What is light: A unit to support Kindergarten students understanding of light and how to manipulate it in order to find out the components of it

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Introduction

This unit is designed for a Kindergarten class and deals with the fundamentals of light. The focus will be on light and how it can be changed or manipulated. In order to change light, there must be a source of manipulation. This source could be a prism, a barrier, a liquid, or something else that forces the light to change. Light behaves equal to sound and water in that it can be changed or altered. Light is a wave and all waves carry power or energy. This unit will go into detail about the aspects of light and how it is created, manipulated, and behaves.

The Science curriculum for Kindergarten at Appoquinimink School District is derived from STEMscopes. The lessons are directly utilized from the website and implemented with minor refining. The concepts imbedded in this curriculum allow the students to be introduced on an age-appropriate level and create a foundation that will be built upon for the remainder of their schooling career. There is a unit that focuses on weather and how weather affects our planet. During this unit, the sun is a minor area of focus and this unit will allow the teacher to go into further detail.

Rationale

This unit is a direct product of my participation in the Delaware Teachers' Institute seminar "What is Light". While engaging in this seminar, I was introduced to the fundamentals of light and the behavior of light. During the seminars, the concept of light being comprised of all colors, light being a transverse wave, creating colors with light is completely opposite of creating colors with pigments, and how the human eye processes light and colors. There were distinct connections made with these concepts that allowed me to better understand light and how it behaves.

I teach Kindergarten in the Appoquinimink School District and science is one of our core subjects implemented. Due to the nature of the cognitive level that my students acquire, the lessons that are taught must be age appropriate. Although this is the first formal year of schooling, the levels of my students vary and therefore I must differentiate all instruction in order to challenge each student on their present level. The information ascertained from the seminars I attended gave me a plethora of background knowledge in which I can use to further inform my students.

Appoquinimink has adopted the concepts of "The Beats" which entails, collaboration, communication, creativity, critical thinking, and engagement. These five beats are used to further assist the district employees as well as the students to strive for excellence in a manner that has not been attempted before. The students are held to the same level of accountability as the staff when it pertains to their work and how they work as a team with their peers. This is evident in the Science curriculum across all grades. The students are encouraged to work together as a team and support each other while engaging in tasks.

Demographics

Appoquinimink is the fastest growing district in New Castle County. It currently has 2 high schools, 3 middle schools, 7 elementary schools, 3 kindergarten centers, and one preschool center. Currently under construction is a state-of-art high school that will open this upcoming school year 2020-2021. This high school will house middle school students for the first year due to the closing of the school for much needed renovations. The second year of operation will only house the Freshman students and the third year of operation, the school will service all students that are allocated to attend.

Cedar Lane Early Childhood Center is located in Middletown, Delaware and is one of three early childhood kindergarten centers in the district. The school serves approximately 310 students and serves students from suburban communities. The minority enrollment is at 36% which consists of African American, Asian, and Indian). The average ratio of students to teacher is 22:1. There are 6 classrooms that service special needs student population and the remainder 7 classrooms service the regular education population.

The Appoquinimink School District is situated in Odessa Delaware and has 16 schools that serves students from grades K-12. I work at Cedar Lane Early Childhood Center, one of three early childhood centers. My class consists of 22 regular education students and there are no identified special education students. I do not have a dual certification in special education and therefore do not service those students.

Content

What is Light?

When a person is exposed to light, there may be little to no thought about what is comprised to create the light they are subjected to. White light is a combination of green, cyan, blue, yellow, magenta, and red light. When all of these colors are mixed together, it creates white light. White light can be separated in order for the human eye to see all the colors that it consists of. A light kit that contains different types of prisms and a light source can be used to separate the colors so that the human eye can see them.

