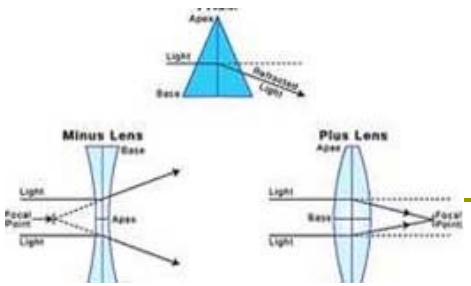
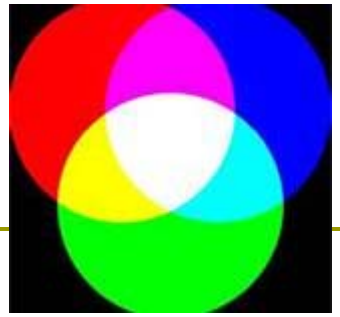
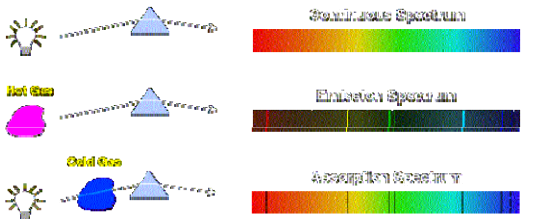
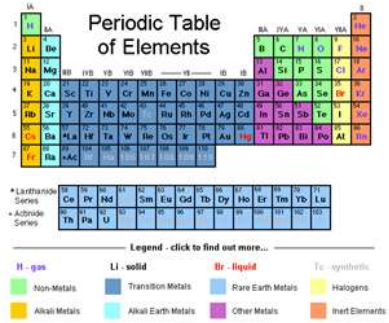




PS-21

Physical Science in the 21st Century

First Fall Institute

September 28, 2012

University of Alabama, Tuscaloosa AL

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

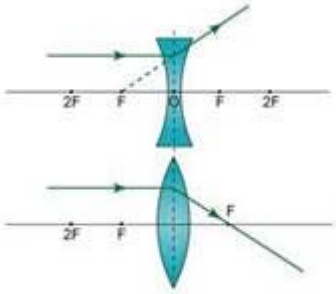
PS-21 Website: http://ps21pd.weebly.com/

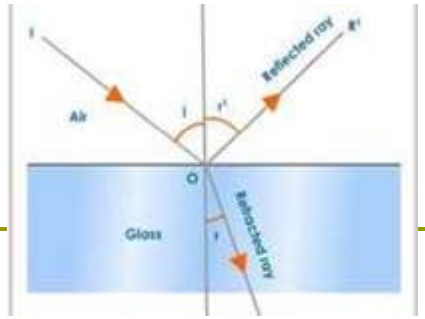
PS-21 Partners: Alabama Commission on Higher Education (ACHE), UA College of Arts and Sciences – Physics Department, Chemistry Department; UA College of Education, C&I Dept. – Science Education; AMSTI, Office of Research in the Disciplines; and Alabama City and County Schools

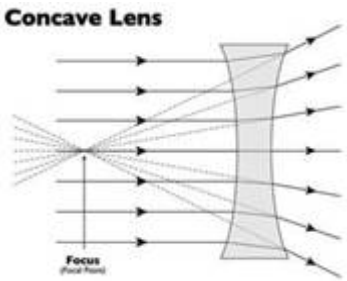
PS–21 First Fall Institute Day 2012- 2013:
Teaching Physical Science

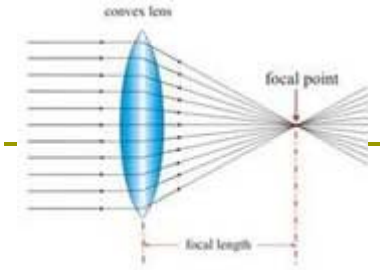
Friday, September 28, 2012 at the *University of Alabama, 3408 SEC, Tuscaloosa AL*

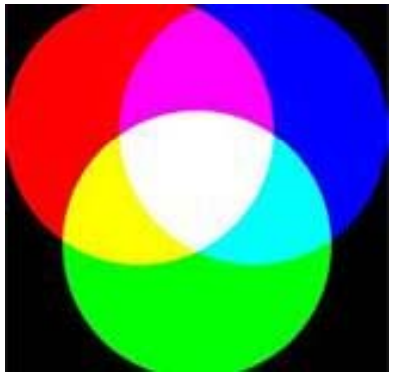
- ***8:30 am:*** **Registration, Coffee, Agenda, Institute surveys, and PS-21 update and Concept Pre-test**
- ***9:00-10:30: Concept–1) Light - reflection and refraction: mirrors and lenses*** **+ engaging students with hands-on strategies, PhET simulations, & sharing teaching / learning ideas**
- ***10:30 – 10:40:*** **Break**
- ***10:40– 12:30 Concept–2) Light – frequency: color*** **+ engaging students with hands-on strategies, PhET simulations, & sharing teaching / learning ideas**
- ***12:30 – 1:30: Lunch***
- ***1:30-3:15: Concept–3) Determining*** **atom / electron structure through spectroscopy + engaging students with hands-on strategies , simulations, & sharing teaching / learning ideas**
- ***3:20– 3:30*** **Break**
- ***3:15– 3:45: Wrap up,*** **Institute surveys, Feedback, post-test, future dates & science topics– Graduate credit assignments**

