Light Time Travel and The Evolution of our Understanding of Light

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This curriculum unit is recommended for:
Science/Light Energy - Grades 3-5

Keywords: Light, Energy, Glow, Sun, Evolution, Wavelength, Photon, Solar Energy

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: Have you ever wondered where light actually comes from apart from the sun and moon? Many students are curious to know how light evolved and what changes have occurred over decades for us to be where we are today with light. This unit will focus on integrating Language Arts, Mathematics, Art and Research with the Science Curriculum to bring this topic to life. Through experiments, research, discussion, videos, and reading materials, students will garner valuable information on the evolution, and the history of light. The use of comprehension skills, the inquiry method, research method, and critical thinking skills, will be used to assist students in better understanding all concepts taught in this unit. The main focus of this unit is to allow students to work cooperatively through research, experiments, and group work while using their critical thinking skills to answer questions and solve problems. Students will be assisted and monitored by a Science teacher. The lessons will allow students to explore on their own and with other peers.

I plan to teach this unit during the coming year to **250** students in **grades 3-5 in Science.**

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Seon S Sloley

Introduction

As the Science Lead at Charles H Parker School, I am given the responsibility of teaching over 450 students on a weekly basis. My job is to ensure all students are actively involved in every lesson they take part in when they visit my lab. This is my 4th year in this position and when I became the new Science Lead, I pledged to have more students involved in all the activities that are offered in Science at my school. Specifically I wanted to target more participation from our Academy students (neighborhood students). I have seen growth in many of my students and the interest they have and desire to learn more about Science. Light is always an interesting topic with students. It is also a part of their curriculum. This curriculum will be used to dive deeper into light travel and its evolution with all 3-5 grade classes.

Science is an integral part of any school curriculum. Research states that Science helps with the development of students becoming knowledgeable citizens, it incorporates meaningful learning of language and mathematics, allows students to ponder and seek answers to questions such as, how the world works, and it helps in preparing them for STEM related careers (Cafarella, et. al., 2010). It is always rewarding in the morning when students greet me by asking what we will be covering in the lab. This shows I am reaching them and I am doing something different in the lab. With this unit, I want all students to have scientific knowledge of the world they live in and how light affects their world. What is the importance of light in their world? The unit will present a consistent science instruction and allow for students to explore, experiment and research with light.

Students become interested in topics that they are interested in and can relate to. This unit is relatable to all students and will help them to answer many questions about light. After all, great Scientists ask questions. The students will be able to formulate their own questions and have peers answer them. With students having autonomy of some activities, it will assist them in developing a favorable attitude towards Science in general.

Rationale

Students are often heard saying Science is boring and too much work. Becoming the Science Lead at my school, I wanted to change that. What can I do to revamp the Science Lab? How can my students leave the lab feeling a sense of accomplishment and joy? Each lesson that I prepare for my students is well planned and thought out. There has to be a balance with experiments and journal entries, as Scientists take notes on their experiments to see errors and build on mistakes. Science assists students in exploring what they do not know while also building on the knowledge they already know with proper guidance. Students make discoveries of new things when participating in meaningful Science lessons. Just like Mathematics and Reading, Science plays an integral part in students' foundation.

Looking at the evolution of light and how our understanding of light has changed over time is similar to how our students will evolve in time with the Science curriculum and how they build on their knowledge on various Science topics. This unit is designed to help students dive deeper into the concept of light. We use it on a daily basis, but do they know the history behind light and how light is accessed daily at home, school, and businesses? Is it just the light from the sun they are familiar with? The unit will also help students in understanding how and why things work. It will explain the reasons and mechanics behind the complex systems of light, light time travel and how light has evolved over the years.

Student and School Demographics

Charles H. Parker Academic Center is a nationally certified magnet school located near the intersection of West Blvd. and Clanton Rd. We are approximately 10 minutes from Uptown Charlotte. Access to Interstate 77 makes Parker easily reachable within 2-3 minutes. We are ideally located on the West Boulevard Corridor near to Dilworth and Wilmore (CMS, 2022).

The current school resides on top of a small former "gold mine" from the eighteenth century. Two large round stones used to pulverize rock to extract gold ore are located in front of our main entrance. The original Barringer Academic Center, built in the 1950's, actually had one of the stones serve as the base for their school flag pole (CMS, 2022).

In 2021, our school community decided to change our school's name due to the racist history associated with Barringer. After several months of learning about the amazing legacy and history of the West Blvd. Corridor, the students and community voted to rename our school, Charles H. Parker Academic Center (CMS, 2022).

Charles H. Parker (1844-1939), born in slavery, became a visionary leader of the African American community along West Boulevard. He modeled the commitment to community self-help that animates the West Boulevard Neighborhood Coalition today. Parker helped start Moore's Sanctuary A.M.E Zion Church (African Methodist Episcopal Zion) and led the fraternal group that built Plato Price School, the anchor of education for Black children in the area for fifty years and alma mater to Philip O Berry and Mel Watt. He also was a founder of the Sunday school that became Amay James Presbyterian Church. Over the years he helped many black families acquire land and build homes in the Remount Road area. In 1970 his children teamed with Charlotte's leading civil rights leaders to build affordable housing on his 19th century homestead. Parker Heights Apartments still provides below-market rents to West Boulevard residents today (CMS, 2022).

The school houses about 549 students. Of which 99.4% are free and discounted lunch recipients. The ethnic composition of the student population is 55.4% African American, 24.4% Asian, 14% white, Hispanic 4.2%, American Indian 0.4%, Pacific Islander 0.4% and two or more 1.3%. There are 48 teachers: 37.2% (16) teachers hold a Bachelor's degree and 62.8% (27) have Advanced degrees. There are 40 (93%) who are Highly qualified and 3 (7%), that are Not Highly Qualified. Years of experience ranges from 0-20+ years. Our school became a Title One school in the year 2015. We operate on a Traditional school calendar (10 months).

Our Academy scholars come from the historic West Charlotte neighborhood around our beautiful school and our Horizons students come from across Mecklenburg County. These Horizon students are considered highly gifted and go through an application process to enter the program (Parker Academic Center PTA, 2022).

Parker is also home to two magnet programs. The Learning Immersion program is for students in kindergarten through second grade who seek accelerated classes to prepare for the Talent Development program, also located at Parker. That program is for third- through fifth-grade students identified as gifted who receive advanced classwork from a certified gifted teacher (Parker Academic Center PTA, 2022).

Content Research

Children are often afraid of the dark. Have we ever asked why? Is it that we are afraid of things we cannot see? Humans are said to be creatures of light and have been deeply programmed throughout millions of years to years in history to avoid the dark dangers of night (Woodford, 2021). It is with this statement, that the unit I am writing will be built. Students will be involved in meaningful discussions on why do we need light? What is the importance of light? How has our understanding of light changed over the years? However, before we dive deeper into the various concepts of light, we will research and discuss the history of light and how it has changed over the years.

There are so many ways in which we can teach our students about light. Students are always fascinated with light and often speak about the sun. To get students moving and more involved with this concept, teachers can take them on a shadow walk where they will be able to see shadows and discuss shapes made (Math concepts). Use chalk to draw what they see and discuss what causes a shadow. What role does light play in shadow making? Why is light important? “Light is essential to our health and wellbeing; it regulates our sleep-wake cycle. It can also help with our daily routines: from bright functional light to keep you energized and up your concentration level, to warm light that creates a cozy ambiance that helps you to unwind in the evening”(Signify, 2020).

It will be emphasized that light is important to us and we need to take time to understand it (Woodford, 2021). Questions such as: What is light? Why does light make some things appear to be different colors from others? Does it travel as particles or as waves? Why does it move so quickly? (Woodford, 2021). Students will work cooperatively to research and find answers to these questions, where they will present in class and have a discussion on findings.

