Teaching Physics in Alabama

Alliance for Physics Excellence (APEX)

Physics Teaching Research Program (PTR)

Dennis Sunal, JW Harrell, John Dantzler, Donna Turner, Cynthia Sunal, and Marsha Simon (PTR Team)

University of Alabama

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.

Teacher Action Research

Action Research is a strategy for extending APEX professional development and facilitating change in your physics teaching

How do you develop more effective physics teaching that supports student learning?

1. Consider your beliefs about teaching physics
2. Investigating your beliefs
3. Developing more effective, evidence-based physics classroom teaching that supports student learning

Creating Change in Physics Teaching

Activity:

Consider the question;

What are important roles you perform that define your way of teaching physics?

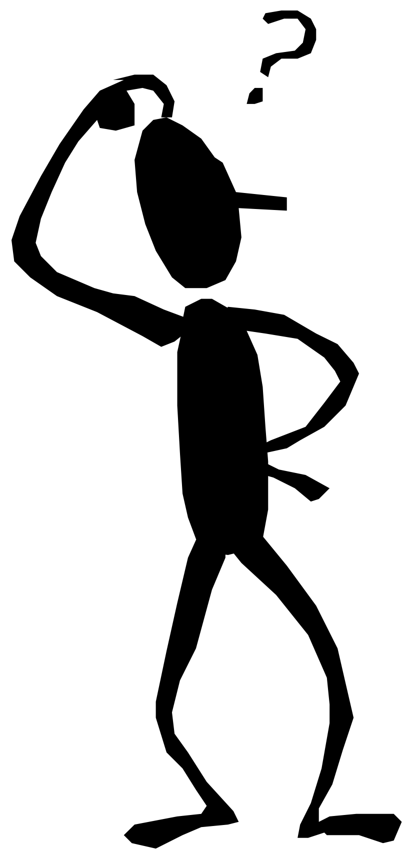
Write down 2 or 3.

Classroom

Creating Change in Classroom Teaching

Now consider:

- If you could use a metaphor to describe your physics teaching, what would it be?(e.g. coach, cook, advisor, general)
- Then, describe how the metaphor works to two others!



Creating Change in Physics Classrooms

- 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.
- **How do you change beliefs?**
- How can you change your beliefs about physics teaching?

“Physical and Biological Science Classes at Bibb County High School”

Developing Two New Classes for Middle and High School Students

A Case Study Example of Action Research

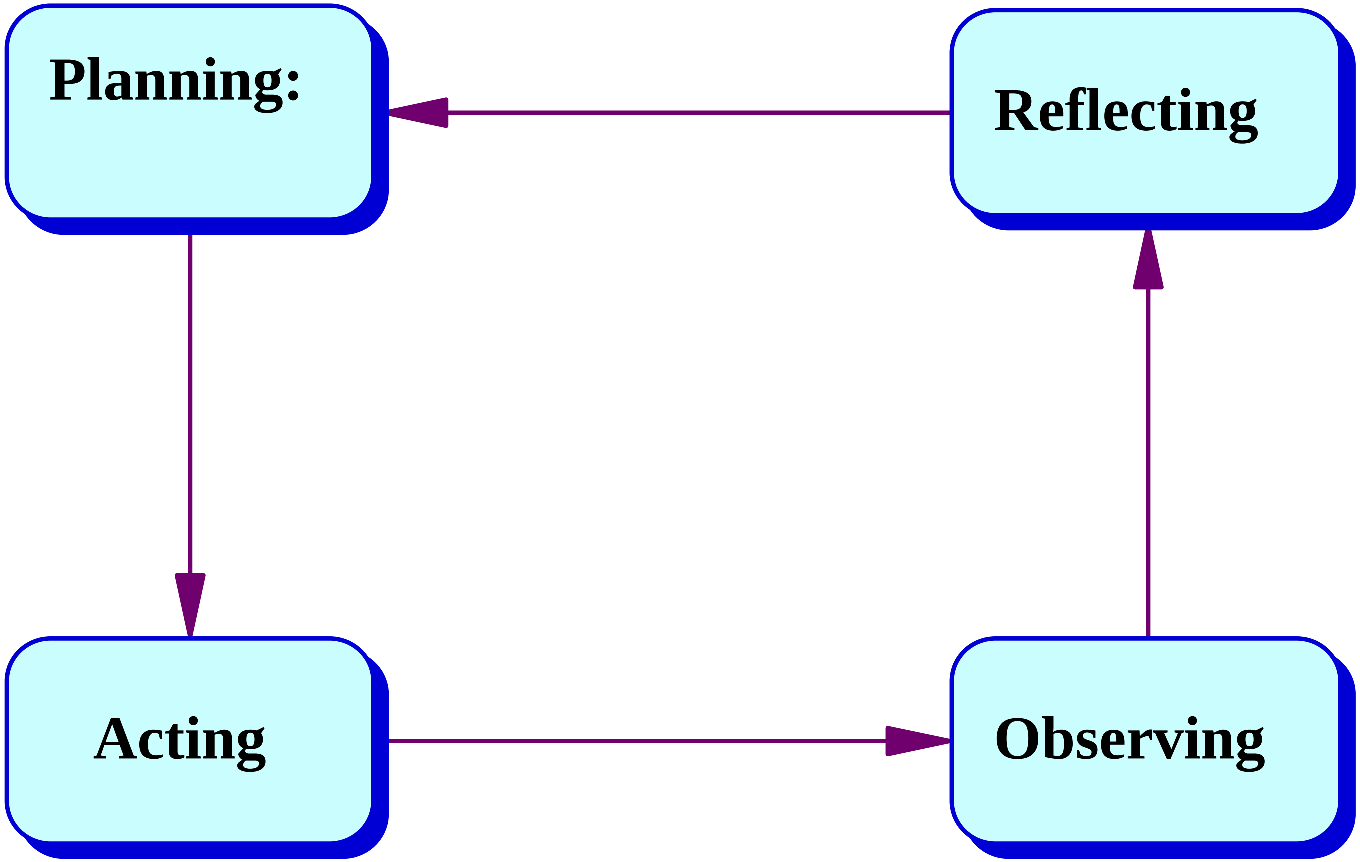
Developing Two New Classes for Middle and High School Students

