Anticipating Student Responses in Your

RESEARCH LESSON DESIGN

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Lesson Study Overview
jugyokenkyuu

- Setting Goals
  - School Improvement & Lesson
- Lesson Design (~5-weeks)

You are here!

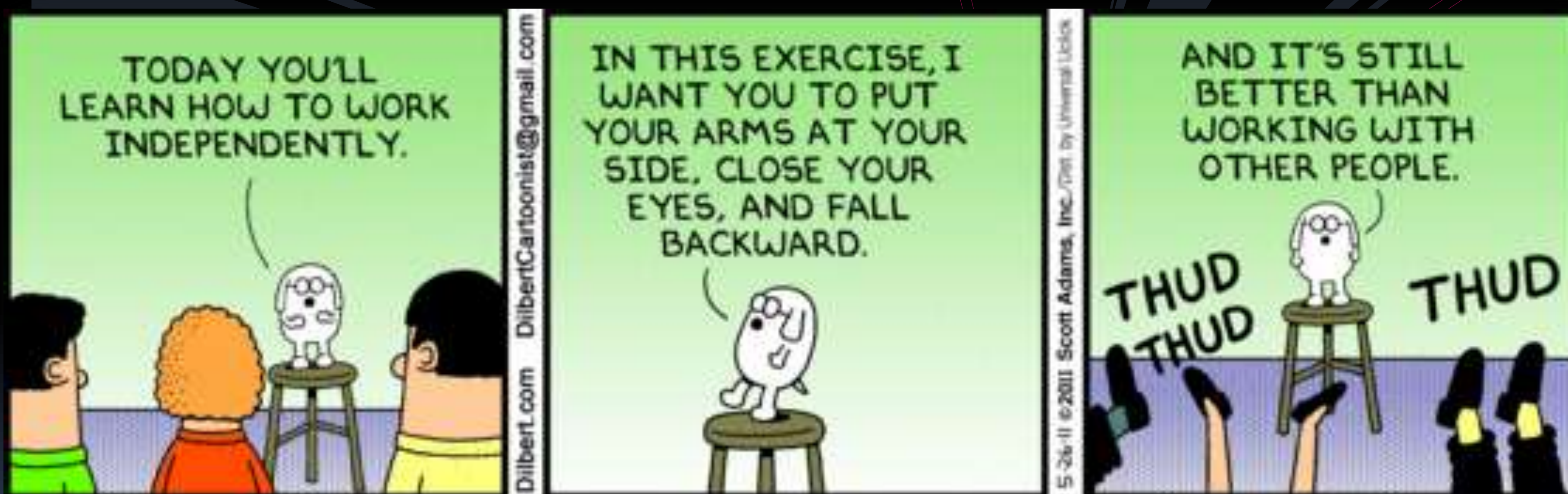
- Research Lesson (Internal or Public)
  - Briefing→ Teaching→ Observing→ Debriefing
- Revising and Re-teaching (optional)
- Reflecting, Sharing Insights, Reporting

Anticipating Student Responses

Let's explore…

Research Lesson

Let’s explore…



“Make Light”


DAD, HOW DOES A LIGHT BULB WORK?
MAGIC.
DIDN'T YOU SAY THAT'S HOW THE VACUUM CLEANER WORKS?
RIGHT. THEY'RE BOTH MAGIC.
YOU JUST DON'T KNOW HOW THEY WORK, I'LL BET.
FINE. DON'T BELIEVE YOUR OWN FATHER, WHO'S BEEN AROUND A LOT LONGER THAN YOU.
LOOK MOM, MAGIC!
THAT'S NOT MAGIC!
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WATTERSON

