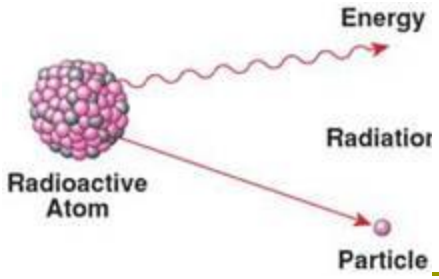
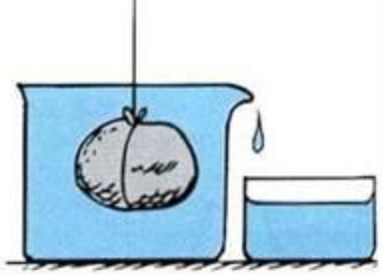
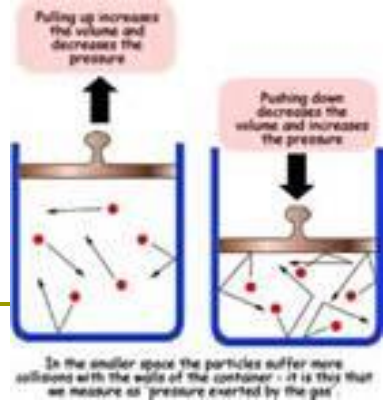
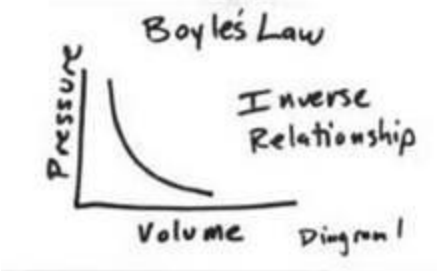








PS-21

Physical Science in the 21st Century

First Spring Institute

February 1, 2013

University of Alabama, Tuscaloosa AL

J. W. Harrell, John Vincent, Stan Jones, Dennis Sunal, Cynthia Sunal, Donna Turner

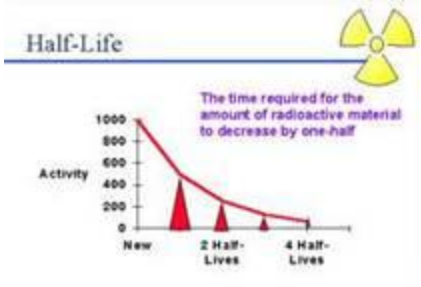
PS-21 Website: http://ps21pd.weebly.com/

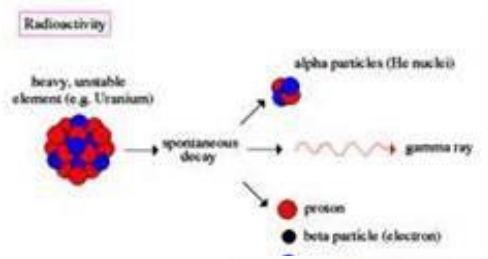
PS-21 Partners: Alabama Commission on Higher Education (ACHE), UA College of Arts and Sciences – Physics Department, Chemistry Department; UA College of Education, C&I Dept. – Science Education; AMSTI, Office of Research in the Disciplines; and Alabama City and County Schools

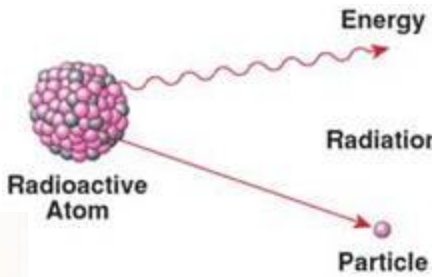
PS–21 First Spring Institute Day 2012- 2013:
Teaching Physical Science

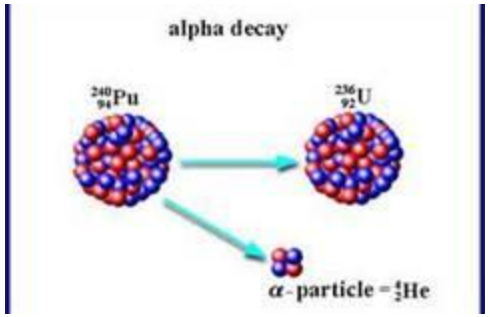
Friday, February1, 2013 at the *University of Alabama, 3408 SEC, Tuscaloosa AL*

