Bay Area Scientists in Schools Presentation Plan

Lesson Name Light and the Electromagnetic Spectrum
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Grade Level 3rd

California Science Standards Connections:

Energy comes from the sun in the form of light. There are many kinds of light, some of which are not visible.

Next Generation Science Standards:

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated.
1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.
1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ・Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ・Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena (1-PS4-2) ・Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)	PS4.B: Electromagnetic Radiation ・Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2) ・Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)	Cause and Effect ・Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3) ---------- Connections to Engineering, Technology, and Applications of Science Influence of Engineering, Technology, and Science, on Society and the Natural World ・People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

Common Core Standards:

ELA/Literacy:

SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Mathematics:

MP.2 Reason abstractly and quantitatively.

MP.5 Use appropriate tools strategically.

FOSS Connections:

Grade 3 Module: Matter & Energy

Investigation 2: Light

Abstract: Many of you have seen a rainbow, do you know how it is formed? Did you know that there are types of light we can't even see? In this lesson we will introduce the students to the electromagnetic spectrum and will use prisms, UV beads, and diffraction gratings to help them visualize some of the sections of the spectrum that cannot be seen with the naked eye.

Objective:

In this lesson students will learn the different sections of the electromagnetic spectrum and the places where we can encounter them in our everyday lives. Students will learn that the sun emits more than just visible light.

Vocabulary/Definitions: 3 – 6 important (new) words

- Electomagnetic spectrum
- Radio
- Microwave
- Infrared
- Ultraviolet
- X-ray

Materials:

What will you bring with you?

- UV Beds
- Cardboard
- Tape
- Markers
- Defraction gratings
- Prism
- Flashlight
- Laser
- Poster of the Electromagnetic spectrum

What should students have ready (pencils, paper, scissors)?

None

Classroom Set-up:

While showing students the Electromagnetic spectrum, students will sit on the floor around the presenters. Will need sunlit and dark areas onto which students can place UV beds

Blank white (or light-colored) wall to project rainbow from the prism

Classroom Visit

1. Personal Introduction: 5 Minutes

I'm Mariana, I study eyes and vision.
I'm Adam, I study astronomy.
We're both interested in light and the different parts of the electromagnetic spectrum [write word on the board].

Topic Introduction: 15 Minutes

What do you know about light? Where do you think it comes from? Do you think there are kinds of light that we can't see? [write answers on the board]. How many of you have used a microwave? Had an X-ray? Microwaves and X-rays are types of light, even though we can't see them.
Light is a form of energy that travels in waves from its source. Can you think of some sources of light? [write answers on board].
The light we see is part of a group of waves called the electromagnetic spectrum – some of these waves are long, others are short. There are parts of the spectrum that we can see, but there are others that we cannot.

2. Learning Experience(s): 30 Minutes

Illustrating waves:

What does a wave look like? Who wants to come to the board and draw a wave?
The top of a wave is called a crest [label this on the drawing], while the bottom of the wave is called a trough [label this area on the drawing]. The distance from crest to crest of from trough to trough is called the wavelength.

Discussing the EM spectrum:

[Presenters and students sit on the floor, presenters are holding a poster of the electromagnetic spectrum]. Notice that the electromagnetic spectrum goes from very long waves to very short waves. We cannot see the parts of the spectrum with very long or very short waves. We cannot see the parts of the spectrum with very long or very short waves. Let's look at some

examples of very long waves: radio waves, microwaves, and infrared waves. Can anyone give me examples of when we encounter these in our lives? Radio waves are what we use for cell phones, satellites, and GPS. We use microwaves to heat our food, infrared rays are experienced as heat.
Now let's look at examples of very short waves: X-rays and ultraviolet (or UV) rays. Has anyone here ever had an X-ray? X-rays are high energy waves that can go through our skin, they are used by doctors to look for bone fracture. Who has heard of UV rays rays? What can they do to you? Ultraviolet rays are very high in energy and can damage your skin cells, which is why it's so important to wear sunscreens, hats, and sunglasses when we go outside.

