Teaching Physics in Alabama High School Classrooms - How can we do better?

Alliance for Physics Excellence (APEX)

Physics Teaching Research Program (PTR)

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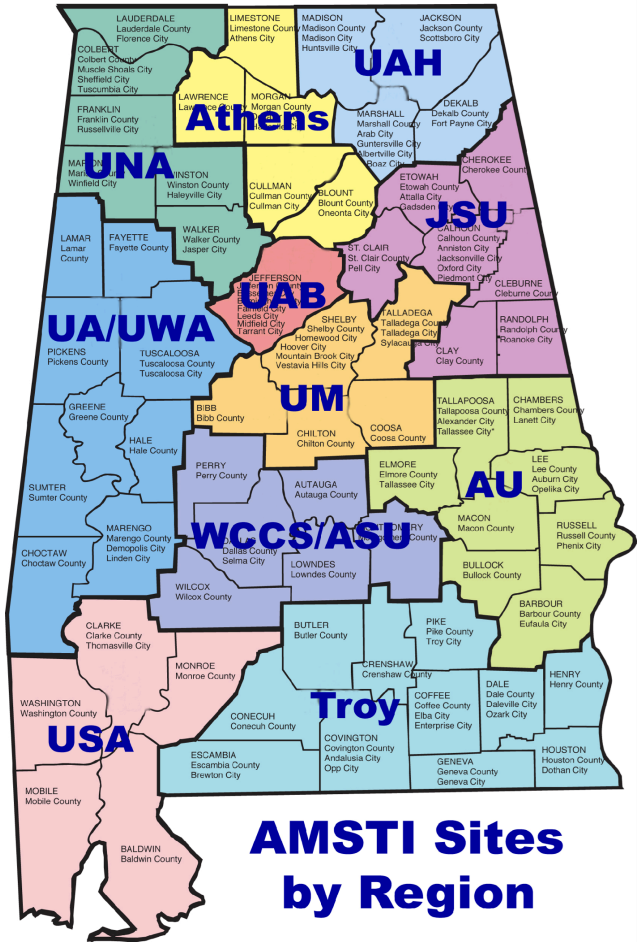
APEX PTI Cohort 1 & 3 Weekend Workshop 2, January 15-16, 2016

Alliance for Physics Excellence

The goal of the *Alliance for Physics Excellence* (APEX) program is to integrate research-based teaching practices into Alabama physics classrooms via in-service teacher education, and evaluate the impact on physics teachers and their students in the state's school systems.

APEX Cohorts 1 & 3

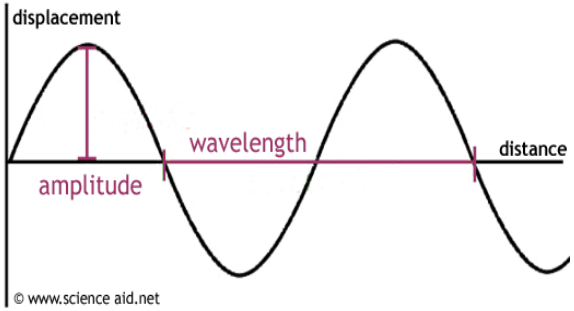
- Physics teachers are associated with each of 11 Alabama Inservice /ASIM Centers
- In Cohort 1 & 3 there are 37 teachers.
- In Cohorts 1-3 there are 67 teachers.



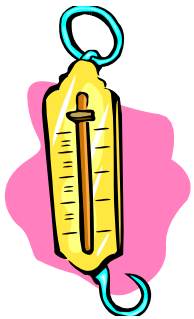
Alabama Inservice/AMSTI Center Areas

Teaching Physics in Alabama High School Classrooms - How can we do better? Overview

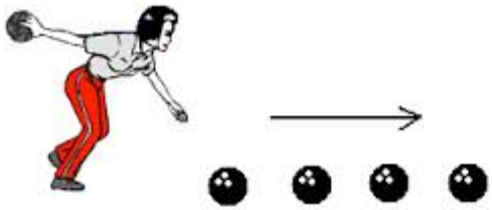
1. **What should happen in our Alabama physics classrooms?**
2. **How do we make sure change happens in our physics classroom?**
3. **Will you share what happens in your physics classroom?**



What should happen in our Alabama Physics Classrooms?



