

PHYSICS STUDIES MANY DIFFERENT TYPES OF MOTION AND FORCES.

# PS-21

## ***Physical Science in the 21st Century Second Spring Institute March 8, 2013***

University of Alabama, Tuscaloosa AL



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

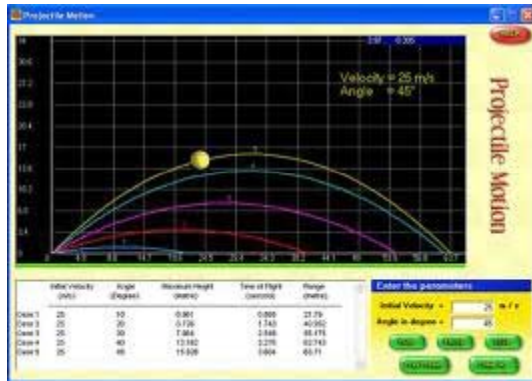
**PS-21 Website:** <http://ps21pd.weebly.com/>


**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 Second Spring Institute Day 2012- 2013: Teaching Physical Science

Friday, March 8, 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) How to Measure Motion + engaging students with hands-on strategies, Smartphone & Tablet App's, & sharing teaching/learning ideas
- 10:15 – 10:25: Break
- 10:25-11:30: Concept-2) Use of Apps in Physical Science Lab Activities + engaging students with hands-on activities, Smartphone & Tablet App's, & sharing teaching/learning ideas
- 11:30 – 12:30: Lunch
- 12:30-2:15: Concept-3) Chemical Reaction Lab Activities in Physical Science + engaging students with hands-on strategies, use of sensors and laptops, & sharing teaching/learning ideas
- 2:15– 2:30 Break
- 2:30– 3:30 Concept-4) Inquiry Lesson Planning + developing physical science lessons to motivate and engage 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



**PHYSICS 101**  
**A BODY IN MOTION,**  
**STAYS IN MOTION,**  
  
**UNTIL HE HITS THE GROUND** © 2012

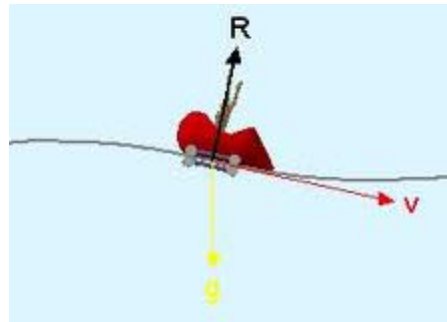
Derivation of motion Equations

Let's derive the motion equations. These equations will be valid if the acceleration is constant.

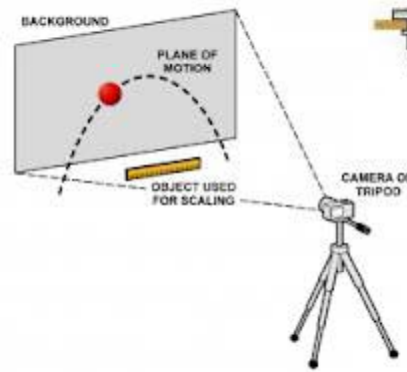
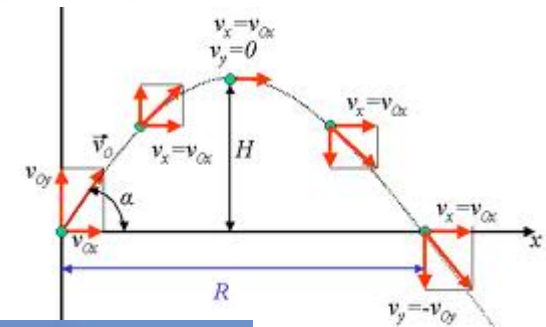
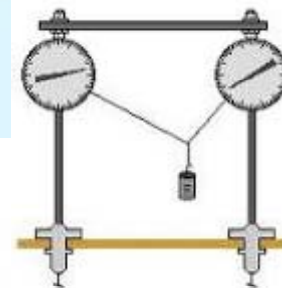
A)  $a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{v - v_0}{t}$   $\Rightarrow v = v_0 + at$   
initial velocity, final velocity, acceleration is const.

