus provides structural support for the alga and improves exposure to sunlight. The alga produces food for the fungus through the process of photosynthesis. As a result of this

relationship, lichens can survive in harsh environments where alga and fungi could not live alone.

Although lichens are very hardy, they are among the first organisms to suffer from the effects of air pollution. Because lichens lack roots, they absorb rainwater directly into their cells. As a result, lichens absorb more dissolved toxic substances like sulfur dioxide than plants. Eventually, these toxicants build up to a level where it breaks down the chlorophyll molecules. The alga can no longer photosynthesize the sun's energy and dies. The death of the alga in turn kills the fungus.

Some lichens are more tolerant of pollution than others. By knowing which species are most sensitive to air pollution and documenting their presence or absence, it is easy to determine how "clean" or "dirty" the air is. Lichens are very useful in monitoring a region's air quality trends. They are especially useful because they can easily be found in most urban environments. An easy-to-use lichen identification key can be found at the Air Quality Biomonitoring Program on Forests of Northwest Oregon and Southwest Oregon's website <http://www.fs.fed.us/r6/aq/lichen/>. It is a comprehensive site for the use of lichens as indicators of air quality that includes sensitivity ratings by species, drawings and photographs, searchable data bases, a literature review and links to other lichen information sites.

The air quality of an area can easily be determined by observing the lichens that are growing on older trees. Generally, the more lichens that are observed, the healthier the air is. Scattered orange and gray lichens usually mean better air quality. Black, scaly lichens are tolerant of higher pollution levels. Some areas are so polluted that no lichens can be found. These areas are called "lichen deserts." As the air quality in these lichen and moss deserts improve, lichens will begin to reappear in a slow process of recovery.

Many regions in North America and Europe are beginning to track changes in lichen populations to monitor air pollution. Results of these studies can be found on the web sites listed at the end of this activity.

**Materials:**

Knife

Sandwich bags

Permanent pens

Flagging tape

Magnifying glass

Misting bottle

Bleach

Eyedroppers

Clipboards

Writing materials

Dissecting scope (optional)

Field guide of local lichen or online access to lichen identification page

**Procedure:****PRIOR TO ACTIVITY:**

Select 3-10 different sites representing a range from inner city to outlying rural areas where lichens can be obtained. Number these sites on a map for easy organization of data. Lichens grow on most trees. Look for trees where students can reach the lower branches avoiding those branches that are heavily shaded. Lichens can also be found on concrete and rocks in areas where few trees are present. Be sure to ask for permission to sample trees on private property

**SAMPLING:**

- 1) Once a tree suitable for sampling has been located, select and mark 10 twigs. Mark each twig with a piece of flagging tape. Assign a number to each twig and write it on the flagging tape with the site number first and then the twig number (example: 1:4).
- 2) Gently pull down a branch to observe lichen colonies. Do not break off twig. If possible, identify lichen in the field. For each lichen observed, record in lab notes:
  - a) Lichen species
  - b) Date
  - c) Pollution sensitivity level (you may wish to create a color coding system for pollution sensitivity)
  - d) Site and twig number
- 3) If a field identification cannot be made, use a knife to scrape a small piece of bark with lichen sample into a sandwich bag for identification back in the classroom. Mark the sandwich bag with the site number, twig number, and date. Then, use the identification guide at The Natural History Museum's webpage to identify the lichen.

**TIPS FOR IDENTIFYING LICHENS:**

Color: Color in lichen varies depending on the amount of sun or rain. Wet the sample with a misting bottle and recheck color if uncertain.

Reproduction: The best means of identifying a lichen is observing the lichens means of reproduction. Use a magnifying glass for easier viewing of these features. These features consist of fruiting bodies called *apothecia* that allow for sexual reproduction or finger-like outgrowths, *isidia*, or sugar-like granules, *soredia*, that allow for asexual reproduction.

Bleach: The identification of some lichen species can be confirmed in the field by a spot test with bleach. For the bleach test, simply scrape away the upper surface of the lichen, add a small drop of household bleach using an eyedropper and watch the reaction. Organic compounds in some fungal partners will turn the bleach red or orange, while others have no reaction at all.

For an easy-to-use dichotomous key to lichen identification, visit The Natural History Museum's website. This key also includes each species' sensitivity to air pollution.

**Analysis:**

After students have sampled and identified lichens from all sites, compile data using charts and graphs that demonstrate difference in pollution levels from site to site.

**Assessment:**

- Chart the variation in lichen populations at different study sites
- Compare lichen diversity and abundance to proximity to potential sources of pollution
- Develop a field guide to local lichens for use by other schools to monitor air pollution
- Present data to city council or local or state agencies and organizations to assist in development of air quality standards
- Link with another school via the Internet to share data on lichen populations
- Submit data to national or international lichen monitoring organizations (see Resources)

**Extensions:**

- Monitor lichen populations over several years to observe changes in populations
- Research source points of air pollution in your region
- Research environmental laws on air pollution
- Develop a chart of air pollution in your region compared with other cities the same size or other cities in your state

**Resources:**

William C. Denison. 1973. A guide to Air Quality Monitoring Using Lichens. Lichen Technology, Inc.

Northwest Mycological Consultants, Inc. Online Lichen Survey  
<http://www.nwmycol.com/>.

Encyclopedia of the Atmospheric Environment  
<http://www.ecoca.ro/meteo/tutorial/english.html>

Lichenland  
<http://ocid.nacse.org/lichenland/>

The Natural History Museum  
<http://www.nhm.ac.uk/nature-online/life/plants-fungi/lichens/index.html>  
<http://www.nhm.ac.uk/research-curation/departments/botany/organisms/lichens/index.html>  
<http://www.nhm.ac.uk/nature-online/life/plants-fungi/lichen-id-guide/>  
<http://www.nhm.ac.uk/nature-online/life/plants-fungi/lichens-pollution/index.html>

**Author/Affiliation:**

Jennifer Madland  
Leslie Middle School  
Salem, OR

## LESSON 22 - PLANTS

### Activity: Conducting a Plant Survey

#### Abstract:

This plant survey can be conducted in any schoolyard or natural area in the community.

#### Age group:

Grades 7-12

#### Time Needed:

60 minutes

#### Major Concepts:

Plant communities  
Plant identification  
Invasive species

#### Objectives:

*Students will be able to:*

- Establish plots to inventory plants
- Identify plants as part of a plant inventory
- Create a map that illustrates the distribution of dominant plant species

#### National Standards Addressed:

*Content Standards 5-8 Life Science:* Populations and ecosystems, Diversity and adaptations of organisms, Use appropriate tools and techniques to gather, analyze and interpret data.

*Content Standards 9-12 Life Science:* Design and conduct scientific investigations, The interdependence of organisms

#### Teacher Background:

The protection of native plant communities and the problem of invasive plant species are a great starting point for plant studies anywhere in the nation. Without their natural controls, some non-native plants became invasive, reducing the diversity and quantity of native plants. Weeds are continuing to spread rapidly in many areas across the country. Weeds spread an estimated 4,000 acres (over 6 square miles) each day on public lands managed by the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS). But weeds know no boundaries. They also are spreading on private and other public lands.

By learning basic methods of plant identification and how to conduct a plant survey, students will be prepared to look at problems in local plant communities. You will find many willing partners in your community for invasive species projects. Each area has its own problem plants. Your local county will have lots of information and resource people to help you with invasive species projects.



This is a basic activity that can be performed in any schoolyard or nearby natural area, but there are many ways to partner with organizations in the community and do plant surveys that will be useful to the community. Each agency will have their own methods of conducting the survey based on how they will be using the information. They will usually train the students so that they will be assured of getting usable data. Partnering with community agencies may also bring with it the ability to use more technical mapping equipment such as Global Positioning Systems (GPS) units. Local community partners are probably already involved in weed control and invasive plant eradication. They may need to have the sites of a particular weed identified and mapped. Students would learn how to identify the weed and then map areas for future eradication or they may be surveying an area to measure how well a previous weed control project is working.

Wildlife agencies have habitat projects in which they are trying to improve the forage and cover for wildlife in some areas. These agencies may need people to survey areas to determine how well their habitat improvement plan is working. Government agencies such as the BLM or USFS may be looking for data on re-growth in areas impacted by fires, floods, drought or pests. Sometimes they also have programs to return an impacted area to native species and they need data to monitor the program.

City parks and recreation departments may have areas that they are monitoring for invasive species, wildlife habitat or erosion. Parks also may want to have a survey of the plants in a natural area to make brochures or signs to educate the public. Every area of the country has local needs for people to help in plant surveys. All you need to do is find the right partner in your community.

