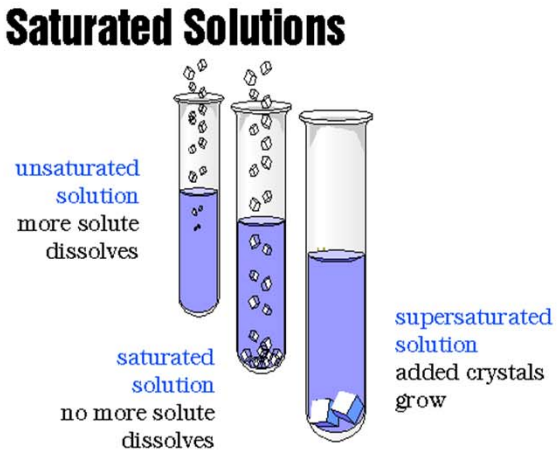
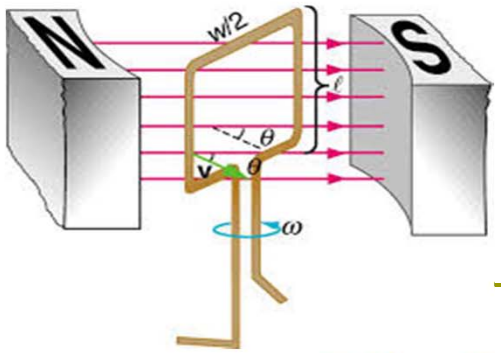
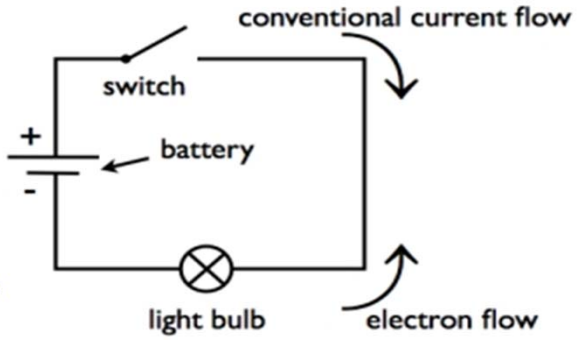






PS-21

Physical Science in the 21st Century

First Fall Institute

January 24, 2014

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 2013-2014:
Teaching Physical Science

Friday, January 24, 2014 `at the *University of Alabama, 3408 SEC, Tuscaloosa AL*

- ***8:30 am:*** **Registration, coffee, agenda, Institute surveys, PS-21 update, and concept pre-tests**
- ***9:00-10:50: Concept–1) Current and magnetism*** **+ engaging students with hands-on strategies & sharing ideas**
- ***10:50 – 11:00:*** **Break**
- ***11:00-11:40: Concept–2) Inquiry lesson planning with currents and magnetism using the Common Core and NGSS*** **+ developing lessons to motivate and engage students in learning ideas**
- ***11:40 – 12:40: Lunch***
- ***12:40-2:30: Concept–3*****) Solutions and solubility + engaging students with hands-on strategies & sharing teaching/learning ideas**
- ***2:30– 2:40*** **Break**
- ***2:40– 3:25 Concept–4) Inquiry lesson planning with solutions and solubility using Common Core and NGSS*** **+ developing lessons to motivate and engage students with hands-on strategies & sharing ideas**
- ***3:25– 3:45: Wrap up,*** **Institute surveys, Feedback, post-test, & science topics– graduate credit assignments**

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.

