TerraPod—Teaching Science and Technological Literacy Through Film-Making

Abstract

TerraPod is both an art- and science-based program that helps pre-teens and teens explore science, engineering, and technology (SET) content through the art of film-making. TerraPod creates a web-based social networking community using a new digital media literacy curriculum designed to teach youth learn about science topics through a discovery process driven by their desire to make their own films. Using a hands-on, experiential learning process, TerraPod helps youth improve their awareness of science and technology while also having fun learning how to plan, produce, edit and upload an original 3-5 minute movie on a science or nature topic. At the same time, youth can "chat" with one another on a secure website, ask questions of one another, "chat" with film-makers and probe the minds and expertise of scientists in a forum. The tools section of the web-based curriculum also includes video-making tips and short subject matter films produced by Montana State University (MSU) graduate film students providing science based information to youth participants. Through this project, youth successfully produce their own original science or nature films, become civically engaged in local issues and improve their understanding of science facts and concepts along the way.

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Program of Distinction Category

Leadership, Citizenship and Life Skills
- Workforce Preparation

Science, Engineering and Technology Literacy
- Natural Resources Education
- Agriculture and Biotechnology
- Science Engineering and Technology

Youth in Governance
- Community Engagement

Sources of funding that support this program

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Program Content

Knowledge and Research Base

Science & Art Education

While Americans consistently voice appreciation for how science has served to improve their quality of life by making advances in technology, health, safety and communications, surveys continue to demonstrate that in general Americans do not understand basic science concepts or facts. For example, NSF surveys have revealed that many citizens do not have a firm grasp of basic scientific facts and concepts, nor do they have an understanding of the scientific process. In addition, belief in pseudoscience (an indicator of scientific illiteracy) seems to be widespread among both Americans and Europeans. Studies also suggest that not many Americans are technologically literate (National Science Foundation, 2004; National Science Foundation, 2006).

Scientific and technological literacy in our nation is fairly low. Moreover, many Americans simply do not understand how science works and are frequently at a loss to explain some of the most basic scientific processes. For example, a study of American's civic scientific literacy found that only 11% of the public could provide an open-ended definition of a molecule or radiation, but 82% knew that the core of the earth was very hot (Miller, 2001).

Americans—both youth and adults—currently learn science from a wide range of sources. These sources include such entities as libraries, museums, zoos, botanical gardens, experiment stations, aquariums, public education institutions such as schools, television programs, newspapers, radio, the Internet, magazines, and through community-based organizations like 4-H (Falk, 2001). The list could go on, but the important point is that today learning has "become so pervasive that it is the single largest leisure activity" in our nation—learning is what people do for enjoyment (Falk & Dierking, 2002, p. 5).

While it may not be evident at first glance, arts education teaches the same critical thinking and processing skills emphasized in science education. In fact, a recent report by independent researchers found that learning in and through the arts improves critical thinking, problem-posing, problem solving and decision-making skills. In addition, these researchers found that arts education fosters higher-order thinking skills such as analysis, synthesis and evaluation and develops an individual's imagination and judgment (President's Committee on the Arts and Humanities, 2003). These are the very same skills emphasized in science education.

Moreover, the arts have been known for some time to be an effective method for engaging learners of varied learning styles. Arts give kids who are troubled or failing in school new ways to succeed and cope with everyday problems. Arts help at-risk youth focus on what is, and what can be, not on what is missing. In ***Art Works!***, former National Endowment for the Arts chairman Jane Alexander wrote, "Art can turn around a troubled teenager, help a child kick drugs, get young men and women off the streets and into creative and constructive pursuits. Art can change attitudes, build self-esteem, and redirect the path of the wayward. Art can prevent despair" (Randall, 1997, p. 7). Finally, a large national study found that youth in arts programs are 23% likely than youth not participating in arts programs to say they can do things as well as most other people can (Randall, 1997).

Informal, or free-choice learning, environments (like film-making) have an important role to play in supporting science literacy. If we can harness youths' intense interest in film-making and direct it to a focus on science, we can accomplish much. Research is quite clear—the more the various elements of schools, family, work, community and free-choice learning overlap and support science literacy, the better people become as life-long learners (Heath & Smyth, 1999). In addition, the populace becomes more literate when science education is present at all levels of the human ecology.

