

students will help with data collection and processing during their field trips to campus every 2-3 weeks through the school year. Data collection protocols are being designed so that classrooms and K-12 teachers can assist with the experiment as the year progresses. Below is more detailed information about the experiment.

Cold Hardiness and Optimal Length of Dormancy

The K-20 STEAM Education component of BAKLAP hopes to contribute to greater understanding of the basic biology of Alaska white birch (*Betula neoalaskana* Sarg.) by studying two critical life cycle factors—1) onset of winter dormancy and 2) optimal length of dormancy during the 2013-14 school year. Our experiment will directly link university personnel with K-12 teachers and students in the Fairbanks North Star Borough School District. Students and teachers will help with data collection during field trips to the IAB greenhouse on the University of Alaska Fairbanks campus. They will also help process information by making line graphs of their results once back at school.



Figure STEAM 2. Master in Education student Diane Hunt (left) discusses cold hardiness and dormancy experiment with Interior legislators, legislative aides, and university personnel during the Legislative Field Tour and Report, Sept 20, 2013. Photo credit: Nancy Tarnai/SNRAS.

The study will be conducted with ± 300 Alaska white birch “half-sibling” seedlings, all collected from same maternal tree, NR14. The seedlings were germinated in January 2013 and reared in the IAB greenhouse until June, then transferred outside to acclimate to Fairbanks temperatures from June-October, 2013. The 2013 growing season, with its exceptionally warm, dry summer and long, moist fall, presents a good opportunity to explore whether local seedlings can take advantage of a growing season that extends past the norm.

As designed, the experiment will:

1) Estimate, retrospectively, when the trees became fully dormant.

During the early dormancy period (October-November, 2013), a sample of 13 dormant seedlings will be brought into the IAB greenhouse each week and observed for the length of time it takes each seedling to proceed to budburst.

Literature pertaining to the onset of dormancy in temperate North American and European white birch tree species indicates that, apart from considerations of diurnal temperature swings and their interactions with diminishing day length, the threshold value of 10 hours of daylight/day limits further growth in white birch trees. If Alaska white birch behaves similarly, our test population of local one-year-old seedlings would be expected to be fully dormant by October 12-13, the date by which Fairbanks' day length decreases to 10 hours/day each fall.

We will use the point (date) in the graph when the trees begin taking fewer than 28 days to proceed to budburst as the signal that the seedlings are beginning to be able to release from winter dormancy. An estimate of when the trees went fully dormant will be made by back calculating from the date that sample was brought in. If, for example, the sample of trees brought into the greenhouse on November 9 takes 33 days to proceed to budburst, whereas the sample brought in November 16 takes only 26 days, we will calculate that our sample of trees was fully dormant by October 19.

2) Determine optimal length of dormancy for Alaska white birch.

At this point, scientists do not know the length of the dormancy requirement for Alaska white birch. White birch seedlings from temperate regions have been found to require a minimum winter resting period of (3) 4 weeks in order to break bud, even when placed under favorable experimental growing conditions. This question of the length of time (accumulated chilling units) our local trees need to satisfy winter dormancy is important when considering the potential effects of mid-winter thaws on them.

Our expectation is to observe a decrease in the amount of time needed to proceed to budburst in samples (October-March). The point at which the graph levels off will be taken as our proxy for 'optimal dormancy length.' Armed with this information, K-12 students, teachers and university personnel will then be able to consider the *potential* effect of mid-winter thaws on either side of this threshold date.

Hardening off the research seedlings: To ensure that our test population is fully dormant before being the time series begins, seedlings will be kept outside in ambient conditions until November 2, at which time they will be placed in a minimally insulated, covered trench behind University Park Building. This treatment is being used to simulate the fluctuating temperatures of a Fairbanks winter, with the trees' roots protected below grade. Dr. Meriam Karlsson, Professor of High Latitude Agriculture and Cameron Willingham, her research assistant, will provide a data logger to track ambient temperature and humidity in the trench throughout the winter.

Table STEAM 1. Dates when samples will be drawn from two experimental treatments to determine onset and optimal length of dormancy in Alaska white birch.

| Number of weeks (and days) seedlings assumed to have been in dormancy | Date | Tray # to be transferred to IAB greenhouse |
|---|-------------------------------|--|
| Week 1 (0) | 9 Oct: trays above ground | 1 |
| Week 2(7) | 19 Oct | 2 |
| Week 3 (14) | 26 Oct | 3 |
| Week 4 (21) | 02 Nov: trays put into trench | 4 |
| Week 5 (28) | 09 Nov | 5 |
| Week 6 (25) | 16 Nov | 6 |
| Week 7 (42) | 23 Nov | 7 |
| Week 8 (49) | 30 Nov | 8 |
| Week 9 (56) | 07 Dec | 9 |
| Week 10 (63) | 14 Dec | |
| Week 11 (70) | 21 Dec | 10 |
| Week 12 (77) | 28 Dec | |
| Week 13 (84) | 04 Jan | 11 |
| Week 14 (91) | 11 Jan | |
| Week 15 (98) | 18 Jan | 12 |
| Week 16 (105) | 25 Jan | |
| Week 17 (112) | 01 Feb | 13 |
| Week 18 (119) | 08 Feb | |
| Week 19 (126) | 15 Feb | 14 |
| Week 20 (133) | 22 Feb | |
| Week 21 (140) | 01 Mar | 15 |
| Week 22 (147) | 08 Mar | |
| Week 23 (154) | 15 Mar | 16 |
| Week 24 (161) | 22 Mar | |

| | | |
|---------------|--------|----|
| Week 25 (168) | 29 Mar | 17 |
| Week 26 (175) | 5 Apr | |
| Week 27 (182) | 12 Apr | 18 |
| Week 28 (189) | 19 Apr | 19 |
| Week 29 (196) | 26 Apr | 20 |
| Week 30 (203) | 3 May | 21 |

3. NEW Growing Hybrid Birch: Two OneTree K-12 teachers, Chris Pastro (Randy Smith Middle School Extended Learning Program) and Marlene McDermott (Watershed Charter School, Kindergarten) are leading development of a new component of the K-20 STEAM Education program. After completing last spring's NRM593, OneTree: From Seed to Tree course (discussed in Q1 and Q2 2013 reports), these two friends and colleagues decided they wanted to germinate and grow hybrid tree x shrub birch seedlings (*Betula neoalaskana* x *B. glandulosa*) as a classroom observation project this year. On Sept. 14, 2013, Ms. McDermott and Ms. Pastro, joined by Tony Pastro and Jan Dawe, made a collecting trip to Smith Lake. Seeds and plant vouchers from six hybrids, two tree birch, and three shrub birch were collected. The seeds will be germinated in November.



Figure STEAM 3. Smith Lake hybrid birch collecting trip. At left: A classic sample of a hybrid birch: this 3-meter tall hybrid has the shrub form and red leaves of its shrub parent (*Betula glandulosa*), but the peeling bark and a leaf shape more reminiscent of its tree parent (*B. neoalaskana*). Second image from left: teachers Marlene McDermott and Chris Pastro examine a hybrid shrub before taking a voucher specimen. Second image from right: a close-up showing the leaf shape of the hybrid. At right: Tony Pastro holds a seed packet to make a voucher of this tagged plant. The seed cones (infructescences) are much larger than those found on shrub birch.

b) “Tapping into Spring” (takes place during fourth quarter of the school year: second half of March through mid-May)

The activity of tapping birch trees for sap each spring brings seasonality and tree physiology alive for K-12 students and adults. Even the toughest middle school students seem to connect to their trees with real gratitude when they run sap for making birch syrup. Sound stewardship makes sense, perhaps for the first time, for many students. They're involved in a reciprocal relationship with the tree and, by extension, with the forest. It comes as no surprise that every school that participated in Tapping into Spring during the 2012-13 school year wants to do so again next spring, and teachers from additional schools are inquiring to see if there's room for them as well.

We learned a number of lessons during the 2013 sap season, which was the latest on record. There are considerable challenges when the sap begins to run only 2-3 weeks before the end of the school year. Thanks to our teachers' dedication to the task, sap collection continued

through the last week of classes, and students were able to boil at least some of the sap they'd collected into syrup. The rest was frozen at the university over the summer. It will be used for training purposes this year.

The popularity of Tapping into Spring, coupled with difficulties that backyard syrup-makers face when trying to turn their hobby an income-generating venture, have prompted BAKLAP to invest time and money into improving sap processing methods as part of our Year 2 work plan. Tappers (called 'sapsuckers' in the trade) agree that the primary hindrances to producing high-quality birch syrup and developing a stronger birch sap industry in Alaska are 1) the high cost of fuel oil to process sap and 2) the near-certainty of scorching sap and creating bitter syrup when the sap is boiled over direct heat. We are taking steps to circumvent these problems by moving away from using #2 fuel oil as our sap evaporator's fuel source next spring. Instead, we are having a special pan made to use excess steam from the UAF steam plant as the evaporator's fuel source. We are also planning to build a DIY reverse osmosis unit to concentrate sap before it goes into the evaporator, thus reducing overall boiling time. *(For more information about these developments, please see entry *Tricia Kent – M.S. student: Birch Sap Evaporator Update in the Legislative Field Investigation and Report section of this report.)*

c) Special projects created collaboratively by classrooms and K-20 STEAM Education personnel: Focus on Model Collaborative Instructional Design Projects

These customized projects cover a wide range of topics, from units exploring the effects of different kinds of light on plant growth, to manufacturing knitting needles and chopsticks and marketing plans for selling them.

