

**The Math-Science Partnership Project**

The Guided Inquiry and Vernier probes  
Science Teacher Institute  
for  
SBCSC Intermediate Center Teachers

Workshop 1A  
Jordan Hall of Science Monday, June 13 to Friday, June 17

**WELCOME**

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**INTRODUCTIONS**

Who are we? (very important people)

Why are we here? (for the money)

What are we going to do here (play, eat and have fun)

Please introduce yourself to your neighbor including answers to the above questions

We will then ask some of you to tell us what your neighbor said (we would like to hear from everyone, but that might take too long...)

Housekeeping: registration, sign-in, pay, restrooms, the binder, schedule, etc

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**Vernier Probes in the classroom**

**Engaging Students** with the Freedom to Inquire and the Technology to Excel

Extending the Indiana Science Initiative curriculum with the use of Vernier probes and Labquests

Bringing Understanding (teachers and students) to the meanings of the New Indiana Science Standards

Using Guided Inquiry Best Practice Teaching

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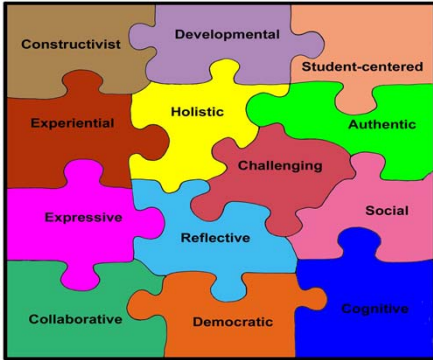
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The 13 Principles of Best Practice Teaching:




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Mis-Guided

Inquiry



Even In South Bend...

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From the South Bend Tribune – 21 June, 2011

A rather atypical rescue by firefighters on Tuesday morning led to some happy ducklings in South Bend.

Around 10:00 a.m., officials said they responded to the intersection of Douglas Street and Juniper Street after receiving calls of ducklings trapped in a drain. They believe the babies were following their mother across a drain when they fell through the holes and became trapped. During the rescue, the mother duck flew around the intersection listening to her babies' cries.

"They were running up three different pipes," said Don Burns of Notre Dame Utilities. "We had to wait for them to come into the catch basins. If you can get in there and plug up the pipes before they come in the catch basin, it makes it a lot easier so they can't get back out.

"Once all the ducklings were rescued from the drain, they were released in a nearby field into their mother's care.

*it really happens...*

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**The rest of the morning...**

**Part 2 -  
Kent's review of  
The Guided Inquiry Classroom**

**Part 3 -  
Presurveys**

**Part 4 -  
Notebooking (Kent)**

**Part 5 -  
Some aspects of best practice teaching (Gordon)**

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Essential Feature	A	B	C	D
1 <b>Learner engages in scientifically oriented questions</b>	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials or other source	Learner engages in question provided by teacher, materials, or other source.
2 <b>Learner gives priority to evidence in responding to questions</b>	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3 <b>Learner formulates explanations from evidence</b>	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence and how to use evidence to formulate explanation
4 <b>Learner connects explanations to scientific knowledge</b>	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	Learner told connections to scientific knowledge
5 <b>Learner communicates and justifies explanations</b>	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to sharpen communication	Learner given steps and procedures for communication.

Student Directed ← ← ← Guided Inquiry ⇒ ⇒ ⇒ Teacher Directed

Adapted from Inquiry and the National Science Education Standards, National Academy Press, 2000, page 29

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**On Learning** (from *How People Learn*)

**What is Learning? – example - the Paul Revere story**

- People of all ages come to class with ideas.
- These ideas/preconceptions are often **different** from those accepted by “experts”.
- Since they are based on the person’s own experiences they can be strongly held.
- Research indicates that “**telling**” and “**rote learning**” do not change the person’s thinking.
- Changes can occur through **active engagement**.

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**Paul Revere's Ride**  
Henry Wadsworth Longfellow (1807-1882)

He said to his friend, "If the British march  
By land or sea from the town to-night,  
Hang a lantern aloft in the belfry arch  
Of the North Church tower as a signal light,-  
One if by land, and two if by sea;  
And I on the opposite shore will be,  
Ready to ride and spread the alarm  
Through every Middlesex village and farm,  
For the country folk to be up and to arm."

Two possible messages - ..... for the students

BUT Did Paul know the code? (or had the code reversed)  
What if, while rowing across the river, he forgot the code!

