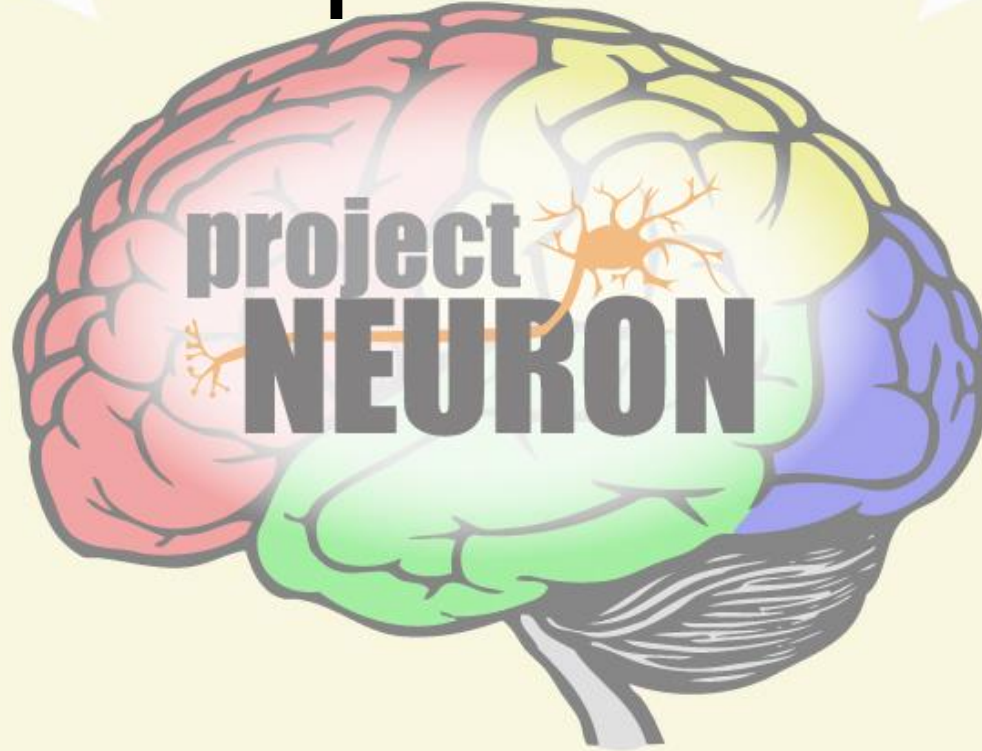


Engaging students in developing and using models: using clay models to visualize action potentials.



Natasha Capell: Unity High School
Barbara Hug: University of Illinois



National Institutes
of Health

SEPA SCIENCE EDUCATION
PARTNERSHIP AWARD
Supported by the National Institutes of Health

Session overview:

- Project NEURON overview
- Nervous system unit
- Modeling action potential activities
- Discussion & sharing of student work

What is Project NEURON?

- Educators, scientists, and graduate students
- Curriculum development
 - Inquiry-based
 - Connect to standards
- Professional development
 - Summer institutes
 - Conferences