The most ambitious project to date is Watershed Charter School's Interactive Mural, started by Moira O'Malley, 1st-2nd grade teacher at the school, and carried forward by her intern, Laura Cartier, Klara Maisch, and Zac Meyers. Work on the mural itself began in earnest in April-May 2013. The overwhelming response to its creation led to significant and very rapid developments. First, Maisch, Meyers, and Cartier formed a consulting group, Interactive Media STEAM Studio. Then, thanks in part to the re-budget of the BAKLAP budget made possible by the quick work of DNR's Division of Forestry Business Office and UAF's Office of Grants and Contracts Administration, the team was able to attend and present at a prestigious international conference: EVA (Electronic Visualization and the Arts) 2013 held in London, England at the end of July. In August, additional work on the mural and associated classroom visits began. Details on these developments follow.

1. WATERSHED CHARTER SCHOOL INTERACTIVE MURAL



Figure STEAM 4. Watershed's Interactive Mural taken on July 3rd 2013.

Summer Art Club and Watershed's Interactive Mural Progress

The canvas for Watershed's Interactive Mural was completed over the summer through hundreds of volunteer hours donated by Klara Maisch, Zachary Meyers, and Laura Cartier. Approximately 45 Watershed students ranging from 1st grade to 8th grade had participated during the school year by blocking colors and adding textures and details. Students were invited to continue the work through the summer via an art club, arranged by Laura Cartier. The summer art club had a dozen students ranging from 1st to 6th grade. Each student played an integral role in the completion of the 8ft X 40ft canvas by suggesting content ideas, creating original art pieces, and adding finishing details. The original art works will be digitally integrated into the mural through augmented reality. The estimated cost thus far is approximately \$10,000 with the majority of the cost covering Klara Maisch and Zachary Meyers' salaries. Five different funding entities have contributed to the project including Delta Kappa Gamma Theta, Watershed PTA, Fairbanks Arts Association (Artist-In-The-School Program) BAKLAP, and Boreal House Art and Science Center. This integrative project has been a true collaboration amongst all the contributors.



Figure STEAM 5. Original artwork from the students of the summer art club. interactive mural at Watershed Charter

Future Plans for Watershed's Interactive Mural

On September 16th Klara Maisch and Zachary Meyers met with John Carlson (Watershed principal) and Moira O'Malley (Watershed 1st/2nd Teacher) to discuss future plans and development of the mural. Maisch expressed interest in adding additional animals and plants to the mural including, a porcupine, rose bush, fireweed, and highbush cranberry; Carlson and O'Malley loved the idea. The second phase of the project will include content integration. The mural was designed to reflect the place-based content that Watershed Charter School fully embraces. The team is now in the initial phase(s) of collecting content ideas from individual teachers and integrating them in the mural through augmented reality (AR). This will allow students to independently explore the wall and learn about aspects of ecology, plant identification, and salmon lifecycle. Reference materials will be overlaid so students can delve deeper into particular content areas. Maisch and Meyers have also begun to develop integrated activities that use the mural independently of any technology so that the teachers have the option of whether or not to use AR. This was a concern brought up in the meeting with O'Malley and Carlson. Discussions of holding an open house were also brought up during the planning meeting. A First Friday event has subsequently been scheduled for December.

Classroom Visits

Maisch and Meyers will begin to model integrated mural activities with K-2 classrooms this fall/winter. Because of the age of the students, these classrooms are less likely to use AR with their curriculum. Thus, the focus will be on activities that use tactile hand-on comparisons with the mural and the surrounding environment. Lesson plans will be developed concurrently with teachers and tested in the classroom throughout the year. Teachers will be encouraged to develop customizable content with their classroom and the mural. Maisch and Meyers will support the teachers and help cultivate their ideas and address any concerns.



Figure STEAM 6. A Watershed student observing frozen dew on the leaves she collected

Marlene McDermott, Kindergarten – Klara Maisch and Zachary Meyers have visited Marlene McDermott’s kindergarten classroom twice this fall. Both lessons focused on comparing the stylized features of the mural to

the natural surroundings outside the school. To take advantage of the prolonged fall season we decided to concentrate on leaf shapes and plant identification. During the first visit we introduced ourselves to the class and asked exploratory questions about seasonality and plant identification. An interactive I-SPY activity was developed to see which plants, animals, and objects the kindergartens could find on the mural. Students then went on a leaf scavenger hunt to

see how many different shaped leaves they could find.

During the second classroom visit, the students compared the leaves they’d gathered earlier to the mural to determine which plant species were present and which were absent. Maisch and Meyers had the students closely observe the colors of the leaves and draw as much detail as they could. Maisch demonstrated different blending techniques using crayons, which got the students really excited. The work will continue with the kindergarteners this fall, and begin with 1st and 2nd graders in the coming months.



Figure STEAM 7. Detailed leaf drawings from Watershed Charter school kindergarteners in Marlene McDermott’s class.

2. EFFIE KOKRINE CHARTER SCHOOL

(A SENSE OF PLACE: A STUDENTS PERSPECTIVE)

This project will target middle school students from four classrooms at Effie Kokrine Early College Charter School. Students in each classroom will be asked to personally explore a sense of place, starting with a traditional place-based narrative. Students will choose topics and areas of content to explore based upon the events within the traditional place-based narrative. Each exploration will have a tangible project associated with it to serve as an anchor for the content

encountered in the story. The teaching is meant to be fluid so the students can maximize the learning experience and link it back to the story in a place-based context. Zachary Meyers and Klara Maisch will lead in the development and implementation of supplemental classroom activities and work in collaboration with the teachers to reinforce classroom content. These activities will incorporate science, art, and technology (old and new) to engage a broad student body and build novel skills. Local elders around Fairbanks will be invited to speak with each classroom to provide context of the narratives. Meyers and Maisch will spend a minimum of three weeks in each class, from September through December of 2013. The last week of class will focus on content integrations in relation to the traditional place-based narrative. A suite of tools (i.e. interactive books, digital quilts, object based media) will be used to tie the classrooms' explorations to the story. The culminating digital work will be housed and accessible through a website which will serve as a portal for sharing content.

An introductory and planning meeting with Zachary Meyers, Klara Maisch, Jan Dawe, Cassie Thacker, Sheryl Meierotto, Sarah States and Alicia Kangas was held on August 13th. Teachers were enthusiastic about incorporating elements from a traditional story and having students explore place-based topics in depth. Teachers will be responsible for choosing the place-based narrative(s) based on their students' overall interests. OneTree Alaska, in collaboration with MapTEACH, IMSS, the Alaska Native Language Center and Alaska Native Language Archive, will lead the project.

Sheryl Meierotto, 8th – Maisch and Meyers have begun developing modulated lessons that weave place-based topics with strands of art and science. A total of four two-hour sessions have been completed to date. Activities ranged from botanical drawings and anatomy of leaves, writing haikus, mental maps. Students have recently started their final project by constructing an altered book. A presentation by Howard Luke is scheduled to replace the traditional narrative, however time and place are still being negotiated. As a result, Maisch and Meyers have begun to modify the overall product design to accommodate a broader "sense of place" by incorporating observational skills, botanical terminology, and introspective thinking with the students. The final product will use altered books to convey personal narratives with the students.



Figure STEAM 8. Students in Mrs. Meierotto's 8th grade class begin to develop their altered books about place.

**Boreal Alaska – Learning, Adaptation, Production (BAKLAP) Quarterly Report
2013 Quarter #3
(July 1, 2013 – September 30, 2013)**

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1) Deliverable 1.4: Forest Entrepreneur Camp (FORENCA)

BAKLAP's Year 1 Forest Entrepreneur 'Camp' was described in the Quarter 2 2013 report (see entry under "Chris Pastro/7th-8th Grade, Extended Learning Program, Literary Arts, and Home Consumer Science Teacher, Randy Smith Middle School"). In that end-of-school-year project, Chris Pastro invited Birch Pavelsky, a local carpenter working with the K-20 STEAM Education team, to come into her classroom over a ten-day period and help her students turn round birch firewood lengths into finished knitting needles, chopsticks and hair chops. The students learned about materials science, product design, and engineering by turning square stock into knitting needles, chopsticks and hair chops on a Stanley 77 tenon and dowel maker. Each piece of stock was measured and weighed as it proceeded through the manufacturing process, to estimate moisture loss and waste. The students' pride in having made something useful and aesthetically pleasing (in time for Mother's Day!) was palpable. This experience convinced the K-20 STEAM Team that these kinds of immersive projects, which we call forest entrepreneur 'camp,' could be an important part of the K-12 experience; offering project-based, authentic research into product design and manufacturing.



Figure STEAM 9. Chris Pastro helps student weigh and measure square stock to be turned into knitting needles (left); Birch Pavelsky helps the student finish shaping the tip of the knitting needle. Photo credit: Nancy Tarnai/SNRAS.

During the summer, word that the K-12 STEAM Education Team was interested in salvage trees, especially exotic woods, spread and allowed us to obtain new materials for the project. Birch Pavelsky worked with samples of wood from one of the oldest chokecherry trees in downtown Fairbanks, as well as crabapple boles cut after their useful life was over as grafting platforms for apple varieties on the Georgeson Botanical Garden. He found that apple wood

turns even more easily than birch in the Stanley dowel maker, producing an exceptionally smooth, clean knitting needle; whereas the variably-colored chokecherry will be set aside to provide covers for artist ‘fitch’ books in upcoming STEAM K-12 professional development courses.



Figure STEAM 10. Facilities Services creates the University Park Forest Education Outreach Center on University Ave. near campus. On left: excavating the trench, Center: building transplant beds; on right: the finished 18’x4’x4’ trench, ready to receive overwintering tree seedlings and insulated cover.