Based on our APEX PTI Experiences?



Benchmark Indicators (from teacher classroom action research reports)

Student Achievement

Indicators (rated by outside reviewer) of APEX model performance with Force and Motion Unit relates to FCI Normalized score gain

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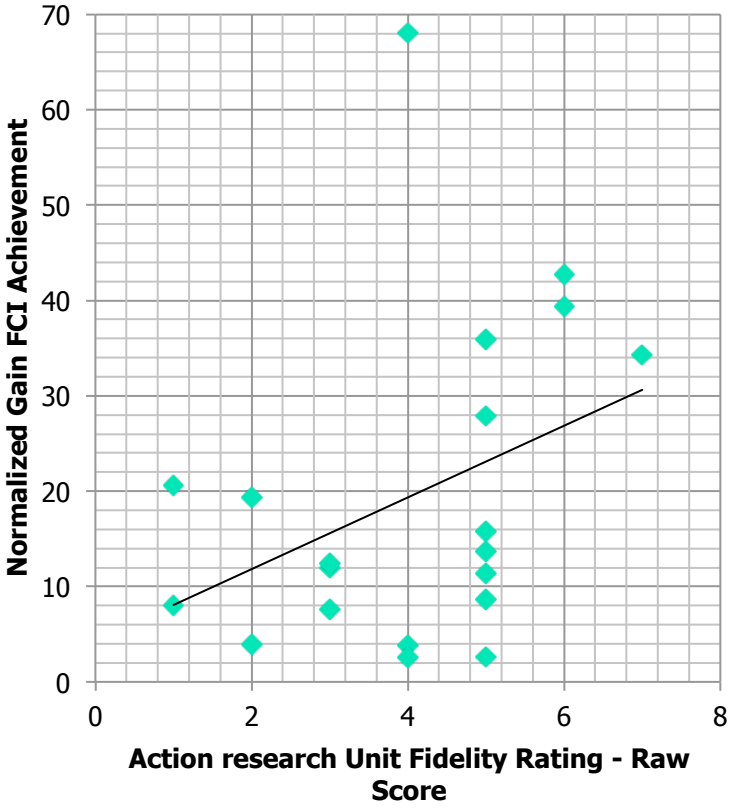
APEX Fidelity Rating of

units above the N-Gain mean represent common individual indicators of performance

N-gain; M=17.7; Range=3-43



Benchmark Indicators (from teacher classroom action research reports)

Student Achievement Indicators of APEX model performance with Force and Motion Unit were developed empirically from the classroom teacher action research reports.

APEX Fidelity Rating of units involved 19 indicators and a Rubric indicating APEX Teacher Characteristics

Rubric	APEX Teacher Characteristics
5. 9-19 Expert use	Demonstrates excellence in implementing and appropriately using MOST of the APEX characteristics, methods, and strategies experienced on the APEX professional development workshops.
4. 7-8 Proficient	Demonstrates evidence of implementing and appropriately using MANY of the APEX characteristics,
3. 5-6 Emergent	Demonstrates evidence of implementing and appropriately using SOME of the APEX characteristics
2. 3-4 Novice use	Demonstrates evidence of implementing and appropriately using a FEW of the APEX characteristics
1. 0-2 Non-use or Trial use	Demonstrates little or no evidence of implementing and appropriately using ANY of the APEX characteristics

Benchmark Indicators (from teacher classroom action research reports)

Student Achievement

<u>Indicators (rated by outside reviewer) of APEX model performance</u> with Force and Motion Unit relates to FCI score gain

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The indicators common to units above the N-Gain mean were

2. **Graphical analysis of data** in a 4 step analysis
3. **Guided inquiry** laboratory activities
4. **Identification** and **addressing** student **alternative conceptions**
8. **Public presentations**- e.g. whiteboards or other presentation styles.
9. **Ranking tasks and Tippers**
12. **APEX/PTRA and other professional development** lesson materials used

Benchmark Indicators (from teacher classroom observations)