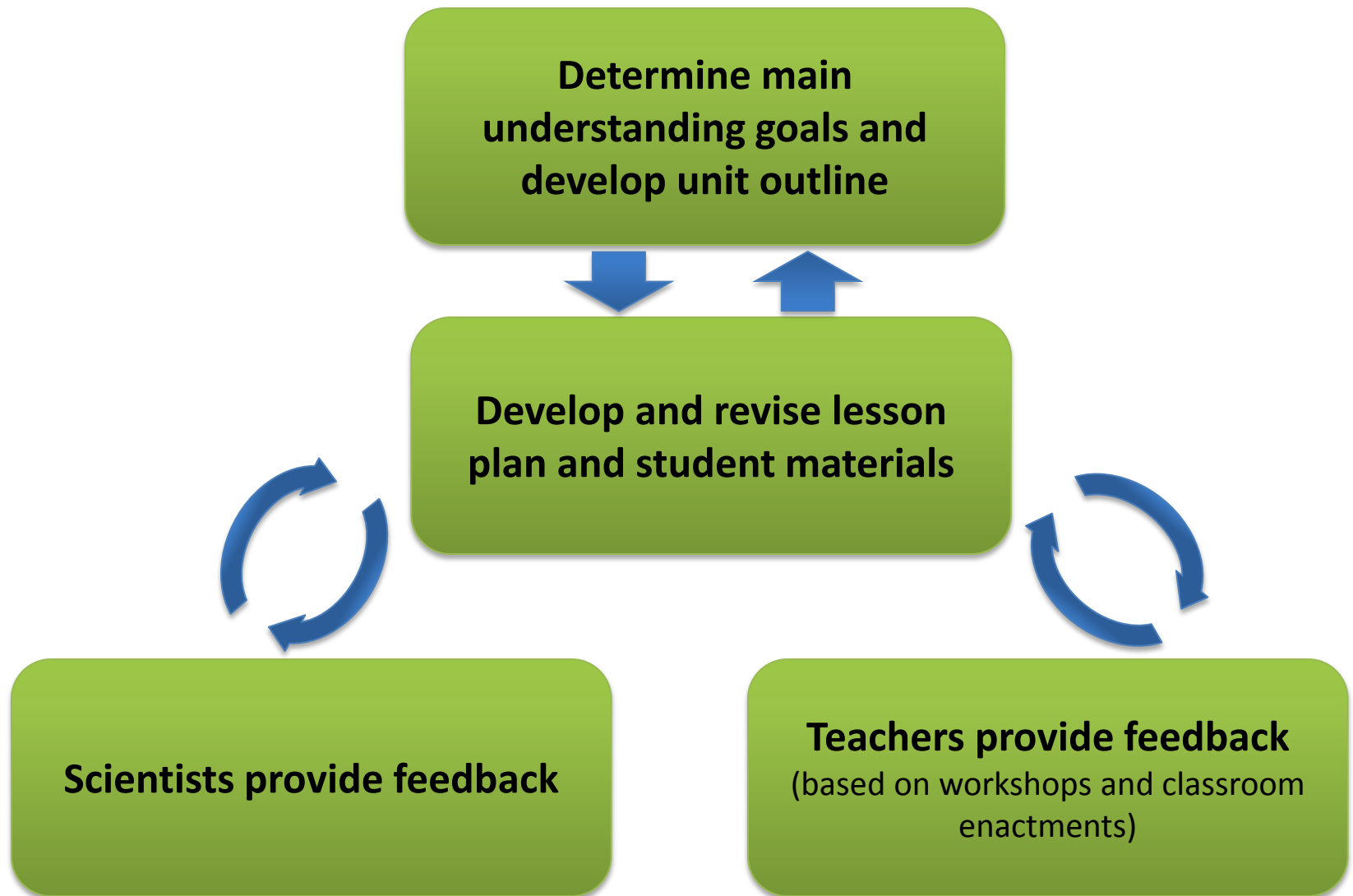


Project NEURON: A Collaborative Process

- Science Educators (Project NEURON)
 - Initial unit planning
 - Developing lessons
 - Modify/revise materials based on feedback
- Scientists (UIUC)
 - Initial unit planning
 - Provide feedback on lesson content
- Teachers (High School Science)
 - Initial unit planning
 - Enact lessons in the classroom
 - Provide feedback



An Iterative Development Process



Project NEURON Curriculum Units

- **Do you see what I see?**
 - *Light, sight, and natural selection*
- **What can I learn from worms?**
 - *Regeneration, stem cells, and models*
- **What makes me tick...tock?**
 - *Circadian rhythms, genetics, and health*
- **What changes our minds?**
 - *Toxicants, exposure, and the environment*
 - *Foods, drugs, and the brain*
- **Why dread a bump on the head?**
 - *The neuroscience of traumatic brain injury (TBI)*
- **Food for thought: What fuels us?**
 - *Glucose, the endocrine system, and health*
- **What makes honey bees work together?**
 - *How genes and environment affect behavior*
- **How do small microbes make a big difference?**
 - *Microbes, ecology, and the tree of life*

Available at:
neuron.illinois.edu

What changes our minds?