The Pew Internet and American Life Project (Lenhart & Madden, 2007) estimates that 55% of online teenagers are active in social networking sites on the Internet. In addition, older teens, especially girls, are more likely to be involved in such sites. Henry Jenkins, the Director of the Comparative Media Studies Program at MIT, points out, though, that the study does not consider newer forms of expression—such as podcasting, video and computer gaming, and game modeling—and that a more accurate estimate of the percentage of teenagers who engage in the participatory culture may be as high as 70% (Cassel & Jenkins, 1999).

The frontier of film-making and the Internet have created successful participatory cultures such as MySpace and YouTube. However, youth today are receiving little training in high quality film production—as many of the amateur films on YouTube attest. Just because your phone or camera will shoot movie footage does not make you a film-maker. Finally, the current avenues for film-making fail to provide an environment that properly promotes science learning, civic engagement, and ethical responsibility.

Needs Assessment

Montana public school students are frequently above national averages in terms of science literacy, but not that far above national averages. For example, in the most recent data reported by the Montana Office of Public Instruction (OPI), Montana students were ranked at the following levels in science knowledge (Office of Public Instruction, 2003):

Grade Level Tested	National Percentile Rank	Normal Curve Equivalent
Fourth	70	61
Eighth	64	58
Eleventh	70	61

Clearly, there is room to improve science knowledge and this is especially true for middle school students who scored the lowest ranking of the Montana groups tested compared with national peers.

In February 2007, an independent evaluator was employed to assess 4-H members' interest in science and film-making. A small pilot group (n= 22) of Montana 4-H adolescents indicated that they had a very high interest in science (4 or 5 on a scale of 1 to 5, with 5 as the highest), but only one knew what "biodiversity" was. Two-thirds had accessed science information on the web, and all had used a video camera before and all had Internet access at home. While one person had posted videos on the web before, and two had downloaded videos from the web, none had downloaded videos about science from the web. All rated their interest in making videos as a 4 or 5 (very interested) and all but one rated their interest in making a movie about science as a 4 or 5. One student rated their interest as a 3—somewhat interested.

Additional pre-assessment surveys were also conducted with two groups of Native American youth from Montana Reservations (n=35). One group was surveyed in April 2007, and a second group who spent 6 weeks on campus participating in TerraPod was surveyed during August 2007. Of those surveyed, one-third had never used the Internet to find science information. In addition, only one youth had posted videos to the web. Nearly all (90%) reported an initial high level of interest in science. Only 2 youth choose "3—somewhat interested." Interests in making films about science were of less interest to these students. The average rating on a scale of 1 (Not interested) to 5 (very interested) was 3.2 on the pre-survey. Only one youth marked "5" on the survey. While most students indicated that they had heard the term biodiversity, few could provide their own definition in response to an open-ended question.

As an additional rationale for our approach and target group, a 2005 study (Lenhart & Madden) found that more than one- of all American teens (57%) created and uploaded content on the Internet. Of these, 40% were urban, 38% were rural and 22% were suburban. In addition, girls between the ages of 15-17 years were more likely to participate (27%) than boys in the same age group (17%). Montana 4-H, like many other 4-H programs, is comprised of more girls than boys. In addition, we have a goal of increasing the interest of girls in science-based careers. Thus, TerraPod is an ideal project to target a variety of demographics represented in Montana and other rural states.

Program Goals and Objectives

Goal: To boost science and technological literacy by providing youth with access to an online participatory community whose focus is to stimulate and inspire exploration of science and nature through the art and creativity of film-making for free-choice learners ages 10-18.

Objectives:

- To enhance youth's awareness of and appreciation for the natural world that exists in their own community
- To assist youth in learning specific science content through an experiential process
- To help youth learn how to use digital camera technology to successfully make their own science and nature-based films
- To teach youth how to use common software technology to edit and produce their own science films
- To teach youth to be able to use Internet technology to upload their films on a public website via a private room for viewing
- To increase youths' interest in making films of their own

Target Audience

The target audience for this project is Montana 4-H youth members ages 10-18, particularly girls. They could be living in any geographic setting (rural, urban or suburban) as long as they had access to the Internet, a computer with movie-editing software (e.g., MicroSoft MovieMaker) and a digital camera or cellular camera phone.

