Project-based Inquiry Science

A Model for Teaching, Learning, and Assessing Science in Grades 7-11 Classrooms

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PBIS Workshop Agenda

- Introduce PBIS with a hook from Vermont Public Radio (3 min)
- Debrief Radio Clip: How can we use this as an entry point for integrating PBIS into our Sound Curriculum? (6-8 min)
- Introduce PBIS through Sound Curriculum then spend time developing your own unit using the PBIS Project Planner and Share (30-35 min)
- Introduction to Compass School’s Science of the Mind Curriculum (5-7 min)
- Questions, comments, resources, and time for completing evaluations (3-5 min)
PBIS Learning Goals

We hope that participants will leave this workshop with:

• an understanding of the main tenants of PBIS,
• several clear examples of how to incorporate PBIS concepts into various types of science curricula and beyond,
• a start on your own science lesson plan that incorporates PBIS, and
• lots of resources to take home to further support your professional development!
Prior Experience with PBIS

Please take a few moments to answer the first question on the Workshop Evaluation Tool to give us an idea of your prior experience with PBIS.

Thumbs up—I’ve had lots of experience with PBIS and use it in my curriculum

Thumbs side—Some experience, I’ve heard about it!

Thumbs down—PBIS is brand new to me!
Imagine...

You are on your way to school and you’re thinking about the sound curriculum that you planning for an upcoming 9th grade physical science unit. Since you’ve heard about an approach called Project Based Inquiry Science (PBIS) you have been trying to figure out how you can integrate your upcoming unit with a real-world, community-based issue. You switch on your radio and you hear the following clip:
**Sound Article Debrief**

So, what were some thoughts and ideas that came up for you?

Share ideas about integrating:

- Social justice
- Student choice
- A captivating hook
- Real-world, local issue
- A differentiated approach
- An interdisciplinary approach
Sound Article Debrief

So, what were some thoughts and ideas that came up for you?

• how they came up with average for decibel rating (compared to I-phone listening)
• Impacts on health would this impact if folks wanted to stay in the area
• Social justice issue – Can the govt. force people out? How can it be related to the different scientific disciplines?
• Demographics – Who lives here?
• Looking at what changes have occurred? Increased traffic, for example.
• Tools or measurement – Authentic Data collection.
“A meme (Blackmore, 2000; Brodie, 1996; Dawkins, 1976) is an idea that has a life of its own. It refers to a unit of cultural information transferable from one mind to another. It thus acts as an underlying belief that drives how people interpret what is going on around them and organizes what they do” (p. 26).

—Caine and Caine, *Natural learning for a connected world: Education, technology, and the human brain*
PBIS is curriculum that...

- is **learner-centered** and honors **teacher as facilitator**

- contains **authentic content and purpose** and is based on a rich, complex, **driving question that is relevant to student lives**

- is grounded in **challenging projects** that integrate **technology** and culminate in a **presentation, model and/or performance (artifacts)** over an extended time frame

- is **collaborative, cooperative, and interdisciplinary**

- is **incremental** and leaves room for **continual improvement**

- incorporates **problem-solving, peer persuasion and/or presentation** (authentic, community-based accountability)

- contains **explicit educational goals** based on **standards (NGSS, CCS)**

Source: Krajcik, Czerniak and Berger (2003)
The PBIS Project Planner

Let’s take a moment to familiarize ourselves with the various sections of the PBIS project planner.

Using the PBIS Project Planner, brainstorm a possible project idea for your own science unit.
The PBIS Project Planner

Let’s see how we can integrate a fairly traditional, yet student-centered, learner-directed, hands-on Sound Lab into the Project Planner.
The PBIS Project Planner

Think ★ Pair ★ Share

Quick walk-thru of planner with Sound Curriculum as example.

Silently read and jot down notes.

Share ideas with partner then switch (give yourselves about 5 minutes each).

Report out to the whole group.
PBIS is curriculum that...

- is **learner-centered** and honors **teacher as facilitator**
- contains **authentic content and purpose** and is based on a rich, complex, **guiding question that is relevant to student lives**
- is grounded in **challenging projects** that integrate **technology** and culminate in a **presentation, model and/or performance (artifacts)** over an extended time frame
- is **collaborative, cooperative, and interdisciplinary** and is **incremental** and leaves room for **continual improvement**
- incorporates **problem-solving, peer persuasion and/or presentation** (authentic, community-based accountability)
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Source: Krajcik, Czerniak and Berger (2003)
More Food for Thought
Examples of Curricula that integrating PBIS Across Disciplines

In your packets on the right side, there are a few examples to prime the imagination.