Food, drugs, and the brain.

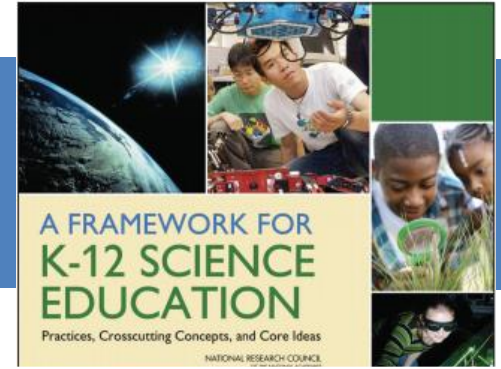
- Lesson 5:
What are the effects of drugs on the nervous system?
- **Lesson 6:**
How do neurons communicate?
- Lesson 7:
How do drugs affect neuron communication?

Why dread a bump on the head?

The neuroscience of traumatic brain injury

- Lesson 1:
What is traumatic brain injury?
- Lesson 2:
What does the brain look like?
- Lesson 3:
How does a CT scan help diagnose TBI?
- Lesson 4:
How to build a neuron
- Lesson 5:
What happens to neurons after TBI?
- Lesson 6:
Exploring the data behind brain injury
- Lesson 7:
What can we tell others about TBI?

A Framework for K-12 Science Education



Dimension 1: Scientific & Engineering Practices

1. Asking questions
2. **Developing/Using models**
3. Planning/Carrying out investigations
4. Analyzing & interpreting data
5. Using math, information and computer technology, and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, communicating information

Dimension 2: Crosscutting Concepts

1. Patterns
2. **Cause and Effect**
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter
6. **Structure and Function**
7. Stability and Change

Dimension 3: Disciplinary Core Ideas

- Core Idea LS1: From Molecules to Organisms: Structures and Processes
- LS1.A: Structure and Function
 - LS1.D: Information Processing

Today's activity

Part 1: Build a model of a presynaptic and postsynaptic cell.

Part 2: Simulate an action potential using your model.

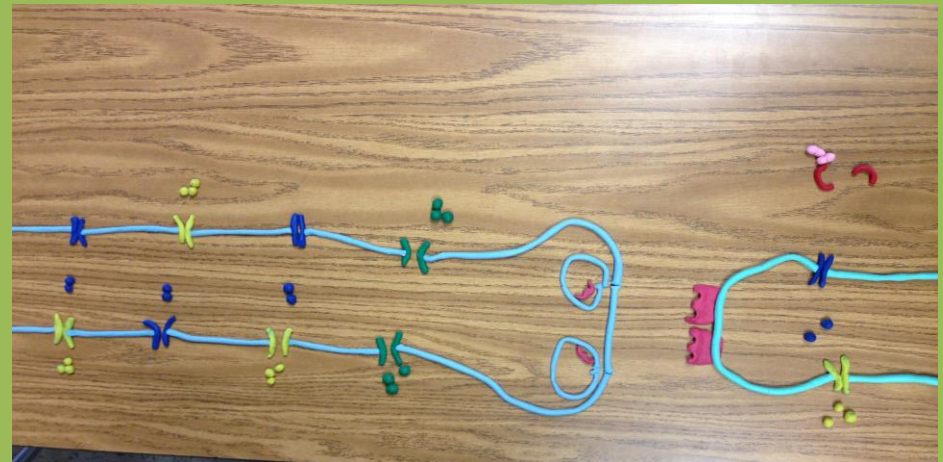
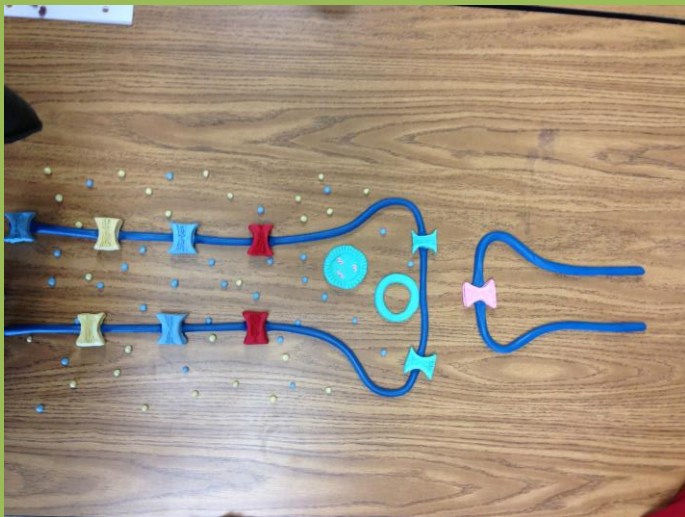
Part 3: Model the possible effects that different drugs have on the nervous system.