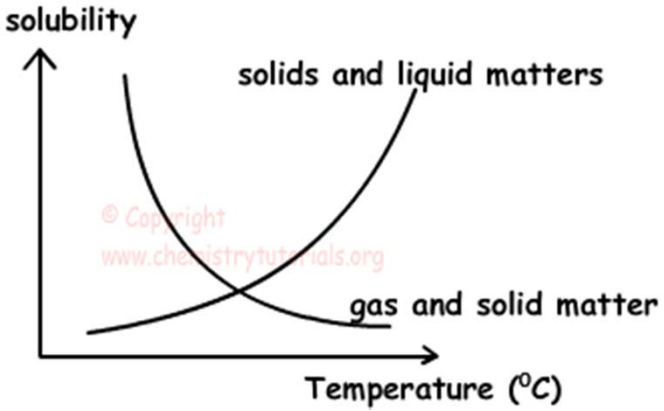
PS–21 Institute Objectives

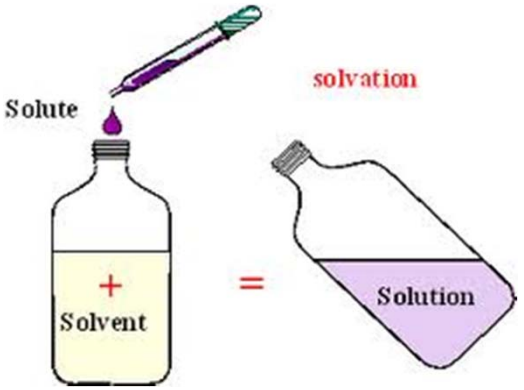
Experiencing, inquiring, using, and measuring to create meaningful learning of concepts in physical science through three questions:

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. <u>We have lap top (netbooks) spares here if you need one.</u>





Websites to Accompany PS-21 Institute Activities

Concept 1: Magnetism due to induction, currents, and permanent magnets

- **Physics4kids.com**

http://www.physics4kids.com/files/elec_current.html

http://www.physics4kids.com/files/elec_magneticfield.html

http://www.physics4kids.com/files/elec_faraday.html

- **PhET**

http://phet.colorado.edu/en/simulation/magnets-and-electromagnets

- **Khan Academy**

http://www.youtube.com/watch?v=KuUMUvwvML8

http://phet.colorado.edu/en/simulation/faradays-law

http://phet.colorado.edu/en/simulation/magnet-and-compass


Solutions and
Solubility

Websites to Accompany PS-21 Institute Activities

Concept 2: Solutions and Solubility

- **Science experiments for kids**

http://www.scienceexperimentsforkids.us/solubility-experiments-for-kids/

- **Onlinemathlearning.com**

http://www.onlinemathlearning.com/solutions-solubility.html

- **PhET**

http://phet.colorado.edu/en/simulation/sugar-and-salt-solutions

http://phet.colorado.edu/en/simulation/acid-base-solutions

http://phet.colorado.edu/en/simulation/soluble-salts

http://phet.colorado.edu/en/simulation/concentration

PS–21 Resources: Physical Science CCSS & NGSS

Concept:

Relevance of Common Core State Standards and Next Generation Science Standards:

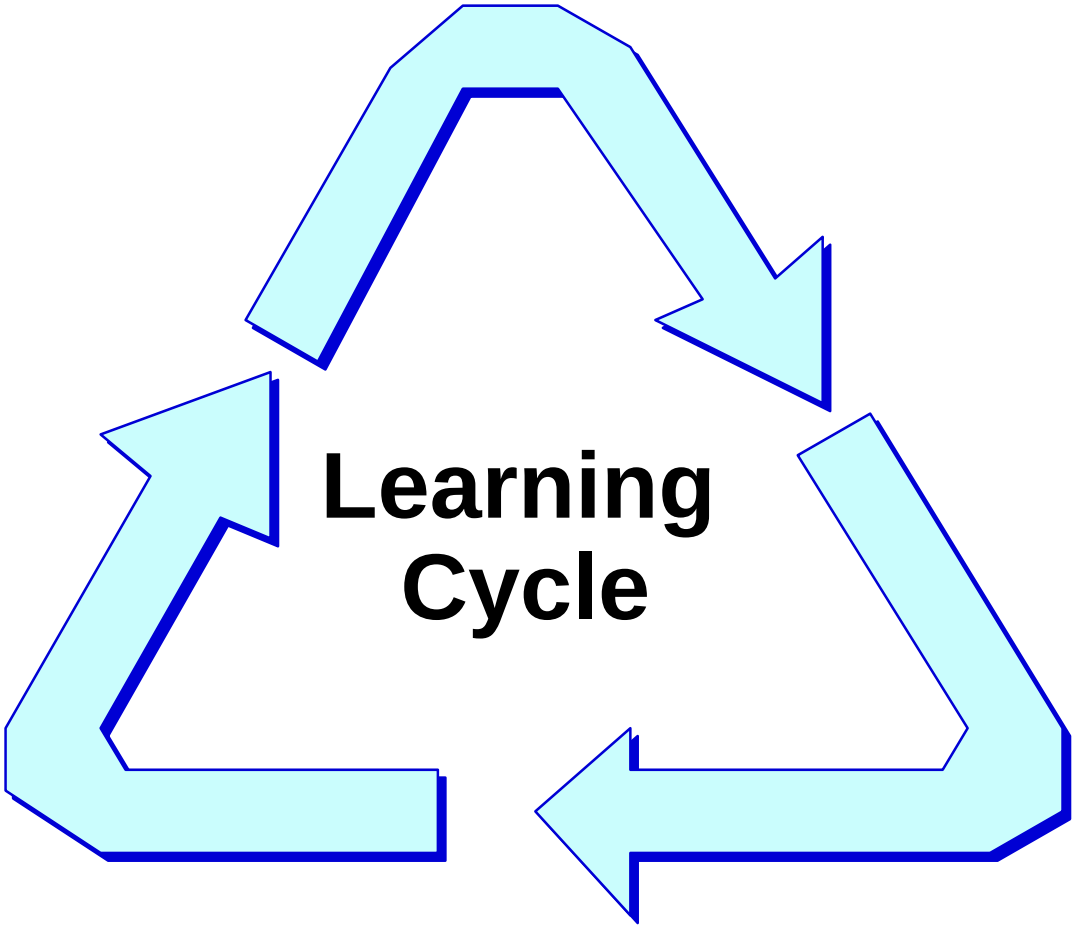
Common Core:

http://www.corestandards.org/

NGSS:

http://www.nextgenscience.org/next-generation-science-standards

PS–21 Resources: Inquiry Instruction Sequence



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

Magnetism and Solutions/ Solubility Misconceptions

Magnetism:

- *All metals are attracted to a magnet.*
- *All silver colored items are attracted to a magnet.*
- *All magnets are made of iron.*
- *Larger magnets are stronger than smaller magnets.*
- *The magnetic and geographic poles of the earth are located at the same place.*

Magnetism and Solutions/ Solubility Misconceptions

- *The magnetic pole of the earth in the northern hemisphere is a north pole, and the pole in the southern hemisphere is a south pole.*
- *Only magnets produce magnetic fields.*
- *A magnetic field is a pattern of lines (not a field of force) that surrounds a magnet.*
- *In a magnet, the magnetic field lines exist only outside the magnet.*

Magnetism and Solutions/ Solubility Misconceptions

Solutions & Solubility:

- Students often do not realize that gases dissolve better in cold water as opposed to hot. They expect all things to dissolve better as the temperature is increased.
- Students often do not understand how to recombine the ions in a double displacement reaction. Write out the equation and the ions with their charges. Stress that cations and anions only recombine with another of opposite charge.

Magnetism and Solutions/ Solubility Misconceptions

- Students often misbelieve that stirring a solute-solvent mixture or increasing the surface area of the solute will increase its solubility in a solution. Wrong. They only dissolve the solution faster (higher rate of reaction) but do not increase the solubility of the solute. Heating the solution, on the other hand, will increase the solubility because temperature affects solubility.

