Welcome

Students to Stewards: Student-centered climate change instruction

NSTA National Conference on Science Education
Denver, Colorado
Saturday, March 23, 2024, 1:00

Transforming science education to benefit all through professional learning, partnerships and advocacy.
Introductions

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NSTA Vision and Mission

**Vision**
Science literacy and education are recognized as vital to the future of our society, enabling us to make informed decisions about the collective challenges we face.

**Mission**
Transform science education to benefit all through professional learning, partnerships and advocacy.

https://www.nsta.org/nsta-strategic-plan
### Collection of Resources

**Students to Stewards: Student-centered climate change instruction Collection**

6 items

- Aerospace
- Astronomy
- Biology
- Chemistry
- Climate Science
- Computer Science
- Earth & Space Science
- Environmental Science
- Engineering
- Evolution
- General Science
- Life Science
- Physical Science
- Physics
- STEM
- Elementary
- High School
- Middle School
- Kindergarten

**Resources in “Students to Stewards: Student-centered climate change instruction” Collection**

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<td>A Framework for K-12 Science Education (pdf)</td>
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<td>Sprocket [Open Source APES Project-Based Learning Curriculum]</td>
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https://my.nsta.org/collection/duNY0Chw8I_Q_E?
The framework is designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.

The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions.
Access to Science Literacy for ALL Students

economically disadvantaged

English learners/multilingual learners

race and ethnicity

gifted and talented

students with disabilities

alternative education programs

girls
Science Instructional Shifts and Sensemaking

**Shift 1**
Explain phenomena and design solutions to problems

**Shift 2**
Doing science (three-dimensional learning)

**Shift 3**
Coherent learning progressions over time
Continuum of Science Instruction

**Information Frame**
- Teacher is focused on disseminating information.
- Students are focused on knowing information.
- Science is portrayed as a body of established facts.
- Assessments are focused on “right” answers.

**Sensemaking Frame**
- Teacher is focused on developing conceptual understanding.
- Students are focused on understanding something.
- Science is portrayed as a way to make sense of something.
- Assessments are focused on use of evidence to support conclusions/generalizations.

**Knowing about…**

**Figuring out…**

Less Like

More Like
Traditional Project-Based Learning

Rather than teaching relevant material and subsequently having students apply the knowledge to solve problems, the problem is presented first. PBL assignments can be short, or they can be more involved and take a whole semester. PBL is often group-oriented, so it is beneficial to set aside classroom time to prepare students to work in groups and to allow them to engage in their PBL project.

Students generally must:

- Examine and define the problem.
- Explore what they already know about underlying issues related to it.
- Determine what they need to learn and where they can acquire the information and tools necessary to solve the problem.
- Evaluate possible ways to solve the problem.
- Solve the problem.
- Report on their findings.

Getting Started with Problem-Based Learning

- Articulate the learning outcomes of the project. What do you want students to know or be able to do as a result of participating in the assignment?
- Create the problem. Ideally, this will be a real-world situation that resembles something students may encounter in their future careers or lives. Cases are often the basis of PBL activities. Previously developed PBL activities can be found online through the University of Delaware’s PBL Clearinghouse of Activities.
- Establish ground rules at the beginning to prepare students to work effectively in groups.
- Introduce students to group processes and do some warm up exercises to allow them to practice assessing both their own work and that of their peers.
- Consider having students take on different roles or divide up the work up amongst themselves. Alternatively, the project might require students to assume various perspectives, such as those of government officials, local business owners, etc.
- Establish how you will evaluate and assess the assignment. Consider making the self and peer assessments a part of the assignment grade.

Source: Cornell University Center for Teaching Innovation
https://teaching.cornell.edu/teaching-resources/engaging-students/problem-based-learning#-text=Problem%20based%20learning%20(PBL),the%20motivation%20and%20the%20learning
Traditional Project Based Learning

Getting Started with Problem-Based Learning

Traditional Project-Based Learning

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Traditional Project Based Learning

Seven Essential Project Design Elements

- **A Challenging Problem or Question**
  The project is founded by a meaningful problem to be solved or a question to answer, at the appropriate level of challenge.

- **Sustained Inquiry**
  Students engage in a rigorous, extended process of posing questions, finding resources, and applying information.

- **Authenticity**
  The project involves real-world context, tasks, and tools, quality standards, or impact, or the project speaks to personal concerns, interests, and issues in the students’ lives.

- **Student Voice & Choice**
  Students make some decisions about the project, including how they work and what they create, and express their own ideas in their own voice.