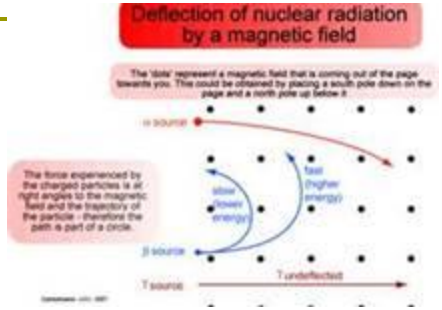
- ***8:30 am:*** **Registration, Coffee, Agenda, Institute surveys, and PS-21 update and Concept Pre-test**
- ***9:00-10:15****: Concept–1) Boyles Law* **+ engaging students with hands-on strategies, PhET simulations, & sharing teaching/learning ideas**
- ***10:15 – 10:25****:* **Break**
- ***10:25-11:30****: Concept–2) Archimedes Principle* **+ engaging students with hands-on strategies, PhET simulations, & sharing teaching/learning ideas**
- ***11:30 – 12:30****: Lunch*
- ***12:30-2:15****: Concept–3*) *Radioactivity*+ **engaging students with hands-on strategies , PhET simulations, & sharing teaching/learning ideas**
- ***2:15– 2:30*** **Break**
- ***2:30– 3:30 Concept–3) Inquiry Lessons Planning*** **+ engaging students with hands-on strategies & sharing teaching/learning ideas**
- ***3:30– 3:45****: Wrap up,* **Institute surveys, Feedback, post-test, future dates & science topics– Graduate credit assignments**

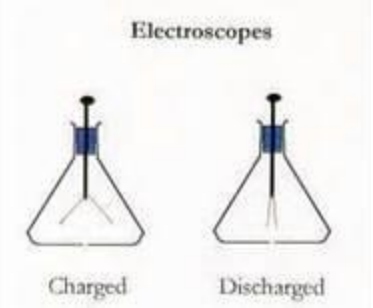


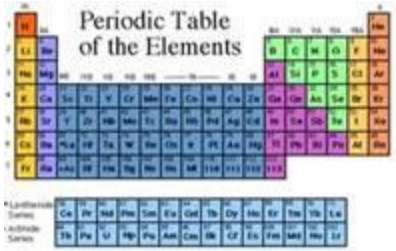


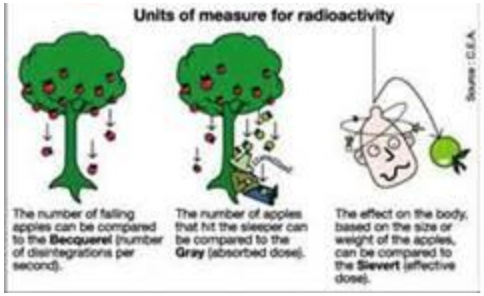


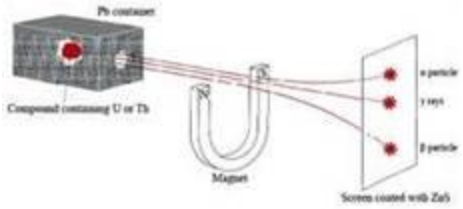


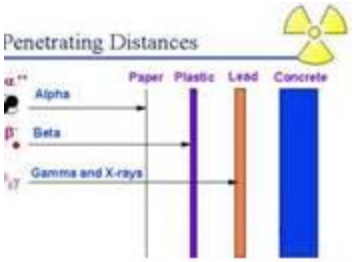






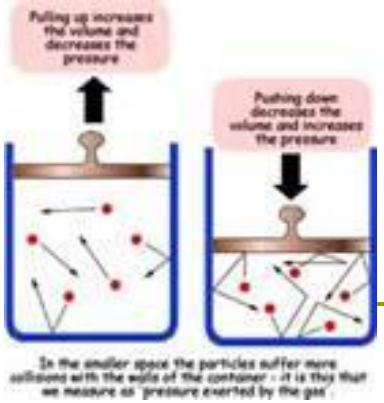


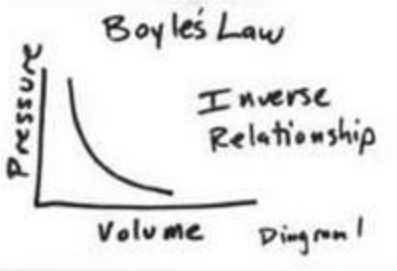


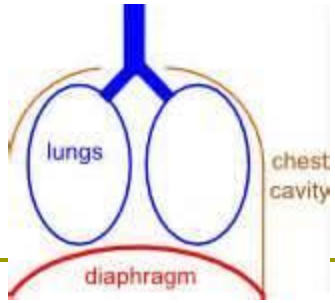


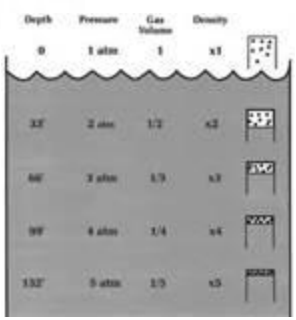
The half-lives of some radioactive isotopes

Radioactive isotope	Half-life
Uranium-238, $^{238}_{92}U$	4.5×10^{9} years
Carbon-14, $^{14}_{6}C$	5.7×10^{3} years
Radium-226, $^{226}_{88}Ra$	1.6×10^{3} years
Strontium-90 $^{90}_{38}Sr$	28 years
Iodine-131, $^{131}_{53}I$	8.1 days
Bismuth-214, $^{214}_{83}Bi$	19.7 minutes
Polonium-214, $^{214}_{84}Po$	1.5×10^{-4} seconds

