It’s a Reflection
(a lesson plan from UEN)

Materials

- Protractor
- Flat mirror
- Hinged mirrors
- Laser pointer
- Star ball
- Alphabet Letters

Procedure

Part I – It’s a Reflection

1. Place a mirror at the edge of the protractor. Use a laser pointer to shine a light from one angle of the protractor and determine at which angle it is being reflected. On your worksheet, complete Chart 1.

2. Place a hinged mirror at the edge of the protractor. Move the hinged part to the degree specified, and place a star balls in front of the mirror. Count how many reflected images you see and complete Chart 2.

3. Set the mirror at 90°. Place a letter against the mirror and, on your worksheet, draw the letter as it is reflected (you should draw all four reflections of the letter exactly as you see them) and complete Chart 3.

What’s Your Angle?
(a lesson plan from UEN)

Materials

- Laser pointer
- Target made from 3” x 5” index card folded in half
- Three mirrors with mirror stands
Safety Concerns: Laser Pointers. Students will follow ALL instructions EXACTLY on how to use laser pointers. Failure to do so will result in being sent, immediately, to the Vice-Principal and loss of further lab activity privileges.

Procedure

1. Place a light on the table and a target somewhere behind it. Use mirrors to create at least three "bounces" before the light hits the target. Draw a picture showing how you did it on your worksheet.

2. Combine with another group and try to make six "bounces." Draw a picture showing how you did it on your worksheet.

Decoding Secret Messages
(from GEMS Color Analyzers)

Materials

- Color Analyzer
- Colored pencils

Procedure

1. Color your secret message sheets according to the key on each picture.

2. After you have finished, use your color analyzer. Look at it through the red filter and the green filter to read the secret message.
It's Bent
(a lesson plan from UEN)

Materials

- Eight straws
- Water
- Eight transparent cups
- Small amount of vegetable oil, corn syrup, and dish soap

Procedure

1. Using four transparent cups, pour ¼ cup, ½ cup, ¾ cup, and 1 cup of water into each cup. Place a straw in each cup and draw what you see. On your worksheet, write your discovery about what each straw looks like in different amounts of water.

2. Using four transparent cups, place ½ cup each of water, vegetable oil, Karo™ syrup, and dish soap in a cup. Place a straw in each cup and, on your worksheet, draw what you see. On your worksheet, write your discovery about what each straw looks like in liquids of different thicknesses.

3. Throw away the straws and the cups.

Refraction and Lenses

Materials

- Concave/convex lenses
- Lens set
- Flashlight with filter
- Comb

Procedure

Part I

1. Take your concave lens and hold it near your eye. Slowly move it away from your
2. Take your convex lens and hold it near your eye. Slowly move it away from your eye. Record what you see on your worksheet.

3. Place your concave and convex lenses together and hold it near your eye. Slowly move it away from your eye. Record what you see on your worksheet.

Part II

1. Take out the lenses in your bag.

2. Take your comb and hold it against a lens. Hold the flashlight against the comb and shine the light through the lens.

3. Draw a picture of what you see on your worksheet.

How Does Primary-Colored Light Affect What You See?

Materials

- Three flashlights
- Rubber band
- Cellophane (green, red, blue)
- Paper (white, blue, green, red)

Safety Concerns: Rubber bands. Discuss appropriate ways to use rubber bands.

Procedure

1. In a darkened room, shine a flashlight on each piece of paper. Record the colors on the data chart on the next page.
2. Cover the front of the flashlight with several layers of blue cellophane. Secure the cellophane with a rubber band. Repeat step one with the blue light.

3. Remove the blue cellophane and cover the front of the flashlight with several layers of green cellophane. Secure the cellophane with a rubber band. Repeat step one with the green light.

4. Remove the green cellophane and cover the front of the flashlight with several layers of red cellophane. Secure the cellophane with a rubber band. Repeat step one with the red light.

Paddle Colors

Materials

- Set of colored paddles
- Flashlight

Safety Concerns: Do not shine flashlight in other students’ eyes.

Procedure

Combine your paddles in the color combinations listed below. Write the color the two paddles together produce.

Adding Colors

Materials

- Three flashlights covered with red, blue, and green cellophane
- White sheet of paper.