NEW Throughout September, the Facilities Services Grounds and Labor group, led by Darrin (Bear) Edson, helped develop the area behind University Park Building on University Avenue as a forest education outreach center. Three 75-foot long transplant beds were created to provide summer growing space for seedlings grown in classrooms, before they are planted out in community service learning projects. A four-foot-deep, minimally insulated, covered trench was dug to overwinter seedlings being used in science experiments, and a 10’x12’ shed was re-connected to electricity and made available for K-20 STEAM Education woodcutting activities. A space request was submitted in early September for a storage room in University Park Building. If granted, it will provide ample space for the plant materials (milled wood, birch bark, boxes of inner bark, seeds) that are the foundation of OneTree’s entrepreneurial projects. We are already reaping the benefits of the University Park Forest Education Outreach Center as a foundation for program “maker activities,” a field trip destination for K-12 schools, and collaborative space between the University’s and other agencies’ forest education programs (Cooperative Extension Service and Division of Forestry’s Project Learning Tree, Fairbanks Soil and Water Conservation’s “Focus on Forests” in Fairbanks).

2) Deliverable 2.2: K-12 Teacher Professional Development Courses (K-12 PD)

Field Sketching and Observation, co-taught by Karen Stomberg (artist) and Jan Dawe (botanist) gave participants (teachers, community members, and graduate students) opportunities to work closely with a single tree in the T-field Generation One Tree Long-term Monitoring Plot from May through August. Twelve participants studied progeny of NR8, the oldest maternal tree harvested from Nenana Ridge in 2009. NR8's oldest visible ring dates to 184. Our thanks to the Tree Ring Lab and Dr. Glenn Juday for providing that information. (For more information about the class, see entry *Karen Stomberg – FNSBSD Art Center Coordinator: The role of the Arts in STEM Education in the Legislative Field Investigation and Report section of this report.)



Figure STEAM 11. Four views of NR 8-4 (3-month age cohort) during the 2013 growing season: on far left—tree diagram drawn on June 1, 2nd from left—the tree as it appeared on the same day (June 1), 2nd from right, the tree on June 13 (note the greater number of leaves), on far right, the tree as it appeared July 10. Note the changes in the height of the sapling relative to the flags surrounding it over the time series. All images by Susan Logue.

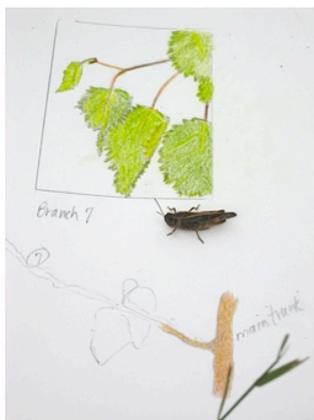


Figure STEAM 12. *The grasshopper that landed on Sue Logue's sketchbook and then crawled onto her drawing of birch leaves attests to how life-like her sketches were!*

*** Timeline and short reports: travel, training, workshops, and special guests**

July 17-18: “*Science: Becoming the Messenger*” — Dawe attended NSF EPSCoR’s two-day communication skills-building workshop. Day One equipped the 100+ attendees with fundamental skills needed to plan, create, and execute effective communications. Sessions covered topics from how to design and deliver convincing messages, to how to apply this knowledge using diverse communications platforms (presentations, videos, and blogs). Dawe was one of 20 attendees invited back for Day Two, which featured in-depth hands-on work with the workshop’s three nationally prominent communication experts.

July 19-21: Talkeetna Birch Festival — Dawe gave an invited presentation “History and Biogeography of Alaska White Birch.” The Festival, sponsored by the Northern Susitna Institute, featured art and science presentations, tours of the Susitna forest and Kahiltna BirchWorks, and an exhibition of products made from Alaska white birch. The event originated as a result of Karen and Arthur Mannix’s work with OneTree Alaska and Week in the Woods Family Camp in summer 2010. Subsequently, Mrs. Mannix led a yearlong OneTree project at Susitna Elementary School and participated in a K-12 professional development course led by Dawe during the 2010-11 school year. A highlight of the Talkeetna Birch Festival was an evening of original song, dance, and story-telling related to Alaska white birch. The evening demonstrated the significant and diverse talent of the Talkeetna community.

July 29-31: EVA 2013 Conference — Klara Maisch, Zachary Meyers, and Laura Cartier had the opportunity to attend an international conference in London, EVA (Electronic Visualization and the Arts) 2013. Boreal House Arts and Science Center and BAKLAP contributed significant funding to travel and registration. This was an opportunity to share the work that the team had done on the Watershed Charter School Interactive Mural, as well as learn new methodologies and technologies to enhance the project and spark new ideas. (*See Appendix entry “EVA 2013” for more information.*)

August 1: Special Guest Lissy Goralnik, a post-doctoral scholar at Oregon State University, met with the Field Sketching and Observation class in the T-field. Dr. Goralnik is conducting research about the impact of arts and humanities projects connected to the National Science Foundation’s Long-Term Ecological Research Network. She also has experience as an informal K-12 educator. From the SNRAS blogspot covering Dr. Goralnik’s visit to Fairbanks: “After visiting with OneTree collaborators, Goralnik said, “The program feels thoughtful, thorough, and also fun, which is so very important when working with learners of all ages. In my mind, the best education happens in relationship: teacher-student, student-student, student-content, teacher-ideas, and learning community-wider community (inclusive of the natural world). The community building aspects of the program foster this kind of learning environment. As well, the passion of the educators involved nurtures this environment and also serves to inspire wonder. When teachers model curiosity and care for the content students get to feed off this energy and approach their own learning with openness and curiosity, too.”



Figure STEAM 13. Lissy Goralnik (front row left) visited with several OneTree collaborators in Fairbanks. Photo Credit: Nancy Tarnai/SNRAS.

August 6: UAF Day at the Tanana Valley — BAKLAP K-20 STEAM Team members, Diane Hunt and Trish Kent, hosted an interactive OneTree Alaska booth as part of the School of Natural Resources and Agricultural Sciences presence at the fair.

August 13: Special guest John Zasada, retired USFS silviculture researcher, visited the T-field with Dawe to look at seedling growth, tree architecture, and special features and give input about the best opportunities for citizen science training and research. After seeing the range of opportunities presented by the seedlings, Dr. Zasada recommended community work in the T-field focus on documenting the evolution of birchbark structure (about 10% of the seedlings have begun peeling over the past year). Dr. Zasada's reasoning: it's a feature that not's been documented in the literature as far as he knows, white birch's peeling outer bark is 'iconic' and something K-12 teachers, students, and community members could readily study.

September 3-7: Oregon State University visit by Zac Meyers, Instructional Designer — Meyers' trip focused on cultivating and strengthening relationships between the University of Alaska Fairbanks and Oregon State University personnel through collaborating on aspects of OSU's "Discovery Trail." Contacts were made via the Cooperative Extension Service to provide opportunities for future program exchanges and to learn about existing infrastructure/partnerships throughout the Northwest Pacific.

Discovery Trail: On September the 4th 2013, Zachary Meyers met with Dr. Lissy Goralnik to discuss the goals and objectives of developing a networked trail system in Andrews Experimental Forest. Goralnik has a deep and diverse education background in environmental ethics and qualitative assessment. She and her advisor Dr. Michael Nelson hope to conduct

research on environmental ethics and empathy through the use of a digital mediated experience on the “Discovery Trail”. The project is still in its infancy but as lead PI to this current funding cycle, Dr. Nelson is striving to bring arts and the humanities to the LTER at Andrews Experimental Forest. Nelson and Goralnik make the argument that in order for a sustainable environment to be achieved it is essential that “we” determine our role in “place”. The following day, Meyers met with Mark Schulze, the Forest Director at Andrews Experimental Forest. Schulze took Goralnik and Meyers on a tour of the “Discovery Trail” and described the current status of the WiFi network on the trail. Several large standing trees have relays to extend coverage and testing is underway. Schulze hopes to minimize impact on the trail system while simultaneously providing guests with an enriched experience about current research at the Andrew Experimental Forest. A meeting in October is scheduled with all co-PIs and personnel to discuss design and implementation of the project.

Oregon Master Naturalist Program: This new non-degree certification program is offered as an online course for individuals interested in Oregon ecology. A background module on Oregon’s natural/cultural history, watershed, landscape, and climate change is offered alongside complimentary courses of specific ecoregions within the state. Once students complete the online coursework, they are expected to volunteer 40 hours with a program in one of four areas including natural resource interpretation, citizen science, land stewardship or program support. The primary demographic of students enrolled in the program range from young professional to retirees. On September 6th, 2013 Meyers met with Jason O’Brien to discuss details of the program’s content and its model of implementation. Discussion points included possible future collaborations with exchange programs whose theme center on the Northwest Pacific and Arctic biomes.

September 30: Art Teacher In-Service Presentation — Maisch and Meyers were invited by Karen Stomberg, the district wide art teacher for the Fairbanks North Star Borough to give a presentation about the Watershed Charter School’s Interactive Mural. The 15 teachers in attendance had questions about mural technology, process, and applicability to the classroom. The presentation was informal and provoked a lively conversation among the teachers, including discussion of future classroom projects. The teachers were impressed by how much Maisch and Meyers had been able to accomplish in a short amount of time and thanked them for taking the time to make the in-service presentation.

*** Project Sustainability: New and revised proposals**

During third quarter 2013, a revised work plan to allow intensive work at Effie Kokrine Early College Charter School was submitted and approved for Dawe and Meyers’ 2013 Alaska EPSCoR Native Engagement Award. In addition, a proposal to the USFS 2013 Competitive Allocation Request was submitted in September, to be led collaboratively by Project Learning

Tree and OneTree Alaska. (*See the Appendix entries a) 2013 Alaska EPSCoR Native Engagement Award: REVISED Scope of Work and b) Proposal to the US Forest Service 2013 Competitive Allocation Request for more details.*)

*** Legislative Field Investigation and Report, September 20, 2013**

K-20 STEAM Education Reports: BAKLAP team and partners

Jan Dawe – Research Assistant Professor of Natural Resource Management Education and Outreach, and Co-PI of BAKLAP: Introduction to K-20 STEAM Education



Figure STEAM 14. Dawe shows products made from the original OneTree (Cache Creek #1) including wool dyed with inner bark, a Finnish hunting knife made from wood, bark 'washers,' moose bone and stainless steel; a turned wooden bowl, and woven birchbark basket.