What are Effective Research Based Strategies in Teaching Magnetism and Solutions & Solubility Models

- It is important to teach what a model is and that all models are limited in specific ways (force, distance, transformation, concentration, etc.)
- Teaching should present students with cognitive conflict challenging their existing models.
- Then students should be offered 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 work or equilibrium in various contexts order to challenge prior ideas.
- Then, ask students to explain what and why these phenomena occur.
- Important to ask students to develop a generalized theory of energy transformation and chemical equilibrium.

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

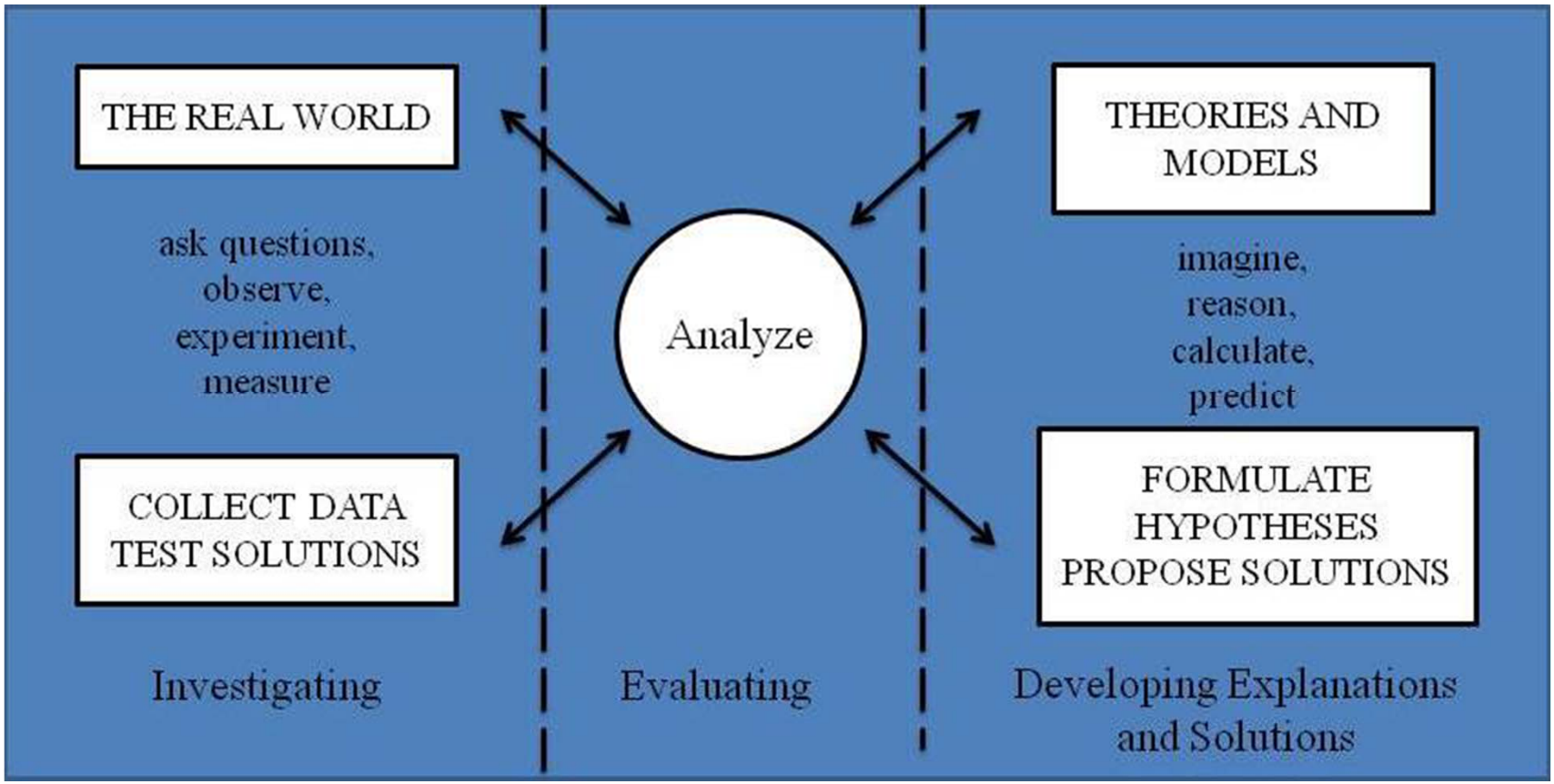
Can you complete the task below?