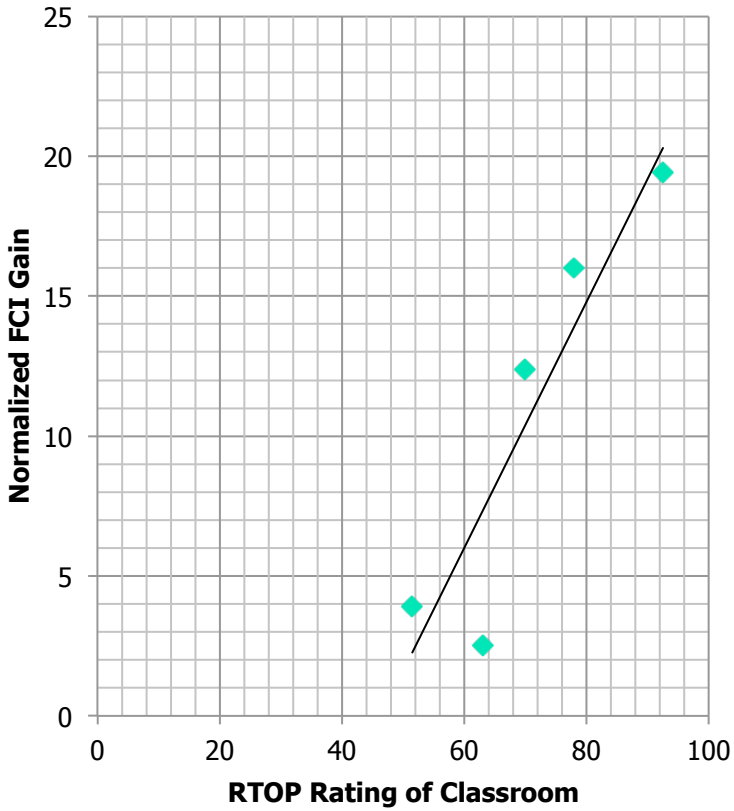
Student Achievement

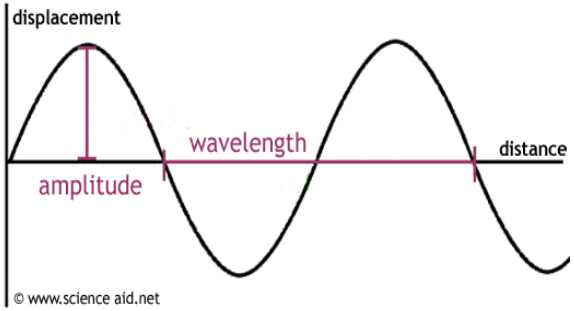
Classroom Rating by outside observer of teaching and learning performance (RTOP)

also correlates with student FCI Normalized gain score

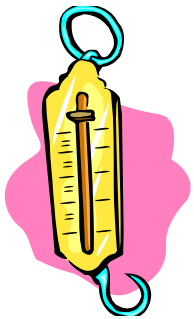
RTOP ratings; Mean=71, Range=51-92

N-gain; M=17.7, Range=3-43





How do we make sure change happens in our Physics Classroom?



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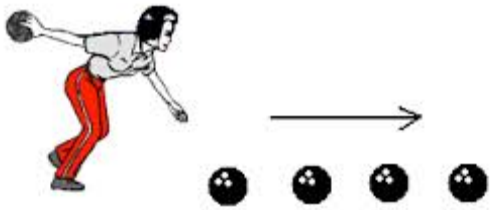


Teacher Action Research

Action Research as a strategy for facilitating change in your physics teaching

the Physics Classroom

Action Research Facilitates Change in Beliefs

- Over the last two years we said……
- ***All teachers have beliefs which guide their teaching.***
- ***Beliefs are constructions of reality.***
- ***Can you determine which of your beliefs are "truthful" or "misconceptions"?***
- ***The process of changing is the process of changing beliefs.***
- ***<u>How do you change beliefs?</u>***
- ***How can you change your beliefs about physics teaching?***

Professional Development through Teacher Action Research

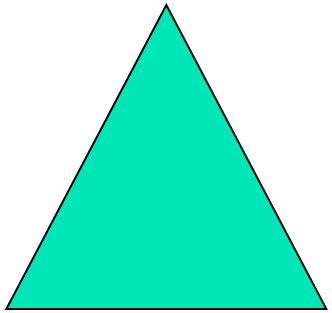
What data driven evaluation process will you use to monitor your progress in using the APEX PTI information and understandings?

- **How can a classroom action research study add to your understanding of teaching and learning?**
- **What different kinds of evidence are you using to answer your action research question?**

Three sources are needed to give you confidence and understand the result in action (practitioner) research.