The Evolution of Light

Light bulbs, solar panels and other light sources that exist now were not available in ancient days. However, since the discovery of light, human civilization has seen the evolution of illumination techniques (Signify, 2022). Light is important to human life whether it was the burning of ancient fire torches, or modern light bulbs (Signify, 2022). However, there is more to switching on and off a light switch to receive light. How does light arrive on Earth? Woodford, 2021 states: "Light arrives on our planet after a speedy trip from the Sun, 149 million km (93 million miles away). Light travels at 186, 000 miles (3000,000 km) per second, so the light you're seeing now was still tucked away in the Sun about eight minutes ago."

There are three different areas of lighting we think about: "The fuel source, the luminaire, and the technology used to produce visible light" (Lighting Solutions, 2016). In this unit, the students will look at the evolution of lighting from its birth to the modern-day revolution that is happening with 21st century LED technology. The students already know through their Science lesson, that the sun is the most important source of light. "One of the most well-known examples of historical architecture utilizing daylight through its design is the Pantheon. Perhaps the most significant architectural achievement from the Roman Empire, the Pantheon is designed almost entirely around the open air circle at the top of its dome" (Lighting Solutions, 2016). In the earlier days, about 70,000 years ago, the very first attempt to produce a light was the torch, according to the Illuminating Engineering Society.

Figure 1: Ancient people used torches for lighting. (Image in the public domain)

"The first lamp was invented made of a shell, hollowed-out rock, or other similar non-flammable object which was filled with a combustible material (probably dried grass or wood), sprinkled with animal fat (the original lighter fluid) and ignited." Handheld and building mounted torches progressed well beyond their rudimentary start but the basic principles remain the same: the fuel source is some type of oil, wax, or combustible material surrounded by non-flammable material" (Lighting Solutions, 2016). Next we had candles, gas lamps, and electric lamps. Englishman Humphry Davey, was said to be the first man to create the first electric light. He used a pack of batteries and two charcoal rods to demonstrate the first incandescent light to the Royal Institute in Great Britain (Lighting Solutions, 2016).

Students will use the scientific method to understand why light makes the journey at all and how the journey is made? They will gather their information by conducting research on why light travels and how. They will then work cooperatively to form a hypothesis. What they want to be tested and how they will test their hypothesis. After they have formulated their hypothesis, they will conduct an experiment guided by the teacher, write and analyze their results, state their conclusions, and report their findings to the class. This process will be used throughout the teaching of this unit. Through the use of the Scientific method, students will get a better understanding of how and why light works, while having a means to formulate questions about the observations they will be making (O'Callaghan, 2002). With this information, students will use the scientific method to work through the history of light and conduct experiments with light bulbs to solve a hypothesis.

Sir Isaac Newton (1542-1727), during the 17th century, was the first Scientist to study the matter of whether or not light is a wave in detail. He thought that light was a stream of "corpuscles" or particles, however, Christiann Huygens, (1629-1695), was quite adamant that "light was made up of waves" (Woodford, 2021). "In some ways, light behaves just like a wave: light reflects off a mirror, for example, in exactly the same way that waves crashing in from the sea "reflect" off sea walls and go back out again. In other ways, light behaves much more like a stream of particles—like bullets firing in rapid succession from a gun. During the 20th century, physicists came to believe that light could be both a particle and a wave at the same time" (Woodford, 2021). Today scientists understand that sometimes light behaves as a wave (when it is traveling from one place to another) and sometimes it behaves as a particle (when it interacts with atoms and molecules),

Before Newton and Huyegens, there were the Greeks. They were the first to have a theory about the nature of light. Euclid and Heor had a theory about light as they came to recognize that light traveled in a straight line. It is with this hypothesis that the Greeks were "able to successfully study phenomena of reflection and refraction and derive the laws governing them" (Light - Wave, Theory, Waves, and Scientists - JRank Articles, 2022).

The nature of light is a puzzle, however, with research and experiments, students can gain insightful information on its evolution and what exactly is light.

Definitions

Light - Light is a form of energy, "light sometimes behaves as a particle and sometimes as a wave. They both can never be seen at the same time (Salih Uzum , Nedim Alev , Işık Saliha Karal, 2013).

Figure 2: Light can behave as a wave or a particle. (Image in the public domain)

Energy - The simplest definition of energy is "the ability to do work". Energy is how things change and move (Ducksters, 2022).

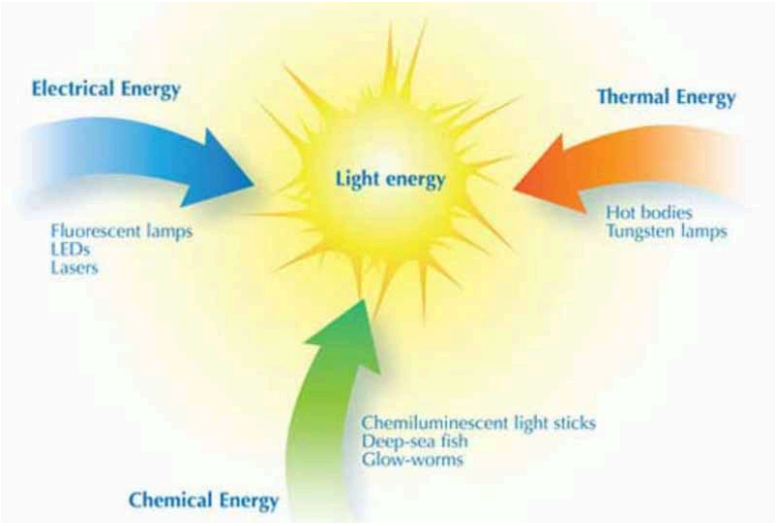


Figure 3: Electrical, chemical, and thermal energy can all be converted into light energy. (Image in the public domain)

Light travel - Light travels as waves. These are transverse waves, like the ripples in a tank of water. The direction of vibration in the waves is at 90° to the direction that the light travels. Light travels in straight lines, so if you have to represent a ray of light in a drawing, always use a ruler (BBC, 2022).

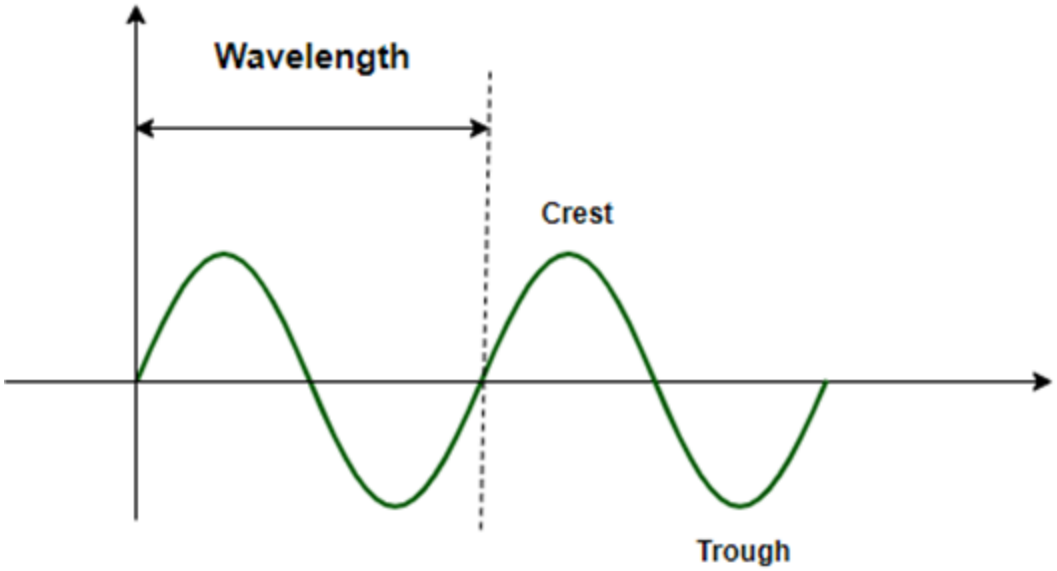


Figure 4: Light travels as a transverse wave. (Image in the public domain)

