Education Outreach

Elena Sparrow, Katie Spellman, Christa Mulder, Rebecca Finger, Mary Beth Leigh, Glenn Juday, Jan Dawe, Zach Meyers, Martha Kopplin, Kenji Yoshikawa, Jill Johnstone, Terry Chapin, Teresa Hollingsworth, Christine Villano, Knut Kieland
EO Activities/Programs

Science Integration with the Arts and Humanities

• In Times of Change (ITOC) – Mary Beth Leigh

• One Tree K-20 STEAM Education - Jan Dawe, Zachary Meyer, Glenn Juday
One Tree K-20 STEAM Education

Jan Dawe, Zachary Meyer, Glenn Juday

Art acts as a bridge or “hook” in to OneTree’s STEM (science, technology, engineering, and math) activities.

Learning is broader and deeper with STEAM.
EO Activities/Programs

• **Science Fair/Symposiums** – Coordination and judging, mentoring

• **Research Experience for Undergraduates**

• **Permafrost/Active Layer Monitoring Project**
  Kenji Yoshikawa & Elena Sparrow
Yoshikawa, K. *Permafrost in Our Time*. e-version on the following web site: http://issuu.com/permafrostbook
EO Activities/Programs

• **GK-12 Changing Alaska Science Education (CASE) program-** 2013 CASE fellow Rebecca Finger at Lathrop High School

• **Dangerous Ice: Changing ice conditions on the Tanana River, Fairbanks.** Schneider, W.S., K. Brewster, K. Kielland and Chas Jones. 2013. Oral History Program, Rasmuson Library and the Institute of Arctic Biology, University of Alaska Fairbanks, 66 pages.
EO Activities/Programs

• Professional development Workshops-Teachers
  - Fairbanks 13 educators from Haines, Juneau, Koyuk, Nenana, North Pole, Shageluk, Valdez and Wasilla
Basic GLOBE Measurement Protocols

Atmosphere/Climate
- Cloud
- Temperature
- Precipitation

Land Cover/Biology
- MUC
- Qualitative Land Cover Sampling
- Quantitative Land Cover Sampling
- Manual Mapping

Phenology
- Budburst
- Green-up/green-down

Hydrology
- Transparency
- Temperature
- pH
- Conductivity
- Salinity

Soil
- Field Characterization
- Bulk Density
- pH
- Temperature
- Gravimetric Moisture

www.globe.gov
# GLOBE Seasons and Biomes Professional Development

## Face-to-face Workshop Model

<table>
<thead>
<tr>
<th></th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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</thead>
<tbody>
<tr>
<td><strong>Science Content</strong></td>
<td><strong>Introductio</strong></td>
<td><strong>Atmosphere</strong></td>
<td><strong>Phenology</strong></td>
<td><strong>Hydrology</strong></td>
<td><strong>Ice Seasonality</strong></td>
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<tr>
<td>and Process</td>
<td><strong>n and setting the stage</strong></td>
<td></td>
<td><strong>-Budburst</strong></td>
<td><strong>-Transparency</strong></td>
<td><strong>-Freeze Up</strong></td>
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<td></td>
<td></td>
<td></td>
<td><strong>-Green Up</strong></td>
<td><strong>-Temperature</strong></td>
<td><strong>-Break Up</strong></td>
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<td></td>
<td></td>
<td></td>
<td><strong>-Green Down</strong></td>
<td><strong>-Dissolved O₂</strong></td>
<td><strong>Frost Tube</strong></td>
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<td><strong>-Electrical conductivity</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>-pH</strong></td>
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<tr>
<td><strong>GLOBE Model</strong></td>
<td><strong>Observation</strong></td>
<td><strong>Asking a question</strong></td>
<td><strong>Data collection and preliminary</strong></td>
<td><strong>Design and conduct an investigation –</strong></td>
<td></td>
</tr>
<tr>
<td>for Student Scientific Research</td>
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<td></td>
<td><strong>analysis</strong></td>
<td><strong>Putting it all together</strong></td>
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<tr>
<td><strong>Best Teaching</strong></td>
<td><strong>Practices in Science</strong></td>
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<tr>
<td><strong>Earth/ecosystem</strong></td>
<td><strong>includes Human Dimension</strong></td>
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<td></td>
<td><strong>Workshop assessment and program implementation planning for classrooms</strong></td>
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</tbody>
</table>
Observe Natural Phenomenon → Pose Research Questions → Develop Investigation Plan → Conduct Investigation

Identify New Research Questions → Observe Natural Phenomenon

Share Findings & Conclusions → Pose Research Questions

Write Research Report → Analyze Data

Legend:
- Primary Pathways
- Additional Pathways
EO Activities/Programs

• Professional development Workshops
  Teachers
  - Philippines: 40 educators from 7 schools from all over the Philippines.
  - Portugal at Univ. of Coimbra Sparrow among presenters at the Polar Educators International PD Workshop for 30 educators
EO Activities