- **Problem:**

Should web-based “lab” activities be used in the new courses?

Labs and field trips on the Web

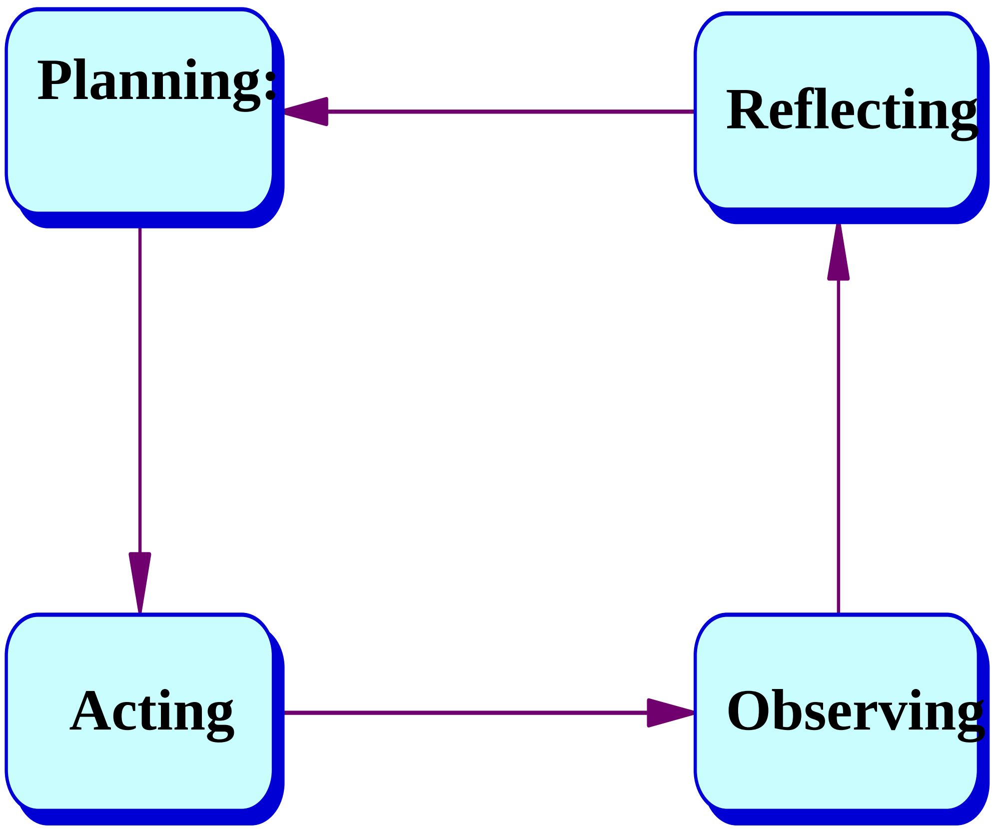
Basic Processes of Action Research



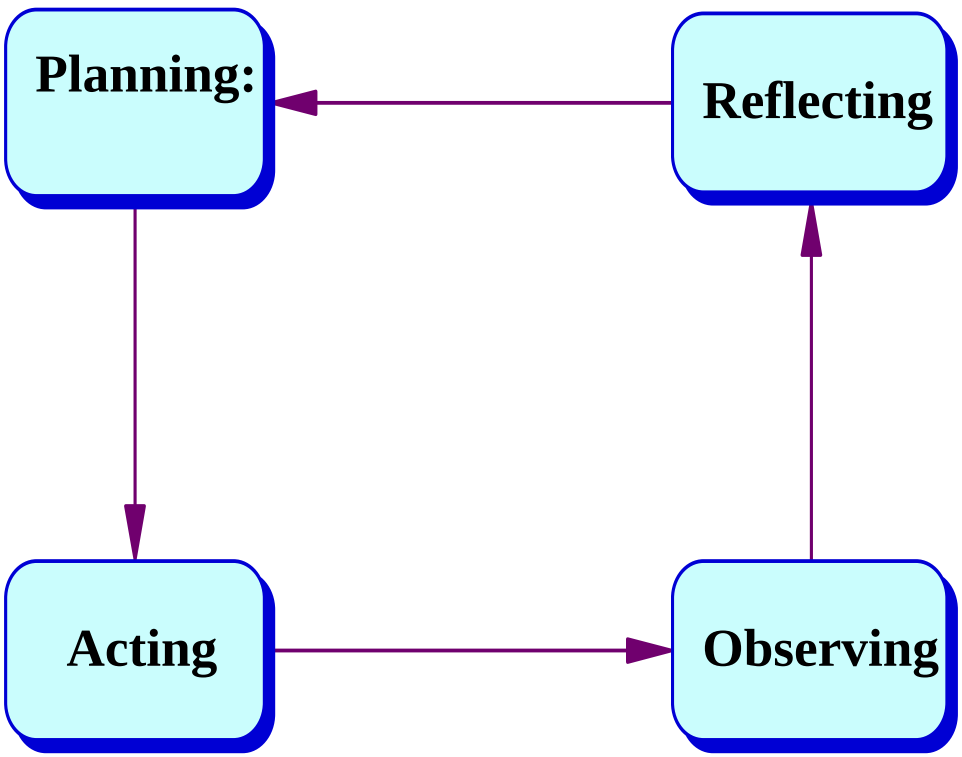
Processes of Action Research

- Planning: Problem finding, problem posing and deciding how to deal with a problem