Type of Program

TerraPod is best described as a short-term, special interest project.

Delivery Methods

TerraPod is delivered through two primary methods—face-to-face instruction and web-based resources/instruction. First, let's describe the personalized, high-touch training. TerraPod film crews of two to three youth are assembled at various locations for a 6-hour training workshop at the beginning of the project. These workshops are conducted by MSU graduate science and film students and use a "learning-by-doing" method of instruction. After some initial groundwork, each film crew is given a digital camera, tripod and other supporting equipment and told to go out and make a 2-3 minute film about any topic of their choice.

After 90 minutes, the youth are re-assembled and all the movies previewed (without any editing at this point). Comments are provided about positive aspects of film techniques, story lines and other components. The remainder of the first workshop is focused on a small discussion about bio-diversity or other subject matter content, viewing one of the web-based modules on the TerraPod website introducing the concept of bio-diversity, and demonstrations of the film-editing steps and uploading process for YouTube. Additional modules under development are road ecology, water resources and climate change.

Following this first workshop, youth film crews are given 4-6 weeks to produce their own film on a science topic. In the interim, youth have access to the password protected TerraPod website where the curriculum and resources are located. This is the high-tech portion of the program. On this website is loaded a wide variety of content to serve as instructional, free-choice learning tools for the 2-3 person film crews. (For access to the TerraPod website and curriculum, please contact Patricia Bean at: patricia.bean@montana.edu.)

After the 4-6 week period allotted for film production and editing, all the original film crews are brought back together for a final meeting, debriefing, and celebration. At this final meeting, participants view all the completed films as posted on YouTube, we collect the camera equipment, and evaluate the project. At this time, the films are simply loaded up on YouTube and then loaded onto the TerraPod website. The YouTube sub-site is pass-protected and not open to everyone but only accessible by password.

TerraPod creates an ideal learning environment for SET (Science, Engineering and Technology) content and for learning critical thinking and decision-making skills emphasized by both art and science education. In addition, though, TerraPod creates an "affinity space" (Gee, 2004) that promotes: (1) a shift in focus from the individual to the community as the result of collaboration, net-working, and communication skills; (2) equal access to knowledge (as opposed to information), skills, opportunities, and experiences; and (3) research and critical analysis skills while engaging in creative participation and artistic expression.

Curricula and Educational Materials

TerraPod is one of the few 4-H projects that is web-based so that it is available completely on-line. The website consists of science-based modules, chat rooms, tools and other resources necessary for producing science-base films. TerraPod uses the following format for this special-interest project. Additional details about components of the on-line curriculum are located in Appendix A.

The goal of the TerraPod curriculum is to engage and entertain young people, and to widen their concept of science and what it means to be a scientist. TerraPod aims to empower kids by not only providing them with accurate and in-depth knowledge and interactive content, but also by giving them tools to pursue further exploration. Through the curriculum on the TerraPod website, youth are encouraged to engage in critical thinking, to combine creativity with science (they belong together), to become curious in a supportive environment, to foster a genuine love of science, the process of science and the people doing science.

While there is not a lot of research on the power of film-making to teach science literacy, TerraPod and other projects like it (e.g., Bayer Corporation's "Making Science Make Sense") are finding that such methods provide an effective platform for youth who are not necessarily on a science track to become more scientifically and environmentally aware using the non-traditional, yet powerful tool of film. The popularity of TV documentaries and programs such as Animal Planet, Crocodile Hunter, and Wild Kingdom all attest to the effectiveness of documentary films to increase interest in science and environmental topics.

The filmmaking process also helps students develop their creative voice, master basic skills—such as researching, reading, writing and speaking—and builds important science literacy skills like critical thinking, problem solving and team work. TerraPod allows young people from a variety of backgrounds to explore science and technology through a unique arts-oriented experience. As we have said, science and film-making involve similar processes: both utilize identification of a problem or question to be understood or explored, research, testing, analysis, synthesis and communication of results.