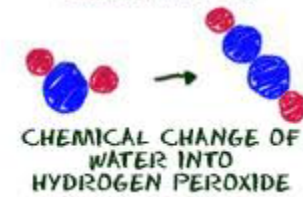
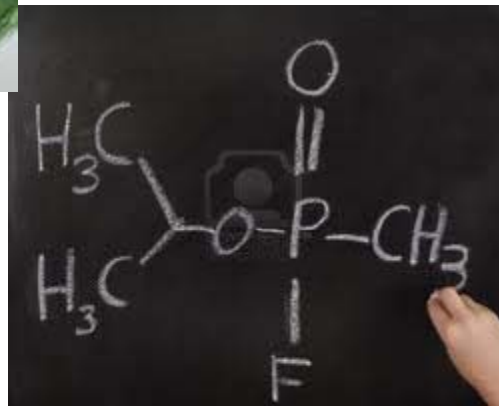
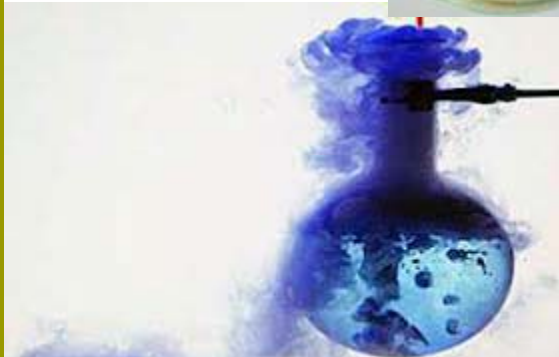
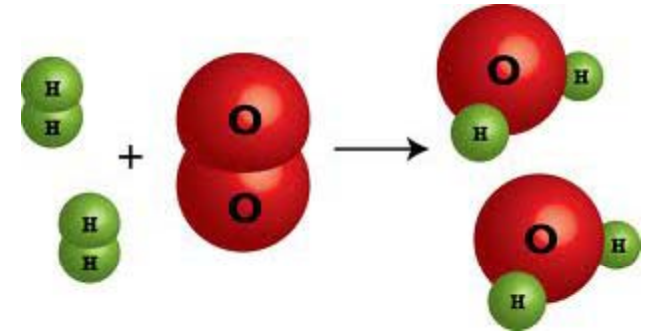
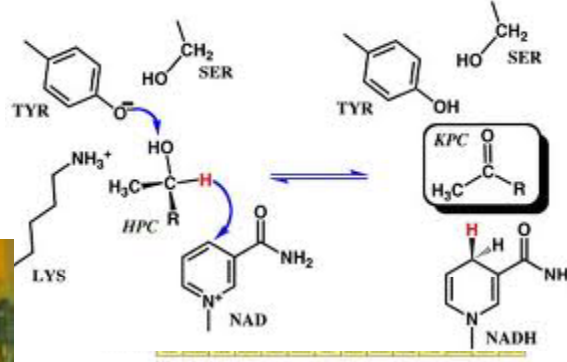
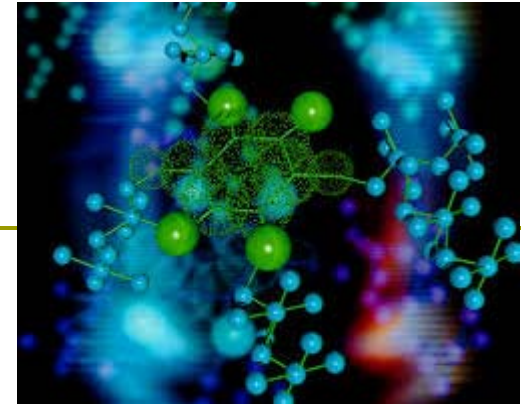
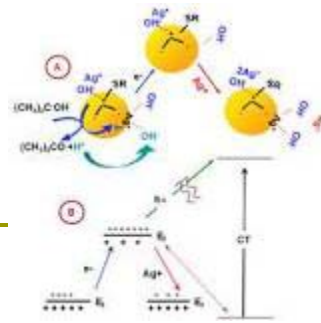
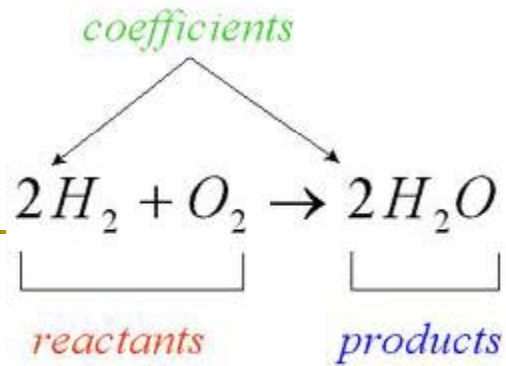
B) The average velocity  $\rightarrow v = \frac{v_0 + v}{2} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$   
average velocity, equal time, initial velocity, final velocity, acceleration is const.