### **Introduction:**

Plants are essential to our survival because they are the producers in food webs. We eat plants either directly or indirectly by eating animals that consume plants. Plants also provide medicines, clothing, paper and many other products. They play a major part on the continuous recycling of the Earth's water, oxygen, carbon dioxide and mineral nutrients. They act as a ground cover to protect the soil and prevent erosion.

Plants exhibit tremendous diversity. They have dominated the land and many bodies of water. They range in size from 1 mm in width to 100 meters in height. There are 12 divisions of the plant kingdom including more than 270,000 species. Some plants can live nearly 5,000 years.

In nearly all plant communities across the country, noxious weeds are invading the landscape like an explosion in slow motion. All citizens need to learn and work together to preserve and protect our native ecosystems from further invasion by invasive plant species. Noxious weeds disrupt natural communities and agricultural lands. Non-native species were introduced without their natural controls that keep their populations under control in their native lands.

Most of our noxious weed species are native to Eurasia. Many originated in the Mediterranean region, where agriculture and domestic livestock have been part of the landscape for thousands of years. Plants from this region evolved under these conditions of disturbance. Therefore, when Europeans brought their land practices with them to the New World, some of the plants that



tagged along with them were better adapted than the native plants to human changes that were being made to the environment.

Each area of the country has its own group of noxious weeds. For a listing in your area check the website <http://plants.usda.gov/java/noxiousDriver>. You will find links to each of the states providing a list of invasive and noxious weeds for that state.

**Materials:**

Plant identification key  
“Map Your Plant Community” activity sheet  
Three rolls of flagging  
Marking pens  
2’X3’ cardboard flip charts with paper

**Procedure:**

In this activity we will learn how plants are distributed in communities. We will lay out plots and map the plants growing there.

- 1) Divide the group into three groups, one for each area to be studied. Assign each group an area.
- 2) Go over instructions to the group before they go to their plot:
  - a) Select an area within your specific plant community that appears to be representative of the plant community.
  - b) Use colored flagging to lay out a plot that is 12 steps by 12 steps.
  - c) Once the plot is established and marked, as a group, determine the plants that seem to be most significant or characteristic of your site.
  - d) Each team member should select one of these plants as a primary study plant to map. A secondary study plant could be included if time and circumstances allow.
  - e) Work by yourself to map the location of your plant on your study plot. Follow the instructions on your “**Activity A**” handout. Also, map significant features such as fallen logs, rocks, fences, or streams.
  - f) Finally after mapping your study plants, work with the other team members to make a representative map of all the study plot plants on a large sheet of flip chart paper provided. Your group will give a short presentation (2-4 minutes) describing your map and the distribution of study plants. Involve all members in the presentation.
- 3) Record the data
  - a) Have teams lay out their maps side by side as they make their presentations
  - b) If two or more teams describe the same plant, a common symbol should be agreed upon so that composite maps in “**Activity B**” are comparable.
  - c) As teams are reporting, have students look for patterns (similarities and differences) among the plots. Tell students that they will be deducing reasons for the differences between the various sites. To help accomplish this, have students record information from the presentations on Activity Sheet B.

4) Discussion

- a) Which plots seemed to have the most plants? The most plant species?
- b) What factors could have led to the distribution of the plants on these plots?
- c) What similarities or differences did you notice between plots?
- d) What patterns seem evident after listening to the presentations and viewing the composite map?

### DATA SHEET ACTIVITY A: Map Your Plant Community

1. Select a representative area and mark the boundaries (corners and midpoints) with flagging. The plot should be twelve steps square.
2. As a group, decide upon the most significant or most characteristic plants of your plot.
3. Each student should choose one of these as a primary plant to map and describe.
4. Working individually, map the location of all occurrences of your study plant. Develop your own plant symbols.

Primary Study Plant Name		(Symbol)	
Secondary Study Plant Name		(Symbol)	
Other Significant Plants Names		(Symbol)	

## DATA SHEET ACTIVITY B: Plant Distribution

As presentations are made, please characterize each plot by sketching general plant patterns that you see.

Plot

	Observations:
--	---------------

	Observations:
--	---------------

	Observations:
--	---------------

**Assessment:**

Some of the products that your class could produce include:

- a brochure of local native species in a natural area
- a map of invasive species

**Extensions:**

- Produce signs that inform visitors to a natural area about the local native species.
- Develop brochures or a *PowerPoint* presentation for educating the public about invasive plants
- Create a slide show of local flora
- Teach elementary students about local noxious weeds
- Develop a local noxious weed display
- Design a plan to eradicate noxious weeds in a study area
- Design a plan to return native species to a study area

**Resources:**

Agencies to seek for partners:

- State Fish and Wildlife Department
- County Weed Supervisor
- City Parks and Recreation Department
- U.S. Forest Service
- Bureau of Land Management
- U.S. Department of Fish and Wildlife
- Soil Conservation Districts

Internet Resources:

*Plant identification sites:*

Lady Bird Johnson Wildflower Center. 2002. Native Plant Information Network.  
[http://www.wildflower.org/?nd=clearinghouse\\_publications](http://www.wildflower.org/?nd=clearinghouse_publications).

USDA Midwestern Wetland Flora Field Office Guide to Plant Species  
<http://www.npwrc.usgs.gov/resource/plants/floramw/>

USDA Northeast Wetland Flora Field Office Guide to Plant Species  
<http://www.npwrc.usgs.gov/resource/plants/florane/index.htm>

USDA Western Wetland Flora Field Office Guide to Plant Species  
<http://www.npwrc.usgs.gov/resource/plants/florawe/index.htm>

USDA Southern Wetland Flora Field Office Guide to Plant Species  
<http://www.npwrc.usgs.gov/resource/plants/floraso/index.htm>

*Plant survey sites:*

Colorado State University Department of Rangeland Ecosystem Science. April 2, 2001. Protocol for surveying and monitoring endangered species.

<http://www.cnr.colostate.edu/frws/research/rc/tes2.htm>.

Washington State Department of Ecology. February 25, 2003. Aquatic plant survey methods.

<http://www.ecy.wa.gov/programs/wq/plants/management/survey.html>.

*Invasive species and weed sites:*

Plant Conservation Alliance. April 23, 2003. Weeds Gone Wild.

<http://www.nps.gov/plants/alien/>.

Bureau of Land Management. January 12, 2000. How to Prevent the Spread of Noxious Weeds.

<http://www.blm.gov/ca/st/en/prog/weeds/weedprevent.html>

<http://www.blm.gov/wo/st/en/prog/more/weeds.html>

University of Idaho. January 9, 2002. Idaho Weed Watchers. May 18, 2003.

<http://www.cnr.uidaho.edu/what-is-range/curriculum/MOD2/Invasives.pdf>

Center for Research on invasive species and small populations

<http://www.cnr.uidaho.edu/crissp/home.htm>

The Nature Conservancy

<http://www.nature.org/ourinitiatives/habitats/forests/howwework/protecting-native-plants-and-animals-taking-on-the-invaders.xml>.

Montana State University, Department of Land Resources and Environmental Sciences. 2001.

Center for Invasive Plant Management

<http://www.weedcenter.org/index.html>

<http://www.weedcenter.org/education/k-12.html>

*Books:*

Wilson, T. D. 1996. Weeds of the West. The Western Society of Weed Science. Pioneer of Jackson Hole. Jackson, Wyoming. 630 pp.

USDA Forest Service. 1993. Investigating Your Environment: Teaching Materials for Environmental Education, USDA Pacific Northwest Region, Portland, OR, 220 pp.

**Author/Affiliation:**

Virginia Jones

Bonneville High School

Idaho Falls, ID

## LESSON 23 - ANIMALS

### Activity: Developing Community Awareness of Local Animals



#### Abstract:

With community input students will survey a park, school grounds or other local natural environments. Students will identify animals and construct a dichotomous key, and design a brochure for community use.