"In 1666, scientist Isaac Newton discovered that white light could be divided into separate colors. This process is called dispersion. He dispersed light using a prism-a transparent solid with two flat surfaces at an angle to each other. As the light hits the first surface, the colors in it are bent (refracted) by various amounts. This splits up the light into its separate colors. This dispersed light s refracted further when it hits the second surface. Colors with the shortest wavelengths, namely blue and violet, are refracted the most". [1]

Light is any source of illumination that emits lights. Light can come from many sources such as light bulbs, candles, televisions, and technology products such as cell phones. Light is a form of energy and can be placed into two groups: moving and stored energy. Potential energy is a type of stored energy and ready to use.

"The visible light spectrum is made of red, orange, yellow, green, blue, indigo, and violet waves. Roy G. Biv is a way to remember the order of the waves, ranging from the

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[1] Helbrough, Emma, ed. *The Usborne Internet-Linked Book of Knowledge*. London: Usborne Publishing, 2005.

shortest wave, which is red, to the longest wave, which is violet. You can see the spectrum of light by shining white light through a prism. The prism bends, or refracts, the light, enabling us to see the rainbow of colors. These colors are reflected or absorbed by objects, enabling us to see color. An apple appears red because red is reflected from the surface while all the other colors are absorbed. When almost all the light rays are absorbed by an object, the light does not pass through that object. Darker colors tend to absorb more light, whereas lighter colors tend to reflect more light. Have you ever noticed in the summer that the black asphalt street is a lot hotter than the white cement sidewalk? Have you also noticed that if you wear a black T-shirt, it gets a lot hotter in the sun than when you wear a white T-shirt? This is because black absorbs more light and heat.". [2]

Light Rays

Light travels in straight lines called rays. This is visible when you look at a light source such as a flashlight or the sun. You can see how the light source is a straight line that does not curve or cannot be manipulated unless something is placed directly in front of the light source. When a light ray strikes an object straight on, it is bounced back or reflected, in the direction it originated from. If the light ray hits an object at an angle, it will bounce back at an angle. If the light hits a surface that is smooth, such as a mirror, the ray will be reflected straight back. If the light hits a surface that is bumpy, it will reflect the light back in many directions.

The sun is the most important and powerful light source we have available to us. The sun's rays travel at speeds of 186, 000 miles per second. Without the sun's light, there would be no life on Earth. It is the largest star in the universe and is a huge ball of burning gas. The sun provides not just light to our planet, but it also provides heat and energy as well.

Bending Light

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[2] "Introducing STEMscopes." STEMscopes. Accessed December 1, 2019. https://stemscopes.com/.

When looking at objects that are submerged in water, it looks as though the object is bent. The object is not bent, but rather viewed differently in the air versus the water. When objects are in different mediums (i.e. air, water, matter), they are conceptualized differently. Light rays travel at different speeds through different mediums. They travel faster through air than water but faster through water than glass. The speed depends on the medium it encounters.

When light hits the surface of an object, several things can occur. The light can be scattered, bent, refracted, reflected, absorbed, or transmitted. It depends on the surface as to what will happen. Most light will scatter when it encounters a surface. When light is scattered, it sends the rays back in all directions. This is different from light being reflected. When light is reflected it bounces off the surface. You must be in the right place to see reflected images, but you are able to stand anywhere to see scattered images.

Windows and mirrors are both reflective, but mirrors are more reflective due to the aluminum or silver coating that is applied to the back of it. When inside of a house at night, a window appears to be reflective due to the lack of light outside and the amount of light inside. When standing outside of the house in the evening, you can see directly through the window and into the home because of the light being inside of the home. This clear glass is not an ideal mirror therefore the coating is applied to create a mirror. This coating is what reflects most of the object which is not reflected by the clear, smooth glass itself.

When light is refracted, it passes from one substance to another substance of a different consistency and therefore bends. For instance, it you place a plastic straw in a glass of water, it appears to look bent. The straw is not bent but rather has changed direction due to the light rays being manipulated by the substance. The light rays will speed up going into a less dense matter and slow down going into a denser matter.