• Development of Teacher Leaders/Trainers
  – multiplier effect
  – Teacher award
Seasons In My Biome

temporary version
November 2009

created by Markus Eugster
markus.eugster@schule-uzwil.ch
EO Activities

• Summer Research Experience/Internship-Upward Bound High School Students
2013 BNZ Research Experience for Teachers

- Marcy Kuntz, Pearl Creek Elementary
- Mulder Lab field work
- Extended research into classroom
- Student-Scientist Symposium
Integrating Ecology and Education Research in the Melibee Project

Key Learning Tools:

- Ecological Research
  - observational
  - experimental
  - historical phenology

- Citizen Science
  - current phenology
  - public participation in science

- Education Research
  - experimental
ECOSYSTEM STRUCTURE AND FUNCTION
Invasive plants managed in vulnerable areas, Pollinator services intact

ECOSYSTEM SERVICES
Supporting (Pollinator services), Provisioning (berries), Cultural (subsistence values)

HUMAN OUTCOMES
• Social capital (civic engagement, social networks)
• Human capital (understanding, skills, adaptive learning)
• Sense of Place
• Stewardship values
• SES understanding

HUMAN BEHAVIOR
Monitoring, stewardship activities, scientific engagement

EXTERNAL DRIVERS:
Changes in invasion rates, concern for subsistence resources

PRESSES:
Planning processes (vulnerable areas take long-term measures to protect berry habitat)

PULSES:
Invasive plant identification and control

Socio-Cultural Template

Bio-Physical Template

Metacognition
Citizen science
Ecological Research

Adapted from LTER Social-Ecological Research Framework (Collins et al. 2011)
Melibee Citizen Science

2012-2013
- 868 observations
- 106 monitoring sites
- 246 volunteers
Figure 1. Learning reported by volunteers who were not engaged in environmental careers that occurred as a result of participation in the Melibee Project phenology monitoring program on key concepts and science process skills on key concepts and science process skills.
Figure 2. Average self-reported activity frequency scores in different outcome categories for volunteers before (pre-) and after (post-) their participation in the Melibee Project Citizen Science Program. Statistical differences between pre- and post- Melibee activity frequency (tested using two-tailed t-tests) is indicated by * (p<0.05).

Changes in Activity Frequency
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Key characteristics of resilient and adaptive thinkers prepared to address climate change issues in social-ecological systems:

<table>
<thead>
<tr>
<th>Thinking Skill</th>
<th>Theoretical Backing</th>
</tr>
</thead>
<tbody>
<tr>
<td>ability to interpret and apply new scientific information</td>
<td>Carpenter 2002, Fazey et al. 2007</td>
</tr>
<tr>
<td>ability to think critically to solve complex problems</td>
<td>Chapin et al. 2010</td>
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<tr>
<td>ability to envision multiple scenarios and prioritize most probable outcomes</td>
<td>Kofinas 2010</td>
</tr>
<tr>
<td>Ability to view problems within a social-ecological system context</td>
<td>Chapin et al. 2010</td>
</tr>
<tr>
<td>ability to think about future events or future desired ecological states and anticipate the consequences of present actions</td>
<td>Ascher 2009, Tschakert et al. 2010, Tidball &amp; Krasny 2011</td>
</tr>
<tr>
<td>ability to make bold decisions in the face of uncertainty</td>
<td>MEA 2005, Fazey et al. 2007, Chapin et al. 2010</td>
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Metacognition may help...
Strategy for improving resilience thinking skills?

Using Melibee ecological research as a context for learning...

Research Questions:

1. Do metacognitive learning interventions improve student metacognitive ability?
2. Do metacognitive learning interventions affect student ability to perform "resilience thinking" tasks?
3. Does the effect of the intervention vary with student ability level?
Experimental Methods

- Metacognitive intervention experiment with 108 7th graders (6 weeks)
  Treatment groups:
  - Inquiry learning
  - Metacognitive inquiry learning

- 3 Standards Based Assessments proficiency levels
  - Advanced, Proficient, Below

- Pre-, Post- and Delayed Post-Assessments:
  - Metacognitive skill survey (Sandi-Urena 2008)
  - “Resilience Thinking” written assessment

- Interviews with 24 students
Change in Resilience Thinking
Written Assessment Scores

% students improving scores

Inquiry  Metacog

% students improving scores

Inquiry  Metacog  Inquiry  Metacog  Inquiry  Metacog

Below  Proficient  Advanced

Grade Level Proficiency and Treatment
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Socio-Cultural Template

Citizen science
Metacognition

Adapted from LTER Social-Ecological Research Framework (Collins et al. 2011)
Bethel Invasive Plants and Melibee Training Workshop, April 2013
Berry Picking, Ester Dome 1984

Berry Picking, Bonanza Creek 2013