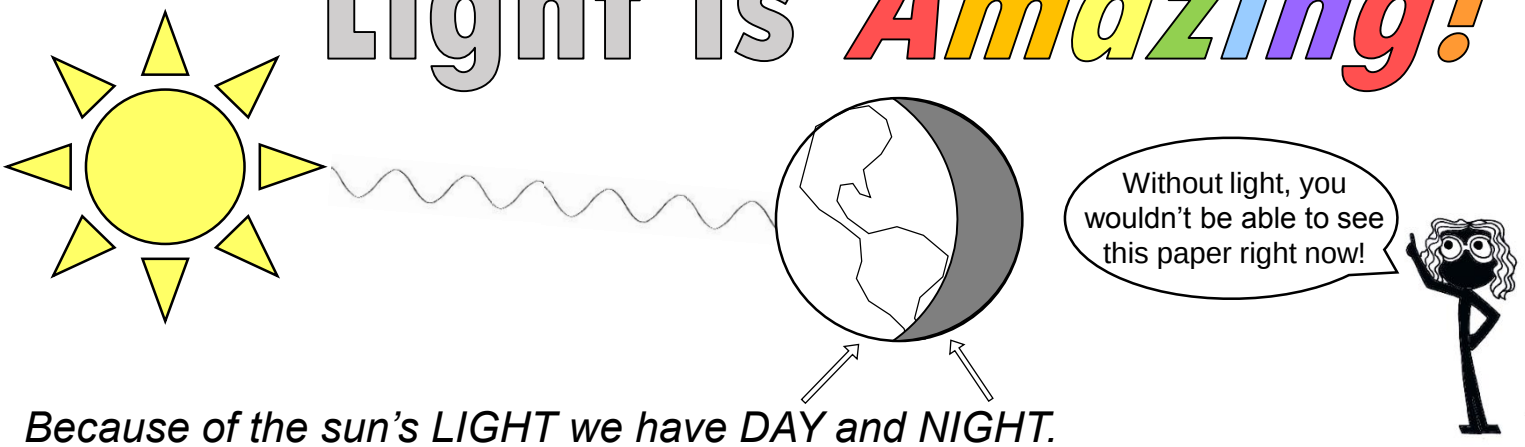
Light is Amazing!



Because of the sun's LIGHT we have DAY and NIGHT.

VIDEO RESOURCE (free on YouTube):

"Light is Amazing – Teaching Tips for Elementary Educators,"
by Jenny Ballif – Science Mom.

WORKSHEETS (in this packet):

- Vocabulary matching worksheet
- "Light is amazing" worksheets (two versions so it can be printed with or without the vocabulary words on the front side.)
- "S.O.S." worksheets (three versions so that you can select the amount of text you prefer for the explanation of Morse Code.)

LESSON OUTLINE (in this packet):

"Move Light Without Moving The Flashlight," A Science Mom lesson activity that satisfies 1-PS4-2 and 1-PS4-3 and includes several book recommendations that could be used to supplement a lesson on light.

COLOR WHEEL TEMPLATE (in this packet):

A printable color wheel that can be spun to demonstrate how the visible colors blend to make white light. Note: it must be spun very quickly. For best results this should be attached to a drill or egg beater. If you do not have a color printer you can color the blank template with markers.

FECHNER WHEELS (in this packet):

Two printable illusions (A Fechner wheel and Benham's Disc) that are black and white, but produce colors when spun (for most viewers).

LIGHT TEMPLATES (in this packet):

Three printable templates for making your own 3-D visual for the "Turn a RAINBOW into WHITE light" activity.

“Move the light without moving the flashlight.”

A lesson that satisfies Next Generation Science Standards 1-PS4-2 and 1-PS4-3

Materials:

*Flashlight
*Squares of different materials that are large enough to cover the front of the flashlight.
Suggested materials include: saran wrap, waxed paper or tracing paper, regular paper, light and dark cloth, cardboard, glass or clear plastic, wood, tinfoil, and a mirror.

Instructions:

Dim the lights and shine the flashlight on the floor. Then give the kids the following challenge: can they get the light to move somewhere else without moving the flashlight? With young kids you can have a lot of fun with making a show of blowing the light or pushing with your hands. If you (or they) blow or push REALLY hard, will that make any difference? What if it were a stream of water falling to the floor instead of light? Then would blowing or pushing make a difference?

Point out how they can make shadows if their hands block the light, and then explore the different materials in the box and see if any of those can move or block the light. Use the mirror to send light to different parts of the room. This is a good activity for introducing the vocabulary words transparent, translucent, opaque, and reflective.

Discussion Outlines and Further Questions:

Ask the kids what makes light (common answers include the sun, moon, lightning, and artificial lights. If no one mentions fire or bioluminescence (fireflies, squid etc…) you could include those to broaden the list.

Ask the kids if they can describe what light is, then explain that light behaves like a wave (you can use the “Light is a wave” hand activity from the video). Some light has more energy than others. The light we can see is called visible light, but there are other forms of light both above and below that spectrum. Ultraviolet Light (which is invisible to us) is visible to some insects. UV light has enough energy to damage our skin and give us sunburns.

Because light travels as a wave, we see something neat when we mix different colors of light. Ask the kids what color they expect to see when we mix all the colors of light. Point out that when we mix all the colors with paint or markers, we see brown or black. Then demonstrate how mixing the visible rainbow of colors creates white light. (Illustrate this by spinning the color wheel or (with flashlights and balloons) overlap various colored lights to make white light.)

Now that you’ve combined the colors of the rainbow to make white light, talk about *how to create rainbows*. Ask the kids where they’ve observed rainbows (common answers include through crystal, from bike reflectors or windows, and with a mist or spray of water). Then make rainbows using a prism or the back of a CD and a flashlight.

Cool Concepts:

This is a great introduction to the idea that light (which moves like a wave) behaves very differently than substances that are made of atoms (like water, smoke, sand, or steam). Key ideas include visible light being made of colors and the ability of colors to combine to make white light. Taking it further, this activity could also explore why something thick and hard like a piece of glass is transparent but a piece of denim fabric is almost opaque. (Glass does not absorb photons but the fabric does). Although understanding why the photons are absorbed is likely too far above grade level, it’s still nice for kids to hear the term and get a taste of the idea. But regardless of whether or not you mention photons, this activity is a great exercise in making observations and predictions.

Book Recommendations: *Potential Reading Companions for this Lesson*

FLASHLIGHT by Lizi Boyd (2014) A picture book with no text and beautiful illustrations of a child exploring the night time world with a flashlight. Ideal for pre-K and Kinder, but could be enjoyed by older kids as well.

KITTEN'S FIRST FULL MOON by Kevin Henkes (2015) Fiction. Ideal for Kindergarten and grades 1, but could be enjoyed by younger and older kids as well. A kitten chases the moon, thinking it's a little bowl of milk. A darling story with potential for great discussion points about appearances versus reality and reflections.

THE DARK by Lemony Snicket and Jon Klassen (2013) Fiction. Ideal for Kindergarten through second grade, but could be enjoyed by younger and older kids as well. A fantastic story about Laszlo and the dark. Discussion on this book could naturally tend toward the symbolic, but the book also touches on the practical aspects of where and when you see dark versus light.

