Greening STEM Toolkits

Water Resources
Energy Efficiency
Climate & Weather
Gardens & Schools
Geography Connections
Increasing STEM (Science, Technology, Engineering and Math) knowledge and expanding STEM education and career opportunities for students is a national priority. Student achievement in STEM is key to fostering a new wave of innovators who can creatively address complex 21st century challenges.

The environment is a compelling context for teaching STEM as it provides teachers with a diverse range of real-world challenges that engage students in hands-on opportunities to apply and reinforce STEM concepts across multiple subject areas. From calculating planting area and productivity in the school garden, to designing model wind turbines, to tracking invasive species with GPS technology, environmental projects inspire students to apply STEM by empowering them to develop innovative solutions to local problems meaningful to them.

Recognizing the role of the environment as a portal for STEM learning, EE Week's multi-year focus is Greening STEM. As part of its professional development program for formal and informal educators, the National Environmental Education Foundation (NEEF) recently launched the Greening STEM Learning Center, a dynamic new learning space for K-12 educators and students that will help to advance STEM learning inside and outside of the classroom, especially in under-resourced communities. The Greening STEM Learning Center was created with start up support from Samsung, national sponsor of National Environmental Education Week.
In this Toolkit:

This toolkit highlights a variety of classroom activities and educator resources that incorporate STEM in the following content areas:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gardens &amp; Schoolyards</td>
<td>Pg 4</td>
</tr>
<tr>
<td>- Activities</td>
<td>Pg 5</td>
</tr>
<tr>
<td>- Resources</td>
<td>Pg 6</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>Pg 7</td>
</tr>
<tr>
<td>- Activities</td>
<td>Pg 8</td>
</tr>
<tr>
<td>- Resources</td>
<td>Pg 9</td>
</tr>
<tr>
<td>Geography Connections</td>
<td>Pg 10</td>
</tr>
<tr>
<td>- Activities</td>
<td>Pg 11</td>
</tr>
<tr>
<td>- Resources</td>
<td>Pg 12</td>
</tr>
<tr>
<td>Water Resources</td>
<td>Pg 13</td>
</tr>
<tr>
<td>- Activities</td>
<td>Pg 14</td>
</tr>
<tr>
<td>- Resources</td>
<td>Pg 15</td>
</tr>
<tr>
<td>Climate &amp; Weather</td>
<td>Pg 16</td>
</tr>
<tr>
<td>- Activities</td>
<td>Pg 17</td>
</tr>
<tr>
<td>- Resources</td>
<td>Pg 18</td>
</tr>
</tbody>
</table>

Key

Use this key to determine which STEM components and teaching strategies are covered in the activities and resources of this toolkit.

- **S**: Science
- **T**: Technology
- **E**: Engineering
- **M**: Math

**SL**: Service Learning
**PBL**: Project Based Learning
**CS**: Citizen Science
There are many educational benefits to school gardens and green schoolyards. These spaces serve as living laboratories that provide a real-world context for lessons across subject areas. They also engage students in hands-on, project-based learning activities.

The opportunities to learn and apply STEM concepts in school gardens and green schoolyards abound. From analyzing soil samples, plotting plant growth and graphing rainfall to designing greenhouses, STEM activities in the schoolyard garden or habitat empower students of all grade levels to improve their community and take pride in their school environment.

Featured Resource: 

KidsGardening offers resources around plant-based education and school gardens, as well as an array of awards programs and products that engage kids in active learning and exploration in the garden.
Growing UP (and around, and down…)  
All Grades  
In this classroom project, students build garden structures, giving them a chance to track and experiment with plant tropisms (responses to various environmental stimuli). The three types of garden structures featured in the activity can be adapted to fit budget and climate and include ideas for connecting the project to the curricular focus of the classroom.

An Eye on the Garden  
Grades K-4  
Students explore the garden by looking carefully at plant selections. Using cameras, students can capture changes in the schoolyard habitat and sharpen their observation skills. Through “framing” items in the garden that most appeal to them, students examine photo-worthy items and learn how to best capture those with the camera. While taking an investigative look into the patterns and shapes of various botanical selections, students gain a new perspective for observing the garden.