#### Age Group:

Grades 9-12

#### Time Needed:

From 5-10 class periods

#### Major Concepts:

Animals, Ecosystems, Classification

#### Objectives:

*Students will be able to:*

- Gather lists from local and state agencies and organizations of sensitive species, or species of local concern
- Research information about the animals from local tribes, local histories from farmers and senior citizens recollections, scientific papers, natural resource agencies and organizations, and the Internet
- Collect data from a survey produced by students and given to appropriate community groups
- Construct a dichotomous key that will allow the identification of local species
- Produce a CD-ROM and web page on the Internet via the school home page

#### National Standards Addressed:

*Unifying Concepts and Processes:* Systems, order, and organization

*Science as Inquiry:* Abilities necessary to do scientific inquiry

*Life Science:* Interdependence of organisms

*Science and Technology:* Understanding about science and technology

*Science in Personal and Social Perspectives:* Science and technology in local, national, and global challenges

## **Teacher Background**

The research, data collection and publishing of information will be done as part of a unit on animals. With community input, students will observe a local park, school grounds or other local natural area. With a list of expected animals from local agencies and organizations, students will inventory the animals that are present. They will then construct a pamphlet, field guide, web page, and/or CD-ROM program that list scientific names, life histories, and local stories to help tie in animal interactions and impact in the local environment. Working with local tribes, senior citizens, and local farmers will add to the information available for students. In addition, forming partnerships with natural resource agencies and organizations will be critical for the protocols and equipment necessary to observe, collect, or identify animals. Call them, they are always eager to help. Most city parks, local trails, and school grounds have not been inventoried for animal presence (insects, aquatic species, reptiles, birds, mammals). Scout troops, Audubon Society, or native plant clubs could use the brochures, or CD-ROM as field guides and foster grassroots awareness of local resources. These data can also be used by city planners, fish and wildlife personnel, and concerned citizens to make informed decisions about how a local area should be managed. Examples of possible management practices include, but are not limited to, watering, spraying or cutting schedules. Schools would have a community study site that will allow students to see how data are collected, recorded, presented, and built on by succeeding classes. Schools could pass on local information with programs like Naturescaping and the GLOBE programs that use local data and pass it on to regional, national, and international centers. This will allow students to see how their data can be merged into the bigger picture encompassing our biosphere.

## **Introduction:**

Animals are a diverse group of organisms that include sponges, worms, arthropods, and vertebrates. Knowing what animals live in your community is important for the future health of our ecosystems. Animals and their diversity are important indicators of the health of an ecosystem and knowing where they are found in your community can affect land use and management practices. Animals are an important part of the energy flow and nutrient cycling that takes place in an ecosystem. They are dependent on a variety of biotic and abiotic factors for their survival. Factors such as temperature and sunlight or plant species for food or shelter can affect the types and numbers of animals you find. Animals have a variety of adaptations that allow them to survive and reproduce in particular ecosystems. They also fill various niches or roles in an ecosystem such as herbivores, carnivores, or omnivores. Removing one species from a system can put the entire system in stress and at risk. Information that is collected and disseminated on the animals present in an ecosystem will allow communities to make more informed decisions about how local ecosystems should be used and managed.

## **Materials:**

Mapping materials (tape measures, trundle wheel, clipboards, rulers, templates, graph paper)  
*Investigating a Community* Worksheet  
Field guides and binoculars  
Computer lab with Internet access, web page development and desktop publishing software



**Procedure:**

Students will:

- Map the site selected for study (agencies and mapping resources are available to assist in this)
- In teams of three, use the *Investigating a Community* worksheet to evaluate the mapped site
- Research the animals that could be present by talking to local parks department, city planners, school district maintenance department, Audubon Society, and other city, state, and county agencies and organizations.
- Inventory the animals that are present (agencies can provide protocols).
- Research animal characteristics and life histories. Research both legendary or mythical and scientific information with the intent of animating stories of each animal.
- Construct a classification key of major animals
- Produce products for the community such as a brochure of the area with student drawings of all animals, create a CD-ROM with local histories and Indian legends of totem animals, and on the high school web site post all the data along with links to local fish and wildlife sites
- Present information to community groups

**ANIMALS – DEVELOPING COMMUNITY AWARENESS OF LOCAL ANIMALS**

INVESTIGATING A COMMUNITY

NAME: \_\_\_\_\_

A. Examine the non-living factors that affect the community you are studying.

1. Describe your community \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. Weather \_\_\_\_\_

\_\_\_\_\_

3. How much sunlight does your community receive during the day? (any shade?)

\_\_\_\_\_

4. Record the air temperature \_\_\_\_\_

5. How much moisture does it have at this time of year?    marshy    dry    damp

B. Describe the different habitats found in this community.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

C. List the different plant types found.

1. Which is the dominant plant type? \_\_\_\_\_

2. Which type shows evidence of having been eaten? \_\_\_\_\_

\_\_\_\_\_

3. How many different kinds of plants did you find? \_\_\_\_\_

\_\_\_\_\_

(Collect samples of each.)

D. List all the different types of animals you can find in the community.

---

---

1. Which animals did you see? \_\_\_\_\_

---

E. Using the list of plants and animals, draw a food web for your community. Include all the feeding relationships you can think of. Draw your food web on another sheet of paper.

1. Identify the ecological niche of each organism:

Producers \_\_\_\_\_

First Level Consumers \_\_\_\_\_

Second Level Consumers \_\_\_\_\_

Third Level Consumers \_\_\_\_\_

2. Which animals might be in competition with each other for food? \_\_\_\_\_

---

---

3. Give examples of how some organisms in this community depend on each other.

---

---

---

4. How have humans affected this community? \_\_\_\_\_

---

---

**Assessment:**

- Map of the site (laminated for outdoor use)
- Dichotomous key of local animals
- Community product such as a brochure of local animals associated with the study site, a CD-ROM of animals /plants of the site, or post the entire project to the Internet using schools web page.

Presentations to various community groups

**Extensions:**

- Participate in national programs such as GLOBE and Naturescaping
- Establish a long-term ecological study site

**Author/Affiliation:**

Ron Okarma  
Kennewick High School  
Kennewick, WA

## LESSON 24 - HUMAN IMPACT

### Activity: Determining Your Ecological Footprint

#### Abstract:

An ecological footprint account is the day-to-day journal of what each person uses to support a lifestyle and can provide a snapshot in time of the number of acres of biologically productive land needed to support that lifestyle.



#### Age Group:

Grades 9-12

#### Time Needed:

There are two surveys in which students can participate. One is a quick 10-minute survey. The second survey requires three days of data collection prior to the completion of a 20-minute survey.

#### Major Concepts:

Human impact on the environment and resource consumption

#### Objectives:

*Students will be able to:*

- Calculate one's own ecological footprint as a measure of the impact each one of us has on the Earth.
- Keep a journal (an ecological footprint account) that documents one's own resource use and waste generation
- Make personal decisions consistent with a more sustainable lifestyle

#### National Standards Addressed:

*Science in Personal and Social Perspectives:* Environmental Quality- Natural and human induced hazards

*Science and Technology:* Developing abilities of technological design

#### Teacher Background:

This activity could be a self-invitation into the community to study how individuals and communities use resources. This can lead into other community connections such as participation in Earth Day, an awareness survey for schools, or a web link from a school web site. Students can estimate the school's ecological footprint and present this information to the school board with a plan to reduce that footprint (and probably, the costs for running the school). The students can survey other students and present this information in a public forum or poster presentations to other schools. Students could also conduct a community campaign and present this information to community organizations and schools.

**Introduction:**

The average American produces four pounds of garbage, uses about 7 gallons of non-renewable fossil fuel and generates 20 pounds of carbon dioxide in the atmosphere each day. The carbon dioxide released into the atmosphere contributes to global warming. Pharmaceuticals and personal care products are showing up in our waterways. Pollutants and pesticides released into our watersheds are placing strains on our water ecosystems, plants, animals and destroying their habitats.

The Earth has a limited amount of resources available to each person on an annual basis. The amount of impact on the environment is dependent on the productive area needed to generate resources and absorb each person's waste. This is called an ecological footprint. An ecological footprint is the amount of biologically productive land needed to support human life. An ecological footprint account is the recording of the amount and kind of transportation, water use, recreation, food and living space each one of us use and how we dispose of our waste.

Before the agricultural revolution, the human population was low and resources were readily available. When resources were used up, people would move on to new locations with accessible resources and start anew. This movement allowed the Earth time to replenish itself before people returned to an area. The agricultural movement allowed people to stay in one area for extended periods of time. Hunting and farming practices tended to have long-term impacts on local environments. Small areas and then larger areas were depleted of forests, tillable soil due to the depletion of soil nutrients, potable water and over hunting and in some instances, hunting some species to extinction. When a whole population exceeds its ecological footprint, the Earth is incapable of renewing itself.

At this point in human history, the Earth can provide us with 5.3 acres per person of biologically productive land. The average person is dependent upon 7.1 acres of productive land, which means some people do without while others exceed their limit. The average American needs the equivalent of 24 acres to support his or her lifestyle. Americans leave a footprint about twice the size of those in Western Europe.