WHAT MAKES DAY AND NIGHT by Franklyn M. Branley and Arthur Dorros (2015) Nonfiction. Probably ideal for grades 1 and 2 but could be enjoyed by younger and older kids as well. Nice explanation of how the earth turns and experiences day and night.

DAY LIGHT, NIGHT LIGHT: WHERE LIGHT COMES FROM by Franklyn M. Branley and Stacey Schuett (1998). Nonfiction. Probably ideal for grades 2 and 3 but could be enjoyed by younger and older kids as well. Colorful illustrations and a nice introduction to basic properties of light, why a filament lightbulb works, how fast light travels, and how our eyes adjust to dim environments.

OWL MOON by Jane Yolen and John Schoenherr (1987) Fiction. A Caldecott winner, this poetic and beautiful picture book follows a child and father as they go owling in a moonlit forest. There are several potential discussion points relating to light with the flashlight, the moon, and nocturnal owls, but those are just justifications for including it here in this list. Really, I read this one for the poetry of the words and the stunning illustrations. It's an absolutely beautiful book. If you look up this book on YouTube you can hear the author read it and see the pictures.

ALL IN A DAY by Mitsumasa Anno and 8 other illustrators. (1986). Fiction. Originally written in Japanese, this fantastic picture book is rich with meaning and explores the similarities and differences during a single day for children in eight different parts of the world. The story is intricate and meant to be savored. Don't just read it once and set it down; look through it several times. Although this book is much more about culture and the human element, it's also wonderful for getting a sense that at the same moment it's morning in one place on earth and evening in another.

A lesson on light is also a great opportunity to talk about one of the most famous scientists in recent history: Albert Einstein. Great books in that vein include:

I AM ALBERT EINSTEIN (Ordinary People Change the World) by Brad Meltzer and Christopher Eliopoulos (2014). A fun comic-book style introduction to Albert Einstein. Geared at grades 1 to 3, this book is humorous and not necessarily a "serious" biography.

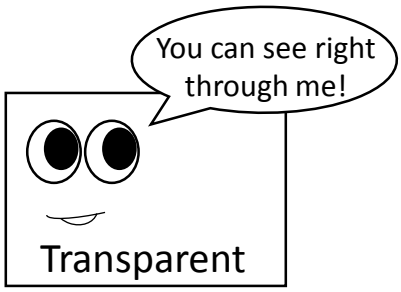
ODD BOY OUT by Don Brown (2004) This one has more of a traditional picture book arrangement and greater depth than the previous recommendation.

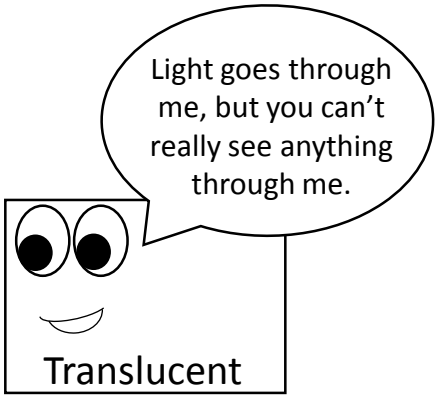
ON A BEAM OF LIGHT: A STORY OF ALBERT EINSTEIN by Jennifer Berne and Vladimir Radunsky (2013) Also a traditional picture book. Good overarching thread about overcoming adversity as well as an informative biographical sketch.

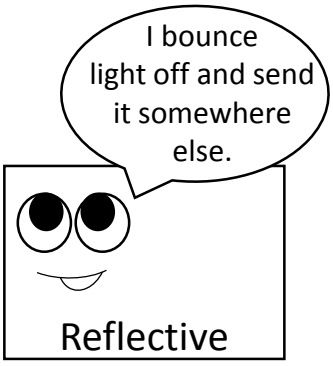
ALBERT EINSTEIN AND RELATIVITY FOR KIDS: HIS LIFE AND IDEAS WITH 21 ACTIVITIES AND THOUGHT EXPERIMENTS by Jerome Pohlen (2012). This chapter book is fantastic. Ideal for grades 3 to 5, it presents a biography as well as some intriguing puzzles.

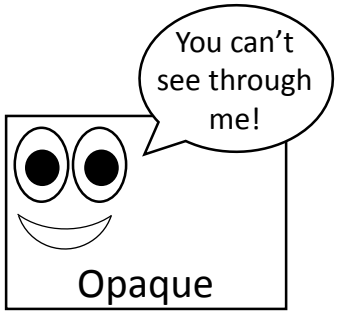
Cool Science WORDS : Transparent Reflective Translucent Opaque

Draw lines to match these things into the boxes that describe them best.









CLEAR PLASTIC WRAP

WAXED PAPER

A WINDOW

A MIRROR

FROSTED GLASS

TINFOIL

CARDBOARD

A WOODEN BOARD

Light is *Amazing!*

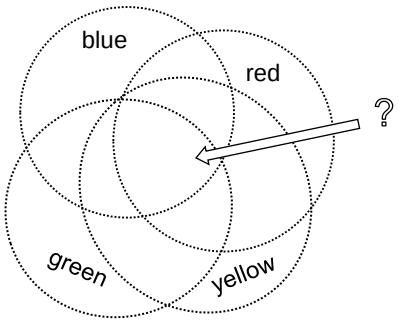
Name: _____

Because of the sun's LIGHT we have DAY and NIGHT.

---

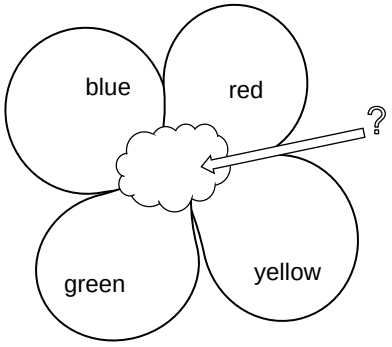
1. What do you see when you mix blue, green, red, and yellow LIGHT?

- ❑ Black
- ❑ Brown
- ❑ White
- ❑ Purple
- ❑ Orange



2. What do you see when you mix blue, green, red, and yellow PAINT?

- ❑ Black
- ❑ Brown
- ❑ White
- ❑ Purple
- ❑ Orange



3. Which kind of light can give you a sunburn?

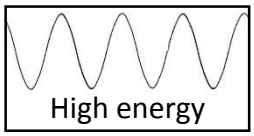
- ❑ Red light
- ❑ Green light
- ❑ Yellow light
- ❑ Ultraviolet light
- ❑ Blue light

4. Mark the ways you can make a rainbow from white light:

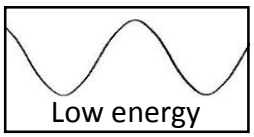
- ❑ Spraying water with a hose on a sunny day
- ❑ Shining light through a prism
- ❑ Shining light on a CD or DVD

5. Light travels in WAVES. Draw lines to match these type of light to the correct wave:

Red light



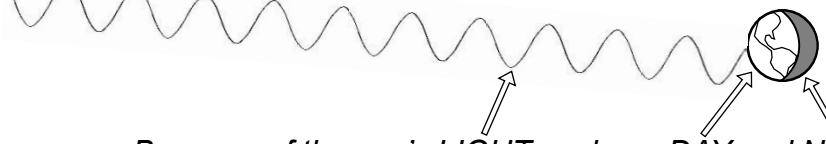
Ultraviolet light



6. Draw a picture of something that makes light:

Name: _____

Light is *Amazing!*



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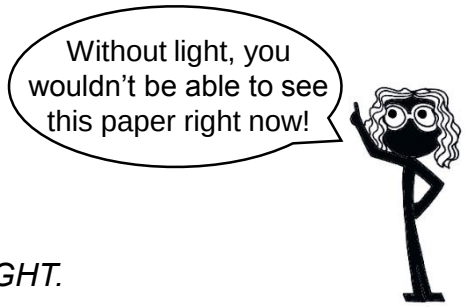

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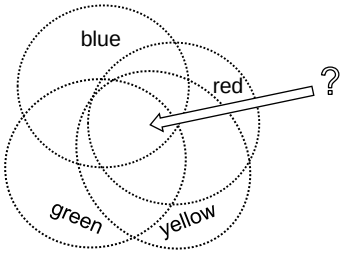

What do you see when you mix blue, green, red, and yellow PAINT?