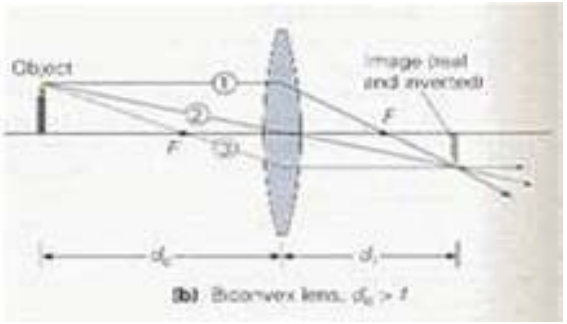

2F
F
O
F
2F
2F
F
F

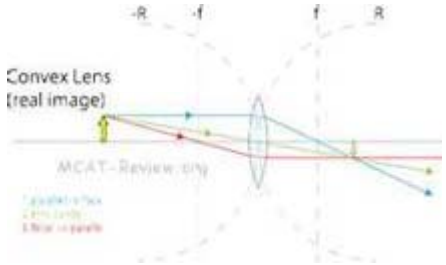

i
Air
r
r'
Reflected ray
R'
O
Glass
Refracted ray


Concave Lens
Focus

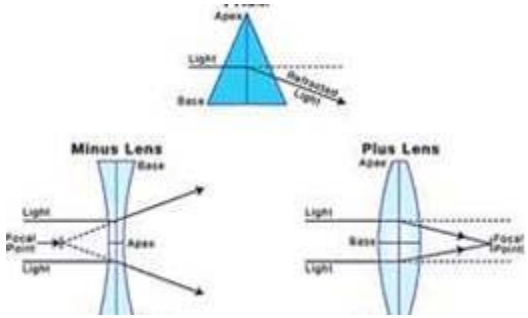

convex lens
focal point
focal length

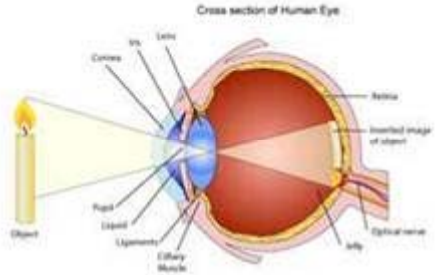


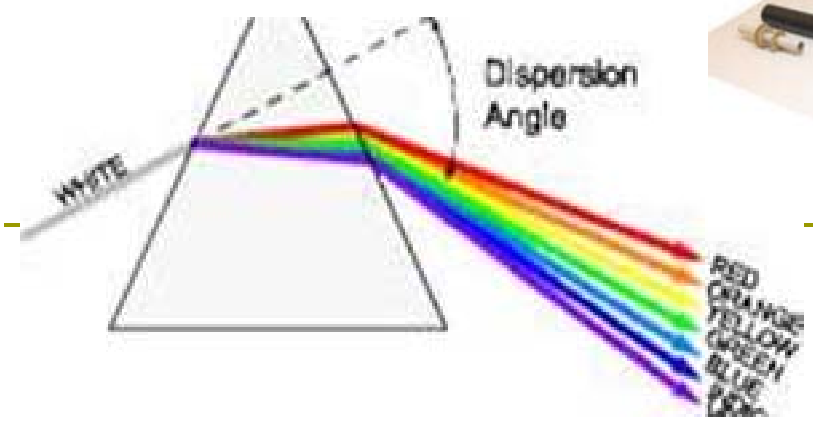

Object
image (real
and inverted)
F
F
(b) Biconvex lens, $d_o > f$

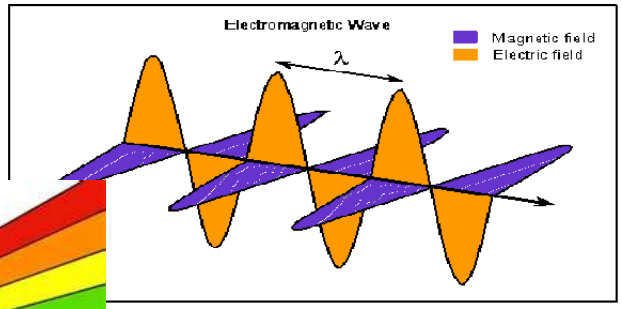

-R
-f
f
R
Convex Lens
(real image)
MCAT-Review.org

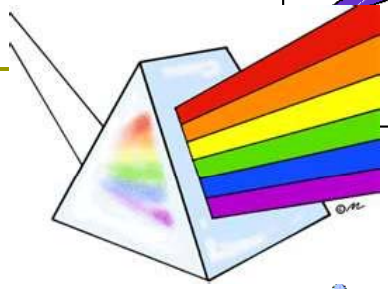

Insert gas
Tungsten Filament
Bulb
Glass Mount
Screw Thread Contact
Insulation
Electrical Foot Contact