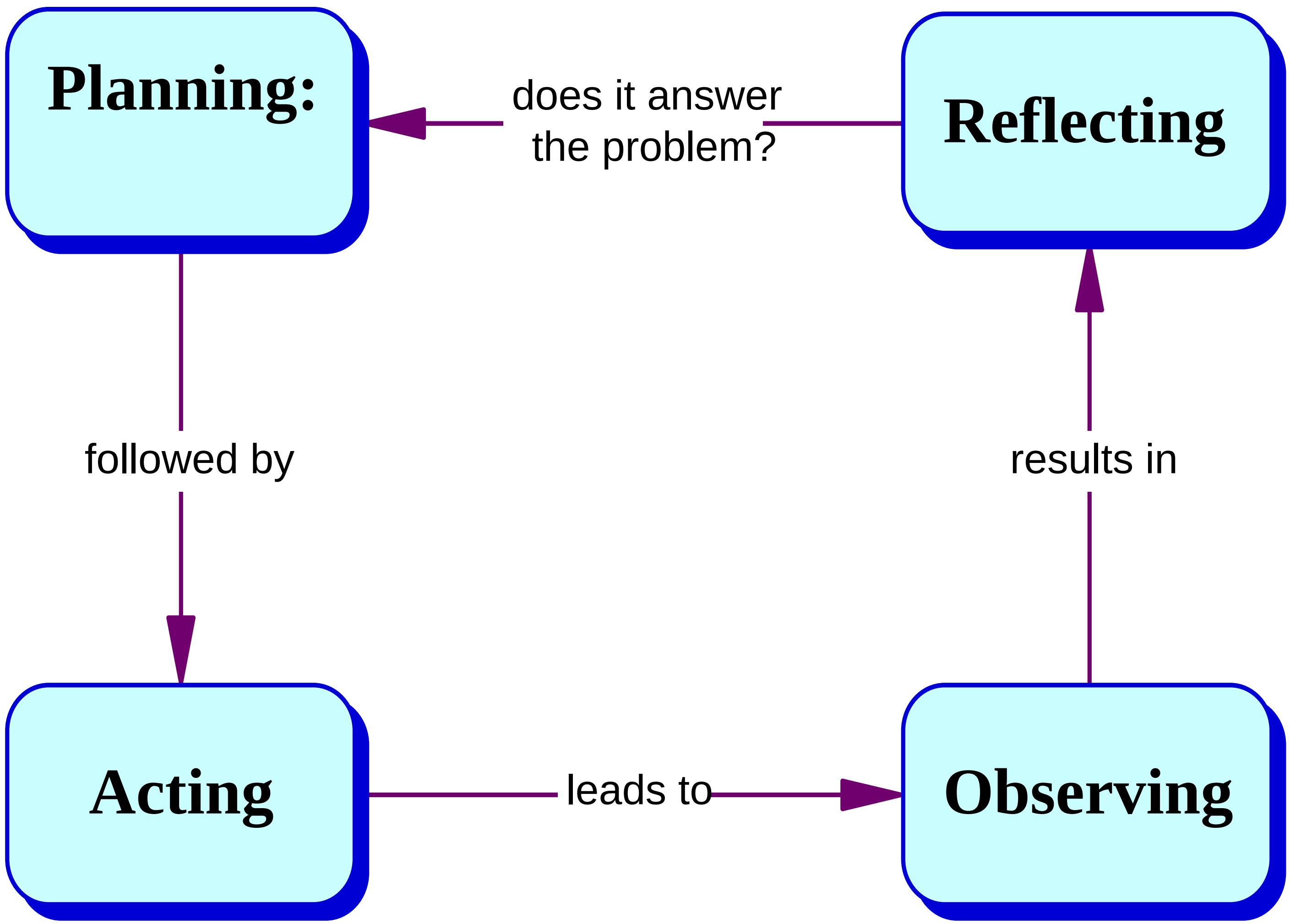
- Acting: Implementing the plan



Processes of Action Research



- Reflecting: Analyzing outcomes and checking with original plan
- Observing: Collecting data and recording what is happening


Planning:
does it answer the problem?
Reflecting
followed by
results in
Acting
leads to
Observing

Action Research: What is it?

- An approach to research that can provide answers to questions and problems you have about your existing teaching practice and to check new ideas put into practice
- A systematic process of practitioner (teacher) problem posing and problem solving
- Designed to be carried out by teachers in a real classroom setting

Plan - Begin by Developing a Focus: Sample Questions for a Case Study

- How do students perceive what is going on in “virtual labs”?
- What are some hypotheses about what is going on?
- What might reflection tell us about this type of problem?

Developing a Focus

Try to more clearly formulate the problem into a

- focus question and an
- hypothesis (also look for alternative hypotheses)

Developing a focus: issues evident from the case study

Some learning issues evident in the "virtual lab" case study are:

- Prerequisite knowledge needed,
- What "lab" design is best, or
- Student learning outcomes (this one was selected).

Developing Two New Classes for Middle and High School Students

- **Problem:** Should web-based “lab” activities be used?
- **Develop a focus question:** Virtual “Labs” outcomes are as transferable to the real world as traditional labs in classrooms.

Developing a focus: sample hypotheses evident from the case study

- Hypothesis 1: the student does not need additional prerequisite knowledge and/or skills for understanding.
- Hypothesis 2: for the conscientious student, the virtual experience design is as effective as the classroom lab on achievement tests.
- ***Hypothesis 3:*** *students can apply concepts they learn from online "labs" to the real world problems as well as students in traditional classroom labs.* (this one was selected)

Developing Two New Classes for Middle and High School Students

- **Problem:** Should web-based "lab" activities be used?
- **Develop a focus question:** Virtual "Labs" outcomes are as transferable to the real world as traditional labs in classrooms.
- **Develop an hypothesis:** the students can apply concepts they learn from online "labs" to the real world problems as well as students in traditional classroom labs.

Developing Two New Classes for Middle and High School Students

Labs on the Web

- **Develop a way to <u>test</u> the hypothesis:** Design a test to find out if web-based "lab" activities enable students to understand and apply concepts they learn to real world problems.