The challenge of TerraPod is to encourage kids to make a film (either by conventional means such as a digital camera or by non-conventional means such as a cellular phone) about science topics that uses the processes common to scientific inquiry, assessment, artistic expression and experiential learning (Kolb, 1984). To accomplish this goal, TerraPod has created an extensive on-line and on-the-ground architecture that provides continuous support for teenagers to build, test, and refine skills critical to the workforce of the future (see Appendix B for an overview).

Teamwork and Collaboration

TerraPod is a collaborative science education program, vodcast and website for kids. It is funded by a grant from the National Science Foundation ESPCoR, Montana 4-H and Montana State University's Science and Natural History filmmaking graduate program. The Montana Space Grant Program is also helping with the module on climate change. TerraPod's purpose is to use film making techniques and the Internet to develop new methods of providing fun, informal science education, ultimately on a national basis.

<u>Partners</u>

<u>Montana Extension/4-H</u>: Montana 4-H reaches over 25,000 young people annually (about 15% of the youth potential) through a wide variety of programs. Montana 4-H provided the youth, parent volunteers, training sites, funding, and some equipment for this project. In addition, though, this project is now a part of our 4-H military clubs program, and eight cameras have been purchased to implement TerraPod with Guard and Reserve youth as well as youth on the Malmstrom Air Force Base in Great Falls.

<u>MSU Media & Theater Arts</u>: The MSU Media and Theater Arts department has a number of highly qualified science graduate students who are committed to outreach in the state. Currently, there are 60 students enrolled in the program. The graduate program has combined the art of filmmaking as a structural and epistemological device for engaging student scientists in the creative process.

<u>Montana/NSF EPSCoR</u> (Experimental Program to Stimulate Competitive Research): Montana EPSCoR provided initial funding to help with the purchase of digital cameras and some other equipment for this project. Throughout, their funding has been a key incubator for securing other support and funding.

<u>Montana Space Grant Program</u>: The SPOT Program (Space Public Outreach Team) has developed components of a module on the influence of the sun on climate and other environmental phenomenon (such as the Northern Lights).

<u>Hopa Mountain</u>: Hopa Mountain is a non-profit program dedicated to supporting Native American youth in realizing the hopes and dreams for their hometowns. Hopa Mountain provides these youth with training, mentoring, networking opportunities, and financial resources to help them create much-needed opportunities for advancing the education, ecological health, and economic well-

being of their communities. Hopa Mountain has helped us reach Native American youth on our reservations with the TerraPod program.

MSU Big Sky Institute: This campus entity focuses on the greater Yellowstone ecosystem and specializes in science and natural history of the region. The Big Sky Institute is a science and education center that develops and connects the important science occurring in the area.

Program Evaluation

Becky Carroll, a professional evaluator with Inverness Research in Billings, Montana, was hired to evaluate this project and provided primary leadership for this part of the program.

a. Methods

The evaluation component of the TerraPod project included:

- Development and administration of a pre-survey to all participants;
- Attendance at the introductory workshop;
- Focus groups with all participants following the introductory workshops;
- Development and administration of a mid-point survey;
- Development and administration of a final survey;
- Informal interviews with a few parents; and
- Post-interviews with the graduate students and with Extension staff.

b. Process Evaluation

Through the process of delivering workshops in a variety of settings, we have learned some valuable lessons and modified the workshop format to build on these lessons. First, participants require more technical assistance on editing techniques to produce really good films. Second, we acknowledge that the youth need at least 6 weeks of time to produce a good, science-based film. Four weeks was not enough time. Third, we assumed that youth had access to some high-speed Internet connections, but this was not the case with many of our rural families. Access to the Internet proved to be an obstacle for some families, but we were able to work with local schools to overcome this barrier.

We also found that we could engage youth in several different delivery modes and still be successful with many of our objectives. For example, TerraPod was run as a 1-week, intensive program on one of our reservations. Several hours each day were devoted to the program. However, because of the unique situation on the reservation, we could not send cameras home with the kids each night (concerns more about the parents than the kids). Several of the youth commented on their evaluations that they did not have enough time to completely record and film everything that they wanted to shoot. Lending out camera equipment presents some challenges in certain socio-economic settings.

In another instance, TerraPod was conducted over 6 weeks on campus with a group of Native American students who were involved in several projects during this time. This format seemed to work well and met many of the objectives. During our annual summer teen conference, TerraPod was intensively delivered over 2 ½ days (a total of about 16 hours) to a group of 14 youth. While not ideal, each film crew was able to shoot, edit and upload a completed film during this time.