Different Kinds of Evidence Used?

1.



2.

3.

How can these three sources work together to answer your question?

- FCI or other comparison tests based on student prior knowledge conceptions
- Progress on Diagnoser questions
- Student individual or small group interviews
- Students' portfolio of work on Diagnoser lessons
- Results on teacher made or standard physics tests
- Suggest others

APEX Cohort 1 & 3: Action Research Activity with Units during the Fall 2015 to Spring 2016 Academic Year

- **Description of context** of the units 1) Force and Motion unit and 2) Electricity unit. The units can be reduced in content covered.
- **Lesson plans** or lesson outline of unit
- **Daily diary of events** that occurred
- Administer students' **pre and post revised FCI, EMCI and, if possible, Diagnoser tests**
- **Interview** your students
- Narrative reflective **summary** of the action research activity- **What did you learn? What was the evidence?**
- **Present**, **compare, and reflect** on your results during the APEX weekend workshops of the 2015-16 school year

APEX Cohort 1: PTI Action Research Results

You know the results from your individual action research studies completed with the Force and Motion Units taught in 2014 and/or 2015.

The results from all Cohort unit studies completed are also useful in planning your future changes.

Student Results from Pre and Post FCI Tests with Force and Motion Unit

Cohorts 1 (6 classes) **and 2** (14 classes)

Number of students = 511

Maximum rating possible = 15 or 100%

Pre test cumulative score = 22.2

Range = 14.3 - 67.4

Post test cumulative score = 41.7

Range = 17.0 – 84.1

Sig. Diff between pre and post test scores

Significance = 0.000

Effect size = 0.447

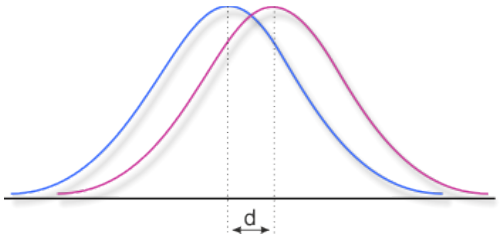
Percentile gain = 17%

0.10 = Small Effect size

0.30 = Med Effect size

0.50 = Large Effect size

Jacob Cohen, 1988, Hedges & Olkin, 1985



Reflections on Teaching Physics Next Year

1. Describe how you will change the Force and Motion unit you will teach during fall 2016. What will be different?

2. What kinds of evidence (results/ products) explain these changes?

Reflections on Teaching Physics Next Year

3. What will be different from what you did previously that did not work well?

What evidence can you provide for this?

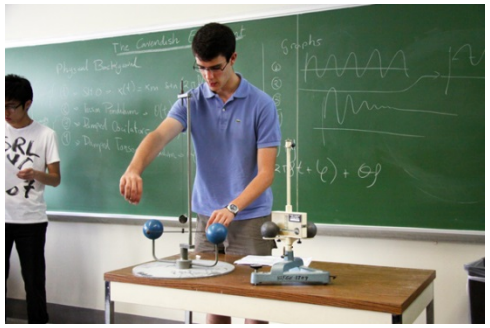
Reflections on Teaching Physics Next Year