$v_0 + (v_0 + at) = \frac{x_2 - x_1}{t}$   $\Rightarrow x_2 = x_1 + v_0 t + \frac{1}{2} at^2$   
initial position, final position, acceleration is const.



The ball arrives at the stationary guy at  $15 \text{ m/s} + 15 \text{ m/s} = 30 \text{ m/s}$

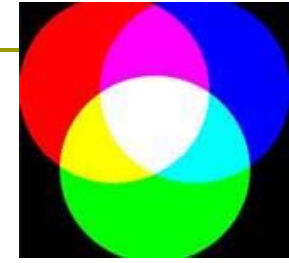




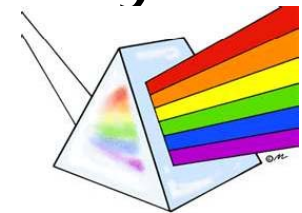
# PS-21 Resources: PS-21 Web Site

**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

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- ❑ 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

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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.**

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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

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## Concept 1: Motion

### Projectile Motion

<http://www.learnerstv.com/animation/animation.php?ani=31&cat=physics>

### Forces and Motion PhET

<http://phet.colorado.edu/en/simulation/forces-and-motion-basics>

## Simple Harmonic Motion

<http://www.learnerstv.com/animation/animation.php?ani=%2046&cat=physics>

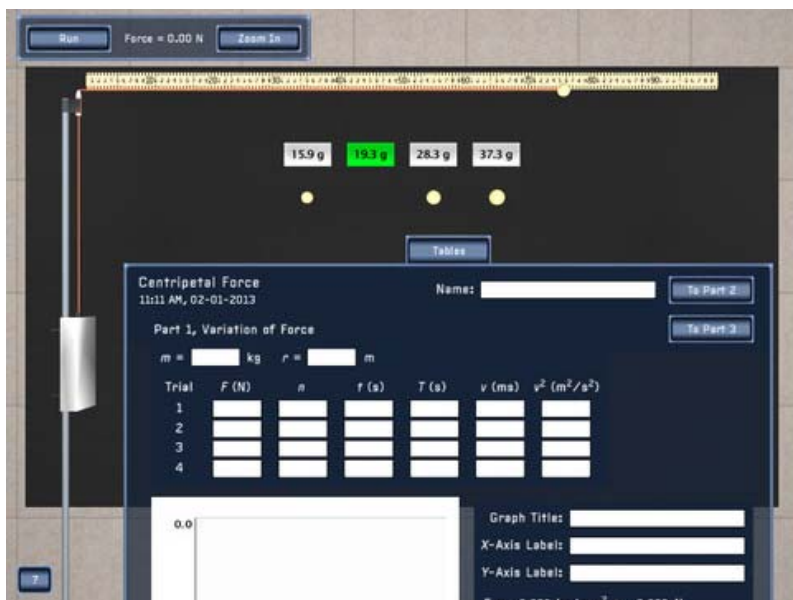
## Physics Problems Animated: Vectors and Projectile Motion-IIIb

