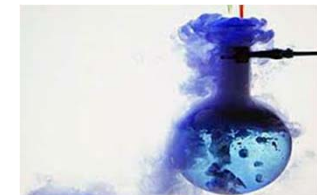


PHYSICS STUDIES MANY
DIFFERENT TYPES OF
MOTION AND FORCES.

PS-21

Physical Science in the 21st Century Second Spring Institute 2013-14

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 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

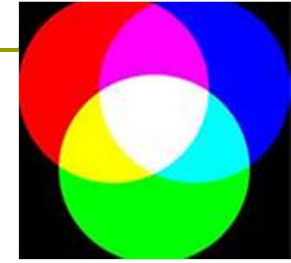
Experiencing, inquiring, using, and measuring to create meaningful learning of concepts in physical science through three questions:

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?

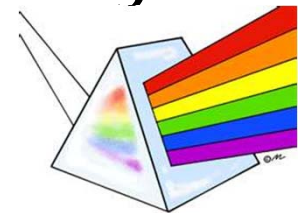
PS-21 Resources: PS-21 Web Site

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/>



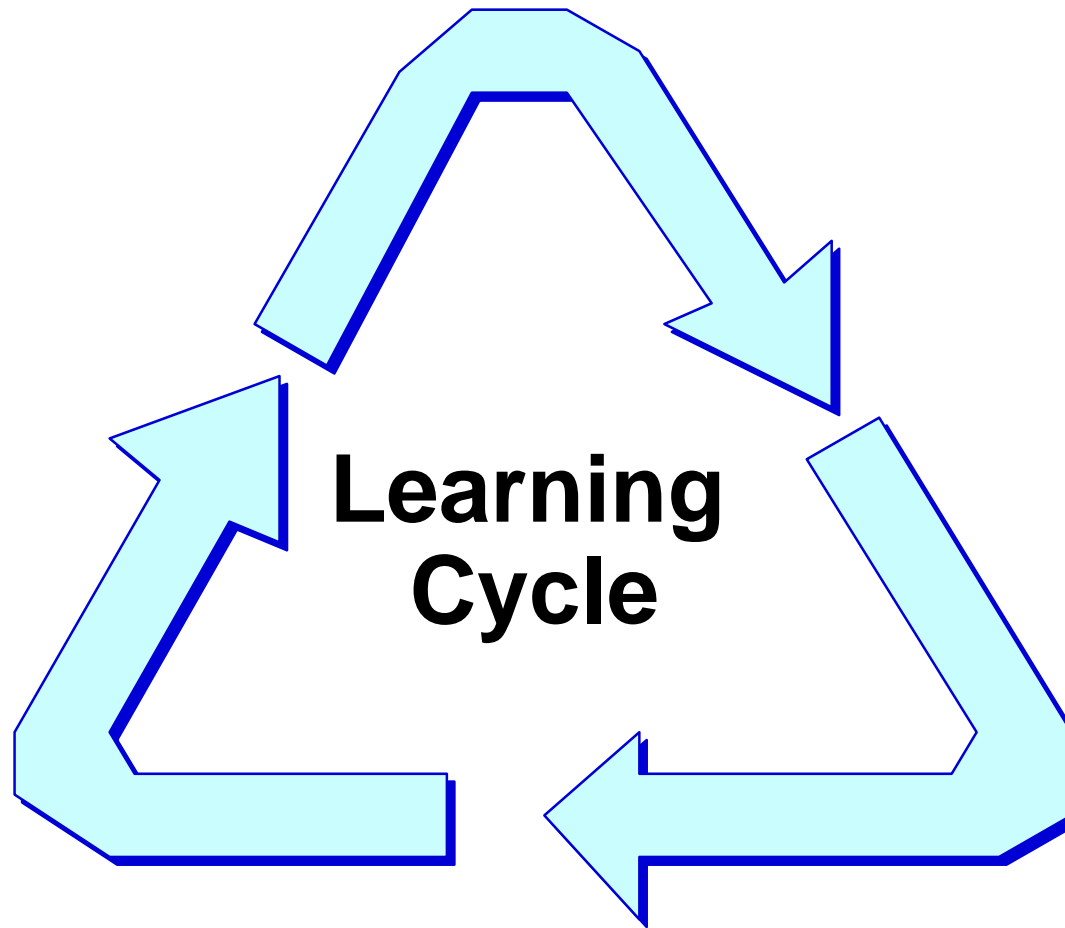
Bring the following materials. We will use them with science concepts at PS-21 Institutes.