Dawe stated the project's philosophy as an introduction to eight BAKLAP K-20 STEAM Education Team presentations to area legislators and university leadership:

K-12 children are budding scientists, artists, technologists, and musicians, capable of entering these worlds by virtue of their innate curiosity, powers of observation, and developing intellects.

K-12 teachers are individuals trained to help each student bring his/her unique self and potential forward.

BAKLAP's K-20 STEAM Education program, using OneTree Alaska as its model, supports children and teachers in this important work. The local boreal forest serves as a springboard for inquiry-based learning, as both a canvas and an outdoor laboratory.

The program strives to engage children, connect them to their forest home, and develop inquiry habits of mind so that youth become life-long learners, critical thinkers and makers, and exquisite expressers. These attributes lie at the heart of a vibrant, well-

informed, and civil society and the program's work promotes its foundation: one child—

one tree at a time.

Karen Stomberg – FNSBSD Art Center Coordinator: The role of the Arts in STEM Education

Over the past four years of her work with OneTree and BAKLAP, Karen Stomberg has developed a successful approach to offering STEAM (Science, Technology, Engineering, Art, Math) intensive workshops for all age groups: K-12 classrooms, teacher professional development short courses, summer community immersion classes, and OLLI (Osher Life-Long Learning) The workshops apply to two deliverables: Deliverable 1.3: K-20 Curriculum Development (STEM to STEAM) and Deliverable 2.2: K-12 Teacher Professional Development Courses (K-12 PD). The following pages show, in reverse order—from most recent to the earliest efforts—the development of this approach. A STEAM committee meets weekly to plan activities. (*Please see the Appendix for the STEAM 2014 announcement, currently being reviewed by the Alaska Arts Education Consortium for funding.*)

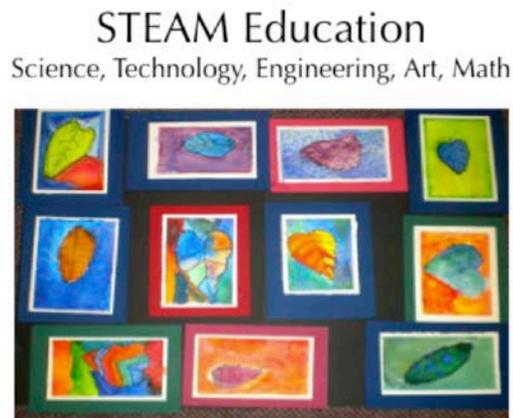


Figure STEAM 15. Birch leaves painted by fourth graders who grew trees from seeds, then measured, observed and recorded data about their growth in journals.

Field Sketching and Observation Class Summer 2013



Figure STEAM 16. Field-sketching and observation course (May-August 2013).

Some of the FNSBSD Teachers and UAF graduate students who participated in the spring one-credit course (NRM593) called from One Tree: From Seed to Tree were joined by community members in a summer-long course called Field Sketching and Observation.

They used the Grinnell method of recording data and recording observations in field sketchbooks—with words and illustrations. Drawing and color theory sessions augmented their skills as recorders of change and closer observation led to inquiry, which deepened scientific understanding.

Each participant adopted a young birch tree from the T Field study plot, as their own, to watch draw and learn from over a three month growth period. They began with a meticulous scientific diagram of the structure of their tree and also completed meticulous color renderings of leaves and branching junctures.



From Seed to
Tree Course
Spring 2013

Figure STEAM 17. Participants in UAF course NRM 593, Spring semester, 2013.

Participants in the semester-long K-12 professional development course, NRM 593: “OneTree: From Seed to Tree” learn drawing techniques with the help of a frame to focus their attention on a confined area of the tree. The course also provided training in using the Grinnell System of Nature Journaling: a protocol the teachers and service learners have since adopted and adapted as appropriate for their use.



Art Kit: Birch Dioramas-one of eight birch art/science kits developed by FNSBSD

The eight kits developed by FNSBSD art specialists about *Betula neoalaskana* have been taught to every student Pre-K through grade six in the district. These kits are now in the District Art Kit library and circulate to teachers for use in their classrooms.

STEAM Institute: Illustrated Botanical Books

TRAILWALK Summer 2012



Professional Development and Workshops in heterogeneous learning communities



Observing, recording, drawing--learning scientific and artistic processes.

Artist Margo Klass with FNSBSD teacher, Osher Lifelong Learning workshop participant, UAF graduate student.

Chris Pastro, Randy Smith Middle School Extended Learning Program: STEAM in the classroom

The following are some of the main points I tried to outline when I presented to the legislators:

1. Connection to Scientists in the

Classroom: Scientists in the classroom give students a "real person" to have as a science mentor. They see that they are real people-- that they don't always wear lab coats. This is such a positive connection for students.

2. Hands-on Authentic Science: Having OneTree and the BAKLAP scientists and graduate students in the classroom helped students bring the inquiry method to life. It is kid centered and authentic. They understand controls, variables, hypotheses, data analysis, and more! It is hands-on and they are in charge of their own learning!



Figure STEAM 18. Middle school student (left) and Jan Dawe (right) observe winter bud formation in actively growing Alaska white birch seedling. Photo credit: Nancy Tarnai/SNRAS.



Figure STEAM 19. Artist books created in Chris Pastro's Extended Learning Program and Literary Arts classes. Photo: Nov. 5, 2010 J Wagner/News-Miner

4. Connections to UAF: Each time the university works with our students, they have a stronger connection with UAF. The field trip to the greenhouses put them on campus; the sap collection put them on campus. UAF becomes real to them, and it brings their understanding of UAF research and education "up close" and personal!

3. Art & Creativity: The book making, the scarves, the birch anatomy, chopsticks and knitting needles were all science based, but students were able to be creative. I love to see students make their own choices and decisions that impact their product designs.



Figure STEAM 20. Chris Pastro (left) and Margo Klass (right) assist student attach pages to covers of his book. Photo credit: Nov. 5, 2010. John Wagner/News-Miner

Birch Pavelsky, Woodworker: Manufacturing Knitting Needles—Inspiring Entrepreneurs



Figure STEAM 21. Chris Pastro and Birch Pavelsky introduce knitting needle project to students (left); Birch cuts flitches from round log (center), and then cuts flitches into square stock (right) to be turned.

How can schools prepare secondary students for jobs as entrepreneurs? What skills do entrepreneurs need to develop early on? What kinds of analysis are required in turning a raw material into a finished, marketable product? This is a sample of questions OneTree Alaska brings to Fairbanks schools.

I work with OneTree in local schools and in May 2013 demonstrated one approach to forest-to-shop training at a local middle school. The workshop included 75 students in several classrooms, and was one week long. In September 2013 I demonstrated to a group of local legislators and staff the same process I had used in the school workshop.

I explained what OneTree's goals were, and then showed them a section of a local birch log that was chosen for straightness and lack of branch scars (chosen to avoid cross grain weakening). Then I split (cleaved) the log to show how grain can be helical or straight, straight being preferred for needle strength. The product we aimed for at our school was knitting needles.

When a straight-grained log was found, I cut a flitch from it ($5/16$ " x about 3"). From the flitch, a piece of square stock $5/16$ " x $5/16$ " x 14". The square stock had one end sharpened in a pencil sharpener, then put through a Stanley #77 dowel maker (hand-cranked). This was then sanded using a German-made horizontally mounted, hand-cranked drill. The sharp end was further shaped and, when the 1" square end was shaped, the needle was done. Some children were interested in putting a very fine finish on their needles, and I provided a sanding sealer that was wiped on, allowed to dry, then sanded with 600-grit paper.

The resulting products were not all of marketable grade. But the children were shown basic quality-control processes and the kind of art/science thinking that lies behind a solid product. The children were excited about presenting their needles as Mothers' Day gifts.



Figure STEAM 22. Seventh grade student turns square stock into round shaft of knitting needle (left); trims the square end (center) and sands his finished needle (right). Photo credit: Nancy Tarnai/SNRAS.

Carri Forbes – Tanana Middle School science teacher: Tanana Middle School Service Learning Project

My name is Carri Forbes and I am a 7th grade science teacher at Tanana Middle School. Last year the OneTree staff was able to come into my classroom and inspire my students to do real science. Because of this collaboration my students were able to design experiments using local birch seedlings in the classroom. They were given the opportunity to come work in the greenhouse at UAF helping to transplant trees that had been grown in classrooms. The program not only taught my students but also taught me how to tap birch trees for their sap and process it into syrup.



Figure STEAM 23. Carri Forbes displays birch sap harvest from two trees on UAF campus, mid-May 2013.

Throughout my experience with the OneTree program last school year I was inspired to see how much I could get my students involved in community efforts that included research and ownership by the students. I set out to create service learners that represented Tanana Middle School and Fairbanks, Alaska. In addition our school has adopted a tree friendly theme this year “Growing Bright Futures”. Due to the high number of Military students that attend Tanana Middle School I feel it is important not only to teach them about our local ecosystems but also to help them to explore and become part of it.

To do this I have started a project this year with the help of OneTree and a State Farm grant that will allow my students to grow seedlings from local seeds that they collect into trees that could be planted at Birch Hill in efforts to help with reestablishing the old ski trails that are no longer being used due to the installation of the new international standard trails. The new trails have been developed first for the Junior Nordic Ski Olympic qualifiers that were held last year and for the Arctic Winter Games that will be held in Fairbanks this winter.

We will also work in conjunction with OneTree to grow seedlings from known mother trees. The seedlings will be planted in different patterns: siblings from the same mother tree in one pot vs. non-related seedlings (from two different mother trees) in another plot. The students will be testing cooperation vs. competition between seedlings. This is known as the "Does Family Matter?" experiment. It will be an ideal project to show the importance of replication and the scientific process to students.