Every choice that one makes can be a choice that allows our planet to regenerate itself or be potentially devastating. Recognizing how much is in our ecological footprint account and how much each individual uses will make the student aware of misuse, overuse and waste. This survey is designed to alert each student to daily activities one can eliminate or modify to make a significant difference in his or her ecological footprint.

**Materials:**

Computer with Internet access

**Procedure:**

Two quizzes can be utilized to allow students to have an increased awareness of how many resources they use on a regular basis. The short quiz allows one to estimate via a computer program, a quick estimate of one's ecological footprint. To access this program go to <http://myfootprint.org/en/>

To use the longer quiz, students must keep a three day log of activities that include, the type of house they live in, how many live there, the amount of water consumed, how they travel, the type of food they consume, where it is purchased, etc. The teacher may download the quiz and print a copy for the students to keep their data or complete the quiz on line. This quiz may be accessed at [www.educ.uvic.ca/faculty/mroth/438/environment/webstuff/footprint.html](http://www.educ.uvic.ca/faculty/mroth/438/environment/webstuff/footprint.html).

**Assessment:**

- Completed ecological footprint account
- Calculate the school's ecological footprint to present to the school board
- Design a method to reduce the school's ecological footprint
- Conduct a student/community survey and post results on school web site
- Develop a display for school awareness of ecological footprints

**Extensions:**

- Make an environmental album of newspaper and magazine articles
- Write letters to the local newspaper or state legislators
- Teach a lesson on ecological footprints to elementary students
- Submit surveys to magazines
- Create an advertisement for public service
- Create a slogan or bumper sticker for Earth Day celebrations
- Create a political cartoon for the school paper
- Invite local politicians or experts for a panel discussion

**Resources:**

Earth Day and The Ecological Footprint, 2002. A short quiz to determine one's ecological footprint by Redefining Progress, Center for Sustainability Studies, 2000, WWF, Gland, Switzerland.

<http://myfootprint.org/en/>

Ecological Footprint. A three day quiz that includes many facets of everyday living that will determine one's ecological footprint.

[www.educ.uvic.ca/faculty/mroth/438/environment/webstuff/footprint.html](http://www.educ.uvic.ca/faculty/mroth/438/environment/webstuff/footprint.html)

Reifer, Susan. April 2002, "Watch Your Step-Reducing Your Footprint", Vegetarian Times.

Reifer, Susan. "Watch Your Step-Reducing Your Footprint", 2002, magazine archives.

[www.vegetariantimes.com](http://www.vegetariantimes.com)

Natural Resources Defense Council (NRDC). A guide to cleaner living, ways to conserve water and energy as well as ways to live more simply.

<http://www.nrdc.org/living/>

Wackernagel, Mathis and Rees, William E. 1996. Our Ecological Footprint: Reducing Human Impact on the Earth. New Society Publisher, Gabriola Island, BC

Chambers, Nicky; Simmons, Craig; and Wackernagel, Mathis. 2000. Sharing Nature's Interest: Ecological Footprints as an Indicator for Sustainability. Earthscan, London.

Sturm, Andreas; Wackernagel, Mathias; Muller, Kaspar. 2000. The Winners and Losers in Global Competition: Why Ecoefficiency Reinforces Competitiveness: A study of 44 Nations. Ruegger, Chur/Zurich.

[www.rueggerverlag.ch](http://www.rueggerverlag.ch)

**Author/Affiliation:**

Diane Warren  
Wichita Collegiate Upper School  
Wichita, KS

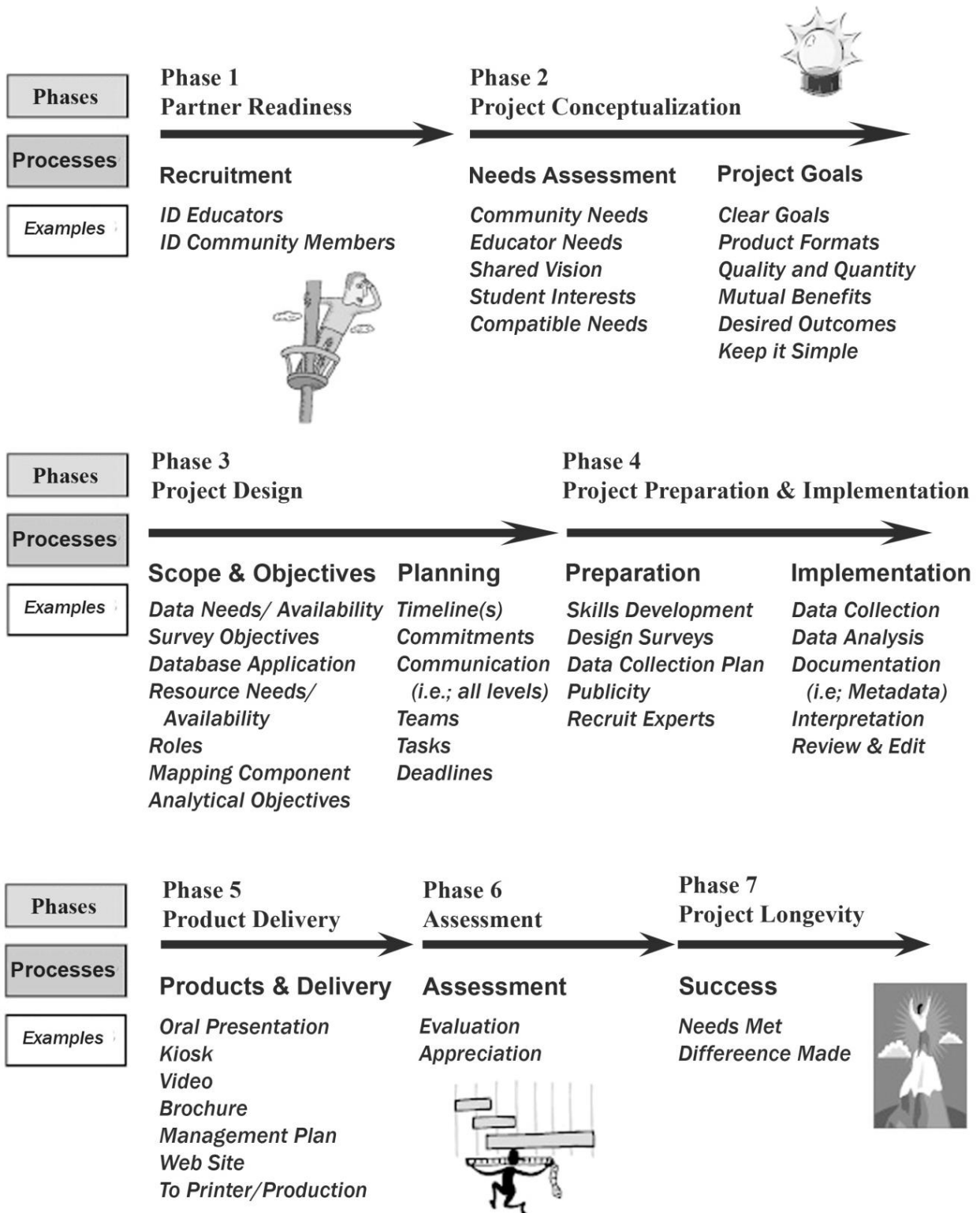


## **Appendix C – Forms and Resources**

The following are a few tools to help students tackle tasks that may be new to them. Part of being an active citizen involves practical skills such as phoning or emailing community organizations, creating and administering surveys, interviewing community members, using public documents and writing grant applications. Some of these tasks may seem intimidating at first; students may benefit from some practice in small groups of classmates before venturing into the community.

Even with practice and the guidance provided by a written form, it is still important for the students involved in community-based projects to be supported at all times by a teacher or another adult. When phoning or emailing community members it is recommended to have an adult present for assistance with unexpected inquiries or situations. If students are canvassing neighborhood homes or surveying community members in a public space, adult supervision is recommended as well. This adult support helps to ensure a feeling of student self-confidence and safety.

## Organizing School and Community - Basic Project Timeline



## PROBLEM IDENTIFICATION AND ANALYSIS FORM

Names of group members:

Date:

The Problem:

What is the problem that you and other people in your community think is important?  
Why?

What level of government or governmental agency is responsible for dealing with the problem?

What policy, if any, does government now have to deal with this problem?

If a policy does exist, answer the following questions:

What are its advantages and disadvantages?

How might it be improved?

Does this policy need to be replaced? Why?