• Physics & Humanities: *Sound Curriculum*
• Biology & Humanities: *Science of the Mind*
• Environmental Science/Physics & Humanities: *Students for Sustainable Energy*
• Chemistry & Humanities: *Research & Service Class*
Biology & Humanities: Science of the Mind

• Teachers and students from Biology & Humanities Classes co-designed the class
• Students democratically decided they wanted to study the brain
• Students picked their own topics which had to relate to subjective experience of mind and the physical brain to go deeper into
• Writing articles were modeled after New York Times science section
• Each had to submit an original piece of artwork
• The drafting process was significant and effective.
Integrating PBIS Across Disciplines and throughout the Sciences

Biology & Humanities: Science of the Mind

- Classes incorporated time for reflection
- We provided time for students to “mess about”
- We utilized a project board
- Students explain their thinking and projects to each other and make recommendations/consult
- Students sent their work to professionals at Harvard
- Students both collaborated with each other and REAL scientists
- Students did better work as evidenced by the journals
We Connected with the Community

Harvard Brain Bank, Harvard MRI Research Lab, UMASS Psychology Department, Brattleboro Meditation Center, Harvard Graduate School of Education Mind Brain and Education Program, Landmark College, Harvard University Mind Brain and Behavior Initiative, Harvard University Moral Cognition Lab, Social Cognitive and Affective Neuroscience Lab at Harvard Center for Brain Science, Harvard University Department of Psychology, Project ZERO at Harvard Graduate School of Education, Harvard-Smithsonian Center for Astrophysics Lab for Visual Learning, and others!
One Example of a SOTM Project:
My Brain Likes Exercise, How About Yours?

Whole class got invited to participate in real-world science study: “The Effects of Physical Activity on Cognitive Abilities across Development: Acute Study” (University of Massachusetts)

Compass student, Max, went deep into this topic to explore: How physical exercise affects brain plasticity

Max extended learning to school community by studying the EQ: Should we have physical education at Compass?
We modeled our journal writing after the New York Times Science Section
“In much the same way we learned to use a scalpel to dissect a brain, this class also gave me the knowledge and skills necessary to dissect my mind, to really look inside and start to understand what is going on.

We were not only taught the physiological ways in which a brain functions; we were taught the emotional and spiritual ways in which those biochemical reactions play out in our lives.”

-Kelty
Resources around the room include:

- Science of the Mind Journal from both years
- Feeding the Community with Hope Journal, a product of a 2-week service learning project at Compass School
- PBIS books
- Buck Institute for Education at: [www.bie.org/project_planner/create_new/](http://www.bie.org/project_planner/create_new/)

Articles/resources in the right side of your green folders under the clip:

- The curriculum mentioned at the end of this PowerPoint (Students for Sustainable Energy and Vermont Commons School Research & Service Program)
- Project Based Inquiry Science Overview
- Chapter 5: “Where's the Joy? Justice and Caring in Science Education” by Maria Rivera Maulucci and Angela Calabrese Barton
“[T]he more an empowered school becomes a model of success, the more nonempowered schools criticize it” (p. 72).

“People have to understand that these programs work not because they are so meticulously crafted and engineered but because the faculty will not let them fail. They developed these programs, and they are determined to make them work” (p. 74).

-Carl D. Glickman, *Holding Sacred Ground*
We very much appreciate your feedback. Please contact us to share ideas and stories!

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Students for Sustainable Energy

Inspiring students to tackle energy projects in their school and community

Regina Tuddenham and Anne Wernig

Additional Resources to Review at Home

Research & Service

The mission of the Research & Service Program is to give beyond the traditional classroom, to go beyond the classrooms walls, and to become engaged in community engagement and environmental stewardship at a local, national, and global level. Furthermore, the Research & Service experience would be students who understand the environment is part of the greater whole, and that they can and should have an active role in improving their communities. The Vermont Sustainable Farming Network is very much about seeking to promote sustainability in our community and our environment. We foster the sense of ownership, both in and outside.