- **Reflection**
  Students and teachers reflect on the learning, the effectiveness of their inquiry and project activities, the quality of student work, and obstacles that arise and strategies for overcoming them.

- **Critique & Revision**
  Students give, receive, and apply feedback to improve their process and products.

- **Public Product**
  Students make their project work public by sharing it with and explaining or presenting it to people beyond the classroom.

Seven Project Based Teaching Practices

- **Design & Plan**
  Teachers create or adapt a project for their context and students, and plan its implementation from launch to culmination while allowing for some degree of student voice and choice.

- **Align to Standards**
  Teachers use standards to plan the project and make sure it addresses key knowledge and understanding from subject areas to be included.

- **Build the Culture**
  Teachers explicitly and implicitly promote student independence and growth, open-ended inquiry, team spirit, and attention to quality.

- **Manage Activities**
  Teachers work with students to organize tasks and schedules, set checklists, and deadlines, find and use resources, create products, and make them public.

- **Scaffold Student Learning**
  Teachers employ a variety of lessons, tools, and instructional strategies to support all students in reaching project goals.

- **Assess Student Learning**
  Teachers use formative and summative assessments of knowledge, understanding, and success skills, and include self and peer assessment of team and individual work.

- **Engage & Coach**
  Teachers engage in learning and creating alongside students, and identify when they need skill-building, redirection, encouragement, and celebration.

Source: PBL Works [https://www.pblworks.org/what-is-pbl](https://www.pblworks.org/what-is-pbl)
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**Figuring out...**

Less Like

More Like
ALL Students

- economically disadvantaged
- English learners/multilingual learners
- race and ethnicity
- gifted and talented
- students with disabilities
- alternative education programs
- girls
Coherence From the Student Perspective

- We figure out the science ideas.
- We figure out where we are going at each step.
- We figure out how to put the ideas together over time.
A Framework provides a pathway

The Earth Force Framework

Does (or can) this framework support coherence from the student perspective?
Marrying two frameworks
Ensuring the project is student driven
Shifting to Student Centered Project Based Learning

Welcome to Sprocket: A portal of no cost, project-based learning courses for educators everywhere.

Sprocket is also an online community where teachers are able to share ways to implement and adapt the courses.

https://sprocket.educurious.org/
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Community Environmental Inventory

- Energy Audit
- Recycling Audit
- Environmental/Carbon footprint
- Food Waste Audit
- Guided Walking Tour
  - Pervious/Impervious Materials
  - Storm Water
  - Water Drainage
- Interviews
- Online Databases
Determined Community Strengths and Potential Issues (listed below) after completing the audits:

- Food waste in our cafeteria
- Electricity/energy waste throughout the building
- Lack of convenient recycling opportunities for both plastic and paper
- Several areas on campus where water pooled
- Lots of impervious surfaces that ran directly into the sewer
- A human-made pond that was in disrepair and covered in duckweed and algae
- A retention pond/drainage ditch that had been overrun by invasive species
Determined list of initial questions that had to be addressed

- Exploring cause and effect
- Exploring assets and constraints involved

Groups presented potential projects to class
Framing our Goals and Project Selection

The class decided on criteria that will help decide which project to choose. They addressed each of these criteria when presenting their group proposals:

- **REALISTIC** will students be able to complete the project given the available resources?
- **PRECEDENT** have others tried doing this before, and how well did it work?
- **RELEVANCE** how much will the project actually address the problem we identified?
- **SIMPLICITY** how easy or difficult will the project be to carry out?
- **IMPACT** how likely is it that the project will have a lasting impact?
- **OPPOSITION** how much opposition will you likely get from other people or organizations?
Framing our Goals and Project Selection

• REALISTIC  will students be able to complete the project given the available resources?
• PRECEDENT  have others tried doing this before, and how well did it work?
• RELEVANCE  how much will the project actually address the problem we identified?
• SIMPLICITY  how easy or difficult will the project be to carry out?
• IMPACT  how likely is it that the project will have a lasting impact?
• OPPOSITION  how much opposition will you likely get from other people or organizations?
Students identified questions they still need to answer

What do we need to figure out to be able to do this?

• What plants do we want?
• Why do we need a pond there? What does it do? Where would the water go otherwise? What are all these big things that look like drains?
• Retention pond/rain garden design - How big will it have to be? Where is the water coming from and how much water enters after rain events?