Glow - A steady light, especially the light given off by something very hot (Kids Wordsmyth, 2022)

Figure 5: Hot objects glow. (Image in the public domain)

Sun - The Sun is located in the center of the Solar System. It is a nearly perfect sphere of hot plasma, essentially, a hot ball of glowing gasses. It is the most important source of energy for life on Earth. The Sun has a diameter of around 1.39 million kilometers / 864,000 miles (Nine Planets, 2022)

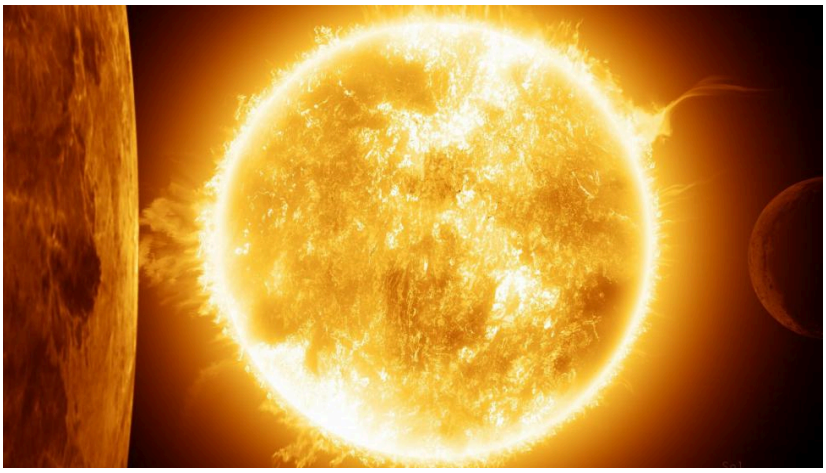


Figure 6: The Sun is the most important light source for earth. (Image in the public domain)

Evolution - According to the Stanford Encyclopedia Of Philosophy, evolution may be defined as any net directional change or any cumulative change in the characteristics of organisms or populations over many generations—in other words, descent with modification… It explicitly includes the origin as well as the spread of alleles, variants, trait values, or character states. (Endler 1986: 5) In this unit we explore the evolution of lighting and our understanding of light.

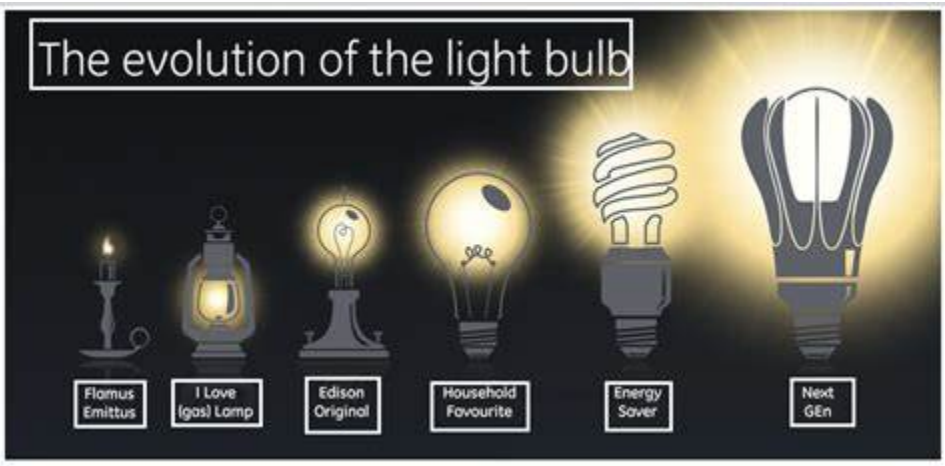


Figure 7: Human use of light evolved or changed over time. (Image in the public domain)

Wavelength - Wavelength can be defined as the distance between two successive crests or troughs of a wave. It is measured in the direction of the wave (The Economic Times, 2022). The sun produces light at all wavelengths.

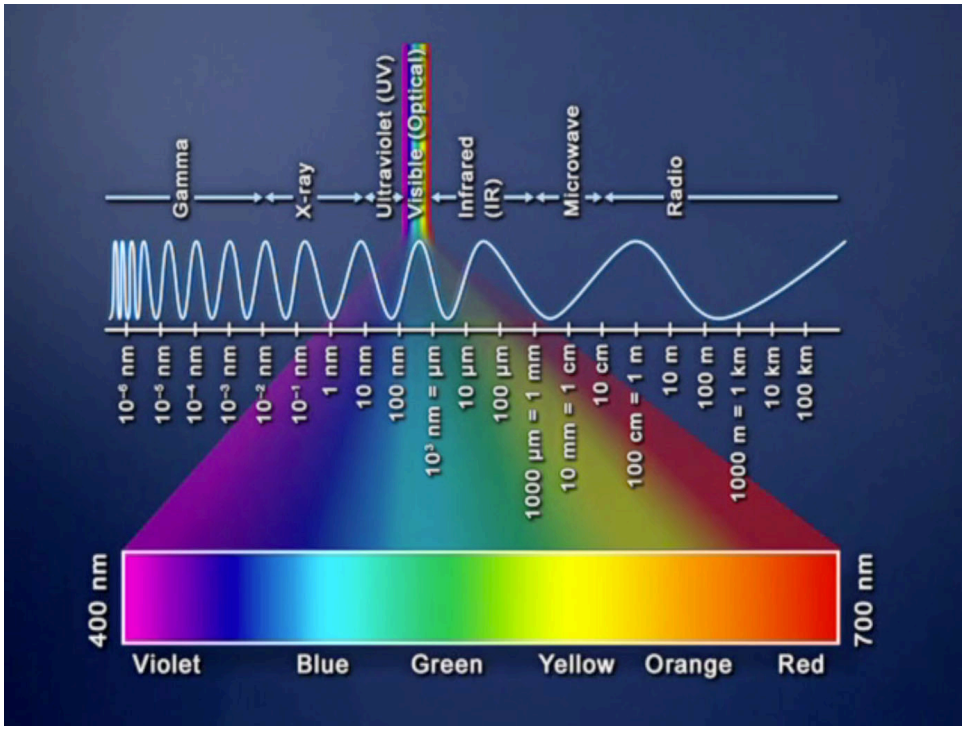


Figure 8: The electromagnetic spectrum showing all the different types of wavelengths of light. (Image in the public domain)

*Photons - P*hotons are fundamental subatomic particles that carry the electromagnetic force — or, in simpler terms, they are light particles (and so much more). The photon is also the "quantum," or fundamental unit, of electromagnetic radiation. Everyone is surrounded by photons (Sutter, 2022)

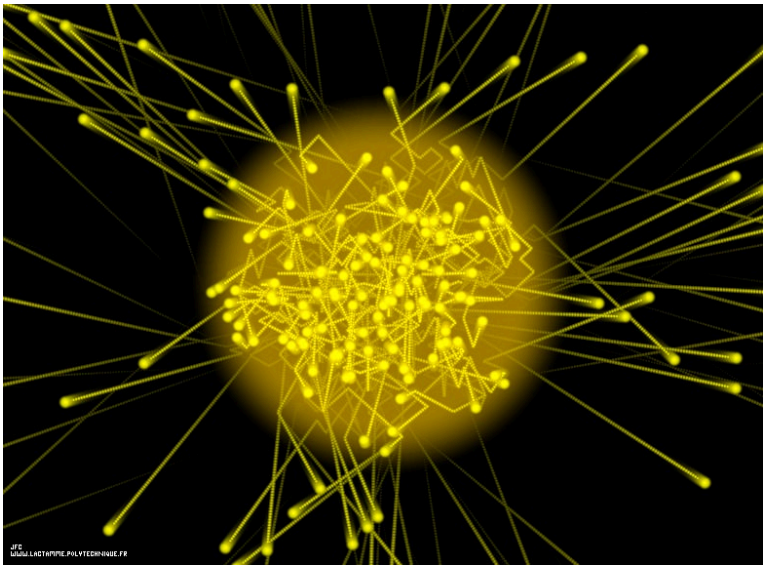


Figure 9: Photons are particles of light that carry energy. (Image in the public domain)

Solar Energy - Solar energy uses the sun's light and heat to generate renewable or 'green' power. The most common form of solar energy is harnessed by solar panels, or photovoltaic cells. In photovoltaic power stations, they're arranged almost edge-to-edge to capture sunlight in large fields (Just Energy, 2022).