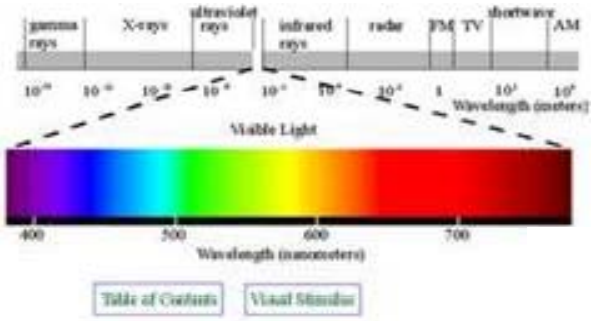

Apex
Light
Base
Refracted Light
Minus Lens
Base
Light
Focal Point
Apex
Light
Plus Lens
Apex
Light
Base
Focal Point
Light

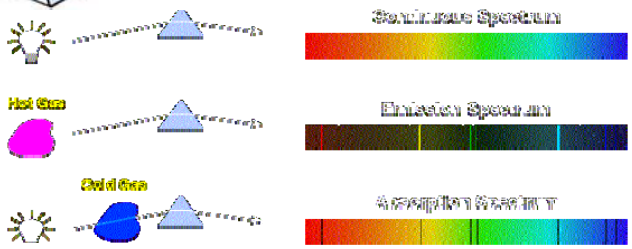

Cross section of Human Eye
Cornea
Iris
Lens
Retina
Inverted image of object
Pupil
Liquid
Ligaments
Ciliary Muscle
Object
Optical nerve

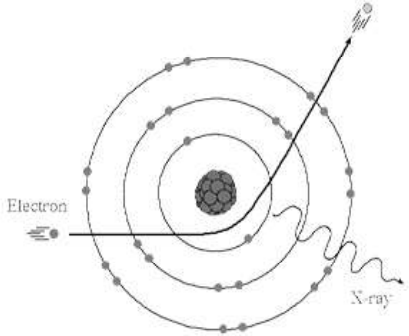

Dispersion
Angle
WHITE

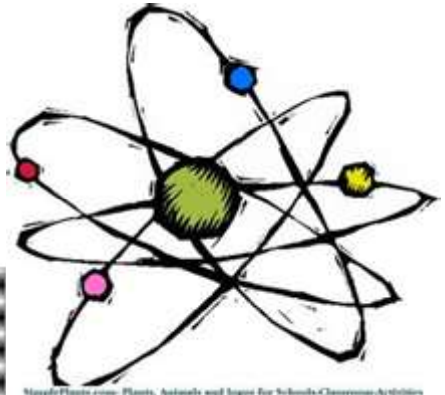

Electromagnetic Wave
Magnetic field
Electric field
λ

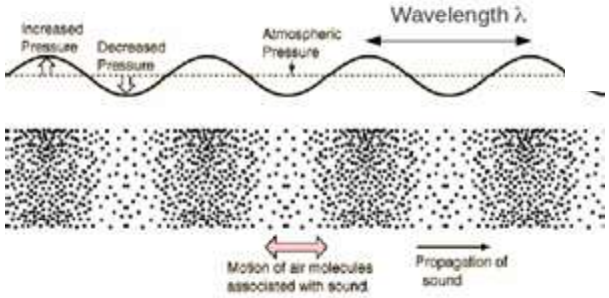


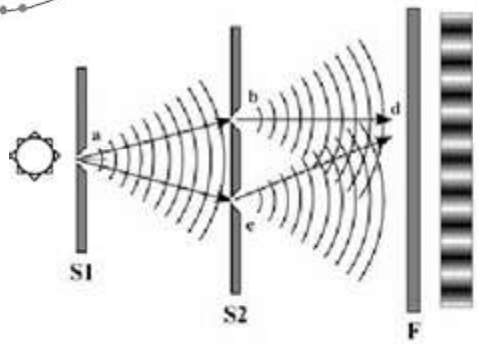

gamma rays
X-rays
ultraviolet rays
infrared rays
radar
FM
TV
shortwave
AM
Visible Light
400
500
600
700
Wavelength (nanometers)


Hot Gas
Cold Gas

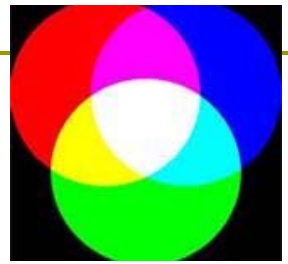

Electron
X-ray




Wavelength λ
Increased Pressure
Decreased Pressure
Atmospheric Pressure
Motion of air molecules associated with sound
Propagation of sound

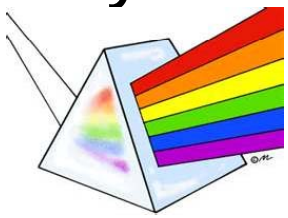

S1
S2
F

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.