“When light is transmitted it passes through an object. If most or all of the light passes through easily, it is transparent as with glass or clear plastic. If some light passes through an object, it is translucent as with wax paper or frosted glass. If little or no light passes

through, the object is opaque. When light strikes an opaque object, a shadow can be created because light cannot bend around the object". [3]

Brightness

Light is a form of energy and is transverse wave. A transverse wave is a wave in which the particles travel or vibrate at right angles to the direction the wave is traveling. Objects that give off light are known as luminous. Most objects that we encounter are not luminous. We are only able to see them due to the reflection of the light coming from a light source such as a light bulb, the sun, or another light source.

Light sources give off different amounts of illumination. Illumination refers to the amount of visibility in your surroundings. This differentiation of luminous amounts is known as intensity. When you are far from a light source, it becomes less intense due to the rays being spread further apart. The closer you are to the light source, the more intense or bright the rays are because they are not being spread out as they would when the light source is traveling a further distance.

Regarding the brightness of the sun and the natural light that is on the Earth, this light is brought to us from the sun. The rays from the sun travel through our five layers of atmosphere prior to touching the surface of the Earth. These layers of atmosphere are thicker as you move closer to the Earth. When light comes into our atmosphere, it encounters particles such as dust, nitrogen molecules, water molecules, and oxygen. When the light comes in contact with these elements, it reflects or bounces off and is redirected in many different paths.

The redirection of the light is referred to as scattering. The level of scattering depends on what it is bouncing off of. The wavelength of the light is what determines how much it scatters. If the wavelength is short, the light will scatter more versus a long wavelength in which the light scatters less. Pertaining to the colors of the rainbow, violet light has the shortest wavelength and blue follows closely behind. The sky has a blue color and not a

[3] "Introducing STEMscopes." STEMscopes. Accessed December 1, 2019. https://stemscopes.com/.

violet color because the human eye is more susceptible to blue light rather than violet light.

Color

When pertaining to color, the beginning theory focuses on hue. The hue of a color is the most basic element of color. When your eye views a color, it is because the specific wavelength is received by your eye. This specific wavelength is then transmitted to the retina part of your eye and translated to a certain color by your brain such as yellow or red. Primary colors are the main colors that most people are aware of. Primary colors consist of yellow, red, and blue. The color wheel is used to display these colors.

Within the color wheel there are secondary colors which are orange, purple, and green. These colors are also on the color wheel, but they are not the dominant colors. The secondary colors are created using the primary colors in different variations. However, primary colors cannot be mixed together through the use of other colors.

"Light from the Sun and light from light bulbs is called white light. White light is made up of seven different colors: red, orange, yellow, green, blue, indigo, and violet, which are colors of the rainbow".[4] These colors that make up the white light are referred to as the spectrum. When you separate white light into these specific colors, it is known as dispersion. Using a prism to separate these colors is an easy way to allow you to see each individual color. When the light enters the prism, it slows down and in turn disperses the light into individual colors. Due to the color moving at different speeds, they refract off the prism differently which separates them. This is how you can see each color of the rainbow independently.

Creating different colors of light can be created by using a different amount of red, green, and blue light. This process is known as additive mixing. Additive mixing is when there is a different combination of red, green and blue light. These three main colors are the only colors needed to create all the other colors that we see in our everyday lives. Due

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[4] Helbrough, Emma, ed. *The Usborne Internet-Linked Book of Knowledge*. London: Usborne Publishing, 2005.

to this fact, these colors are known as the primary colors. When two these colors are blended together, they will then make a secondary color. An example of this would be if you mix red and green together, it will create yellow. Another example would be if you mix green and blue together it will make cyan and if you mix blue and red together it will create magenta. If you add two colors together that are opposite of each other on the color, they will create the color white. These colors are known as complementary colors (i.e. red and cyan).

"You can see colors when light reflecting off objects is detected by color-sensitive cells in your eyes. All colored objects and paints contain pigments. These are substances that absorb certain colors and reflect others. You can see the color of an object because it reflects only light of that color. White objects appear white because they reflect all the colors of light equally. Black objects also absorb all the colors, so hardly any light is reflected making the object look black. Black and white colors are known as achromatic colors".[5]

To better understand the concept of color mixing, it would be best to use the example of a light bulb. When you turn on a light bulb, it is transmitting all the colors in the spectrum in an even form. If you were to take a blue color filter and place it in front of the lightbulb, it would then project only a blue color. The blue filter is not changing the light that is coming from the lightbulb. It is filtering all the other colors out and only allowing the blue light rays to come through.