**The messenger is part of the message....**

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Key concepts - 1

**Learning**  **Play**

**INQUIRY**

**Quality Intellectual Work**

Quality intellectual work, learning, and play are different  
angles in the process of  
**INQUIRY**

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**Let's Take a Sip\* of Play**

- S – It's satisfying
- I – It's intentional
- P – It's problem solving



Are your students engaged and motivated?  
**Three important ingredients in play and in learning...**  
How would notebooks enhance SIP/engagement?

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Key Concepts – 3

### The SIP Principle

**Play is**

- ✓ Satisfying
- ✓ Intentional
- ✓ Problem solving

Do you feel the same way about your students' learning in class?

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Key Concepts - 4

**Inquiry**  
calls for deep engagement  
with the **(guiding)** question;

**Misconceptions and error**  
are essential to the process  
of  
**problem-solving**

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### Quality intellectual work

Has three essential features:

**Construction of knowledge** that actively involves the learner in developing his/her understanding

Through the use of **Guided/disciplined Inquiry**

To produce discourse, products, or performances that have **Value beyond** the classroom.



cf: Newman, F. and associates. (1996)  
*Authentic achievement: Restructuring schools for intellectual quality.*  
San Francisco: Jossey-Bass. (a print-on-demand title)

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### What Makes Guided Inquiry?

[An alternative to Roger Bybee's "3 E's"  
And Klentschy's 7-part-plan notebooks ]

#### A 3-part lesson-plan: PIP

Each part must be Satisfying, Intentional Problem-solving

Problem-setting (Engagement)

Investigate (Explore)

Publish (Evaluate)

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### What makes PIP Guided Inquiry

Problem setting

The learners are **engaged** in a science problem that may not have a unique solution; (usually) the teacher introduces this problem through the "hook" of a good story, an interesting real world situation, or a challenge; the group discusses and more closely defines the exact nature of the problem, stressing that it must be "set" in terms that are actionable.

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### What Makes PIP Guided Inquiry?

Investigation

**the learners** focus on a problem, make a prediction, and investigate the problem; the learners work in small groups drawing on prior knowledge and experience and produce data using methodology appropriate to the discipline, which is then analyzed and synthesized. The students' ideas, plans, and later their data and analyses, are recorded in their own notebooks, which become their record of learning—an assessment tool for themselves and for the teacher

**The Teacher facilitates** by raising clarifying, probing questions.

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# What Makes PIP Guided Inquiry?

## Publishing

Each small group shares its synthesis and analysis of the data used to solve the problem(s). This leads to a full group discussion exploring questions such as: *Is this a sufficient answer to the problem? Are there new questions/problems to pursue? Or does the question need revising? Was there a problem with the investigation?* (e.g. identify new variables, refine data collection, use tools better or use better tools). Such questions are asked after any investigation, scientific or otherwise. Through this process, the students become investigative scientists, equipped with an approach they can apply to other learning experiences in life.

And link their investigations (their own knowledge) to the rest of their experiences – past present and future

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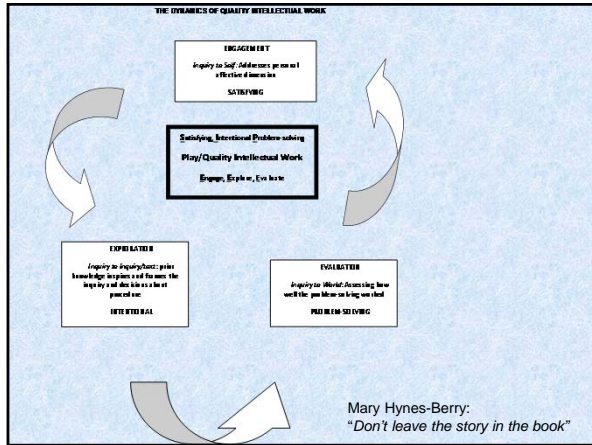
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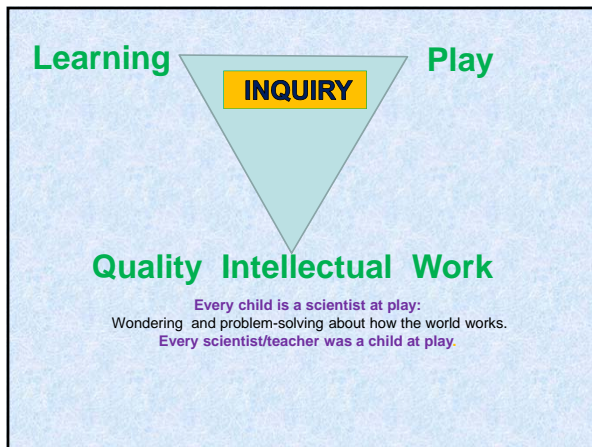
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**Becoming Science Literate....**  
**Learning how to learn - about science...anything**

What kind of **Learning Path** works best for you?