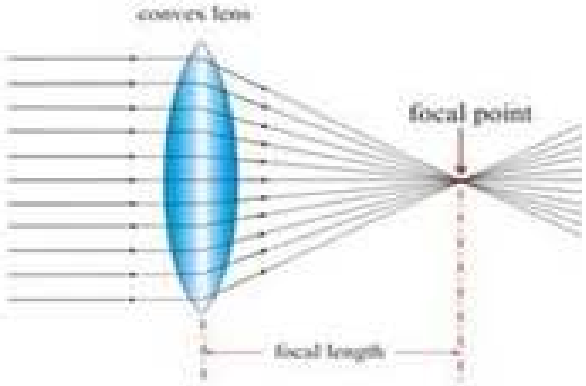
PS–21 Institute Objectives

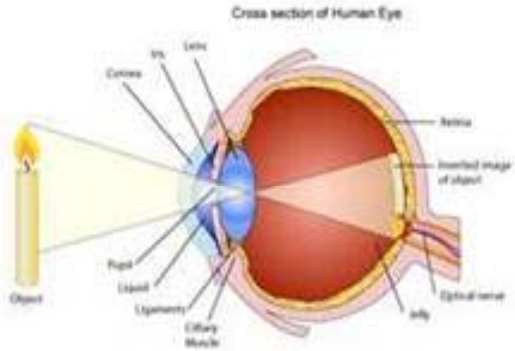
Experiencing, inquiring, using, and measuring to create meaningful learning of concepts in physical science through three questions:

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:*Light:Optics*

- **Optics For Kids - Optical Society of America:** Web site is devoted to everything optics! Optical Society of America (OSA)

www.optics4kids.org

- **Physics Front and PhET Simulations:** Multiple examples

http://www.compadre.org/precollege/static/unit.cfm?sb=13&course=2

- **Hands-On Optics**
- Many websites

http://www.hands-on-optics.org/resources/links.aspx

- **Fun Science Gallery**

Optics Projects
http://www.funsci.com/texts/eno.htm

- **PhET Simulations**

http://phet.colorado.edu/en/simulations/category/physics/light-and-radiation

Properties, Reflection, Refraction, & Dispersion of Light

The Science Spot

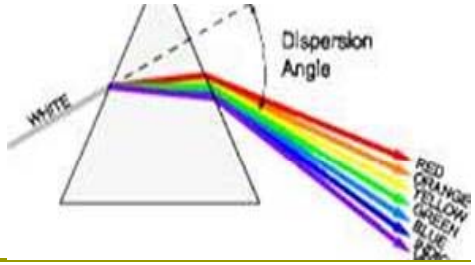
http://sciencespot.net/Pages/kdzphysics4.html

- **The Science of Light**
- **Physics of Light**
- **Shockwave Physics**
- **Sandlot Science**
- **Optics for Kids**
- **See The Light**
- **Color Matters**
- **OMSI Color Mix**
- **Colors - Stroop Effect**
- **Carmine Chameleon:**
- **Color Theory**
- **Color Cube Activities**
- **Exploratorium - Mix & Match**
- **NOVA - The Light Stuff**
- **iknowthat.com**

Operation Optics

- **iknowthat.com - Optics Workbench**
- **http://micro.magnet.fsu.edu/primer/lightandcolor/java.html**

Websites to Accompany PS-21 Institute Activities



Concept 2: *Light: Color*

- **PhET Simulations**

http://phet.colorado.edu/en/simulations/category/physics/light-and-radiation

- **Physics Front and PhET Simulations:**

Multiple examples

http://www.compadre.org/precollege/items/detail.cfm?ID=4592

- **Lesson Plan Library**

http://www.discoveryeducation.com/teachers/free-lesson-plans/sight-and-light.cfm

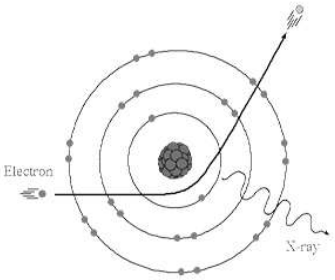
- **Middle school color and light activities**

http://www.delta-education.com/downloads/samples_dsm/ColorLightLink1.pdf

- Bill Nye: Light and Color #16

http://www.tv.com/shows/bill-nye-the-science-guy/light-and-color-241864/

Websites to Accompany PS-21 Institute Activities



Concept 3: Atom / electron Structure through Spectroscopy

- **Atomic spectra and the Bohr model**

  http://www.learnnc.org/lp/pages/3563

- **Bill Nye Atoms 1**

  http://teachertube.com/viewVideo.php?video_id=105573

- **Atoms and Light Energy**

  http://imagine.gsfc.nasa.gov/docs/teachers/lessons/xray_spectra/background-atoms.html

- **Middle school color and light activities**

  http://www.discoveryeducation.com/teachers/free-lesson-plans/the-color-spectrum-how-does-it-work.cfm

  http://www.discoveryeducation.com/teachers/free-lesson-plans/the-electromagnetic-spectrum-waves-of-energy.cfm