Additive mixing is one method to create different colors, but there is a second method referred to as subtractive color mixing. There are two different ways in which this method can be done. The first method is similar to the lightbulb example used in the previous paragraph. When a color filter is placed in front of a typical lightbulb, it is only allowing that specific light ray to shine through the filter. It is blocking all of the other light rays and not allowing them to shine through the filter and this is why you are only able to see the specific color light that is the color of the filter. If you were using a magenta filter (which is a color comprised of red and blue) and you wanted to have just the red light, you would need to eliminate the blue.

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[5] Rogers, Kirsteen, Verinder Bhachu, Joanne Kirkby, and Laura Howell. *Light, Sound & Electricity*.

When looking at the color wheel, notice that blue and yellow are opposite of each other. If you add yellow to the magenta, it will cancel out the blue and leave you with red. This is a difficult concept to understand. Referring to the color may help to make sense of this method.

Continuing to focus on color when dealing with light, we will move from the focus of the hue and move into saturation and chroma. The saturation and chroma pertain to the brightness of the hue or color. Saturation pertains to the amount of hue that is produced and chroma relates to where the hue lies in a range from gray to full chroma. When dealing with light and focusing on saturation, the focus would be on how much of the color is in the filter being used. If something has low saturation, it is closer to the color white. The colors that fall in this range are referred to as tints.

Tints are low level and allow a great deal of light to pass through. Deeper colors such as dark blues do not allow much light through and are difficult to work with when attempting to show how colors interact with one another. Adding different colors together for shading purposes or to create a different look can be a bit tricky. Making sure to use different color combinations prior to implementing an experiment in front of a crowd would be the optimal choice.

Lighting is very important in the world of theater and they have mastered the concept of making those on stage look flawless. The ability to use light to make images look clear and crisp is also used in television. There needs to be the right amount of light for certain images to look their best. If the wrong amount of colored light is used, it could prove to show the image in a less than flattering way.

Missing color syndrome is the circumstance when two lights with more saturated color medium are integrated with a less saturated or clear light. The color that is less saturated takes on the property of the shadow color of the more superior light. This results in the light looking a very different way than the original intended color light. This occurs due to the human eye and more so the human brain creating patterns and making a mistake with the colors in use.

When the three primary colors are in use, the eye is able to see things as they are intended to be seen. When you omit one of these colors, the eye does its best to manipulate the two colors being used to produce something that is closely related to what is previously known. The eye will essentially attempt to produce the third missing color by using different variations of the two colors that are being offered. For example, if you were to only use blue and green, the eye would urgently search for red and then go as far as turning non-red colors into red if need be.

Wave

There are many different types of waves. They range from radio waves to gamma rays. Electromagnetic waves are waves such as light waves and radio waves. Mechanical waves include water waves and sound waves which are vibrations in a solid, liquid or gas. The electromagnetic spectrum hosts a vast array of waves, many of which are not visible to the human eye. There is a small portion of waves that are visible to the human eye and they are the visible light spectrum.

Nothing moves faster than the speed of light. The speed of light in a vacuum is 300,000 km/s. Waves consist of amplitude and wavelength. The amplitude is the difference between intensity and wavelength. The wavelength is measured in meters and feet from the distance from one peak to another peak.

Light is a type of transverse wave in that the vibration of the wave moves in a right angle according to the direction it is traveling. The human eye is not equipped to see much of these rays due to our limitations of our sight. When perceiving this, we are only able to see a very narrow portion of the entire spectrum. Light wavelengths appear in color and are visible to the human eye. Red light has a longer wavelength whereas blue has a shorter wavelength. Therefore, blue has a higher frequency and red has a lower frequency. The figure out the frequency of the wave, you would divide the wavelength into the speed (how fast the light is going).