Figure 10: Solar panels convert sunlight into electrical energy. (Image in the public domain)

Instructional Implementation

Teaching Strategies

Discussion - This teaching strategy is used by most teachers in building a collective knowledge from students' understanding. Through discussions, students are able to display their reasoning ability and also show their capability in scientific reasoning goals, which will also allow them to practice their listening, reasoning, and interpreting skills. The use of discussions in this unit will be used to garner information from students on their prerequisite knowledge of light and questions they have on the topic and concepts being taught. Discussion will be used to begin this unit as it will assist students in processing information rather than receiving it from teacher and other peers. Discussion will also help to stimulate students' critical thinking skills and learn more about the topic being discussed. This will eventually allow students to generate more ideas and build confidence within themselves.

Figure 11: Class discussions will be used to stimulate learning. (Image in the public domain)

Cooperative Learning - Throughout this unit, students of mixed abilities will work together through the use of small groups and whole group activities. This strategy will work with their research activity as individual students will be given a specific duty to complete. It will promote team building, build self-confidence, and enhance their communication and critical thinking skills. Shift Learning , 2021, states, "Students effortlessly relate emotions with visuals, which make what they're learning more impactful and memorable than only adding text".

Figure 12: Cooperative learning will be used to explore light. (Image in the public domain)

Exploring - In exploring, students will be given the opportunity to conduct research on the history of light and its evolution. They will participate in activities that will allow them to explore various concepts of light and how it works. Students will have access to technology and other scientific materials to conduct research and complete varied activities to understand concepts taught.

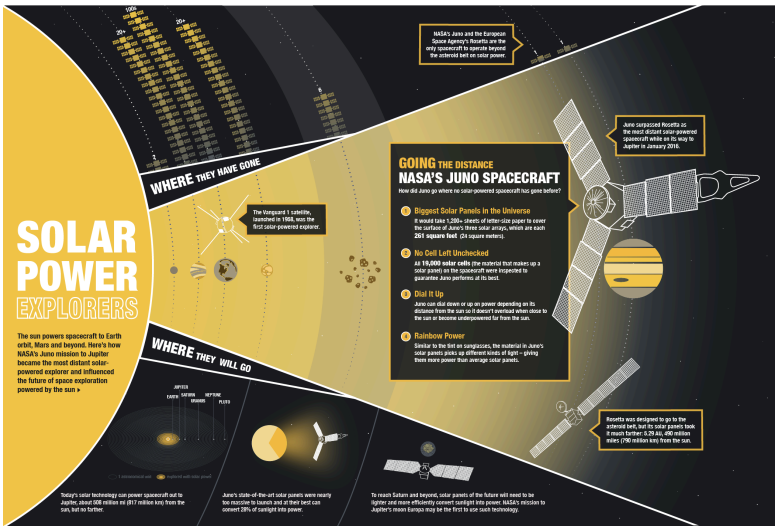


Figure 13: Students will learn about our understanding of light and the uses of light through their own research. (Image in the public domain)

Inquiry Based - Thought provoking questions will be posed to students during the teaching of this unit. These questions will be used to inspire students in thinking for themselves and becoming more independent learners. They will conduct investigations on their own prompting them to ask questions, develop and investigate their own ideas. Through inquiry based learning, students will develop and improve problem solving skills, which will allow them to gain a deeper understanding of all concepts being taught in this unit.

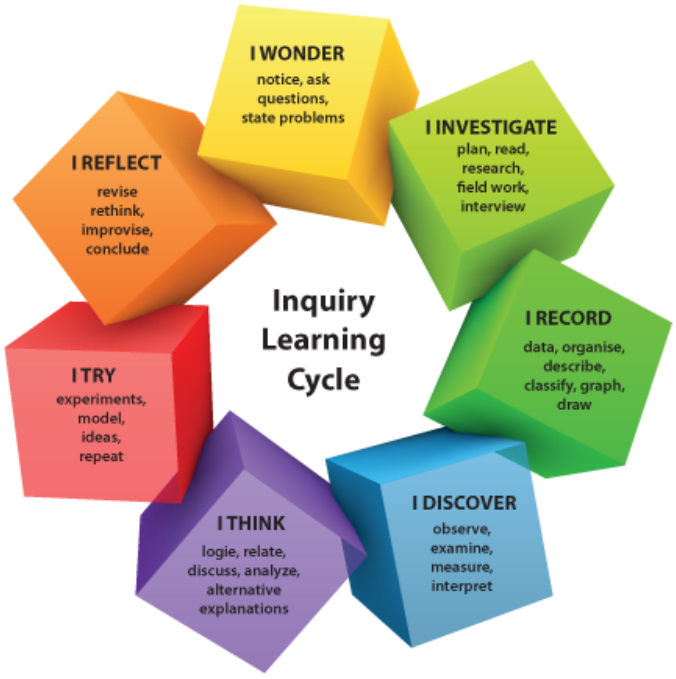


Figure 14: Inquiry-based learning is essential in science education. (Image in the public domain)

Visualize - Using pictures allows for students to better understand certain concepts. The teacher will be using various pictures and diagrams to explain concepts as this will assist students to be more inclined to participate in classroom discussions. The use of pictures will also aid students in making connections with new information being taught. Visuals assist with students' cognitive and emotional level.

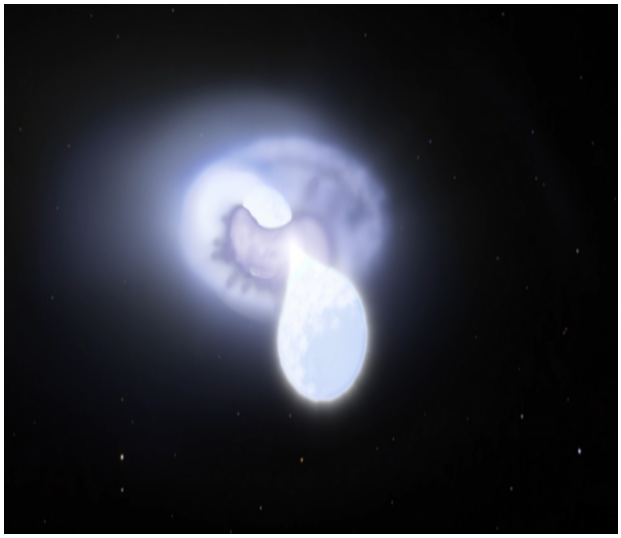


Figure 15: Visuals such as these will be used throughout the unit to aid student learning. (Images in public domain)

Lesson 1 Introduction of New Vocabulary. (Grades 3-5)
Light, Energy, Glow, Sun, Evolution, Wavelength, Photon, Solar Energy

Objective: 4.P.3.1 Recognize vocabulary words that are associated with the basic forms of energy (light, sound, heat, energy, glow, sun, evolution, wavelength, photon , solar energy, electrical and magnetic) as the ability to cause motion or create change.
4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical and magnetic) as the ability to cause motion or create change.