Anticipating Student Responses

Let's explain…

Questions to discuss

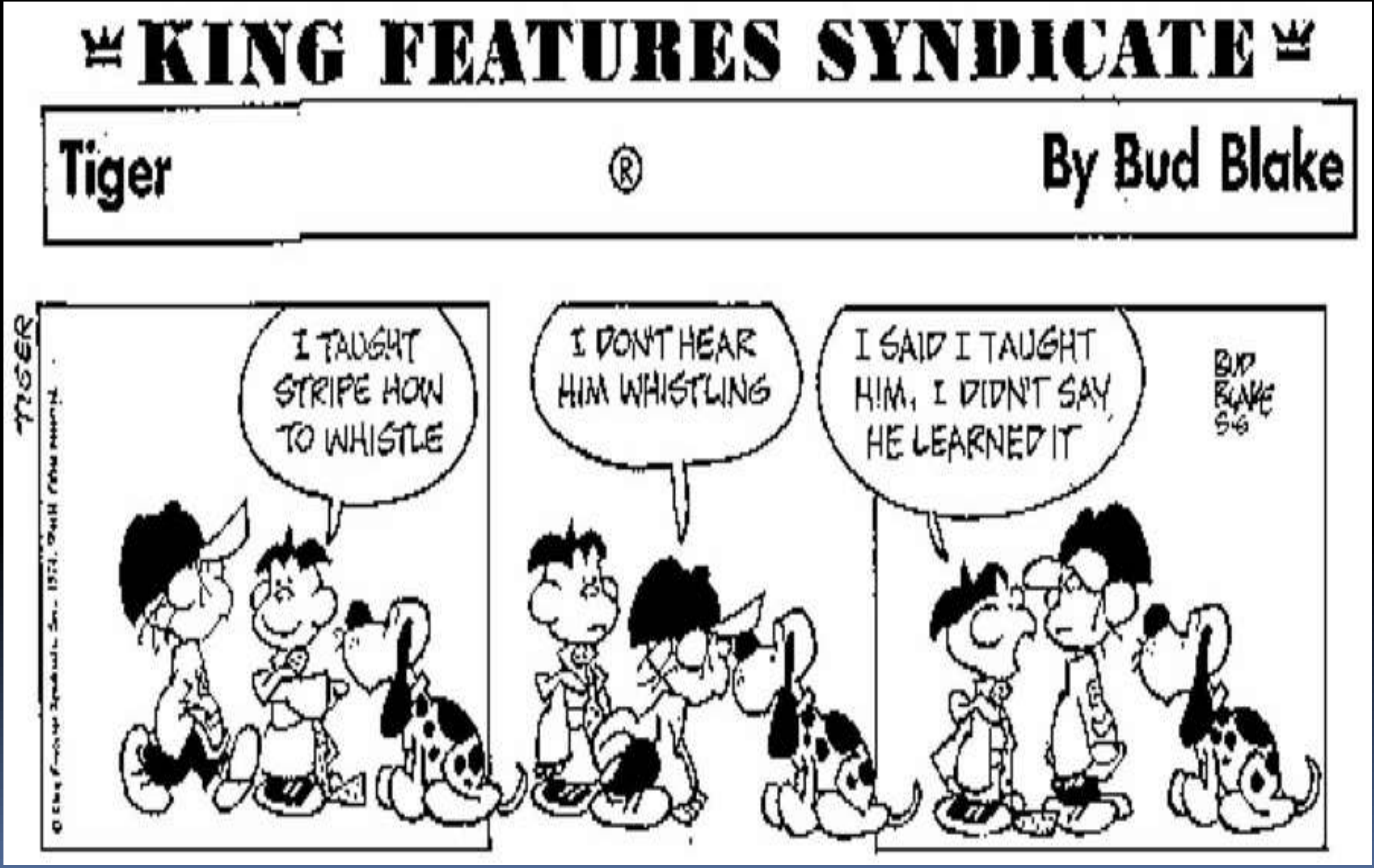
- What does "anticipating student responses in research lesson design" mean?
- Why does this matter?
- How can we do this both efficiently and effectively?

What is your basis for anticipating student responses?

What is your basis for anticipating student responses?

- Personal Experience
  - your own experiences/ideas of schooling
- Local Experience
  - …with your prior cohorts of students
  - …with your current cohort of students
- Studied Experience
  - insights from generalized systematic research
- Others?

