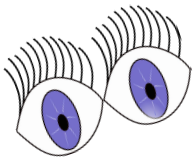
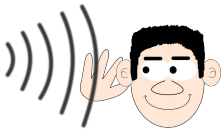
QWQED

SUPPORT
OUR
SCHOOLS

Grades 3 – 4





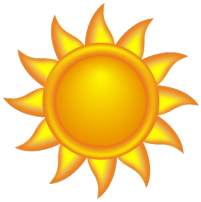
Light and Sound

You see examples of light and sound every moment of every day. However, over the next few weeks, you are going to explore how light and sound impact our world in ways you probably never even realized!

Both light and sound travel in *waves*. You'll learn how sound waves reach your ears, and how your eyes process light. Without sound waves, we wouldn't be able to hear musical instruments playing our favorite songs or our people talking to us. Without light waves, our eyes wouldn't be able to recognize the different colors in a rainbow or see in the dark!

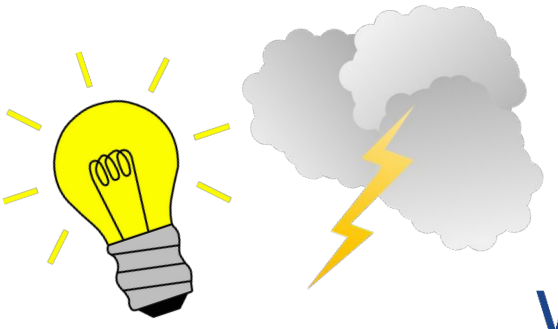
You will learn how people used sunlight and shadows to tell time before the creation of the clock, and how the invention of the telephone helped people communicate with friends and family far away.

You will explore how light and sound can be used to create energy, and you will create your own solar oven! You'll also see how certain animals create and *emit* light! (Have you ever seen a lightning bug in your backyard?)



Light and sound can also be used to create art, tell stories, and more!

Each activity in this packet will have you thinking, discovering, creating, and having fun! Enjoy!

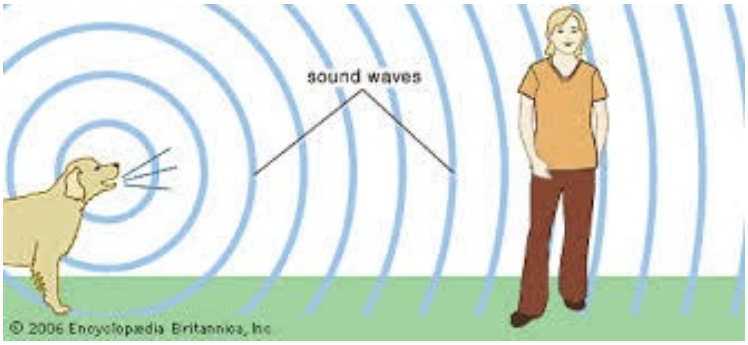


WQED education

Day 1 Sound: Waves

Science

Soundwaves are vibrations, and the vibrations cause us to hear different sounds!



Try it out! Pour water in varying amounts into different glasses. Gently tap the glasses with a spoon, or another object.

Does the amount of liquid in each glass change its sound? What happens if you change the type of liquid? Or the type of container?

Watch this Zoom video to learn more!: http://ow.ly/f9A550AGFDB

WQED education

Day 1 Sound: Waves

Social Studies

Did our experiment remind you of playing drums?

Many cultures have used drums as an effective form of communication. However, one culture in particular used it as an early form of a telephone. The African drum was a marvel to Europeans who were amazed that most villages knew of their arrival days before they entered the settlement. Scientists have stated that the speed of an African message can be transmitted at about 100 miles in an hour.

Among the famous communication drums are the drums of West Africa. From regions known today as Nigeria and Ghana, they spread across West Africa to America and the Caribbean during the 18th and 19th centuries. Unfortunately, the drums were banned because they were being used by the enslaved to communicate with one another over long distances.

Drums from Around the World

https://melodyful.com/types-of-drums-around-world

Extension:

Take a look at how drums are used for communication in Japan!
http://ow.ly/k7Qn50AGFAz

WQED education

Day 1 Sound: Waves

Math

Use the code box clues to complete the story below. Once you complete the story, use a tabletop as a drum to play out the story (each = one drum beat).

NAME _____

AFRICAN DRUM COMMUNICATION - MATH

Directions: Utilize a tabletop as a drum to use the code box clues to decode the puzzle below. (each ● = one drum beat)

CODE BOX	
●	**RUN**
● ●	**JUMP**
● ● ●	**HIDE**
● ● ● ●	**GO HOME**
● ● ● ● ●	**STOP**

Imani and Aliyah are playing a game of Simone says. Imani is Simon. She says to Aliyah, "Simone says _____ ● ●_____." Next, Imani says to Aliyah, "Simone says _____ ●_____." After that, Imani says to Aliyah, "Simone says, _____ ● ● ●_____." Then, Imani says to Aliyah, "_____ ● ● ● ● ●_____!" Finally, Imani says to Aliyah, "You're out because I didn't say Simone Says. It's time for you to _____ ● ● ● ●_____."

WQED education

Day Sound: Waves

English Language Arts

Create your own "Drum Code" and story. Then, ask a family member to use your code to complete your story.

Directions: Utilize a tabletop as a drum to use the code box clues to decode the puzzle below. (each ● = one drum beat)

CODE BOX	
●	RUN
● ●	JUMP
● ● ●	HIDE
● ● ● ●	GO HOME
● ● ● ● ●	STOP

_____

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WQED education

Day 2 Sound: Music

Science

Design your own instrument! Will it have strings like a guitar? Keys like a piano? Pads like a drum? Use materials from around your house to create your instrument.

For more information about how strings can vibrate to make different sounds, check out:

pbskids.org/designsquad/build/build-instrument/

WQED education

CYBERCHASE

Create a Music Maker

30 min activity

Discover the benefits of designing for function by creating musical instruments!

Before You Play

Invite your child to share times when she's made plans before doing something. Ask, "Why do we make plans?" Discuss how inventors often make plans before they build their inventions. These plans or designs help them think about what they want their inventions to do and how, and can help them avoid problems. If possible, watch the Cyberchase episode "Designing Mr. Perfect" with your child to further explore this idea.

Materials

- [ ] Plastic and paper cups
- [ ] Paper plates
- [ ] Beans
- [ ] Beads
- [ ] Jingle bells (or something that rattles)

- [ ] Paper towel rolls
- [ ] Pipe cleaners
- [ ] Paper straws
- [ ] Waxed paper
- [ ] Combs
- [ ] Rubber bands
- [ ] Balloons
- [ ] Popsicle sticks
- [ ] Plastic food containers
- [ ] Aluminum foil
- [ ] Other found objects
- [ ] Masking tape
- [ ] Stapler
- [ ] Pencil
- [ ] Printable: Music to our Ears (PDF)
- [ ] Printable: My Invention Design (PDF)
- [ ] Printable: Ideas to Get Started (PDF)

Directions

1. Give your child the "Music to Our Ears" and "My Invention Design" printables.

2. Allow time for her to examine and make sounds with the instrument-making materials provided. Have her use the "My Invention Design" printable to write about her ideas for a music maker and sketch a plan that shows what parts it should include.

3. To help your child think of sounds she might make, talk about ways that some familiar musical instruments make sound (striking, plucking, blowing, shaking, vibrating, etc.). If your child has trouble coming up with ideas, use the "Ideas to Get You Started" printable for suggestions.

4 After your child has designed her invention, have her build it. Then have her check the sound the invention makes against the original plan. Is she getting the sound she wanted? If not, have her revise her design or set a new goal to fix the problem.

5 Invite your child to talk about her instrument and the different ways she found to make different sounds. Encourage your child to experiment and try making more music makers!

https://www.pbs.org/parents/crafts-and-experiments/create-a-music-maker

Cyberchase SM
Inventive Innovations

Music to Our Ears!

Help! Hacker stole all the musical instruments from the borgs in R-Fair City on the day of their big parade! Can you invent a musical instrument to save the parade?

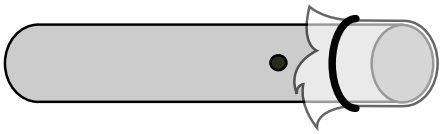
Materials

For your Music Maker:

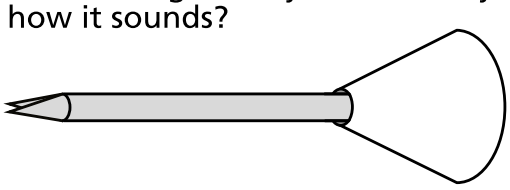
- ❒ plastic and paper cups, paper plates, beans, beads, jingle bells, paper towel rolls, pipe cleaners, paper straws, waxed paper, combs, rubber bands, balloons, craft sticks, plastic salad bar containers, aluminum foil, and other found objects
- ❒ Masking tape
- ❒ Stapler
- ❒ "My Invention Design" handout
- ❒ Pencil

Make Your Instrument

1. Play with the materials. Find sounds that you like by shaking, striking, or spinning objects.



2. Use the "My Invention Design" handout to plan your Music Maker. Make a sketch to show what it looks like.
3. Make your instrument and try it out. Does it work the way you planned?
4. What changes can you make to your instrument to improve how it sounds?



How Am I Inventing?

Inventors take time to plan an invention before they start building. They start with an idea of what they want their invention to do and make a plan. When they stick to that plan, they can build an invention that works the way they want. This is called *designing for function*. When you design your instrument to make a particular sound, you're designing for function, too.

WQED education

Get inventive with CYBERCHASE on PBS KIDS GO!
Check local listings or visit www.pbskidsgo.org/cyberchase.

CYBERCHASE is produced by Thirteen / WNET New York and Nelvana Limited.
Major funding for CYBERCHASE is provided by the National Science Foundation, Ernst & Young LLP, Northrop Grumman Corporation, Intel Corporation, Intel Foundation, PBS and the Corporation for PublicBroadcasting. Additional funding is provided by The Volckhausen Family.

My name: _____

Cyberchase
Inventive Innovations

To be used with "Music to Our Ears"

Day 2 Sound: Music
Science

My Invention Design

Name of my invention:

_____

Sounds I want my invention to make:

_____

_____

Materials I need to make my invention:

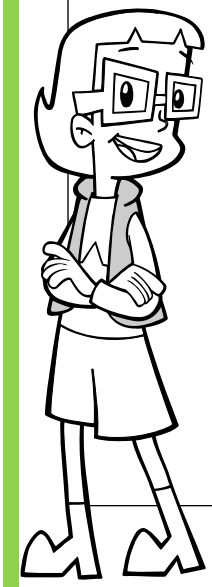
_____

_____

_____

_____

What my invention will look like:



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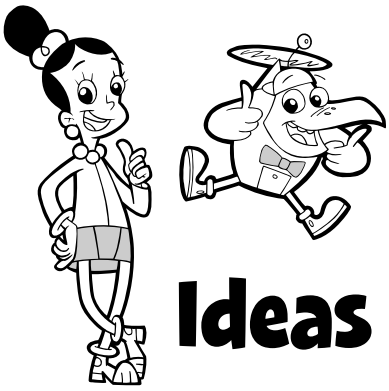


Cyberchase Inventive Innovations

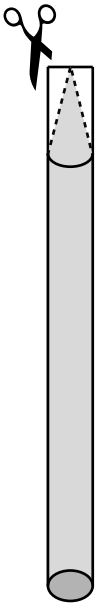
To be used with "Music to Our Ears"

Ideas to Get You Started...

Kazoo

- Cut out a piece of waxed paper big enough to fit over one end of a cardboard tube (toilet paper or paper towel roll).
- Securely wrap the piece of waxed paper around one end of the tube and use a rubber band to hold it in place.
- Make sure that there are no gaps between the waxed paper and the tube. If the paper feels loose, use more rubber bands.
- Using a pencil, carefully punch a hole in the side of the tube near the waxed paper.
- Hum or sing into the opposite, open end of the tube.

Straw Oboe

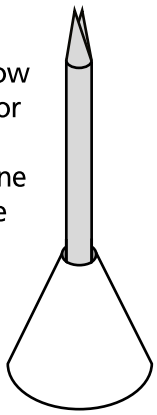


- Flatten the last ½ inch of a straw with your fingers.
- Cut off the top 2 corners of the flattened portion of the straw so that it looks like an upside down V.
- Place the V end in your mouth.
- Tighten your lips and blow through the straw.
  Do you hear a buzzing noise?
- Now cut off an inch of the straw end not in your mouth.
- Listen to the sound your shorter straw makes. What do you notice about the sound? How did it change?

