Welcome

Web Seminar: Case Studies from *Connected Science Learning*: Transformative Science Learning through Museum-School Collaboration

May 16, 2022
7:00 PM ET

Transforming science education to benefit all through professional learning, partnerships and advocacy.
The National Science Teaching Association strongly supports diversity, equity and inclusion in the classroom, and in all of our programs. We are committed to providing a welcoming, safe, productive, harassment-free environment for all participants of our events and programs, regardless of their gender, gender identity, sexual orientation, ability, ethnicity, race, color, age, marital status, veteran status, socioeconomic status or religion.

We ask that all attendees be mindful of their surroundings and of their fellow participants. All participants are expected to exercise consideration and respect in their speech and actions, and to refrain from demeaning, discriminatory, or harassing behavior and speech.

NSTA does not allow promotion of other products in our chats during web seminars. We ask that attendees keep the conversation on topic, use positive language and remain courteous of others throughout the event, and allow everyone time to participate in the chat.
Meet Today’s Presenters…

Beth Murphy
NSTA

Kirsten Butcher
University of Utah

Deborah Hanuscin
Western Washington University

Madlyn Larson
Natural History Museum of Utah

Abby Whatley
SPARK Museum of Electrical Invention
Connected Science Learning

Read NSTA’s journal highlighting STEM education experiences that bridge the gap between in-school and out-of-school settings.

www.nsta.org/connected-science-learning
1. With which learning setting do you most closely identify?
   - K-12 school/district
   - Museum, science center, zoo/aquarium, nature center
   - College or university
   - Youth development organization
   - Other educational program provider
   - Other (please share via the chat window)

2. Which of the choices below best represents your role? Check all that apply.
   - Leadership
   - Research
   - Program development
   - Program delivery
   - Program evaluation
   - Other (please share via the chat window)
CSL’s Purpose and Scope

The online-only journal features highly effective programs and research that connect preK–16 STEM learning across settings, and that:

- **Bridge the gap** between in- and out-of-school learning
- **Incorporate blended practices** from and across formal and informal settings
- **Result from authentic collaboration and co-creation** across settings and organizations
- **Utilize transdisciplinary approaches and integration** within STEM and with other fields
Bridging the gap between in-school and out-of-school STEM learning: A research to practice study group

NSF Award ID 2031157
GOAL: Advance the field by providing resources that empower STEM educators to design and deliver high-quality connected learning experiences based on relevant research and incorporating evidence-based practices.

**Define**
- Determine focus areas for invited publications
- Finalize issue themes and call for contributions
- Open abstract application process
- Recommend authors, review abstract submissions, select invited authors

**Publish**
- Secure ten invited authors to write on focus areas
- Public call for regular CSL contributions on themes/topics
- Review and publish invited articles in CSL
- Focus area editorials in CSL

**Disseminate**
- Web seminars and other virtual events
- Report summarizing existing research and future recommendations
- Compilation document articles, editorials, summary report
- Conference presentations

**Evaluate**
- Published articles receive high ratings, strong web analytics, wide dissemination
- Web seminars & online forums well attended and positively received
- Study group participants report deliverables were effectively produced and disseminated
SPARK Discovery and Invention! is a classroom-based NGSS-aligned curriculum supplement for 4th grade students in Bellingham Public Schools that was developed and piloted in collaboration between Western Washington University, Bellingham Public Schools, and the SPARK Museum of Electrical Invention. Development of the materials provided a venue for reciprocal learning by all stakeholders, and implementation and revision of the lessons provided a unique and authentic context for preservice teachers’ science practicum experience. Ongoing use of the materials as a complement to a field trip to the SPARK museum is supporting the vision of the NGSS in local classrooms.
Growing Understanding from a SPARK
Today’s Session

- Overview of the partnership between SPARK Museum, Western Washington University, and Bellingham Public Schools
- Describe the process we used to collaborate and improve our collective capacity
- Preview the product of our collaboration: an NGSS aligned 4th grade curriculum supplement
- Discuss outcomes and lessons learned for those seeking similar collaborations
Located in Bellingham, WA

- Gallery organized by different eras in development of electrical devices
- Artifacts and interactive exhibits
- MegaZapper Tesla Coil show
- Field Trip Program
It all started with a cup of coffee...
Science, Math, & Technology Education (SMATE)

19 faculty, 4 full-time staff, and a resource center with a library, technology, and equipment for STEM teaching

- Instructs science and science methods courses for preservice elementary teachers
- Offers a General Science BAE with Elementary Certification
Hey, Debi—Might we collaborate to support our STEM education efforts in elementary?

Sure! Let’s see who else we can rope in!