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.

Bring your physical science textbook to compare curriculum sequences.



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

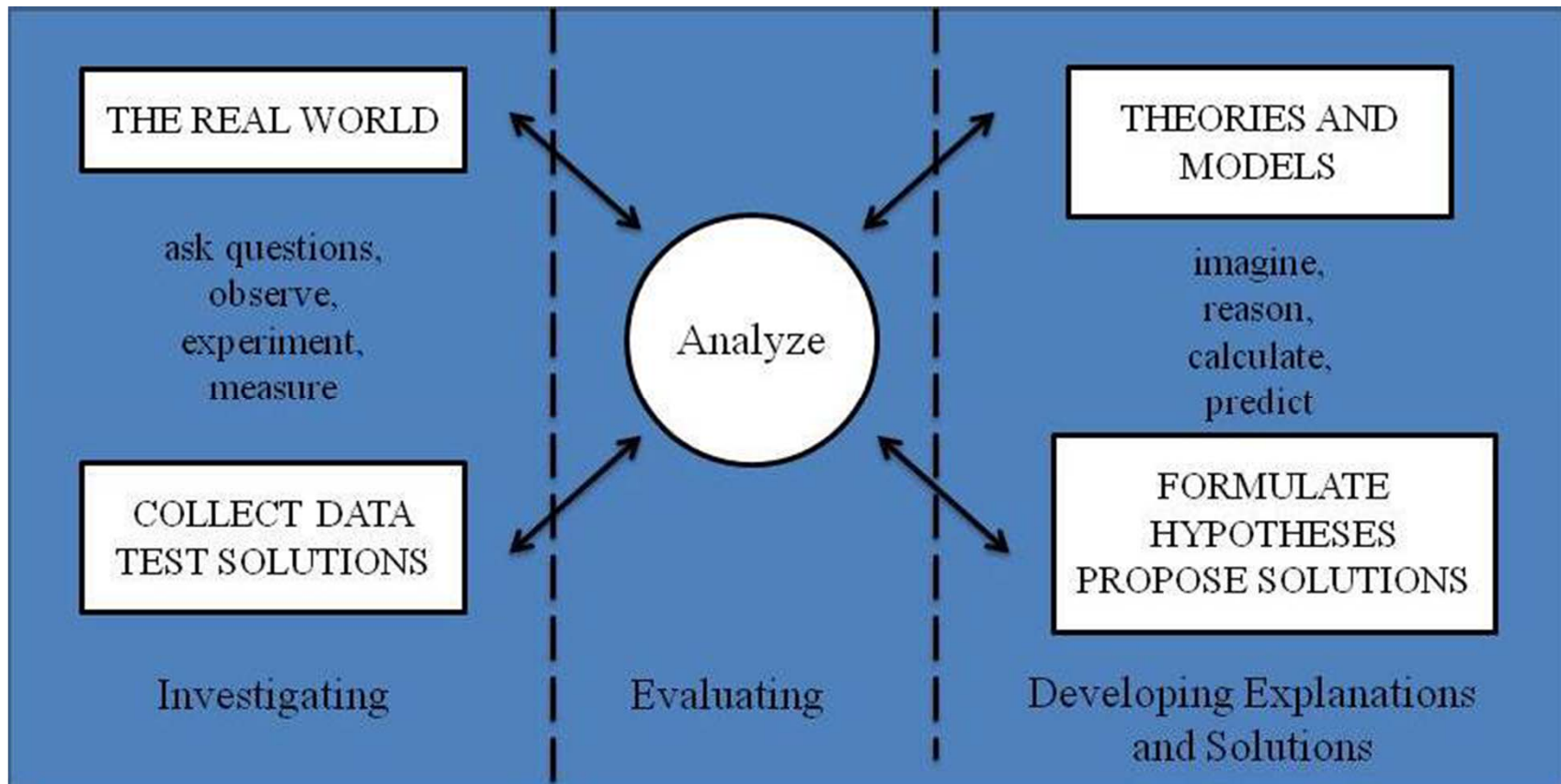
Planning Physical Science Lessons

- 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

PS–21 Resources: Next Generation Science Standards (NGSS) & Common Core Standards