Straw Trombone

- Make a Straw Oboe.
- Place the Straw Oboe inside a larger straw, with the mouth end sticking out.
- Blow through the Straw Oboe and slide the large straw to change the pitch.

Straw Oboe Megaphone



- Make a Straw Oboe.
- Cut out a small hole at the bottom of a snow cone cup. Make sure it is just big enough for your Straw Oboe to fit through.
- Place your Straw Oboe through the snow cone cup with the mouth end sticking out of the pointed end of the cup. Tape it together with masking tape.
- Blow through the Straw Oboe and notice what happens.

Goose Call

- Tie a piece of yarn to a paper clip.
- Have an adult help you poke a hole in the bottom center of a plastic cup.
- Thread the other end of the yarn through the hole in the bottom of the cup so the paper clip is inside the cup.
- Wet your thumb and first finger with water.
- While holding the cup in your dry hand, pinch the yarn where it reaches the cup.
- Pull down on the yarn away from the cup, letting it slide through your fingers.

Pluck Drums

- Get a plastic cup.
- Get a balloon and cut off the end where you blow into it.
- Stretch the balloon and then place over the top of the cup. The balloon's rubber should be stretchy enough to hold it in place.
- Pinch a little of the balloon over the top of the cup between your thumb and index finger.
- Pull up slightly and let go.

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WQED education

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Day 2 Sound: Music

Social Studies

You have an instrument that you carry with you all the time! Your voice!

Check out yodeling, one form of singing that started in the Alps of Switzerland as a way for herders to communicate with their sheep. Overtime, it became a way for people to express themselves.

Read the attached article: How Do You Yodel?

After reading, talk about the article with a family member. Do you have any songs or types of singing that is important to your culture?

Singing involves changing the pitch of your sounds in order to make different notes.

Find out more about how vibrations and pitch affect sound here:
https://bit.ly/330brQk

WQED education

Wonder of the Day **#526**

How Do You Yodel?

ARTS & CULTURE — Music

Have You Ever Wondered...

- How do you yodel?
- What are the two types of vocal registers?
- Who started the yodeling craze in the United States?

Here's a joke for you to share with your friends:

Knock-knock.

Who's there?

Little old lady.

Little old lady, who?

Hey! We didn't know you could yodel!

Yodeling is a unique type of singing that features a fast, repeated change from a low to a high pitch. If you've ever heard Tarzan yell, then you have a bit of an idea of what yodeling sounds like.

Your voice has two separate vocal registers: a lower- pitch " chest" voice and a higher- pitch "head" voice. The differences in these vocal registers result from the different ways your body produces sounds.

Singing requires air support from either your lungs (your " chest" voice) or your mouth and throat (your "head" voice). Some people can even sing in a very high pitch without either chest or head air support. We call this singing in falsetto.

For most people, there is a natural gap between the chest voice and the head voice. Yodeling takes advantage of this gap by incorporating quick, repeated switches between the chest and head voices at a high volume.

So how did yodeling get started? Scholars believe that yodeling got started in the Central Alps of Switzerland. They think yodeling was a way for herders to communicate with their flocks or people from different villages to communicate with one another.

Over time, yodeling became a traditional part of Alpine culture, folklore, and music. Yodeling made its way into other cultures, too. As early as the 1800s, traveling minstrel shows in England and the United States featured yodeling.

Yodeling didn't become mainstream in the United States until the 1920s, though. In 1924, country music singer Riley Puckett released "Rock All Our Babies to Sleep," the first yodeling recording ever.

Then, in 1928, Jimmie Rodgers released "Blue Yodel No. 1 (T for Texas)." His song became a hit that started an immediate national craze for yodeling. Many blues and country musicians credit Jimmie Rodgers as a big influence on their careers.

Yodeling remained popular for many years. By the 1950s, however, yodeling was rarely heard in either blues or country music. Yodeling remains a unique form of singing that many people still enjoy listening to today.

Wonder Words (18)

VOCAL, PITCH, REGISTER, FALSETTO, VOLUME, HERDERS, FLOCK, MINSTREL, CHEST, MOUTH, THROAT, UNIQUE, REPEATED, DIFFERENCES, ADVANTAGE, INCORPORATING, COMMUNICATE, TRADITIONAL

Wonder What's Next?

Tomorrow's Wonder of the Day explores what could possibly be alien territory!

Try It Out

Are you ready to yodel? Find a friend or family member to help you explore the following activities:

Learning to yodel can be a lot of fun. First, you'll need to find your chest voice and your falsetto voice and learn to switch between the two. Can you sing low notes from your chest? Now try to sing really high from the top of your throat. Turn on the radio and try to sing songs in both your chest voice and your high falsetto voice. Practice switching between the two. When you think you have both voices down pat, try singing a simple phrase as a yodel. Take the joke that kicked off today's

Wonder as an example. Can you sing "little old lady who?" as a yodel? The entire phrase should be in your low, chest voice except for the "dee" sound in "lady," which should be in your high falsetto voice. Keep practicing, because practice makes perfect!

If you want some inspiration, check out this fun yodeling video: Cowboy's Sweetheart by 9-Year-Old Yodeler (http://www.youtube.com/watch?v=-_XSevhw0-4) Do you think you could ever become a professional yodeler? Why or why not?

Why do you believe yodeling has waned in popularity? Can you imagine turning on the radio and hearing yodeling in your favorite Top 40 songs? Why not give it a try? Choose one or two songs that are popular right now and try singing along with them while also adding in your own yodeling from time to time. What do you think? Can you make today's hits even better with yodeling?

Wonder Sources

https://www.britannica.com/art/yodel

http://www.esquire.com/news-politics/q-and-a/a5407/history-of-yodeling-0109/

http://www.neatorama.com/2010/05/21/a-brief-and-incomplete-history-of-yodeling/

http://www.buzzle.com/articles/how-to-yodel.html

http://www.wonderopolis.org/wonder/how-do-you-yodel

Day 2 Sound: Music

Math

Can you solve these musical instrument word problems? Carefully read each question for clues and help the musicians organize their instruments!

NAME _____

Musical Instrument Addition/Subtraction Word Problems

Directions: Read each question and solve the equations.

The symphony school is moving to a larger space. The musicians are busy organizing instruments.

1. Three boxes filled with brass instruments and two boxes filled with woodwinds were just delivered. If each box is filled with 120 instruments, how many brass instruments are there?

2. From the boxes delivered, a musician takes out 40 string instruments to put on the shelf. Then, she takes out another 65 string instruments and leaves them on the counter. How many string instruments are left in the boxes?

3. There were 445 drums, but 83 went missing, and 45 were transferred to another symphony. How many drums are left?

4. The school's musical instrument library has a total of 2,475 instruments. 592 instruments are on loan, and 137 instruments are missing. Out of the 592 instruments, 74 are on loan for six months. How many instruments are there left in the library?

5. Solve for "x" in the following equation.

   The school purchased 115 new brass instruments, 38 new drums, and "X" new string instruments. They ordered 174 instruments in total. How many string instruments did they order?

Day 2 Sound: Music
English Language Arts

Your musical talents have earned you a spot on today's hottest TV show! Can you write a song that captures your feelings about working from home and perform it LIVE?

NAME _____

WRITE AND PERFORM A HIT SONG - ELA

You have earned a spot on American Idol. You have to write a song about being stuck at home. Then, using the instrument you designed from today's science lesson to create music for your song and sing your song.

MATERIALS: Your Brain, Pencil, Paper, Things from around your house
REMEMBER: Think creatively! You might even want to use family members of as backup singers.

PROCEDURE (You will have 20 minutes to complete this project):

Do the following steps:

- Step 1 – Ask a question about your problem (e.g. How can I Write an original Song in that relates to Being Stuck at Home for Virtual School in less than 20 minutes?
- Step 2 – Brainstorm your song ideas: e.g. style of music, are you going to make a happy or sad song, will it be rock, rap, classical, folk, etc. (This should take approximately two (2) minutes):
- Step 3 – Use the instrument your made earlier in this week's assignments to help you create your music while you write the lyrics to your song (approximately fifteen (13) minutes.
- Step 4 - Practice singing your song while playing your instrument. (approximately three (3) minutes)
- Step 5. Sing your song for your family or record it on a cell phone and play it back for your friends and family (approximately two (2) minutes)

WQED education

Day 2 Sound: Music
English Language Arts

NAME _____

Using the Engineering Design Process (EDP) Write a Song

Step 1 – Ask a question: How can I Write an original Song in that relates to Being Stuck at Home for Virtual School in less than 20 minutes?

Step 2 – Brainstorm Ideas for your song (ex. Rap, Country, Rock, Opera, etc.**)**

_____

_____

Step 3 – Write Your Song Lyrics

_____

_____

_____

_____

_____

_____

WQED education

Step 4 – Practice singing your song (Does it sound close to the way you want it to sound?)

_____

_____

Step 5 – Perform you song (What could you change to make it better?)

_____

_____

Day 3 Sound: Communication

Science

Today, our cell phones work by sending information to radio towers, which then transmit the signals to the people on the other end of the call. However, early telephones were not as sophisticated. The early “message transmitters” channeled sound through pipes or other similar materials.

Create your own version of a simple telephone by following the instructions below:

Make a String Telephone

Materials:

- 2 paper cups
- Scissors
- Tape
- A sharp pencil
- 30 feet of string (kite string and fishing lines work well)

Instructions:

1. Measure and cut your long piece of string
2. Using a sharp pencil, poke a small hole in the bottom of each cup in the middle
3. Thread the string through each cup and tie knots at each end to stop it pulling through the cup and use a piece of tape to secure it
4. Move into position with you and a friend holding the cups at a distance that makes the string tight (make sure the string isn't touching anything else).
5. When one of you talk into the cup, the other person puts the cup to their ear and listens, can you hear each other?

WQED education

Day 3 Sound: Communication

Social Studies

The invention of the telephone was very important because it helped people communicate in real-time, without having to physically be right next to each other.

Many inventors worked to create different forms of the telephone. However, Alexander Graham Bell is the inventor most commonly known for this invention. Read more about Bell and his work (see attached) and then take a few minutes to discuss the question below with a family member:

How do you think the invention of the telephone changed peoples' daily lives? What would be different in your life if you did not have access to a telephone?

Looking to learn more?

Invention of the telephone as the natural extension of the telegraph

http://ow.ly/fWVK50AJqQH

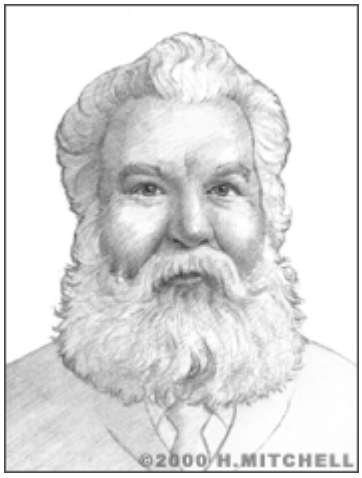
Teaching Guide: Exploring the Invention of the Telephone

http://ow.ly/LNjU50AJqRe

WQED education

Alexander Graham Bell

LEMELSON-MIT
Celebrating invention, inspiring youth



The Telephone

When the word "inventor" is mentioned, Alexander Graham Bell, creator of the telephone, is undoubtedly one of the first names that springs to mind.

Bell was born on March 3, 1847 in Edinburgh, Scotland and was educated at the University of Edinburgh and the University of London. He immigrated to Canada in 1870 and to the United States in 1871. He was an early student of sound and speech, inspired, perhaps, by the fact that his mother, Eliza, was almost totally deaf, and his father, Melville, developed the first international phonetic alphabet. In his early 20s, Bell himself taught deaf children to speak and gave speech lessons at schools in his community.

As a boy, Bell built a speaking robot and found that he could touch his dog's throat in ways that seemed to form his barks and growls into words. Once, he successfully obtained a human ear from a medical school, which he used to conduct experiments tracing sound patterns. Bell was also a gifted pianist, who learned to discriminate pitch very well. As a teenager, he noticed that a chord struck on a piano in one room would be echoed by a piano in another room. He realized that chords could be transmitted through the air, vibrating at the other end at exactly the same pitch.