Review the ideas and materials presented earlier for a magnetism and electricity or solutions concepts and **create / write** 6 station activity **cards** that when sequenced form a learning/teaching cycle for the concept selected. First, name the concept.

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



Crosscutting Concepts
PS-21 Institute #2

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

PS4.B: Electromagnetic Radiation (Example)

- *What is light?*
- *How can one explain the varied effects that involve light?*
- *What other forms of electromagnetic radiation are there?*

- At the surface between two media, like any wave, light can be reflected, refracted(its path bent), or absorbed. What occurs depends on properties of the surface and the wavelength of the light.

By the end of grade 8

- *When light shines on an object, it is reflected, absorbed, or* transmitted through the object, depending on the object's material and the frequency (color) of the light.

By the end of grade 12

- *Electromagnetic radiation (e.g., radio, microwaves, light) can be* modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. Quantum theory relates the two models. (Boundary: Quantum theory is not explained further at this grade level.)

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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- Post your questions to be answered. Respond to other teachers questions
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- 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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- 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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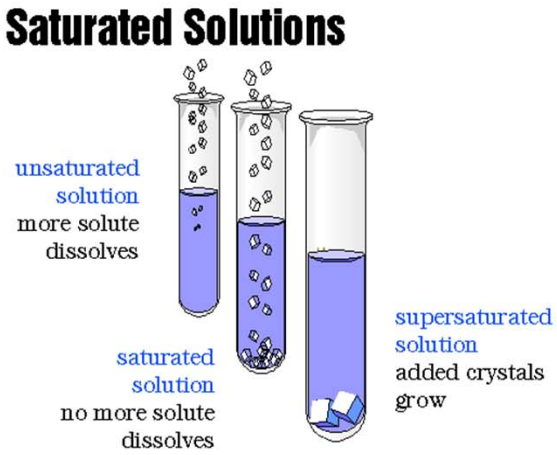
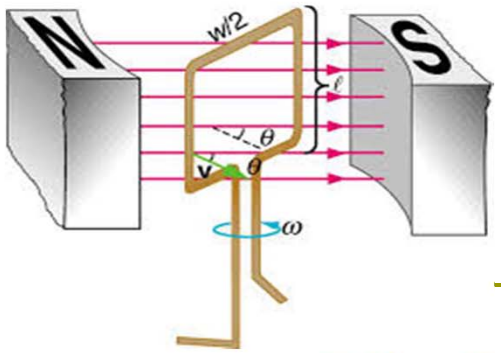
Planning Physical Science Lessons

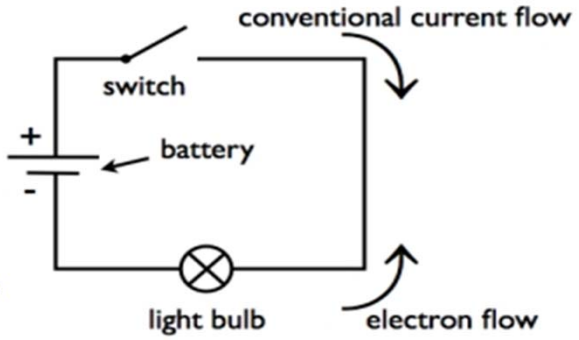
- Elicit student ideas
- Provide data to link student ideas to science concepts
- Have students present and defend their ideas
- Introduce scientific perspective
- Change context
- Have students apply and defend their new understanding
- Have students reflect on their learning

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?







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