- **Concord Consortium: High school activities with the atom**

  http://concord.org/activities/atomic-structure

PS–21 Resources: Physical Science Teaching Videos

Annenberg Free videos online

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

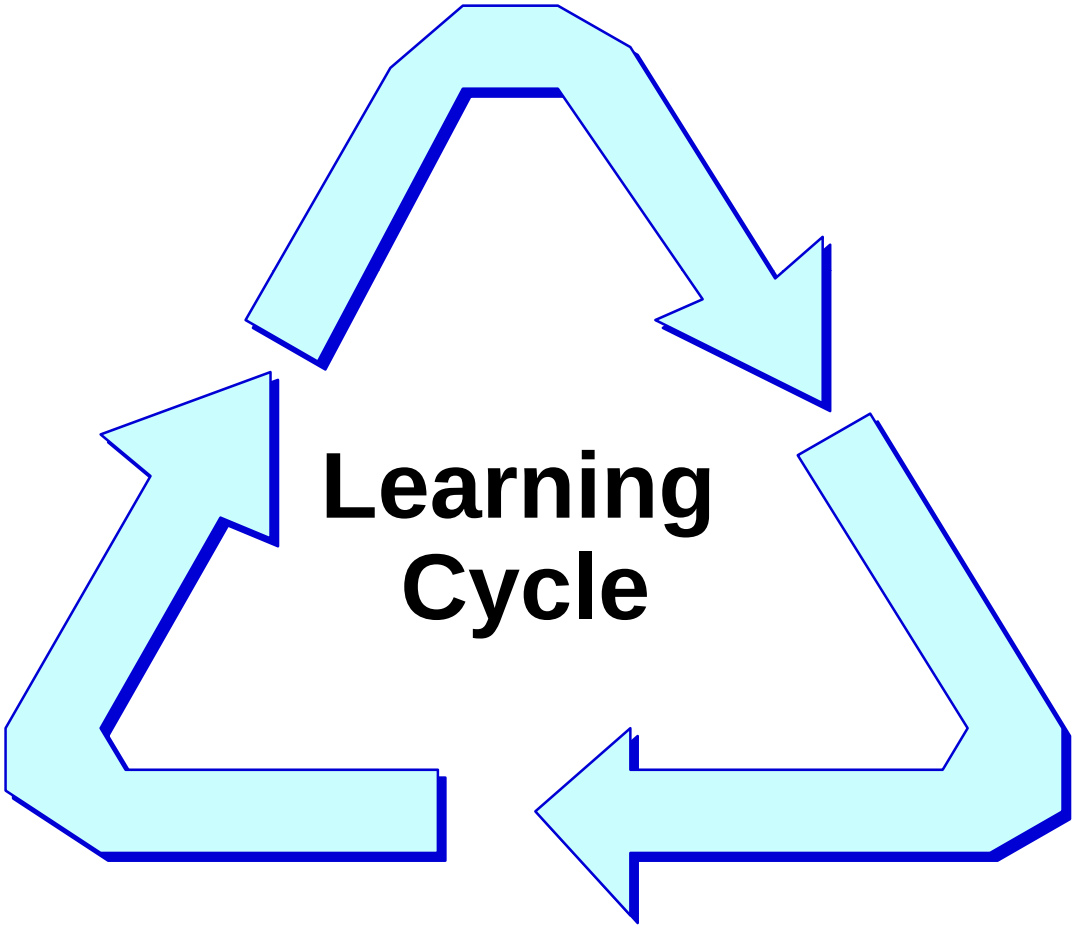
Minds of our own -- 1. Can we believe our eyes? – Mirrors

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

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

Light and Color Misconceptions

- Visible light is the only type of light
- All radiation is harmful.
- The primary colors of light are identical to the primary colors of pigments.
- Red objects in space are hot; blue objects are cool.
- Filters change the color of light.

http://amazing-space.stsci.edu/resources/myths/light.php

- **Misconceptions: Color and vision**

http://www.cyberphysics.co.uk/PGCE/Misconceptions/colour.htm

- **NASA From Questions to Discoveries PDF**

http://www.nasa.gov/pdf/274682main_Light_and_Color_Educator.pdf

Light and Color Misconceptions

- The pupil of the eye is a black object or spot on the surface of the eye.
- The eye receives upright images.
- The lens is the only part of the eye responsible for focusing light.
- The lens forms and image (picture) on the retina. The brain then "looks" at this image and that is how we see.
- The eye is the only organ for sight; the brain is only for thinking.
- A white light source, such as an incandescent or fluorescent bulb, produces light made up of only one color.
- Sunlight is different from other sources of light because it contains no color.
- When white light passes through a prism, color is added to the light.

Light and Color Misconceptions

- The rules for mixing color paints and crayons are the same as the rules for mixing colored lights.
- The primary colors for mixing colored lights are red, blue and yellow.
- A colored light striking an object produces a shadow behind it that is the same color as the light. For example, when red light strikes an object, a red shadow is formed.