With this discovery, Bell set out to develop a multiple telegraph, using Morse code to convey several messages simultaneously, each at a different pitch. He knew his greatest challenge would be finding a way to convey pitch across a wire. He ascertained, eventually, that this could be accomplished by reproducing sound waves in a continuous, undulating current. That's when he realized that this could also apply to human speech, which is composed of many complex sound vibrations.

In 1875, Bell developed his first version of what came to be known as the telephone. He received a patent for it on March 7, 1876, just after his 29th birthday. Five days later, on March 12, he tested his device, speaking into the phone to his associate, Thomas Watson, when he said, "Mr. Watson, come here. I want to see you."

Bell first demonstrated his most famous invention on June 25, 1876 at the Centennial Exhibition in Philadelphia. There, he showed that the sound of the human voice could be reproduced, which confirmed his theory that speech patterns can be made to change the intensity of an electrical current.

A year after Bell's initial public demonstration, he placed the world's first phone call over telegraph wires between two towns in Ontario, Canada – a span of eight miles. Just two months later, the long-distance reach of telephone technology was expanded to 143 miles. Today, of course, telephone calls may be placed to virtually any location around the globe. The Bell Telephone Company was established in 1877 to bring telephones to the masses. The company provided the foundation for today's telecommunications industry.

While Bell is best known for his telephone invention, he worked on hundreds of projects throughout his life and received a number of patents in various fields.

In 1880, Bell patented the photophone, which applied his telephone principle in order to transmit words on a beam of light. This has been recognized as the first wireless transmission of speech. Not until more than a century later would this idea have any widespread use. The principles behind the process enabled the development of what we know today as the cellular phone.

Bell was also an aviation enthusiast. He worked on designs for airplanes, kites, and helicopters with members of the Aerial Experiment Association. In 1909, Bell's Silver Dart airplane flew for a half mile in Baddeck, Nova Scotia, six years after the Wright Brothers took their first flight in North Carolina. Later, Bell developed the tetrahedron while he worked on the design for a kite that could carry a man. The figure, made up of four equilateral triangles, is one of nature's most stable structures and forms the basis for many modern bridges and towers. At the age of 75, Bell received a patent on one of the fastest watercrafts in the world, the HD-4.

To sum up his approach to invention, Bell once said, "Leave the beaten track behind occasionally and dive into the woods. Every time you do you will be certain to find something that you have never seen before. Follow it up, explore all around it, and before you know it, you will have something worth thinking about to occupy your mind."

Bell's notebooks are still available for public consultation. Researchers believe his early ideas may still hold clues that can help provide the solutions for modern technological problems.

Day 3 Sound: Communication

Math

Phones often have alphanumeric keys. This means that certain numbers and letters correspond. Can you use the phone below to decode these secret messages?

NAME _____

Secret Agent Message Decoder

Directions: Use the keyboard to match the numbers with the correct letters to decode the message.

OK kid, we need your help. The dastardly Dr. Von Slick has sent a secret message to his double agent in the SKO (Secret Kid Organization), Annie Can. The SKO intercepted the message and has to crack the code using only a telephone keypad. Your mission, should you choose to except it, is to crack this code in less than ten (10) minutes, or she'll get away. We need you to utilize all of your logic and deduction skills to decode this note!

SORRY, 4 5669 8463 47 RUNNING 688. 8439 5669 946 968 273. 968 NEED 86 786!

Extra Practice: Create your own code message for a friend or family member to decode.

WQED education

Answer: I know time is running out. They know who you are. You need to RUN!

Day 3 Sound: Communication

English Language Arts

Prior to the invention of the telephone, it was often difficult to get messages to people far away. People would need to write letters and wait weeks for the letters to arrive and/or get a response, OR, they would need to pass information along verbally and hope that the correct person got the message. Don't believe how hard that was? Try it out!

Play the game "Telephone." Tell your someone at home a message and ask them to retell it to someone else. Have that person retell the message to a new person. After a few rounds, see how much of the message remains intact--did the message change over time?

Day 3 Sound: Communication
English Language Arts

NAME _____

Telephone Game Rules

Materials: Message Giver, group of people

1. Ask everyone to form a circle. The message giver takes a place in this circle.
2. The message giver then whispers a message to one neighboring person.
3. The message will now be passed round the circle by whispering to the next person and the next, until it reaches the last person at the other end of the circle (just before the message giver).
4. Ask the last person to say the sentence aloud.
5. Ask the first person who received the message from the facilitator if the message is correct.
6. Discuss the activity.
7. Brainstorm ways to communicate more effectively.
8. Play the game again with a new message giver.

Sample Telephone Game Sentences:

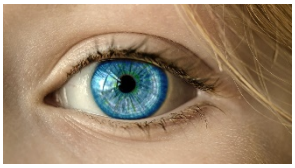
- Wednesday is the hump day, but is the camel happy about it.
- I'd love eating toasted cheese and tuna sandwiches.
- A pink pig and a pesky donkey flew a kite at night.

Day 4 Light and Sound: Senses

Science

We are constantly using our five senses to experience the world around us. Try these two experiments to explore sight and sound:

Are Two Eyes Better Than One?



What this experiment shows: How two eyes give you more depth perception, which is the ability to judge how near or far objects are.

Materials: Two pencils

Instructions:

1. Hold a pencil lengthwise (on its side) in each hand.
2. Now, with one eye closed, try to touch the erasers together. Did you miss?
3. Now, try it with both eyes open. Voila! Two eyes give you better depth perception.

Do You Hear What I Hear?

What this experiment shows: How many sounds you can recognize.

What you need:

- A friend or two
- A blindfold
- Stuff to make noise (coins to jingle in a jar, a book to close, hands to clap, paper to crumble, paper to rip, bubblegum to crack or pop, a ball to bounce, and supplies for any other sounds you want to make)

Instructions:

1. Blindfold your friend.
2. Make each noise.
3. Ask your friend to guess what the noise is. How many did your friend guess right?

Reviewed by: Eric H. Chudler, PhD

Additional Resources:

Learning about synesthesia
http://ow.ly/wAvL50AJsCW

Can You Taste with Your Ears? | Braincraft

http://ow.ly/pEPG50AJsEi

Day 4 Light and Sound: Senses

Social Studies

Wassily Wassilyevich Kandinsky was a Russian painter and art theorist who is believed to have had synesthesia, a harmless condition that allows a person to appreciate sounds, colors or words with two or more senses simultaneously.

Read about Kandinsky and his artwork and consider how his ability to "hear" colors may have influenced his work.

Day 4 Light and Sound: Senses

Social Studies

Art History and Artists

Wassily Kandinsky

Taken from: https://www.ducksters.com/biography/artists/wassily_kandinsky.php

- **Occupation:** Artist, Painter
- **Born:** December 16, 1866 in Moscow, Russia
- **Died:** December 13, 1944 in Paris, France
- **Famous works:** *Composition VI, Composition VII, On White II, Contrasting Sounds*
- **Style/Period:** Expressionism, Abstract Art

Biography:

Where did Wassily Kandinsky grow up?

Wassily Kandinsky was born in Moscow, Russia on December 16, 1866. He grew up in the Russian city of Odessa where he enjoyed music and learned to play the piano and the cello. Kandinsky would remark later that, even as a child, the colors of nature dazzled him. Both music and colors would have a huge impact on his art later in life.

Becoming an Artist

Kandinsky went to college and then became a law teacher. However, when he was thirty he decided to change careers and become an artist. He attended art school at Munich, Germany. Early on his art was influenced by painters like Claude Monet as well as music composers and philosophers.

Early Art

Kandinsky's early paintings were landscapes that were heavily influenced by Impressionist artists as well as Pointillism and Fauvism. The most famous of his early works is *The Blue Rider* which he painted in 1903.

Abstract Expressionism

About 1909 Kandinsky began to think that painting didn't need a particular subject, but that shapes and colors alone could be art. Over the next several years he would start to paint what would become known as Abstract Art. Kandinsky was one of the founding fathers of Abstract Art.

Colors and Shapes

Kandinsky felt that he could express feelings and music through colors and shapes in his paintings. For example, he thought that yellow had the crisp sound of a brass trumpet and that certain colors placed together could harmonize like chords on a piano. The shapes he was most interested in were the circle, triangle, and the square. He thought the triangle would cause aggressive feelings, the square calm feelings, and the circle spiritual feelings.

Later Years

While refining his art and ideas over the next several years, Kandinsky took on different positions and moved around some. From 1914 to 1921 he returned to Russia. During this time he married his wife Nina. When his art was rejected in Russia he moved back to Germany to teach at an art school called the Bauhaus. He left Germany in 1934 because of the Nazis and moved to Paris where he lived until his death in 1944.

Composition VII

Composition VI (1913)

This painting is an example of Kandinsky's Abstract Expressionist art. He planned the painting for six months and wanted it to represent a number of feelings including flood, baptism, destruction, and rebirth. When he finally went to paint he was blocked and could not paint. He finally resorted to repeating the word "flood" over and over again and began to paint. He finished the painting in three days.

Composition VI

Concerning the Spiritual in Art

In 1911 he wrote an essay called *Concerning the Spiritual in Art*. He described three types of paintings including "impressions", "improvisations", and "compositions". Many of his paintings were named using these titles and a number. Some examples of this include the paintings *Composition X* and *Impression V*.

Legacy

If Kandinsky wasn't the first abstract artist, he certainly was one of the founding fathers of the art form. His art an essays on art have had influence over many artists during the last century.

Interesting Facts about Wassily Kandinsky

- Many of his paintings used names as if they were songs or musical works like Composition and Improvisation.
- He named the paintings he considered the most accomplished "Composition". He only named ten of his paintings this way.
- He once said that "Everything starts with a dot".
- About abstract art he said that "the more frightening the world becomes…the more art becomes abstract".

Day 4 Light and Sound: Senses
Math

Recreate Kandinsky's Concentric Circles on Squares using the attached key.

NAME _____

Recreating Kandinsky's Concentric Circles

Materials: Sheet of computer paper; crayons or markers

Directions: Take a minute to closely look at this famous work of art. After you review it, use the sounds from the "What Does The Color… Sound Like" worksheet to recreate your own version of the picture. When you create your picture, think about what it would "sound" like.

1. Fold your paper in half.
2. Fold it in half again
3. Then, fold it in half a third time
4. Unfold the paper and you should have eight (8) sections
5. Draw and color in a different colored circle in the center of each section
6. Draw a larger circle around the first circle and color that circle in next
7. Repeat step 6 until you "FEEL" you have enough circles
8. Once you complete your circles, complete each section by coloring in the background **(NO WHITE SPACE ☺)**
9. Share your masterpiece with your family and teach them about Kandinsky and his medical condition **synesthesia** which gave him the ability to "hear" colors

Additional Resources:

Kandinsky Experiment | The Majesty of Music and Math

http://ow.ly/chC250AJumD

Kandinsky Sample Project

Day 4 Light and Sound: Senses

English Language Arts

What Does the Color Red (and Others) Sound Like?

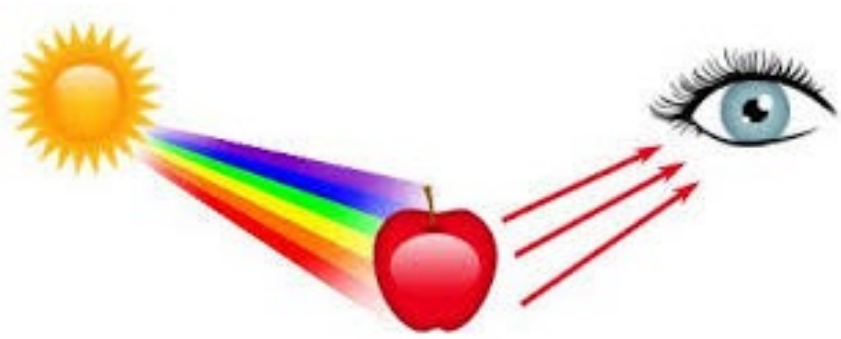
Directions: Think carefully about the colors on the pages. If these colors were a sound, what would you hear? Record your answers below! You will be using this chart to recreate Kandinsky's Concentric Circles on Squares.

Color	What Does it Sound Like?
RED	
YELLOW	
ORANGE	
GREEN	
BROWN	
BLUE	
PURPLE	

Day 5 Light: Colors/Sight

Science

Our eyes are able to distinguish between different colors because of the signals they send to our brain.



