SAGES: Science for All Generations through Environmental Stewardship

The Role of Environmental Stewardship in SAGES

What is SAGES?
SAGES uses the natural world as a context for learning and engages students in science and engineering practices based on research from the *Framework for K-12 Science Education*. The SAGES model includes a curated collection of 3-dimensional Next Generation science lessons, corresponding supplies and resources, professional development for teachers, and assessment tools that can be used for competency-based learning or differentiated instruction. Every science topic offers an opportunity for students to participate in research, an inquiry investigation, problem-solving, and implementation of an environmental stewardship project.

What is environmental stewardship?
Environmental stewardship is a type of project-based learning that gives students a chance to solve real problems and make a difference in the world. It is characterized by experiential learning based in a specific community and culture to provide students with relevance and context for deeper understanding of the core ideas in science, as well as measurable benefits to the environment.

Why environmental stewardship?
SAGES features environmental stewardship activities for two reasons: 1) to provide students with a systemic, relevant, experiential way to understand science concepts; and 2) to empower young people to think critically, solve problems, and take action in their schoolyards and communities to protect earth’s resources.

Essentials of Environmental Stewardship

Problem definition
Identification / authentication of need

Research
- Literature review
- Meta-analysis of previous research (methods and findings)

Inquiry
- Extended student-led investigation
- Data collection and analysis
- Citizen Science (data reporting)
- Critical thinking & sense-making

Stewardship
Iterative Design Process
- Brainstorming solutions
- Collaborative planning
- Creative problem-solving
- Deciding on project approach
- Prototype or Implementation
- Redesign, as necessary

Evaluation and Reflection
- Benefits to the Environment
- Student academic gains
- Changes in attitudes, behaviors
- Communication of results
Examples of Environmental Stewardship Projects that Students Have Designed Based on Local Needs

**Habitat Restoration on Schoolyards and in Communities**
- Removal of non-native, invasive species
- Planting native plant species
- Creating pollinator habitats for bees, butterflies
- Restoring missing elements of wildlife habitat (water, shelter, food, places to raise young)
- Organic practices to reduce pesticides and herbicides
- Creating artificial habitats as necessary

**Water Quality Monitoring and Improvement**
- Water quality testing and monitoring
- Water pollution prevention or mitigation
  - Storm drain marking to reduce dumping
  - Stream bank stabilization to reduce siltation
  - Stream shading (tree planting) to restore cooler water temperatures and habitats
  - Reduction of carbon releases to limit ocean acidification and impacts on marine life
  - Planting wetlands, bio-swales, or rain gardens to filter the first flush and slow flow
  - Replacing turf with native ground covers
  - Reducing use of disposable plastics
- Water conservation methods

**Bioremediation**
- Planting hyper-accumulating plants to remove toxins
- Inoculating straw bales or wood chips with fungi to absorb and digest oil from run-off

**Climate resilience**
- Promoting use of renewable energy to reduce GHGs
- Reducing energy consumption

**Species Protection**
- Biodiversity inventory or species inventory
- Raising / releasing threatened or endangered species

**Waste Reduction**
- Recycling, repurposing to divert waste from landfills
- Reduction of wasteful packaging and product use
- Composting, vermiculture, and soil conservation
SAGES Research Questions about Environmental Stewardship

Background: Children Gain a Deeper Understanding of the Core Ideas of Science by Engaging in Problem-Solving with Science and Engineering Practices when Developmentally Appropriate. Project-based learning is more effective that rote memorization of facts in science education, particularly for some underserved groups of students. (NRC, 2011. Framework for K-12 Science Education)

Research Question #1
Can authentic environmental stewardship projects that engage children in relevant, student-directed problem solving be a) more engaging and inclusive of traditionally-underserved groups of children and b) more effective in promoting a deeper understanding of science concepts and critical thinking than contrived project-based learning (i.e. building pointless spaghetti and marshmallow towers)?

Background: Children Connect to Nature through Wild Play
Environmentally-friendly attitudes and behaviors in adulthood are correlated to childhood experiences of wild play but not to environmental education in a classroom setting. (Wells, 2006. Nature and the Life Course)

Research Question #2
For a generation of digital natives with little or no time spent outdoors, can field investigations and exploration during inquiry-based science substitute for missing wild play experiences in childhood, in terms of connecting children to nature; instilling wonder; and providing motivation for adult environmentalism?


Research Question #3
Can engaging children in bite-sized, local environmental stewardship projects, characterized by authentic real-world problem-solving and student-directed solutions, reduce disengagement, increase self-efficacy and empower children to make a difference in the world?
## SAGES Logic Model

<table>
<thead>
<tr>
<th>OUTPUTS</th>
<th>OUTCOMES</th>
</tr>
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<tbody>
<tr>
<td><strong>Short Term</strong></td>
<td><strong>Medium Term</strong></td>
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<tr>
<td>Establishing <strong>partnerships</strong> with school districts and <strong>recruitment of teachers</strong> for field testing and replication of SAGES model</td>
<td><strong>Growing perception of the environment as an effective context for teaching</strong> all the core ideas in science, among teachers, administrators and community</td>
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<tr>
<td>Delivering <strong>professional development</strong> workshops on instructional strategies and Next Gen science and engineering practices</td>
<td><strong>Greater student exposure to the outdoors thru inquiry,</strong> which fosters a sense of wonder and discovery, cultivates curiosity, and creates an affinity for nature which is necessary in childhood . . . .</td>
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<td><strong>Continuing professional development via</strong> hybrid <strong>hands-on distance learning</strong> and mentoring methods, with additional science content introduced monthly</td>
<td><strong>Fidelity to model</strong> and curriculum materials and instructional strategies is improved with continuing contact. Hybrid distance learning model has potential to provide <strong>effective teacher training in rural states</strong> with limited internet</td>
</tr>
<tr>
<td>Distribution of NGSS-aligned <strong>curriculum supplies</strong> and stewardship project kits containing lesson plans, protocols, and materials based on best practices in environmental ed</td>
<td><strong>Availability of supplies make outdoor learning opportunities more feasible and varied,</strong> including citizen science, data collection, investigative projects, engineering challenges, and stewardship</td>
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<td><strong>Award sub-grants</strong> for custom, student-designed, place-based environmental stewardship projects in SAGES field testing locations.</td>
<td>All sub-grantees will be required to collect data that measures <strong>tangible benefits to the environment.</strong></td>
</tr>
<tr>
<td><strong>Documentation, data collection and evaluation of student and teacher performance</strong></td>
<td>Feedback provides valuable information for re-tooling of SAGES model. Films and lessons for sub-grantee’s projects will make them <strong>easily replicable.</strong></td>
</tr>
<tr>
<td><strong>Award sub-grants</strong> for custom, student-designed, place-based environmental stewardship projects in SAGES field testing locations.</td>
<td><strong>Student engagement in project-based learning and environmental stewardship is empowering,</strong> and give students the confidence that they can make a difference</td>
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