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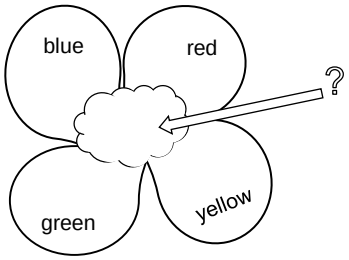

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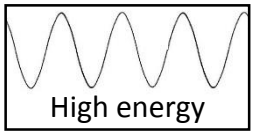
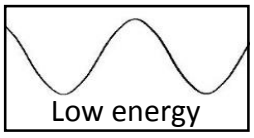


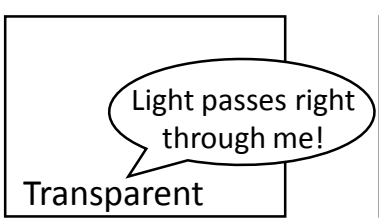
Ultraviolet light

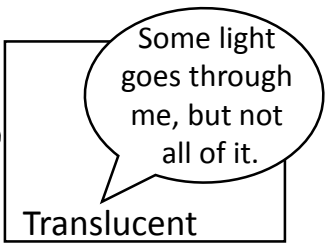


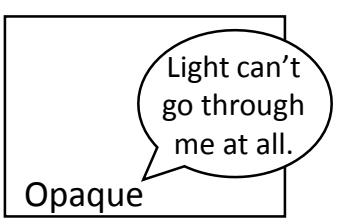
Draw a picture of something that makes light:

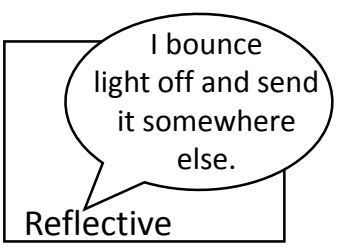
COOL SCIENCE WORDS: Draw lines to put these things into the boxes that describe them best.

A WINDOW
PLASTIC WRAP
WAXED PAPER
CARDBOARD
TINFOIL
A MIRROR









Name: _____

SENDING SIGNALS WITH LIGHT

Sam and Sydney are stranded on the ocean in a floating umbrella!

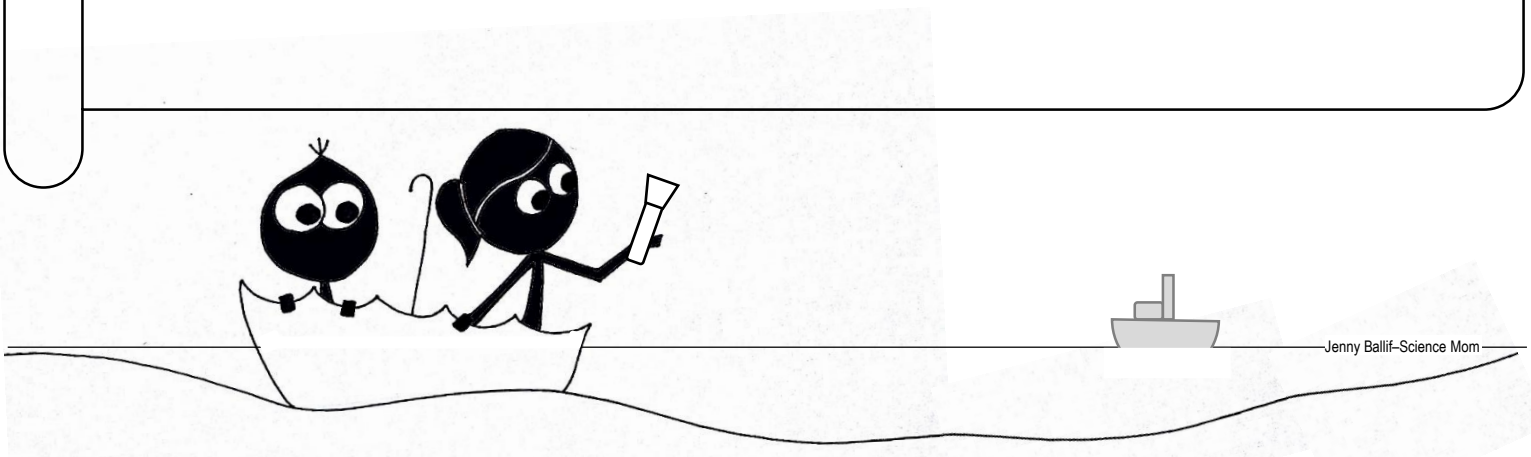
FORTUNATELY, there's a large boat visible in the distance.

UNFORTUNATELY, it's too far away to hear their yells for help.

FORTUNATELY, they have a flashlight and it's almost dark.

UNFORTUNATELY, they don't know what to do!

FORTUNATELY, you have an idea that will help them! Tell Sam and Sydney how they can signal to the big boat for help. Write your instructions here:



SENDING SIGNALS WITH LIGHT

Name: _____

S.
O.
S.

One of the most well-known phrases in Morse Code is the S.O.S. signal. It means "Help!" and here's how you say it:

○ ○ ○ ▭ ▭ ▭ ○ ○ ○

The dots and dashes can be anything, flashes of light, sounds, or marks on a paper. As long as you can tell that the first three are short, the next three long, and the last three short, then you've successfully sent the message "Send Help! I'm in big trouble!"

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UNFORTUNATELY, it's too far away to hear their yells for help.

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UNFORTUNATELY, they don't know Morse code!