For this experiment, you'll need markers or paint. Using primary colors, how many different colors can you make?

Materials

- Primary color food coloring (red, blue, yellow) or paint or watercolors or markers
- Water
- Rimmed cookie sheet or a place to experiment without worrying about mess
- White Paper (for testing)
- Colored markers (at least 8 colors)
- Plastic spoon (if using paint or food coloring to mix)

Directions

1. Put all materials on a rimmed cookie sheet or conduct your experiment in a place that parent approved in case of mess.

2. Before mixing any colors together, make a hypothesis or a prediction about the new color

3. Use the chart to record your experiment and hypotheses results.

4. Time to start mixing and hypothesizing! Use markers to write your experiments and hypotheses on the observation chart. Then start mixing the colors on your white testing paper see the results. Repeat until the chart is full.

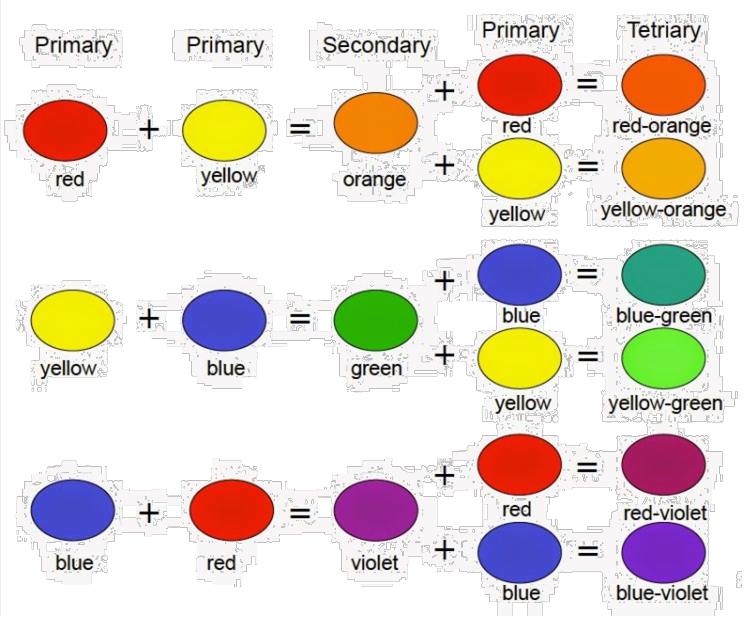
5. How many new colors are you able to create?

Color 1	Color 2	Hypothesis	Results

Additional resources:

Light and Color
http://ow.ly/WXew50APAxB

What is Color
http://ow.ly/MkPg50APAFp



WQED education

Day 5 Light: Colors/Sight

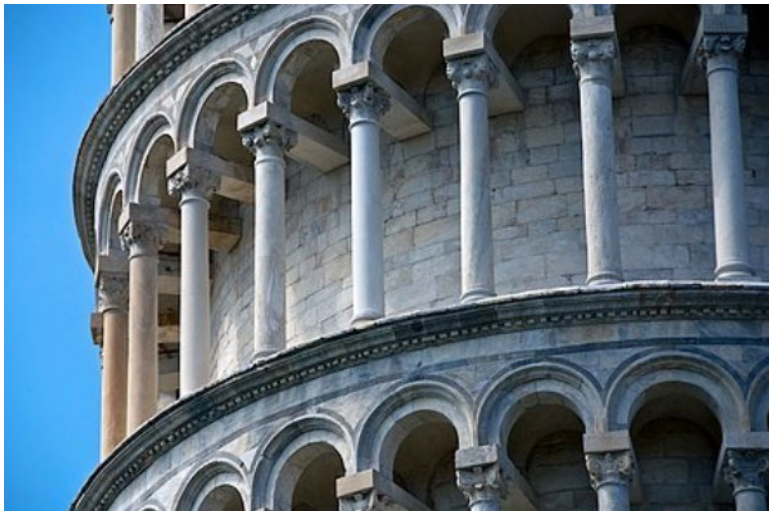
Social Studies

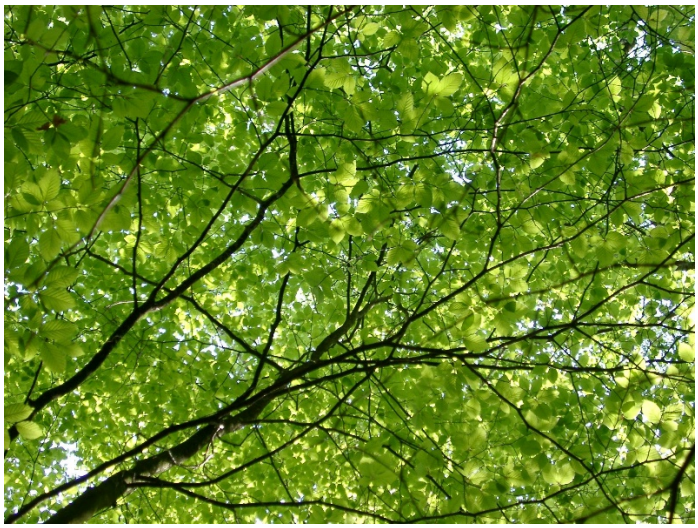
Perspective is the way in which we look at an object. Have you ever heard some someone say, “Look at this from my perspective?” or “Try to get a new perspective?”

Our brain interprets what our eyes see. We can view an object from different perspectives and experience it in entirely different ways! Take a look at the photos below. They are of the same location, but each one makes you think differently about the place.

Look at items around your home. How does changing your perspective change the way you view each item?

WQED education





WQED education

Day 5 Light: Colors/Sight
Math

Kaleidoscopes are optical instruments that use reflective surfaces to create new images. Can you design your own? Use the how-to guide to make one!

The reflective materials in a kaleidoscope make objects appear to replicate themselves (show up over and over again) in a pattern formation. Use your kaleidoscope to solve the math problems attached.

Directions for Homemade Kaleidoscope

Adapted from: https://buggyandbuddy.com/science-for-kids-how-to-make-a-kaleidoscope/

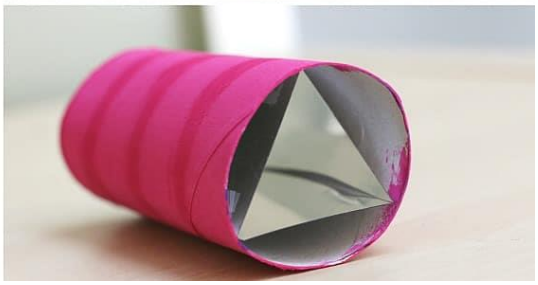
- Toilet paper roll
- Mylar sheets (thicker sheets, not rolls of thin paper) or mirrored sheets or tinfoil (shiny side out)
- Scissors
- Tape
- White cardstock
- Bendy straw
- Markers, stickers, or other materials for decorating your spinning circle

1. Cut your mylar sheets or mirrored sheets into three equal strips. You'll want the size to be just right so the finished kaleidoscope inserts fits snuggly in your cardboard tube and won't fall out. We cut our mylar into strips that measured 9.7cm x 3.5 cm.

2. Line up your mylar strips, leave a tiny space between each one. (Place the shiniest/least scratched sides face down.) Tape them together over the spaces.

3. Fold the taped mylar into a triangular prism and tape along the top to hold in place.

4. This should fit snuggly inside your cardboard tube.



5. Cut off the bendy end of a flexible straw.

6. Tape it along the top of your tube with the flexible part of the straw hanging over the edge.

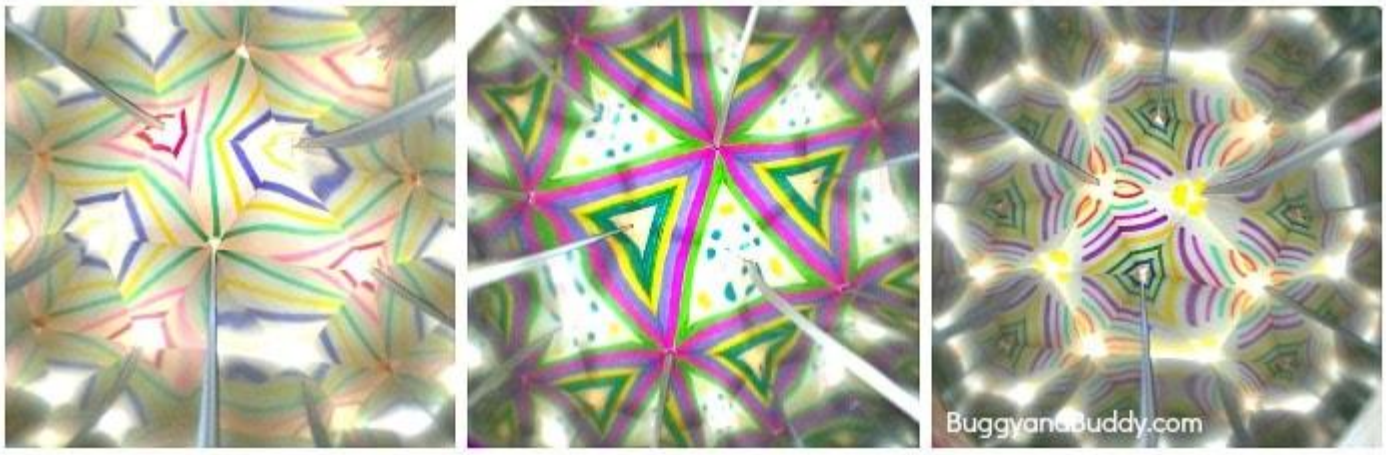
7. Cut out 3 circles from cardstock. Ours measured 3.75 inches in diameter.

8. Poke a hole in the center of your circle. (I used a sharp pencil.)

9. Decorate the circle using markers, stickers, crayons etc. Try out different designs, shapes, and letters!

10. Place the circle onto your straw with the design facing the kaleidoscope. You want the hole to fit over the flexible portion of the straw so it will turn easily.

12. Look into your kaleidoscope and explore all the reflections created by your design!



Tips

- If you have trouble getting your triangular prism to fit snuggly into your cardboard tube, it will work on its own. Simply tape the straw directly on top of the prism rather than using a tube.
- Make as many cardstock circles as you want and try them all out!

Day 5 Light: Colors/Sight
Math

NAME _____

Kaleidoscope Word Problems

Directions: Read each question and solve the equations.

Kylie and Khadijah love kaleidoscopes. But, they're not that good at solving math problems about kaleidoscopes. Use your amazing math skills to help them find the correct answers.

1. Khadijah had 114 kaleidoscopes. She kept 10. Then she divided the rest between Kylie and 7 other friends. How many kaleidoscopes did each of Khadijah's friends get?

2. Kylie bought 12 cases of kaleidoscopes. Seven of the cases had 10 kaleidoscopes each. The other five cases had 9 kaleidoscopes each. How many total kaleidoscopes did Kylie purchase?

3. Khadijah made kaleidoscope party favors for Kylie's birthday. She made 36 kaleidoscopes. There were nine kids at the party. How many party favor kaleidoscopes did each kid take home?

4. Khadijah and Kylie decided to open a kaleidoscope company. In one day, they made four orange, 97 purple, and 355 pink kaleidoscopes. They made the same amount of kaleidoscopes. How many kaleidoscopes did each girl make?

Day 5 Light: Colors/Sight

English Language Arts

NAME _____

WHAT AM I MISSING (Observation)

Directions: Take two minutes to look closely at an item that you choose **(ex. I did a deep observation of a penny).** What is something about that item that you never noticed before **(ex. I noticed on the back of the penny, there is a figure of a man in the middle of the Lincoln Memorial)?** Draw a picture of the item with as much detail as possible. Write down what the item is. Then, write an explanation about why you think you never noticed the item before **(ex. I don't think I noticed it before because it is so small and pennies aren't that valuable. I may have noticed if it was a hundred dollar bill ☺)**.

Item Observed: _____

What I Noticed: _____

Why I Never Noticed It Before: _____

_____

_____

_____

_____

WQED education

Day 6 Light: Sunlight

Science

Can you create a shadow puppet? For this activity, create a silhouette of an object. A silhouette is a solid, opaque object. Follow the attached instructions to create a shadow puppet.

Take your object outside, stand it up, and let the sun hit it. Can you see it's shadow? Move your object around or hold it in different positions. Does the shadow change?

Looking to learn more?