When waves are the same, they are “in phase”. This means that their amplitude is the same in height. They have the same maximum and minimum meaning that their peaks match and their dips match. If a wave is out of phase, the peaks and dips do not match up.

The Human Eye

The human eye consists of an iris and pupil. We can see objects because light bounces off objects and sends the image to our brain. Our brain then interprets the object which allows us to understand what we are seeing. Both eyes work together to project an image that becomes 3 dimensional. Each eye contains rods and cones (there are about 125 million rods and 7 million cones). Rods only detect black and white whereas cones detect color. The cones need bright light in order to see the colors and the rods are capable or working in dim light.

When dealing with seeing color, you have cones that are capable of seeing specific colors (red, blue, and green). The blue cones are sensitive to blue and have a reading of 420 nanometers, green cones are sensitive to green light and have a reading of 534 nanometers. Red cones are sensitive to yellow and have a reading of 564 nanometers. Seeing color that is created by light is different than seeing color that is created by pigments. When the eye sees blue paint, the blue paint is absorbing most of the light and scattering the blue color for the eye to see. When the eye sees yellow paint, the yellow paint is absorbing most of the light and scattering the yellow color for the eye to see. If you mix these colors together, they scatter green. When you add pigments together, you are subtracting the other colors.

If you are looking at the color purple, red and blue cones in your eye respond more dominantly than the green cones. Due to this you will see the color purple. When a person is color blind, they are not able to see certain colors because their cones faulty. Depending on what colors they cannot see will decide which cones are faulty.

Objectives

The intended objectives for this unit is for the students to understand that white light is comprised of several colors (green, blue, cyan, yellow, magenta, and red) that are mixed together. Another learning goal for this unit is for students to understand that white light

is made up of several colors combined. According to the Performance Expectations in STEMScopes, **1-PS4-3** Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.**1NGSS Standard 1-PS4-2** Make observations to construct an evidence-based account that objects can be seen only when illuminated.[6]
Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).

Teaching Strategies

When implementing this unit, the teacher will need to have a basic understanding of waves, color, and light behavior. The students will engage in lessons that will help them to better understand all these concepts. The teacher will use flashlights and colored filters, a light kit in another activity, and colored filters with white as well as different colored construction paper in the third activity. The students will engage in experiments with these different objects to better understand the concepts taught.

The teacher will use a KWL chart (What the students Know, what they Want to know, and what they have Learned) before, during, and after the activities to display the student's knowledge of the content. This chart will be utilized before, during, and after the lesson to further assist the concepts taught. The students will also engage in a think, pair, share routine that they are familiar with. This strategy allows for all students to have an opportunity to share their thoughts. The teacher will also incorporate videos prior to the lessons beginning. These videos will focus on the key teaching strategies for the lesson. The teacher will make sure to model the expectations of the lesson prior to allowing the students to engage. This modeling will assist the students with the expectations of the lesson.

Classroom Activities

[6] "Introducing STEMscopes." STEMscopes. Accessed December 1, 2019. https://stemscopes.com/.

First Lesson

The lessons that will be implemented for this unit will focus on color as well as manipulating light. The first lesson will focus on changing color by using different colored filters with flashlights. The materials needed for this lesson are: flashlights (at least 10), filters of different colors (yellow, red, blue), chart paper, and markers.

The lesson will begin with a viewing of a video: https://www.youtube.com/watch?v=dH1YH0zEAik During the video, the teacher will pause it after the scientist states that white light is made up of all colors. The teacher will ask the students if they knew that and if they agree with it. The students will have time to think about their answers and then have a think/pair/share moment with the neighbor. The teacher will then resume the video. It will pause again after the scientist introduces the prism and shows how the light can be separated into different colors. The teacher will ask the students if these colors remind them of anything.