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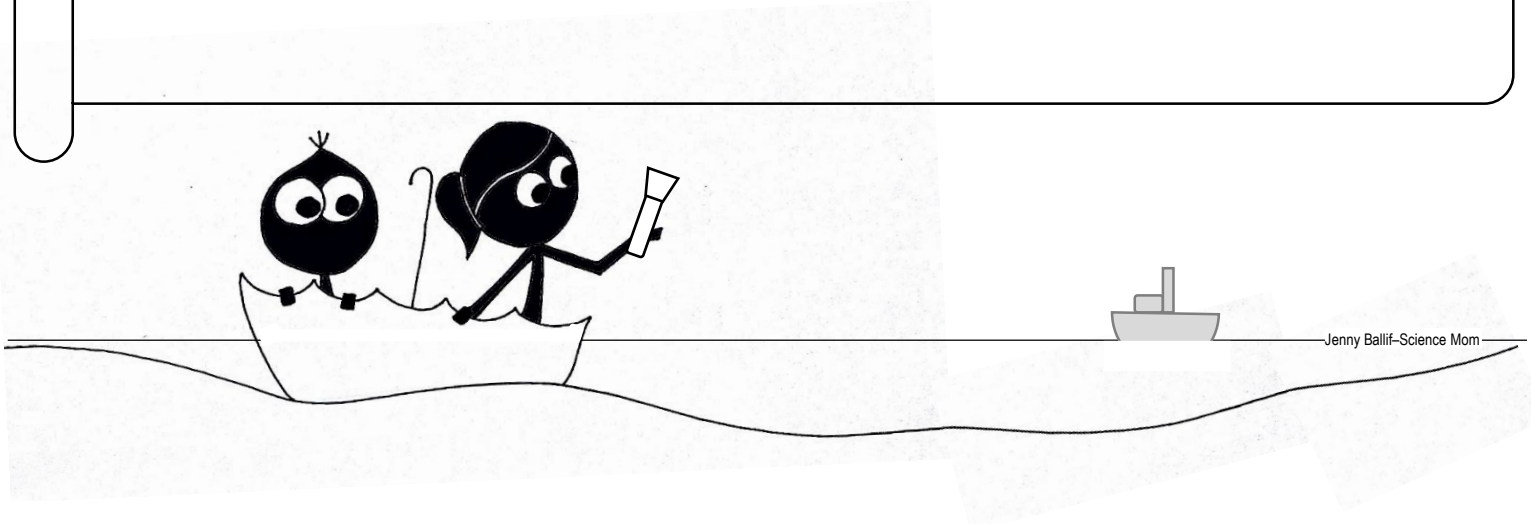
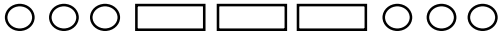


S.
O.
S.

In the early 1800s, there was no such thing as a cell phone. If someone in New York needed to talk to someone in Boston, they had to travel to Boston themselves or they had to send another person to Boston with a message—and then wait for them to get back. Then, in 1836, Samuel Morse and Joseph Henry invented the TELEGRAPH. This machine made it possible to send messages through a wire using a code of short and longer sounds—dots and dashes. One of the most well-known phrases in Morse Code is the S.O.S. signal. It means "Help!" and here's how you say it:



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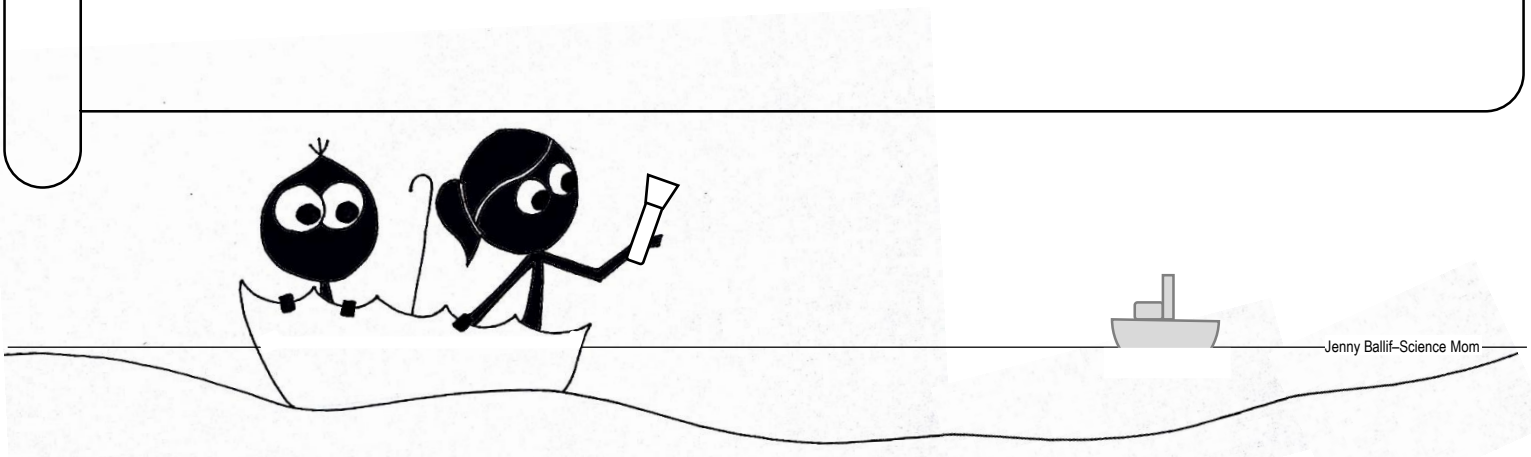
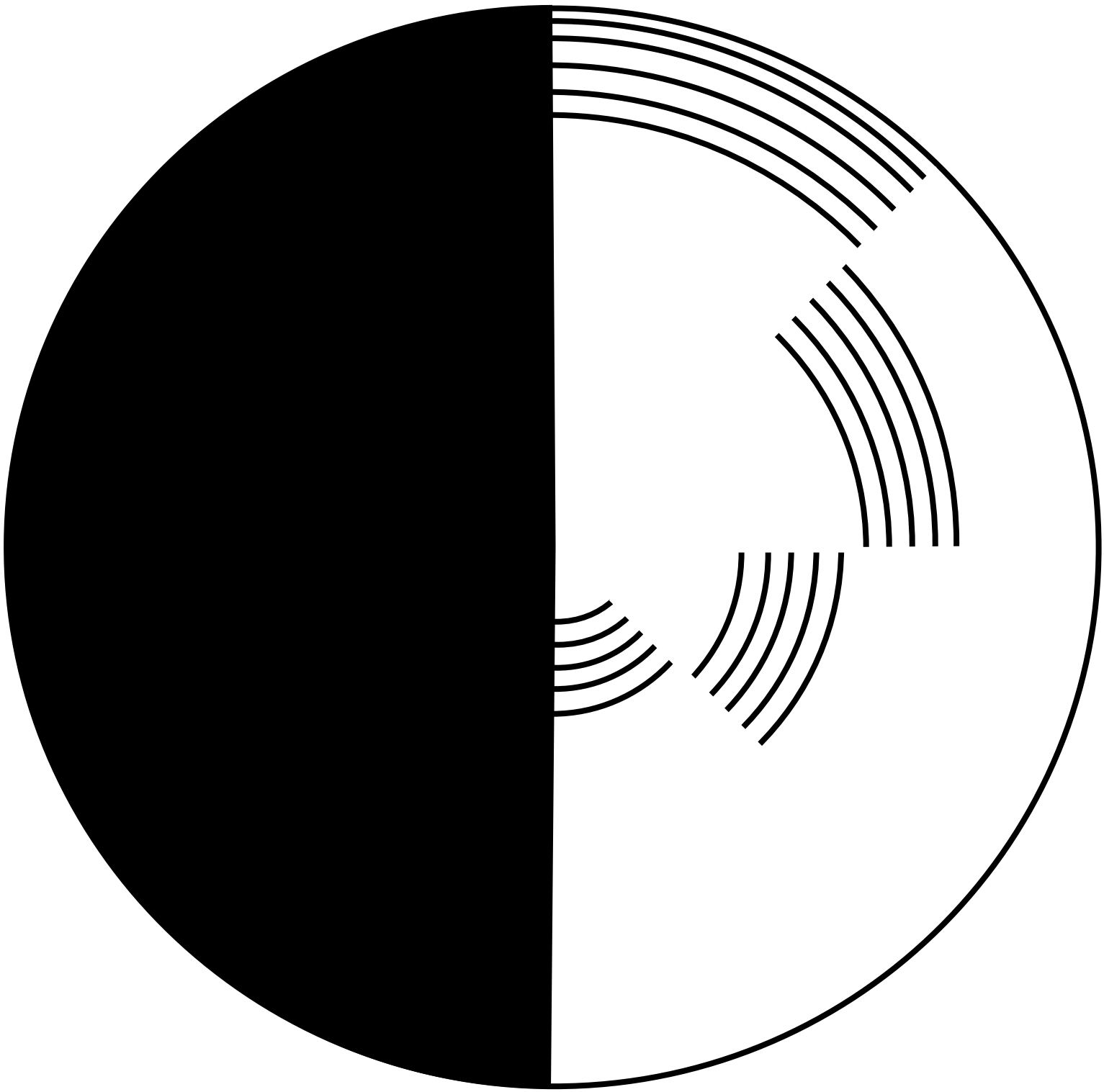


