Answer Booklet

Reflection of Light With a Plane (Flat) Mirror—Trace a Star

Observations, Data, and Conclusions

Page 16

1. The individual students will complete the activity with varying degrees of difficulty.
2. The student will see the images reversed left to right.
3. The brain and the senses, especially touch, tend to get confused and the brain will try to correct for the reversal of the images.
4. The hand will appear to be located behind the mirror at a distance equal to the distance of the object from the front of the mirror.
5. It tends to be easier to trace with a finger because the body gets additional feedback through the sense of touch.
6. This activity deals with reflection.
7. At the end of the lesson, the students might share their designs with the class. If a computer is available the students could design and compile a booklet of class designs on the computer.

Reflection of Light With Two Plane Mirrors—Double Mirrors Placed at a 90-Degree Angle

Observations, Data, and Conclusions

Page 18

1. When the mirrors are placed at 90 degrees, the image is not reversed and this is called a true image.
2. The eyes see a true image or they see the student as other people see the student.
3. Over the years, the student has adjusted to a reversed image in the mirror. Also, the activities ask the student to use the hand to cross midline of the body. The right brain controls the left side and the left brain controls the left side and this adds another variable which the student must consider.
4. Reflection

Reflection of Light With Two Plane Mirrors—Double Mirrors Placed at a Number of Angles

Observations, Data, and Conclusions

Page 20

1. Computation.
2. You will see whole images at 60, 90, and 180 degrees.
3. The number of images and the number of mirror frames that are reflected will be equal.
4. The number of images equals 360 degrees divided by the angle indicated on the protractor.
5. The number of observed images and the computed images should be equal, but the observed images may be one or two less because of the crude equipment used.

Making a Kaleidoscope

Observations, Data, and Conclusions

Page 24

1. There is no exact number of images because the equipment being used is very crude. The activity is included to encourage the student to observe more carefully.
2. The objects appear to be the same size, but they are reflected in parts or pieces.
3. In some segments of the kaleidoscope, the images are reversed left to right or even upside down.

Making a Periscope

Observations, Data, and Conclusions

Page 28

1. The lines are the same as those shown in the illustration at the top of page 17.
2. No, the periscope will not function if the mirrors are positioned at different angles.

Exploring Diffraction With a Spectroscope

Observations, Data, and Conclusions

Page 32

1. The student will see a spectrum or bands of color like a rainbow. Each bulb will also have a set of distinct vertical lines. Each different element has its own distinct set of vertical lines, or signature.

2. If the light observed is a white light source, the student will observe the seven major colors in a continuous spectrum. The name Roy G. Biv will help the student to remember the names of the colors in order—red, orange, yellow, green, blue, indigo, and violet. If the light observed is not a white light source, some of the colors of the spectrum will not be seen.

3. The bands of color fade or blend into each other. Depending on the spectroscope, the student may observe very distinct vertical lines of color. You might also see some black lines which are absorption lines.

4. No, each light source has its own unique pattern of colored vertical lines.

5. There are bands of color, but they also tend to fade together. With some spectroscopes, the students will see very distinct and precisely spaced vertical lines. These lines are the signature of that particular element. The black lines (Fraunhofer lines) are the absorption lines of certain elements. For more information, see an encyclopedia.

6. Though light bulbs may look the same, they are filled with different elements or gases. Each gas or element has its own emission spectrum or bands of colors.

Diffraction of Light by Very Small Apertures

Observations, Data, and Conclusions

Page 36

1. This activity is intended to encourage the student to observe more carefully.

2. The shape, direction, or number of pattern may change as the screen is slowly rotated. A varying combination of patterns and colors will appear.

Discovering Color With a Prism

Observations, Data, and Conclusions

Pages 38

1. By refraction, a prism can break white light up into its seven major colors. Some of the suggested light sources will appear to be white light to the eye, but a prism will show that some wavelengths are not present.

2. The acrylic plastic or plastic prism will refract and break the light into color, but the quality of the plastic or glass will determine the sharpness of the colors.

3. Colors always come out of a prism in the same order. Some colors will be omitted if the light source is not white light.

4. The colors blend or shade into each other.

5. The bands of color do not always have the same shape or width. The shape or width of the color band depends on the type of light source.

Light and Color—Color Spinners

Observations, Data, and Conclusions

Page 42

1. The colors seem to blend and form other colors. The perception of color is determined by light, the source of color; material and its response to color; and the eye of the perceiver of color.

2. The colors seen by the student will depend on the design, the kind of pigment used, and the speed of the movement.

3. While spinning, the colors seem to mix and become other colors. The mixing of the colors is a function of the eyes and brain.