5. What do you want to try that you did not do yet?

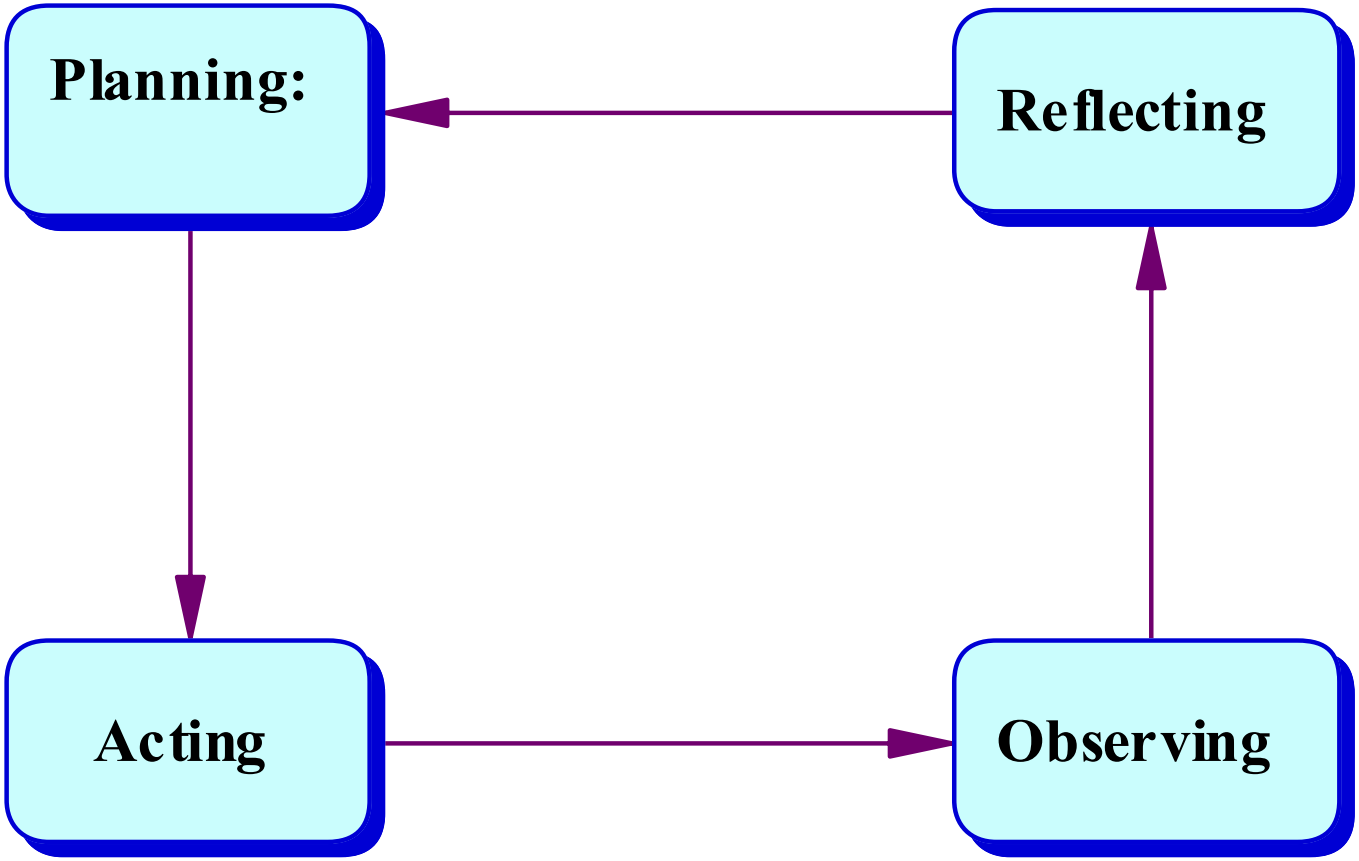
Teacher Action Research

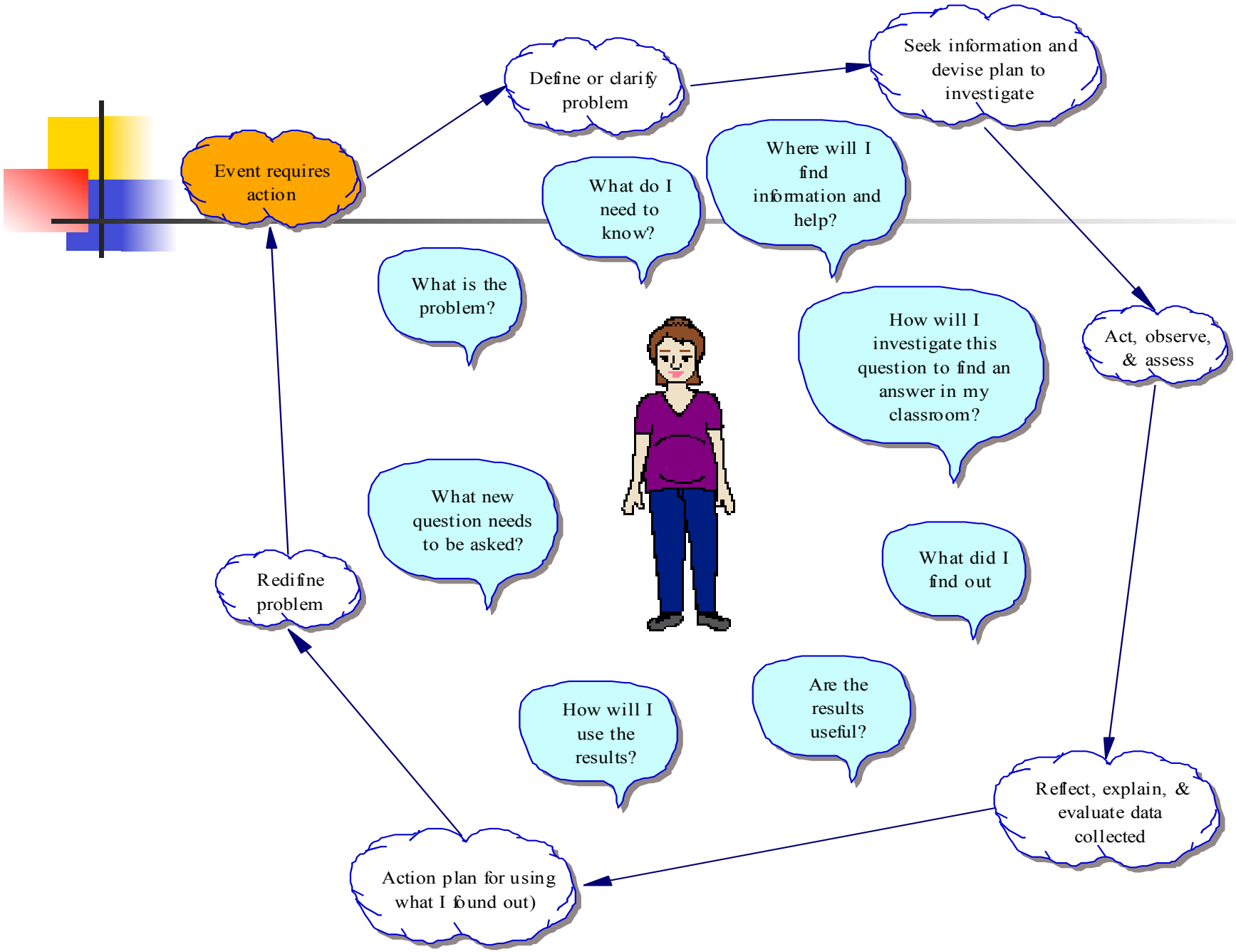
Action Research is the only strategy for extending APEX professional development and facilitating and sustaining change this year and in the future.

There are several forms, we all use one.



Basic Processes of Action Research



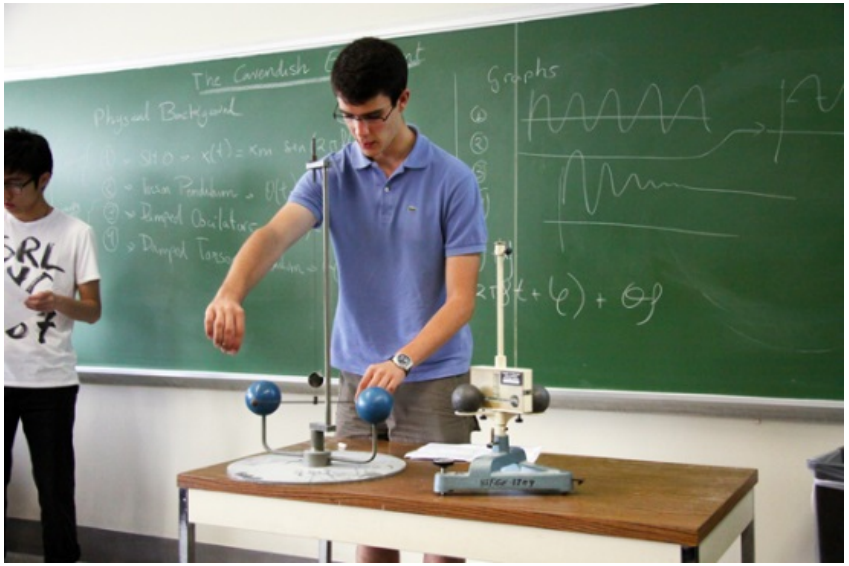

Event requires action
Define or clarify problem
Seek information and devise plan to investigate
What do I need to know?
Where will I find information and help?
What is the problem?
How will I investigate this question to find an answer in my classroom?
Act, observe, & assess
What new question needs to be asked?
What did I find out
Redifine problem
How will I use the results?
Are the results useful?
Reflect, explain, & evaluate data collected
Action plan for using what I found out)