Their final films were shown at the closing banquet for the event to over 400 people.

TerraPod has been a successful experience for almost all of the youth. In particular, our external evaluator found that:

- Youth were interested in, engaged by, and enjoyed the process of making their films. As one student said, "It was the funnest thing I did all winter!"
- The website is well done and the youth accessed it, as well as directly e-mailing the graduate students. The website is fairly well-organized and contains sections of value to youth. The section where youth could download music clips was cited frequently by youth as the most useful. Youth indicated that they would have used the website more if they had had more time to make their films.

c. Outcome Evaluation

So far, more than 100 youth have been involved in the TerraPod program. In addition to our pilot work in February 2007, we also delivered the program on one Native American reservation, during our summer 4-H teen conference, and during a special 6-week session for high school students on campus. In addition, we are currently using TerraPod with youth whose parents are in the military through our 4-H military clubs program.

The external evaluator used a numerical survey tool for the pre-test and open-ended survey questions for the post-test to gather input from youth who have participated in the project. Group interviewing was also used because some of our audiences are averse to paper and pencil survey instruments.

- All film crews have completed films and only one was unsuccessful at uploading it to the website. Youth had very little guidance when it came to creating their films other than it had to be about biodiversity and around five minutes in length. The 4-H members took very well to the open-ended approach. The final films were highly creative; most were full of interesting filmmaking techniques, and most contained quite a bit of science content.
- Youth learned science content (in this case, biodiversity) through the making of their films, the content available on the website, and resources in their own communities (such as parents, teachers, naturalists, and scientists). For example, in one group, only 5 of 18 participants returning a pre-survey knew what biodiversity was. In another group, only 2 out of 15 youth said they did not know what biodiversity was. However, when asked on the mid-point and final survey what they had learned during the course of the project, all youth responded learning things about biodiversity. In one of the Native American youth groups, by the end of the project, most could give a passable definition of biodiversity. The following quotes illustrate the types of responses from youth:

  "If you don't have much rainfall, there are not many species, and therefore, not much biodiversity."

  "How an invading life form can completely disrupt, if not destroy, the creatures already living in that area."

  "Biodiversity involves all living things."

  "That the possibility of genetic engineering in natural species could affect the natural biodiversity of the world drastically."

"I know that there is ecosystem diversity and species diversity and genetic diversity. I learned these things from my mom."

- Through focus group interviews, the outside evaluator found that youth also learned quite a lot about filmmaking--from good filming tips, to how to use sophisticated software, to adding special effects. Graduate students working with the youth were impressed by some of the filming and editing techniques the youth incorporated into their films. Again, here are some examples of the comments provided by youth when asked to identify 3 things they learned about film-making that they did not know before:
  "How to edit, how to add stuff to it, how to change voice pitch."
  "You can edit, you could have hours of filming and use only 5 minutes of it. You can add music to films."
  "How hard it is, how long it takes, how fun it is."
- Youth involved in this project also reported learning about technology. The following comments are illustrative of the learning that occurred when asked to identify 3 things they learned about technology that they did not know before:
  "Cutting edge stuff, using music, special effects."
  "Editing, photo-shop."
  "Editing movies, how to control a camera, how to take care of a camera."
- Most youth from all the different groups reported that they wanted to make another film "because it was fun." Science topics the kids were interested in making future films about included: habitats, chemistry, Yellowstone, snakes, insects, nanotechnology, nuclear field, biology, flower pollination, photosynthesis, string theory, brain wiring, climate and gravity. Only one student said she did not want to make another film about science because "it is very hard to make a film about science."
- When asked whether participating in the project changed their interest in science, most youth reported that it had. Here are some sample comments from the evaluations:
  "Yes, because I learned new stuff."
  "Yes, it made it more interesting and fun."
  "Yes, because it showed me there is more to science."
  "A little because it was a fun way to learn science."
- In answer to another question about whether participation in TerraPod changed their interest in making films about science, most of the youth again said it had. Here are some common responses.
  "Yes, because it was fun."
  "Yes, because it teaches me how to do science in an entertaining film."
  "Yes, because you could make it funny."

d. Communication to Stakeholders

Program results have been shared with key partners through the outside evaluator's report and recommendations. In addition, representatives of both groups were in attendance at nearly all phases of the program and could report back about progress and challenges. During the initial phases, we held weekly meetings on campus between 4-H and the Media & Theater Arts department students and faculty to access progress and debrief.

