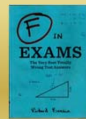
When a star's life cycle is over there is a possibility it will become a black hole. Describe a "black hole."

Something very dark in the ground and it looks like this

More science from Richard Benson



Name a regular triangle.

a three - sided triangle

Why do some researchers believe that living close to a cell phone tower might cause poor health?

You might walk into it.

NISMEC
Northern Indiana Science, Mathematics & Engineering Center

South Bend Community School Corporation

The Math-Science Partnership Project Day-2, Tuesday

Schedule:

1- Discussion of the overnight homework
2- **NOT** Naked Science – Gordon
3 - 7th/8th grade whiteboards
4 - From the kits - developing Vernier extension #1

5 - Developing a Vernier measurement extension
6 - Presenting our SIP extension
(white-board reporting out…)
7 - Completing one-page report (preliminary version)

Morning Break
Lunch

Kent's GI delicacies
Afternoon Break

Which of these questions tend to support SIP ? (satisfying Intentional Problem-solving)

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

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.*

"The Ladder" of Questions…

Level	Level of Inquiry	Developmental Trajectory
3	**Evaluating/ Synthesizing inquiry**—explores fully open-ended questions • Emphasis on *why* questions, questions that make *text to self, text to text, text to world* connections • No single right answer; in fact, responses are often varied and may lead to a new direction • A good response will be supported with examples and connections • Response involves discussion/ conversation as the responder expresses, clarifies, and extends thinking • Calls for active listening and facilitating on questioner's part; questions may need to be rephrased or prompts given	***Abstract Symbolic Thinking*** • 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. • 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. • Before, and in the early part of this stage, children's evaluative statements tend to be based on a specific/concrete factor. • 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.
2	**Analyzing/ Applying inquiry** –explores leading to open ended questions, • Emphasis on *how, why,* some *what* questions; includes comparison/ contrast; categorizing • No single right answer but a "good" answer may need to include a certain amount of information/facts in support (leading questions) • Response involves discussion/ conversation as the responder expresses, clarifies, and extends thinking • Calls for active listening and facilitating on questioner's part—questions may need to be rephrased or prompts given	***Pictorial*** • This is a *transitional* point between concrete and the abstract thinking and understanding. At this stage, there is some generalization in terms of developing schema or frameworks. However, the analysis or application is based on concrete data or ideas. • 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. • *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.*
1	**Knowledge and Comprehension inquiry** –tends to use closed questions • Emphasis on *what, where, when* questions that can be supported by direct reference to the text; • At lowest level, open-and-shut closed questions be call for yes/no or single word responses & are asked test memory (or attention. • Level 1 questions can be **unlocked closed questions**" that such questions call on respondent to visualize, recall, describe, sequence. • Level 2 and 3 inquiries require basic comprehension and knowledge as part of checking facts, building support for an idea, clarifying, & creating connections. • In a conversation/discussion, this level inquiry involves active listening and facilitating —questions may need to be rephrased or prompts given.	***Concrete*** All learning/thinking begins with the concrete. • Young children who are still at the concrete level developmentally need extensive opportunities to explain and "unpack" the literal level of meaning . • 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. • Fully mature learners often move quite quickly from this stage to the symbolic in areas of expertise; 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.

WHAT'S THE STORY IN SCIENCE
OR
DOWN WITH NAKED EXPERIMENTS
OR
SCIENCE AND LITERACY

Co-opted by Gordon
from a presentation on "NAKED NUMBERS"
By Mary Hynes-Berry – ILEAYC – 2010

"Don't leave the story in the book"
Teachers College Press – November 2011

What Makes the Difference— for you and for the students?

What are you teaching:
Science facts ?
or
Science concepts and ideas ?

Do you engage the students with a story?

Example: Science **story problem**

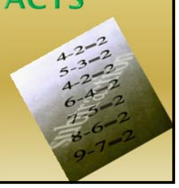
Turn & Talk

- ***What solutions can you find to this problem?***
- *What are some ways the 42 elephants can carry 17 kings to Kabul?*

$$\mathbf{l}\cdot\mathbf{s} = [j(j+1) - \ell(\ell+1) - 3/4]/2$$
$$= \ell/2 \qquad (j = \ell + 1/2)$$
$$= -(\ell+1)/2 \qquad (j = \ell - 1/2).$$

THE PROBLEM WITH SCIENCE PROBLEMS
IS THAT
THEY ARE FILLED WITH
NAKED SCIENCE FACTS

$<M> = \int d^3r\, u_\rho^*(r) M_{\rho\sigma} u_\sigma(r)$



Naked --because the science facts in the problems have been stripped of their stories—

That means they lose the

Science all around us

Big Ideas & Problem situations That make them meaningful.

Every critical question of students is essentially scientific:

e.g.