***http://www.eskimo.com/~billb/miscon/opphys.html**

- The shades of gray in a black and white newspaper picture are produced by using inks with different shades of gray.
- When white light passes through a colored filter, the filter adds color to the light.
- The different colors appearing in colored pictures printed in magazines and newspapers are produced by using different inks with all the corresponding colors.

Light and Color Misconceptions

- The mixing of colored paints and pigments follow the same rules as the mixing of colored lights
- The primary colors used by artists (red, yellow and blue) are the same as the primary colors for all color mixing.
- Color is a property of an object, and is independent of both the illuminating light and the receiver (eye).
- White light is colorless and clear, enabling you to see the "true" color of objects.
- When a colored light illuminates a colored object, the color of the light mixes with the color of the object.
- Novel explanations of visual phenomena involving color perception usually involve only the properties of the object being observed, and do not include properties of the eye-brain system.

Bibliography on Light and Vision

- Andersson, B. and C. Karqvist. 1983. How Swedish pupils, aged 12-15 years, understand light and its properties. *European Journal of Science Education* 5(4): 387-402.
- Anderson, C.W. and E.L. Smith. 1983. Children's conceptions of light and color: understanding the concept of unseen rays. Paper presented at the annual meeting of the American Educational Research Association.
- Asoka, H. 1993. First steps in the construction of a theoretical model of light: A case study from a primary classroom. In *Proceedings of the Third International Seminar: Misconceptions and Educational Strategies in Science and Mathematics,* J. Novak, ed. Ithaca, NY: Cornell University.
- Brickhouse, N. 1994. Children's Observations, Ideas, and the Development of Classroom Theories of Light. *Journal of Research in Science Teaching* 31(6): 639-656.

- Cole, K.C. *Vision: In the Eye of the Beholder.* San Francisco, CA: Exploratorium.
- Driver, Rosalind, Edith Guesne and Andree Tiberghien, eds. 1985. *Children's Ideas in Science.* Philadelphia, PA: Open University Press.
- Falk, David, Dieter Brill and David Stork. 1986. *Seeing the Light: Optics in Nature, Photography, Color, Visions, Holography.* New York: Harper and Row.
- Feher, E. and K. Rice. 1987. A comparison of teacher-student conceptions in optics. In *Proceedings of the Second International Seminar on Misconceptions and Educational Strategies in Science and Mathematics,* J. Novak, ed. Ithaca, NY: Cornell University.
- Goldberg, Fred 1986. Student Difficulties in Understanding Image Formation by a Plane Mirror. *The Physics Teacher* 24: 472-480.

- Guesne, E. 1985. Light. In *Children's Ideas in Science*, R. Driver, E. Guesne and A. Tiberghien, eds. Philadelphia: Open University Press.
- Sadler, P. 1991. Projecting Spectra for Classroom Investigations. *The Physics Teacher* 29(7): 423-427.
- Shapiro, B.L. 1989. What children bring to light: giving high status to learners' views and actions in science. *Science Education* 73(6): 711-733.
- Shapiro, Bonnie L. 1994. *What Children Bring to Light.* New York: Teachers College Press.
- Stead, B.F. and R.J. Osborne. 1980. Exploring science students' concepts of light. *Australian Science Teacher's Journal* 26(3): 84-90.
- Watts, D.M. 1985. Students' conceptions of light-a case study. *Physics Education* 20: 183-187.

Common Student Ideas About Light and Vision

Students explanations and mental models of what is light and how light works.

- Reflected light is shine or glare not something associated with seeing objects.
- Light can only do some of the following: be absorbed, blocked, reflected, or refracted by an object.
- Light is not reflected in a predictable manner & angle.
- Light is not refracted in a predictable manner & angle.
- The reflection of an object is located on the surface of the mirror. The reflection is often thought of as a picture on a flat or curved surface.

- To be seen in a mirror, the object must be directly in front of the mirror or within the line-of-sight from the observer to the mirror.
- Light always passes straight through transparent material (without changing direction).
- When an object is viewed through a transparent material, the object is seen exactly where it is located.
- Light only reflects from mirrors and shiny objects.
- If students are asked what helps you see? Most will answer glasses, seeing-eye dogs, binoculars, hand lenses, or microscopes, not light.

- White light is pure and colorless light.
- Color is a property of something other than a property of light.
- Sunlight is red, yellow, or orange
- Light travels from our eyes so we can see.
- Light eminates from the object being looked at (not a property of what light is reflected or absorbed).
- A prism or colored filter (piece of gel or plastic) puts color into light when it passes through it.
- Bright light travels further than dim.
- Light travels further at night.

- Light only travels a short way.
- Light stops.
- Bats and owls can see in complete darkness.
- Humans can see in complete darkness after the eye adjusts. Students can persist with this belief by simply extending the time minutes, hours, days, years...
- Rainbows are sunlight reflected from rain
- Water has color in it and when it hits the light you see it.

Summary List of Student Misconceptions of Light to Plan Lessons Around

- Nature of light rarely taught before middle school, only definition - Light is a form of energy (Watts, 1984).
- By 13-14 understand light is a source (bulb), an effect (spot of light), or a state (bright) but may not recognize light as a *physical entity* (Guesne, 1985).
- Students need to construct understanding while exploring properties in secondary science.