<http://www.youtube.com/watch?v=dfgfGEv0wuM>

# Apps for Motion and Chemical Reactions with Costs

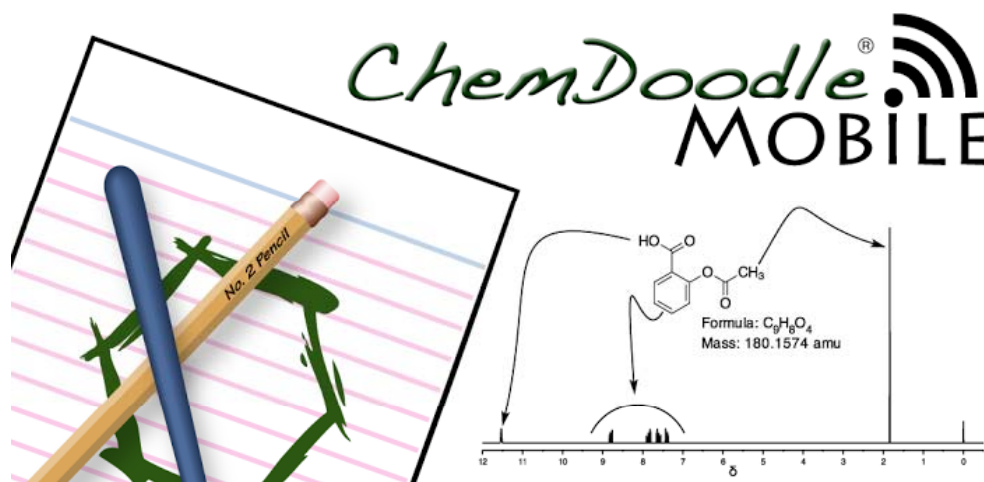
## Motion App for iPad

- ❑ HSVPL Centripetal Force
- ❑ Cost \$1.99



## Chemical Reaction APP for Android

- ❑ ChemDoodle Mobile
- ❑ Cost: Free



# Websites to Accompany PS-21 Institute Activities

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## **Chemical Reaction** **Websites**

- ❑ **Wisc-Online Bio Molecules for Anatomy and Physiology**

<http://www.wisc-online.com/objects/ViewObject.aspx?ID=ap13004Types of Radioactivity Teacher Tube>

- ❑ **NeoK12 – Chemical Reactions**

<http://www.neok12.com/Chemical-Reactions.htm>

- ❑ **How Stuff Works Video – Chemical Reactions**

<http://videos.howstuffworks.com/science/chemical-reaction-videos-playlist.htm#video-29165>

- ❑ **The Naked Scientist: Kitchen Science**

<http://www.thenakedscientists.com/HTML/content/kitchenscience/food/reactions/>

# ***PS-21 Resources: Physical Science Teaching Videos***

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**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

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- ❑ 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 Motion**

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## Misconceptions –

- ❑ Students do not see motion as belonging to a number of different categories – at rest, constant velocity, speeding up, slowing down, changing direction, etc.
- ❑ Instead, they see motion as moving or not moving
- ❑ If there is motion, there is a force acting.
- ❑ There cannot be a force without motion and if there is no motion, then there is no force acting. (for example, students see a downward force of a book acting on a table, but they do not see an upward force of the table acting on the book.)
- ❑ When an object is moving the force is acting in the direction of its motion.