Gardening: A Math Adventure  
Grades 4-6  
Students learn how math computations can be applied to a real life situation in planning the layout of a garden. Students also use group decision-making skills to determine the kinds of items a garden will have.

Launching Laudable Landscapes  
Grades 9-11  
Students find or design their own garden plan while using knowledge of geometry and shapes, with the potential of actually implementing the garden design in their school or community.
Kidsgardening.org
(website)
Kidsgardening.org provides preK-12 lessons, activities, hand-outs and articles that apply across the curriculum. Educators can register school and community gardens, communicate with other programs, and engage in meaningful discussions about garden activities. Complete with how-to guides, garden stories, and grants and resources, this free resource helps educators engage children of all ages in hands-on learning opportunities.

Project BudBurst
(website & mobile app)
Project BudBurst is a network of people across the United States who monitor plants as the seasons change; a national field campaign designed to engage the public in the collection of important ecological data. The website provides educational resources including classroom activities and guides for elementary, middle and high school teachers on how to engage their students in the data collection process.

Project Noah
(website & mobile app)
Project Noah is a tool to explore and document wildlife and a platform to harness the power of citizen scientists everywhere. Students can incorporate a mission to document local plants and animals into their garden or schoolyard projects.

Schoolyard-Enhanced Learning: Using the Outdoors as an Instructional Tool
(book)
Schoolyard-Enhanced Learning shows how the school grounds can become an enriching extension of the classroom, providing educators with practical suggestions and teacher-tested activities for using the most powerful audio-visual tool available: the outdoors.
We use a vast amount of energy at home and at school every day. Energy use costs an estimated $6 billion in U.S. schools each year. As energy challenges continue to play an important role at home, at school and around the globe, it is increasingly important that students understand energy use and energy efficiency.

The subject of energy naturally lends itself to STEM and interdisciplinary learning. STEM is an important part of energy extraction, distribution and use, and also plays a key role in energy efficiency. Students can use STEM to become energy efficient leaders at home and at school by conducting energy audits, and engineering innovative solutions to improve energy efficiency.

Featured Resource:
The Alliance to Save Energy’s Green Schools Program—now PowerSave Schools—empowers students to save energy at school by using the school building as a learning lab for applying science, math and even language arts to solve a global problem.
Activities

School Energy Map
Grades 3-12
Students make a map of the school, chart the energy users on campus, and discuss energy use and potential ways to save.

The Air Around Us
Grades 3-5
In this lesson, students will learn how using electricity causes air pollution and examine ways to save electricity. They will initiate energy saving tips at home and compare two electric bills to determine how much energy they saved.

How Big is Your Carbon Footprint?
Grades 6-12
Students learn the extent of their ecological footprint and explore the mean, median, mode and standard deviation of a set of data.

Energy Sources and Energy Use
Grades 9-12
Students discuss relationships between energy use and pollution, sort energy sources into renewable and non-renewable and create a pie chart of the estimated energy use of the class.
Energy Efficiency

Resources

PowerSave Schools
(website)
Alliance to Save Energy’s PowerSave Schools Program trains students to use a diagnostic toolkit that assesses the energy usage in their school. The school building becomes a learning lab for students to apply science, math and even language arts to solve a global challenge.

Energy Hog
(website & game)
In this online game, students eliminate energy hogs that pig out on wasted energy. In the process, they discover fun facts about using energy wisely at home. The teacher's section of the game's website provides a set of classroom activities that include lessons on energy sources, energy use at home and how to bust energy hogs to save energy.
Geography connects us to the world around us. It engages students in STEM learning to explore the physical features of the Earth and how they influence climate and ecosystems, as well as trends in human population dynamics. The study of geography allows students to apply their learning in core concepts to real-world situations and enables them to take part in decision-making that affects their communities.

Featured Resource:
Since its founding in 1888, the National Geographic Society has worked to educate audiences about our planet. National Geographic Education is responsible for creating and disseminating educational programs for schools, out-of-school settings, and the home.
Activities

Introduction to Latitude and Longitude
Grades K-2
In this National Geographic Xpeditions lesson, K-2 students learn an overview of latitude and longitude. They also explore the variations in temperature and conditions at different latitudes.

The Geography of Ocean Currents
Grades 6-8
In this activity, students use National Geographic's MapMaker Interactive tool to learn about the movement of ocean currents and investigate how currents affect pollution events.