Hey, Caroline—want to put your mad CS skills to use?

Yes! Count me in!

Dr. Caroline Hardin, Computer Science & SMATE

Hey Debi—Can we get some volunteers for STEM education at the Museum?

Could we also work on connecting to the NGSS and classrooms?

Sure! We have an NSTA student chapter, but let’s not stop there… Do you know Bill from BPS?

Bill Palmer, Director of Teaching, Learning, & Technology

Abby Whatley, Director of Programs at SPARK Museum

Debi Hanuscin, SMATE @ WWU

Dr. Caroline Hardin, Computer Science & SMATE

Could we also work on connecting to the NGSS and classrooms?
BPS serves approximately 12,000 students

- Has 14 elementary schools, all of which have sent students to SPARK in the past
- Hosts SMATE practicum students in elementary classrooms
- Implementing NGSS-aligned curriculum in middle school, but still uses pre-NGSS kit-based curricula in elementary, which have been adapted to [STEM storylines](#)
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<thead>
<tr>
<th>Partner</th>
<th>Resources</th>
<th>Needs/Challenges</th>
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<tbody>
<tr>
<td>Bellingham Public Schools</td>
<td>• Students &amp; teachers</td>
<td>• High-quality NGSS-aligned curriculum materials</td>
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<td>• Pedagogical expertise &amp; mentoring</td>
<td>• Opportunities for professional learning</td>
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<td></td>
<td>• Experience working with children</td>
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<td>SPARK Museum of Electrical Invention</td>
<td>• Exhibits, materials, and resources related to the history of science and engineering</td>
<td>• Alignment between field trip program and classroom learning aligned to the NGSS</td>
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<td>• Expertise in science &amp; engineering content</td>
<td>• Promote understanding of museum as part of a larger learning ecosystem</td>
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<td>• Field trip program</td>
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<td>SMATE Program at Western Washington University</td>
<td>• Expertise in teacher education</td>
<td>• Practicum opportunities for prospective teacher to enact NGSS-aligned instruction</td>
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<td>• Expertise in instructional design</td>
<td>• Support for continued learning of prospective teachers</td>
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<tr>
<td></td>
<td>• Expertise in NGSS</td>
<td></td>
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<td></td>
<td>• Prospective teachers</td>
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Instructional Materials to Connect Learning in the Museum with Classroom & Everyday Learning Experiences

- Provide Bellingham Public Schools with NGSS aligned materials for wider use
- Enable SPARK to support classroom learning in connection to field trips
- Enable preservice teachers to understand and practice teaching in ways that align with the vision of the NGSS
- Enable SMATE faculty to secure high quality practicum placements for preservice teachers
<table>
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<th>Fall 2019  (Science Methods Course)</th>
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<td>• Preservice teachers attended a panel discussion with SPARK and BPS staff at the start of their methods course as an orientation to the project.</td>
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<td>• Preservice teachers visited the SPARK museum and participated in a mock “field trip” experience and gain familiarity with real-world examples of science and engineering through artifacts in the collection.</td>
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<td>• In their methods course, preservice teachers were introduced to the NGSS and worked to identify and unpack relevant performance expectations.</td>
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<td>• Preservice teachers co-developed curriculum modules aligned to the NGSS using existing high-quality resources, with support from faculty and SPARK/BPS staff.</td>
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<th>Winter 2019  (Science Teaching Practicum)</th>
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<td>• Preservice teachers co-taught the curriculum modules in pairs, collaborating with grade-level teams (grade 4) at four BPS elementary schools.</td>
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<td>• Using feedback from implementation, preservice teachers collaborated with classroom teachers to revise and improve the modules.</td>
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<th>Spring 2020 and beyond…</th>
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<tr>
<td>• SPARK museum staff, WWU faculty, and preservice teacher volunteers collaborated to transform the curriculum modules into an accessible eBook format (with virtual options for activities).</td>
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<tr>
<td>• Curriculum modules were made freely available and shared within BPS and more broadly at NSTA conferences in joint presentations by SPARK staff and WWU students.</td>
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### Part 1: Introduction - What Do Engineers Do?

Students are introduced to the unit and examples from SPARK’s collection that illustrate how electrical devices have been designed to solve various problems, and how their designs have improved over time. They are then introduced to a series of “client cards” that motivate them to solve a problem using the engineering design process to design an electrical device. They create an Engineering Manual in the modules that can inform their designs.