# Teaching Physical Science Concepts: Common Student Ideas About Chemical Reactions

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## Misconceptions -

1. ... the term "reaction" simply means a change in appearance with no change in substance (Johnson, 2000).
2. ... in order for a chemical reaction to occur, two substances (especially two liquids or a liquid and a solid) must be poured or stirred together. (HF, DU Student interviews).
3. ... a chemical reaction occurs during a change of state (Ahtee et al., 1998).
4. ... a chemical reaction occurs when a substance dissolves (HF, DU student interviews).
5. ... after a chemical reaction, the product is a mixture where the old substances persist and the new sample is not a substance in its own right (Johnson, 2000).
6. ... substances are inert objects (and, therefore, cannot change into other substances (Solomonidou et al., 2000).

# Teaching Physical Science Concepts: Common Student Ideas About Chemical Reactions

## Misconceptions -

7. ... substances cannot change into other substances (Johnson, 2000).

8. ... matter disappears when a chemical reaction occurs (Driver et al., 1994).

9. ... that the new properties that result from a chemical reaction preexisted inside the reactant (Solomonidou et al., 2000). (The products of chemical reactions have been there all the time, though hidden, but when the conditions are right they appear.)

10. ... even though change occurs (e.g. rusting), they did not believe this to be a change of substance (Johnson, 2002). They believe that the product is the reactant in a different form (Driver et al., 1994).

11. ... chemical changes are physical changes in form or state (Hesse et al., 1992).

12. ... invisible gases cannot act as reactants or products in chemical reactions (Hesse, 1992).

13. ... a chemical reaction only corresponds to changes at macroscopic level (van Driel et al., 1998).



# Bibliography on Motion and Chemical Reactions

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## □ Misconceptions about Motion

<http://www.physicsfirstmo.org/files/Misconceptions.pdf>


## Student Misconceptions about Chemical Reactions

<http://fmstudy.wikispaces.com/Student+Misconceptions+about+Chemical+Reactions+Compiled+by+Project+2061>

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

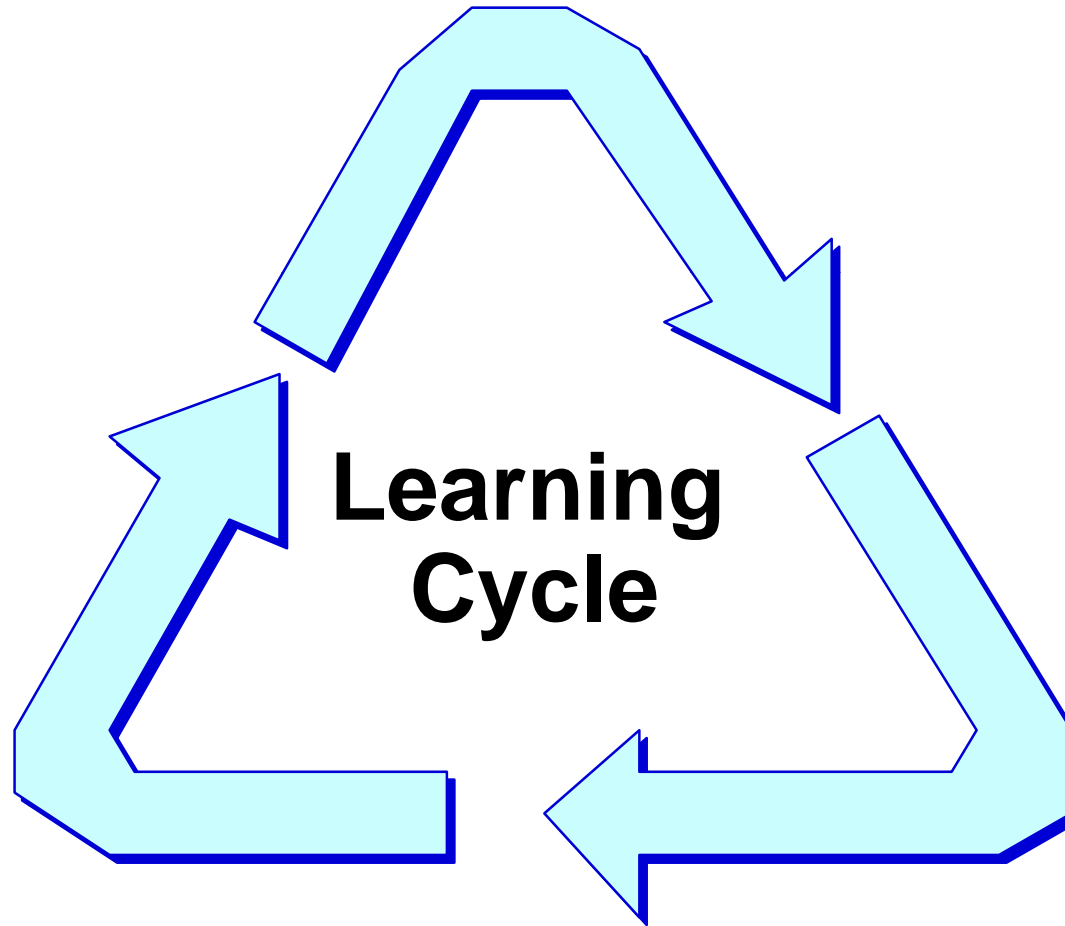
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- ❑ Important to teach what a model is and that all models are limited in specific ways.
- ❑ Need to present students with cognitive conflict challenging their existing models.
- ❑ Then need to offer a new “better” model that must be practiced.
- ❑ 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.