In order to make the most of this year I have been and will continue to work closely with the OneTree staff and I am on my way this weekend to a training session in Phoenix, Arizona that is part of my State Farm Grant in order to develop the best Tanana Middle School service learners possible.

I am excited to also be bringing in one of my colleagues at Tanana and his students to these projects. I have encouraged this addition so that every one of the approximately 250 7th grade science students at Tanana this year will be included in “Does Family Matter?” experience. This experience has and will continue to provide students with useful job skills such as collaboration, problem solving, and good old fashioned hard work, just to mention a few. Service learning to me needs to be sustainable and reachable and the more ideas on the table and people on the ground the further the efforts will go.

Tricia Kent – M.S. student: Birch Sap Evaporator Update

In July I visited three venues—Leader Evaporator Company, CDL, and a syrup maker in Franklin County Vermont—to collect information about creating a steam-powered birch sap evaporator. Leader Evaporator confirmed that they fabricate pans and parts in house, but CDL has no experience working with steam. CDL passed along the contact information of Harold Torre, a retired engineer who is now a syrup maker among other things. Torre uses steam to make his sap and showed me his design, emphasizing that it is simple and makes excellent-quality syrup. He uses copper tubing radiators that are placed directly into the sap. He generates his own steam using a boiler, but believes that we could easily harvest steam from the power plant and create a similar system in order to make syrup.



Figure STEAM 24. Harold Torre in front of his boiler. Franklin County, VT.



Figure STEAM 25. Torre's radiator design that is used to pipe steam through sap.

Upon returning to Fairbanks, I shared this new information with UAF's Facilities Services, suggested as a possible source of support for fabrication. After several meetings with Facilities Services staff to discuss possibilities for radiator design and evaporator location, it was decided that Facilities Services employees could not fabricate a radiator in house due to lack of

equipment and expertise. It was also determined that the evaporator would need to be located at the UAF power plant because 80 – 100 lbs of steam would be needed for syrup making, and the utiliduct to our preferred location (University Park Building on University Avenue) can only transport 15-20 lbs of steam. Leader Evaporator located in Swanton, VT was contacted to discuss to possibility of having the evaporator made there. Leader has made dozens of steam radiators and is a reliable choice for a manufacturer. Prices and shipping options are currently being discussed.

Additionally, we are planning to build a reverse osmosis (RO) unit to use in the syrup making process. Reverse osmosis is standard practice with syrup makers because it reduces the time and energy needed for evaporation by reducing the water content of sap prior to boiling. Prices have been investigated for parts for a homemade RO unit.

Zachary Meyers – SNRAS Instructional Designer and Klara Maisch – Artist: Watershed Charter School’s Interactive Mural

On September 20th 2013, Klara Maisch and Zachary Meyers presented to local Fairbanks legislators about the Watershed Interactive Mural Project implemented in May. Maisch and Meyers emphasized the collaborative effort from BAKLAP, Fairbanks Art Association, and Watershed Charter School. Moira O’Malley and Laura Cartier were the people who initiated the idea and invited participation from Meyers and Maisch. The idea of having an interactive wall to teach place-based education that houses various elements of each classroom’s curriculum is a novel idea that impressed many in the September 20th audience. Another point that was brought home was the total cost of the mural. Maisch and Meyers estimated that it cost \$10,000 with hundreds of volunteer hours donated by students, teachers, and staff. Many legislators requested additional information about the overall process, funding sources, and wanted to know when they could view the functional work of art. After the meeting, legislators and aides came up to Maisch and Meyers to congratulate them on the work.



Figure STEAM 26. The Watershed Interactive Mural presented at the Legislative Field Investigation and Report as well as the Art Teacher in

Margo Klass –Visual Artist and UAF Instructor, Curator: Science–Art Exhibitions

One of the goals of BAKLAP is to promote the integration of science and art in the context of learning and engagement of communities. Our efforts in this area build upon some previous experience. The exhibition *Betula neolaskana: Celebrating OneTree* took place in April 2011 at the Well Street Art Co. gallery. A large community was already involved in the OneTree project – students, teachers, artists – everyone was welcome. Material from the birch tree CC1 was distributed – logs, cross sections, twigs, inner bark, outer bark, pieces large and small. Over the next several months artists and craftspeople created art for the OneTree exhibition. On in-take day a wide variety of works arrived for exhibition. The resulting one-month show had high attendance and was extremely well received.



Figure STEAM 27. *Betula neolaskana: Celebrating OneTree* exhibited a wide variety of responses to working with birch material from CC1. Artists and craftspeople responded to the charge: “Get to know this material,” “See its beauty,” “Create!” The show included prints, paintings, sculptures, artist books, hangings, wearing apparel, and functional pieces such as furniture and storage boxes.



Figure STEAM 28. *A companion exhibition of student work was shown at the Morris Thompson Center. This included examples of student science and art projects. Hands-on activities were featured at the shows opening.*

Since 2011 so much has happened within the BAKLAP community, it is time to propose another exhibition, this one involving an even wider community and a greater range of responses. *Our Boreal Forest: Observing, Interpreting, Communicating* is the working title of a show that will be proposed to the Fairbanks Arts Association at its portfolio review for shows to be scheduled in 2015.

Our goals for this show have expanded too. We will be looking for the art, craftsmanship, and imagination of the artists and craftspeople, but the curatorial committee wants to create an exhibition infused with science and where the viewer becomes participant. Some examples of how this can be done (using works from the 2011 show):



Figure STEAM 29. Woven birch bark display from 2011 exhibition.
From the exhibition, Betula neoalaskana: Celebrating OneTree.

1. Hands-on activities: offer viewers opportunities to work with materials used by artist in creating works in the show. For example, viewers can try their hands at weaving pre-cut strips of birch and take home a sample of a simple weave.



Figure STEAM 30. Birch bark vessel, from 2011 exhibition.
From the exhibition, Betula neoalaskana: Celebrating OneTree.

2. Augmented reality: with embedded codes within the display the viewer can use a digital device (e.g., iPhone) to see a short video about preparation of the bark and formation of the vessel.



Figure STEAM 31. Artist book made of shelf mushrooms and handmade paper. From the exhibition, *Betula neoalaskana: Celebrating OneTree*.

3. Writing activity: offer viewers an opportunity to imagine what kind of writing is on the pages of this artist book and to write a poem of one's own for the book.
Augmented reality: offer information of why shelf mushrooms occur; offer one to handle.



Figure STEAM 32. Artist book made from cross-section of birch; embellished with scientific notations. From the exhibition, *Betula neoalaskana: Celebrating OneTree*.

4. Augmented reality: offer viewers scientific explanations of what the material is, how to understand it, and what the notations mean.

These are ambitious ideas. They are being incorporated now in science and art museums all over the country. We look forward to the challenge of putting them to work here with the philosophy of making an exhibition that is "NOT SO MUCH A DESTINATION BUT A TRAILHEAD."

APPENDIX

Supplemental K-20 STEAM Education documents

Sample OneTree Program Teacher Evaluation 2013

“Plants with Family Values” (a NOVA and the World news brief)

EVA 2013

2013 Alaska EPSCoR Native Engagement Award: Revised Scope of Work

Proposal to US Forest Service 2013 Competitive Allocation Request

Fairbanks STEAM Institute 2014 (preliminary announcement)

0



Sample OneTree K-12 Teacher Evaluation 2013

May 10, 2013

Please tell us: what was the best part of this program?

Having Andrew and Celia interacting with my students was great. The kids were excited!

What was the most challenging part?

It really was all quite straight forward. I did have a bit of difficulty getting the thermometer to register in a room.

Please tell a story where you saw this program make a difference for a student(s).

My students see me every day, this program gave them an opportunity to have two other adults listen to their opinions. This is a big deal to young people and I appreciate Andrew and Celia listening and engaging my students.

Did you see students excel in the subjects that OneTree delivered? Did they retain the concepts taught? Please give an example.

Yes, during our 'cookie' activity the kids were able to tell me what the layers meant and how to count the age of the tree.

Are you interested in being part of the program next year?

Yes, definitely. It would be great for my returning kids to see how next year's collection differs, or not, from this years.

Your name: (optional): Marcy Kuntz

Please circle which parts of the year you were involved with OneTree:

Fall 2012

(Spring 2013)

All Year

“Plants with Family Values” (a NOVA and the World news brief)

- By Anna Rothschild
- Posted 04.11.13
- NOVA <http://www.pbs.org/wgbh/nova/nature/plant-family-values.html>

When people say, "It's a jungle out there," they generally mean that the world can be cold and heartless. Yet it turns out that a literal jungle may not be so uncaring after all. A team of Canadian scientists has found that some plants recognize close relatives and help them.

The greenhouse at McMaster University in Hamilton, Ontario, teems with life. Banana trees, bamboo, and cacao (the source of chocolate) fill the lush tropical room.

It's a scene of fierce competition. Leaves, pods, and Technicolor flowers sprout in all directions, fighting for the light.

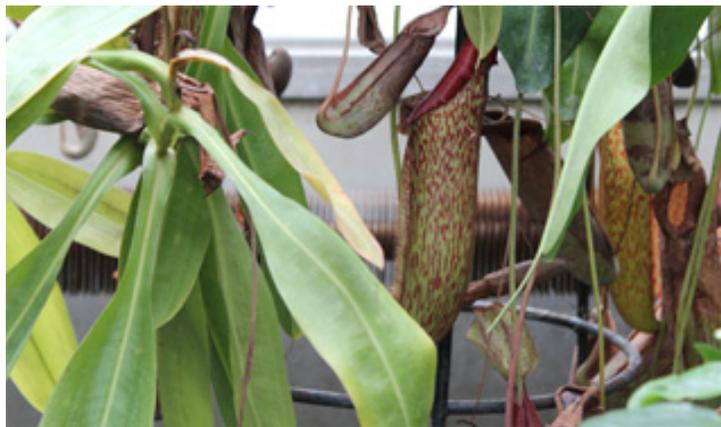


Figure STEAM 32. *The McMaster University greenhouse is home to many tropical plants, including this carnivorous pitcher plant.*

Photo credit: Courtesy Anna Rothschild / WGBH Educational Foundation

"Our view of nature is sometimes that nature is red in tooth and claw—that every organism is out for itself," says biologist Susan Dudley.