Plan to Test Hypothesis

- Test setting(what students)
- Test procedure (one class, or two classes, or ?)
- Data collection and analysis (act, observe, and assess)

- Results and conclusions leading to action (reflect, explain, and evaluate)

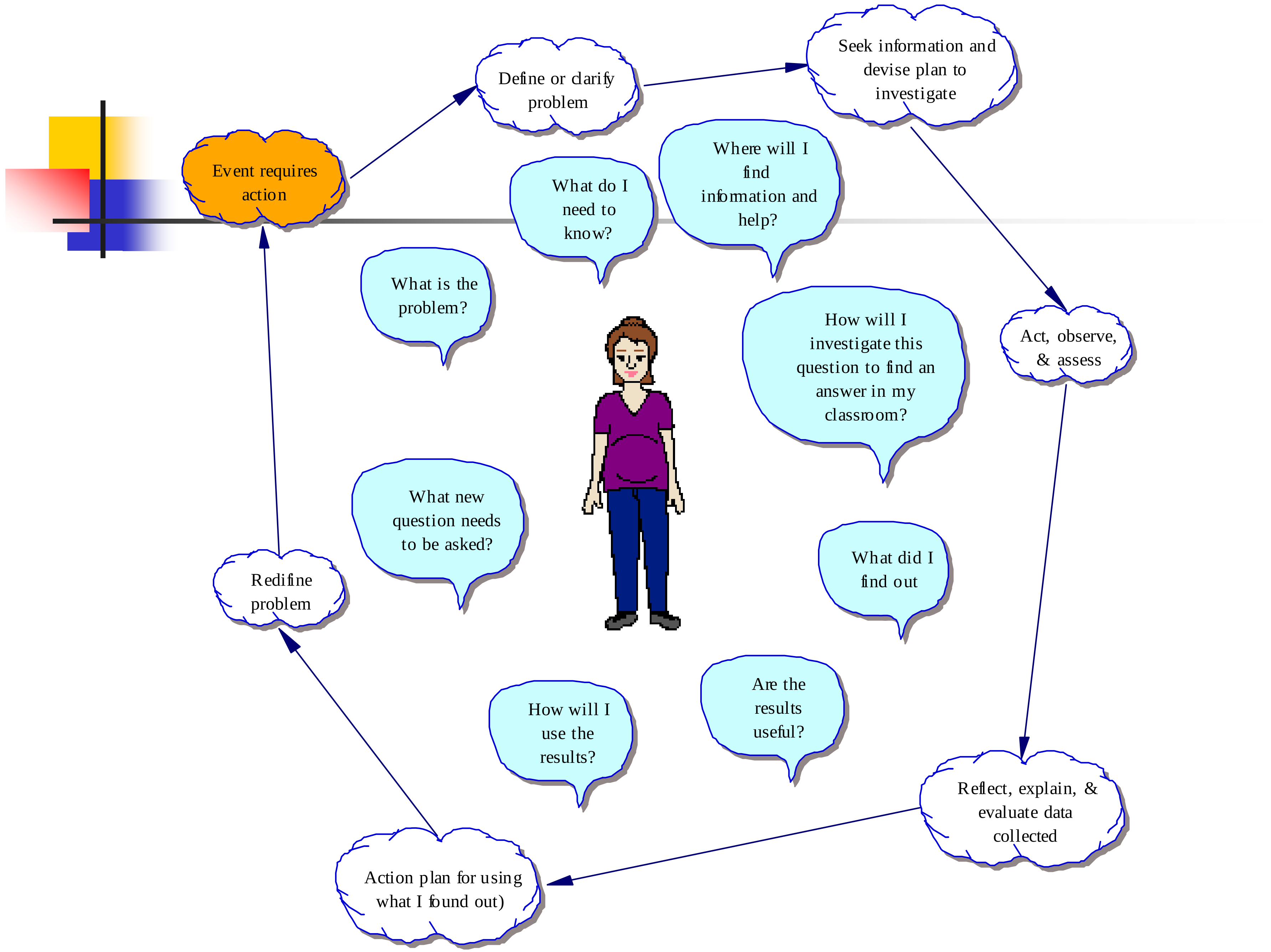
Act & Observe - Classroom Data Gathering and Analyzing Data

- Implement the virtual labs and continue traditional labs
- Using your action research design collect the needed data, make observations and perform interviews.
- Data analysis should go on concurrently.
- Revise your testing procedure based on observed needs (and fairness of testing).

