

A TIME FOR PHYSICS FIRST

ACADEMY FOR TEACHERS
INQUIRY AND MODELING EXPERIENCES FOR PHYSICS FIRST

LEADERSHIP IN FRESHMAN PHYSICS, 2009-14



A TIME for PHYSICS FIRST

NEWSLETTER: Vol 5, No. 1, April 2011

A GREAT TEACHER

Doug Steinhoff,
Jefferson Junior High School, Columbia

What are the characteristics of a great teacher? Are there criteria that distinguish the good teachers from the bad ones? Is it the number of years of experience? Level of college education? Degrees earned? Number of hours spent at school?

Researchers across the world have been puzzled as to why we can't produce the best teachers for our students year in and year out. If you ever figure out the formula for generating exceptional teachers, please remember who gave you the idea, and offer me a cut. What are the criteria for identifying great teachers? Student improvement? Test scores? EOC's? Student, parent or principal opinions? Now I see why "Merit Pay" has such negative connotations.

I have a couple of observations from my 27 years of teaching. First, we've all been around teachers that don't pull their weight, that is, someone who is just going through the motions, someone who really doesn't have a clue as to what they are doing. Maybe someone who doesn't know enough content to be effective. There have been scads of books written about what it takes to be a good teacher, some of them carry some weight, while most don't hold water.

I too consider myself a poor instructor, and to this day, I am constantly striving to get better. Nevertheless, there have been a couple of traits that I have observed successful teachers as possessing, while others are lacking. The first of those traits is content knowledge. I think we would all agree that if you don't know the content, it's hard to be effective. We've all seen this; a teacher second guessing what they are teaching, and even worse, when students discover what you already know. Of course there is also the opposite, the teacher who truly knows everything but just can't get their points across to a lower "life form" (student). The "teaching" escapes them as they only assume that

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everyone already knows what they would identify as "basic" knowledge.

The second of those traits is an easy one to identify. The word to best describe it is PASSION. Teachers who love what they do so much that they incorporate their lives into their job. These are the teachers that are always looking for new ways to help their kids understand a difficult concept.

So you may be asking, "Doug, why are you telling us of your opinions on the differences between good and bad teachers?" Since you asked, the answer was shown to me at our last get together. At the round table discussions I noticed a motivation that I had not yet witnessed in the summer institute. I was amazed at how many of you had new ideas or suggestions on how to "tweak" a lab or activity or even new ways to grade homework/lab papers, and it wasn't just the enthusiasm, it was much more. I could tell that many of you were getting exponentially more comfortable with the content and it really showed. There were glimpses of heartfelt interest and success. In my eyes I could see that there were a lot of good teachers on their way to excellence. The content knowledge was coming full circle and even more so, the passion for what you do was starting to shine through. I know that when I bought into the Physics First program, it took me a long while to feel acclimated to the content and the way that it was taught, but I remember starting to see that it was the "how" content was taught as to why it was so successful. Does this make me the "perfect" teacher? Definitely not, but I know that I am better off than I used to be, and from what I saw last month, you are too. What do you think?

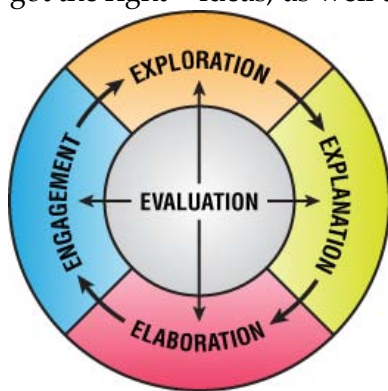
5-E LEARNING CYCLE IN YOUR PHYSICS CLASSROOM

Marsha Tyson, Oakland Junior High School

Think back to college.... The professor lectured, then you did a series of confirmation labs. These labs were essentially demonstrating what you already knew should happen. I remember many hours in a chemistry lab, scraping the bottom of a beaker or adding a little extra powder to ensure I "got the right mass." The point of the lab was not to teach, it was to confirm. The surprise of learning was diminished, because I already knew the answer.