But in her laboratory here, Dudley has shown that nature has a softer side. Even plants can embrace family values.

"Friendly" Plants

Dudley and her students have shown that plants can recognize their siblings and give them preferential treatment. In 2007 they tested a hypothesis: that plants from the same mother would compete less for valuable resources (like root space in the soil) than plants that were strangers. To her amazement, Dudley says, "We found exactly what we predicted."

"For a plant to have this fungus associated with the roots kind of gives them super-roots."

In other words, the plants seemed to act altruistically toward their relatives. Now, this doesn't necessarily mean that the plants are being selfless. This altruism is most likely a strategy that evolved to increase the odds that a plant will pass on its genes.

"If your relative does better, then your relative's genes are passed on and you share some of those genes," says Amanda File, one of Dudley's graduate students.



Figure STEAM 33. *McMaster University Biology Professor Susan Dudley (right) and Graduate student Amanda File examine daffodils being grown for a study of plant altruism.*

Photo credit: Courtesy Anna Rothschild / WGBH Educational Foundation

The altruistic behavior the scientists saw in this first study was passive. The plants were not working together; they simply were not being aggressive toward their siblings. So the scientists wondered, was there a situation in which sibling plants would actually cooperate?

To find the answer, Amanda File turned to ragweed.

"Many of us are allergic to it, and it's not very nice to touch because it's very hairy and kind of yucky," File says. But she chose it because, like about 80 percent of land plants, ragweed forms a partnership with something called mycorrhizal fungi.

These are networks of fungi that live in the soil and associate with the roots of many neighboring plants. A plant will provide sugars to the fungus to help it grow. In return, the fungus gives the plant nutrients, water, and in some cases, protection from pathogens.

"For a plant to have this fungus associated with the roots kind of gives them super-roots," Dudley explains.

But there's a catch. Since multiple plants work together to help the fungus grow, there is an incentive to "cheat." A plant could donate no sugar, which is a costly resource, but still receive nutrients from the fungus.

"The more that I know about plant behavior, the more I love what I do."

Dudley and File wondered if plants would be less likely to cheat, and in fact be more generous, in the presence of siblings.

In a recent study, they grew pots of siblings and pots of unrelated plants. They found that plants that were related did, in fact, work together to promote the growth of the helpful fungus. And, in turn, that seemed to benefit the plants.



Figure STEAM 34. Pairs of ragweed plants. Some are siblings, others are strangers.
Photo credit: Courtesy Amanda File

Dudley says the siblings grown together were healthier overall.

"This is our first bit of evidence that not only do plants change their behavior in the presence of siblings, but they may benefit from the presence of siblings," she says.

Fertile Field of Study

Other labs have made similar findings, but this is still a new and provocative idea, and there are a lot of questions left to answer. For example, how do plants know who their siblings are? One theory holds that plants detect chemicals emitted by roots, but what those chemicals are and how plants sense them remain unclear. For Amanda File, this is an exciting new frontier in biology.

"The more that I know about plant behavior, the more I love what I do," she says.

"There's just so many cool questions to ask."

The next question she is exploring concerns maternal care in trees. She is studying a species of tropical oak in Taiwan and wants to find out: do mother trees take better care of their own babies than they do the saplings of others?

EVA 2013

EVA (Electronic Visualization and the Arts) 2013

BCS, 1st Floor, 5 Southampton Street, London

July 29-31, 2013

The Watershed School Library Interactive Mural



Place-Based, Augmented Learning

This spring, the partnership between The Watershed School, Fairbanks Arts Association, and OneTree Alaska led to the Watershed Library Interactive Mural. The multimedia and multi-discipline school project developed into a fully interactive mural (8 x 40ft) that ties place-based curricula to appropriate books in the library. Students played a pivotal role in the creative process by brainstorming mural content, creating personalized artwork for augmented reality components and participating in artist-led painting sessions.

INTERACT WITH US:

1. Download Aurasma
2. Follow our channel: [Steamworks: Interactive Mural](#) or find us at: <http://auras.ma/s/lyvtq>
3. View images and explore!



Figure STEAM 35. A handout given to attendees at EVA London 2013, highlighting the progress and scope of work on the interactive mural at Watershed School.

Summary

The 24th Annual Electronic Visualization and the Arts was hosted in Central London from July 29-31 2013. Approximately 100 delegates attended that conference with representatives from Australia, France, Israel, United Kingdom, and United States. Klara Maisch, Laura Cartier, and Zachary Meyers attended the event as representatives from IMSS (Interactive Media STEAM Studio) founded through the collaboration of OneTree Alaska and the Watershed Charter School. Graduate students, museum directors, and IT consultants were among the guest presenters who offered a wide range of topics (i.e. from telepresence performances to augmented reality in museum exhibitions). IMSS gave a dynamic presentation about the progress of the interactive mural project, attendees were elated with the project and many encouraged us to continue our work with helpful suggestions. Overall the conference offered a stimulating platform for collaborations, ideas, and future projects.

Keynote Speakers

Steve DiPaola – A computer based cognitive scientist, artist, and researcher at Simon Fraser University in Vancouver, Canada. Dr. DiPaola is the director of the Cognitive Science Program, whose works includes modeling Beluga whale behavior with 3D rendering technology to using creative computer programs in evolving artwork. His presentation touched upon recent developments from the Cognitive Science Program including the analysis of Rembrandt's use of vision based techniques to guide the eye path of the viewer. DiPaola postulates that the sharpness and contrast within facial features (i.e., eyes) significantly engage the viewer and direct their gaze. DiPaola multidisciplinary approach offers a refreshing insight in scientific eye tracking science as well as a historical context in its application.

Linda Candy – A writer and researcher specializing in creativity through art and science. Dr. Candy is adjunct professor in the Creativity and Cognition Research Studios at the University of Technology, Sydney. Her presentation at EVA London 2013 focused on systematically evaluating digital media/systems. The effectiveness of visual and digital systems rarely receives assessments. Candy argues that a methodical evaluation is crucial to progress the evolution and effectiveness of digital systems.

IMSS began to correspond with Dr. Candy prior to EVA requesting a meeting to discuss evaluative measures for the effectiveness of the interactive mural at Watershed School.

She suggested that we evaluate the project through several lenses, firstly to reflect on the process as whole as well as design a questionnaire or form for the students/teachers. This will allow documentation for what worked well and what needed to be improved upon through various perspectives, which in turn will enhance the overall experience of the project as a whole. In addition, the lessons learned from this interactive multimedia project will be beneficial for IMSS in future projects. We would like to thank Dr. Candy for taking the time to meeting with IMSS as well as her sound advice of evaluating the project.

Don McIntyre – Programme Director/ Creative Technologist at the Institute of Design Innovation at Glasgow. McIntyre presented Open Locast, an open source program that connects people, media, and physical spaces. Some of the most provocative parts of the talk included that need for smart design for social change and services. The need for design atheistic and function is prolific in almost every industry and will continue as technology allows customizable interfaces. McIntyre is also working on designing 3d interfaces for car and interior designers. His unique insight into the artistic and technical world was very thought provoking leading to the reevaluation of the mural's interface.



Figure STEAM 36. *Laura Cartier, Zachary Meyers, and Klara Maisch (left to right) present at EVA 2013*

IMSS (Interactive Media STEAM Studio) Presentation

On the second day of the conference Laura Cartier asked conference organizer Stuart Dunn if IMSS could present about progress on the interactive mural thus far. Due to unforeseen fiscal delays IMSS registered late to EVA and was unable to provide a paper or secure a timeslot. Throughout the conference many of the lecturers gave thought provoking presentations and we felt that our idea had just as much merit as some of the other topics. Dunn secured us a thirty min time slot in the afternoon of the third day.

Our dynamic and enthusiastic presentation prompted a lot of excitement amongst the audience. Many were particularly struck by the student integration throughout the process of developing the mural. The project was unlike any at the EVA 2013 because teachers, students, and community members led it. Moira O'Malley and Laura Cartier who wrote a \$300 grant from Delta Kapa Gamma drove the mural at Watershed. The majority of the talks at EVA focused on academic interests and had substantial capital to support their research. The idea itself was novel through the integration of community, place, and media. A number of people approached IMSS after the presentation to congratulate us as well as offer helpful suggestions on how to proceed. We were invited to attend the 25th EVA conference next year and offered an opportunity to be a reviewer for future papers submitted to EVA 2014. The overall experience of London inspired and validated all the hard work IMSS and partners have invested in the interactive mural. IMSS would like to thank BAKLAP and Boreal house for their financial support as well as the teachers at Watershed School who entrusted us with their students. This fall we plan on beginning content integration with K-2nd graders at Watershed. We feel that it is crucial that teachers and students be actively involved in the evolution of the mural so that it will create a dynamic platform for learning and exploring.

Report submitted by Zachary Meyers, Instructional Designer.

2013 Alaska EPSCoR Native Engagement Award: REVISED Scope of Work

Project Description

Climate change is disrupting many communities in rural Alaska with increased fire frequency, thawing permafrost, reduction in sea ice, large-scale vegetation changes, and shifts in seasonality. Traditional lifestyles cannot keep pace with the rate of change. Each generation faces greater challenges adapting to environmental change while attempting to preserve its cultural identity.