Reflect - Continuing the Action

Reflect on results and draw conclusions

- Continue the innovation as completed or
- Plan modified or new action
- Act on the conclusions by making changes and monitoring effects
- Continue with a new cycle of action research



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

Continuing Cycle of Action Research

- problem situation (reflect)

Plan

- develop focus (define problem)
- reflect on hypotheses (plan design)

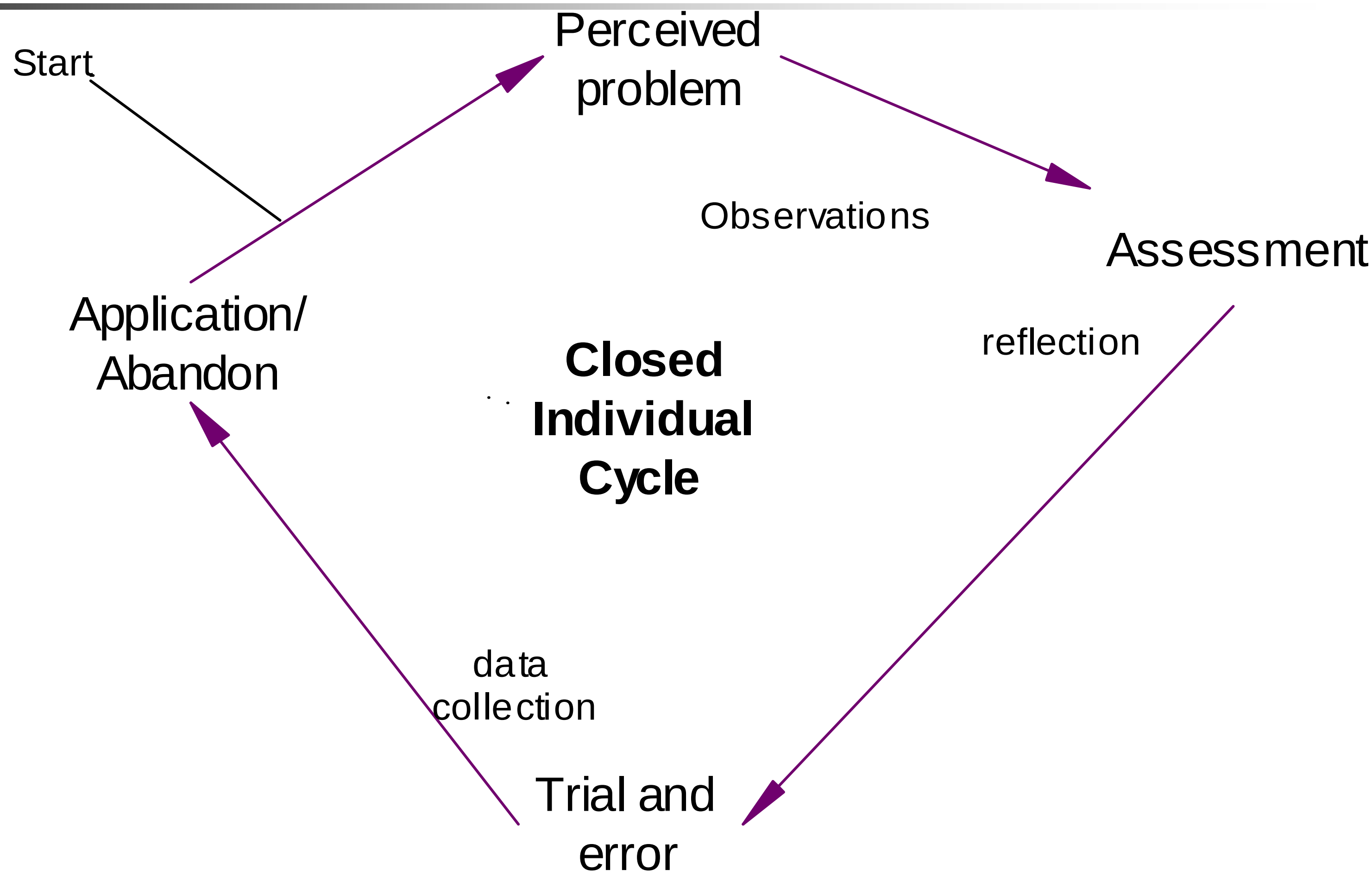
Act & Observe

- data collection and analysis (act and observe, and assess)

Reflect

- conclusions leading to action (reflect, explain, and evaluate)
- make decisions (redefine problem)

Continuing Cycle of Action Research



Teaching and Investigating APEX Physics in Alabama

Alliance for Physics Excellence (APEX)

Physics Teaching Research Program (PTR)