Puppet Power

http://ow.ly/Hzfl50APE7p

WQED education

How to Make Shadow Puppets

Materials:

- Black paper
- Bamboo skewers or popsicle sticks
- Scissors
- Pencil
- White paper
- Glue or tape

Directions:

1. Find different objects or toys to put outside on a sunny day or put in front of a flashlight in a dark room

2. Put a piece of white paper on the behind the object/toy so you can see the object's shadow

3. Trace the shadow on the white paper

4. Place the white paper on black paper and cut out the outline

5. Tape or glue the black paper cut out on a skewer or a popsicle stick

Alternatively, you can print and cut out puppets from online or trace your own design from books or photos.

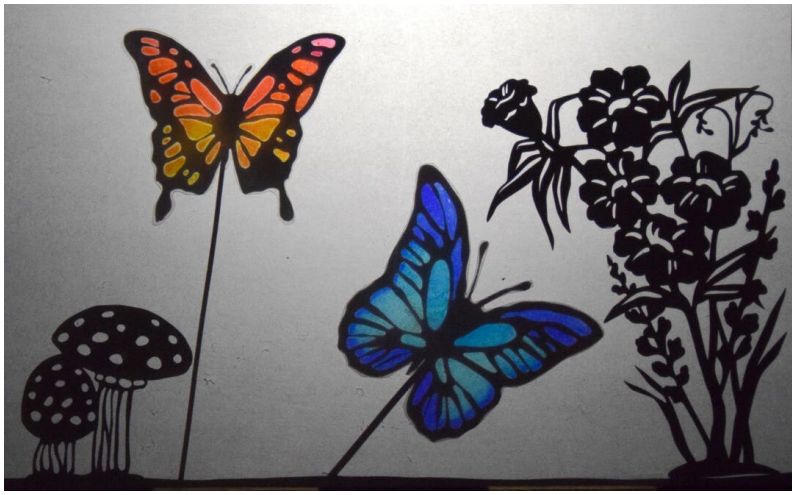
How to Make Colorful Shadow Puppets

- You can either use an empty single-use plastic container (the kind of clam shell package they sell fruits and pastries in), a plastic folder with clear sheets, or marker colored cling wrap.
- Glue your black paper design outline onto the plastic material and cut it out to put on your popsicle stick or skewer.

Adapted from:

https://www.adventure-in-a-box.com/make-shadow-puppets-home/

https://kidsactivitiesblog.com/137133/how-to-make-shadow-art-with-kids/



Day 6 Light: Sunlight

Social Studies

NAME _____

YOUR FAMILY FOLK TALE

A folktale is a story that is typically passed down via word of mouth. In other words, someone from the family or the community tells a story at different events (e.g. party, barbecue, campfire, etc.). The story becomes so popular that other people begin to tell the story. Then, the people who were children when they first heard the story, tell the story to their children. This happens for generations.

Directions: Talk to a family member about a story that has been told in your family. Can you record the main details?

Detail 1: _____

Detail 2: _____

Detail 3: _____

Detail 4: _____

Detail 5: _____

Detail 6: _____

WQED education

Day 6 Light: Sunlight

Social Studies

Learn more about folktales and shadow puppet theater with the links below!

Folktales around the world

http://ow.ly/OT0F50APDKj

Shadowlight Production: Theater (Shadow Puppetry)

http://ow.ly/vrhJ50APDLV

WQED education

Day 6 Light: Sunlight
Math

NAME _____

How Tall is Your Shadow? (Measurement)

A shadow's length will change depending on the time of day (if outside), or its position to a light source (inside).

Materials: Sunny Day, Chalk, Measuring Tape

Directions: For this, you will need a sunny day, a friend to draw an outline of your shadow, and a tape measure. At the times listed below, go outside and have your friend draw an outline of your shadow on the sidewalk. Then, use the worksheet below to measure the length of each shadow.

How long is your shadow at 12:00 pm?

_____

How long is your shadow at 2:00 pm?

_____

How long is your shadow at 4:00 pm?

_____

Is there a difference in the length of each one?

_____

Explain why you think there is a difference in the lengths?

_____

_____

_____

_____

WQED education

Day 6 Light: Sunlight
English Language Arts

NAME _____

Write Your Own Shadow Puppet Play

Now that you have your shadow puppets. You are going to write a play that will use the puppets you made using the "5 W's": Who is in their story (the characters)? What will these characters do? Why will they do it? Where does their story happen? When does it take place? Will your play be like the folktales you read? Or will it be something entirely new? Once you have the play written, you will perform it for friends and/or family.

Materials: Shadow Puppets, Chalk, Measuring Tape

Who is in the story? (Main Characters): _____

_____

What will the characters be doing? _____

_____

Why will they do it? _____

_____

Where does the story happen? _____

_____

When does it take place? _____

_____

Once you have the "5Ws," use that information to tell a story using your shadow puppets to act it out. Invite your family and friends to watch. Or, you can record it to watch later.

WQED education

Day 6 Light: Sunlight
English Language Arts

Additional resources:

Creating live cinema with puppets and shadow

http://ow.ly/9u5450APDfZ

Shadow Dance

http://ow.ly/a5Ke50APDjB

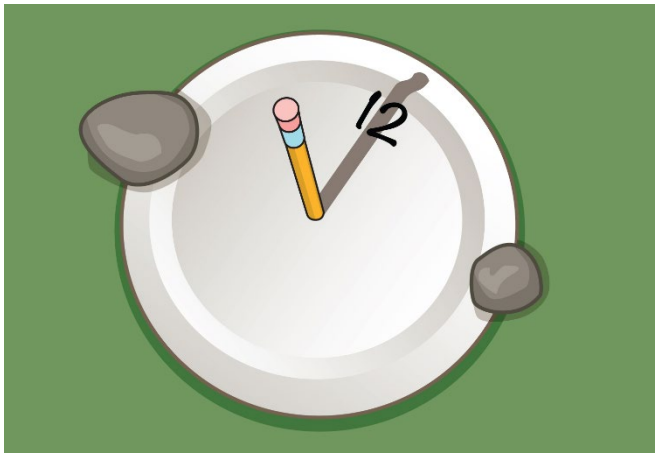
Day 7 Light: Sunlight Part 2

Science

A sundial is a tool that helps us determine the time of day, based on the position of the sun in the sky.

A sundial is an instrument with a pole, or gnomon, in its center and markings that tell the time like a clock. When the sun shines on the gnomon, shadows are cast, or appear at different markings on the sundial. This is a sundial. Its gnomon has a shadow that indicates the time on the sundial.

Create your own sundial using the attached instructions!

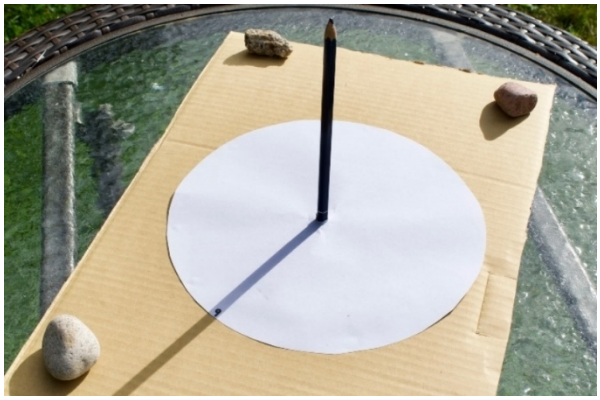


Additional resource:

Measure shadow distance
http://ow.ly/Ub3P50APF5O

WQED education

Make Your Own Sundial



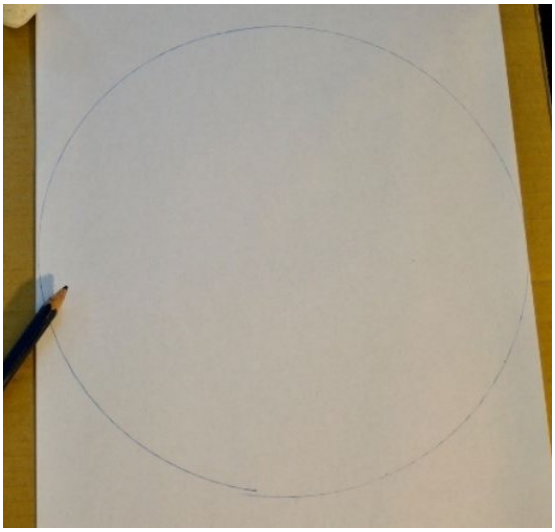
Following the movement of a shadow during the day is a way to track time. Try it yourself by making a sundial.

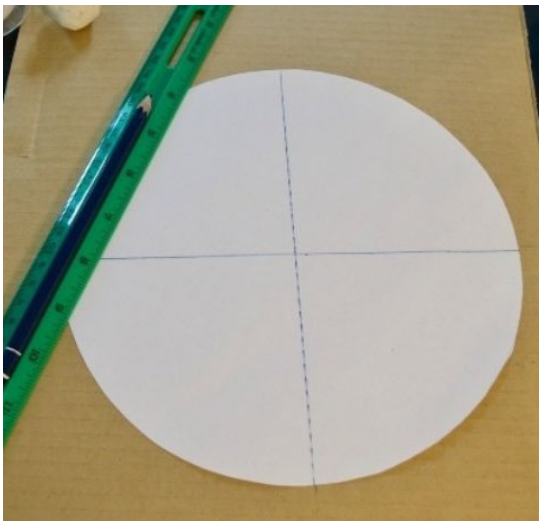
A very long time ago (long before there were digital clocks and mobile phones), people used a sundial to tell time. A sundial may consist of a round plate with a vertical stick, called a gnomon, that casts a shadow on the dial. On the plate of the sundial are numbers for each hour of the day. The gnomon's shadow points to the time.

Materials

- ☐ Construction paper (pale color works best) or a 9- to 12-inch paper plate
- ☐ Piece of stiff cardboard (should be a little larger than your piece of paper)
- ☐ Large bowl (for tracing)
- ☐ Pencil or crayon (for tracing)
- ☐ Scissors
- ☐ Pencil or other straight stick (the gnomon)
- ☐ Mounting putty or soft clay
- ☐ Four small stones or clear tape (for securing your sundial when it's outside)
- ☐ Marker (dark color works best)
- ☐ Compass (optional)
- ☐ Ruler (optional)

1. Turn your bowl upside down on your piece of paper and trace a circle. Cut out the circle.

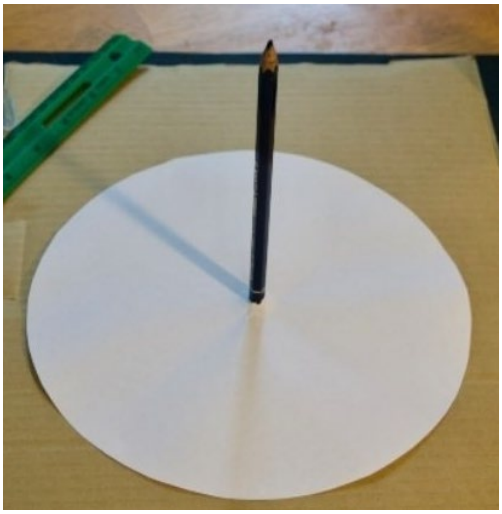




2. Poke a small hole in the center of the circle. (An estimate is fine, or you can use a ruler to find the center.) The hole should be no wider than the pencil or stick you'll use for the gnomon.

3. Place a small ball of mounting putty or class in the center of the piece of cardboard, and push the eraser-side of the pencil (gnomon) into the putty. Test to make sure the pencil stays upright.

4. Once your pencil is secure, slide the paper all the way down to the cardboard and press firmly to flatten the putty/clay. If there are marks on one side of the paper, keep the blank side up.



5. Find a flat spot outside that will stay sunny for all or most of the day and place your sundial on the ground or outdoor table. Choose a spot that won't be disturbed by foot traffic, including the muddy paws of your favorite four-legged friend. (Ahem, Hal.)

6. Secure the base of your sundial so it won't move using either small stones or clear tape. It's important your sundial stays in the same place while you are making it.

7. Check the time and set an alarm for a few minutes before the beginning of the next hour.

8. When your alarm sounds, head outside to your sundial with the marker. Where the shadow meets the edge of the circle, write the time (whole hours only). Set your alarm for the next hour and repeat until your sundial is in the shade or the sun sets and there are no more shadows.

