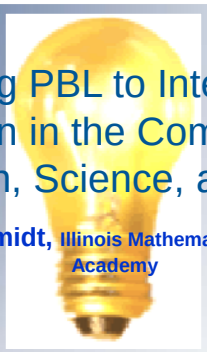
Using PBL to Integrate Instruction in the Common Core in Math, Science, and ELA



Kathy Schmidt, Illinois Mathematics and Science Academy

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- Virginia
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- Washington D.C.
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How Learning Happens:

Think of something you've learned well….

How did that happen?

How Learning Happens:

- Hands on experience
- Need/desire to know
- Enthusiasm and passion
- Self-interest
- Trial and error
- Family/social
- Practice
- Some prior knowledge
- Failure leads to improvement
- Teaching others
- Watching experts
- Break into smaller steps
- Feedback and reflection

Learner's Perspective of the PBL Process

Identify Know and Need to Know

Know	Need to Know	Need to Do

Define the Problem

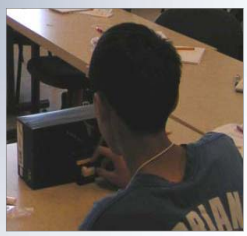
	Here's what I think . . .	Here's what we (pair) think . . .	Here's what our group thinks . . .
Overall Task			
Factors to Consider			

How can we…
in such a way that we consider…

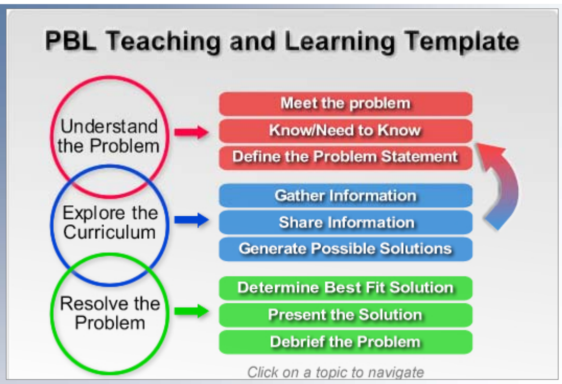
Teacher's Perspective of the PBL Process

Prepare the Learners

Teachers pave the way for PBL by establishing a classroom environment conducive to collaboration.



PBL Teaching and Learning Template



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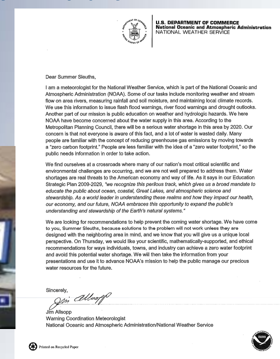
Meet the Problem

Students encounter a messy problem that engages their interest and compels them to need to know more.



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

Dear Summer Sleuths,

I am a meteorologist for the National Weather Service, which is part of the National Oceanic and Atmospheric Administration (NOAA). Some of our tasks include monitoring weather and stream flow on area rivers, measuring rainfall and soil moisture, and maintaining local climate records. We use this information to issue flash flood warnings, river flood warnings and drought outlooks. Another part of our mission is public education on weather and hydrologic hazards. We here NOAA have become concerned about the water supply in this area. According to the Metropolitan Planning Council, there will be a serious water shortage in this area by 2020. Our concern is that not everyone is aware of this fact, and a lot of water is wasted daily. Many people are familiar with the concept of reducing greenhouse gas emissions by moving towards a "zero carbon footprint." People are less familiar with the idea of a "zero water footprint," so the public needs information in order to take action.

We find ourselves at a crossroads where many of our nation's most critical scientific and environmental challenges are occurring, and we are not well prepared to address them. Water shortages are real threats to the American economy and way of life. As it says in our Education Strategic Plan 2009-2029, *"we recognize this perilous track, which gives us a broad mandate to educate the public about ocean, coastal, Great Lakes, and atmospheric science and stewardship. As a world leader in understanding these realms and how they impact our health, our economy, and our future, NOAA embraces this opportunity to expand the public's understanding and stewardship of the Earth's natural systems."*

We are looking for recommendations to help prevent the coming water shortage. We have come to you, Summer Sleuths, because solutions to the problem will not work unless they are designed with the neighboring area in mind, and we know that you will give us a unique local perspective. On Thursday, we would like your scientific, mathematically-supported, and ethical recommendations for ways individuals, towns, and industry can achieve a zero water footprint and avoid this potential water shortage. We will then take the information from your presentations and use it to advance NOAA's mission to help the public manage our precious water resources for the future.

Sincerely,

Jim Allsopp
Warning Coordination Meteorologist
National Oceanic and Atmospheric Administration/National Weather Service

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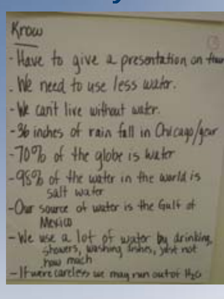
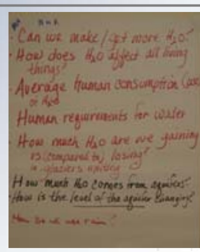
Identify Know and Need to Know



The group generates lists:

- ✓What we know
- ✓What we need to know
- ✓What we need to do



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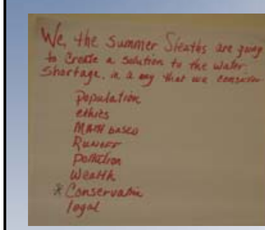
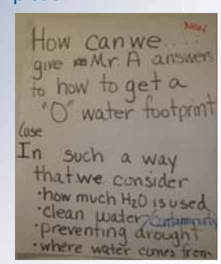
Define the Problem

Students list the **Task** to be completed and the **Factors** for successful completion.