Dennis Sunal, JW Harrell, John Dantzler, Cynthia Sunal, Michelle Wooten, Marsha Simon, Donna Turner, and Tara Ray (PTR Team)

University of Alabama

Developing and Revising Your Physics Teaching for your High School Students

APEX Cohort 1 Model for Action Research with PTI Physics Teaching of Force and Motion Strategies

Developing and Revising Your Physics Teaching for your High School Students

Plan -

- **Problem (reflect):** How should PTI Force and Motion activities be used effectively in my teaching?
- **Develop a focus question (define problem):** How can PTI Force and Motion activities lead to learning outcomes that are as good as traditional teaching in physics classrooms.
- **Develop hypothesis:** students can apply concepts they learn from incorporating PTI as well as students in traditionally taught classrooms.

Developing and Revising Your Physics Teaching for your High School Students

Act -

- **Reflect on hypothesis (plan test procedure):** Plan a physics unit that implements PTI Force and Motion activities so that they facilitate student understanding and application of concepts they learn.

Observe -

- **Collect:** pre/post achievement scores on a common test and student interviews.
- **Compare** student outcomes from their pre-test scores or another comparison course completed in a traditional classroom.

Developing and Revising Your Physics Teaching for your High School Students

Reflect -

- **Reflect on Outcomes:** What happened, how do the results compare to your goals? Should you continue next year or the next unit using this type of approach, if not what should be changed?

Repeat of this Unit: Plan revisions for the next time you teach your physics unit that implements PTI Force and Motion activities.

Next Unit: What did you learn from this unit that you can apply to your next PTI unit (e.g.. Energy) to facilitate student understanding.

Developing and Revising Your Physics Teaching for your High School Students

- **Conclusion (1)**

My application of PTI activities in the class increased student physics knowledge, transfer, and their comfort with conducting inquiry activities as well as traditional physics instruction.

Developing and Revising Your Physics Teaching for your High School Students

Conclusion Options (2&3)

My application of PTI activities in my physics class:

a. increased student physics knowledge, transfer, and their comfort with conducting inquiry activities as well as traditional physics instruction. I will continue the innovation as just completed in the next unit and see if it works there too.

b. did not increase student physics knowledge, transfer, and their comfort with conducting inquiry activities as well as traditional physics instruction. I will plan a new way of implementing PTI in the next unit and see if it works there.

Developing and Revising Your Physics Teaching for your High School Students

Conclusion Option (4)

My application of PTI activities in my physics class:

c. did not increase student physics knowledge, transfer, but did increase student comfort with conducting inquiry activities as compared to traditional physics instruction. I will use the conclusions to make changes, modify application of PTI and monitor the effects in a new cycle of action research in the next unit.