9. If it isn't going to rain, leave your sundial in place and use it to tell time the next day.

Tips for Success

Check the weather forecast. You'll need a sunny day to fill in your sundial. Two or three sunny days in a row will let you use your sundial to tell time once it is finished!

Prepare your sundial the day before it will be sunny so you are ready to start filling it in the following morning.

A Closer Look at Sundials

Today, we often like to know exactly what time it is. Sometimes down to the second! But a sundial doesn't even count minutes. It also doesn't work on cloudy days or at nighttime. And you can't wear one on your wrist! What do you think it would be like to tell time with a sundial for a day?

Head outside to your sundial with a compass. At noon, the gnomon's shadow on your sundial should point towards north (unless you live in the southern hemisphere). Toward which direction does the shadow point at 3 or 9?

Day 7 Light: Sunlight Part 2

Social Studies

How did people keep track of time before clocks? Read this article to find out!

Wonder of the Day **#1820**

How Did People Keep Time Before Clocks?

TECHNOLOGY — Inventions

Have You Ever Wondered...

- How did people keep time before clocks?
- What were some of the earliest timekeeping devices?
- Why are sundials not always reliable?

As you make your way through a typicalschool day, you're probably very aware of what time it is. School probably starts around 8 or 9am. You probably know exactly what time recess and lunch occur. You're probably also aware that school gets out around 2:30 or 3:30pm. How do you keep track of all these different times?

Fortunately, thanks to modern technology, there's no shortage of timekeeping devices you can rely upon. At home, you probably have at least one clock on the wall. You may also have appliances, such as a microwave or an oven, that have clocks.

Some kids wear a wristwatch to keep track of the time throughout the day. In lieu of a wristwatch, other kids might rely upon a smartphone instead. At school, every classroom likely has a clock on the wall.

Have you ever WONDERed, though, what people did before modern clocks were invented? How did they know what time it was? How did they keep track of appointments? How did they know when they needed to be somewhere?

Although we can't know for certain how the earliest human beings kept track of the time, scientists believe they probably relied upon the natural world around them. For example, historically, humans have relied upon the movement of the Sun across the sky to track time.

Historians believe many ancient peoples, including the ancient Babylonians, Egyptians, Chinese, and Hindus, divided the Sun's cycle into different timekeeping periods. The ancient Egyptians, for example, built tall obelisks that would cast shadows to help divide the day into sections. These obelisks worked in much the same way as sundials, which were a popular means of timekeeping long ago. Of course, sundials didn't help much at night or on cloudy days. To help keep time when it wasn't sunny, ancient peoples also learned to track the movement of the planets and constellations after dark.

Other devices were developed over time, including hourglasses and water clocks. These devices relied upon the time it would take a particular substance, such as sand or water, to move from one

part of a container to another. Rather than clocks, though, these devices were more like timers.

How did people long ago set up a meeting at a certain time in the future? Some historians believe many people relied upon a technique as simple as pointing to an area of the sky. When the Sun reached that point, that's when you would meet the next day.

Of course, humans, being the clever creatures we are, relied upon a variety of natural solutions to the problem of timekeeping. For example, many people simply trained their bodies to wake up at the first light of dawn. Others may have relied upon animals, such as roosters, as alarm clocks.

If people had to be up before dawn, they might have relied upon the full bladder method. By drinking a lot of water before going to bed, they would be assured of waking up in the middle of the night to go to the bathroom!

https://www.wonderopolis.org/wonder/how-did-people-keep-time-before-clocks

Day 7 Light: Sunlight Part 2

Math

NAME _____

Tell Time on a Sundial

Sundials are like clocks. The gnomon acts like a clock hand and lets us know what time it is. Can you use the sundials on this worksheet to figure out the approximate time?

_____

_____

_____

_____

WQED education

Day 7 Light: Sunlight Part 2
English Language Arts

NAME _____

A World Without Time

After reading about how people kept track of time before there were clocks, you are going to write a paragraph explaining how our lives would be different if we didn't have a way to keep track of time (Ex. How would you know when to be at school? How could you tell someone when you would meet them at the playground?, etc.) Do you think you would like it? What would be easier about life? What would be more difficult? Write your paragraph on the lines below.

_____

_____

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WQED education

Day 8 Light: Heat

Science

See if you can use light waves to generate heat and make your own solar oven! For this activity, you'll only need a few items: a box, a sheet of black paper, tin foil (reflective materials absorb more heat!), and plastic wrap. Use the attached handout to create your oven.

Additional resource:

Zoom: Cooking Cookies
http://ow.ly/Bg8E50AVr66

WQED education

Solar Oven S'mores

Can you cook a s'more without a fire or electricity?

@home

BEST FOR GRADES
3-6

ESTIMATED TIME
45-60 Minutes

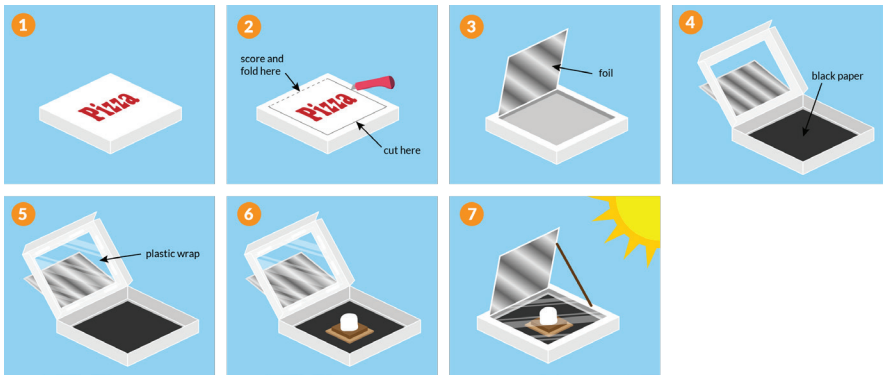
You Will Need

- ❑ Pizza Box
- ❑ Aluminum Foil
- ❑ Black Paper
- ❑ Clear Plastic Wrap
- ❑ Two Wooden Skewers
- ❑ Glue
- ❑ Tape
- ❑ Exacto knife or scissors (both require adult supervision)
- ❑ Graham Crackers *
- ❑ Marshmallows *
- ❑ Chocolate *
- ❑ A Sunny Day!

*Note: This experiment can be done with other types of food - try making nachos with tortilla chips and shredded cheese, or english muffin pizzas. If experimenting with a group of children, ask parents about any potential food allergies when choosing foods.

Directions

1. Ask student to create a testable question (a hypothesis). Example: Will it take longer than 10 minutes to cook the s'mores?
2. Cut a three sided flap on the top of the pizza box (1-2" from all sides)
3. Spread glue on the inside of the flap and cover with aluminum foil
4. Lay black paper on the bottom of the box
5. Tape layers of clear plastic across the opening that you cut in the lid.
6. Place a graham cracker, chocolate bar, and marshmallow inside the oven and close the lid with the flap propped open with wooden skewers
7. Aim your oven at the sun and check in every few minutes to check progress. Is the chocolate melting?



Discovery Questions

Beginning the Experiment

Where does most of the energy on our planet come from?

What is the purpose of the aluminum foil?

Why did we use black paper and not a different color?

Why do we need the plastic wrap?

During the Experiment

How does the angle of the "flap" of the solar cooker affect the cooker temperature?

How can you make it cook faster?

Do you think it would take the same amount of time to melt four s'mores as it does to melt one?

Is the evidence and data you are collecting helping you test your hypothesis question?

After the Experiment

What provided the heat to melt the s'mores?

How do you think it would work on an overcast day?

Which factors impacted the solar oven the most?

If you could start over, what might you do differently?

Science-U @ Home is brought to you by a grant from EQT

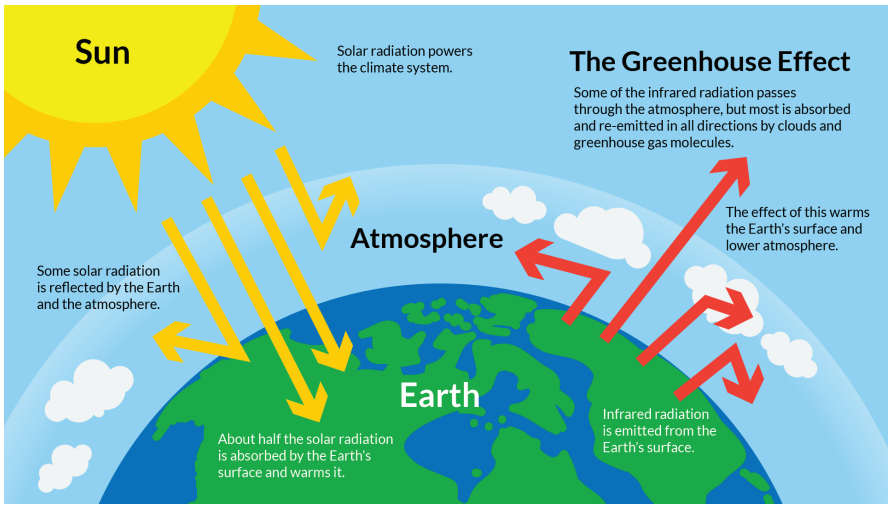
PennState

Solar Oven S'mores

The science powering the solar oven.

How does it work?

Solar ovens use solar energy—light and heat from the sun—to cook food. The oven is designed to absorb more heat than it releases. Rays of sunlight come to the earth at an angle. The foil reflects the ray, and bounces it into the opening of the box. Once it has gone through the plastic wrap, it heats up the air that is trapped inside. The black paper absorbs the heat at the bottom of the oven, and the plastic wrap helps the heat stay inside the box to cook the food.



The concept behind creating the solar oven is similar to the concept of the Earth's greenhouse effect. The greenhouse effect is a warming of the Earth's surface and the air above it. It is caused by gases in the air that trap energy from the sun. These heat-trapping gases are called greenhouse gases. The most common greenhouse gases are water vapor, carbon dioxide, and methane. These gases create a blanket-life effect, like the plastic wrap in your solar oven, that traps the sun's heat. Without the greenhouse effect, Earth would be too cold for life to exist.

Keywords

Solar Radiation
Light energy from the sun in the form of electromagnetic waves, including visible and ultraviolet light and infrared radiation

Nuclear Reactor
An apparatus or structure in which atomic material can be made to undergo a controlled, self-sustaining nuclear reaction with the consequent release of energy.

Infrared Radiation
A type of electromagnetic radiation; often referred to as heat rays. Infrared radiation is electromagnetic radiation of a wavelength longer than visible light but shorter than microwave radiation.

Direct Sunlight
Sun rays which have reached an object without obstruction.

Indirect Sunlight
Sun rays reaching an object with an obstruction creating a barrier between the rays and the object.

Greenhouse Effect
The greenhouse effect is a warming of Earth's surface and the air above it. It is caused by gases in the air that trap energy from the sun. These heat-trapping gases are called greenhouse gases. The most common greenhouse gases are water vapor, carbon dioxide, and methane. Without the greenhouse effect, Earth would be too cold for life to exist.

Insulation
Insulating materials reduce the flow of heat or electricity. Thermal insulation decreases the flow of heat from a hot region to a cooler one.

Science-U @ Home is brought to you by a grant from EQT

PennState

Day 8 Light: Heat

Social Studies

Why use a solar oven? Many of us have ovens in our homes which are powered by gas or electricity. However, not all places around the world have access to the same devices. Solar Ovens similar to the one you made can be helpful in many communities. Read more about how they are used around the world.

Solar Cookers in Developing Countries

March 27, 2005

Millions of people around the world cook their food over a smoky fire every day. It is often difficult to find wood for the fire. People who do not have wood must spend large amounts of money on cooking fuel. However, there is a much easier way to cook food using energy from the sun.

Solar cookers, or ovens, have been used for centuries. A Swiss scientist made the first solar oven in seventeen sixty-seven. Today, people are using solar cookers in many countries around the world. People use solar ovens to cook food and to heat drinking water to kill bacteria and other harmful organisms.

There are three kinds of solar ovens. The first is a box cooker. It is designed with a special wall that shines or reflects sunlight into the box. Heat gets trapped under a piece of glass or plastic covering the top of the cooker. A box oven is effective for slow cooking of large amounts of food.

The second kind of solar oven is a panel cooker. It includes several flat walls, or panels, that directly reflect the sun's light onto the food. The food is inside a separate container of plastic or glass that traps heat energy. People can build panel cookers quickly and with very few supplies. They do not cost much. In Kenya, for example, panel cookers are being manufactured for just two dollars.