In the past, oral history was the main vehicle for transmitting cultural knowledge. Today, there is a growing body of literature and documentary films—short stories and memoirs told by Alaska Native elders and storytellers—that act as time capsules for future generations. Many of the traditional stories delve into peoples' sense of place in relation to the land. These act as great conduits to explore historical environmental change to present and future climatic changes through ecological processes as well as reinforcing cultural context of the local people.

The goal of this project is to provide tools to blend traditional and scientific knowledge of place names, cultural knowledge, and ecological processes through an integrative multidisciplinary STEAM (STEM + Art) curriculum, using a range of multimedia tools. By learning of past, present, and predicted changes it will help prepare the current generation to respond to socioeconomic and environmental changes.

Scope of Work

This project will target middle school students from four classrooms at Effie Kokrine Early College Charter School. Students in each classroom will begin with a traditional place-based narrative that lends itself to in-depth exploration on local topics (i.e., salmon life cycle, fire ecology, edible plants, and seasonality). Students will choose topics and areas of content to explore based upon the events within the traditional place-based narrative. Each exploration will have a tangible project associated with it to serve as an anchor for the content in relation to the story. The teaching is meant to be fluid so the students can maximize the learning experience and link it back to the story in a place-based context. Zachary Meyers and Klara Maisch will lead in the development and implementation of supplemental classroom activities and work in collaboration with the teachers to reinforce classroom content. These activities will incorporate science, art, and technology (old and new) to engage a broad student body and build novel skills. Local elders around Fairbanks will be invited to speak with each classroom to provide context of the narratives. Meyers and Maisch will spend a minimum of three weeks in each class through the months of September and December of 2013. The last week of class will focus on content integrations in relation to the traditional place-based narrative. A suite of tools (i.e. interactive books, digital quilts, object based media) will be used to tie the classrooms' explorations with the

story. The culminating digital work will be housed and accessible through a website which will serve as a portal for sharing content.

An introductory and planning meeting with Zachary Meyers, Klara Maisch, Jan Dawe, Cassie Thacker, Sheryl Meierotto, Sarah States and Alicia Kangas was held on August 13th. Teachers were enthusiastic about incorporating elements from a traditional story and having the students explore place-based topics in depth. Teachers will be responsible for choosing the place-based narrative(s) based on their students' overall interest level. OneTree Alaska, in collaboration with MapTEACH, IMSS, the Alaska Native Language Center and Alaska Native Language Archive, will lead the project.

How does the project increase engagement of Alaska Native K-12 or university students in STEM activities, thereby increasing Alaska's STEM capacity?

The goal of this project is to work with one K-12 school, to integrate traditional and scientific knowledge in a way that can be used as a model in schools throughout Alaskan rural communities. The melding of technology, art and science with traditional place-based narratives will provide a novel way for students to see their surrounding landscape. By studying a specific site through a story, and documenting the story's cultural, historic, and ecological relevance, students will gain a deeper appreciation of, and sense of connection to, their local landscape. They will also gain skills and knowledge to respond to future changes in ways that reflect local interests and values.

The project increases Alaska's STEM capacity by combining the resources and multidisciplinary approaches of OneTree Alaska, IMSS, MapTEACH, the Alaska Native Language Center and the Alaska Native Language Archive, thus providing a rich STEAM experience (Science, Technology, Engineering, Art, Math).

Does the proposal integrate with a test case or a programmatic goal of Alaska EPSCoR ACE?

The proposal targets Effie Kokrine Early College Charter School as a pilot study for the Northern test case in AK EPSCoR ACE. We will collaborate with Elena Sparrow and Gary Kofinas to evaluate the overall methodology of blending disciplines with the common thread being place based narratives. Our goal is use this model in more remote test cases involved in ACE to aid in the delivery of substantive place based content of environmental change.

How will this award assist you in achieving your career goals?

My early career goals were those of a classically trained research plant taxonomist, dedicated to field research, analysis, publication, and undergraduate teaching. In 1993, in response to a forest policy debate, I left university life to engage fully in community-centered work. My concern was that our community had too little information, and too little understanding of the information that *was* available, to come to an informed decision about the natural resource policy issue being debated (Senate Bill 310: Forest Management Agreements). As Executive Director of Alaska Boreal Forest Council, a single issue, alternative dispute resolution NGO, I helped forge bridges of trust between the university and the broader community. My principal career goal became one of creating communities of learners whose connection and understanding of the Alaskan landscape would translate into a sense of personal responsibility and obligation to act as good land, resource, and cultural stewards.

This Native Engagement Award assembles a learning community of unusual partners—K-12 students and university personnel, teachers from mainstream and charter schools, basic and applied researchers, and artists and community members interested in blending traditional and modern technology tools to create enriched learning experiences. This is the kind of learning community that my experience has shown to be the most successful and effective.

The award also significantly advances my secondary career goal: i.e. of developing a cadre of young professionals committed to implementing community collaborative K-20 learning approaches with high academic standards. Previous work on this goal took the form of mentoring AmeriCorps VISTA members (11), Peace Corps International Masters students (3), graduate students involved in the NSF GK-12 project: Changing Alaska Science Education (2), and advanced undergraduate students taking my Silvics and Dendrology course (12).

Much of the responsibility for this project's development and implementation will fall on a member of this new generation of young professionals I helped mentor. Zachary Meyers, working with Klara Maisch (the artist who will co-lead classroom activities with Meyers) will model an exciting new multidisciplinary, multimedia approach: one that honors old and new technology, traditional and mainstream knowledge. The project will bring the unique promise and attributes of these elements into a new learning context for middle school students at Effie Kokrine Early College Charter School: a model we believe holds great promise for urban and rural schools throughout Alaska.

How do you plan to shore your project results and sustain project outcomes?

An open house of the students' work will be held at the end of the school year to celebrate their accomplishments. In addition, A website will be developed to house the multimedia visualizations each classroom produces. This will serve as an archive for teachers and allow other schools to view the work. The project will be evaluated with the help of AK EPSCoR (Sparrow, Kofinas) and serve as a pilot study for further development in remote Northern Test Case communities.

Proposal to US Forest Service 2013 Competitive *Allocation Request* Alaska GreenSchools!

Project Overview:

5 Points. 1,000 Characters Including Spaces – Provide a comprehensive but succinct overview of the proposed project that includes basic details of who is doing what, where, and why. This should give reviewers the "Big Picture."

This project will integrate, evaluate, and promulgate techniques for two forest education programs. Project Learning Tree (PLT) and OneTree Alaska (OTA) will jointly develop an intensive Forest Education Institute that integrates PLT GreenSchools!, K-12 science, and citizen science training. The location will be the community of Fairbanks due to proximity to University of Alaska and highly engaged schools. Partners will include University of Alaska, the Fairbanks North Star Borough School District, Effie Kokrine Early College Charter School, and state and federal agencies. Matching funding will come from the BAKLAP state appropriation, Alaska Natural Resource & Outdoor Educators, American Forest Foundation, and others. A presentation will be given at the 2015 PLT Coordinators Conference. The outcome will be enhanced understanding of forest management by educators, students, and public, and also development of conservation education methods with national applicability.

Context, Goals and Objectives

15 Points. 2,000 Characters Including Spaces – What resource issue/s, threats, and/or opportunities does the project address? What is the desired vision or end state? What are the project goals (long-term) and objectives (short-term), and what impacts do you hope to achieve?

As elsewhere in the country, our forests are an important resource that supports and enhances the quality of life for both urban and rural populations. Conservation and management of these natural resources is challenged by increasing demand for forest products, changing climate and ongoing natural threats, legacy of historic management practices, limited infrastructure, varying community capacity, and fragmented forestland ownerships with a wide range of management objectives. At issue is how to educate the

public about these natural resources with such a diverse set of ownership and management challenges.

Project goals are to promote environmental literacy; increase public understanding of the forests and build support for managing forests for maximum benefit. Objectives include: establish the first certified GreenSchools! in Alaska that will serve as a model for other schools; increase the content and quality of forest education in AK K-12 classrooms; increase the knowledge and skills of educators and community citizen scientists; provide natural resource education and outreach service learning opportunities for UAF students and share successes and lessons learned with the nationwide PLT educator network.

PLT GreenSchools! is a nationwide environmental education program that helps improve students' academic performance and provides teachers and students with training and resources to develop and implement service learning projects on and around their schools. The EKECCS will serve as a model GreenSchools hosting a Forest Education Institute targeting teams of educators and community scientists from other Alaska communities at the beginning of Year 2. The institute will result in an additional 10 schools participating in the GreenSchools! program and additional community scientists with the skills to work with the AK Fire Science Consortium.

Proposed Activities

20 Points. 2,500 Characters Including Spaces – What specific activities will be completed using which grant funds and/or which leveraged resources in the Project Budget? Who will do the work over what timeframe? How do the activities contribute to achieving stated project goals and objectives?

1. PLT GreenSchools! Training: by Nov. 15, 2014

Partners will use grant and leveraged funds to work with university faculty and staff to deliver training to teachers and teacher aides, as well as to university service learners involved in the project.

2. Establish Green Teams: Oct. 2014 - end of project

University of Alaska Fairbanks (UAF), National Park Service, and the Fairbanks North Star Borough Department of Parks and Recreation will use grant and leveraged funds to mentor educators, conduct school investigations, and identify student projects. Issues addressed through mentoring will include natural resource and public land management, recreation and community involvement, watershed management, art/science sculptures, interactive park kiosks, cultural history of the area, and interviewing community members. Community forums and blogspots on UAF School of Natural Resources and Agricultural Sciences website and Facebook page will keep the university and Fairbanks community apprised about progress on the project.

3. Fuel moisture sampling training: by Dec. 2014

Fire science partners will use leveraged funds to provide new fuel moisture sampling training modules to participating teachers, students, and community members. This training reflects improved methods for monitoring fire effects. This project will provide an anchor point for training efforts across the region.