The Physics First curriculum is designed differently

than the way we were taught in college. It utilizes the 5-E Instructional Model, which is designed to support student questioning and exploration. The 5-E Learning Cycle promotes enthusiasm, builds understanding, and allows students to explore beyond the essential content ideas, as well as have them discover physics relationships rather than confirm an equation. The Learning Cycle supports our students through a process of Engage, Explore, Explain, Elaborate and Evaluate. As the picture



suggests, it is a cycle utilizing formative assessments along the way. Have you ever wondered why the Electricity, Energy, and Forces units all began with a gadget lab? It is to Engage at the beginning. As in any cycle, there is no absolute end to the process. Evaluation is not – or should not be – the last step. Evaluation occurs in all four parts of the learning cycle.

The following chart outlines what learning activities are consistent with the Model, as well as what is not consistent. It has been adapted from http://dese.mo.gov/divimprove/curriculum/science/SciLearnExp5_E11.05.pdf

5-E CYCLE	LEARNING ACTIVITIES	STUDENT'S ROLE	INCONSISTENT WITH MODEL	TEACHER'S ROLE	INCONSISTENT WITH MODEL
ENGAGE <ul style="list-style-type: none"> • Accesses and builds connections with prior knowledge, stimulates learner curiosity, provides motivation to learn. 	<ul style="list-style-type: none"> • Brainstorming • Free-Write • Gadget Stations • KWL • Framing Questions • Box-O-Cars 	The student shows interest in the topic by asking and/or answering questions, such as: <ul style="list-style-type: none"> • What do you observe? • Why do you think this happens? • What do you already know about this? 	The student: <ul style="list-style-type: none"> • Asks for the right answer • Seeks only one solution • Insists on answers and explanations 	The teacher: <ul style="list-style-type: none"> • Creates interest • Generates curiosity • Raises questions • Uncovers students' misconceptions 	The teacher: <ul style="list-style-type: none"> • Explains concepts • Provides definite solutions and answers • Lectures • Provides closure
EXPLORE <ul style="list-style-type: none"> • To satisfy curiosity, build background through exploration of natural phenomena Learner gathers, organizes, interprets, analyzes, evaluates data 	<ul style="list-style-type: none"> • Perform an investigation • Solve a problem • Design • Plan • Collect data • Build models • Bubble Tube Lab • Strength of Gravity Lab 	The student: <ul style="list-style-type: none"> • Thinks freely, but within limits of activity • Records observations and ideas • Suspends judgment • Makes predictions • Tests predictions 	The student: <ul style="list-style-type: none"> • Is passively involved • Works without interaction with others • Plays around" with no goal in mind 	The teacher: <ul style="list-style-type: none"> • Acts as a facilitator • Encourages students to work together • Asks probing questions to redirect student thinking • Observes and listens to students 	The teacher: <ul style="list-style-type: none"> • Provides answers • Tells or explains how to work through a problem • Tells students they are wrong • Leads students step-by-step to the solution