Anticipating Student Ideas



PRINCIPLES OF LEARNING

Learning Is Not Necessarily an Outcome of Teaching

Cognitive research is revealing that even with what is taken to be good instruction, many students, including academically talented ones, understand less than we think they do. With determination, students taking an examination are commonly able to identify what they have been told or what they have read; careful probing, however, often shows that their understanding is limited or distorted, if not altogether wrong. This finding suggests that parsimony is essential in setting out educational goals: Schools should pick the most important concepts and skills to emphasize so that they can concentrate on the quality of understanding rather than on the quantity of information presented.

The Research Lesson…

Science Research Lesson Plan

Date:	March 15, 2010	March 18, 2010
Location:	Greenman Elementary School, Aurora, Illinois	Prairie Point Elementary School, Oswego, Illinois
Instructor:	Steven Rogg, Ph.D.	
Planning Team:	Steven Rogg, Emily Hergenrother, & Evelyn Mazzucco	

I. Title of the Lesson

Experience the 5E Instructional Model with Electrical Circuits

II. Participants

This lesson is designed for adult preservice elementary teachers enrolled in EDU3330 "Methods of Teaching Science" at Aurora University.

III. Goals of the Lesson:

1. Experience a Science Research Lesson
2. Experience and recognize the phases of the 5-E instructional model (Bybee, et al., 2006).
3. Relate the 5E model to characteristics of exemplary science teaching.

IV. Relationship of the Lesson to the Standards

A. Related prior learning standards (topics/objectives)

- Candidates examined a classic case study (video) of cognitive change in which a skilled interviewer exposes a child's conceptions before, during, and after a common Grade 6 lesson on "photosynthesis" taught in apparently exemplary fashion (H. Schneps & Sadler, 1987; M. H. Schneps & Crouse, 2002).
- Candidates have read about and discussed characteristics of effective science teaching as represented in representative sources (Center for Science Mathematics and Engineering Education. Committee on Development of an Addendum to the National Science Education Standards on Scientific Inquiry., 2000; Harwood, 2004; NRC, 1996; Rutherford, Ahlgren, & Project 2061 (American Association for the Advancement of Science), 1994, Chapter 13; Sawada, et al., 2000)