To engage in both ways, they need to be engaged. Students become more engaged when they learn is a community service. The Research & Service Program at Vermont Commons School offers students the opportunity to apply theoretical knowledge to current problems and to work toward improving the environment. This program is designed to improve students' understanding of the environment and to elevate their awareness of the impact we have on the environment.

The purpose of this newsletter is to share information about the current projects and programs available to the students. We also want to recognize the efforts of our students and teachers in making a difference in our school and community.

We encourage you to visit our website for more information on our upcoming events and programs. You can also follow us on social media for updates on our activities and achievements.

Price Courses for 2011-2012 Include:

- Introduction to Sustainability
- Sustainable Agriculture
- Environmental Science
- Renewable Energy
- Green Building

For more information, please visit our website at www.vermontcommons.org.

The UNIVERSITY of VERMONT
Literature on Project Based Learning

• Teachers are generally enthusiastic, motivated, and successful in their quest to implement project-based learning in their science classrooms (Rosenfield and Ben-Hur, 2001).

• Standards-based, inquiry science curriculum can lead to standardized achievement test gains in historically underserved urban students, when the curriculum is highly specified, developed, and aligned with professional development and administrative support (Geier, et al. 2008).

• School culture and mission and teacher prior knowledge and experience of PBI played a significant role in teachers successfully implementing PBI in secondary science classrooms (Toolin, 2004).

• Driving Question Board (DQB) in project-based science (PBS) units: How to organize, focus, and link students questions to content learning goals. Examples in physics and chemistry provided (Weizman, et al. 2008).

• A planning team from a new urban public high school featuring project-based science, technology, engineering, and mathematics (STEM) education, with a population of African-American, low-income, and special needs students, creates a positive school culture with a clear vision and core values that engender relational trust, a strong sense of community, and principal and teacher co-leadership (Rhodes, 2011).
PBL maximizes the use of technological tools for analyzing, presenting, and communicating results (Grant, 2002; Morrison & Lowther, 2005).

How can science instruction help students and teachers engage in relevant genetics content that stimulates learning and heightens curiosity? (Alozie, 2010).

Underrepresented HS students' interest in science and science teaching increased as a result of engaging in a PBL summer program (Toolin, 2003).

At the start of an integrated Algebra I and Environmental Science class, students were presented with the following challenge: "How much carbon is stored in the Normanskill Preserve?" They were told they had one month to investigate and present their results, and asked, "What do you need to begin?" (Penniman, 2011).

The frequency of teachers' use of specific inquiry-based activities correlates with improvements in students' science attitudes and plans; the extent of the success of a PBS curriculum with students from groups underrepresented in science careers appears to be dependent on elements of both teacher knowledge and teachers' frequency of use of inquiry-based activities that are consistent with culturally relevant pedagogical practices (Kanter, 2010).
Integrating PBIS Across Disciplines and throughout the Sciences

Environmental Science/Physics & Humanities: *Students for Sustainable Energy*

- Winooski River Cleanup Project
- Solar Powered Greenhouse—applying energy concepts, equations, and theories to sustainability initiatives
- Composting System
Integrating PBIS Across Disciplines and throughout the Sciences

Environmental Science/Physics & Humanities: Students for Sustainable Energy

1. Assessing/teaching fundamental concepts of energy

2. Students brainstorm project options and formed teams based on following essential question: How can we reduce the need for energy or switch to alternative forms of energy consumption in the Northeast?
Integrating PBIS Across Disciplines and throughout the Sciences

Environmental Science/Physics & Humanities: *Students for Sustainable Energy*

3. Students and teacher identified and created protocol to prevent potential risks and began work on projects based on flexible project criteria.

4. Community members/experts were contacted via email or phone

E.g. Restoration of Lane Shops Hydro Dam in Montpelier, VT
Integrating PBIS Across Disciplines and throughout the Sciences

Chemistry & Humanities: Research & Service Class

Students in the Environmental Engineering Research & Service class at Vermont Commons School (vermontcommons.org) conducted a survey to assess potential sources of contamination to the Bartlett Brook watershed, a natural and recreational resource for the City of South Burlington, Vermont, and a drinking water source for 70,000 people.

Thanks again, and please consider contacting us!

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