- By 13-15 year old students do not think of light as
  - traveling at all from place to place (Guesne, 1985).
  - traveling out from source very far before it stops.
  - not traveling in the daytime
  - traveling further at night (Stead and Osborne, 1980)
- Lenses not necessary to form images
- Whole lens needed to form an image

- Light bounces off mirrors but not other objects
- Light scattering off objects not understood (Anderson & Smith, 1983)
- Moving back from a mirror enables you to see more (Goldberg & McDermott, 1986)
- White light is an entity not a mixture of colors
- Red light from a projector not understood as transmission of some frequencies of light
- Color an innate property of an object, light just helps us see the color

What are Effective Research Based Strategies in Teaching Light and Vision?

- Important to teach what a model is and that all models are limited in specific ways (light, frequency, wave length, transmission, etc.)
- 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 sound in in various contexts order to challenge prior ideas.
- Then, ask students to explain what and why these light phenomena occur.
- Introduce light with a focus on energy as well as properties
- Important to ask students to develop a generalized theory of light and light transmission, and light waves

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

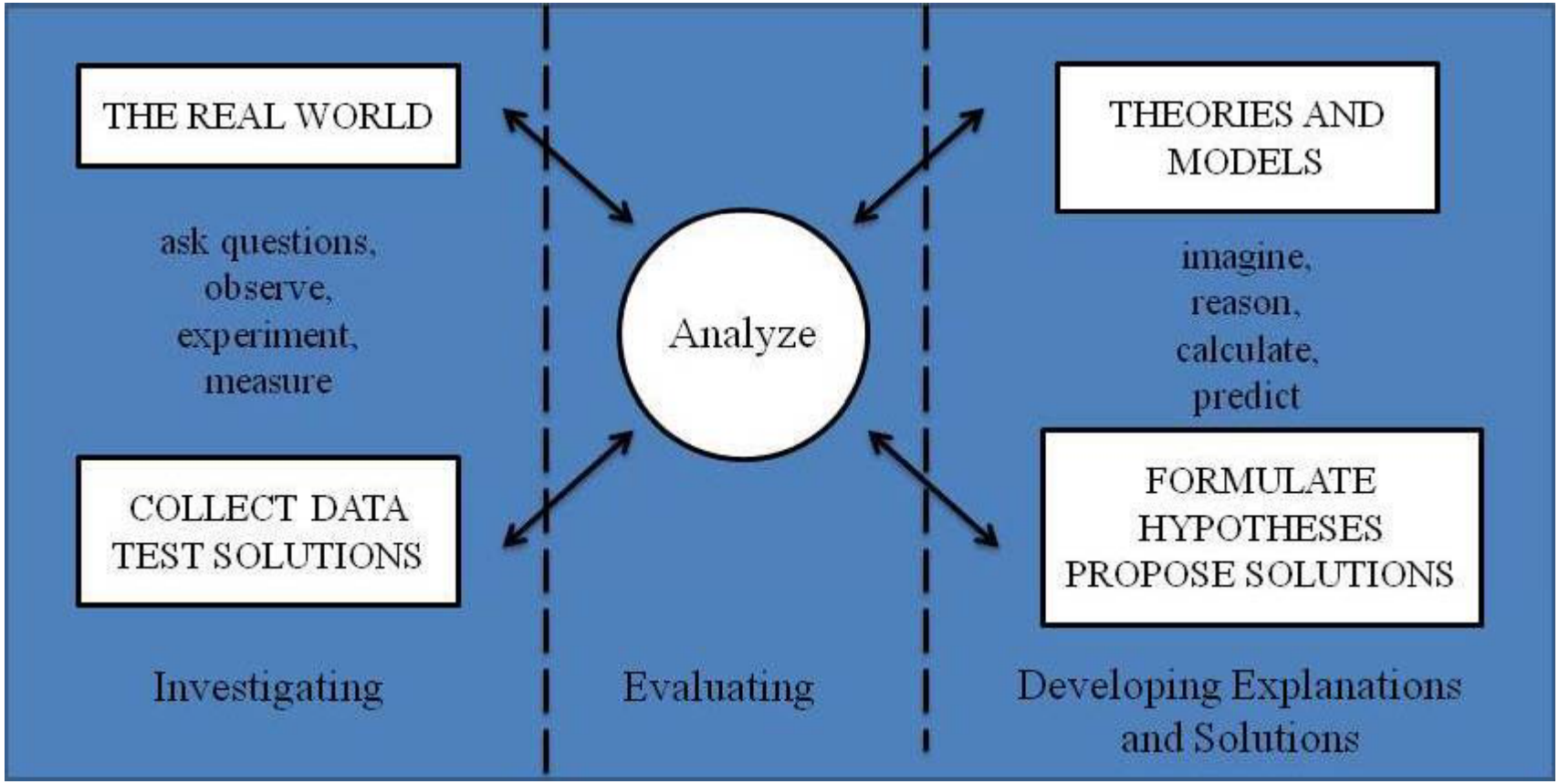
Can you complete the task below?