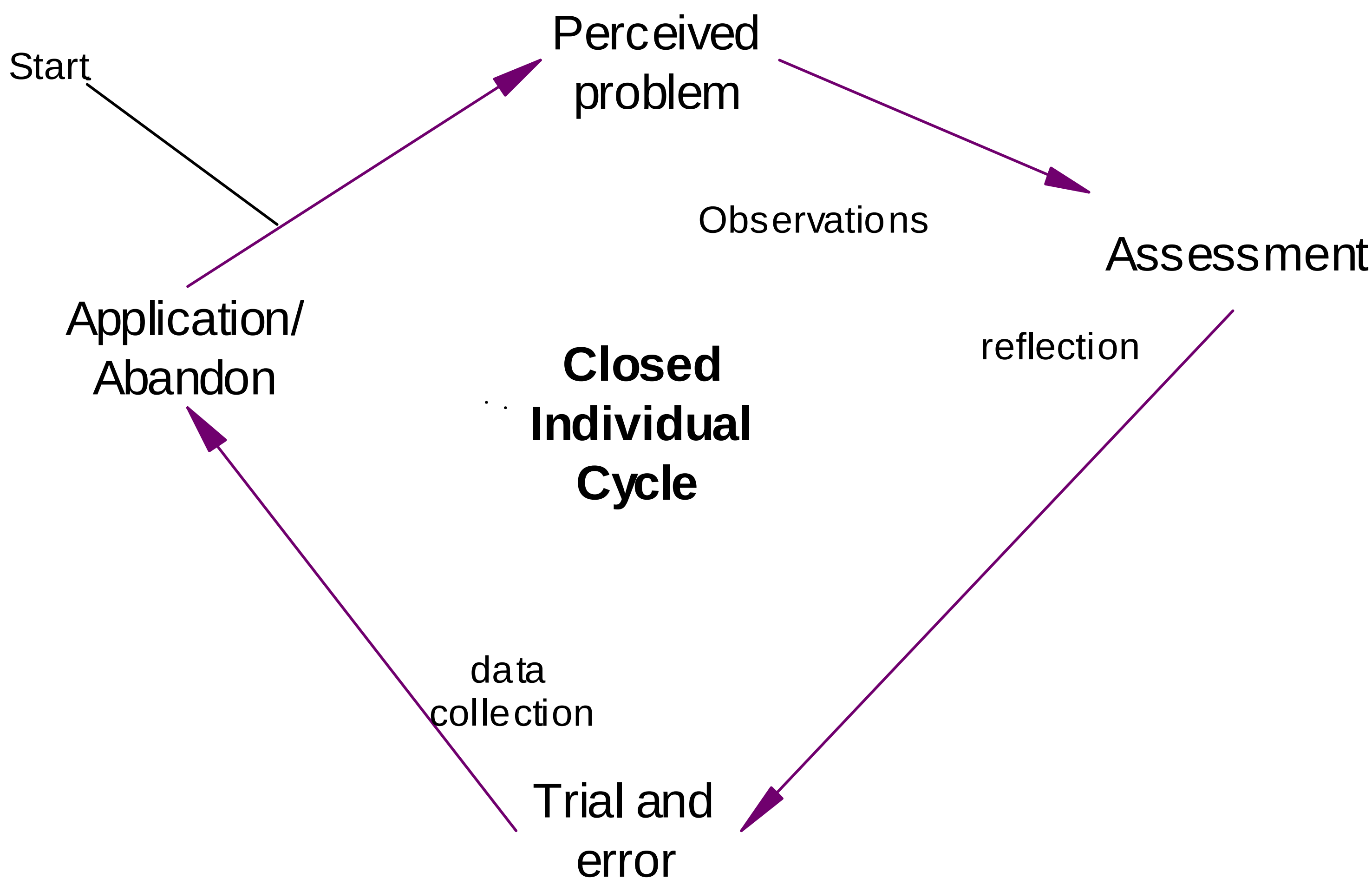
⇩

Later, you should modify sections of the your physics courses, investigate other variables in and monitor the effects in other units, disseminate information to other teachers in the school about the effective use of PTI activities in physics.

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

A Spiraling Process:

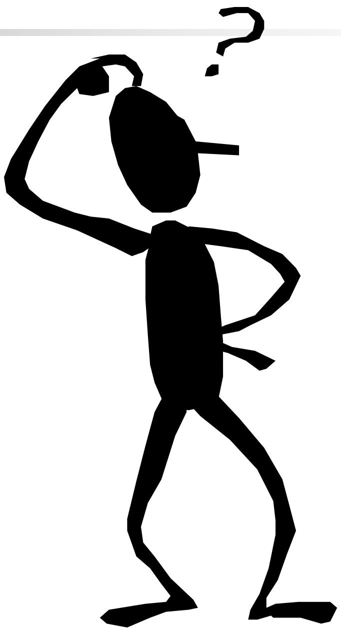
- revise focus (**redefine problem**)
- modify or use new hypotheses (**plan**)
- leading to new actions and new data analysis (**act, observe & assess**)
- revise previous conclusions (**reflect, explain & evaluate**)
- redevelop grounded theory (**understand**)
- etc…. in a continuous spiral leading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


Start
Perceived problem
Observations
Assessment
reflection
Application/ Abandon
Closed Individual Cycle
data collection
Trial and error

Cohort 2
PTI Action Research Case Study
For Fall-Spring 2014-15

APEX activity for fall or next academic year

- Using the unit on Force and Motion you will be teaching next year in one of your physics classes, conduct an action research activity to determine the effectiveness of your application of the PTI professional development you received this summer.
- Consider the example presented to represent the process for you to ask and act on your physics teaching action research question.



- **See the Cohort 2: PTI Action Research Case Study instruction sheet for additional guidance.**

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.

Action Research - An Act Used to

- Enhance (understand) your own teaching and others teaching
- Test assumptions you make in teaching everyday (evidence-based practice)
- Enhance teacher judgment (evidence-based practice)
- Evaluate and/or determine meaning of what happened in class
- Understand more fully understand the effectiveness of innovations in practice (evidence-based practice)
- Implement new ideas into the physics classroom

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

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 <u>our</u> idea that is fully meaningful to us.
- Successful change must use <u>our</u> ideas

References

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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

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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