Ongoing Action Research Model
(perhaps several cycles for a complex innovation)

A Spiraling Process:

- revise focus (**redefine problem**)
- modify or use new hypotheses (**plan**)
- leading to new actions and new data analysis (**act, observe & assess**)
- revise previous conclusions (**reflect, explain & evaluate**)
- redevelop grounded theory (**understand**)
- etc.... in a continuous spiral leading to self-professional development and change

Questions



- **What is the meaning of "Action research provides us with a 'Lens' to consider our practice…"**

Action Research: Summary

- Note that the question is not, "What should the teacher do next Monday?", but rather "How can you select, adapt, use, or re-conceptualize PTI materials to make learning more productive for students?"
- Action research, also, involves physics teachers in the process of defining, making decisions about, and solving problems leading to their own professional change and growth.

Why Action Research?

- Educational ideas of others are of little real use on their own
- Any "good idea" is a only working hypothesis, not a conclusion. It needs to be tested by you in your physics classroom to gain credibility. Then it becomes our idea that is fully meaningful to us.
- Successful change must use our ideas

Action Research

- Not a deficit model
- Experience is not enough
- Creates a climate of search for knowledge. This is more likely to produce change than finding answers.
- Not traditional formal research
- Self-reflective inquiry to improve teaching

Take a Break
What do you think?

- **How would you summarize results from classroom action research reports on teaching physics in Alabama?**

Making Your Practice More Expert

- **You use the Action Research process now to helps monitor your progress using the APEX PTI information and understandings.**

- **What do you do next? What questions can you ask?**

Making Your Practice More Expert

The questions you need to ask should be those you want answered and then you seek data to answer the questions.

Your questions should probably be versions of the following

Making Your Practice More Expert

a. Are the reforms I have introduced working to create higher achievement, **more learning engagement, and higher interest and attitudes toward learning physics** in my students?

b. If so **what element** is working in the reforms that I have introduced. Why? How does it work to create change in student outcomes?

Making Your Practice More Expert

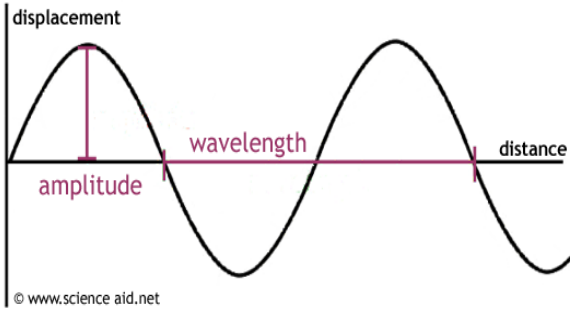
c. If this reform works for Force and Motion concepts **does it work for electricity and magnetism concepts**, For waves and sound concepts. For light concepts etc.

Making Your Practice More Expert

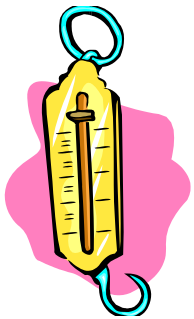
d. If I continue the reforms in my method of instruction, **how can I improve on the gains** I have documented already with action research data?

e. Etc. with an additional round of action research each semester.

This is the most effective process of becoming an expert teacher, and different from our normal teaching.



Will you share what happens in your Physics Classroom?



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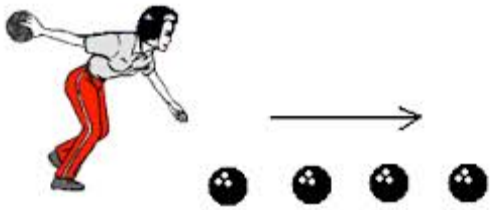

Reflections on Teaching Physics at This Time

6. How can share and disseminate what you have done in your classroom as innovative teaching?

Places to Share #1

- **Alabama Science Teachers Association (ASTA)**
- **February 16-17**
- Proposal date ?
- 2016 ASTA Conference
- Birmingham, Alabama

- **American Association of Physics Teachers (AAPT)**
- Proposal date?
- Meeting Date in 2016

Your Local School Region

- With one or two teachers

A Place to Share: ASTA

Tuesday, February 16, at 2:30 - 3:25, in Classroom GENEius Labspace (Level 1)

at the McWane Science Center in Birmingham. "**Are you frustrated teaching physics and physical science?**"

What are effective research-based teaching strategies for physics? The interactive session is based on the strategies from the Alliance for Physics Excellence (APEX) professional development model.