Because one of the venues was during our 4-H summer teen conference, the project was widely promoted and advertised to all counties. The youth's final films were also shown at the closing banquet during the conference, viewed by more than 400 people. All the films are loaded on the TerraPod web site as well.

One of the most visible elements of communications to all stakeholders is the website. TerraPod has all of the currently produced films on the website for viewing. This is a very visible means of relaying what has been accomplished. In addition, though, Montana EPSCoR has received copies of the evaluation report and access to the films produced by youth. As a partner, they have been kept informed all along the way about the return on their investment. A statewide press release about TerraPod was also distributed to all counties in July 2007.

4-H and the Media and Theater Arts department are committed to maintaining the website and supporting training workshops to reach more youth and adults. As indicated elsewhere, this is already ongoing.

Evidence of Sustainability

TerraPod is committed to keeping all content free and easily accessible to the public. To this end, the site hosts past and present content in a digital archive. This archive is designed to be a permanent resource for educators, youth, and free-choice learners of all ages. TerraPod will remain free to the public and the site is designed to be a democratic tool rooted in twin ideals: (1) working towards global environmental sustainability via the dissemination of high-quality programming; and (2) free and equal access to information from an unfettered distribution model.

Through the resources of Montana 4-H, eight cameras have been purchased. In addition, three camera sets were donated to three counties who expressed initial interest in this project. All youth participating in the project receive a free TerraPod t-shirt with a 4-H clover on the sleeve to celebrate their participation in this project. In just the short time we have worked on this project, cell phones have now advanced enough to the point that they could be used to produce a movie as well, so cameras are no longer the sole source of movie-making equipment needed.

TerraPod is now a part of our 4-H military clubs program, and we will include it in our next CYFAR grant as the program model we will utilize. We have grant applications out for review to NSF, the Green Foundation, and the MacArthur Foundation as well. In the meantime, we are utilizing funds from our 4-H curriculum account to sustain the project and expand its reach. While the workshops rely on the graduate science and film students, they are willing to travel and conduct workshops for minimal costs. 4-H continues to cover the costs of training.

Replicability

TerraPod is already being replicated in Montana, and we have plans to go national in scale over the next several months. As a result of our booth at the National 4-H Curriculum Summit in June 2007, we have already received inquiries or requests to conduct trainings in Oregon and New Jersey. Because the bulk of the curriculum is web-based and free, the existing and future resources will be readily available to anyone with an interest in producing a science-based film. Because the curriculum has already been developed, the only cost for participation is a digital camera, tripod and cables to link the camera to computers. We purchased cameras and all equipment for about $375. While significant, this cost is not prohibitive to county offices that want to help youth have this unique experience. Grant funding is also possible to obtain cameras. Again, cellular phones have advanced to a point where they can be used to produce films. Grants and corporate sponsorships are possible as well to replicate this program and keep it going.

We have now incorporated TerraPod as one feature of our 4-H military clubs program and are actively offering the program to Guard and Reserve families as well as to youth on the Malmstrom Air Force Base. With this funding, we have purchased 10 digital movie cameras that we can use at workshops. The graduate students are available to teach workshops anywhere, and we will be conducting an introductory workshop for adults at the upcoming Western Regional 4-H Leaders' Forum in Boise, Idaho, for example.

Rationale and Importance of Program

TerraPod is an innovative web-based program teaching pre-teens and teens about science and technology literacy through the art of film-making. With the fast-paced environment of Internet sites like MySpace and YouTube where youth can "broadcast themselves," TerraPod provides a way to engage youth during leisure time learning in ways that ennoble and strengthen scientific and technological literacy and create interest in the arts. The future well-being of our planet and certainly our nation depends on a scientifically literate populace who support scientific investigation and arts education. Arts education strengthens the same critical life skills taught in the scientific method.