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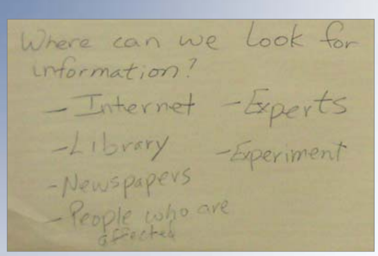
Plan for Information Gathering



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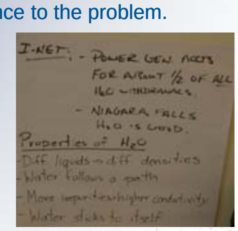
Gather Information

Learners gather information from multiple and varied resources to resolve their need to knows.

Share Information

Students share information they have gathered with their group and discuss its relevance to the problem.



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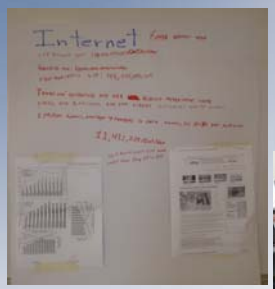
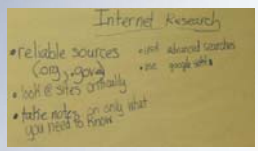
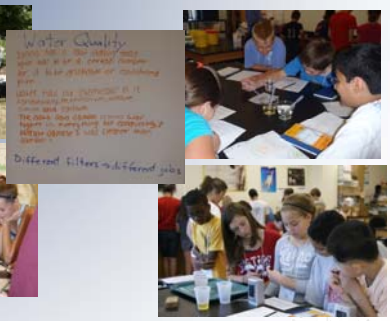
Gather and Share Information
Internet Research

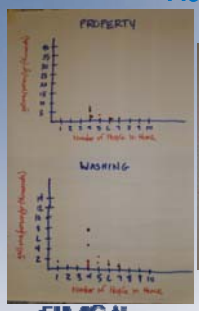


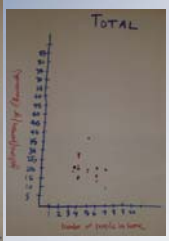


Gather and Share Information
Hands-on Inquiry



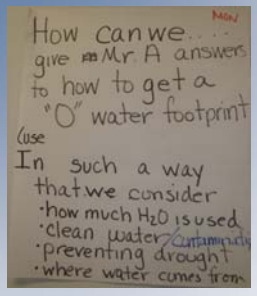
Gather and Share Information
Hands-on Inquiry

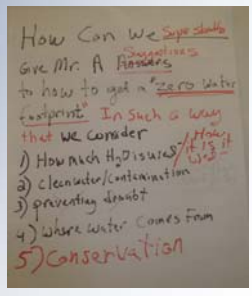




Gather and Share Information
Experts

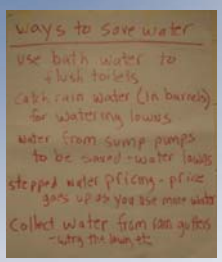
Refine Problem Statement

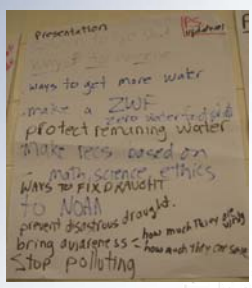




Generate Solution Elements

Students synthesize the information to find solution elements which fit the factors in their problem statement.



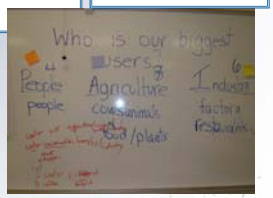


Determine Best Fit Solution

Students develop a graphic organizer to find a solution which fits the factors in their problem statement.

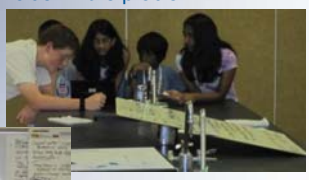
SWOT Analysis
- **S**trengths
- **W**eaknesses
- **O**pportunities
- **T**hreats

Decision Matrix
- Pros
- Cons
- Long-term effects



Present the Solution

Students present their solution to and get feedback from a real-world stakeholder in the problem.



Debrief . . . the Presentation

Learners debrief the presentation to emphasize learning from other groups' presentations.

"I loved how we were able to bring the information that we learn in class to the real world. It made us think outside of the box and it was something that none of my teachers have ever done before."

Debrief . . . the Problem

Learners debrief the problem and the process to emphasize the curriculum and group skills learned.