Mapping Our Human Footprint
Grades 6-12
Using the Human Footprint data layer in National Geographic's MapMaker Interactive tool, students will discover the degrees of human impact around the world and how humans impact the physical environment.

Climographs: Temperature, Precipitation, and the Human Condition
Grades 9-12
In this lesson from National Geographic Xpeditions, students learn how to use and create climographs as a tool to study climate data. In doing so, they gain an understanding of the effects climate has on humans in different parts of the world.
MapMaker Interactive
(website)
An interactive mapping experience from National Geographic Education with rich layers of information on the physical earth, oceans, culture and more.

FieldScope
(website)
National Geographic FieldScope is a web-based mapping, analysis, and collaboration tool designed to support geographic investigations and engage students as citizen scientists investigating real-world topics - both in the classroom and in outdoor education settings.

BioBlitz Education
(website)
Whether participating in a National Geographic/National Park Service BioBlitz or schoolyard bioblitz, the bioblitz experience helps students study biodiversity firsthand with activities that support students to make observations, record data, understand classification and map their findings.
With links to weather, climate, energy and public health, water is one of today’s most important environmental topics. In addition to covering 70% of the Earth’s surface and being vital to survival, water is a key element in weather and climate systems. Water also has an intimate connection with energy, as generating power consumes 3 percent of our nation’s water annually and 13 percent of the energy produced in the United States each year is used to treat, transport and heat our water.

The interdisciplinary nature of water provides an excellent context for study in STEM and other subjects. Conducting water audits of the school building empowers students to employ math and engineering concepts in an investigation that is meaningful to them, while exploring technologies for water conservation. Water quality monitoring projects connect students with their watershed and allow them to make a hands-on contribution to real-world science.

**Featured Resource:**
Earth Force's mission is to engage young people as active citizens who improve the environment and their communities now and in the future. The Earth Force GREEN (Global Rivers Environmental Education Network) program focuses on improving water quality through the investigation to action process.
The Water Sourcebooks
All Grades
The Water Sourcebooks, developed by the U.S. Environmental Protection Agency, contain 324 interdisciplinary, hands-on activities on water resources and water use.

WaterSense Activities
Grades 3-5
A Day in the Life of a Drop and Fix a Leak Week Learning Resources are sets of activities that introduce students to water supplies, how water use habits affect the environment and human health, and the importance of saving water.

The Dirty Water Project
Grades 3-5
In this activity, developed by the University of Colorado at Boulder, students investigate different methods of removing pollutants from water. They also design and build their own water filters.

Graphic Data and Analyzing Trends in Water Quality
Grades 6-8
In this lesson adapted from a Project Wet guide, students learn how to identify and monitor a watershed, using topographic maps and water quality data sets.

Read a Water Meter and Water Bill
Grades 8-12
In this lesson from WET in the City's Water Watchers Guide, students learn how to read a water meter and water bill to get an overview of their school's total water consumption cost.
Earth Force GREEN
(website)
The Global Rivers Environmental Education Network program (GREEN) provides opportunities for young people to learn more about the watersheds they live in and to use their findings to create lasting solutions for pressing water quality challenges.

H2O Calc
(mobile app)
This app for iPhone provides a quick and easy method of estimating household water usage. This can serve as a supplement to water use lessons.

Going Blue: A Teen Guide to Saving Our Oceans, Lakes, Rivers, & Wetlands
(book)
This guide, created in part by EarthEcho International, illustrates relevant facts about our oceans and waterways. It also gives readers ideas for how to make a positive change for the environment by completing a service learning project.
Weather and climate affect us every day. While weather describes the conditions of the atmosphere during a short period of time, climate describes the way the atmosphere tends to behave in a certain place over long periods of time. A helpful analogy for remembering the difference is: weather tells you what to wear on any given day; climate tells you what wardrobe to have.

From using the latest technology to track and analyze weather patterns to designing new tools to measure and predict weather and climate phenomena, there are many ways in which students can employ STEM in their study of weather and climate. The dynamic nature of weather and climate make for engaging and challenging topics of study and provide abundant opportunities for STEM exploration.