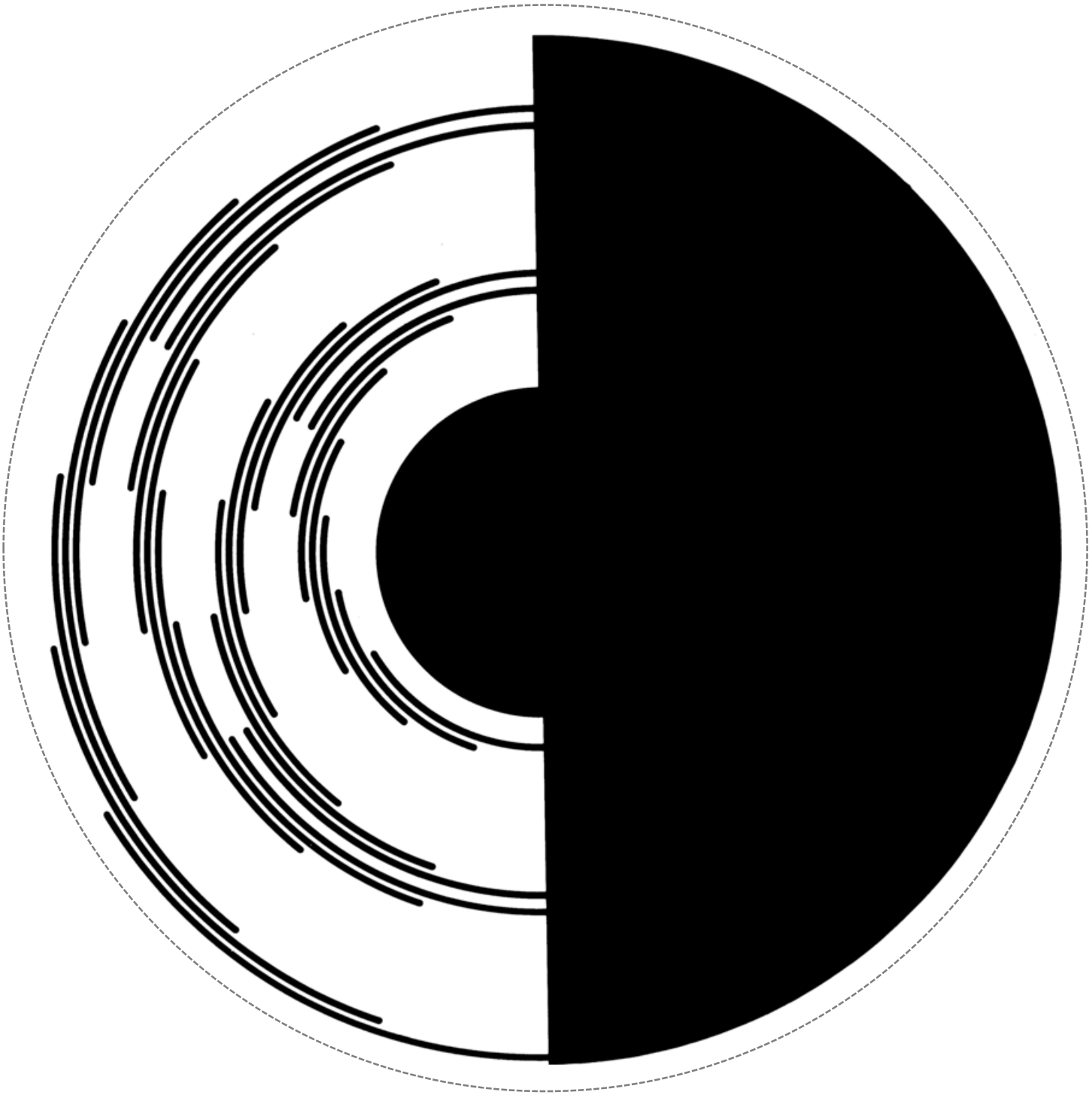
A Fechner Wheel



Benham's Disk

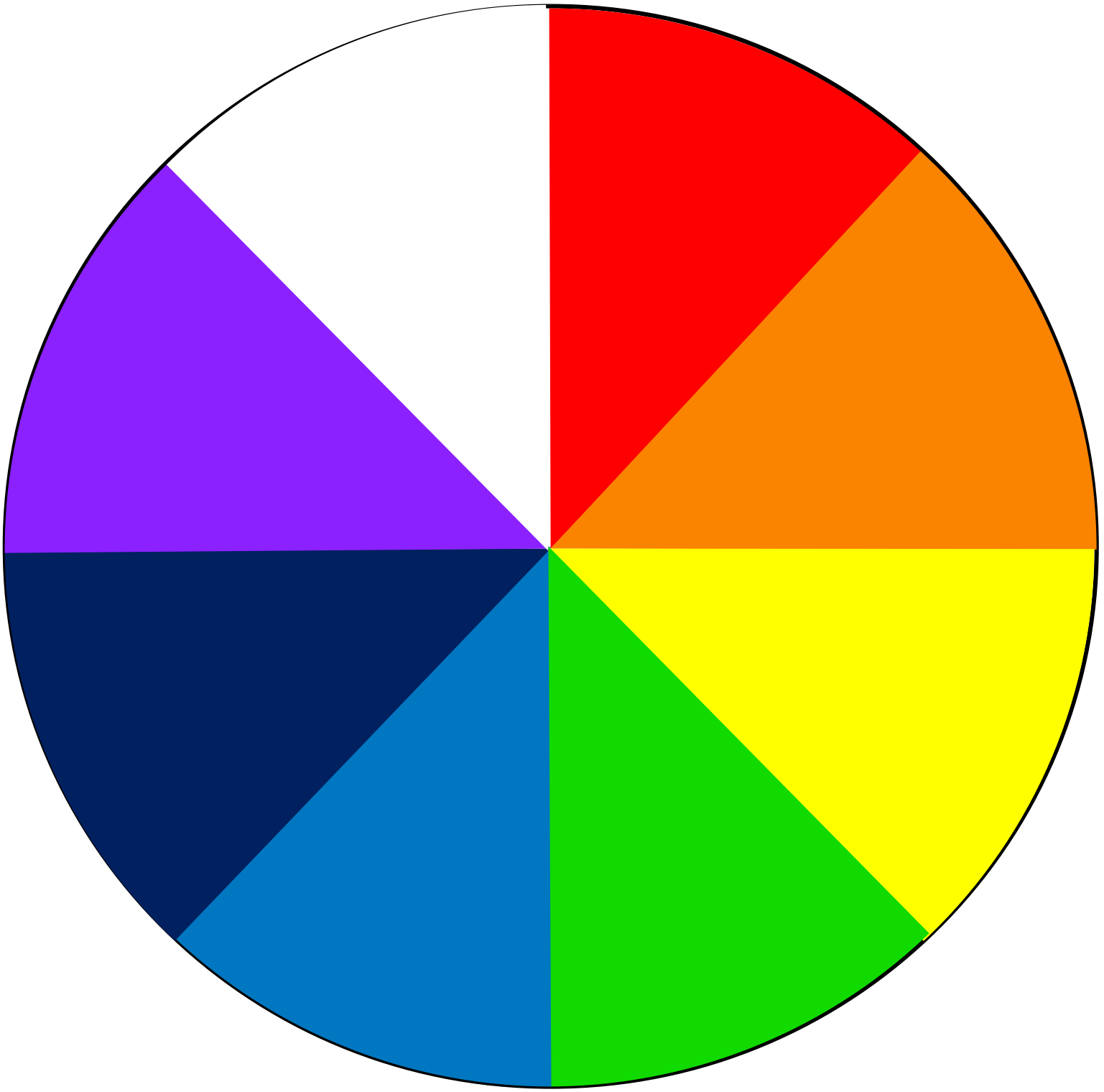
Cut along the dotted line and mount the disk to a drill or egg beater. This optical illusion is usually even more effective at producing colors than the previous wheel. For best effect, spin very quickly and view it under bright lights. Sunlight or incandescent lights work best. Fluorescent and LED lights will also work but their strobe effect can give the disk a pulsating appearance. Be sure to try spinning it both directions and vary the speed of the spinning.