- **The *Next Generation Science Standards (Practices, crosscutting concepts, and core ideas)* were released summer 2013 by the National Academies Press. The NGSS are based on the Common Core framework.**
- **These new core standards (NGSS) are designed to strengthen the National Science Education Standards and gradually replace them. Free access at <http://www.nextgenscience.org/>**
- **The Common Core Standards have already been developed in English-Language Arts and Math to teach science across all subjects.**
http://www.nap.edu/catalog.php?record_id=13165

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 Institutes

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

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

Example 1

□ ***PS1.B:
Chemical
Reactions***

Key Question

Why are some physical systems more stable than others?

Key Concept

Many substances react chemically with other substances to form new substances with different properties. This change in properties results from the ways in which atoms from the original substances are combined and rearranged in the new substances. However, the total number of each type of atom is conserved.

By the end of grade 8

- ▣ Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change. Some chemical reactions release energy, others capture or store energy.

By the end of grade 12

- ❑ Chemical processes, their rates, and whether or not energy is absorbed or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in total binding energy (i.e., the sum of all bond energies in the set of molecules) that are matched by changes in kinetic energy. In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present.
- ❑ The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. Chemical processes and properties of materials underlie many important biological and geophysical phenomena.

PS2: Motion and Stability: Forces & Interactions

Example 2

PS2.A: Forces and Motion

Key Question

How can one predict an object's continued motion, changes in motion, or stability?

Key Concept

Interactions of an object with another object can be explained and predicted using the concept of forces, which can cause a change in motion of one or both of the interacting objects.

By the end of grade 8

- Any two interacting objects exert forces of equal magnitude on each other in opposite directions (Newton's third law). The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The heavier the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. Forces on an object can also change its shape or orientation. In order to share information with others, all positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference system and arbitrarily chosen units of size.

By the end of grade 12

- Newton's second law accurately predicts changes in the motion of macroscopic objects, but it requires revision for subatomic scales or for speeds close to the speed of light. Momentum is a property of objects, defined for a particular frame of reference, that depends on their mass and speed. (Boundary: No details of quantum physics or relativity are included at this grade level. There is just the observation that, at the relevant scales, multiple phenomena necessitate revisions to Newton's laws and that these two theories developed to provide more adequate explanations.)
- In any system, total momentum is always conserved. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in momentum of objects outside the system.

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
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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.
- 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

<http://assessment.aaas.org/>

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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<http://www.project2061.org/publications/atlas/sample/toc.htm> Table of Contents Vol 1 & 2 at
<http://www.project2061.org/publications/atlas/media/combinedTOC.pdf>

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- National Research Council (2000). *Inquiry and the national standards*. Washington D. C: National Academy Press. ISBN 0-309-06476-7 pbk & pdf. Accessed free online at <http://www.nap.edu/booksearch.php?term=Inquiry+and+the+National+standards&isbn=030906533X&Search+This+Book.x=17&Search+This+Book.y=15>

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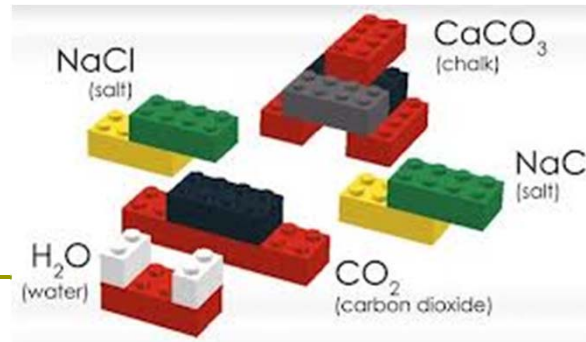
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Feedback

- ❑ 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?
- ❑ Chemistry and Physics 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?

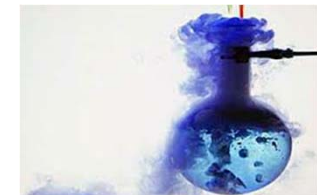


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