Why is it bigger… (because bigger is always better?)

Am I getting bigger/better?

What kind of bigger is it?

How much/ how many?

Is it fair/How do things compare?

What's the pattern/rule?

Here's another problem

Naked Science Facts Don't Invite Conversation

Problem-solving & Thinking

Are deeply grounded in language

As conversation and discussion, not

As rote recitation or Ping-pong teaching/learning

& yet another problem

Naked Science Facts look like Nouns

There is no such thing as big or or small!

There are always comparisons

Big, small is an **ATTRIBUTE**—an adjective not a noun

In science this attribute is called **measurement**

3 elephants might seem obviously bigger when compared to 3 mice

- —if you used the attribute of size
- BUT for the attribute of *how many*
  - they are identical….

In simple SCIENCE Nouns are the

UNIT (kg, meters, joules…) to which the attribute belongs.

In real science

MEASURING/CLASSIFYING

Can be described as grouping qualities which share one or more attributes.

A Group can include like or unlike units:

- Above we can see one set of 3 grey elephants and another of 3 grey mice.
- Above is a group of 6 grey animals
  3 gray elephants & 3 grey mice

We can make up stories about the pictures that give us quite different scientific sentences

the gray elephant family met the blind grey mouse family so that there were 2 families of animals altogether.

Both families had a mother, a father and a baby.

The blind mice couldn't see the elephants but the elephants could see the mice. They were terrified , of course, so they galumphed off as fast as they could, leaving the mice behind.

Each family stayed together

How about this story?:

2 of the elephants were scared by the mice and ran away; but the baby elephant decided to stay to talk with them.

We can represent this with two very different **scientific deductions**:

Grown-up elephants are frightened of mice

or

Baby elephants are not frightened of mice

Can you make up some more stories involving these pictures?

Feel free to add attributes that might change the groupings and their actions

Write some descriptive sentences explaining them.

$F = Ma$ $3x + 2Y = 5$

Notice that the sentences alone don't necessarily tell the whole story about the interactions between the elephants and the mice.

What members of all the gray animals are in the alternative stories?

Just the NAKED Science Facts!!

$X = (1/2)\, gt^2$ $D = m/v$

Naked Facts= dull Disconnected science

Action stories* = *Science in Life

It is much more EFFICIENT to deal with the science descriptions if we have lots to calculate-

BUT it is critical to remember the fundamental learning trajectory

[aka the C-P-S principle]

CONCRETE TO PICTORIAL TO SYMBOLIC

However old or young we are, true understanding—including mathematical and scientific understanding:

- Starts with the **concrete**, that is a hands-on experience—putting one cup with one plate for each person at a table, touching each item as we count, stacking two piles of blocks to make one "bigger"—taller than the other.
- Moves into the **pictorial**—the student can look at pictures or tally marks know how to count or compare sizes visually, without actually having hands-on proof.
- And finally progresses to the **symbolic**—the student knows that the words *red, blue, yellow* are colors, and that there are lots more of them...

Students can think and problem-solve at a high level BUT they are

very concrete

Brain research is showing us that even young students (and grownups too!) can evaluate and analyze —

But only if they can directly see & touch or have direct experiences to draw on

What are the implications for Scientific understanding and instruction for students?

ALL Science INSTRUCTION must focus on THINKING & PROBLEM-SOLVING & Must be deeply embedded in CONCRETE EXPERIENCE

Science Sense is Developmental

- When we have good control of *science concepts* –that is how groups of scientific facts can be collected together—we can be said to have **Science Understanding –**
- Strong science sense includes ***making connections***—such as immediate recognition that elephants and mice are both animals.

Rational vs. Rote Science

The trajectory from emergent to fluent is well known for literacy. But too few realize we should also be looking for where children are with scientific deduction –and the ability to rationally connect not just facts but also ideas.

But the emphasis on science facts can make it difficult to assess where a student is in mastering these 4 principles:

1. Collecting
2. Comparing
3. Sorting
4. Connecting

This is just the tip of the iceberg!

What questions/comments do you have about

- **Scientific thinking vs. Science Facts**
- **Naked Numbers and Facts**
- **Counting things (of what?)**
- **Sorting things (comparisons)**
- **Story problems**
- **??????????????**

The importance of concepts:
And linking them to learning

Just the Facts - NO ->> Concepts and Ideas – YES

Naked numbers Arithmetic to **(merchant) math**

Naked Science Facts to **everyday use**

Naked words **Stories! Reading** with/for **meaning**

Naked Dates **Stories! Experiencing experience**

We all are stories We are all connected! ….

Example: Words Are Concepts

Recognition **Recognizing word when it is heard or read.**	**Definitional** **Knowing what the word means.**
Relational **Understanding how the word is related to other words.**	**Contextual** **Being able to use the word in various appropriate contexts.**