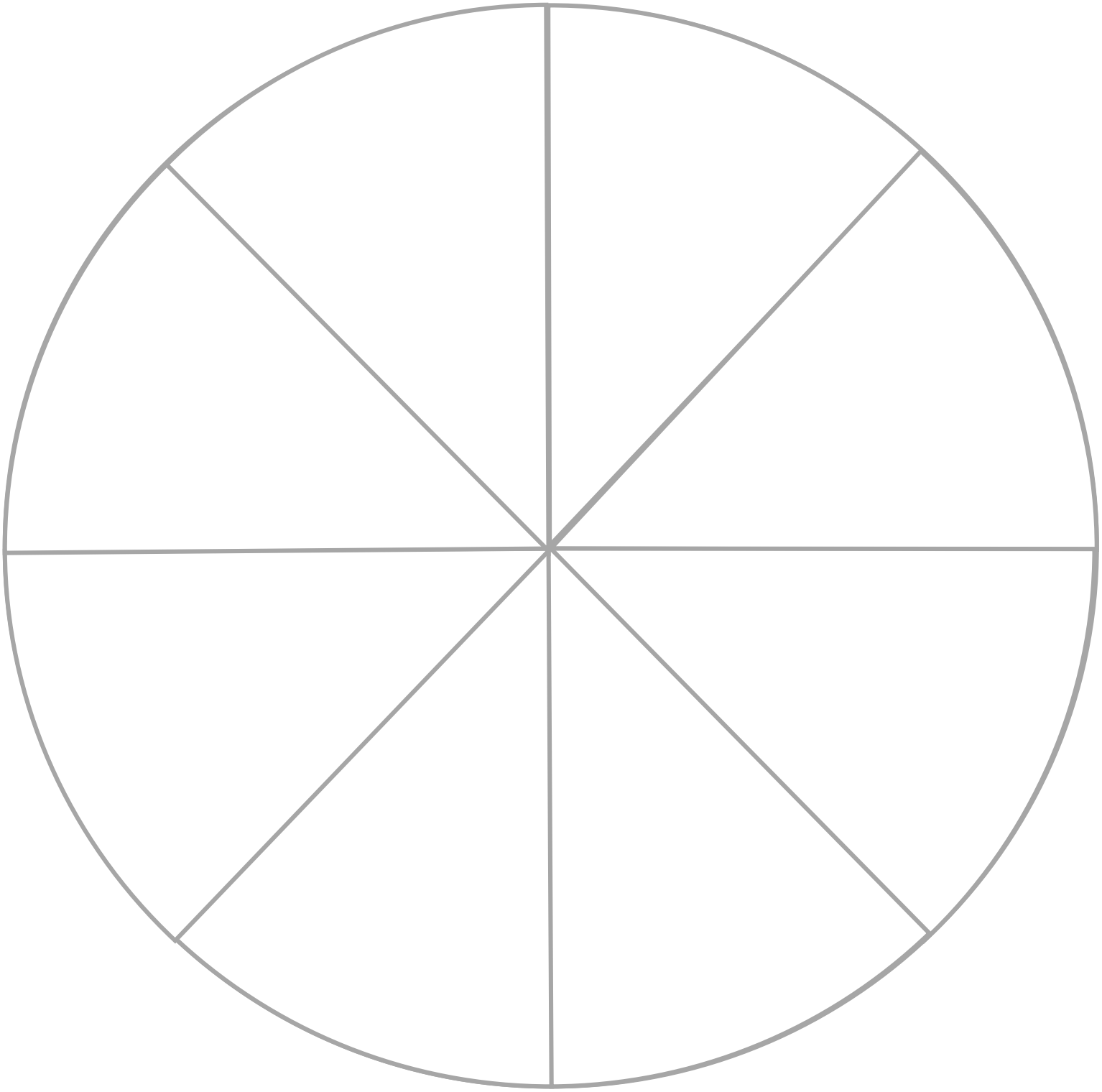
HOW THE FECHNER EFFECT WORKS: The quick and simple answer is that the part of your eye that recognizes colors (cones) come in three varieties. One sees green, another red, and the third sees blue. These types of cones don't respond to light the same—some are faster than others—and so with blinking white and black light these color receptors are sending information to the brain at different rates. This is the main reason behind the illusion. Look up "Benham's Disk" or "Benham's Top" or "The Fechner Effect" to find out more!