Safety Concerns: None

Procedure
1. Tape a white sheet of paper on the wall.

2. While the red remains on, aim the beam of blue so that it overlaps half the red spot.

3. Now, aim the beam of green so that all three colors ball on the same spot.

What Determines Sky's Colors At Sunrise And Sunset?

*Molecules and small particles in the atmosphere change the direction of light rays, causing them to scatter and resulting in colorful sunsets. (Credit: iStockphoto/Michael Valdez)*

ScienceDaily (Nov. 15, 2007) — The colors of the sunset result from a phenomenon called scattering, says Steven Ackerman, professor of meteorology at UW-Madison. Molecules and small particles in the atmosphere change the direction of light rays, causing them to scatter.

Scattering affects the color of light coming from the sky, but the details are determined by the wavelength of the light and the size of the particle. The short-wavelength blue and violet are scattered by molecules in the air much more than other colors of the spectrum. This is why blue and violet light reaches our eyes from all directions on a clear day. But because we can't see violet very well, the sky appears blue.

Scattering also explains the colors of the sunrise and sunset, Ackerman says.
“Because the sun is low on the horizon, sunlight passes through more air at sunset and sunrise than during the day, when the sun is higher in the sky. More atmosphere means more molecules to scatter the violet and blue light away from your eyes. If the path is long enough, all of the blue and violet light scatters out of your line of sight. The other colors continue on their way to your eyes. This is why sunsets are often yellow, orange, and red.”

And because red has the longest wavelength of any visible light, the sun is red when it’s on the horizon, where it’s extremely long path through the atmosphere blocks all other colors.

**Sun Glints**

Brief glints of light reflected from distant planets may reveal the presence of liquid water or ice.

Glints that hint at water. I'm Bob Hirshon and this is Science Update.

If you look at a lake on a bright day, you’ll see glints of sunlight reflecting off the water. That's how Drake Deming, senior scientist for exoplanet studies at NASA's Goddard Space Flight Center hopes to find liquid or ice on distant planets - which would make them candidates for extraterrestrial life. His team will use NASA's Deep Impact spacecraft to look for the distinctive flashes.

These are called specular reflections; they’re almost exactly the same thing as the glare reflected from the hood of your car as you’re driving in traffic with the sun ahead of you.

A tell-tale sign will be glints that appear at regular intervals, which would indicate a large body of water rotating into view as the planet turns. To calibrate the instruments, his team has been analyzing how the Earth's sun glints appear from space. I'm Bob Hirshon for AAAS, the Science Society.
Heat, Light, and Sound Workbook - Light Worksheets

Clipart Source: Florida Educational Technology Clearing House
Light Vocabulary

Absorption - retaining heat.

Angle of incidence - the angle that the light ray hits an object.

Angle of reflection - the angle that the light-ray reflects off the object.

Opaque - does not let light pass through it.

Prism - an object that refracts light and shows the color of the spectrum.

Reflection - light or sound bouncing off an object.

Refraction - the bending of light.

Spectrum - the colors white light is made of - red, orange, yellow, green, blue, indigo, and violet; (ROY G BIV)

Transparent - allows light pass through it.

Translucent - semi-transparent. Light is diffuse (fuzzy) looking as it passes through it.

Words from Science

(Taken from Words of Science and the History Behind Them and More Words of Science, by Dr. Isaac Asimov)

Absorption - Before it was fully understood why water was absorbed by something, it looked like the sponge, etc. was simply "sucking" up the water. It comes from the Latin "ab-" and "sorbere" (to suck up). A dry sponge, placed in a water-filled pan, "sucked water up from" the pan.

Angle - Angle is a geometry term that deals with the intersection of two straight lines. Angle comes from the Latin "angulus" meaning a "corner."

Prism - Comes from Latin through the Greek "prisma" meaning "something sawn (cut with a saw)" (because of the shape of the prism).

Refraction - From the Latin "re" meaning "back" and "frangere" meaning "break." The beam is "broken (or bent) back."