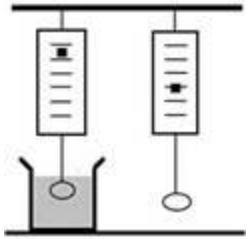


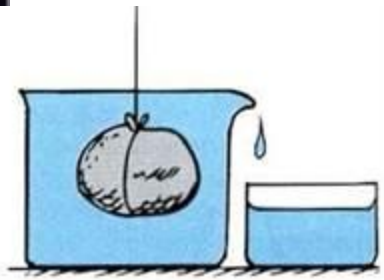


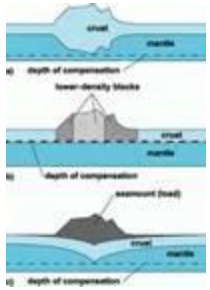


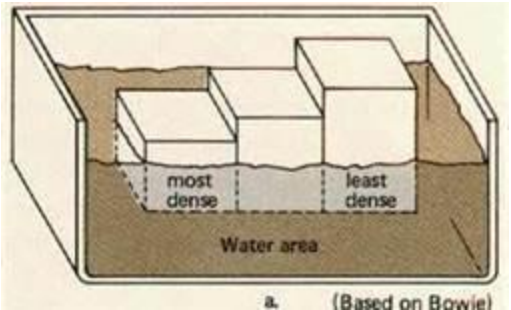


Archimedes' Principle

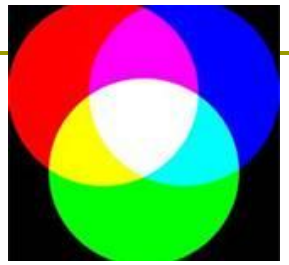






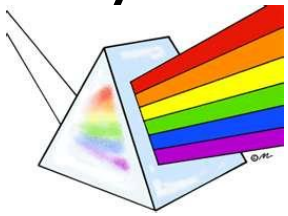


PS–21 Resources: PS-21 Web Site



Website:PS-21 WEEBLY
http://ps21pd.weebly.com/

- Current activities and many resources
- Post your questions to be answered. Respond to other teachers questions
- Threaded discussions on physical science questions – e.g. light & color and other discussions.
- Request each teacher make a monthly posting to the discussion board on **http://ps21pd.weebly.com/**



PS-21 Year long objectives

- Acquire and demonstrate greater and deeper 21st century content knowledge on key physics concept themes in the physical sciences found in the national and state standards,
- Acquire and implement in science classrooms effective teaching techniques aimed at facilitating students' meaningful understanding of physical science content [Science pedagogical content knowledge (PCK)]
- Use student inquiry labs and interactive approaches to model conceptual themes in the physical sciences
- Engage in professional development with both science content and pedagogy during the school year through varied venues as a means of maintaining and enhancing practice as highly qualified science teachers.

PS–21 Institute Objectives

Experiencing, inquiring, using, and measuring to create meaningful learning of concepts in physical science through three questions:

1. **What misconceptions do your students bring to physical science and what should you do about them?**
2. **What engaging explanations and activities can be used in teaching the concepts?**
3. **What applications can be used with the concepts to assist application and transfer to the real world?**

Bring the following materials. We will use them with science concepts at this PS-21 Institute.

Bring lap top computer and/or a flash drive if you have one, you can bookmark URLs of useful sites on it. We have lap top (netbooks) spares here if you need one.

Websites to Accompany PS-21 Institute Activities

Concept 1:Boyles Law

Boyles Law simulation

http://content.blackgold.ca/ict/Division4/Science/Div.%204/Boyles%20Law/boyleslaw.htm

Boyles Law PhET

http://phet.colorado.edu/en/simulation/gas-properties

Boyles Law animated

http://www.grc.nasa.gov/WWW/K12/airplane/aboyle.html

What is Boyles Law

http://www.wisegeek.org/what-is-boyles-law.htm

Chen Ed Digital Library

http://chemteacher.chemeddl.org/services/chemteacher/index.php?option=com_content&view=article&id=1

Websites to Accompany PS-21 Institute Activities

***Concept* 2: Archimedes principle**

- **Buoyancy**

http://hyperphysics.phyastr.gsu.edu/Hbase/pbuoy.html

Definition
http://cnx.org/content/m42196/latest/?collection=col11406/latest

Archimedes principle PhET

http://phet.colorado.edu/en/contributions/view/3560

Archimedes principle You Tube
http://www.youtube.com/watch?v=eQsmq3Hu9HA

Websites to Accompany PS-21 Institute Activities

***Concept 3*:**
Radioactivity

- **Radioactive Decay Teacher Tube**

http://teachertube.com/viewVideo.php?video_id=181054

Types of Radioactivity Teacher Tube

http://teachertube.com/viewVideo.php?video_id=181178

Radioactivity definition

http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/radact.html

PS–21 Resources: Physical Science Teaching Videos

Annenberg Free videos online

http://www.learner.org/resources/browse.html

Minds of our own -- 1. Can we believe our eyes? – Mirrors

http://www.learner.org/resources/series26.html Problem and explanation 5:30-9:50

Private Universe Project in Science: Workshop 5 Can we believe our eyes? – Mirror interviews and explanation 4:50-9:00-11:30

http://www.learner.org/resources/series29.html

Students Prior Knowledge

- Created from personal experiences
- Disagrees with scientific inquiry
- Partially valuable and useful in coping with everyday world
- Uses household meanings of scientific words
- Acquired from physical and social world
- Incorporated new facts with prior knowledge