APEX teachers are needed to demonstrate effective lesson strategies from the APEX model at ASTA next month

Places to Share #1 -Sustaining APEX Changes

The overall goal of the APEX VPLC through use of the APEX Website is building capacity and sustainability during and after APEX.

- This can be measured by
  - APEX teachers' sustained participation in the VPLC
  - Changes in APEX teachers' "professional vision" while using the VPLC
  - APEX teachers willingness and ability to become leaders in Alabama in physics education.

Sherin & van Es, 2009

APEX Website

- The URL for the APEX website is:
  - **apex.ua.edu**
  - **APEX Cohort** is a page specifically for information for Cohort 1, 2, & 3 participants.
  - **Blog** – is a blog site for questions and comments about physics, physics lessons, and the APEX workshops that are to be shared with other cohort 1 members and the University of Alabama content area specialist.
  - Sites are password protected. Name is: **your email address** & the password is: **make your own up**

Inquiry Teacher's Actions and Students' Responses

Essential Features of Classroom Inquiry and Their Variations

Essential Features of Inquiry	1 Full Inquiry Teaching (Can Use Learning Cycle)	2 Coupled Inquiry (Can Use Learning Cycle)	3 Guided Inquiry	4 Directed Inquiry	5 Verification	6 Expository

More <_____ Amount of Learner Self-Direction _____> Less

Less <_____Amount of Direction from Teacher or Material _____> More

Essential Features of Inquiry	1 Full Inquiry Teaching (Can Use Learning Cycle)	2 Coupled Inquiry (Can Use Learning Cycle)	3 Guided Inquiry	4 Directed Inquiry	5 Verification	6 Expository
1. Learner engages in scientifically oriented questions	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	Learner engages in question that replicates one provided by teacher, materials, or other source	Learner engages in no question to investigate
2. Learner gives priority to evidence in responding to questions	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	Learner given data and told how to analyze that replicates one provided	Learner given no data just conclusions
3. Learner formulates explanations from evidence	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	Learner provided with evidence that replicates conclusions already given	Learner provided with no evidence, only conclusions
4. Learner connects explanations to scientific knowledge	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 provided with connections	Learner provided with connections that replicates one provided	Teacher reports connections
5. Learner communicates and justifies explanations	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	Learner reports how close to the textbook the conclusions were	Learner reports no conclusions

References

- Albern, S. (2011). A toolkit for action research. Lanhan MD: The Rowman & Littlefield Publishing Group, Inc.
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- Lawson, A. (1995). *Science teaching and the development of reasoning*. Belmont, CA: Wadsworth
- Sagor, R. (2005). *The action research guidebook: A four-step process for educators and school teams. Thousand Oaks CA: Corwin Press.*
- Schmuck, R. (2006). *Practical action research for change.* Thousand Oaks CA: Corwin Press.
- White, R. & Gunstone, R. (1992). *Probing understanding*. New York: Falmer Press.

Action Research Related Web Sites

Developing an Action Research Plan with Examples

http://www.bamaed.ua.edu/sciteach

Web-based Action Research Activities:

http://archon.educ.kent.edu/Oasis/Pubs/0200-08.ht

An Introduction to Action Research

http://www.phy.nau.edu/~danmac/actionrsch.html

Action Research-Linked Sites

http://carbon.cudenver.edu/~myder/itc/act_res.html

Virtual Fly Lab: http://vcourseware3.calstatela.edu/VirtualFlylab/IntroVflyLab.html

Physics Teaching Resource:

Pathway: Physics Teaching Web Advisory. Ask an expert a question.

- ***http://www.physicspathway.org/***
- ***Digital video library for physics teaching at secondary school level***
- ***Four expert physics teachers provide expert advice in short scenes through synthetic interviews - Roberta Lang, Paul Hewitt, Chuck Lang, & Leroy Salary***
- ***Related Videos are also available***

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