This lesson will be used to activate students' prior knowledge of the words they will be using in this unit.

Introduction
Engage:
Step 1: Students will turn and talk to peers and discuss any knowledge, if any they have of each word displayed. The words being introduced to the students are the vocabulary words associated with this unit. The class will then discuss the meaning of all words and use a Picture Dictionary Worksheet (See Appendix B: Adapted from: Education.com Learning Library, 2022).

Teacher will play a video: Where Does Light Come From? Students will write new words from the video to add to words given to them by the teacher.
https://www.youtube.com/watch?v=zBosbqByR3c

Step 2: Students will be shown various pictures associated with the topic, in a think-pair-share, students will discuss what they know about the pictures. What do all of the pictures have in common? (See Appendix C for some pictures taken from google images) How are they associated with light and its evolution?

Investigate:
Step 3: Using their computers, students will be allowed to work in pairs on finding additional definitions and pictures for their worksheet. This will allow them the brief opportunity of working freely together to explore new vocabulary.

Step 4: Students will complete their picture dictionary worksheet.

Wrap-Up
Step 5: Students will share their definitions and pictures.

Lesson 2: Research and Creating a Timeline on Light Evolution (Grades 3-5)

Objective: Students will be able to conduct research on individuals who played an important role in the evolution of light.

Introduction:
***Engage*:** Teacher will lead students into discussion on various scientists who were involved in light. Discussion will entail how far light has come (its evolution), based on students prerequisite knowledge. Questions will be asked such as:

1. How do you think ancient people lived without light?
2. Instead of light-bulbs, what do you think ancient people used?
3. Why do you think scientists began to design lighting fixtures and structures?
4. What is the importance of light?
5. Do you think people in today's world could function without light? Why or why not?

Students will then watch a few videos on the history of light and scientists who played a role in the evolution of light.
https://www.youtube.com/watch?v=OLCqaWaV6jA This video will explain what happened from Ancient Greece to the present day, where scientists have been studying light to try to penetrate the mysteries of its composition and how to measure it..
https://www.youtube.com/watch?v=9OJ7piwbbHc This video will discuss what is light, who discovered light, wavelength of visible light, and how do we perceive color?
https://www.youtube.com/watch?v=6_HroTxaZe0 This video will show Isaac Newton's discovery of the spectrum of light.
https://www.youtube.com/watch?v=iT2AdNK9l5Y In this video, Keith Ramsey explains how the first electric light, that was invented by Sir Humphry Davy in 1807, was created 70 years BEFORE Thomas Edison's lightbulb!
https://www.youtube.com/watch?v=XI4NTTDi3-E This video dives deeper into what is light, what it's made of, how it moves, and how it interacts with other objects.
https://www.youtube.com/watch?v=fti-sg2-6Q4 In this video, students will learn more on the invention of the light bulb by Thomas Edison and how it changed the way the world lived.

Investigate:
Students will be placed in groups of 5.

Activity 1: The first activity they will conduct is research on the history and evolution of light. Based on the videos watched and information gained from discussion, they will create a timeline to show how light has evolved including the scientists and the role they played. Students will be asked to be creative with their timeline, as they will be presented and displayed.

Activity 2: Students in their groups will be given one scientist that played a role in the evolution of light (Isaac Newton, Humphry Davy, Christiann Huygen or Thomas Edison). They will be given 2 weeks to meet in class and possibly outside of school via Google meet. They will conduct research on the scientist and give a presentation to the class. Their presentation must include: Scientist Biography (2 paragraphs), pictures of scientists working on light. What was their invention of light? The impact their invention on light has on society today, and what if anything they would change as a scientist. Presentations must be presented using google slides.

Wrap-Up: Students will present timelines and research projects which will be displayed in the Science lab and in the school's hallway.

Lesson 3 (Grades 3-5) Using prisms to show Refraction and Dispersion

Lesson partially adapted from:
https://sciencing.com/ideas-for-science-fair-projects-with-light-12748014.html
https://study.com/academy/lesson/prism-lesson-plan.html

When light enters a prism, it does not travel directly through it but the path gets bent.

Objective: 4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium or another, and that light can be reflected, refracted, and absorbed.
4.P.3.2 Students know that light travels in a straight line. Students know that light can be refracted, reflected, and/or absorbed.

- Define the terms 'prism,' 'refraction' and 'dispersion.'
- Explain how a material's index of refraction affects the speed of light
- Explain how the different wavelengths of visible light create dispersion

Engage:
Begin the lesson by placing a spoon into a large beaker and ask the class what they see.

Show students an image of a rainbow in clouds or mist and ask students to describe how rainbows are created. Do they know how the two processes are related?

Explain to students that they are witnessing refraction and that they will learn more about this phenomenon in today's lesson.

The students will be asked:

What do you think will happen when you shine a light source through a prism at a piece of paper?

They will then be directed to watch this video on What is a Prism? Definition and Refraction

https://study.com/academy/lesson/what-is-a-prism-definition-refraction-quiz.html
As they watch this video, pause and ask:

1. What is a prism?
2. Define the term refraction.
3. How does the density of a material affect the speed of light?
4. Why does light slow down as it passes through a material?
5. What are two properties of lightwaves?
6. Which color has the longest wavelength? Which has the shortest?
7. What is dispersion?

Students will then watch another short video on using a prism to show refraction.
https://www.youtube.com/watch?v=KgqV975EtA0

Discuss: When light enters a prism it is refracted. Each color of the spectrum is refracted by a different amount and the colors are dispersed (spread out) allowing you to see them. A prism is a great way to demonstrate visually that white light is actually made up of 7 different colors (Science Sparks.com, 2022)

Investigate:
Materials: Triangular prism, white cardboard, white sheet of paper, glass, crystal, jewels, liquids (water, mineral oil, etc), flashlight, lamp, candles.

Step 1: Students will be asked to mark on the piece of paper where they think the light will shine.

Step 2: They will work in pairs to shine the light through the prism.

Step 3: Students will make observations by drawing and taking notes of what they see.

Step 4: Teacher will ask students what is happening. They should be able to discuss that as the light travels through the prism, it becomes refracted and actually displays itself in a spot at an angle opposite to where the light source is. Upon passage through the prism, the white light is separated into its component colors - red, orange, yellow, green, blue and violet. The separation of visible light into its different colors is known as dispersion.

Teacher: Light can become bent as it travels through the prism.

Extension:
Using household items, students will work together and explore light refraction. They will shine a light, to see whether or not they can create and measure the conditions that produce a rainbow in each object.

For higher level students, they will focus more on the actual bending of light. Using different substances, they can measure refractive indexes or see whether density is an indicator of refractive indexes or if changing the temperature of a refractive liquid affects the refraction index.

Lesson 4 Grades 3-5 Light Reflection and Vision

I adapted this lesson from Generation Genius: I use this website for some of my science lessons. There are very great lessons and DIY available.
https://www.generationgenius.com/videolessons/light-reflection-and-vision-video-for-kids/

Objective: 4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium or another, and that light can be reflected, refracted, and absorbed.

Engage: Teacher will begin lesson with discussion questions:
Where does light come from?
Is light necessary for us to see objects? Why or why not?
How does light travel from place to place?
Teacher will then explain to students that for today's lesson, they will be watching a video on light reflection and vision. https://www.generationgenius.com/?share=8B61E
They will learn from this video that:

- Light travels in a straight line and reflects off of things.
- We can see because light reflects off objects and enters our eyes.
- Our eyes do not produce light, they only detect it.

Explore: After watching the video and having a discussion with the teacher. Students will begin their DIY project. Students will use light reflection to create an illusion that looks like a hologram!