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- 
- 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**

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# Using the **LEARNING CYCLE** to Plan **Lessons\***

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## □ **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

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

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- 1) Review the ideas and materials presented earlier for **Motion or Chemical Reaction** 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

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- ❑ 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

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- ❑ 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.



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- 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

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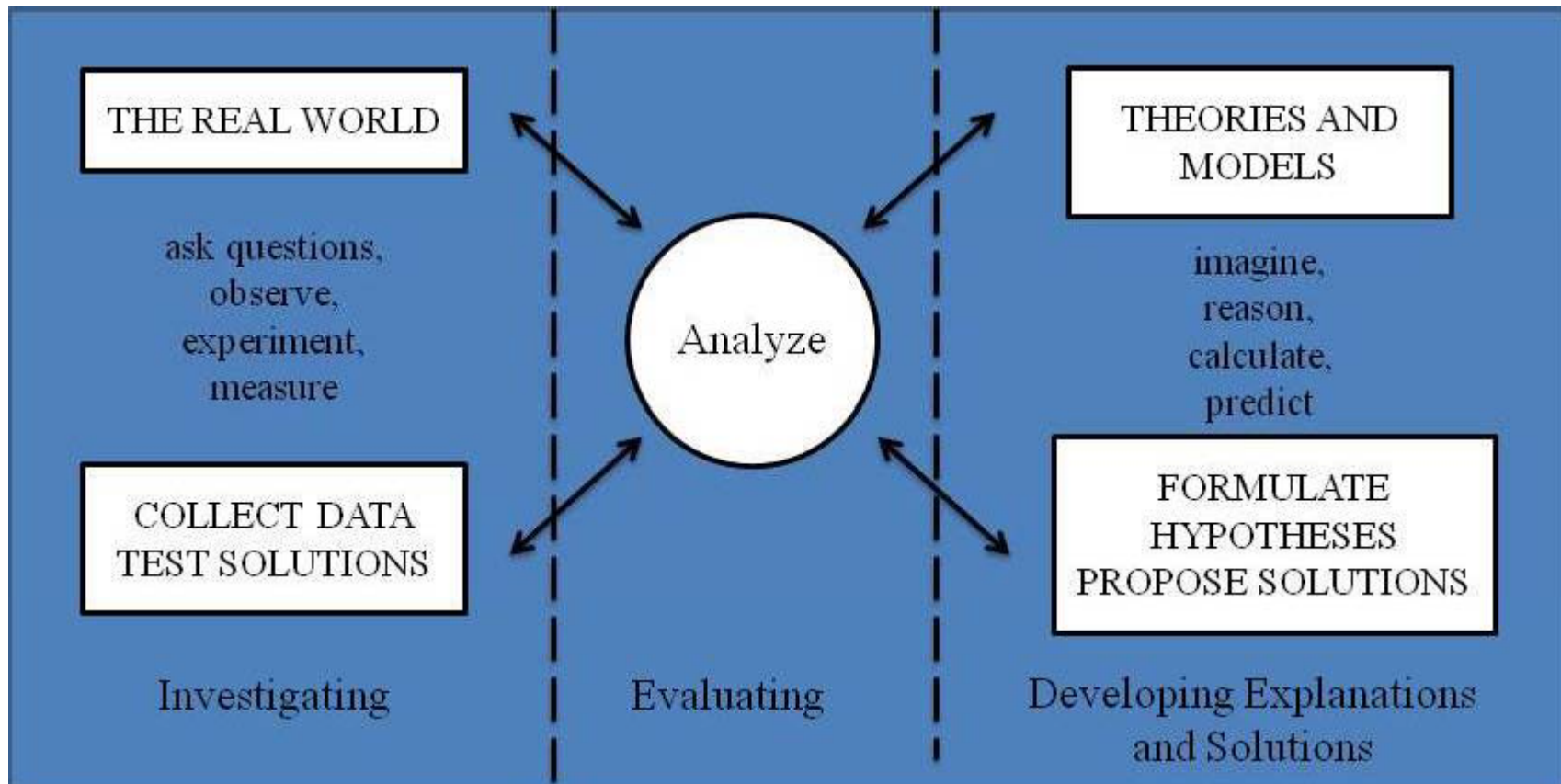
- ❑ Step 1--Introduce the concept to be learned
- ❑ Step 2--Review with the students' the analogous situation.
- ❑ Step 3--Identify the relevant features of the analog model.
- ❑ Step 4--Map out the similarities between the analog model and the concept.
- ❑ Step 5--Indicate where the analogy breaks down.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

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

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- ***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](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

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- 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

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### 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

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## ***PS1: Matter and its interactions***

PS1A: Structure and properties of matter

PS1B: Chemical reactions

PS1C: Nuclear processes

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## ***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

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## ***PS4: Waves and their applications***

PS4A: Wave properties

PS4B: Electromagnetic radiation

PS4C: Information technologies and instrumentation

# *PS1: Matter and its interactions*

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## □ *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

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- ▣ 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

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- ❑ 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 and Interactions*

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## ***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

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- 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

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- 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

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### 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](http://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*

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### **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 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

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- 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*

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## 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*

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## **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*

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## **4. Physics Topics**

[www.physicsclassroom.com/Class](http://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*

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**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

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- ❑ 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*

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**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

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- **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](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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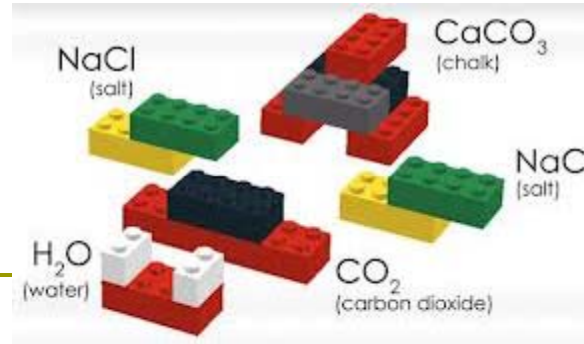
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# Feedback

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- ❑ 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?



PHYSICS STUDIES MANY  
DIFFERENT TYPES OF  
MOTION AND FORCES.

# PS-21

## ***Physical Science in the 21st Century Second Spring Institute March 8, 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