TerraPod uses the hands-on, experiential learning process of helping youth learn about science while also having fun learning how to plan, produce, edit and upload an original 3-5 minute movie on a science or nature topic. Through web-based curriculum that is free and enduring, youth can download public domain music, graphics, sound effects and other tools to enliven their movies. At the same time, youth can "chat" with one another on a secure website, ask questions, talk with film-makers and probe the minds of scientists in an interactive forum. The tools section also includes video-making tips and short subject matter films produced by MSU graduate film students, providing science-based information to youth participants. Completed films are posted on the secure website for viewing and voting, and the best films and their crews are recognized with accolades. TerraPod is one of the most unique, dynamic and creative projects available to youth today that brings together science and technological literacy and the arts. Youth who have participated in this project have fun, improve their understanding of science concepts and learn how to employ the technology of film-making.

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Appendix A

Montana State University is fortunate to have the only master's of fine arts program in science and natural history film-making (see http://naturefilm.montana.edu/). Students must already possess a degree in science to be admitted to this program. In 2000, MSU launched this graduate program with a major grant funded by the Discovery Channel. In the six years since its creation, the program has been an unambiguous success. In September 2004, "TERRA: The Nature of Our World" began broadcasting in primetime on the campus public television station, KUSM-TV Montana PBS. TERRA broadcasts some of the finest science and environmental content available, free of charge, to the public via both traditional television broadcast methods and web-delivery systems of vodcasting (video podcasting). In October 2005, the TERRA vodcast series was launched on the Apple iTunes Podcast webpage. By January 2007, TERRA programming had been downloaded over 2 million times from viewers around the world. At this time, graduate students became increasingly interested in how to engage teenagers in science film-making, especially with the explosive popularity of MySpace and YouTube.

The curriculum for TerraPod is outlined below and supports the "roadmap" in Appendix B.

1. Subject Matter

a. The Module. The module defines the subject matter of a SET topic. A module consists of a series of host-driven documentary segments that present a science topic, define the research task and its methodology, define the video to be produced, directs teens to research and technical knowledge about the subject and filmmaking, and engages participants in the community. Modules are posted on the website in the Gallery section for viewing at any time. In addition, some modules will be culturally relevant (for example a module created by and for Native Americans). Modules include biodiversity, water resources, road ecology, and climate change.

2. Communicating

a. Peer Chat Room. A public space in which any member of the community may communicate with other members; also for peer mentoring between beginners and experienced practitioners. This chat room has been used extensively by our 4-H members. Peer mentors are selected from the experienced youth who have been in the project for a sustained period of time.

b. Mentor Chat Room. A public space in which experts outside the community communicate with the community—such as scientists who specialize in the module topic, professional filmmakers, and other experts. Mentors are recruited from campus through departments and institutes with specific expertise in the science topic. In some cases, the mentors are graduate students with specific science expertise related to the module who are enrolled in the Media and Theater arts program on science film-making.

c. Preview Theater. A public space that hosts model films produced by the community.

3. Tools and Resources

a. Filmmaking Toolbox. A repository of how-to skills (camera and lighting techniques, interview techniques, and editing techniques) and tools for making a video (editing, in particular).

b. Laboratory. A repository of information that relates to the module topic, including elaborations of research and analysis skills.

c. Digital Library. A repository of open source images and music related to the module topic that participants may elect to use within their films

4. Exhibition

a. Main Theater. All community member's films that have been produced for a module are uploaded into an exhibition site for public viewing, thus encouraging members within and without the community (friends and family) to watch (and vote for) the films on display. The "stars" on the website indicate the strength of these votes.

5. Evaluation

a. Voting Booth: "Audience Choice Award. A public space where anyone may vote for his or her favorite film playing in the Main Theater.

b. Voting Booth: "Judges' Award." A public space where selected scientists, filmmakers and community mentors choose the films that best exemplify scientific methodology and communication skills.

c. Incentives. Winners of the judging are awarded certificates, t-shirts and prizes (e.g., a video camera or an iPod, donated by the manufacturer) and an opportunity to move to a larger online audience.

Appendix B

TERRAPOD DESIGN FLOW CHART			
	Information	Collaborative/Participatory Community Rooms	
Learning	Explicit	Implicit	Implicit
Offering	Module	Chat Rooms	Tools/Research