Materials: Video on a black background. Example :
https://www.generationgenius.com/wp-content/uploads/2018/03/Clip-For-Generation-Genius-Light-Reflection-DIY.mp4
Large screen (Ipad or Tablet)
Sheet of clear plastic
Role of tape
Box or doll house (should be large enough for the sheet of clear plastic to fit inside diagonally)
Instructions: Download the video in the materials section, or make your own on a black background.
Cut a hole in the side of the box to fit your tablet. Tape it in place.
Place the sheet of plastic diagonally inside the box and secure it with tape.
View the video from the front, and adjust the room lighting to make it look realistic.

Explain : Teacher will allow students to explain what is happening.

How It Works

This may look like a high-tech effect, but we are simply using light reflection. The light from the video is reflected off the surface of the clear plastic. Since the plastic is at an angle, the reflection is visible from the front of the box. Since the plastic is also transparent, you can see through the image as well, giving it a ghostly effect.

Elaborate: Students will apply what they have learned by drawing pictures of DIY with explanation. The higher level students will develop another DIY with different materials to show the same concept.

Evaluate: Students will complete exit ticket questions:

Level 1

What are 3 different sources of light?

Level 2

List 2 materials that are good reflectors of light.

Level 3

Does light reflect off black objects? How do we know?

Appendix A
Content and teaching standards

4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical and magnetic) as the ability to cause motion or create change.
4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium or another, and that light can be reflected, refracted, and absorbed.
4.P.3.1 Students know basic forms of energy: light, heat, sound, electrical and energy of motion. Students know that electricity flowing through an electrical circuit produces magnetic effects in the wires. In an electrical circuit containing a battery, a bulb, and a bell, energy from the battery is transferred to the bulb and the bell, which in turn transfer the energy to their surroundings as light, sound, and heat (thermal energy).
4.P.3.2 Students know that light travels in a straight line. Students know that light can be refracted, reflected, and/or absorbed.

Appendix B
Picture Dictionary

Name: _____ Date: _____

Picture Dictionary

Fill in the chart below to create your own picture dictionary.

Word	Draw a picture of the word.	What does it mean?	Use the word in a sentence.

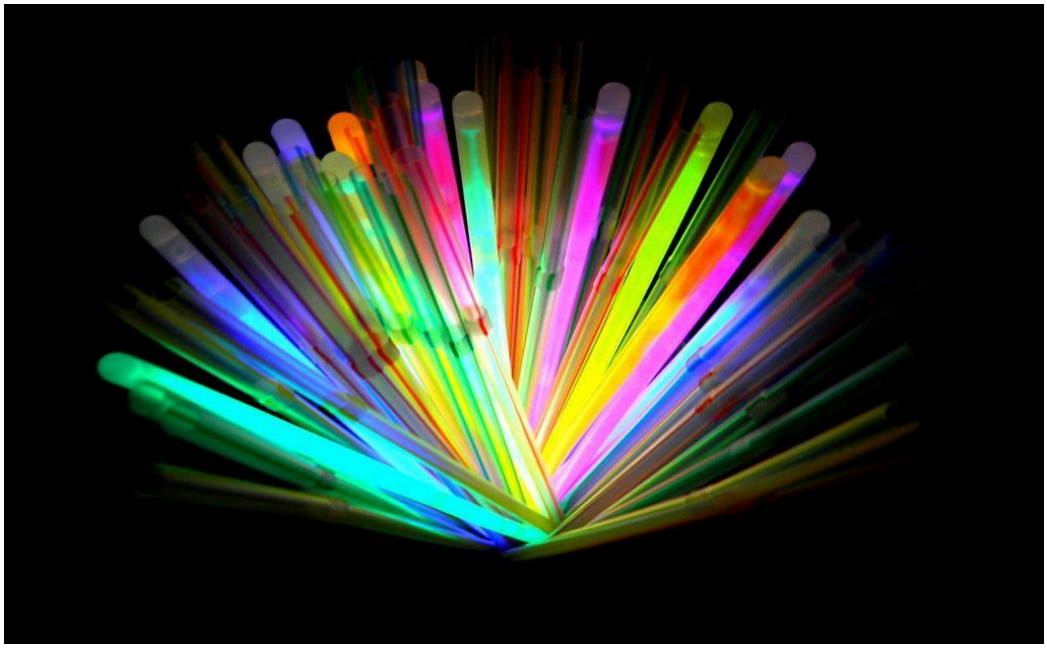
Image retrieved from: https://www.education.com/worksheet/article/picture-dictionary/

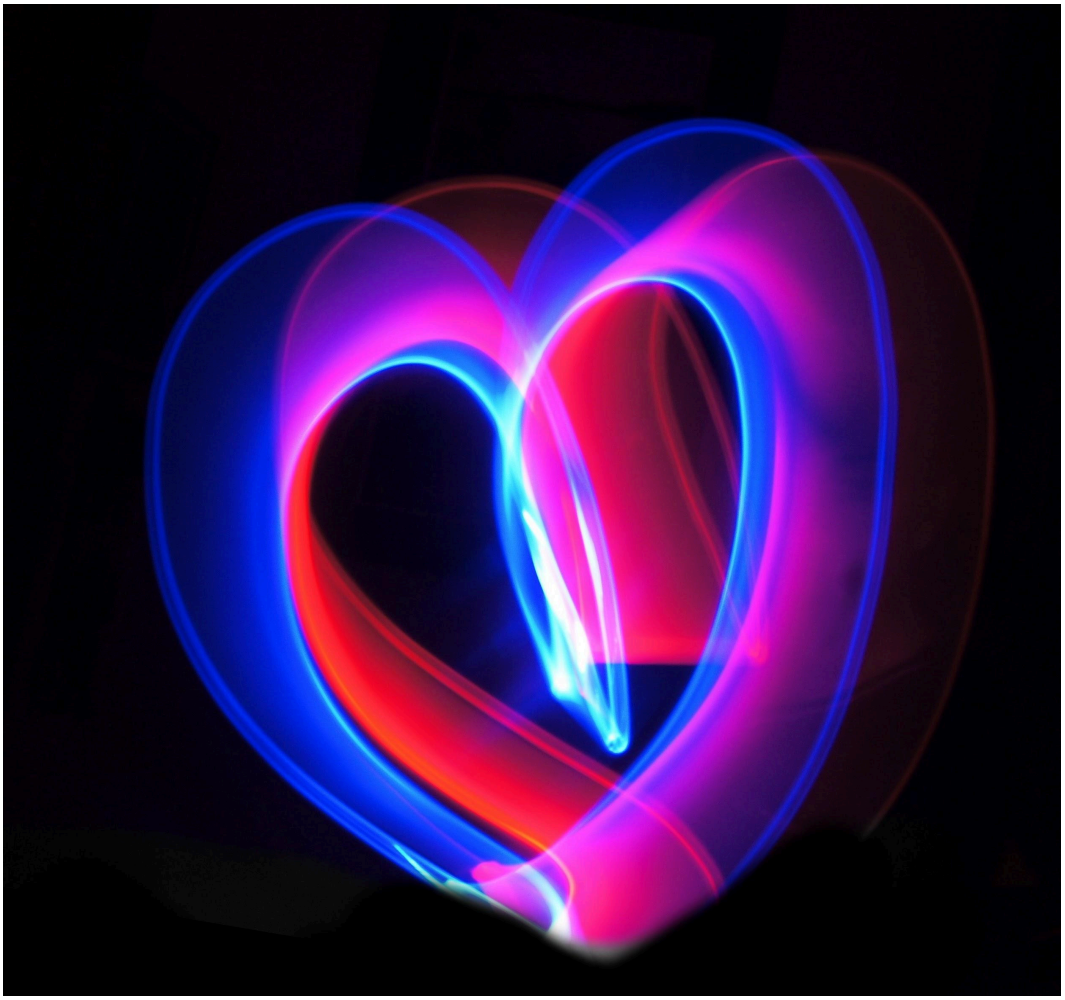
Appendix C
Sample Pictures for Lesson 1
(Images in the public domain)