The third kind of solar oven is a parabolic cooker. It has rounded walls that aim sunlight directly into the bottom of the oven. Food cooks quickly in parabolic ovens. However, these cookers are hard to make. They must be re-aimed often to follow the sun. Parabolic cookers can also cause burns and eye injuries if they are not used correctly.

You can make solar ovens from boxes or heavy paper. They will not catch fire. Paper burns at two hundred thirty-two degrees Celsius. A solar cooker never gets that hot. Solar ovens cook food at low temperatures over long periods of time. This permits people to leave food to cook while they do other things.

To learn more about solar cooking, you can write to Solar Cookers International. The address is nineteen nineteen Twenty-First Street, Sacramento, California, nine-five-eight-one-four, USA. Or you can visit the group's Internet Web site. The address is www.solarcooking.org.

This VOA Special English Development Report was written by Jill Moss.
Taken from: https://learningenglish.voanews.com/a/a-23-solar-cookers-83126737/125024.html

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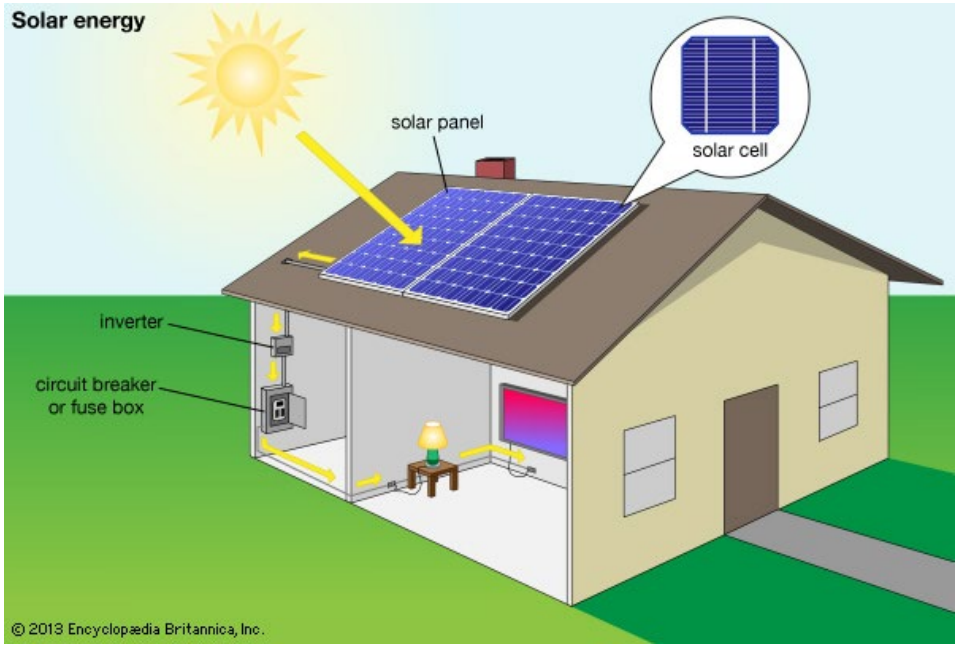
Around the world, the sun's energy is also used to power many objects. This is called solar power. Learn more about it here:

CyberChase clip: pbskids.org/video/cyberchase/2365192014/



Day 8 Light: Heat

Math

Time to experiment! You will need two ice cubes and your solar oven. Put one cube in the oven and leave one outside the oven. Measure how much time elapses as each ice cube melts. Which ice cube melts the fastest? Why?

How Fast Will Ice Melt?

Materials: – 3oz. Dixie cups, Tablespoon, Salt, Sugar, Flour, Water, Freezer, Sharpie Marker, Chart, Stop Watch.

Overview: Have you ever noticed, on a hot summer day, that the ice cubes in a glass of water or lemonade melt into a liquid extra fast? That is because the heat from the sun causes water in the ice to turn from solid to liquid.

However, temperature is not the only thing that affects how a liquid melts. For example, the oceans contain a lot of dissolved salts. A substance that dissolves in water is called a solute. When certain solutes are mixed with water/ice, they lower the melting/freezing point below 32°F. This makes the ice melt at a lower (colder) temperature than normal. In this activity, you'll investigate how several solutes (salt, sugar, and flour) affect water's freezing point.

***Think about the following questions and write down your predictions*:**

1. Do you think all of the ice cubes will melt at the same time? Why?
2. If you said "no" to question 1, which ice block do you think will be the first to completely finish melting?
3. Do you think there will be a big difference between the ice block that melts the fastest and the ice block that melts the slowest?

Directions:

1. Use the Sharpie Marker to write one of the following on each the cups:
   - Plain, Salt, Sugar, Flour
2. Pour the same amount of water into the four Dixie cups
3. Put one tablespoon of the labeled substance (Salt, Sugar, Flour) in each cup (gently stir each cup for about 30 seconds
4. Place each cup in the freezer and allow them to freeze for 3 hours
5. Remove each cup from the freezer and place them outside in the sunlight
6. Press "start" on your stopwatch and watch as your ice samples start to melt. When one of the ice cubes melts completely, record the time under the correct column for that sample. Keep the timer running and record the time it takes for each ice cube to fully melt. You may stop the stopwatch after the last ice cube melts.
7. Use the chart to write down how long it takes for each of the cups of ice to melt.

Day 8 Light: Heat

Math

NAME _____

How Fast Will Ice Melt? Chart

WATER	SALT	FLOUR	SUGAR
_____ min.	_____ min.	_____ min.	_____ min.

Extension activity:

Melting ice around the globe is a concern for many scientists. Find out more here: https://bit.ly/3ko257o

WQED education

Day 8 Light: Heat
English Language Arts

Now that you have your solar oven, use it to conduct some experiments of your own. Using the Scientific Method and the attached sheet, write down the steps of a possible experiment, conduct the experiment, and record what happens!

WQED education

Day 8 Light: Heat
English Language Arts

Conduct an Experiment

Ask a question 	*What would happen if….*
Make a prediction 	*I think...*
Make a plan and follow it 	
Observe 	*I noticed...*
Record the results 	
Share your conclusion 	*This means...*

WQED education

Day 9 Light: Electricity

Science

Electricity is the flow of tiny particles called electrons and protons. It can also mean the energy you get when electrons flow from place to place. ... It can then power such things as heaters, light bulbs, and computers.

Static electricity is the build-up of an electrical charge on the surface of an object. The reason that it's actually called static electricity is because the charges stay in one area for some time and don't flow or move to a different area.

Examples of Static Electricity:

- Clothes sticking together from a dryer
- Hair standing up after jumping on a trampoline
- Dust sticking to a balloon
- "Shocking" someone when you shake hands
- Lightning

Try it out! Can you create your own examples of static electricity using the samples on this page?

1. Shuffle your socked feet on the carpet and then touching someone else

2.Hair Standing With Static Electricity

What you will need:

- an inflated balloon
- a piece of cloth

Steps:

a. Rub the surface of the balloon with the cloth for 40 seconds
b. Hold the balloon a short distance above your head and watch your hair stick to it!

How it works:
The balloon gains electrons from the cloth and becomes negatively-charged, so it attracts your hair, which is positively-charged in comparison.

For more static electricity experiments visit:
iswitch.com.sg/fun-static-electricity-home-experiments/

WQED education

Day 9 Light: Electricity

Social Studies

Electricity -- we depend on it every minute of every day. And yet to many of us, electricity seems a mysterious and even magical force. Before Ben Franklin did his famous and very dangerous kite flying experiment, electricity was thought to be a type of fire. In 1847, the year Thomas Edison was born, most people considered electricity to be some sort of dangerous fad. By the time Edison died in 1931, entire cities were powered by electricity, and Edison took credit for the invention of the lightbulb.

Taken from: www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.lp_electric/electric-circuits/

Read more about how Thomas Edison invented the first commercial lightbulb with the attached handout.

Additional Resource:

Invention of the Light bulb

http://ow.ly/OEbz50AVv3c

WQED education

Day 9 Light: Electricity
Social Studies

Biography
Thomas Edison

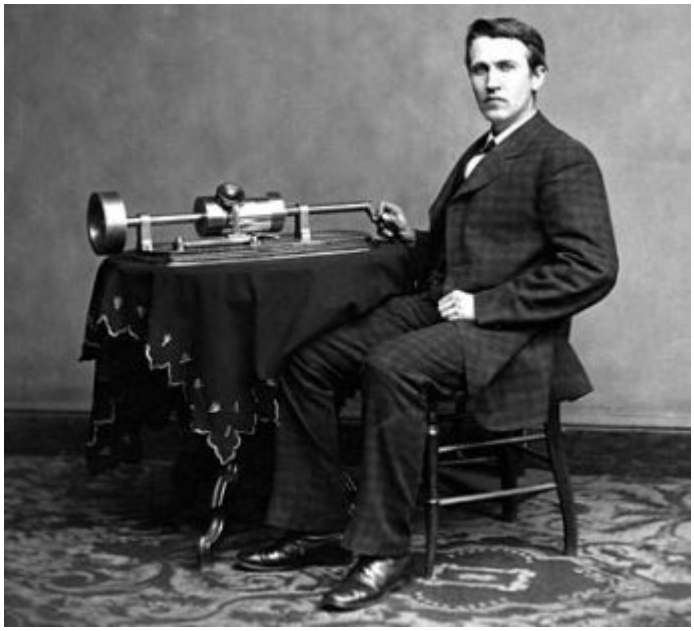
- **Occupation:** Businessman and Inventor
- **Born:** February 11, 1847 in Milan, Ohio
- **Died:** October 18, 1931 in West Orange, New Jersey
- **Best known for:** Inventing many useful items including the phonograph and a practical light bulb

Biography:

Thomas Edison may be the greatest inventor in history. He has over 1000 patents in his name. Many of his inventions still have a major effect on our lives today. He was also a business entrepreneur. Several of his inventions were group efforts in his large invention laboratory where he had lots of people working for him to help develop, build, and test his inventions. Edison used his inventions to form companies including General Electric, which is one of the biggest corporations in the world today.

Where did Edison grow up?

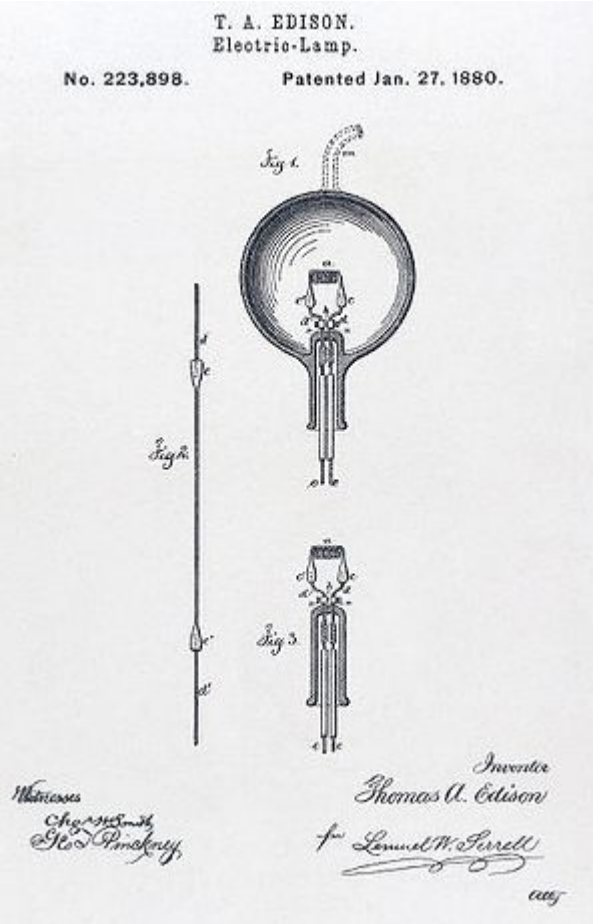
Thomas Edison was born in Milan, Ohio on February 11, 1847. His family soon moved to Port Huron, Michigan where he spent most of his childhood. Surprisingly, he did not do well in school and ended up being home schooled by his mother. Thomas was an enterprising young man, selling vegetables, candy and newspapers on trains. One day he saved a child from a runaway train. The child's father repaid Edison by training him as a telegraph operator. As a telegraph operator, Thomas became interested in communications, which would be the focus of many of his inventions.