4. Combine blue and yellow pigments to make green.

5. Combine red and yellow pigment to make orange.

6. If all colors are equally combined in design, they should make white or gray. The kind of pigment used will affect the colors.

7. Most of the time, brown can be made by adding red, yellow, and blue.

8. Color one side of the circle and add a few lines or dots on the other half of the circle. Experiment.

Teacher's Resource

9. Color varies a great deal with the type of pigment used. The colors in light also combine differently than pigment.

Light and Color—Filters

Observations, Data, and Conclusions

Page 44

1. The students will record what they observe. Answers will vary depending on the filters used.

2. Answers will vary.

3. Answers will vary.

4. Filters subtract or absorb some colors. Two filters may be used to transmit a third color.

Light and Color—Hidden Messages

Observations, Data, and Conclusions

Page 46

1. The student should see a confusion of lines, letters, and shapes of varying colors.

2. If a red filter is used, red will not be seen and yellow may appear to be orange. Green will appear to be dark blue. If a yellow filter is used, all the yellow designs will not be seen. The colors will vary with the pigments and filters used.

3. Answers will vary depending on the pigment and filters used.

4. Each filter absorbs and transmits different wavelengths of light.

5. A booklet of secret messages might be a nice class project.

Simple Magnifiers

Observations, Data and Conclusions

Page 48

1. The letters are magnified.

2. The magnification is better with smaller drops of water.

3. The water drop magnifier is focused by moving it back and forth from the surface of the print or picture.

4. The smaller water drop magnifies more because of the way it bends or refracts light. The focal length of the small drop is shorter because the curvature of the surface of the water drop is greater. The shorter the focal length of a lens, the greater the magnification.

5. Bottles with curved edges magnify better.

6. The bottom or curved side of a bottle magnifies best.

7. The water acts as a lens and refracts or bends light to a focal point.

8. Some bottles serve as converging or convex lenses, and they bend or refract the light to focus it.

Focusing Light With a Lens

Observations, Data, and Conclusions

Pages 50 (Part 1)

1. Answers will vary depending on the lenses provided.

2. Answers will vary depending on the lenses provided.

3. The lens of the eyepiece of a telescope will have the shorter focal length and the greater magnification. The object lens will have the longer focal length and less magnification.

Pages 51–52 (Part 2)

1. Answers will vary depending on the lenses provided.

2. With a single lens, the focal image will generally be smaller than the object. The focal image may be the same size as the object, but it will never be larger.

3. If you found two distinct images, one will be large and one will be small. One may also be reversed. There are two distinct images because the object distance is different. The object distance is the distance between the object and the lens. The student must consistently use the same object distance when measurements are made.

4. Answers will vary depending on the lenses provided.

Teacher's Resource

Building a Telescope

Observations, Data, and Conclusions

Pages 55

1. Answers will vary with the lenses used.

2. The student will observe with and without the telescope. After observing the striped chart, or some other object provided, the student will make a judgment about the amount the telescope magnifies. Generally, simple telescopes constructed by students will have a magnification of less than five.

3. Answers will vary with the lenses used.

4–5. These questions were included to encourage the student to observe carefully.

6. This is a refracting telescope and the image will appear upside down. For more information, see telescopes in an encyclopedia.

Building a Microscope

Observations, Data, and Conclusions

Page 58

1–2. Answers will vary.

3. The microscope with the better set of lenses will have a clearer, sharper image.

4. The purchased microscope will be better.

5. The purchased microscope is better because the glass in the lenses is a better quality and has been ground and polished more carefully. It is also mounted and aligned more precisely.

Interference Fringes

Observations, Data, and Conclusions

Page 62

1. See the top left figure on page 62.

2. See the bottom left figure on page 62.

Polarization of Light

Observations, Data, and Conclusions

Page 64

1. Polarized material allows light to pass through it only in one direction or plane. See the figure on page 64.

2. The plastic is transparent and it will allow the light to pass through it, but the student should notice the bands of color around areas of stress. As the object was molded into shape, there were areas that were pulled and pushed, and these stress marks were molded into the plastic. The stressed areas interrupt the light rays entering the plastic and change the plane or direction of that light.

3. The transparent tape changes the plane or direction of polarization. The tape may also act as a filter and absorb some wavelengths. Layering the tape may also reinforce the light waves that are in or out of phase. Two or more light waves that exactly match or overlap at the crests and troughs of the waves are said to be in phase. When the crests and troughs of two or more waves do not match or overlap, the waves are said to be "out of phase."