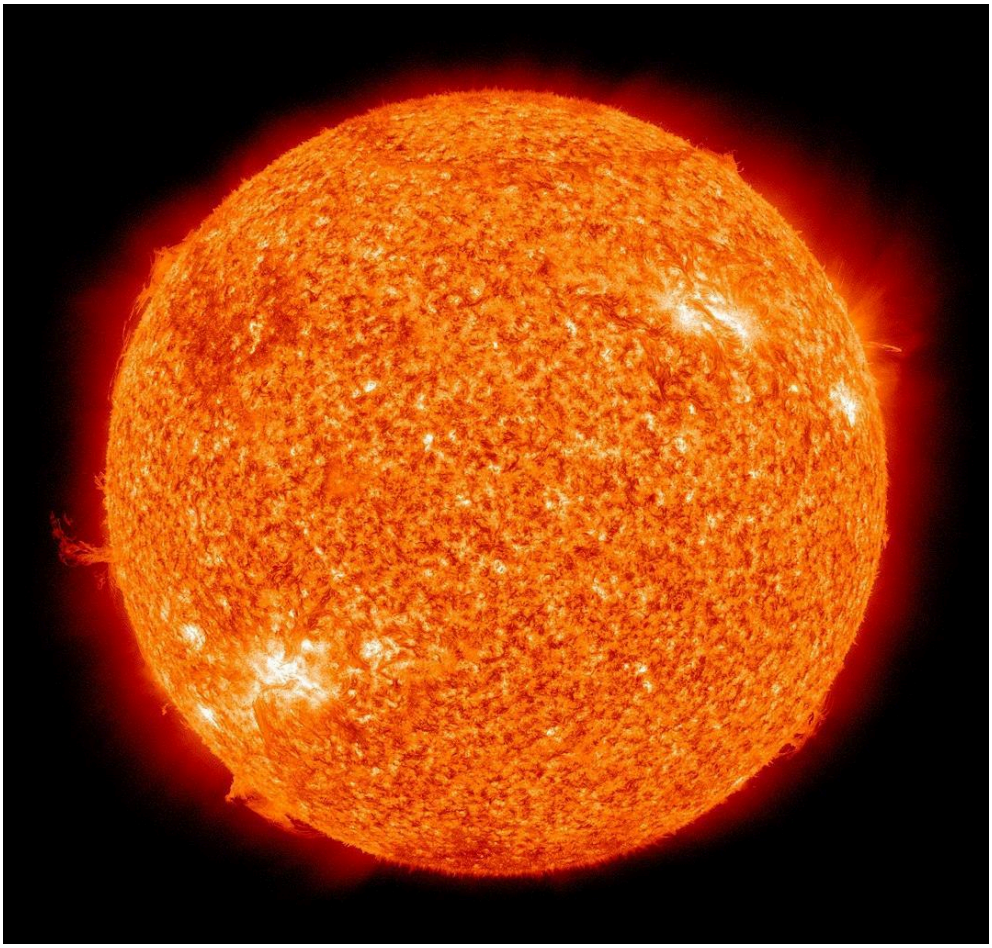
Light

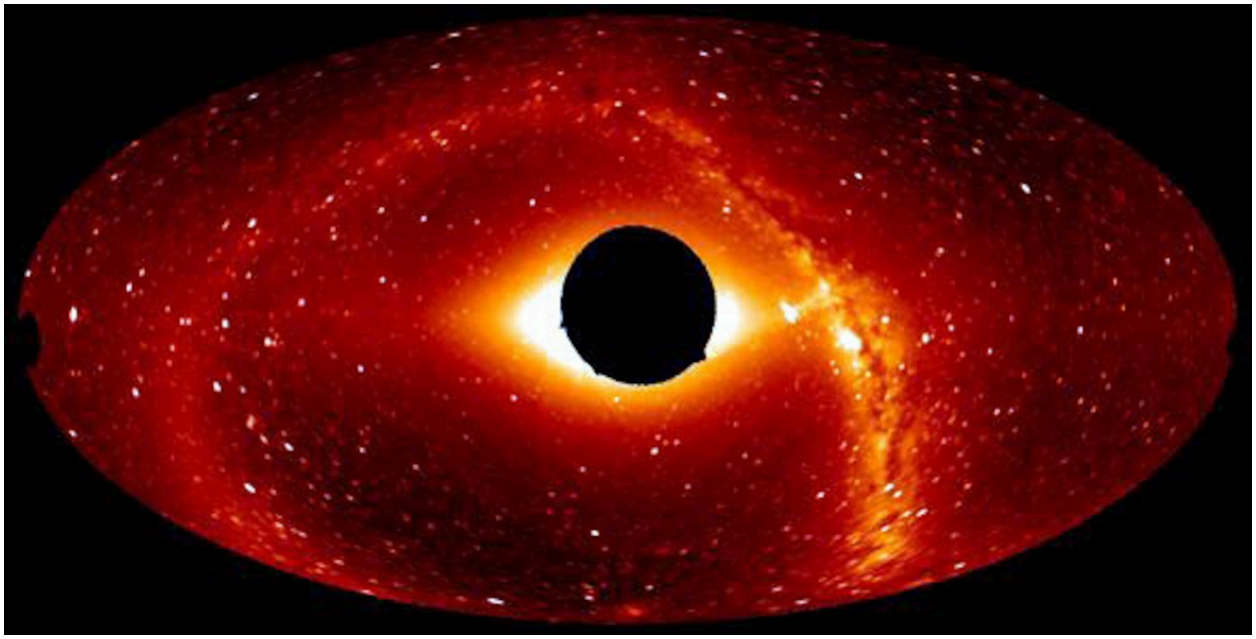
Energy

Glow

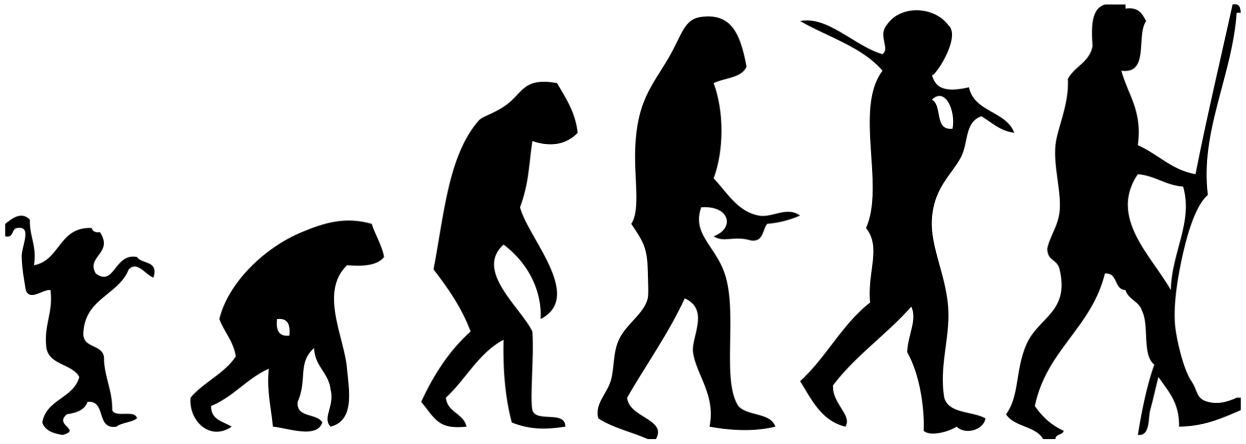


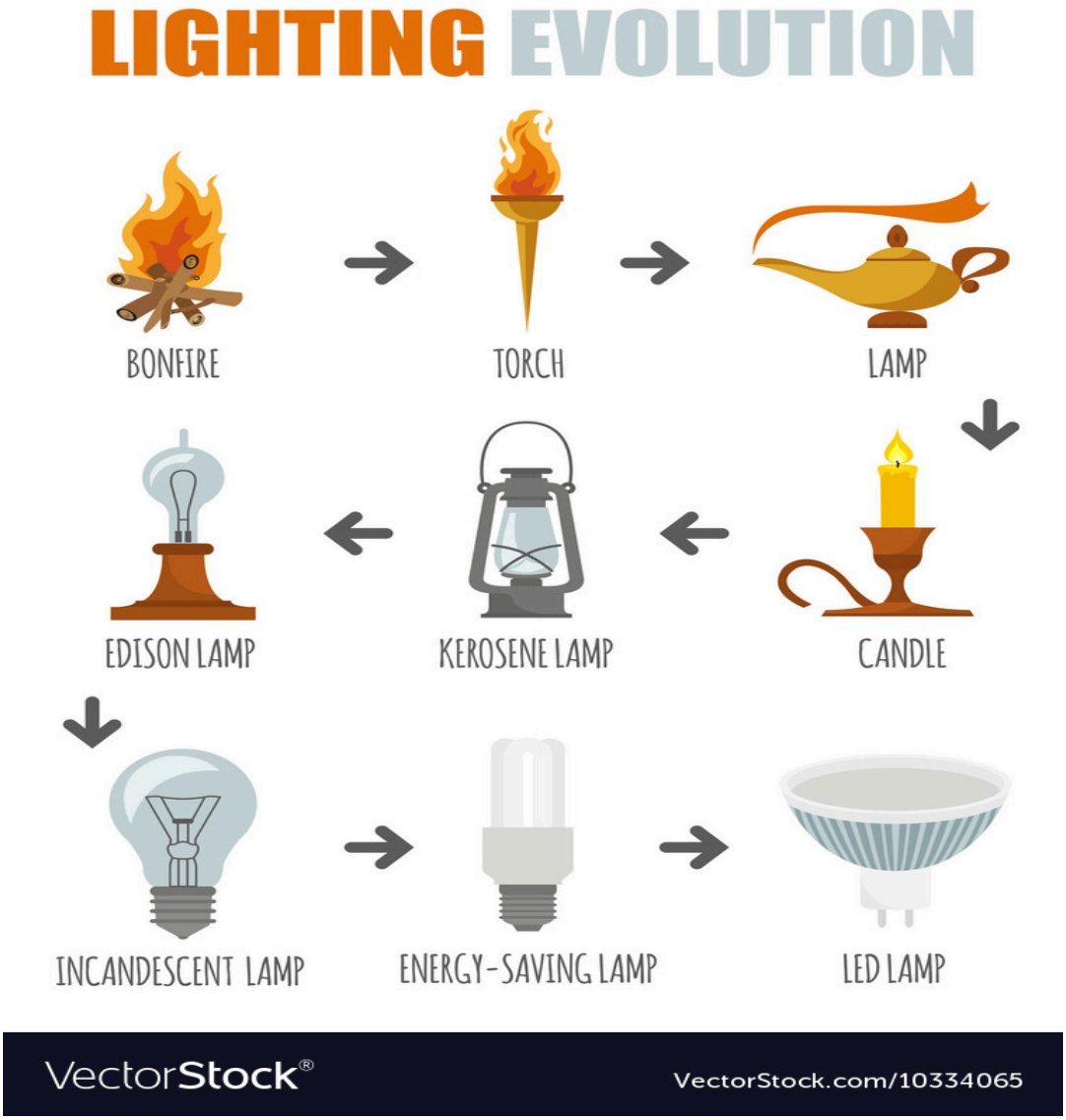


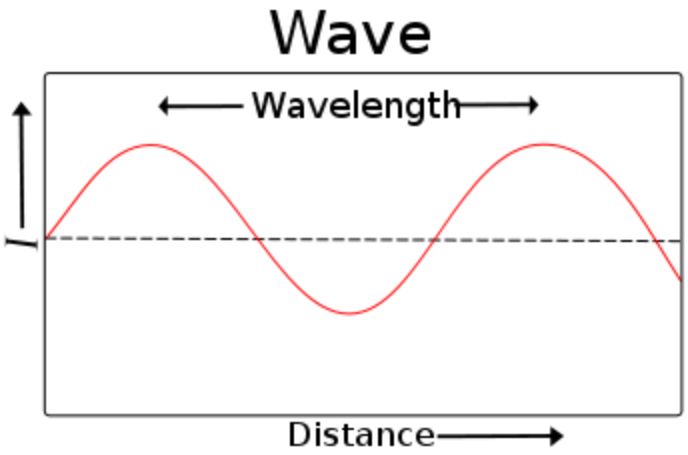




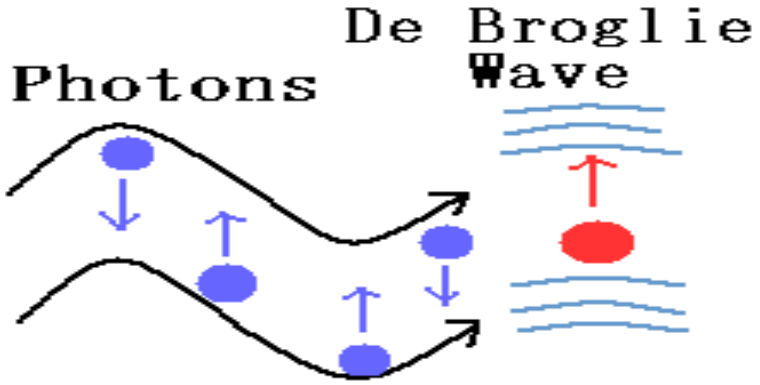