Review the ideas and materials presented earlier for a light and color concepts and **create / write** 6 station activity **cards** that when sequenced form a learning/teaching cycle for the concept selected.

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



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

- *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
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

- 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/

Bibliography
Light and Color

- Alabama State Department of Education. (2001). *Alabama Course of Study: Science*. Montgomery, AL: Alabama State Department of Education.
- American Association for the Advancement of Science, (1993). *Benchmarks for scientific literacy*, New York: Oxford University Press.
- American Association for the Advancement of Science, (1993). *Science for all Americans*, New York: Oxford University Press (Oxford Univ. Press, Dept. EC, Madison Ave. N.Y.,10016, 1-800-230-3242).
- American Association for the Advancement of Science (2000 & 2007). *Atlas of Science Literacy, Vol 1 & 2,* New York: Oxford University Press. http://www.project2061.org/tools/atlas/default.htm
- Beisenherz, P. & Dantonio, M. (1996). *Using the learning cycle to teach physical science*, Portsmouth, NH: Heinemann Publishers.

- Driver, Squires, Rushworth, Wood-Robinson, (1994). *Making Sense of Secondary Science*, New York: Routledge.
- Driver, R. (1983). *The pupil as scientist*, Philadelphia: Open University Press,
- Sunal, D. & Wright E. (2011). (Series Eds.) *Research in Science Education:* DeBoer, G. (Ed. Vol. 5), *The role of public policy in K-12 science education*. Charlotte, NC: Information Age Publishing.
- Sunal, D., Sunal, C., & Wright, E. (Eds.). (2010). *Teaching Science with Hispanic ELLs in K-16 Classrooms.* Charlotte, NC: Information Age Publishing.
- Sunal, D., Wright, E., & Sundberg, C. (Eds.) (2008). *The impact of the laboratory and technology on learning and teaching science K-16.* Greenwich, CT: Information Age Publishing.

- Sunal, D. & Wright, E. (Eds.) (2006). *The impact of state and national standards on K-12 science teaching*, Greenwich, CT: Information Age Publishing.
- Sunal, C., Karr, C., & Sunal, D., (2003). Fuzzy logic, neural networks, genetic algorithms: Views of three artificial intelligence concepts used in modeling scientific systems, *School Science and Mathematics*, *103*(2), 81-91.
- Wright, E. and Govindarajan, G. (1992). *Teaching with scientific conceptual discrepancies*, Manhattan, KS: Kansas State University. (C/O Emmett Wright, College of Education, Bluemont Hall, Kansas State University, Manhattan, KS 1-913-532-7838)

Use of Analogies in Teaching Light Concepts

- 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

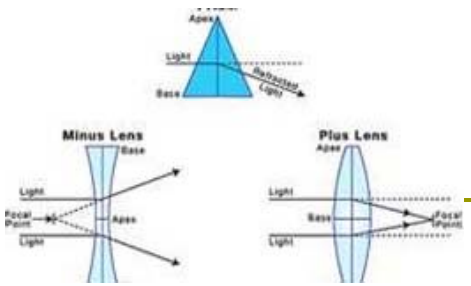
- Step 1--Introduce the concept to be learned
- Step 2--Review with the students' the analogous situation.
- Step 3--Identify the relevant features of the analog model.
- Step 4--Map out the similarities between the analog model and the concept.
- Step 5--Indicate where the analogy breaks down.
- Step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

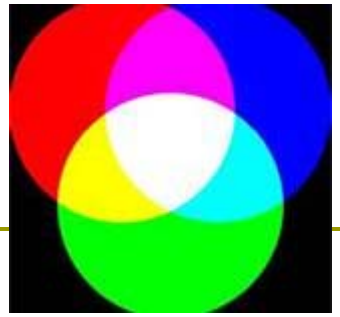
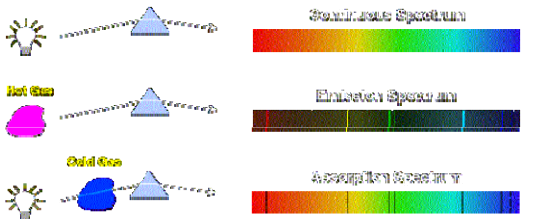
Planning Physical Science Lessons

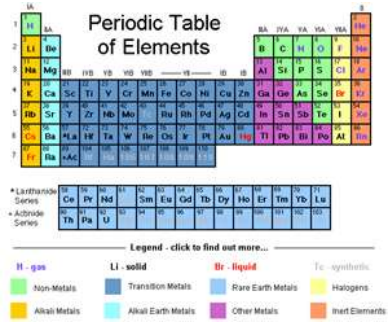
- Elicit student ideas
- Provide data to link student ideas to science concepts
- Have students present and defend their ideas
- Introduce scientific perspective
- Change context
- Have students apply and defend their new understanding
- Have students reflect on their learning

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?





PS-21

Physical Science in the 21st Century

First Fall Institute

September 28, 2012

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