What disagreements, if any, exist in your community about this policy?

Where can you get more information about this problem and the positions taken by different individuals and groups?

Are there other problems in your community that you think might be useful for the class to study? What are they?

## Stoplight Importance and Resource Availability Worksheet

Project: \_\_\_\_\_

Combined Score: \_\_\_\_\_

	IMPORTANCE					
LOW	1	2	3	4	5	HIGH
	AVAILABILITY OF RESOURCES					
LOW	1	2	3	4	5	HIGH

Project: \_\_\_\_\_

Combined Score: \_\_\_\_\_

	IMPORTANCE					
LOW	1	2	3	4	5	HIGH
	AVAILABILITY OF RESOURCES					
LOW	1	2	3	4	5	HIGH

Project: \_\_\_\_\_

Combined Score: \_\_\_\_\_

	IMPORTANCE					
LOW	1	2	3	4	5	HIGH
	AVAILABILITY OF RESOURCES					
LOW	1	2	3	4	5	HIGH

Project: \_\_\_\_\_

Combined Score: \_\_\_\_\_

	IMPORTANCE					
LOW	1	2	3	4	5	HIGH
	AVAILABILITY OF RESOURCES					
LOW	1	2	3	4	5	HIGH

Project: \_\_\_\_\_

Combined Score: \_\_\_\_\_

	IMPORTANCE					
LOW	1	2	3	4	5	HIGH
	AVAILABILITY OF RESOURCES					
LOW	1	2	3	4	5	HIGH

# Stoplight Worksheet

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

Project

	Recommendation
_____	<input type="radio"/> STOP
_____	<input type="radio"/> WAIT
_____	<input type="radio"/> START

## PARTNER-SCHOOL EXPECTATIONS

### **What *partners* need to know about when working with *schools***

Teacher schedule and time expectations- when and how to contact and communicate with teacher

How to enter and exit the building

Parking

Entering the building and reporting to office

Getting to the classroom – students escort

Background check

School rules – dress, language

Classroom expectations

Content and curriculum being taught and how it will be used

Background of the students – academic, diversity, previous knowledge and experiences, students with special needs

Developmentally appropriate language and tasks

Number of students and size of room

Technology and resources available

Behavior of students – what to expect and teacher’s role in supervising

Teaching strategies – hands-on is best, 10-20-30 rule of *PowerPoint*

Teacher role – co-teacher or observer

Field site information needed

Exchange of contact information for change of plans or emergency

Materials and equipment

Mode of transportation

Training of field protocols

Organization of students in the field

Responsibility for student behavior

Media involvement

Liability responsibilities

Assessment involvement – student and project

Teacher may have discomfort with other adult in leadership role or working with others

Partner is a role model

Work often takes longer than expected.

Emergency procedures

Confidentiality issues with students

Students are not a work crew

### **What *schools* need to know about when working with *partners***

Purpose of the project – how it fulfills partner and community need

Products expected and format for delivery

Understanding roles and responsibilities

Teachers responsible for student behavior

Partner responsible for training

Field site organization and planning important – communicate this

How will students be grouped and chaperones involved

Issues of collecting reliable data need to be resolved

Communication critical - responses timely, contact information (cell phone)  
Providing feedback to partner important  
Recognition and a thank you to partner appreciated  
Preparation and planning critical to success  
Liability issues resolved  
Administrative support necessary  
Notification of school for partner visit needed  
Any funding already arranged  
Trained and involved chaperones needed  
Follow through important  
Meal arrangements if present all day  
Previous experiences with schools  
Know the mission, policies, and procedures of the partner organization  
Need to know the time commitment – calendar and timeline  
How students will be transported to field site  
Documenting volunteer hours (for nonprofit partners)  
School open to multiple partners if needed

**FORMALIZING CONNECTIONS TO THE COMMUNITY**  
*Example of agreement between a city council and a school*

RESOLUTION # \_\_\_\_\_

A RESOLUTION OF THE CITY OF \_\_\_\_\_, \_\_\_\_\_, SUPPORTING THE DEVELOPMENT AND IMPLEMENTATION OF A COMMUNITY-BASED EDUCATION PLAN FOR ALL CITIZENS INCLUDING APPROPRIATE ACCESS FOR YOUNG CITIZENS

WHEREAS, we have unique human, economic, and natural assets in our local communities and the region; and

WHEREAS, involved citizens are an essential element of vibrant communities; and

WHEREAS, the best way to learn how to be an involved citizen in a democratic society is through active participation; and

WHEREAS, the \_\_\_\_\_ have developed a community education framework and can act as a facilitator to help support opportunities for the application of knowledge and skills in a local context.

NOW, THEREFORE, BE IT RESOLVED BY THE \_\_\_\_\_ CITY COUNCIL THAT:

SECTION 1. The City of \_\_\_\_\_ will cooperate with education institutes to develop and implement an educational framework for all citizens to improve participation in the public processes of community.

SECTION 2. The City of \_\_\_\_\_ will partner with \_\_\_\_\_ to facilitate administratively approved access for students to participate in planned citizen-based programs that further the goals of the City, its citizens and the community.

SECTION 3. The steps for this program would include:

Cooperative identification of civic engagement actions.

Identification of resources, including funding, and the necessary skills and knowledge required to complete the community project.

A detailed plan that would include a timeline, deliverable products, and responsibilities of those involved.

A plan that will clarify how young citizens' actions will contribute to ongoing community renewal and continued educational development.

An assessment process that measures the contributions of students, work to the community and academic development of young citizens.

PASSED by the City Council of the City of \_\_\_\_\_ on this \_\_\_\_ day of \_\_\_\_\_, year \_\_\_\_\_.

SUBMITTED to the Mayor and approved by the Mayor on this \_\_\_\_ day of \_\_\_\_\_, year \_\_\_\_\_.

ATTEST:

\_\_\_\_\_  
City Auditor

\_\_\_\_\_  
Mayor



## PROJECT PLANNING OUTLINE FORM

### I. Project Background

A. Project Title:

School Mission Statement:

State Content Standards

Course(s)

### II. Project Information

A. Project Overview

B. Project Process

1. Public Domain

a. Community exploration (community awareness and context)

b. Community invitation (specific documents, requests, etc.)

c. Partners (consider Memorandum of Understanding and roles and responsibilities)

2. Information Gathering (identify those delivered by teacher or partner)

a. Knowledge (include content and activities used)

b. Skills (include tasks to accomplish)

c. Attitudes

3. Policy / Decision Making (Products)

a. Products

1. Partner

2. Community

### III. Project Implementation

A. Project Check List (duties, responsibilities and expectations for field work)

B. Approval(s) needed

1. Administration

2. Staff Collaboration

3. Parents

4. Site Permission

5. Other

C. Other Considerations

1. Transportation

2. Budget

3. Timeline

### IV. Assessment

A. Student

B. Project (include partner)

C. Instruction (use community-based rubric)

## PROJECT RESOURCE PLANNER

Purpose: To identify the resources a project team can access, to locate resource providers, and to assign responsibility for contacting resource providers. This assumes all key partners have agreed to explore the feasibility of carrying a project. For each project idea, consider the critical and optional resources.

Resource Description	Type Code	Quantity Available or Required	Contact Information	Person Responsible

Type Codes:

B=Budget    C=Cost    D=Data    E=Equipment    L=Location  
 M=Mentor    P=People, Experts    S=Space    SW=Software  
 T=Time    TR=Training    TS=Technical Support

## CHECKLIST FOR ESTABLISHING A FIELD STUDY SITE

### **Watershed Maps:**

Larger area than study site - watershed perspective  
Watershed boundaries  
Site location in larger watershed  
Stream locations  
Wetland locations  
Population (human)  
Rainfall  
Fish distribution  
Topography  
Zoning  
Land Cover and/or Vegetation  
Geology  
GIS data on CD ROM

### **Aerial photographs**

Scale  
Black and White  
Color  
Stereo pairs of photographs

### **USGS quad map**

### **Detailed site maps**

Topography  
Contour interval  
Vegetation cover &/or habitats  
Tax maps showing property boundaries  
Soils map from NRCS (SCS)  
Mosaic of photos

### **Inventory of site**

Plant species list  
Forbes, shrubs, trees, fungi, lichen  
Mammals species list  
Reptile & amphibian species list  
Bird list  
Migration patterns-arrival dates & departure dates  
Insects list  
Water quality  
Set photo points  
Study plots

### **History of the site**

Historical photographs  
Oral histories  
Resources use histories  
Legends or rumors about the site  
Natural history &/or site specific geology  
Native American History