4. Forest Education Institute: Oct. 2015

A three-day training hosted by EKECCS. Training will include PLT GreenSchools! and OTA STEAM modules, successes and lessons learned establishing Alaska's first GreenSchools! and fuel moisture sampling training. Teams of educators and community scientists from 10 Alaska communities will be invited to participate. PLT and OTA will use grant and leveraged funds to develop training materials; other partners including the Alaska Natural Resource & Outdoor Educators and Fairbanks North Star Borough School District will use leveraged funds to assist with logistic planning, advertising and promotion and provision of continued education credits to participants. AK Fire Science Consortium will use leveraged funds to provide forest fuel moisture sampling techniques reflecting improved methods for monitoring fire effects. Other partners including Society of American Foresters, National Park Service, and University of Alaska Fairbanks will provide technical assistance and review of training materials as well as instructors for training sessions.

Deliverables, Outputs and Outcomes

15 Points. 2,000 Characters Including Spaces – What are the project deliverables, outputs, and outcomes? What metrics or indicators will be used to measure and monitor progress? Outcomes and outputs should relate directly to proposed activities, goals, and objectives.

In Year 1, a successful project will include full EKECCS staff participation in PLT GreenSchools! training; establishment of a Green Team, implementation of one or more school investigations, and application for student project funding. In Year 2, a successful project will include completion of the identified school project and certification of EKECCS as a PLT GreenSchools!; participation of educators and/or community citizen scientists from 10 Alaskan communities in the Forest Education Institute and presentation of the project at the 2015 PLT Coordinators Conference. Benchmark dates will be identified to monitor progress toward project objectives.

Success for this project will also be measured by an increase in knowledge of participants (pre- and post-training evaluations). Teachers will monitor student engagement in GreenSchools! activities and informally report back to project mentors on their observations. At the end of the year, teachers will provide observations on student learning improvements they attribute to participation in project activities. Although anecdotal, this information will provide an assessment of project engagement and success. Participants receiving citizen scientist training in monitoring forest fuel moisture content will also be given pre- and post-evaluation surveys to identify any increase in knowledge and skills after the training.

Site visits to the Alaska GreenSchools website and UAF blog sites will provide feedback on interest in PLT GreenSchools! programs for future planning.

The project will directly benefit 240+ underserved youth in grades 7-12 by improving student learning in forest and conservation topics and enhancing 21st century workplace skills. The project will broaden Fairbanks' and Alaska Native communities' recognition of local school accomplishments. The project will increase awareness of the GreenSchools! program and encourage more schools to participate.

Collaboration

15 Points. 2,000 Characters Including Spaces – Describe the contributions and commitments that each partner has made toward the proposed project. What is the nature of their contributions (project planning, implementation, financial resources, etc.)? How does the project integrate S&PF and/or other programs in a meaningful and complementary way that goes beyond “business as usual”?

1. Effie Kokrine Early College Charter School: In Year 1, the staff (9 teachers, 6 special aides and administrators) will become GreenSchools! trained. Classroom and after-school time will be devoted to Green Team project discussions throughout year. The school will be a venue for community events in Year 1, and the Forest Education Institution training site in Year 2.
2. Fairbanks North Star Borough a) Department of Parks and Recreation will provide logistic, legal, and technical assistance for developing trails in Peirce Park and consult on best practices for resource management b) School District Central Office (Curriculum Department/Professional Development) will help plan and market the Forest Education Institute and register participants for continuing education credit.
3. University of Alaska Fairbanks a) Land Management Office will provide technical assistance in developing a multi-landownership MOA for the project b) Facilities Services will provide technical and logistic support for trail development c) School of Natural Resources and Agricultural Sciences/OneTree Alaska will provide mentors and university service learners throughout Year 1 d) Cooperative Extension Service’s Project Learning Tree Coordinator will provide GreenSchools! training/mentoring.
3. Alaska Fire Science Consortium will provide citizen science training, protocols, and data management oversight for NEW upland mixed forest fuel moisture data collection efforts.
4. Alaska Natural Resource and Outdoor Educators will provide logistic support for GreenSchools! and PLT workshops and training, and access to their statewide membership of formal and informal educators.
5. Society of American foresters will provide technical assistance and be a resource for teachers and projects at EKECCS.
6. National Parks Service will mentor student projects, Green Team development, and assist in developing citizen science program focused on monitoring Peirce Park’s natural and cultural attributes.

Forest Action Plan Integration

10 points. 1,250 Characters Including Spaces – How does the project align with stated priority issues, areas, and/or activities in the State Forest Action Plan?

The AK GreenSchools! Initiative (AK GSI) aligns with both the national and Alaska Forest Action Plan (AK FAP) goal to enhance forest resources and values for communities and private landowners. Effie Kokrine Early College Charter School (EKECCS) is ideally suited to be AK's first GreenSchools! because of its commitment to creating a resource management plan for its campus and surrounding public lands (e.g. the "Peirce Park Project.") Three state and Borough landowners are already partners in the school-led effort to develop Peirce Park as a "citizen science park" for monitoring Alaskan forestry issues. AK GSI will add value and needed partner expertise to this effort: for example, the Alaska Fire Science Consortium (AFSC) will provide fuel moisture training to teachers, students, and community members during Year 1 of the project, and fine-tune training modules and protocols for citizen scientists in grades 7-12. QA/QC and data management will be provided by AFSC. This example shows direct alignment with the AK FAP objective "...to mitigate risks to forest health, ensure best management practices are deployed and ecosystem services are maintained."

Meaningful Scale

10 Points. 1,250 Characters Including Spaces – What is the scale of the project? Why/How will the scale of the project facilitate achievement of the stated goals, objectives, and outcomes?

Year 1 of this project will create the first Alaskan GreenSchools! certified school at the EKECCS and directly involve 240+ youth in AK forestry issues. This school reaches a unique cross-section of underserved youth in Alaska representing several communities and different Alaska Native constituencies. The make-up of the school body provides the opportunity to reach a larger secondary audience of parents and families: These audiences have often lacked access to this type of school- and student-driven activity. In Year 2, AK

GreenSchools! will build upon this foundation through extension of the program to 10 new Alaskan schools and reach a larger audience by sharing their story at the 2015 PLT Coordinators Conference. The AK GreenSchools! website and UAF blogspots will provide wider scales of visibility and access for Alaskan communities and schools that may want to develop GreenSchools! programs for their areas. Partner websites will link to the AK GreenSchools! website and UAF blogspots: thus further increasing the network of agency practitioners interested in becoming involved in the project.

Sustainability of Outcomes

10 Points. 1,250 Characters Including Spaces – What skills and capabilities will result from and extend beyond the life of the project; how? Can the project be replicated in other areas; how? What plans are in place or being developed to replicate or expand the project, to build on skills, capabilities, and lessons learned?

PLT inspires students, teachers, families and volunteers to take personal responsibility for improving the environments at their school, home and community. The GreenSchools! program provides a set of tools for students to analyze data and design a student-driven project to address an identified issue or concern. These skills will help them become a more environmentally literate citizen. Benefits to participation schools include possible cost savings to schools, improved student learning, enhanced leadership skills for students, recognition within the wider community of the school's accomplishments, a solid foundation for a lifetime of environmental stewardship, and a healthier school. EKECCS's faculty and staff are committed to developing a resource plan for their campus, directed by and for their students, and represent an ideal model school for Alaska's first GreenSchools!. Sharing their experiences through the national PLT educator network, their successes and lessons learned will serve as an example for schools throughout all states. An Alaska GreenSchools! website will be designed and maintained by UAF-SNRAS-CES to archive project activities and serve as a portal to the program and a resource for other PLT GreenSchools!.

Fairbanks STEAM Institute 2014 (preliminary announcement)

BOREAL HOUSE ART & SCIENCE CENTER



Fairbanks STEAM Institute 2014

Through Multiple Lenses: a Botanical Immersion Stillness, Observation & Interpretation

Dates and times Sunday, July 6th Evening Reception, Keynote

Daily July 7-11 and 14-18 8:30-4:15

Locations This class is both **Outdoors** on the UAF campus, and **Indoors**

- Outdoors: North Campus trails, the Arboretum, the OneTree research plot, and Smith Lake
- Indoors: West Valley High School fine arts classrooms (tentative plan)

Description

Join this two-week immersion designed for teachers, artists, scientists, University students, and community members. Educators can earn four 500 level credits while participating in ongoing teacher connections throughout the two-weeks to discuss classroom practice and implementation. A well-developed curriculum piece is required for credit.

Participants will choose a small natural area then will identify and work with the plants, insects, and interrelationships through multiple lenses for the two-week Institute. They will learn, observe, and record with drawing, data collection, words, poetry, technology and design. Each student artist will contribute an illustration to an encased portfolio which will be printed and presented to each participant in the institute.

Faculty

Dr. Jan Dawe - botanist, Natural Resource Education & Outreach
Dr. Margo Klass - mixed media artist, collaborative artist books
Karen Stomberg - artist, art educator, integrated learning
Chris Pastrow - extended learning educator curriculum integration
Zac Meyers - technologist, instructional design
Frank Soos - creative writer, UAF Professor Emeritus

- **Science:** plant identification, structure, phenology (repeating events in life-cycle of an organism), ecological relationships
- **Technology:** use of iPads for time lapse photography, augmented reality, writing
- **Engineering:** design of casement structure for suite of art plates
- **Art:** drawing in color pencil, fine pen, watercolor, color theory, botanical illustration history, layout and design exercises, completion of an
- **Math:** scientific measuring, calculations for engineering paper portfolio casement



Collaborators/Sponsors UAF School of Natural Resources and Agricultural Sciences, FNSBSD, AAEC, AKSCA, BAKLAP State Appropriation, State Division of Forestry

For Information please contact: Karen Stomberg karstomberg@gmail.com (907) 590-2605