(Almost) All learning  
Begins with the Concrete  
Moves to the Pictorial  
And then to the Symbolic

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As understanding deepens and develops, we continue to move back and forth between the three levels.

The role of Questions should be

to deepen and expand our students' understanding

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Which of these questions tend to support a SIP ?

- *Closed questions*
  - "Open-and-shut" closed
  - "Unlocked" closed questions
- *Leading questions*
- *Open questions*

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## What kinds of questions are characteristic in your classrooms?

- *Q&A Ping Pong*
- *Teacher wondering questions*
- *Learner wonder/wander questions in the course of a guided inquiry.*

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"The Ladder" of Questions...	
Level	Developmental Trajectory
<p><b>3</b></p> <p><b>Evaluating/Synthesizing Inquiry</b>—explores fully open-ended questions</p> <ul style="list-style-type: none"> <li>• Emphasis on why questions, questions that make text to self, text to text, text to world/connections</li> <li>• No single right answer; in fact, responses are often varied and may lead to a new direction</li> <li>• A good response will be supported with examples and connections</li> <li>• Response involves discussion/conversation as the responder expresses, clarifies, and extends thinking</li> <li>• Calls for active listening and facilitating on questioner's part—questions may need to be rephrased or prompts given</li> </ul>	<p><b>Abstract Symbolic Thinking</b></p> <ul style="list-style-type: none"> <li>• At all stages of development, this kind of inquiry tends to elicit high engagement and satisfaction because the responder "owns" the discussion and is constructing personal understanding. Such inquiry typically goes beyond the classroom and may be seen in children's play.</li> <li>• The 5 to 7 shift marks the transition from early to mid-childhood. In this period, children gradually increase their ability to abstract and to reason.</li> <li>• Before, and in the early part of this stage, children's evaluative statements tend to be based on a specific/concrete factor.</li> <li>• In the next 4-5 years, between 7 and 12, children's ability to generalize and engage in abstract thought goes through another significant development.</li> </ul>
<p><b>2</b></p> <p><b>Analyzing/Applying Inquiry</b>—explores leading to open-ended questions.</p> <ul style="list-style-type: none"> <li>• Emphasis on how, why, some what questions, includes comparison/contrast, categorizing</li> <li>• No single right answer but a "good" answer may need to include a certain amount of information/facts in support (leading questions)</li> <li>• Response involves discussion/conversation as the responder expresses, clarifies, and extends thinking</li> <li>• Calls for active listening and facilitating on questioner's part—questions may need to be rephrased or prompts given</li> </ul>	<p><b>Formal</b></p> <ul style="list-style-type: none"> <li>• This is a transitional point between concrete and the abstract thinking and understanding. At this stage, there is some generalization in terms of developing schemas or frameworks. However, the analysis or application is based on concrete data or ideas.</li> <li>• While young children in the concrete stage of development are very capable of analyzing/applying, their explanations tend to reflect direct experience or literal details rather than abstractions.</li> <li>• As children reach the end of the 5-7 shift, their ability to generalize increases and they are able to make more complex inferences about character, motivation, cause and effect, etc.</li> </ul>
<p><b>1</b></p> <p><b>Knowledge and Comprehension Inquiry</b>—tends to use closed questions</p> <ul style="list-style-type: none"> <li>• Emphasis on what, where, when questions that can be supported by direct reference to the text.</li> <li>• At lowest level, open-ended/closed questions that call for yes/no or single word responses &amp; are asked test memory (or attention).</li> <li>• Level 1 questions can be <b>unlocked closed questions</b> that such questions call on respondent to visualize, recall, describe, sequence.</li> <li>• Level 2 and 3 requires basic comprehension and knowledge as part of checking facts, building support for an idea, clarifying, &amp; creating connections.</li> <li>• In a conversational/discussion, this level inquiry involves active listening and facilitating—questions may need to be rephrased or prompts given.</li> </ul>	<p><b>Concrete</b></p> <p>All learning/thinking begins with the concrete.</p> <ul style="list-style-type: none"> <li>• Young children who are still at the concrete level developmentally need extensive opportunities to explain and "unpack" the literal level of meaning.</li> <li>• Novice learners at all stages of development need time to make sense on the concrete and pictorial levels as a foundation to strong conceptual understanding at the symbolic level.</li> <li>• Fully mature learners often move quite quickly from this stage to the symbolic in areas of expertise.</li> </ul> <p>At all stages of development when the focus is exclusively or extensively on this level, participants' sense of inquiry or ownership can be lost and learning inhibited by anxiety and poor disposition.</p>

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