Greening STEM Idea Journal for Educators

In this supplement to the Greening STEM Educator Toolkit you will find prompts and suggestions for developing your own learning activities, set of lessons, or ideas for projects using a combination of proven approaches to learning collectively referred to as the Greening STEM model, an instructional approach designed to increase student engagement and achievement.

What is Greening STEM?

The Greening STEM model is an interdisciplinary and collaborative approach to teaching STEM subjects that uses the natural environment and real-world challenges to engage learners and deliver high-quality STEM education. It is a student-centered approach to learning STEM content and developing a 21st century skills set. Greening STEM is an adaptable, hands-on, and inquiry-based approach where students take an active role in learning. Students can be tasked with different levels of responsibility from working as a team on a project to planning and leading a learning expedition. Greening STEM is an experiential approach to learning that encourages authentic problem-solving while making gains in environmental knowledge and engendering a stewardship ethic.

Who benefits from a Greening STEM approach?

Greening STEM promotes partnerships where formal and non-formal educators can gain experience and confidence by collaborating to design, develop, and co-deliver standards-based STEM learning activities. It uses place-based investigations of the natural environment and real-world challenges to engage learners, often on public lands or waters, to connect young people to the real-world problems that STEM education can prepare them to help solve. Greening STEM makes environmental issues relevant and accessible for educators and learners.

A Greening STEM Checklist

There are several essential components to the Greening STEM approach. They include incorporating elements of placed-based learning, three dimensional learning, project-based learning, and community-based learning.

Place-Based Learning Elements

Place-based learning is an educational approach that uses all aspects of the local environment, including local cultural, historical, and sociopolitical situations and the natural and built environment, as the integrating context for learning. In its most developed forms, it includes a clear focus on learning through civic engagement and participation in service projects of obvious relevance to the local school and community. [The Center for Place-based Learning and Community Engagement, 2008]

- Does the proposed topic of study, issue to investigate, or problem to explore encourage direct firsthand experiences?
    Notes:

- Who else is concerned about or working to understand the issue or problem? Examples could include public land or water managers, municipal planners, the parks and recreation department,

the zoo, businesses, farmers, an environmental or land conservation group, or persons who have been directly impacted. These individuals and/or groups may be potential collaborative partners.
    Notes:

- Is there an existing way to involve learners? If so, who can be an ally, make introductions, or provide support?
    Notes:

Three Dimensional Learning Elements

General brainstorming for an environmental issue or problem to use as an anchoring phenomenon.

- Is the proposed anchoring phenomenon relevant to learners' interests?
    Notes:

- What will learners need to figure out (i.e. the driving question of the investigation)?
    Notes:

- Will exploration of the anchoring phenomenon encourage questioning assumptions and current understanding? If not, then the phenomenon is probably too simple.
    Notes:

- What are some examples of related phenomena? Inability to list any is likely an indicator to keep brainstorming.
    Example #1 _____

    Example #2 _____

    Example #3 _____

- Does exploration of the anchoring phenomenon connect with approved curriculum, a specific content area, or a specific learning/performance objective(s)? What are they?
  Notes:

- Which science and engineering practice(s) will bring the problem-solving aspect of the anchoring phenomenon alive for learners?
  - ☐ Asking Questions (science) and Defining Problems (engineering)
  - ☐ Developing and Using Models
  - ☐ Planning and Carrying Out Investigations
  - ☐ Analyzing and Interpreting Data
  - ☐ Using Mathematics and Computational Thinking
  - ☐ Constructing Explanations (science) and Designing Solutions (engineering)
  - ☐ Engaging in Argument from Evidence
  - ☐ Obtaining, Evaluating, and Communicating Information

  Notes:

- Which disciplinary core ideas (DCIs) would exploration of the anchoring phenomenon lead to?
  DCI #1 _____

  DCI #2 _____

  DCI #3 _____

    [Consult the NGSS or your state's own standards for grade specific descriptions.]

- Which cross-cutting concepts connect the anchoring phenomenon with a range of other real-world events? Check all that apply.
  - ☐ **Patterns:** Observed patterns in nature guide organization and classification, prompt questions about relationships and causes underlying them.
  - ☐ **Cause and Effect | Mechanism and Prediction:** Deciphering and Identifying causal relationships behind observable events.
  - ☐ **Scale, Proportion, and Quantity:** Recognizing what is relevant at different size, time and energy scales; recognizing proportional relationships between different quantities as scales change.
  - ☐ **Systems and System Models:** Grouping related objects or components for understanding and predicting behavior or outcomes.

□ **Energy and Matter | Flows, Cycles, and Conservation:** Understanding behavior or outcomes through tracking of energy and matter flows into, out of, and within systems.

□ **Structure and Function:** Physical shape or structure determines many of an object's properties and functions.

□ **Stability and Change:** Understanding conditions that affect stability and rates of change.

Project-Based Learning Elements

The best practices of this instructional approach enable learners to master academic skills and gain content knowledge while developing 21st century skills and personal agency.

- What kind of project(s) could learners engage in? A learning expedition (see NEEF's toolkit)? A citizen science project (check out Hands on the Land monitoring projects)? A habitat restoration project? A community outreach and engagement campaign? Or is this an opportunity for something new?
  Notes:

- How can the project design require learners be engaged over the course of days, weeks, or even months?
  Notes:

- What tools, techniques, and technology can the project design include to ensure a high level of real-world authenticity?
  Notes:

- With whom will the learners share their work? Will it include audiences beyond the classroom or campus?
  Notes:

- What elements of the project will require learners work collaboratively as members of a team? How will group products synthesize individual member contributions?

Notes:

- How will the project design ensure learners use project management processes, tools, and strategies?
  Notes:

- How will the project design ensure learners periodically reflect on the quality of their work (i.e. self-assessment), ways to improve it, and their acquisition of new skills and knowledge?
  Notes:

Community-Based Learning Elements

These elements bring cultural relevance and issues of equity and justice into the Greening STEM model. Learners are challenged to differentiate between environmental problems in need of solutions and environmental issues. Learners gain understanding concerning the nature of environmental issues— that people disagree about their resolution, and those disagreements are based on differing beliefs and values related to the issues. Incorporating environmental justice and social equity, learners are more likely to become intelligent consumers and processors of issue-related information.

- What is the cultural context associated with the selected topic of inquiry?
  Notes:

- What are the impacts of power and privilege? Who has them and who doesn't? Who in the community is affected as a result?
  Notes:

- What cultural knowledge and/or tradition(s) is discounted or unacknowledged? Who in the community is affected as a result?
    - Notes:

- What role does equity have in finding solutions acceptable to the community?
    - Notes:

- What would environmental justice look like to the community?
    - Notes:

Pulling everything together

Implementing this approach does not require that every learning activity incorporate all aspects of Greening STEM. Some ideas will encompass more elements from the very start. Others over time will evolve into fuller more robust versions. No need to wait until every piece is figured out. Go ahead and get started at whatever level you can reasonably achieve now. If you come up with something that works well, please share it with others via the Greening STEM Facebook page. Likewise, you can query the community of practitioners for their ideas.