Evolution

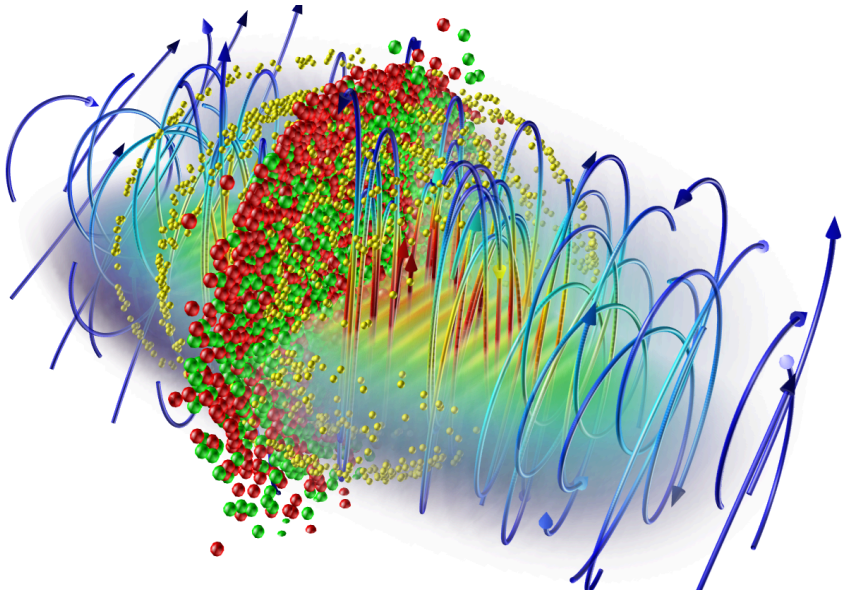



LIGHTING EVOLUTION
BONFIRE
TORCH
LAMP
CANDLE
KEROSENE LAMP
EDISON LAMP
INCANDESCENT LAMP
ENERGY-SAVING LAMP
LED LAMP
VectorStock®
VectorStock.com/10334065



Photons





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