↓

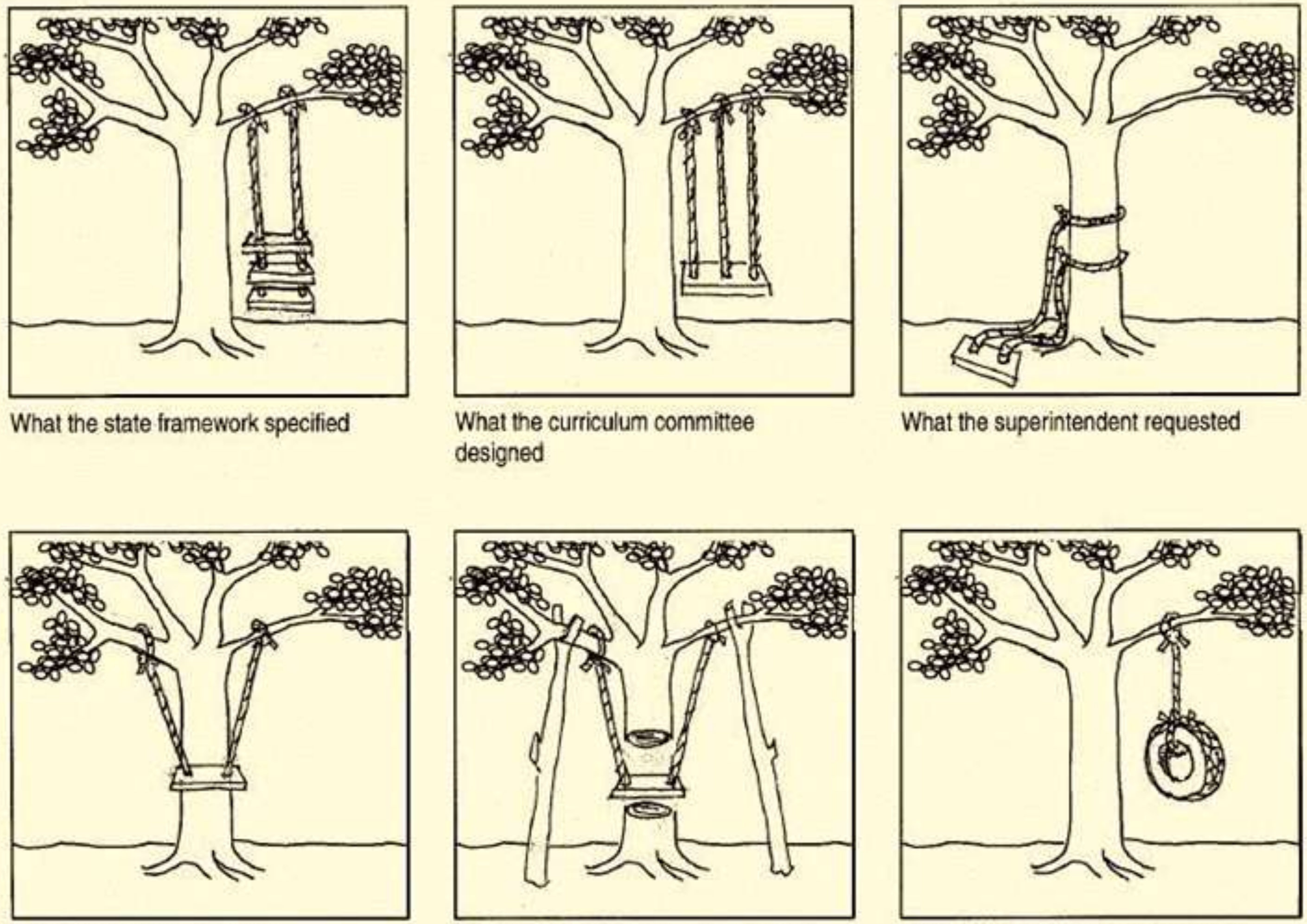
This Lesson

↓

B. Related post learning standards (topics/objectives)

- Candidates will work in teams at the host school to develop a Science Research Lesson which uses the BSCS 5E instructional model and this lesson as an example.

Research Lesson *Design*



What the state framework specified

What the curriculum committee designed

What the superintendent requested

What the board of education approved

What the publisher actually produced

What the literacy goals had intended

Project 2061 (American Association for the Advancement of Science). Designs for Science Literacy. xi, 300p. Oxford University Press, New York, 2001. Page 37.

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7-Es: Experience the 5-E Instructional Model with Electrical Circuits

- Engage: Set up the challenge “Make Light”
- Explore: Alternative ways to “Make Light”
  - or ~~*not*~~
- Explain: Construct Meaning from Solutions
  - seeing the “circuit” as an unbroken *path*
- Elaborate: The Circuit Inside
- Evaluate: The “Post Lesson Discussion”

Topic Study: Electrical Circuit

OK so far?

Kyozaikenkyu and CTS

Curriculum Topic Study

- Benchmarks
- Standards
- Atlas
- Research
- Experience

Research Lesson

- Content Knowledge
- Pedagogical Knowledge
- Curricular Knowledge
- PCK ✓

Electrical Circuits (1/3)

Project 2061 took a close look at the topic of electrical circuits. This happens to have been the subject of considerable research on students' learning difficulties, in terms of both the necessary input of learning effort and the likely output of fruitful knowledge. On the input side, how learnable are circuit ideas? Some researchers have spent their careers trying to understand why students—from elementary school to college—have so much difficulty in understanding not just the differences in behavior of series and parallel circuits, but even the very notion of what a circuit is. Even when researchers have thought they understood the nature of students' difficulties and misconceptions, they still have had trouble figuring out how to overcome them. So, at best, a great deal of extra classroom time would have to be spent on getting students to understand electrical circuits.

Electrical Circuits (2/3)

On the outcome side, how important is it to science literacy for students to understand electrical circuits? The judgment has to be made on the basis of the importance of that knowledge itself, the prior knowledge required to learn it, and what other knowledge it will lead to or support. By itself, electrical circuitry does not have much to offer science literacy. Practical knowledge of electrical circuits may be required for students who will specialize in physics or engineering, and it would also be of value to do-it-yourselfers to understand what is happening in, say, a three-way switch arrangement, but even they would be well advised to follow standard wiring diagrams rather than figure it out on their own. On the other hand, the idea of an electric current plays an important role in science literacy because of its relationship to magnetic fields in electric motors, power generators, Earth's magnetic field, and more. For those links, however, less need be known about currents than is necessary for making sense of series and parallel circuits.