5-E CYCLE	LEARNING ACTIVITIES	STUDENT'S ROLE	INCONSISTENT WITH MODEL	TEACHER'S ROLE	INCONSISTENT WITH MODEL
EXPLAIN <ul style="list-style-type: none"> • Student gains understanding of the concepts and can verify answers to questions or problems. Terms are introduced and defined as appropriate labels for concepts and phenomena. 	<ul style="list-style-type: none"> • Student analysis and explanation • White boarding at the end of a lab • Supporting ideas with evidence • Thinking skill activities" compare, classify, error analysis • Teacher explanation • Deriving mathematical patterns from data 	<p>The student:</p> <ul style="list-style-type: none"> • Uses group discussions and teacher interaction to derive definitions and explanations of topic • Uses recorded observations to derive meaning • Find patterns in data • Questions others explanations • Share ideas through white boarding 	<p>The student:</p> <ul style="list-style-type: none"> • Proposes explanations from "thin air" • Brings up irrelevant experiences • Accepts explanations without justification 	<p>The teacher:</p> <ul style="list-style-type: none"> • Encourages students to propose explanations for their observations • Asks for evidence • Uses student's previous experiences as a basis for explanation • Formally provides definitions, explanations, and new labels 	<p>The teacher:</p> <ul style="list-style-type: none"> • Accepts explanations without justification • Neglects student explanations • Introduces unrelated concepts or skills
ELABORATE <ul style="list-style-type: none"> • Activities allow students to apply concepts in contexts, and build on or extend understanding and skill. The teacher gives students new information that extends what they have been learning in the earlier parts of the learning cycle. 	<ul style="list-style-type: none"> • Propose explanations for problems • Design additional experiments • Set up a multi-step challenge • 2 Cars Approaching Challenge • Motion Detector lesson allowing students to duplicate graphs 	<p>The student:</p> <ul style="list-style-type: none"> • Applies new labels, definitions, equations to a new, yet similar situation • Draws conclusions from evidence • Makes connections of concept to real world applications • Makes connections to concepts in other content areas 	<p>The student:</p> <ul style="list-style-type: none"> • "Plays around" with no goal in mind • Proposes explanations from "thin air" • Ignores previous information or evidence 	<p>The teacher:</p> <ul style="list-style-type: none"> • Reminds students of the existing evidence and asks "What do you already know? Why do you think...?" • Asks probing questions • Expects students to use definitions, labels, equations 	<p>The teacher:</p> <ul style="list-style-type: none"> • Explains concepts • Provides definite solutions and answers • Lectures • Provides closure • Explains step-by-step how to work through a problem
EVALUATE <ul style="list-style-type: none"> • Assess student understanding of concepts and skills. 	<ul style="list-style-type: none"> • Produce a product • Journal entry • Test • Performance assessment • Formative and summative assessment probes • Framing Questions--revisited 	<p>The student:</p> <ul style="list-style-type: none"> • Answers open-ended questions by using previous experiences • Demonstrates and understanding of knowledge • Participate in self-evaluation • Uses alternative assessments to demonstrate understanding 	<p>The student:</p> <ul style="list-style-type: none"> • Memorizes answers without providing explanations • Draws conclusions without evidence • Introduces new, irrelevant topics/ideas 	<p>The teacher:</p> <ul style="list-style-type: none"> • Revisits Framing Questions as a form of assessment • Looks for changes in student thinking based on new experiences • Assesses student knowledge or skills 	<p>The teacher:</p> <ul style="list-style-type: none"> • Tests vocabulary words, terms and isolated facts • Introduces new ideas • Creates ambiguity • Promotes open-ended discussion

WHAT IF A LEADER WANTS TO GO TO A QUIET, DARK ROOM?

Elizabeth Dyer, Kingston K-14

From Elizabeth Dyer's leadership blog post:

I have procrastinated on this final blog because every post that I started sounded whiny. So I've decided to embrace my inner two-year-old and explore what a leader can do when she is feeling tired and put upon.

I am stealing some of these ideas from other teachers in my school, but they make me feel better. Or at least open to sticking with it until things do get better.

- There are times when it seems like all the due dates have come due at once. Prioritize and do a little at a time. Get things started and don't wait until everything is perfect. Sometimes it doesn't have to be perfect – it just needs

get done. But use this as a wake-up. We expect our kids to plan ahead and start early – see how it feels to be on the other end of the grading pencil?

- Get enough sleep. If you are tired, it's easy to feel like everyone is picking on you. They probably aren't, you are just taking everything personally. If you snap your students' heads off the next day, the fact that you spent hours grading papers until midnight isn't that commendable.
- Have a no-complaint, no shop-talk lunch so you can decompress. This was suggested by a teacher at my school. We are going through a stressful time at my school and lunch had become a vent session. After lunch, we'd feel even more frustrated. So the

teacher suggested a Friday lunch in which people would bring in small snacks to share and we would completely swear off any talk about school business. It really has helped.

- Share a positive thought with someone. A previous administrator had a program called "A drop in the bucket" in which we had half-sheet pages of paper with a drawing of a bucket. There were lines in the bucket for us to write a short note of congratulations, thanks, or encouragement. It was fun to get them but it was also fun to write them and make someone know that people had noticed what they were doing.