<table>
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<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
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<td><strong>Circuits as Systems</strong></td>
<td><strong>Energy Flow in Circuits</strong></td>
<td><strong>Makey-Makey A Circuit Work</strong></td>
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<tr>
<td>Students learn how the components of a circuit function together as a system.</td>
<td>Students learn more about how energy is transferred and transformed as it moves through a circuit.</td>
<td>Students use Makey-Makey to enhance the functionality of their circuits.</td>
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### Part 2: Culminating Event - Design Showcase

Students apply what they have learned in the modules to design and test a device that converts energy from one form to another. They present their final designs to their peers.
Learning from Artifacts in a World Class Collection

1857 Arc Lamp

Edison’s first successful electric lamp

Dual Gas and Electric Fixture
Learning from History/Highlighting Diversity

This Maxim Lamp, developed by Latimer in 1881, is in SPARK Museum's collection.
Learning from Relevant, Everyday Experiences

Students see relevance in learning about circuits as systems by examining systems from their everyday life experiences including familiar toys (Operation Game) and systems in their own homes (switches, lights, fans, etc.)
Learning Together

Curriculum materials position students as experts and co-constructors of knowledge.

Students have agency and choice throughout the learning process as they engage in science and engineering.
Successful Shifts towards NGSS Alignment in BPS

- Integration of science & engineering
- Focus on deeper understanding of content as well as application of content
- Design of lessons so that science concepts build coherently
- Experiences that reflect the interconnected nature of science as it is practiced in the real world
Insights & Outcomes for Preservice Teachers

Benefit from Common/Shared Teaching Experiences

- Enhanced skills for Collaborating as Colleagues
- Improved Understanding the Complexities of Science Teaching and Learning
- Recognition of decision-points and choices in enacting lessons
Insights & Outcomes for SPARK Museum

Providing meaningful informal learning experiences

- Understanding of NGSS and its role in science education at the elementary level
- Tools to continue creating concrete and helpful resources
- Expanded capacity to fill needs and support classroom learning through partnerships
EPIC Bioscience uses digitized museum specimens to guide middle school learners through authentic research investigations. As they work with EPIC Bioscience investigations, students participate in a full range of science practices: engaging with a key question, gathering and analyzing relevant data, interpreting findings, and communicating conclusions. EPIC Bioscience is a true interdisciplinary effort, bringing together educators, curriculum developers, domain scientists, and learning researchers from the Natural History Museum of Utah and the University of Utah. EPIC Bioscience investigations are fully online and free for educational use.
Interdisciplinary Team

Kirsten R. Butcher
Kirsten.butcher@Utah.edu

Madlyn Larson
mlarson@nhmu.utah.edu

Mitchell J. Power

Michelle Hudson  Matt Orr

McKenna Lane  Merinda Davis

Vanessa Bailey  Susana Velásquez-Franco
Project Approach

Science

NGSS Authentic Practices

Investigations: Digital, “Hands-on”

Natural History Collections Specimens
Why Museum Specimens?

Natural History Collections

Estimated 2 – 4 billion specimens (Ariñó, 2010)

Contain the data necessary to study pressing global issues (e.g., climate change)

Digitized Specimens

More equitable (anytime, anywhere) access

Reduces barriers to learning with important specimens (in collections)
Why Museum Specimens?
Why Museum Specimens?
Question: What physical features drive predator behaviors when encountering harmful prey and their mimics?

NGSS MSLS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
Immediate, learn-by-doing activity with digitized specimens

INVESTIGATION: Don’t Eat Me! Physical Features Influence Predatory Interactions in an Ecosystem

To Eat or Not to Eat?
How do predators make decisions about prey?
You’re a young, hungry lizard who needs to survive in the wild. How do you decide to eat or not to eat?

Part 1: Be the Predator!
How will you decide? Will that prey be delicious or disastrous?

Part 2: How to Fool a Predator.
Analyze features of prey to identify key cues used by their predators.

Part 3: Predicting the Future!
How will ecosystem changes affect predator-prey interactions?
INVESTIGATION: To Eat or Not To Eat?

To Eat or Not To Eat?
How do predators make decisions about prey?

You’re a young, hungry lizard who needs to survive in the wild. But how do you figure out what to eat?!

Part 1: Be the Predator
How will you find food? Is that prey delicious or distastrous?

Part 2: How to Fool a Predator
Analyze which physical features influence predator behaviors.

Part 3: Predicting the Future!
Will rapid changes affect predator-prey interactions?

Could we get going? Feeling pretty hungry over here.
One reason that this is a mystery is because velvet ants in different environments have very different physical features. Which ones are important to their predators?

Another reason is that different predators pick up on different physical features of prey. We don’t know which features matter until we investigate further.
Collect and analyze relevant data from museum specimens

INVESTIGATION: To Eat or Not To Eat? How do predators decide?