Edison and Phonograph
by Levin C. Handy

What was Menlo Park?

Menlo Park, New Jersey is where Thomas Edison built his research labs. This was the first business or institution with the sole purpose of inventing. They would do research and science and then apply it to practical applications that could be manufactured and built on a large scale. There were a lot of employees working for Edison at Menlo Park. These workers were inventors, too, and did a lot of work on Edison's ideas to help turn them into inventions.


T. A. EDISON.
Electric-Lamp.
No. 223,898. Patented Jan. 27, 1880.
Fig 1.
Fig 2.
Fig 3.
Witnesses
Inventor
Thomas A. Edison
for Samuel W. Serrell

Light Bulb Patent Application
by Thomas Edison

Light Bulb by Thomas Edison
Photo by Ducksters

What are Thomas Edison's most famous inventions?

Thomas Edison has the patents and credits for many inventions. Three of his most famous include:

The Phonograph - This was the first major invention by Edison and made him famous. It was the first machine that was able to record and playback sound.

Light Bulb - Although he did not invent the first electric light, Edison made the first practical electric light bulb that could be manufactured and used in the home. He also invented other items that were needed to make the light bulb practical for use in homes including safety fuses and on/off switches for light sockets.

The Motion Picture - Edison did a lot of work in creating the motion picture camera and helping move forward the progress of practical movies.

https://www.ducksters.com/biography/thomas_edison.php

Day 9 Light: Electricity
Math

NAME _____

Speed of Light Math

Directions: Read each question and solve the problem.

When you flick a light switch, your room lights up immediately, right? Light travels super-fast! It actually travels at approximately 186,000 miles per second!!! Can you solve the problems below to find out just how far light moves?

1. Light travels at 186,000 miles per second. How many miles will it travel in 5 seconds?

   _____

2. How many miles will light travel in 10 seconds?

   _____

3. How many miles will light travel in 30 seconds?

   _____

4. How many miles will light travel in one minute?

   _____

Additional Resource:
Speed of Light
http://ow.ly/aaj550AXz3y

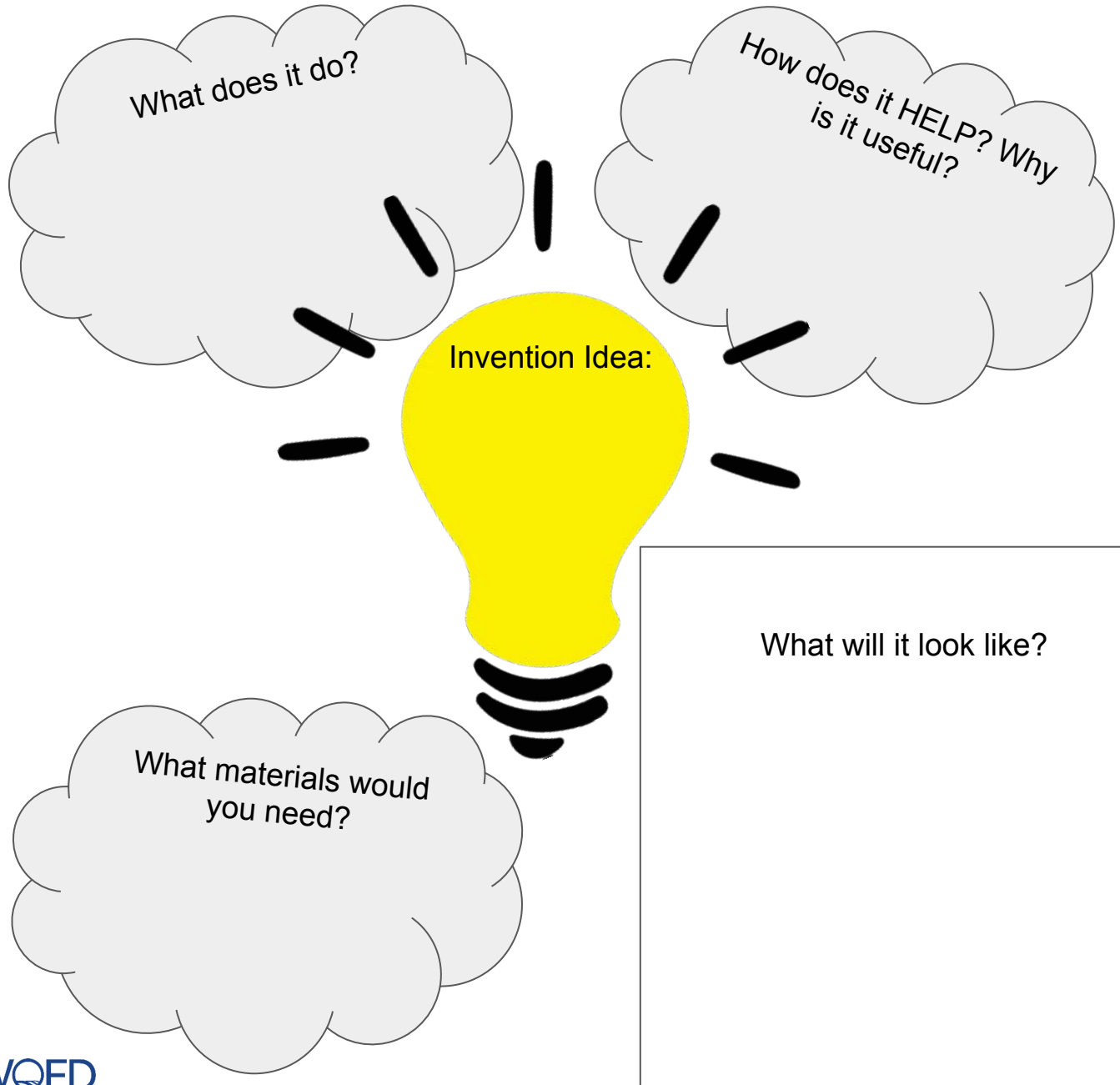
WQED education

Day 9 Light: Electricity

English Language Arts

Think Like An Inventor

Great inventions take creativity and courage. You won't know if an invention will be successful until you make it! The lightbulb changed the way people lived...think like an inventor. What could you create? Remember, the best inventions come from trying to solve a problem or help others. Use the brainstorming sheet to help you design your invention!



WQED education

Day 10 Light: Glowing
Science

Some creatures, like fireflies and glowworms are bioluminescent– they have the ability to make their own light, which makes it look like they are glowing. There are also many ocean creatures, including the lantern fish and mauve stinger, that have this ability. Scientists estimate that 90 percent of deep-sea animals – those that live deep down where it's darker – are bioluminescent. Bioluminescence can help animals see in the dark, create camouflage or attract others.

Try this activity to see how bioluminescence in living creatures really works! See attached instructions.

Want to learn more?

Creatures of Light
http://ow.ly/n80750AVx1N

Bioluminescence: Nature's Fireworks!
http://ow.ly/VCqP50AVx45

Make your own glowing decals: http://ow.ly/9gir50AVx65

WQED education

Day 10 Light: Glowing

Science

SPLASH AND BUBBLES

Make Glowing Water

With this simple project, kids and parents will create "glowing water" by adding the contents of a non-toxic highlighter to water and using a flashlight to create a "glowing" effect. This project is a great way to learn about bioluminescence in nature.

Materials

- [ ] Water
- [ ] 1 non-toxic yellow highlighter
- [ ] Glass jar, plastic water bottle, or other clear container
- [ ] Flashlight

Before You Play

Explain to your child that some creatures, like fireflies and glowworms are bioluminescent — they have the ability to make their own light, which makes it

look like they are glowing. There are also many ocean creatures, including the lantern fish and mauve stinger, that have this ability. Scientist estimate that 90 percent of deep sea animals — those that live deep down where it's darker — are bioluminescent. Bioluminescence can help animals see in the dark, create camouflage or attract others.

Day 10 Light: Glowing
Science

Directions

1 Fill the container with the water.

2 Pop off the back of the highlighter and pull out the ink soaked felt that is inside.

3 Put the highlighter felt under the water and squeeze it until the water is stained with the highlighter ink.

4 Turn off the lights, place a flashlight under the jar, and watch the water glow! As you admire, start a discussion with your child: What other things might glow in water? Do any fish glow under water? Why would a creature living in the water need to glow? Would this be helpful to those creatures living near the sunlight at the top of the water or those deep in the depths of the ocean? Why?

WQED education

Day 10 Light: Glowing

Social Studies

In the summer and early fall, fireflies are out in full force! There is no better time to explore your own backyard and observe these interesting creatures.

Did you know that fireFLIES aren't really flies at all? They are actually a type of beetle!

Read more about these insects using the attached handout.

Wonder of the Day **#1963**

Where Do Lightning Bugs Go During the Day?

SCIENCE — Life Science

Have You Ever Wondered...

- Where do lightning bugs go during the day?
- Are fireflies really flies?
- Do all fireflies glow?

Do you love warm summer evenings? We do! There's nothing better than sitting around a campfire in your backyard while you roast marshmallows for s'mores and look for lightning bugs.

Lightning bugs — also commonly known as fireflies — are so easy to spot during the night when their lights glow bright. But where do they go when the Sun rises?

Do they burrow underground to wait for the night to return? Maybe they bathe in the sunlight to recharge their lights?

Fireflies don't burrow underground. They also don't need sunlight to recharge their lights. So why don't we notice them during the day? Where do they go?

Fireflies are interesting creatures, and there's a lot about them that still mystifies scientists.

For example, fireflies aren't really flies at all. They're beetles! And there are over 2,000 species of them that can be found all over the world. Not all firefly species glow, though. In fact, most fireflies west of the Rocky Mountains in the United States do not glow.

Fireflies that glow do so when oxygen mixes with a pigment called luciferin, an enzyme called luciferase, and a chemical called adenosine triphosphate. This process is known as bioluminescence. Fireflies light up after dark in order to attract mates.

Since fireflies are nocturnal insects, they spend most of their daylight hours on the ground amongst tall grasses. Long grass helps to hide fireflies during the day, so you're unlikely to see them unless you're on your hands and knees looking for them.

Another reason you might not notice fireflies during the day is that they might not be there! Fireflies have very short life cycles. Adult fireflies live only long enough to mate and lay eggs. Some scientists believe fireflies may not even need to eat during their adult period. Firefly larvae usually live about one year (from one mating season to the next) before they become adults and give birth to the next generation of fireflies.

So even though you might not see fireflies once the Sun comes up, they're hanging around amongst the tall grasses. If you look for them, you'll find them. Of course, if you're like most people, you'd rather simply wait for dusk when they come to life and shine their lights for all to see!

Wonder Sources

http://www.smithsonianmag.com/science-nature/14-fun-facts-about-fireflies-142999290/?no-ist
http://www.firefly.org/facts-about-fireflies.html
http://www.firefly.org/firefly-habitat.html

Day 10 Light: Glowing

Math

NAME _____

Logic puzzles test your problem-solving skills. Can you use the clues to solve this glowworm puzzle?

THE STORY

Three glow worms named Curly Slinky, and Slim were sharing their home in a cave. They each had a favorite fruit they liked to eat: apples, pears, and peaches. Their biggest fears were fishermen, bats, and moles. They also loved hats and wore a beret, a cowboy hat, and a sombrero. Based on the clues, match the glow worms with their favorite fruits, biggest fears, and favorite headgear.

THE CLUES

Slinky thought the worm in the sombrero looked sillier than the worm that was afraid of the fishermen.

The worm that feared moles wore a sombrero and only ate pears.

Slinky was allergic to apples and never went near them.

Slim did not eat pears or wear a beret

CURLY	SLINKY	SLIM
apples	apples	apples
pears	pears	pears
peaches	peaches	peaches
fishermen	fishermen	fishermen
bats	bats	bats
moles	moles	moles
beret	beret	beret
cowboy hat	cowboy hat	cowboy hat
sombrero	sombrero	sombrero

Day 10 Light: Glowing
English Language Arts

NAME _____

What Would You Do If You Could Glow?

What would you do if you could glow? Would you wait until dark to shine your light? Or would you shine bright all day long? What uses can you think of for an ability to glow? Could you use your glow to communicate? What would you say? Think about what it would be like if humans could glow. Write a short story about what you would do if you could glow bright in the night!

Directions: Answer the questions. Then, write your story.

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Taken from: https://wonderopolis.org/wonder/where-do-lightning-bugs-go-during-the-day)

WQED education