I liked that this unit called for a lot of thinking and creativity ... this unit made us use all parts of our brain and then mix it together to find solutions.

I liked how it was a real-world situation/challenge. It was logical problem solving for a worthwhile cause.

Stages of PBL, Science and Engineering Practices, Mathematical Practices, and College and Career Readiness in Reading, Writing, Speaking, Listening, and Language

Stage of PBL	Science and Engineering Practices	Mathematical Practices	College and Career Readiness in ELA
Meet the Problem	Ask Questions and Define Problems; Obtain, Evaluate, and Communicate Information	Make Sense of Problems and Persevere in Solving Them	Comprehend as Well as Critique; Come to Understand Other Perspectives and Cultures
Identify Know/Need to Know	Plan and Carry Out Investigations; Obtain, Evaluate, and Communicate Information	Make Sense of Problems and Persevere in Solving Them	Value Evidence
Define the Problem Statement	Ask Questions and Define Problems	Make Sense of Problems and Persevere in Solving Them	Respond to Varying Demands of Audience, Task, Purpose, and Discipline; Comprehend as Well as Critique; Come to Understand Other Perspectives and Cultures
Gather Information	Plan and Carry Out Investigations; Analyze and Interpret Data; Use Mathematics and Computational Thinking; Engage in Arguments from Evidence; Obtain, Evaluate, and Communicate Information	Make Sense of Problems and Persevere in Solving Them; Model with Mathematics; Use Appropriate Tools Strategically; Look for and Express Regularity in Repeated Reasoning	Demonstrate Independence; Build Strong Content Knowledge; Respond to Varying Demands of Audience, Task, Purpose, and Discipline; Comprehend as Well as Critique; Value Evidence; Use Technology and Digital Media Strategically and Capably
Share Information	Ask Questions and Define Problems; Develop and Use Models; Plan and Carry Out Investigations; Analyze and Interpret Data; Use Mathematics and Computational Thinking; Construct Explanations and Design Solutions; Engage in Arguments from Evidence; Obtain, Evaluate, and Communicate Information	Make Sense of Problems and Persevere in Solving Them; Reason Abstractly and Quantitatively; Construct Viable Arguments and Critique the Reasoning of Others; Model with Mathematics; Attend to Precision; Look for and Express Regularity in Repeated Reasoning	Demonstrate Independence; Build Strong Content Knowledge; Respond to Varying Demands of Audience, Task, Purpose, and Discipline; Comprehend as Well as Critique; Value Evidence; Use Technology and Digital Media Strategically and Capably

Stages of PBL, Science and Engineering Practices, Mathematical Practices, and College and Career Readiness in Reading, Writing, Speaking, Listening, and Language

Stage of PBL	Science and Engineering Practices	Mathematical Practices	College and Career Readiness in ELA
Generate Possible Solutions	Ask Questions and Define Problems; Develop and Use Models; Plan and Carry Out Investigations; Analyze and Interpret Data; Use Mathematics and Computational Thinking; Construct Explanations and Design Solutions; Engage in Arguments from Evidence	Make Sense of Problems and Persevere in Solving Them; Construct Viable Arguments and Critique the Reasoning of Others; Model with Mathematics; Use Appropriate Tools Strategically; Look for and Make Use of Structure	Comprehend as Well as Critique; Value Evidence
Determine Best Fit Solution	Ask Questions and Define Problems; Develop and Use Models; Analyze and Interpret Data; Use Mathematics and Computational Thinking; Construct Explanations and Design Solutions; Engage in Arguments from Evidence; Obtain, Evaluate, and Communicate Information	Make Sense of Problems and Persevere in Solving Them; Reason Abstractly and Quantitatively; Construct Viable Arguments and Critique the Reasoning of Others; Model with Mathematics; Use Appropriate Tools Strategically; Attend to Precision; Look for and Make Use of Structure; Look for and Express Regularity in Repeated Reasoning	Respond to Varying Demands of Audience, Task, Purpose, and Discipline; Comprehend as Well as Critique; Value Evidence
Present the Solution	Develop and Use Models; Analyze and Interpret Data; Use Mathematics and Computational Thinking; Construct Explanations and Design Solutions; Engage in Arguments from Evidence; Obtain, Evaluate, and Communicate Information	Reason Abstractly and Quantitatively; Construct Viable Arguments and Critique the Reasoning of Others; Model with Mathematics; Use Appropriate Tools Strategically; Attend to Precision; Look for and Express Regularity in Repeated Reasoning	Demonstrate Independence; Build Strong Content Knowledge; Respond to Varying Demands of Audience, Task, Purpose, and Discipline; Comprehend as Well as Critique; Value Evidence; Use Technology and Digital Media Strategically and Capably; Come to Understand Other Perspectives and Cultures
Debrief the Problem	Construct Explanations and Design Solutions; Engage in Arguments from Evidence; Obtain, Evaluate, and Communicate Information	Construct Viable Arguments and Critique the Reasoning of Others; Look for and Make Use of Structure	Comprehend as Well as Critique; Value Evidence

PBL Resources

Kathy Schmidt, Professional Development Specialist, kschmidt@imsa.edu

http://pbln.imsa.edu