### **Access agreements**

Documentation that you can be on the site with students

### **People**

List of Resource People  
List of Teachers  
List of Volunteers  
List of Agency (City, County, State, Federal and NGO's)  
Peer teaching plan  
Hunting and fishing groups  
Plan to discuss stewardship of the site as well as use of the site  
Community Interface  
What are we doing and why?  
Partnerships within the community  
Organizations and agency involvement  
Connection with resource people  
Knowledge of the Zoning Ordinance  
Knowledge of other Community Documents  
Plan to involve the press and other news sources in your work  
Community event: celebration/  
recommendations/ recognition  
Teacher's Guide  
Activities  
Equipment needs  
Evaluation of students  
Standards (benchmarks)  
Protocols  
Student behavior contract  
Overheads: aerial photos, topography, stream, satellite imagery, fisheries, information

## PROJECT AND FIELD SITE CONSIDERATIONS

### Pre-site visit considerations:

- Understand reason for doing the project – need by partner/community
- Community context for project
- Process for selecting project – student involvement and ownership
- Content/standards taught
- Partner training - practice protocols and use of equipment

### Permission secured – school and parents

- Transportation arranged
- Funding secured
- Student expectations and details of travel clear – dress, times, locations
- Organize equipment for transport – assign students
- Arranged material needed – data sheets, clipboards, journals, field guides
- Visit site with partner before taking students - Check for necessary permits
- Inform chaperones of role and responsibilities
- Notify office, lunch room and other teachers if classes missed
- Have student list with emergency numbers and medical needs
- First aid kit
- Plan for food and drink if needed
- Back-up plans – anticipate bad weather and changing circumstances
- Notify media – student release forms may be needed
- Procedures for exiting and returning to classroom
- Second driver
- Agenda - teams and the work needed with times for completing tasks
- Communication and behavior expectations – signals, walkie talkies
- Partner communication – dates, times, place to meet, roles and responsibilities
- Camera
- Bathroom needs addressed

### On-site considerations

- Monitoring student work and behavior
- Organizing work site
- Staying on task and on time
- Taking pictures
- Directing drop off and pick up sites and times
- Serving as a resource and support for students and partner
- Find teachable moments to refer back to content/standards or other skills and attitudes
- Check for all students and equipment before leaving site

Post-site visit considerations

- Reflection by students and teacher – include what else to do or know
- Reinforce content connections
- Plan and begin product development – for partner and for community
  - Displays and slide shows for class and for new year
  - Practice presentations
  - Peer review of journals and reports
- Check in all equipment and materials – students clean and organize
- Students send out a thank you to partner, volunteers, others
- Assess students learning
- Evaluate project with students and partner

## STUDENT PROGRESS REPORT EXAMPLE

DIRECTIONS: Please complete one report per group. Attach your communication log to the back. This report will be submitted to \_\_\_\_\_ on \_\_\_\_\_.

Please make a copy for your group's records before you submit this report.

*NOTE: Groups who do not submit this report may not receive a passing grade for the project.*

Interest Area:

Subgroup:

Subgroup Members:

Mentor(s):

Summarize the work your group has done since your last progress report.

With which other subgroups have you worked?

What is your timeline for the completion of this work? (Make sure it fits the due dates!)

What support do you need from your mentor? What is your specific plan to get this support?

What support do you need from your interest area teacher? What is your plan to get this support?

How is the project going for your group at this time? What complaints or kudos do you have? What can be done to resolve your complaints?

## INTERNSHIP EVALUATION

*Partner Form*

Evaluator (Host): \_\_\_\_\_ Intern: \_\_\_\_\_

Dates: From \_\_\_\_\_ To \_\_\_\_\_ Total Hours: \_\_\_\_\_

Please evaluate the student you worked with using the following scale

1	2	3	4	NA
Very Little	Well	Better Than Expected	Much Better Than Expected	Not Applicable

1. How well did the student use technology:

Select Technology	1	2	3	4	NA
Apply appropriate Technology to Task	1	2	3	4	NA
Maintain and Troubleshoot Equipment	1	2	3	4	NA

Comments:

2. How well did the student understand systems:

Understand Systems	1	2	3	4	NA
Monitor and Correct Performance	1	2	3	4	NA
Improve or Design Systems	1	2	3	4	NA

Comments:

3. How well did the student use the following resources:

Time	1	2	3	4	NA
Money	1	2	3	4	NA
Materials and Facilities	1	2	3	4	NA
Human Resources	1	2	3	4	NA

Comments:

4. How well did the student acquire and use information:

Acquire and Evaluate Information	1	2	3	4	NA
Organize and Maintain Information	1	2	3	4	NA
Interpret and Communicate Information	1	2	3	4	NA
Use Computers to Process Information	1	2	3	4	NA

Comments:

5. How well did the student express the following qualities:

Responsibility	1	2	3	4	NA
Self-esteem	1	2	3	4	NA
Sociability	1	2	3	4	NA
Self-management	1	2	3	4	NA
Integrity/Honesty	1	2	3	4	NA

Comments:

6. How well did the student work with others:

Participate as Member of Team	1	2	3	4	NA
Teach Others New Skills	1	2	3	4	NA
Serve Clients/Customers	1	2	3	4	NA
Exercise Leadership	1	2	3	4	NA
Negotiate	1	2	3	4	NA
Work with Diversity	1	2	3	4	NA

Comments:

What did you expect the student to gain from this internship?

What were the best outcomes of the internship?

What did not go very well with the internship?

Comments and suggestions for improvement:

Host/Employer Signature: \_\_\_\_\_ Date: \_\_\_\_\_



## INTERNSHIP EVALUATION

*Student Form*

Intern: \_\_\_\_\_ Host/Employer: \_\_\_\_\_

Dates: From \_\_\_\_\_ To \_\_\_\_\_ Total Hours: \_\_\_\_\_

Use this scale to answer the next two questions. Explanations can be found at the end.

1	2	3	4	NA
Very Little	Well	Better Than Expected	Much Better Than Expected	Not Applicable

1. How much did your internship help you express or develop the following qualities?

Responsibility	1	2	3	4	NA
Self-esteem	1	2	3	4	NA
Sociability	1	2	3	4	NA
Self-management	1	2	3	4	NA
Integrity/Honesty	1	2	3	4	NA

Comments:

2. How well did you work with others?

Participate as Member of Team	1	2	3	4	NA
Teach Others New Skills	1	2	3	4	NA
Serve Clients/Customers	1	2	3	4	NA
Exercise Leadership	1	2	3	4	NA
Negotiate	1	2	3	4	NA
Work with Diversity	1	2	3	4	NA

Comments:

3. Rate your employer and internship in the following areas using the criteria listed below:

	Not Enough	Just Right	Too Much
Employer was supportive	NE	JR	TM
Employer was pleasant	NE	JR	TM
Employer gave good instructions	NE	JR	TM
Employer clarified instructions	NE	JR	TM
Employer's expectations were	NE	JR	TM
Employer was demanding	NE	JR	TM

Comments:

4. Adequate resources were available to complete the job:

Time	NE	JR	TM
Equipment	NE	JR	TM
Committed people	NE	JR	TM
Technology	NE	JR	TM
Space	NE	JR	TM
Feedback was timely	NE	JR	TM
Feedback was constructive	NE	JR	TM
I had a flexible schedule	NE	JR	TM
I had a variety of tasks	NE	JR	TM

Comments:

5. What did you expect to gain from this internship?

6. What were the best outcomes of the internship?

7. What did not go very well with the internship?

8. Comments and suggestions for improving the internship experience:

Intern Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Please return to:

## FINAL PROJECT EVALUATION

Please answer the following questions and be as specific as possible. Your comments, ideas, and suggestions will be very helpful in planning future projects.