Work in groups of 3-4



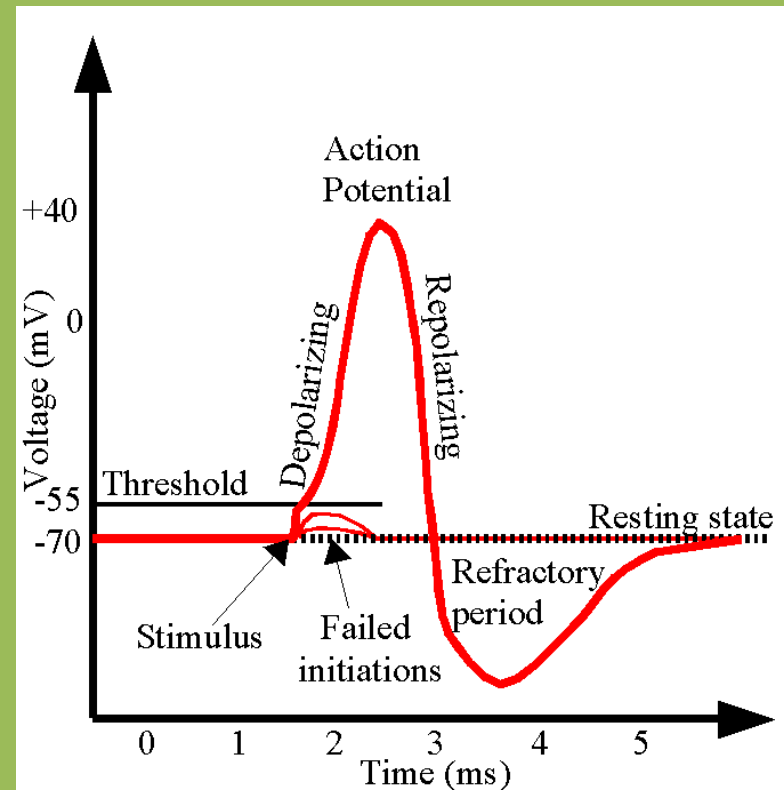
Part I: Building the model (15 minutes)

- Using the laminated cards as a guide:
 - build the axon and an axon terminal of a presynaptic cell, and the dendrite of a postsynaptic cell.
 - build the transport proteins
 - build ions, and vesicles
- Split up work!