Teaching Physical Science Concepts: Common Student Ideas About the Radioactivity

Misconceptions –

- **Nuclei disappear when they decay**
- **Half-life is half the time for the radioactivity to disappear**
- **You get contaminated by radiation**
- **Radiation makes things radioactive**
- **Beta particles are electrons so come from an atom's electron shells**
- **Alpha particles cause more ionizations than beta particles**
- ***Add others that students use!!***

Teaching Physical Science Concepts: Common Student Ideas About Archimedes Principle and Boyles Law Concepts

Misconceptions -

- Water is pushing up on the object
- Weight determines if an object will sink or float.
- Heavy objects always sink and light objects always float.
- A larger heavier object will not float as well as a smaller lighter object of the same material.
- The amount of water will cause objects to float or sink better.
- Fluid pressure only acts downward
- There must be more water for larger objects to float.
- Weight of the water must be more than the weight of the object.
- Objects with holes will always sink.
- Objects with air float.
- Objects float on top of the liquid.
- Pressure and force are synonymous
- Pressure arises from moving
- Liquids rise in a straw because of "suction." fluids.

Bibliography on Boyles law, Archimedes Principle, and Radioactivity

- **Scientific Misconceptions Quiz**

http://www.furryelephant.com/quiz/

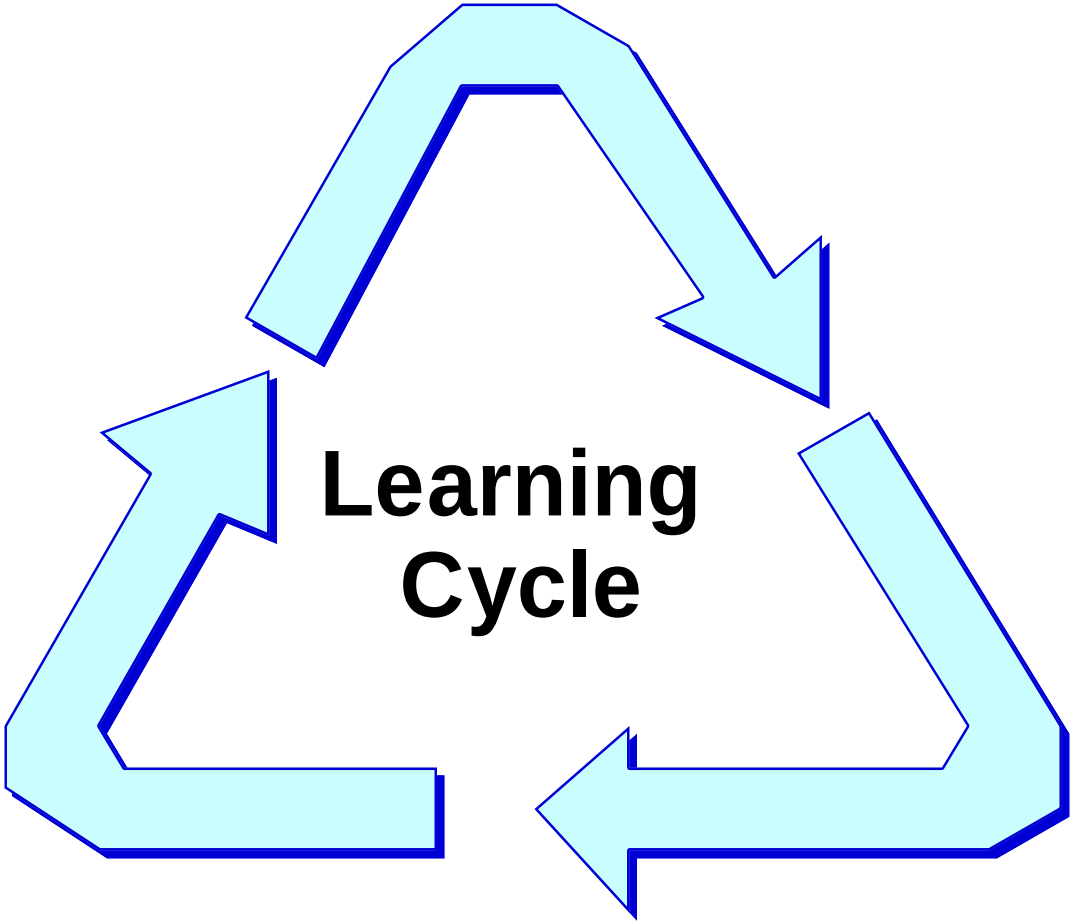
- **Animations, Simulations & Activities for Teaching and Learning-** http://www.furryelephant.com/

What are Effective Research Based Strategies in Boyles law, Archimedes Principle, and Radioactivity?