This actually has helped. I'm looking forward to getting together this summer.

STUDENT WORK

Angie Nichols, Ashland High School

For the April Physics First Follow Up meeting, my presentation was called Student Work. I chose to share a poster project and rubric for the acceleration unit.

For this project, students are given a data set of certain positions at certain times. Then students are asked to do a range of calculations and graphing to illustrate the different parts of the process of studying acceleration. First, students are asked to make an x-vs-t graph. Next, students are asked to find the instantaneous velocities for times 2 seconds through 8 seconds. Then, students are supposed to graph

these velocities on a v-vs-t graph.

After the v-vs-t graph is completed, students are supposed to find the change in position by finding the area "under the curve" in the v-vs-t graph. They are also required to calculate the change in position by using the formula. Finally, students should draw a motion diagram to match the x-vs-t and v-vs-t graphs. After the posters are completed, students are given a rubric with which they are asked to peer review or grade posters of two other groups.

The next class period, students were given a picture of one of the

posters on the smart board to identify the correct and incorrect components. Students are able to easily identify the errors in their own work and the work of their peers

The other subject that I briefly discussed was the homework practice I use. Students begin by doing all of their work in pencil. When we whiteboard the material, students are expected to correct their work in pen. This gives me an idea of who completes the work and who understands it. I give points for completing the assignment and completing the corrections. It seems to work fairly well most of the time.

WHAT AN EXPERIENCE!!!!!!

Darrell Bolin, Bunceton High School

Lincoln University recently hosted its 29th annual International Science Fair. Students from central Missouri entered projects they had been working on for most of the school year and a couple were actually extensions from previous year's projects. The experiments are conducted by students ranging from sixth grade through seniors in high school. Students competing in the junior division grades six – eight may work in teams of up to three members. The senior division is for freshman through senior year students who must compete individually.

What is unique about this science fair is the top two overall projects qualify for expenses paid to the Intel International Science and

Engineering Fair. The international competition is a week-long process. In 2010 students competed for over \$4 million in cash and scholarships. This year's competition is being held in Los Angeles with students from throughout the world competing.

I must admit that I kind of messed up with some projects. I didn't exactly read all the instructions and many of my freshmen Physics First students competed as teams. Lincoln University's Dr. James Rooney and his team of judges were not too harsh. They allowed my students to compete with the understanding that if any won the category they would not be allowed to compete for overall. This being Bunceton's first time compet-

ing on such a large scale, we were not expecting a great showing.

That evening at the awards ceremony Dr. Rooney explained what had occurred with the team entries in the senior division and we all live and learn from mistakes. Then much to my surprise, two projects in the physics category from Bunceton High School were announced as first and second place. I am very proud of these students along with all my students who stepped out of their comfort zone at this prestigious event.

In closing, science teachers of Missouri, take a look at this science fair for your students. It is a great event.



*Jack Wieggers meets with his PLC, February 2011.
Cory Grage, Amy Denother, Danielle Camarota and Ellen McCray*

COFFEE CUP BRAIN BENDERS

Dorina Kosztin, University of Missouri

RUBBER BANDS AND WEIGHTS

Attach two rubber bands to the center of the bottom of a coffee cup. Attach two heavy washers (or nuts) at the other ends of the rubber band. The washers should be heavy enough to stretch the rubber bands and hang over the side of the cup. Predict: What happens with the washers when you hold the cup with one hand, and then release it? Do it and watch!



As the cup and its contents fall, the whole system is in free fall, falling with the gravitational acceleration g . The rubber bands are not affected by the fall and as soon as you let go of the cup, the rubber bands will pull the washers into the cups.

WEIGHTLESSNESS

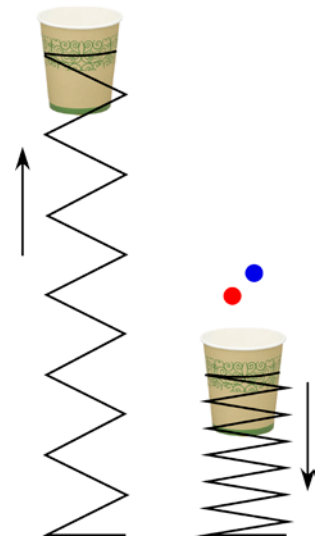
Take a coffee cup and fill with water. Punch a few holes in the cup's wall near the bottom. Water begins to stream out of the holes. Hold the cup in one hand over a sink or garbage can, and release the cup to fall freely. What happens?