Electrical Circuits (3/3)

Project 2061 concluded, therefore, that series and parallel electrical circuits as a subject was best left out of the goals for the core science curriculum on the grounds that it would require a high instructional cost and provide a low payoff. Paradoxically, one of the most popular instructional units among elementary- and middle-school science educators is the hands-on science activity “batteries and bulbs,” in which students investigate series and parallel circuits. It may be that this engaging activity can be adequately justified by its contribution to understanding scientific reasoning— hypotheses, evidence, modeling, observation, and so on—even if students are not likely to retain knowledge about series and parallel electrical circuits. And of course any student with an interest in electrical or electronics technology ought to have some opportunity outside of the common core to study circuits. In any case, the point here is not to single out conclusions about the topic of electrical circuits for special attention but to illustrate the kind of analysis that is needed in deciding which topics ought to be included and which left out.

For more about electrical circuits…

1. Search for the term "electric" in Chapter 7 of Designs for Science Literacy at: http://www.project2061.org/publications/designs/ch7.pdf
2. Check the research base (albeit not up-to-date) in Resources for Science Literacy. Simply search for "electric" (or "electric circuit") in the search field on this page: http://www.project2061.org/publications/rsl/online/RESEARCH/COG_TOC.HTM
3. The Illinois Learning Standards for Science do not speak to electric circuits explicitly. The only goal found for electricity at the elementary level was: "12.C.2a Describe and compare types of energy including light, heat, sound, electrical and mechanical." Of course, we can look to *Benchmarks for Science Literacy* and the *National Science Education Standards*, too. http://www.isbe.net/ils/science/pdf/goal12.pdf
4. The new *Handbook of Research on Science Education* has a relevant chapter. It turns out that there are at least **444 published studies about electric circuits** (Duit, Neidderer, & Schecker, 2007, p606). Reference: Duit, R., Neidderer, H., & Schecker, H. (2007). Teaching Physics. In S. K. Abell & N. G. Lederman (Eds.), Handbook of research on science education (pp. 599-629). Mahwah, N.J.: Lawrence Erlbaum Associates.

Research Lesson Conclusions

- Did the teacher candidates learn something about electricity?
  - Yes, and this was very limited.
  - This is forgivable since this is ***not*** a physics or physical science class.
  - Mostly the teacher candidates were confronted with how little they had learned in elementary school, high school, and college! (Which is, of course, disturbing enough.)
- Did the teacher candidates experience a reasonable representation of a 5-E learning cycle model?
  - We are confident that they did.
  - It was striking how naturally the 5-E model mapped into the lesson study template.
- Did the teacher candidates consider the utility of the 5-E instructional model?
  - Feedback from students at the subsequent meeting was very positive.
  - Consensus was that the experience was far more effective that simply reading and discussing.

Anticipating Student Responses

Revisited!

Questions to discuss

- What does “anticipating student responses in research lesson design” mean?
- Why does this matter?
- How can we do this both efficiently and effectively?

THE MONTILLATION AND USES OF TRAXOLINE

It is very important to learn about traxoline. Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians found that they could gristerlate large amounts of fervon and then bracter it to quasel traxoline. This new, more efficient bracterillation process has the potential to make traxoline one of the most useful products within the molecular family of lukizes snezlaus.

THE MONTILLATION AND USES OF TRAXOLINE

QUIZ

1. What is traxoline?

2. Where is it montilled?

3. How is traxoline quaseled?

4. Why is traxoline important?

"How Students Learn…"

A community-centered classroom that relies extensively on classroom discussion, for example, can facilitate learning for several reasons…

- It allows students' thinking to be made transparent—an outcome that is critical to a learner-centered classroom. Teachers can become familiar with student ideas... Teachers can also monitor the change in those ideas with learning opportunities, the pace at which students are prepared to move, and the ideas that require further work—key features of an assessment-centered classroom.
- It requires that students explain their thinking to others. In the course of explanation, students develop a disposition toward productive interchange with others (community-centered) and develop their thinking more fully (learner-centered)...
- Conceptual change can be supported when students' thinking is challenged, as when one group points out a phenomenon that another group's model cannot explain (knowledge-centered).