Project Name: \_\_\_\_\_

Teacher Name(s): \_\_\_\_\_

Date: \_\_\_\_\_

School: \_\_\_\_\_ Grade(s) Involved: \_\_\_\_\_

Class(es)/Disciplines Involved: \_\_\_\_\_

No. of Students: \_\_\_\_\_ Project Duration: From (mo/yr) \_\_\_\_\_ To (mo/yr) \_\_\_\_\_

Approximate Total Hours: Classroom \_\_\_\_\_ Field \_\_\_\_\_ Other \_\_\_\_\_

Primary Community Partner:

\_\_\_\_\_

Primary Community Mentor Name(s):

\_\_\_\_\_

Other Community Partners:

\_\_\_\_\_

\_\_\_\_\_

Project Description:

Where ranking is requested, please refer to this scale:

1	2	3	4	5
Not At All	Very Little	Yes	More Than Expected	Much More Than Expected

1. Did the project meet your expectations? 1 2 3 4 5

Comments:

2. Do you feel your project met your goals? (overall rating) 1 2 3 4 5

Mentoring Relationships 1 2 3 4 5

Student Interests 1 2 3 4 5

Curriculum Development 1 2 3 4 5

Ongoing Information Sharing 1 2 3 4 5

Comments:

3. Were the project goals relevant (overall rating) 1 2 3 4 5

Mentoring Relationships 1 2 3 4 5

Student Interests 1 2 3 4 5

Curriculum Development 1 2 3 4 5

Ongoing Information Sharing 1 2 3 4 5

Comments:

4. What did the students do?

How were they organized to tackle various tasks of the project?

5. What did the mentor do?

6. What made the student/mentor relationship most effective?

What did not go well with the student/mentor relationship?

7. What were the best academic outcomes of your project?

8. What did not go very well with your project?

What constraints posed problems, e.g.; time, budget, scheduling, equipment, etc.?

Comments and suggestions for improvement or avoiding specific problems:

9. What was your main incentive or motivation for deciding to undertake this project?

10. Were the following skills important for students to be successful with their community project? (Use the rating system from the first page.)

	1	2	3	4	5			
	Not At All	Very Little	Yes	More Than Expected	Much More Than Expected			
Teamwork				1	2	3	4	5
Data Collection				1	2	3	4	5
Independent Research				1	2	3	4	5
Oral Presentation				1	2	3	4	5
What other skills did the students need to be successful?								

Comments:

11. How easy was it to incorporate community projects into your curriculum?

What would make it easier?

What benefits, outcomes & products did the community partner realize?

How will the community partner use the products?

12. Do you think the community partner realized the benefits and outcomes they expected?  
YES/NO

How were the anticipated and actual benefits different?

What caused the difference?

13. How much of the technological work was done by the following entities?

	Proj. Team	Partner Coord.	School Tech	Teachers	Students
Teaching skills and concepts	_____%	_____%	_____%	_____%	_____%
Project preparation	_____%	_____%	_____%	_____%	_____%
Data collection	_____%	_____%	_____%	_____%	_____%
Data analyses	_____%	_____%	_____%	_____%	_____%
Final product development	_____%	_____%	_____%	_____%	_____%

Comments:

14. From your perspective, what did your students learn by participating in a community project?  
Do you think your students bought into the community partner's project objectives?

Comments:

## COMMUNITY-BASED EDUCATION DEVELOPMENT CONTINUUM

### Section 1 – Acquiring and utilizing knowledge of the local community

#### *Knowledge of the local community*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>1a</i>	Teacher's knowledge of community assets, challenges and systems is minimal.	Teacher's knowledge of community assets, challenges and systems is developing.	Teacher feels quite knowledgeable regarding community assets, challenges and systems.	Teacher facilitates school and community's knowledge of one another's assets, challenges and systems.

#### *Identifying community resources*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>1b</i>	Teacher is not sure how to find resources within the community to help identify meaningful opportunities for middle school students.	A few resources within the local community have been identified with assistance from an outside facilitator.	Several resources within the local community have been discovered through attendance at neighborhood meetings and events, local newspapers, family members of students, etc.	Original contacts have contributed to growing community resource network. Teacher helps school and community stay abreast of each other's events and activities.

#### *Community as a basis for curriculum*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>1c</i>	Activities drawing student's attention to their local community's assets, challenges and systems are minimal or have not occurred.	Activities drawing students' attention to their local community's assets, challenges and systems are textbook-based or suggested by an outside facilitator.	Activities drawing students' attention to their local community's assets challenges and systems are drawn from student input. Community themes are driving large portions of the curriculum.	Activities drawing student's attention to their local community's assets, challenges and systems are drawn from the community itself. The community ecosystem, events, and needs provide the framework for students' learning.



## Section 2 – Forming partnerships with the local community

### *Identifying potential partners*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
2a	Teacher is not sure how to establish contact with potential community partners.	Teacher has made a few contacts within the community. Firm connections or commitments have not yet been established.	Teacher increasingly reaches out to make contacts within the local community. Ongoing relationship being established.	Teacher has established relationships and reciprocal partnerships with local businesses, community members or organizations, and shares information about potential partners with others.

### *Partnership development*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
2b	At this time, project activities developing without a partner in place.	Partnership initiated by external facilitator (such as UEP, AmeriCorps member or other teacher).	Partnership developed out of teacher-initiated activities or community organization.	Partnership arose out of ongoing community-school relationship. Partner is active within school and both teacher and partner view the school as valuable to community building efforts.

### *Student roles in partnerships*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
2c	Teacher facilitation of activities that build students' awareness of their assets and how they can benefit the community are not part of the classroom curriculum.	Activities that build students' awareness of their assets and how they can benefit community partners are becoming part of the classroom curriculum.	Activities where students identify individual and group assets as well as roles for themselves within local community partnerships are regularly incorporated into classroom curriculum.	Students, teacher and community partner have identified their assets and how they can benefit one another. Students are active participants in the community process.

### Section 3 – Working cooperatively with the local community

#### *Project planning*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
3a	A process for planning community-based activities is not in place. Others are not included when teacher develops project ideas.	Community-education project planning is conducted at the last minute. Teacher frequently depends on outside facilitator for assistance.	Plans for community-education projects are outlined in advance, though plans often change and significant pieces are planned at the last minute. Students are becoming part of the planning process.	Process for planning community-education projects is in place and responsibilities are shared amongst teacher, students and community partner. Process is ongoing, timely and flexible.

#### *Effective communication*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
3b	Teacher has not yet established regular contact with partner and/or community members.	Communication with partner and/or community members is sporadic. Teacher may depend on outside facilitator for maintenance of timely, effective contact.	Communication with partner and/or community members is fairly regular. Teacher listens effectively and involves students with partner communication.	Project momentum drives the need for and implementation of planned, consistent, and effective communication between student, teacher and community partner. Teacher ensures timely contact, listens effectively, and helps facilitate discussion and feedback loops.

#### *Understanding project roles*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
3c	Teacher is currently working in isolation of community members, businesses or organizations.	Teacher is unsure how all participants (self, students and community) can contribute to and/or benefit from the project. Clear roles have not yet been established or communicated.	Teacher can explain how all participants contribute to the project team. He/she assumes a role and helps facilitate students' understanding of how all participants fit.	Teacher clearly understands and can explain all participants' roles and goals. All partners see themselves as important contributors to and benefactors of successful community-school relationships.

## Section 4 – Sharing community project information and findings with others

### *Where community project is shared*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
4a	Teacher and students share project information within classroom.	Teacher and students share project information within their school and classroom.	Teacher and students share project information both within and outside the school, when invited.	Teacher and students initiate and respond to requests to share project information with others, including community groups and in conference settings.

### *Use of technology in community projects*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
4b	Teacher has little background in using technology (including databases, spreadsheets, graphs, web pages, word processors and presentation software) to organize, analyze and disseminate project information and findings.	Teacher has some background using technology (including databases, spreadsheets, graphs, web pages, word processors and presentation software) to organize, analyze, and disseminate project information and findings.	Teacher and students use a variety of previously mentioned technological tools to organize, analyze and disseminate project information and findings.	Teacher and students create and use previously mentioned technology with confidence. Project documentation can be produced for community partner or others as needed.

## INSTRUCTIONAL DEVELOPMENT

### Section 5 – Organizing effective student work groups

#### *Student arrangement*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>5a</i>	Students are arranged to facilitate time spent listening or responding to teacher-centered activities.	Students are arranged in groups in which they share materials and respond to teacher-centered activities. Information is shared between groups on occasion	Students are arranged to increase interaction within and between groups. Activities are planned to heighten cooperation, students have clear roles for which they have received training. Teacher brings groups together for closure.	As in "transitional," plus closure activities involve group problem solving that lead to further progress in community-based activities.

## Section 6 – Managing student field work

### *Student field work*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>6a</i>	Teacher has little or no experience involving students in work outside of the classroom.	Teacher has some experience involving students in work outside the classroom. Activities are primarily designed, organized and implemented by individual other than teacher.	Teacher is experienced in involving students in work outside of the classroom. Activities are primarily designed, organized and implemented by classroom teacher with student input.	Teacher collaborates with students and community partner to design, organize and implement field experiences closely tied to classroom curricula. Students have learned necessary skills and are invested in trip success.