Once the students finish watching the video, the teacher will then take out the flashlight. The lights in the classroom will be turned off so that the students are able to see the flashlight in the dark. The teacher will then take out the red filter and ask the students what they think will happen if the filter is placed over the white light of the flashlight. They will then share their thoughts with their partner. The teacher can ask 2 or three students to share their thoughts and ask them why they made that specific prediction.

The yellow filter will then be taken out and the teacher will ask the students about placing the red and yellow filter together. The students will be asked to make a prediction about what they think will happen. A few students will be asked to share their thoughts. Then the teacher will inform the students that they will be in groups of two or three for an experiment that will engage in. The teacher will explain to the students that they are to take the light filters and place them in front of the flashlight. They will use different combinations of colors to see what it will create.

When the students are engaging in their experiments, the teacher will walk around the room to ask questions to the groups. They will be asked what colors they used and what has happened. They will also be asked if the color changes are what they thought would happen. The students will be encouraged to try many different combinations. They will also be encouraged to pair up with another group and cross their lights using different filters to see what color is produced.

After the students are finished with their experiment, they will come back to the rug and review their findings. The teacher will have chart paper ready to record the students' responses. They will be asked to share what happened when they used single color filters, when they joined two filters together, and when they used all three. They will then be asked to tell what happened when they joined their light with another group's light. This will be discussed and the teacher will write down all responses.

Second Lesson

The teacher will need to view the following lesson ahead of time prior to watching with the students.

https://www.youtube.com/watch?v=d7yTlp4gBTI

The teacher will also need to practice with the light projector prior to implementing this activity with students. There will need to be practice of how to use each port/opening on the light projector as well as using each prism and mirror. The teacher needs to have experience using this so when it is implemented in front of the students, there is smooth transitions between each object.

For this lesson, the teacher will need 4 light projectors that are able to display light in different manners, different shaped prisms, mirrors, chart paper, markers, black construction paper, several hole punchers, scissors for each student, sticky notes and cardboard toilet paper roll for each student.

For the beginning of this lesson, the teacher will have prepared a KWL chart for light. The lesson will begin with the teacher asking the children what they know about light.

Once the teacher has written down several of the student's answers, the teacher will then ask the students what they would like to know about light. When both areas are filled in, the teacher will reread the students' responses to refresh them of their answers.

The teacher will then play the youtube video: **https://www.youtube.com/watch?v=d7yTlp4gBTI.** During the video, the teacher needs to pause the video where information that was given for the "know" or the "want to know" areas. There needs to be reinforcement of concepts that are already known, or attention drawn to things they would like to know. References need to be made to connect the video to their current knowledge or their newly acquired knowledge. They can always stop the video and replay a section for the students to fully understand the information given.

Once the video is completed, the teacher will then refer to the KWL chart. The teacher will need to go over concepts that were already known to ensure they are correct. The teacher can then go over the category of what the students want to learn to see if any concepts can be connected. The teacher can use information from the video to assist with this aspect of the lesson. Then the students will be asked to think about one fact they just learned from the video. They will then engage in a think/pair/share moment with their partner.

A few students will have the opportunity to share what they have learned, and the teacher will scribe their responses onto the KWL chart. The teacher will then bring out the light kit and ask the students what they think it is. A few students will have the opportunity to share. Then the different prisms and mirror will be demonstrated. The students will have a moment to think about what they think all the materials are for. They will then be informed that it is a light kit and explained that it is a source of light that is used to do scientific experiments.

The students will be informed that they are scientists today and they will be conducting an experiment using the light kit and the accessories (i.e. different shaped prisms, mirrors, black construction paper, and toilet paper rolls). The light kit will be plugged in and a student will be asked to turn off the lights. The first light that the students will be shown will be the single beam light that is located in the front of the light machine. The teacher will be sure to point out that the light can be changed when

something is placed in front of it. When explaining this, the teacher will place a hand in front of the light to prevent it from shining on the original surface.

A prism will then be used to create a directional change in the light. The students will observe what happened and then discuss with their partner what they see. The teacher will allow for several students to share what they see and how the light has changed. They will be asked why it has changed directions. A few students will share out their thoughts and the teacher will use another piece of chart paper to write down their responses under the heading of “Prism”.