As soon as you release the cup, water stops streaming out of the cup until the cup hits the sink or garbage can. When the cup is released, both the cup and the water inside are falling with the same acceleration g . You can also cover the cup (without holes at the bottom) with a lid and make a hole in the lid. Throw the cup anyway you want, up, down or projectile like, and you will see that no water comes out of the cup as long as the cup and water are in free fall.

EXCEEDING GRAVITATIONAL ACCELERATION

Hold one end of a slinky firmly down on the floor with tape or a very heavy object. Stretch the spring upward by holding its other end. You may want to stand on a stool or table. When the upper end



is released, it races down with an acceleration that exceeds g .

To demonstrate this effect, attach a paper or foam cup tightly at the upper end and place one or more marbles in it. Release the cup. The contents of the cup will separate from the cup and follow the cup down to the floor. You may replace marbles with water for a more dramatic effect.



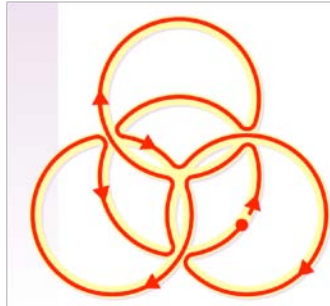
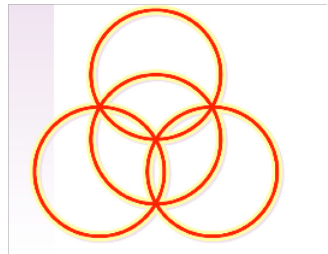
Cohort 1 Fellows share successes and challenges at the February 2011 follow-up session

Solutions to December 2010 Brain Benders

INTERSECTING CIRCLES

Draw the four intersecting circles on the left without taking your pencil off the paper, nor going over any part of the line twice.

(www.puzzles.com)



Solution:

CROSSING THE RIVER

Three kids from Bristol went for a walk. About a mile into the walk, they came to a deep, wide river. There was no bridge. They didn't have a boat or raft, or any materials to make one. None of them could swim. How did they get across?

Solution: It was winter. The river was frozen and they walked across.

GYMNASTICS

A true story: the bishop was hanging around minding his own business. Suddenly a horse jumped over a castle and landed on him, and he found himself disappearing from the landscape. Where did it happen?

Solution:

On a chessboard. The white knight (horse) was moved over the rook (tower) and landed on the square occupied by the black bishop, which was immediately removed from the board.

ATOMIC PLANT

A man and his son were on a tour of an atomic power plant. In the control room, the boy asked if he could see the controls for the reactor core. The head physicist said yes, and explained how the controls worked. After the boy left, the head physicist turned to an assistant and said, "That was my son."

How could that be?

Solution: The head physicist was the boy's mother.

MYSTERY STUFF

Lisa walked out the back door of the farmhouse on a Thursday afternoon and found a man's pipe, a scarf and three lumps of coal lying on the wet grass near the barn. The nearest neighbors lived a mile away, and no one had visited that day. Where did the objects come from?

Solution:

The weather had gotten a lot warmer and Lisa's snowman had melted.

FAST FACTS:

Grant period: September 1, 2009 - August 31, 2014

Funding Agency: National Science Foundation

Target Participants: Ninth grade science teachers in Missouri school districts

2011 summer academy:

Science Teachers: June 6-July 1, 2011

Math Teachers: June 13-18, 2011

Administrators: June 17-18, 2011

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*More discussions at the Feb 2011 follow-up session.
Left: Kari Bumgarner, Joe Burkemper, Paul Schaefer
and Majed Dweik.
Below: Elizabeth Dyer, Jesse Wolf, Luke Kirkendoll*



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