National Research Council. (2005). *How students learn: science in the classroom. Washington, D.C.: National Academies Press.*

Questions to discuss

- What does "anticipating student responses in research lesson design" mean?
- Why does this matter?
- How can we do this both <u>efficiently</u> and <u>effectively</u>?

Practical Strategies

- Give it **time**!!!
  - Do NOT "short circuit" this process!
  - Refuse to proceed until you know you are ready.
- Put your *knowledgeable other* to work.
  - Find key research & curriculum resources
  - And hold their feet to the fire!
- Study the potent sources…
  - summaries, position papers, metaanalyses
- *Divide et impera…*

Together we will conquer!

7E References

- Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., et al. (2006). *The BSCS 5E Instructional Model: Origins and Effectiveness*. Colorado Springs, CO: BSCS.
- Center for Science Mathematics and Engineering Education. Committee on Development of an Addendum to the National Science Education Standards on Scientific Inquiry. (2000). *Inquiry and the National Science Education Standards : a guide for teaching and learning*. Washington, D.C.: National Academy Press.
- Duit, R., Neidderer, H., & Schecker, H. (2007). Teaching Physics. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 599-629). Mahwah, N.J.: Lawrence Erlbaum Associates.
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- NRC. (1996). *National Science Education Standards : observe, interact, change, learn*. Washington, DC: National Academy Press.
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- Rutherford, F. J., Ahlgren, A., & Project 2061 (American Association for the Advancement of Science). (1994). *Science for all Americans* (Rev. ed.). New York: Oxford University Press.
- Sawada, D., Piburn, M., Turley, J., Falconer, K., Benford, R., Bloom, I., et al. (2000). *Reformed Teaching Observation Protocol (RTOP) Training Guide* (No. Technical Report No. IN00-2): Arizona Collaborative for Excellence in the Preparation of Teachers (ACEPT), Arizona State University.
- Schneps, H., & Sadler, P. M. (1987). A Private Universe. from http://www.learner.org/resources/series28.html
- Schneps, M. H., & Crouse, L. (2002). A private universe misconceptions that block learning [videorecording]. S. Burlington, Vt.: Annenberg/CPB.

Resource Links

http://lessonstudygroup.net/

http://www.project2061.org/

http://www.house.gov/science/hot/Competitiveness/aci06-booklet.pdf

http://www.ed.gov/about/inits/ed/competitiveness/

http://www.ed.gov/about/inits/ed/competitiveness/strengthening/strengthening.pdf

http://seconline.wceruw.org/secWebHome.htm

Three characteristics set Lesson Study apart from typical professional development programs:

- Lesson Study provides teachers an opportunity to see teaching and learning in the classroom in a concrete form. Teachers focus their discussions on planning, implementation, observation, and reflection on classroom practice. By looking at actual practice in the classroom, teachers are able to develop a common understanding or image of what good teaching practice entails. This in turn helps students understand what they are learning.
- Lesson Study keeps students at the heart of the professional development activity. It provides an opportunity for teachers to carefully examine the student learning and understanding process by observing and discussing actual classroom practice.
- Lesson Study is teacher-led. Through it teachers can be actively involved in the process of instructional change and curriculum development.

http://hrd.apecwiki.org/index.php/Lesson_Study_Overview#Lesson_Study_in_Japan

Some Key Processes

Term	Meaning
jugyokenkyuu	lesson study
kyozaikenkyu	instructional material research
kenkyu jugyo	research lesson
hatsumon	posing key questions
bansho	blackboard writing
kikanshidoi	in-between desk instruction
neriage	extensive whole-class discussion

http://hrd.apecwiki.org/index.php/Glossary_of_Lesson_Study_Terms