The teacher will then display the mirror and ask the students what they think will happen when this is placed in front of the light source. Once a student has answered that it will “bounce off” or reflect off the mirror, the teacher will ask the students where the light will shine (on what surface) in the classroom. The students will be able to make a prediction as to where they believe the light will shine. Several students will be given sticky notes and told to write their name on the sticky note. The sticky note will be placed in the location by the student or the teacher if the location is too high.

After the mirror has been placed in front of the light source, the students will observe where the light shines and if it is close to any of the sticky notes placed around the room. There will be a brief discussion about what happened with the light ray once it shined on the mirror. The teacher will then refer to the chart paper to write “Mirror” in the column next to “Prism” and record the student’s responses. The teacher will then turn the light source to the side that has three colors and display the light source going through this side.

The angled prism will then be used for this portion. The teacher will show the angled prism to the students and explain that it will be placed in front of these colored light rays. The students will then take a moment to share their predictions with their partner. The teacher will allow the students to share out after this portion of the experiment has occurred. The angled prism will then be placed in front of the colored light source and the teacher will then ask for students to share out what they see. They will then be asked if it is what they predicted and if not, how is it different and why did they not predict what they are currently seeing. The students will be asked to defend their predictions.

The teacher will place on light source on each of the students' tables (there will be four light sources total). Each student will be given black construction paper, a rubber band and a toilet paper roll. They will already have scissors at the table. The teacher will then demonstrate how they are to cut holes into their black construction paper or use the hole puncher to create holes. Then, the teacher will model how to take the rubber band and wrap the construction paper around the end of the toilet paper tube. The tube will then be placed in front of the light source that has one direct light.

The teacher will explain that the students are to move the tube around the light to change the direction of the light and make it "dance" around the room. The teacher can compare this light source to the sun and explain that this is how the light from the sun is manipulated or changed. The students will be monitored by the teacher as they begin to prepare their papers ensuring that no students are using the materials improperly. If students need assistance with the hole puncher, this will be provided by the teacher. The teacher can support the student by doing hand over hand accommodation with the hole puncher and then encourage the student to attempt without assistance.

Once the students have assembled their light tubes, they will then take turns using them directly in front of the light source. As the students are conducting their experiment, the teacher will ask probing questions to guarantee the students comprehension of the objectives. These questions can be along the lines of, "What is happening to the light?, Does it look like what you predicted? How can you change the light from what it is doing right now?, What does the reflection look like to you?".

After the students had time to manipulate the light source with their light tubes, they will be asked to refer to the KWL chart. The teacher will then ask the students to think about something they learned about light today. They will engage in one last think/pair/share moment with their partner and then a few students will share what they have learned. The teacher will record the students' responses under the "Learned" section of the chart. The teacher will then play the video that was viewed at the onset of the lesson. When the video is playing, the teacher will pause it to further established learning points. There will also be connections made while viewing the video that pertain to using the prisms with the light source as well as the mirrors.

Third Lesson

The teacher will view the following video prior to teaching the lesson.

https://www.youtube.com/watch?v=ybt2jhCQ3lA

The following materials will be needed for implementing this lesson: Four sheets of white construction paper, four sheets of red, yellow, and blue construction paper, clear lay color film or cellophane filters that are red, yellow and blue, a record sheet for each child.

The teacher will begin the lesson by referring to the KWL chart that was done for the previous lesson and discuss what was learned about light thus far. The teacher will allow time for the students to recall what they have learned and then some of the recorded answers will be read aloud. The students will be asked to share what their favorite activity has been and why. Once several students have shared, the teacher will begin to explain what the students will be doing today.

The teacher will then inform the students that will be scientists once again and participate in an experiment. This experiment will deal with color and the changing of it. The teacher will then play the color video for the students. During the beginning of the video, the teacher will pause it after the red and blue color mix to make purple. There will be a question posed to the students, “why did that just happen?”. The students will be given a moment to think and then engage in their think/pair/share routine.