Part 2: How to Fool a Predator

Choose a Physical Feature to Investigate
Investigate the physical feature you think predators will use to avoid Western velvet ants (and their mimics). Remember, jumping spiders are a mimic of the Western velvet ant. They live in the same environment as the Western velvet ant.

Size
Investigate this physical feature by taking specimen measurements.

Color, Pattern, Shape
Investigate these physical features by observing specimen similarities.

Why can’t I investigate hair as a feature?
INVESTIGATION: To Eat or Not To Eat! How do predators decide?

Part 2: How to Fool a Predator

Interpreting Your Measurement Data

1. Abdomen width. What pattern do you see? Who is similar to whom?

2. Overall length. What pattern do you see? Who is similar to whom?
Interpreting Your Ratings Data

Higher ratings mean stronger similarity. What patterns do you see?

**Color:** Are the jumping spiders more similar to Western or Desert velvet ants?

**Pattern:** Are the jumping spiders more similar to Western or Desert velvet ants?

**Shape:** Are the jumping spiders more similar to Western or Desert velvet ants?
INVESTIGATION: To Eat or Not to Eat? How do predators decide?

Part 3: Predicting the Future

**Predicting the Future**

In part 2, you examined physical features that predators may use to avoid harmful Western velvet ants. Mimics who share important features gain a survival advantage—they fool predators into skipping a good meal!

- But what happens when environments change?
- Will predators' interactions with their prey change as well?

There are two rapid changes affecting many environments. Pick one to explore.

**Biodiversity Loss**

- How would the loss of these Western velvet ants affect predator behaviors?

**Range Change**

- What physical feature(s) did you previously investigate?
- What did your data say about how the feature(s) you studied influence predator behaviors?

Given your findings, how would this biodiversity loss likely affect predator behaviors in new generations of lizards?

How would the relationship between future lizard predators and jumping spiders likely change? (Please explain.)
Museum – School Collaborations

Making Strategic, Interdisciplinary Partnerships Work
Seek Opportunities to Connect Entire Team to the Science
Ensure Frequent, Sustained Opportunities for Discussion

Pre-Pandemic

Post-Pandemic
Immediate, learn-by-doing activity with digitized specimens

Focus on an authentic question (aligned to NGSS & relevant to global issues)

Collect and analyze relevant data from museum specimens

Infer impact and communicate conclusions

Articulate Educational Structure/Approach for Shared Vision
Leverage Subteam Expertise – Report Back Using Visual Media
Recognize Bi-Directional Opportunities for Innovation
Be Patient, Embrace Chaos & Compromise
Create a free, online account for investigations access:
www.researchquest.org

FEATURE

Rethinking Online Science Learning
Creating Virtual Research Experiences Using Digitized Museum Specimens

Connected Science Learning March-April 2022 (Volume 4, Issue 2)
By Kirsten R. Butcher, Madlyn Larson, McKenna Lane, and Mitchell J. Power

A lasting impact of the COVID-19 global pandemic likely is the permanent inclusion of online learning in K-12. The rapid move to online learning left many teachers, parents, and students reeling for in-person learning and highlighted major gaps in the online resources necessary for fully remote K-12 learning, but it also underscored considerable strengths of online formats for flexible learning and instruction—particularly as district capacities expanded and familiarity with online instruction increased. Many administrators now envision a permanent end to sustained school closures (goodbye, snow days!) and long-term support for full online learning.
Thank you!
We welcome your questions!
Panel discussion

Deborah Hanuscin
Western Washington University

Abby Whatley
SPARK Museum of Electrical Invention

Kirsten Butcher
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Madlyn Larson
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Please share your questions via the chat window.
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Thank You for Participating!

https://www.nsta.org
We value your feedback!

The post-program survey link will be shared after the recording is stopped at the end of the program.

Your completed survey confirms your attendance which allows us to award you a certificate of participation and attendance.
This collection includes the slides (as PDF), handouts and other resources.

Link to the collection: 
https://my.nsta.org/collection/UfTd9OUVPhY_E
Transforming Science Learning: Evaluating Lessons for Sensemaking Using the NSTA Sensemaking Tool  
May 25, 7:00 PM ET

Web Seminar: Industry-based Artificial Intelligence STEM Program in Your Classroom, 
_sponsored by Milestone C and STEMI_  
June 1, 7:00 PM ET

Science Update: Underwater Sound in Our National Marine Sanctuaries  
June 2, 7:00 PM ET

Transforming Science Learning: Scientific Literacy: Our Lives Depend On It!  
June 8, 7:00 PM ET

Science Update: Exploring Seamounts of the Atlantic and Pacific  
June 23, 7:00 PM ET

July 28, 7:00 PM ET

https://www.nsta.org/webseminars
This concludes today’s program.