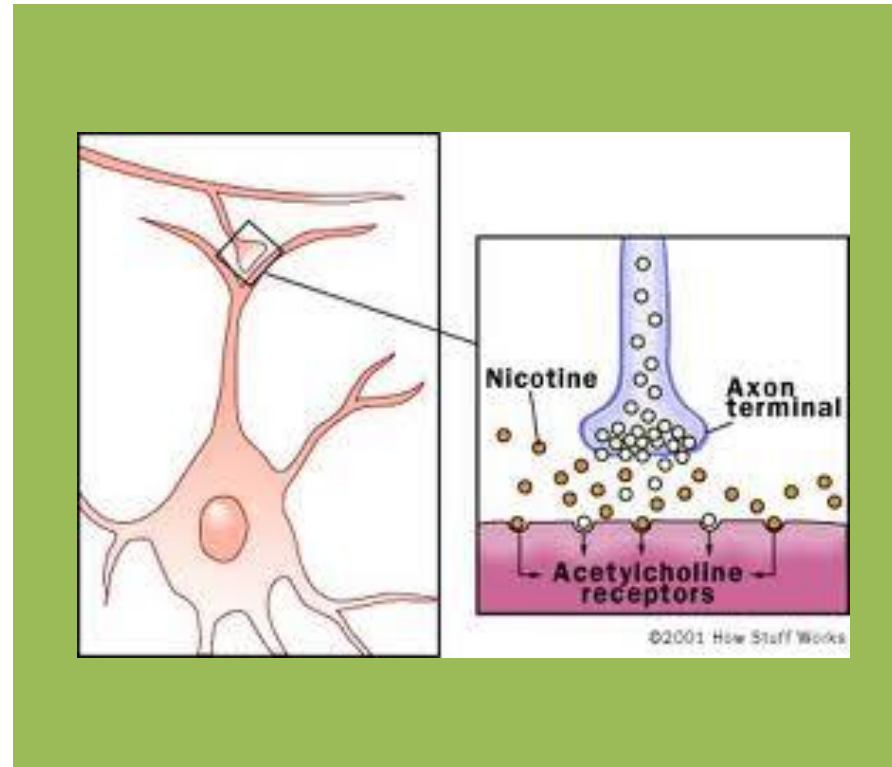
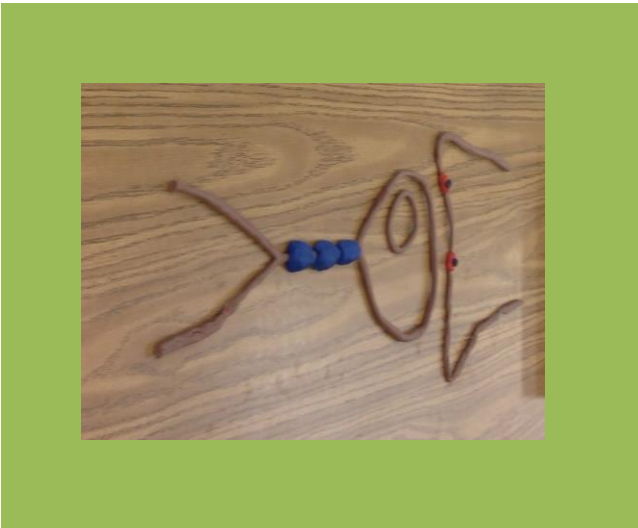
Part II: Simulate an action potential (15 minutes)

- Use your model to show what happens during an action potential. You need to include what is happening during each phase (depolarization, repolarization, refractory period)
- Include how the presynaptic cell communicates with the postsynaptic cell (what happens at the synaptic cleft).
- Use your smartphone/tablet to make a video of an action potential.



Part III: Model how different drugs effect neuron communication (5 minutes)

- Use your model to predict what happens when different drugs are introduced to the nervous system:
 - Nicotine
 - Hexamethonium



Discussion

- Could you use this lesson in your classroom?
 - Why or why not?
- Where might your students struggle?
- How could you support them?