- Important to teach what a model is and that all models are limited in specific ways.
- Need to present students with cognitive conflict challenging their existing models.
- Then need to offer a new "better" model that must be practiced.
- Next, the new model must impress the students by working when applied in new settings
- The new models must be simple ones that clearly relate to students prior knowledge.

- A great amount of experience is needed with predicting and measuring in various contexts order to challenge prior ideas.
- Then, ask students to explain what and why these momentum and change. phenomena occur.
- Introduce momentum and change with a focus on energy as well as properties
- Important to ask students to develop a generalized theory of momentum and change.

PS–21 Resources: Inquiry Instruction Sequence



Using the LEARNING CYCLE to Plan Lessons*

- **EXPLORATION**
  - Confront existing knowledge - focus student's attention
  - Recall and relate previous knowledge in small groups
  - Try out prior knowledge in a new setting
- **INVENTION**
  - Reflect on and discuss the results of exploration
  - Use a variety of analogies
  - Provide examples and models
  - Provide closure
- **EXPANSION**
  - Provide additional student practice
  - Provide application and transfer skills
  - Provide summary

* See ALCOS - Science

Group Activity

Complete the professional task below applying what you have just experienced. You will need eight 3x5 cards.

1) Review the ideas and materials presented earlier for a **Boyles Law, Archemedes Principle, or Radioactivity** concepts.
2) For one concept, write one card that provides the lesson title and the lesson objective(s).
3) **Create/write** 5-6 station activity **cards** that when sequenced form a **learning/teaching cycle** for the concept selected.
4) Create one card that briefly describes an assessment activity.

Planning Physical Science Lessons

- Elicit student ideas
- Provide data to link student ideas to science concepts
- Have students present and defend their ideas
- Introduce scientific perspective
- Change context
- Have students apply and defend their new understanding
- Have students reflect on their learning

Use of Analogies in Teaching Science

- Analogies have both value and problems. You must judge the cost vs benefit.
- Students naturally use their own experience and generate analogies
- Biological, hydrodynamic, thermal, and mechanical analogies have been used. There are many traps and false conclusions with analogies.
- As with all analogies you must review or teach the analogy first – understand and experience it, then make specific connections.

- Important to use multiple analogies citing limitations in each.
- Research has shown some value in mechanical analogies – v waves from a row of swimming ducks
- Students applying ideas find it hard to recognize the concepts of waves and sound in the practical situations.