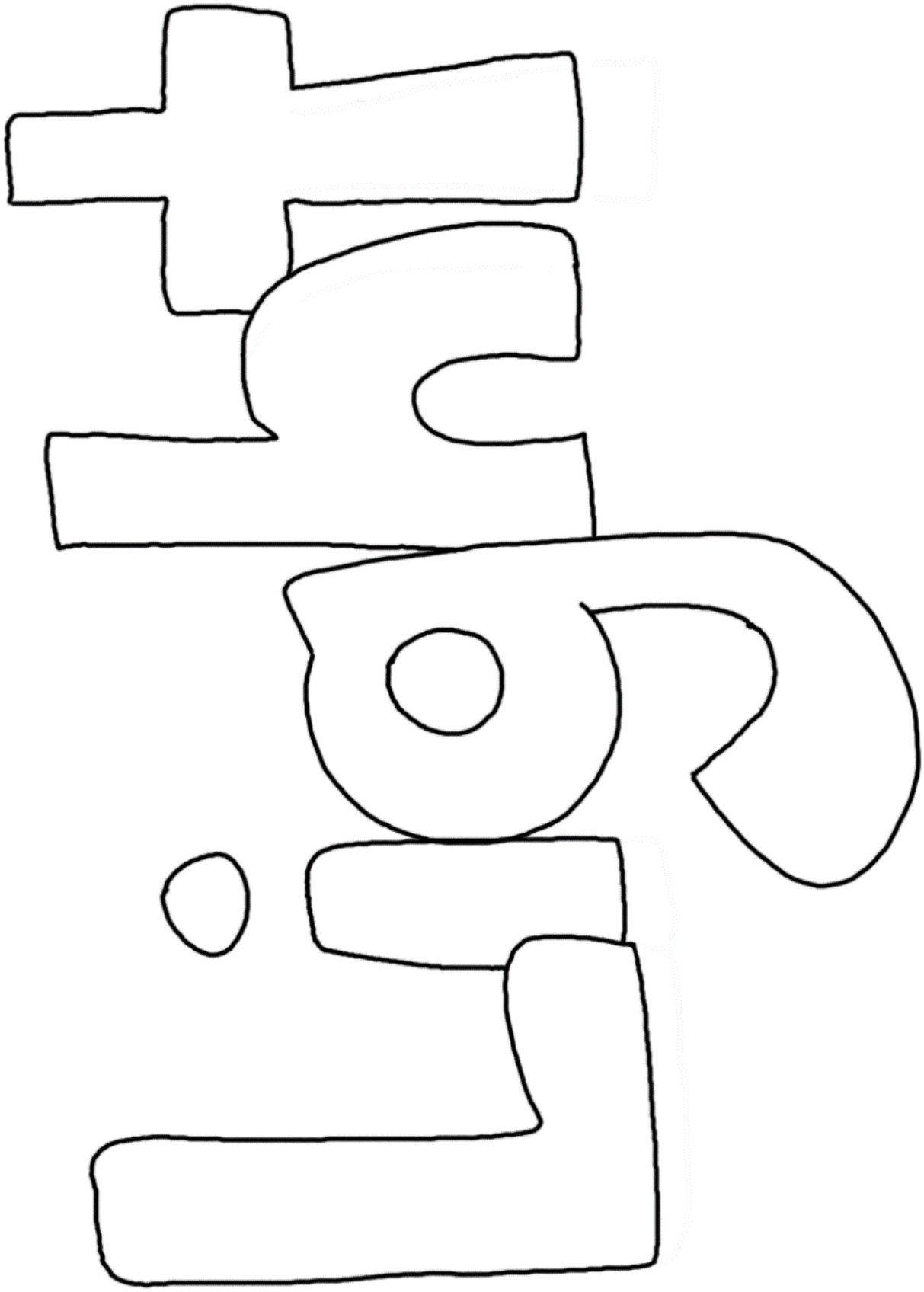
Color Wheel

If you have a color printer that is printing true, then this wheel should work quite well. If not, print and color the blank wheel on the following page. Regular markers will work well enough to demonstrate the effect even though the color wheel will not turn completely white when spun. For very best effect spin very quickly and under bright lights (incandescent or sunlight).

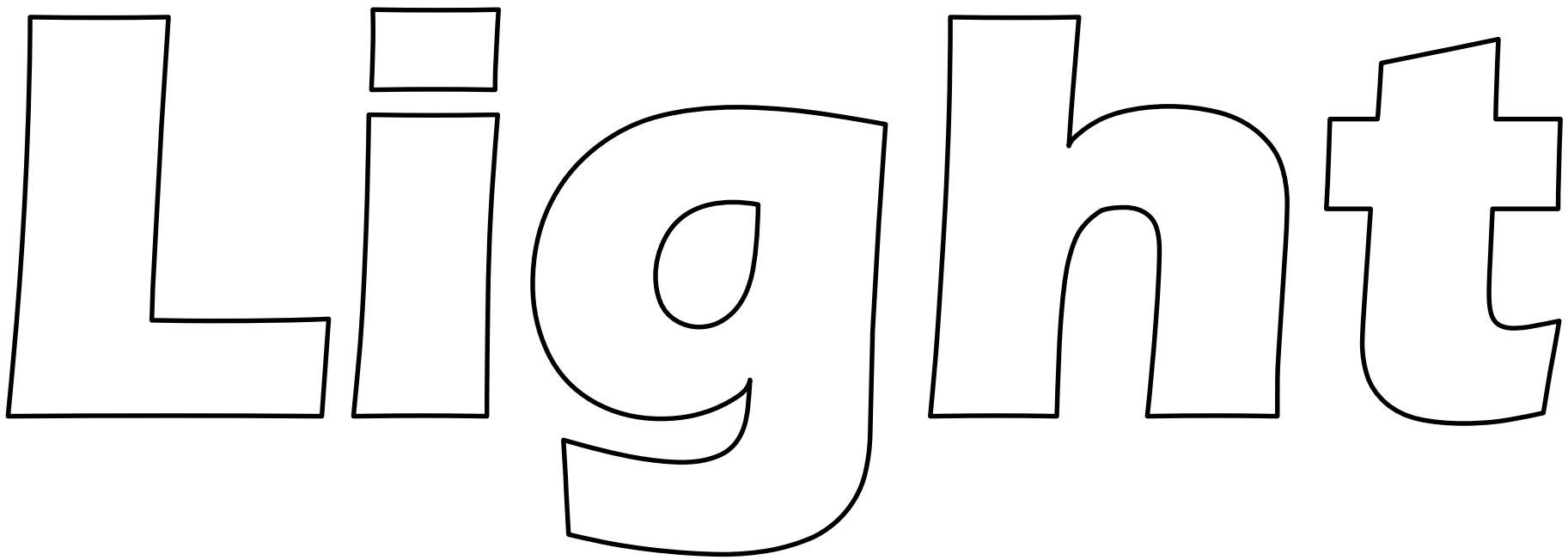




With the help of some flashlights, colored balloons, scissors, and tape, any of these templates can be used for the “Turn a RAINBOW into WHITE light” activity as demonstrated on the YouTube video “Teaching Elementary Students about Light – and a look at NGSS for 1st Grade.” Simply cut out everything around the letters in this version and the fix it above a background. For the other two templates you will want to cut out the inside of the letters..