### *Quality control*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>6b</i>	Teacher manages quality of data or product by providing directions for students to follow. Students ask questions when they don't understand.	Teacher manages quality of data or product by having students learn and practice skills before using them in the classroom or field. For validation, students compare their results with a standard.	Teacher manages quality of data or product by helping students understand the criteria for ensuring accuracy of the data or product. For validation, students check one another's work.	Teacher manages quality of data or product by bringing students and partner together to determine whether student work meets partner needs. Students collaborate with community partner to validate the quality of their work.

## Section 7 – Connecting project activities to ongoing curriculum

### *Connecting to district goals and benchmarks*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
7a	Project activities are not regularly linked to District goals or Benchmarks.	Project activities are linked to District goals or Benchmarks by teacher when request is received from administrator, project funder or other external authority.	Project activities are guided by teacher-targeted District goals and Benchmarks. Students are being drawn into identification process.	Project activities are regularly framed around District goals and Benchmarks, which can be identified by students, teachers and community partners.

### *Integration of subject matter*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
7b	In general, subject matter is not integrated across disciplines.	Integration of subject matter across disciplines occurs during a few project activities. An outside facilitator's assistance with planning cross-curricular links is helpful.	Teacher integrates subject matter across disciplines on many occasions and observes that students are beginning to see how disciplines fit together to explain the world around them.	Project curriculum is being integrated across disciplines on a regular basis. Community partner is involved with helping students see interconnections within disciplines affecting their project.

## Section 8 – Using inquiry with students

### *Lesson-type preference*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>8a</i>	Teacher prefers using activities that he/she knows to be tried and true.	Teacher prefers using activities known to produce expected results, though variables exist that may produce some unpredictability.	Teacher prefers new activities for which he/she can practice skills and learn background information before implementation in the classroom or field.	Teacher prefers activities where he/she can learn new skills and information along with students. Teacher works with community partner to both prepare the learning environment and teach and model critical thinking and manipulative skills.

### *Lesson planning*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>8b</i>	Activities are planned so that prepared directions guide students to achieve the same results and conclusions found in text, manual, or handout.	Activities are planned so that prepared questions and directions guide students toward expected results. Teacher is developing capacity for managing unexpected results.	Activities are planned so that specific topics are presented to students. Teacher models how to formulate appropriate questions and carry out open-ended investigations.	Activities are planned so that teacher and community partner engage students in explorations of new material. Teacher helps students formulate their own questions, determines their capacity to answer them, and facilitates students in carrying out their investigations.

### *Lesson implementation*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>8c</i>	Teacher relies upon textbook, manual or specialist as questions or problems arise from classroom or field activities.	Teacher consults a textbook, manual or specialist while developing his or her capacity for helping students respond effectively as questions and problems arise from work in classroom or field.	Teacher determines capacity of students to acquire the inquiry skills of observing, questioning, investigating, etc., which are taught as student work progresses.	Teacher and community partner assist students in learning new inquiry skills (including collecting and interpreting information and communicating findings to others) as project develops.

## Section 9 – Assessing student learning and project direction

### *Assessment tools used*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>9a</i>	Assessment is addressed informally through teacher observation of student performance.	Teacher records observations of student performance for analysis. Further assessment is composed of questions with right or wrong answers or prompted responses.	Assessment tools provide students with opportunity to demonstrate key learning skills, knowledge and growth.	As in transitional, but partner, teacher and students collaborate to create assessment tools that also assess quality of project data and/or product.

### *Assessment strategy used*

	ENTRY	DEVELOPING	TRANSITIONAL	COMMUNITY-BASED
<i>9b</i>	Assessments are primarily summative; results are used to determine student grades.	Assessments are primarily summative; results used to determine student grades as well as further development of student skills.	Assessment strategies determined prior to activity implementation. Teacher guides project direction based on assessment results.	Assessment provides ongoing feedback to establish project direction, further development of student skills, and partnership performance. After project activities, partners debrief to discuss results and possible modifications.

*Developed by Urban Ecosystems Project, Center for Science Education, Portland State University, Portland OR 97207, <http://cse.pdx.edu>. For information call 503-725-4243*



## Appendix D - Contributors

### NORTHWEST CENTER FOR SUSTAINABLE RESOURCES — NCSR

1995-2012

The Northwest Center for Sustainable Resources (NCSR) was a collaborative effort among educators, employers, and others, which enhanced natural resources programs at community colleges and high schools and provided a clearinghouse for information on sustainable use of natural resources. A Center of Excellence funded by the National Science Foundation's Advanced Technological Education program, the Center has incorporated innovative teaching methods, state-of-the-art technology, knowledge from cutting-edge research, and hands-on field experiences into natural resource technology programs. Major goals for the project included integrating community college programs into a "seamless education" from K-12 through university, working closely with employers in curriculum development, emphasizing work experience for students through internships, and developing core programs that prepare students to work as technicians for organizations dealing with aquatic and terrestrial ecosystems. Programs feature environmental monitoring, mapping, instrumentation, and other related skills woven within the context of managing complex ecosystems. Combining improved curricula with professional development opportunities and an information clearinghouse for natural resources education, the Center has provided an effective model for education/employer alliances for the nation.

The Center's main activities focused on curriculum development, faculty and teacher enhancement institutes, and national dissemination of products. The Center developed 58 (including this final manual) curriculum items to support natural resources education.

NCSR materials are available at [www.ncsr.org](http://www.ncsr.org). Additionally, NCSR materials may be found at the following national curriculum repositories:

Applied Math and Science Education Repository: [www.amser.org](http://www.amser.org)

ATE Central: [www.atecentral.net](http://www.atecentral.net)

National Science Digital Library: [www.nsdlib.org](http://www.nsdlib.org)

*"NCSR—EDUCATION FOR A SUSTAINABLE FUTURE"*

## **CENTER FOR SCIENCE EDUCATION – PORTLAND STATE UNIVERSITY**

The mission of the Center for Science Education (CSE) is to enhance science teaching and learning through innovative education, research and community outreach programs. The Center provides undergraduate general education courses in the sciences for all majors, a Master of Science Teaching program, and professional development opportunities for existing science educators. The Center also supports community partnerships that involve citizens and community institutions in activities that employ the inquiry practices of science. Through its programs, the Center aims to help students and teachers raise their capacity to participate in the community as informed citizens.

The contributions provided by the Center for Science Education were made possible through two grants funded by the U.S. Department of Education. The Community as a Curriculum activities and the Community-Based Education Development continuum (CBED) were developed as part of the Urban Ecosystems Project, from 1995-2001—Dr. William Becker, P.I. The Community Survey Activity Guide was developed through the 21st Century Learning Centers Initiative, a partnership between Portland Public Schools and the Center for Science Education, Dr. Patrick Burk, P.I., 2000-2003.

For more information about the Center for Science Education and its programs, please visit the website at <http://www.cse.pdx.edu> or call (503) 725-4243.

## THE ORTON FAMILY FOUNDATION

The purpose of The Orton Family Foundation is to promote sustainable development within small cities and towns by engaging and empowering citizens in land use planning to make informed, equitable, and collaborative decisions affecting their environment and quality of life. The Foundation advances its mission by providing a diverse suite of planning tools and cultivating a community of civic leaders across generations, backgrounds, and regions through action research and publications, learning networks and convenings, place-based education, and technology development.

The Foundation's focus on land use planning as a pathway to sustainable development stems from its belief that the physical settings in which community life occurs can be a uniquely powerful force in inspiring civic action, establishing common ground and a basis for collective problem-solving.

The appeal of small city and town life is drawing people to America's countryside as never before. Today's technologies permit many Americans to earn their living farther away from urban centers, and more people are drawn to the quality of life that smaller communities offer. As a result, many communities are coping with rapid economic, social and environmental change, and their citizens are struggling to manage these pressures in ways that promote and enhance the beauty, community and quality of rural life.

Responding to this challenge, The Orton Family Foundation was established as a not-for-profit, private operating foundation with a mission to help citizens of small cities, towns and communities shape the future of their communities. Founded by Lyman Orton and Noel Fritzinger in 1995, the Foundation is supported by profits generated by The Vermont Country Store, the Orton family business.

As an operating foundation, our primary assets are ideas and programs. Instead of making grants, we bring resources together in creative entrepreneurial ways to create tools and programs that can be adapted by small communities that are actively grappling with growth and community-planning issues. Our approach is not to convince people of the "right" choice, but to instead connect people (including students) with resources that encourage and enable them to participate in fully informed decision-making processes about their community's future.