Acknowledgements

- NIH, SEPA
- University of Illinois
 - Project NEURON

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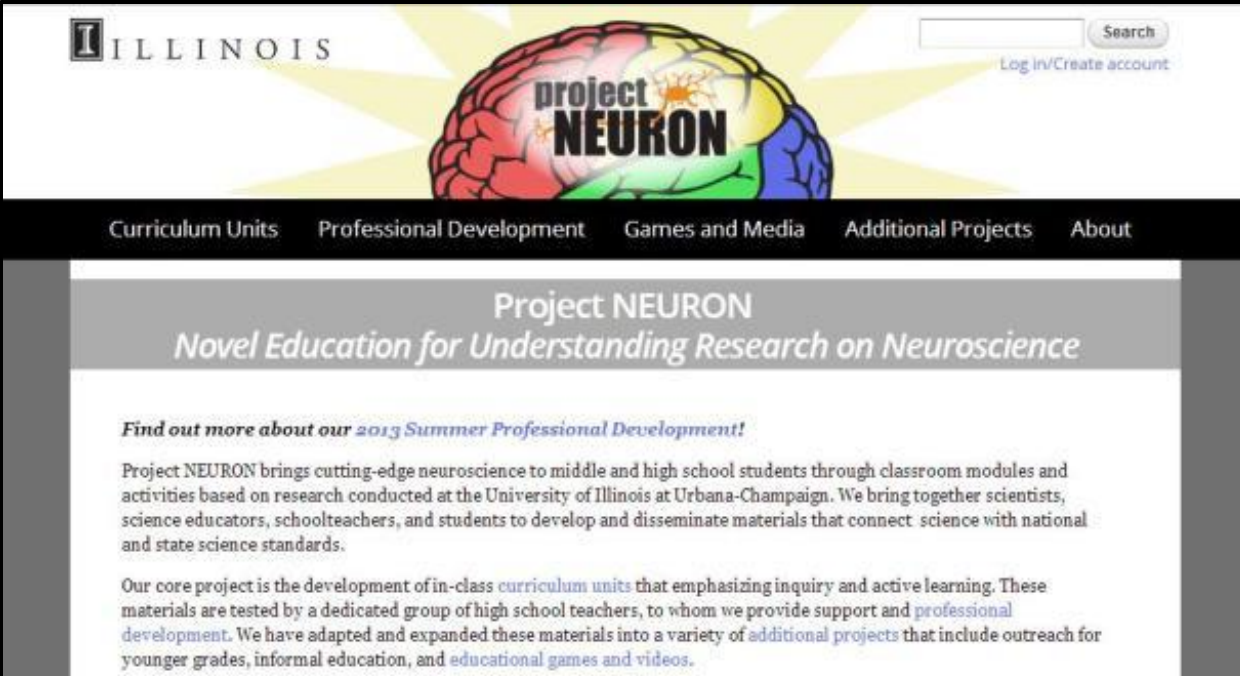
Thanks!

For additional information visit:
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neuron@illinois.edu



The screenshot shows the top portion of the Project NEURON website. At the top left is the University of Illinois logo. In the center is a colorful brain graphic with the text "project NEURON" overlaid. To the right of the brain is a search bar and a "Log in/Create account" link. Below the header is a navigation menu with links for "Curriculum Units", "Professional Development", "Games and Media", "Additional Projects", and "About". The main content area features the title "Project NEURON" and the subtitle "Novel Education for Understanding Research on Neuroscience". Below this is a section titled "Find out more about our 2013 Summer Professional Development!" followed by two paragraphs of text describing the project's goals and activities.

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Curriculum Units Professional Development Games and Media Additional Projects About

Project NEURON
Novel Education for Understanding Research on Neuroscience

Find out more about our 2013 Summer Professional Development!

Project NEURON brings cutting-edge neuroscience to middle and high school students through classroom modules and activities based on research conducted at the University of Illinois at Urbana-Champaign. We bring together scientists, science educators, schoolteachers, and students to develop and disseminate materials that connect science with national and state science standards.

Our core project is the development of in-class [curriculum units](#) that emphasizing inquiry and active learning. These materials are tested by a dedicated group of high school teachers, to whom we provide support and [professional development](#). We have adapted and expanded these materials into a variety of [additional projects](#) that include outreach for younger grades, informal education, and [educational games and videos](#).