A few students will have an opportunity to share out, and then the video will resume. The teacher will pause the video prior to the next two colors (blue and yellow) blending. The teacher will ask what color these two colors will make. A few students will have an opportunity to share out. Each student that shares out will be asked why they answered their specific color. They will defend their choice and the teacher will resume the video allowing the students to see if their answer was correct.

When the last two colors connect in an attempt to blend, the teacher will pause the video once more to ask the students what color these two colors will make. The students will have a moment to think and the teacher will call on students who have not had a turn to share out. These students will also be asked to defend their answer. The teacher will then resume the video to expose that red, blue, and yellow make black. The teacher will

ask the students if they were aware of this. The video will then show red and white together. The video will be paused again, and the students will be asked what color will be created. Several students will share out and the video will resume thereafter. For the remainder of the video, the teacher will pause as the colors continue to mix and give the students two color options to vote on. They will give a thumbs up or thumbs done for each color of their choosing.

Once the viewing of the video is complete, the teacher will show the students the different colored cellophane and explain that the students will use this today with different colored construction paper. The students will have a chance to look through the cellophane and view objects around them prior to using it with the construction paper. The students that are paired up for think/pair/share will both have different colored cellophane. The teacher will ask the students how things look differently in their classroom. The students will think/pair/share with their partner to discuss what they see. The students will then be instructed to exchange their colored cellophane with their partner.

The students will then be told that they will take their colored cellophane and use it with white construction paper first, then with red, yellow, and blue construction paper. The teacher will then display the record sheet and explain that they will look at the white paper first. They will record what colors they see. They will then be instructed to use the different colored cellophane on each of the colored construction paper and record the color they see. The teacher will do this whole group and all students will use the same colored cellophane and construction as instructed. This will ensure that all students are following the expectations of the lesson and if some students are not sure of what to do, they will be guided step-by-step.

The teacher will record the answers for the colors on the smartboard for the students to follow. This accommodation will assist those lower students that may have trouble with scribing the answers on the record sheet. Each color that is created will be discussed when it is created. The teacher will also intermittently ask the students to predict what color they think will be created when combining the cellophane and the construction paper. Their predictions will be challenged by the teacher or other classmates. The student will have to defend their prediction.

Once all combinations have been created, the teacher will ask the students if they were surprised by any of the color combinations and why or why not. The students will have a

chance to share out. The students will be able to use the cellophane and paper freely after the main portion of the lesson is finished. They may combine the cellophane together and look at the white or colored paper. They may combine the cellophane and look around the classroom to see how it changes the color of familiar objects.

Teacher and Student Resources

https://Stemscopes.com this is a useful resource for content information pertaining to our science curriculum

The Usborne Book of Knowledge is also a great resource for teachers as well as students. It has kid-friendly pictures and information pertaining to all areas discussed in this unit.

Bibliography

"Introducing STEMscopes." STEMscopes. Accessed December 1, 2019. https://stemscopes.com/.

Helbrough, Emma, ed. *The Usborne Internet-Linked Book of Knowledge*. London: Usborne Publishing, 2005.

Rogers, Kirsteen, Verinder Bhachu, Joanne Kirkby, and Laura Howell. *Light, Sound & Electricity*. New York: Scholastic, 2001.

Annotated Bibliography

Introducing STEMScopes. https://stemscopes.com is a great website for additional information pertaining to the lesson implemented in the science curriculum.

Helbrough, Emma, ed. *The Usborne Internet-Linked Book of Knowledge*. This text has a vast amount of information that pertains to the human eye, electromagnetic waves, light, and color. London: Usborne Publishing, 2005.

Rogers, Kirsteen, Verinder Bhachu, Joanne Kirkby, and Laura Howell. *Light, Sound & Electricity*. This text focuses on light and the different types of waves. New York: Scholastic, 2001.

Appendix A: Implementing District Standards

1-PS4-2	Performance Expectation	Make observations to construct an evidence-based account that objects can be seen only when illuminated.

1-PS4-3	Performance Expectation	Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.