<u>UV beads:</u>

We normally cannot see UV light, but there is a special kind of plastic that changes colors when it's exposed to UV light. We brought some of these beads with us today and you'll get the change to see how they work. Could each of you come up here and get on UV bead, one piece of cardboard and a piece of tape. Tape the bead to the cardboard and write your name on it. now let's split you in tow groups: half of you go to the sunny side of the room, and half of you to the unlit side. What can each of you see? If you cover the beads with your hands, what happens? Now let's switch sides. What do you think is happening? When you are in the sunny side of the room, the UC rays from the sun can hit the beads and turn them purple. When you move to the unlit side of the room, there are no UV rays to hit the bead, so it turns transparent again.

<u>Breaking up the visible light spectrum:</u>

The only electromagnetic waves we can see are the ones in the middle of the spectrum – we call this section visible light. Visible light appears white to our eyes, but it actually includes all the colors of the rainbow: red, orange, yellow, green, blue, indigo (purplish blue), and violet. Which color do you think has the longest wavelength? Which has the shortest?
TO see how white light can be broken up, we're going to shine a very powerful white flashlight onto this prism. What can you see?
The prism bends each component of white light differently, so we can see the entire visible light spectrum. What do you think would happen if we shine a non-white light onto the prism? [shine a laser onto the prism]. A laser is what we call a monochromatic beam, it's composed of only one color. So when we shine a laser onto the prism, we don't see a spectrum of colors.

We don't always need a prism and flashlight to break up white light, we can also use a diffraction grating. Now we're distributing a diffraction grating, which you can take home with you – use this grating to look at different light

sources, such as different light bulbs. Just be very careful not to look directly at the sun, as this can seriously hurt your eyes.

If you have spare time, discuss where rainbows are formed: A rainbow is created when white light from the sun passes through tiny droplets of water in the air. After a rain storm there are many of these little droplets in the air. The white light separates into the colors the rainbow.

3. Wrap-up: Sharing Experiences ____5____ Minutes

In your own words, who can tell me what light is?
What are the parts of a wave? What is wavelength?
The electromagnetic spectrum has visible and invisible components. What are some examples of invisible components of the spectrum?
What causes sunburns?
How does a rainbow form?

4. Connections & Close: ____5____ Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

Have you ever noticed that not every lightbulb is the same color? Come are more yellowish, others are blueish. Why do you think this is? If you were to look at these lightbulbs with your diffraction grating, what do you think you would see?

Interesting websites: http://solar-center.stanford.edu/webcast/wcpdf/SunBurns2-4.pdf

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to construct the UV bead apparatus. Write vocabulary, e.g. light, waves, on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action, and/or redefined in very simplistic terms.

Advanced Learners: Have students think of different places they believe there may be visible or invisible light. Students may write down their hypotheses.

Follow-up Possibilities

ELA Activity:
Students answer the following prompt:

"Write a letter to a friend explaining what you learned about the electromagnetic spectrum and how it affects our everyday lives.

Reading Connections:

- Waves: Principles of Light, Electricity, and Magnetism (Secrets of the Universe) by Paul Fleisher http://www.amazon.com/Waves-Gloria-Skurzynski/dp/0792235207

Mathematics Activity:

Have students measure, record, and graph the heights/widths of different waves in the electromagnetic spectrum.

Other:

Students can learn more about the benefit of sunscreen by conducting the following activity: Before the lesson, soak several beads in sunscreen and let dry for at least an hour. Divide the students into two groups, give one group the treated beads, and the other group the normal beads. Have the each student place his/her bead onto a sunny surface, then have them record what happens to the bead. Discuss how sunscreen can protect our skin from harmful effects of UV rays.

See the Light (American Museum of Natural History) - In this three-part activity, learners conduct simple experiments to see how light refracts and reflects, and how colors of light affect what we see. Use these activities together or individually to explore properties of light. http://www.amnh.org/ology/features/stufftodo_einstein/seelight.php?TB_iframe=true&height=500&width=740

Rainbow in the Room (Baylor College of Medicine) - This activity generates learner excitement about light through the creation of a room-sized rainbow. Learners also make their own "rainbow" drawings that incorporate the sequence of colors they observe. For a dramatic effect, set up rainbow projection while learners are out of the room. This activity guide includes background information and variation ideas. http://www.k8science.org/resources/files/Global_02_s.pdf