Featured Resource:

Earth Gauge provides environmental and climate knowledge to broadcast meteorologists. Earth Gauge Kids, a subset of Earth Gauge, provides students in grades 5-8 with educational materials linking weather and the environment.
Activities

What to Wear? What to Drink? Weather Patterns and Climatic Regions
Grades 3-5
In this lesson developed by the University of Colorado at Boulder, students learn about the different climatic regions and the factors that determine climate. They also explore how engineers enable humans to adapt to living in most environments by designing buildings, water systems and other technologies.

Weather Watchers
Grades 6-8
In this Illuminations activity by the National Council for Teachers of Mathematics, students gather weather data, interpret the information and make a stem-and-leaf plot to illustrate patterns.

Prehistoric Climate Change: And Why It Matters Today
Grades 9-12
This activity, developed by Smithsonian Education, introduces students to environmental topics using fun and challenging real-world math problems. Students determine average annual temperatures 55 million years ago by examining the fossils of leaves from various prehistoric tree species.
Resources

Earth Gauge
(website)
Earth Gauge provides science-based quick facts, in-depth fact sheets, videos and online courses that make the links between climate, weather and environment. Earth Gauge Kids makes the connection between weather and the environment for middle school students.

Journey North
(website & mobile app)
Journey North enables students to track the seasons on a real-time basis, by monitoring migration patterns, plant budding and other natural events. Student then share their observations and data with classmates across North America.

Climate Change, Wildlife and Wildlands: A Toolkit for Formal and Informal Educators
(website)
This kit, developed by several government agencies including the U.S. Environmental Protection Agency, helps illustrate how climate change affects wildlife and public lands. It contains classroom activities, video, links and other materials.

NOAA Climate.gov
(website)
Climate.gov, developed by the National Oceanic and Atmospheric Administration (NOAA) provides multimedia information, data and educational resources on climate.
Greening STEM Infographic

STEM & Our Planet

The environment is a compelling context for teaching and engaging today's students in science, technology, engineering, and math (STEM).

SCIENCE

Green chemistry alone is expected to grow from a $3.8 billion industry to about $100 billion by 2020.

95% of STEM college students believe that math/STEM can help prepare students to address the world's toughest problems.

Only about 1 in 18 workers in America currently are in STEM fields.

99% of kids ages 6-17 believe that it's important to care for the environment.

92% of teens are concerned about our environment.

By 2014, about 2 million STEM-related jobs will be created.

95% of STEM college students believe that math/STEM can help prepare students to address the world's toughest problems.

Near 4 in 5 STEM students decided to study math/STEM in high school or earlier.

Employment of mathematicians is expected to grow by 23% between 2008-18, much faster than average for all occupations.

Sources:

- National Center for Women & Information Technology
- National Environmental Education Foundation
- National Science Foundation
- U.S. Dept. of Commerce, Census Bureau
- Education Week
- Science News

Find out more: www.eeweek.org

TECHNOLOGY

Environmental science jobs are expected to grow by 25% by 2016 — the fastest among the sciences.

29% by 2018, there will be 1.4 million American computing job openings, but only 29% of those are expected to be filled by U.S. graduates.

78% of businesses and organizations believe that the value of job candidates' environmental knowledge will increase in importance as a hiring factor.

About 2 million organizations and businesses now produce or offer green goods or services.

Environmental engineers are projected to have employment growth of 31% between 2008-18, much faster than average for all occupations.

57% of math/STEM college students say that, before college, a teacher or class got them interested in STEM.

Workers with a STEM background have earned about 26% more, with engineers earning some of the highest avg. starting salaries for bachelor's degrees.

Civil engineers, who increasingly deal with the environment, are expected to have employment growth of 24% between 2008-18, much faster than avg. for all occupations.

57% of math/STEM college students say that, before college, a teacher or class got them interested in STEM.

MATH

Employment of mathematicians is expected to grow by 23% between 2008-18, much faster than average for all occupations.

ENGINEERING

Civil engineers, who increasingly deal with the environment, are expected to have employment growth of 24% between 2008-18, much faster than avg. for all occupations.

EE Week is made possible by generous support from SAMSUNG

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eeweek.org

for more activities and resources.

NEEF sees a future whereby 2022,

300 million Americans actively use environmental

knowledge to ensure the well-being of the earth

and its people.