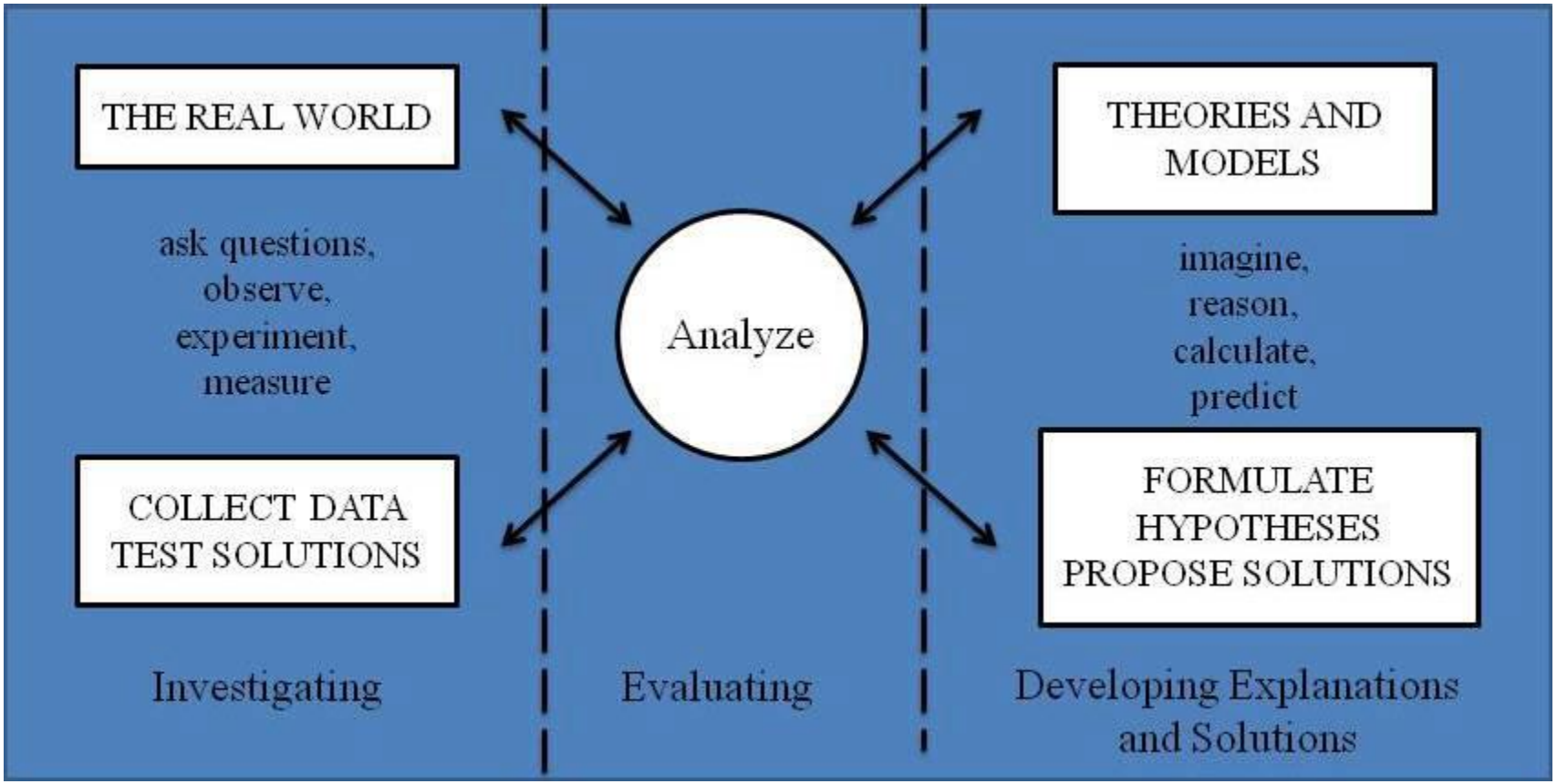
Teaching Strategy for Science Analogies

- Step 1--Introduce the concept to be learned
- Step 2--Review with the students' the analogous situation.
- Step 3--Identify the relevant features of the analog model.
- Step 4--Map out the similarities between the analog model and the concept.
- Step 5--Indicate where the analogy breaks down.
- Step 6--Draw conclusions about the concept.

PS–21 Resources: A New Framework for K-12 Science Education & Common Core Standards (NGSS)

- **The *Framework for K-12 science standards: Practices, crosscutting concepts, and core ideas* was released in July, 2011 by the National research Council (NRC). The NRC was responsible for developing the NSES in 1996. PDF available from http://www.nap.edu/catalog.php?record_id=13165**
- **These new core standards (NGSS) are designed to strengthen the National Science Education Standards and gradually replace them.**
- **The Common Core Standards have already been developed in English-Language Arts and Mathematics.**

Three Spheres of Activity for Scientists and Engineers



Common Core Crosscutting Concepts

1) Patterns
2) Cause and Effect
3) Scale, proportion, quantity
4) Systems and models
5) Energy and matter
6) Structure and function
7) Stability and change

Disciplinary Common Core Idea Areas PS-21 Institute #2

Physical Sciences

- **PS 1: Matter and its interactions**
- **PS 2: Motion and stability: Forces and interactions**
- **PS 3: Energy**
- **PS 4: Waves and their applications in technologies for information transfer**

Common Core Ideas in the Framework: Physical Sciences - PS-21 Institute #2

PS1:Matter and its interactions

PS1A: Structure and properties of matter

PS1B:Chemical reactions

PS1C: Nuclear processes

PS2: Motion and stability: Forces and interactions

PS2A: Forces and motion

PS2B: Types of interaction

PS2C: Stability and instability in physical systems

PS3: Energy

PS3A: Definitions of energy

PS3B: Conservation of energy and energy transfer

PS3C: Relationship between energy and forces

PS3D: Energy in chemical processes and everyday life

PS4: Waves and their applications

PS4A: Wave properties

PS4B: Electromagnetic radiation

PS4C: Information technologies and instrumentation

PS1:Matter and its interactions

PS1.c Nuclear Processes

Key Question

What forces hold nuclei together and mediate nuclear processes?

Key Concept

Phenomena involving nuclei are important to understand, as they explain the formation and abundance of the elements, radioactivity, the release of energy from the sun and other stars, and the generation of nuclear power.

By the end of grade 8

- Nuclear fusion can result in the merging of two nuclei to form a larger one, along with the release of significantly more energy per atom than any chemical process. It occurs only under conditions of extremely high temperature and pressure. Nuclear fusion taking place in the cores of stars provides the energy released (as light) from those starsand produced all of the more massive atoms from primordial hydrogen. Thus the elements found on Earth and throughout the universe (other than hydrogen and most of helium which are primoridial) were formed in the stars by this process.

By the end of grade 12

- Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve changes in nuclear binding energies. The total number of neutrons plus protons does not change in any nuclear process. Strong and weak nuclear interactions determine nuclear stability and processes. Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials from the isotope ratios present. Normal stars burn out after having converted all of the material in their cores to iron. Elements more massive than iron are formed by fusion processes only in the extreme conditions of supernova explosions, which explains why they are relatively rare.

PS2: *Motion and Stability: Forces and Interactions*

- **PS2.C: Stability and Instability in Physical Systems**

Key Question

Why are some physical systems more stable than others?