Spectrum - From the Latin "spectrum" meaning "image" or "apparition (appearance of something unexpected or strange)." Spectrum comes from the Latin base "specere" which means "to see." The colored strip produced is pure light, which you see!
It's a Reflection  
(a lesson plan from UEN)

### Chart 1

<table>
<thead>
<tr>
<th>Angle of Incidence</th>
<th>20°</th>
<th>60°</th>
<th>80°</th>
<th>40°</th>
<th>70°</th>
<th>10°</th>
<th>50°</th>
<th>30°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of Reflection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chart 2

<table>
<thead>
<tr>
<th>Angle of Mirrors</th>
<th>10°</th>
<th>30°</th>
<th>50°</th>
<th>70°</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Images</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chart 3

![Chart 3 Diagram](Image)
1. In the box below, show how your group reflected light off three mirrors to hit a target.

2. In the box below, show how your group worked with another group to reflect light off six mirrors to hit a target.
## Decoding Secret Messages
(from GEMS Color Analyzers)

### Secret Messages

<table>
<thead>
<tr>
<th>Picture #</th>
<th>Read it Thru Red</th>
<th>Read it Thru Green</th>
<th>Secret Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Which color is the best message decoder, red or green? Explain.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

2. Explain why you are best able to see the messages through the color you selected in #1.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
1 - Orange
2 - Green
3 - Yellow
4 - Violet
5 - Red
6 - Blue
It’s Bent
(a lesson plan from UEN)

1. Draw a picture of your straws in the different amounts of water.

¼ Cup  ½ Cup  ¾ Cup  1 Cup

2. In the space below, write about your discovery about what each straw looks like in different amounts of water. Make sure you use complete sentences.

¼ cup - __________________________________________

__________________________________________________________________

__________________________________________________________________

½ cup - __________________________________________

__________________________________________________________________

__________________________________________________________________

¾ cup - __________________________________________

__________________________________________________________________

__________________________________________________________________

1 cup - __________________________________________
2. Draw a picture of what each straw looks like in liquids of different thicknesses.

Water

Oil

Corn Syrup

Dish Soap

3. In the space below, write about your discovery about what each straw looks like in liquids of different thicknesses.

Water - __________________________________________

__________________________________________________________________

__________________________________________________________________

Oil - __________________________________________

__________________________________________________________________

__________________________________________________________________

Corn Syrup - __________________________________________

__________________________________________________________________

__________________________________________________________________

Dish Soap - __________________________________________

__________________________________________________________________

__________________________________________________________________
Refraction and Lenses

Part I

1. Describe what happens as you move the concave lens away from your eye.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

2. Describe what happens as you move the convex lens away from your eye.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

3. Describe what happens as you move the concave and convex lenses away from your eye.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
Part II

In the box below, draw a picture of what happens to the light as it travels through the lens.

1. Explain how these two experiments demonstrate refraction. 

__________________________________________________________________
__________________________________________________________________
How Does Primary-Colored Light Affect What You See?

Complete the table as you do the experiment.

<table>
<thead>
<tr>
<th></th>
<th>White Paper</th>
<th>Blue Paper</th>
<th>Green Paper</th>
<th>Red Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>No filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results and Conclusions

1. Which color combinations produced black?

__________________________________________________________________

2. Which color combinations looked the lightest? The darkest? Why?

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________
3. Did the results of this experiment surprise you? Why or why not?

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

Paddle Colors

Combine your paddles in the color combinations listed below. Write the color the two paddles together produce. (*X in a column means don’t do it!*)

<table>
<thead>
<tr>
<th></th>
<th>Red</th>
<th>Orange</th>
<th>Yellow</th>
<th>Green</th>
<th>Blue</th>
<th>Violet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Violet</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Adding Colors

1. What color do you see when you shine a red beam at a white piece of paper?
2. What happens when you add the blue light to the red?

________________________________________________________

3. What happens when you shine all three colors together?

________________________________________________________

What Determines Sky’s Colors At Sunrise And Sunset?

1. Which colors are scattered more than any other colors.

________________________________________________________

2. How are the colors at sunrise and sunset explained?

________________________________________________________

3. Explain why the Sun is red when it’s near the horizon.

________________________________________________________

Sun Glints

1. What is a “sun glint”?

________________________________________________________

________________________________________________________

________________________________________________________

2. Explain why scientists are looking for sun glints.

________________________________________________________

________________________________________________________

________________________________________________________
3. What would sun glints occurring at regular intervals represent?