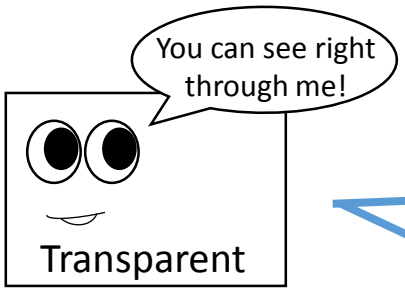

Light

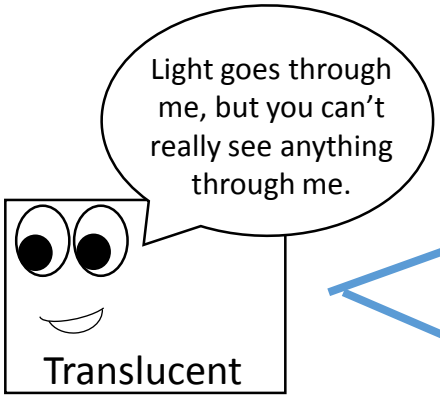

Light

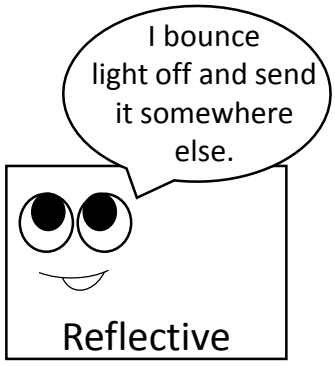
Answer Keys to Worksheets

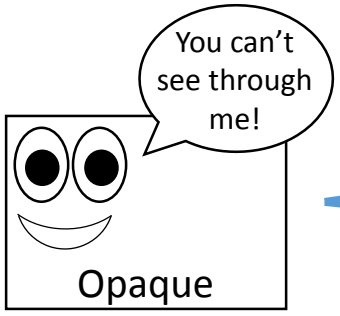
Cool Science WORDS : Transparent Reflective Translucent Opaque

Draw lines to match these things into the boxes that describe them best.









CLEAR PLASTIC WRAP

WAXED PAPER

A WINDOW

A MIRROR

FROSTED GLASS

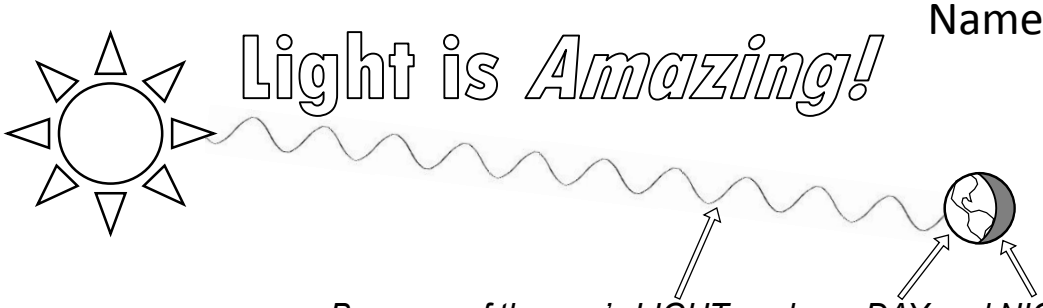
TINFOIL

CARDBOARD

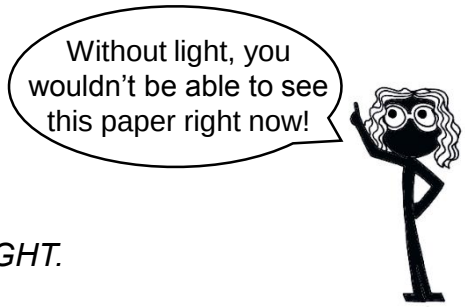
A WOODEN BOARD

Light is *Amazing!*

Name: _____

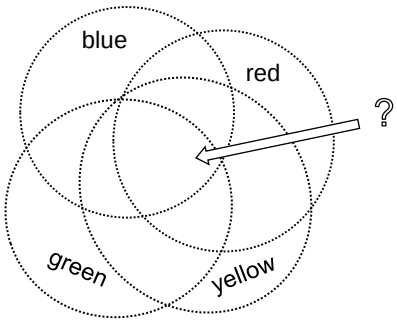


Because of the sun's LIGHT we have DAY and NIGHT.



1. What do you see when you mix blue, green, red, and yellow LIGHT?

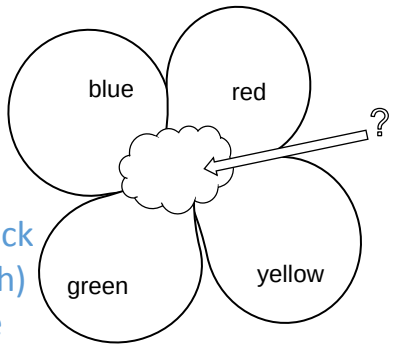
- ❑ Black
- ❑ Brown
- ☒ White
- ❑ Purple
- ❑ Orange



2. What do you see when you mix blue, green, red, and yellow PAINT?

- ☒ Black
- ☒ Brown
- ❑ White
- ❑ Purple
- ❑ Orange

*Note: Either black or brown (or both) are perfectly fine answers here.



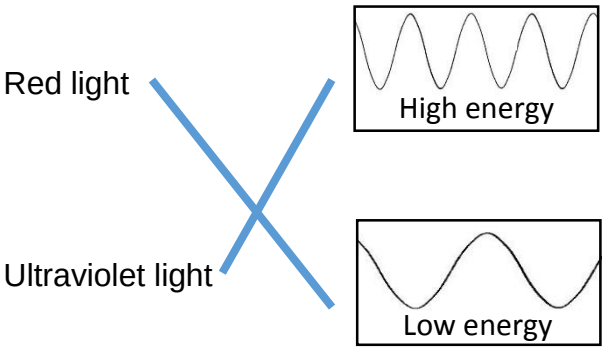
3. Which kind of light can give you a sunburn?

- ❑ Red light
- ❑ Green light
- ❑ Yellow light
- ☒ Ultraviolet light
- ❑ Blue light

4. Mark the ways you can make a rainbow from white light:

- ☒ Spraying water with a hose on a sunny day
- ☒ Shining light through a prism
- ☒ Shining light on a CD or DVD

5. Light travels in WAVES. Draw lines to match these type of light to the correct wave:



6. Draw a picture of something that makes light:

Answers could include:

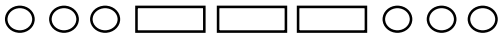
The sun
The moon
Stars
Fire
Fireflies, squid, or jellyfish (bioluminescence)
Light bulb
Lightening
Glow-in-the-dark bracelet (chemiluminescence)
Aurora borealis
Lava
and several more…

SENDING SIGNALS WITH LIGHT

Name: _____

S.
O.
S.

One of the most well-known phrases in Morse Code is the S.O.S. signal. It means "Help!" and here's how you say it:



The dots and dashes can be anything, flashes of light, sounds, or marks on a paper. As long as you can tell that the first three are short, the next three long, and the last three short, then you've successfully sent the message "Send Help! I'm in big trouble!"

Sam and Sydney are stranded on the ocean in a floating umbrella!

FORTUNATELY, there's a large boat visible in the distance.

UNFORTUNATELY, it's too far away to hear their yells for help.

FORTUNATELY, they have a flashlight and it's almost dark.

UNFORTUNATELY, they don't know Morse code!

FORTUNATELY, you have an idea that will help them! Tell Sam and Sydney how they can signal to the big boat for help. Write your instructions here:

Answers could include any type of picture or written instructions to flash the light 3 times fast, 3 slow, and 3 fast. Students may include details about how to flash the light (clicking the flashlight on and off, covering the flashlight with a hand, or moving the flashlight behind the umbrella and then raising it up again to be visible), or they might draw out the S.O.S. signal using dots and dashes. Or they might come up with an alternative suggestion.

If time and space permit, a great follow up to this worksheet is to provide the child with a flashlight and then encourage them to make the S.O.S. signal themselves, or incorporate it into a game and let a group of children play out a rescue operation where the coast guard observes a signal and needs to decide if it's a call for help or not…