Key Concept

Events and processes in a system typically involve multiple interactions occurring simultaneously or in sequence. The system's stability or instability and its rate of evolution depend on the balance or imbalance among these multiple effects.

By the end of grade 8

- A stable system is one in which any small change leads to forces that return the system to its prior state (e.g., a weight hanging from a string). A system can be static but unstable (e.g., a pencil standing on end). A system can be changing but have a stable repeating cycle of changes; such observed regular patterns allow predictions about the system's future (e.g., Earth orbiting the sun). Many systems, both natural and engineered, rely on feedback mechanisms to maintain stability, but they can function only within a limited range of conditions. With constant conditions, a system starting out in an unstable state will continue to change until it reaches a stable configuration (e.g., sand in an hourglass).

By the end of grade 12

- Systems often change in predictable ways; understanding the forces that drive the transformations and cycles within a system, as well as the forces imposed on the system from the outside, help to predict its behavior under a variety of conditions. When a system has a great number of component pieces, one may not be able to predict much about its precise future. For such systems (e.g., with very many colliding molecules), one can often predict average but not detailed properties and behaviors (e.g., average temperature, motion, and rates of chemical change but not the trajectories or other changes of particular molecules). Systems may evolve in unpredictable ways when the outcome depends sensitively on the starting condition and the starting condition

PS-21 Internet Resources
Table of Contents

PS-21 WEEBLY
http://ps21pd.weebly.com/

1. Pathway: Physics Teaching Web Advisory

http://www.physicspathway.org/

2. Annenberg Free videos online

http://www.learner.org/resources/browse.html

3. **Physical Sciences Resource Center**

http://www.compadre.org/psrc/

4. Physics classroom topics

www.physicsclassroom.com/Class

5. Physics Forums: help in teaching

http://physicsforums.com/

6. Physics related websites

7. Online simulations

http://phet.colorado.edu/index.php

8. Physical science classroom

PS–21 Resources: PS-21 Web Site

Website:PS-21 WEEBLY
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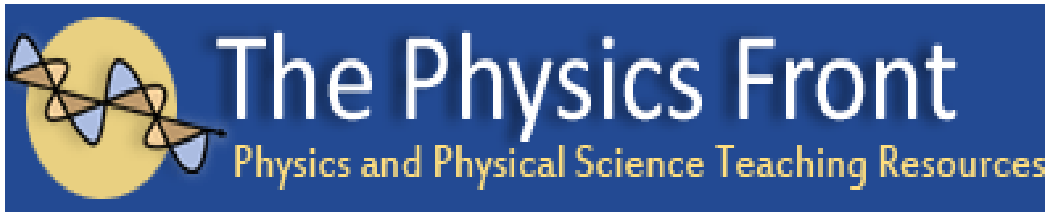
- Current activities and many resources
- Post your questions to be answered. Respond to other teachers questions
- Threaded discussions on physical science questions – e.g. light & color and other discussions.
- Request each teacher make a monthly posting to the discussion board on **http://ps21pd.weebly.com/**

PS–21 Resources:

1. **Pathway: Physics Teaching Web Advisory**
   - **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**



K-8 Physical Science

Physics First

Conceptual Physics

http://www.thephysicsfront.org/items/detail.cfm?ID=2493

Some Topics

Education Foundations
- Alternative Conceptions

Modern Physics
- General

Oscillations & Waves
- Wave Motion
= Interference and Diffraction
= Longitudinal Pulses and Waves
= Phase and Group Velocity
= Transfer of Energy in Waves
= Transverse Pulses and Waves

Quantum Physics
-Probability, Waves, and Interference

AAAS Project 2061 Science Assessment Website

- Here you will find free access to more than 600 items. The items:
- Are appropriate for middle and early high school students.
- Test student understanding in the earth, life, physical sciences, and the nature of science.
- Test for common misconceptions as well as correct ideas.

http://assessment.aaas.org/

- This website also includes:
- Data on how well U.S. students are doing
- My Item Bank," a feature that allows you to select, save, and print items
- A feature that allows you to create and take tests online using items from the item collection

PS–21 Resources: Physical Science Teaching Videos

2. Annenberg Free videos online

http://www.learner.org/resources/browse.html

- The Missing Link: Essential Concepts for Middle School Math Teachers

This video workshop for middle school math teachers covers essential topics missed in most U.S. math curricula.

- Physics for the 21st Century

A multimedia course for high school physics teachers, undergraduate students, and science enthusiasts; 11 half-hour programs, online text, facilitator's guide, and Web site.

- The Science of Teaching Science

This video workshop for new and veteran K-8 science teachers inspires them to explore new methods of teaching science.

- Teaching High School Science
- This video library for high school teachers shows the practice of effective inquiry teaching in the science classroom.