How will they find the information?
Who will find the information?
Do we need permission to do this?
Marrying two frameworks

1. Discover Community Environmental Inventory
2. Decide Issue Selection
3. Discover Policy and Community Practice Research
4. Decide Goal and Strategy Selection
5. Act Planning and Taking Civic Action
6. Conclude Assessing Success

A Storyline Uses the Five Classroom Routines in Combination to Support Coherence for Students
Connection to Sensemaking

We are solving a problem, but there are phenomena that must be explained in order to solve the problem.....
Connection to Sensemaking

STEP 1: DISCOVER
COMMUNITY ENVIRONMENTAL INVENTORY

STEP 2: DECIDE
ISSUE SELECTION

STEP 3: DISCOVER
POLICY AND COMMUNITY PRACTICE RESEARCH

STEP 4: DECIDE
GOAL AND STRATEGY SELECTION

STEP 5: ACT
PLANNING AND TAKING CIVIC ACTION

STEP 6: CONCLUDE
ASSESSING SUCCESS

A Storyline Uses the Five Classroom Routines in Combination to Support Coherence for Students
Project Goals

Student Goals

1. Improve watershed health
2. Increase biodiversity
3. Create opportunities for elementary and middle school students to have a local field trip where they learn about factors affecting the health of their local environment
4. Create opportunities for students (my AP students) to teach these concepts to the other students (5th graders) to raise awareness
5. Create outdoor space where students have place-based educational opportunities

Teacher Goals - Student Goals PLUS:

+ Prepare my students for the AP Environmental Exam by increasing their understanding of key content knowledge and science practices
+ Increase the analytical and critical thinking skills of students.
+ Increase the likelihood that students will think about the environment and become good environmental stewards and/or activists.
+ Increasing student knowledge of how to approach community leaders and think about stakeholders when leading stewardship action projects
+ Increase the likelihood that students will choose to go outside for recreation
How can I do this in my class?

Audits

• ArcGIS Living Atlas of the World

• Ecological Footprint

• LAUNCH Toolkit: Energy Audit (6th-12th) | Grades of Green

• Waste Assessments | US EPA
How can I do this in my class?

Funding and other support

• NOAA Planet Stewards

• KidsGardening Grant Opportunities

• Grants – Captain Planet Foundation
How Students Experience Sensemaking
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How Students Experience Sensemaking
Now that WE know, how do we help others learn?

- Maybe we could invite the 5th grade students from Addams?
- Hmmmm – that is interesting… What a coincidence… I’ve been helping some 5th grade teachers with a storyline unit called “Where does our clean water come from and where does it go after we make it dirty?”
- I bet they will love to learn from you guys and help with your project!
Students plan learning stations and garden layout then host learning stations for 5th graders
5th grade students help us plant the native plants
5th grade students help us plant the native plants
2017-2018 Survey Results:

Students were asked the following four questions in September 2017 (prior to starting the project) and again a few weeks before the end of the school year in May of 2018.

- How likely are you to participate in an environmental stewardship project if asked by someone?
- How likely are you to seek out opportunities to participate in environmental stewardship projects?
- How likely are you to help recruit your friends and family to participate in environmental stewardship projects with you?
- How likely are you to organize or help organize an environmental stewardship project in your community (now or in the future)
8% of student answers reflected a positive attitude about Participation in Environmental Stewardship at the start of this year (% of answered scored as 4 or 5 were counted as reflecting a positive attitude).
39% of student answers reflected a positive attitude about Participation in Environmental Stewardship after participating in this project (% of answered scored as 4 or 5 were counted as reflecting a positive attitude).
2017-2018 Pre- and Post-Survey Comparison:

At the beginning of the class only 8% of student answers reflected a positive attitude about Participation in Environmental Stewardship.

At the end of the class 39% of student answers reflected a positive attitude about Participation in Environmental Stewardship.
24% of student answers reflected a positive attitude about Participation in Environmental Stewardship at the start of this year (% of answered scored as 4 or 5 were counted as reflecting a positive attitude).
53% of student answers reflected a positive attitude about Participation in Environmental Stewardship at the start of this year (% of answered scored as 4 or 5 were counted as reflecting a positive attitude).
At the beginning of the class 24% of student answers reflected a positive attitude about Participation in Environmental Stewardship. At the end of the class 53% of student answers reflected a positive attitude about Participation in Environmental Stewardship.
Thank you for your participation!

Holly Hereau
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Be an NSTA Conference Reviewer!

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NEW ORLEANS 24
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Together, we are NSTA.

Please review this session.