PS–21 Resources: PS Resource Center URL

3. Physical Sciences Resource Center

- **http://www.compadre.org/psrc/**

Browse the PSRC by Subject:

- **- Astronomy**
- **- Education Practices**
- **- Electricity & Magnetism**
- **- General Physics**
- **- Modern Physics**
- **- Optics**
- **- Oscillations & Waves**
- **- Other Sciences**

PS–21 Resources: The Physics Classroom Topics URL

4. Physics Topics

www.physicsclassroom.com/Class

- **The Physics Classroom Tutorial**
- **Multimedia Physics Studios**
- **Shockwave Physics Studios**
- **Minds on Physics Internet Modules**
- **Curriculum Corner**
- **The Laboratory**

- Physics Tutorials
  - 1-D Kinematics
  - Newton's Laws
  - Vectors - Motion and Forces in Two Dimensions
  - Momentum and Its Conservation
  - Work, Energy, and Power
  - Circular Motion and Satellite Motion

PS–21 Resources: Physics Forums URL

5. Physics Forums: help in teaching science

- **http://physicsforums.com/**

- **Science Education**
- **Physics**
- **Astronomy & Cosmology**
- **Mathematics**
- **Engineering**
- **Chemistry**
- **Biology**
- **Other Sciences**

PS–21 Resources:
6. Physics-Related Websites

- American Association of Physics Teachers http://www.aapt.org.
- Alabama Section of AAPT http://bama.ua.edu/~alaapt/
- More links from AL/AAPT http://bama.ua.edu/~alaapt/links.htm
- Colorado http://phet.colorado.edu/index.php
- Campadre http://www.compadre.org/
- MERLOT http://www.merlot.org/merlot/index.htm
- American Physical Society educators' page http://www.aps.org/studentsandeducators/index.cfm
- Physics Central http://www.physicscentral.org/
- Particle physics http://particleadventure.org/
- Physics Teacher Education Coalition http://www.phystec.org/
- Live photo project http://livephoto.rit.edu/
- A good site for physics applets is: http://www.falstad.com/mathphysics.html

PS–21 Resources: Interactive Science Simulations

7. Interactive, research based simulations of physical phenomena from the PhET project at the University of Colorado.

http://phet.colorado.edu/index.php

PS–21 Resources:
8. The Physical Science Classroom

- **Physical Science Activities** Teacher's Guides by Program Title

http://www.pbs.org/wgbh/nova/teachers/resources/title.html

- **Chemistry Activities – Videos**

http://www.pbs.org/wgbh/nova/teachers/resources/subj_02_03.html

- **PBS-NOVA for Teachers**

http://www.pbs.org/wgbh/nova/teachers/

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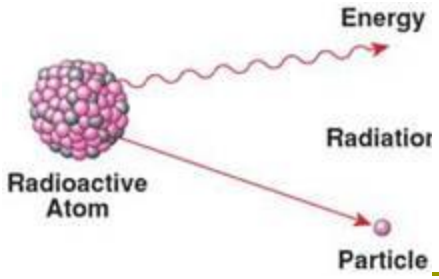
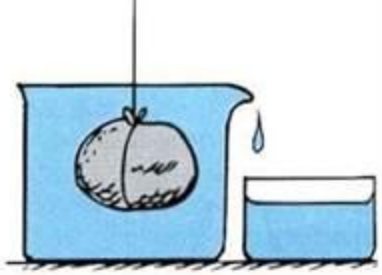
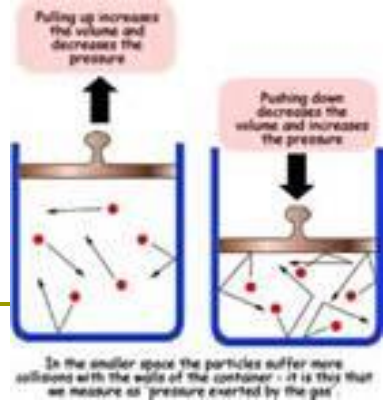
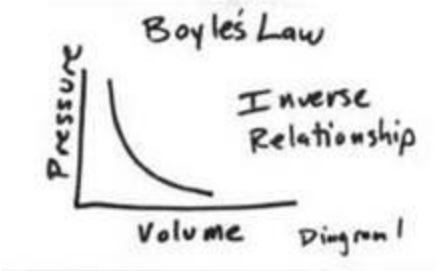
Feedback

- Status: How are you doing? What are you doing? What is coming up next in your planning?
- Planning: What are you now planning that relates to this workshop? How far are you along? Do you need any help?
- Light and Color Concepts: Do you see difficult physical science concepts coming up that we could discuss with you?
- Technical: What comments on problems do you have with using technology/internet materials or other technical questions?









PS-21

Physical Science in the 21st Century

First Spring Institute

February 1, 2013

University of Alabama, Tuscaloosa AL

J. W. Harrell, John Vincent, Stan Jones, Dennis Sunal, Cynthia Sunal, Donna Turner

PS-21 Website: http://ps21pd.weebly.com/

PS-21 Partners: Alabama Commission on Higher Education (ACHE), UA College of Arts and Sciences – Physics Department, Chemistry Department; UA College of Education, C&I Dept. – Science Education; AMSTI, Office of Research in the Disciplines; and Alabama City and County Schools