Community in the Classroom Presentation Plan

Lesson Name Optics and Light
Presenter(s) Gautham Venugopalan

Grade Level 3 **Standards Connection(s)** Sunlight can be blocked to create shadows. Light is reflected from mirrors and other surfaces. We see objects when light traveling from an object enters our eye.

Abstract:
Your opportunity to tell teachers and kids what's going to be fun and interesting about your visit!
Light is a fascinating form of energy. The properties of light are responsible for things we take for granted every day such as mirrors, shadows and eyeglasses. In this lesson we will demonstrate and experiment with many aspects of the science of optics. Students will learn about refraction by performing the "Disappearing Penny" illusion – a trick sure to impress people of all ages! They will also learn how to construct their very own liquid lens using everyday objects.

Vocabulary/Definitions:
3 – 6 important (new) words
Optics
Light
Mirror
Lens
Reflection
Refraction

Materials:
What you'll bring with you
Clear plastic cups
Pennies
Newspaper
Plastic Wrap
Transfer Pipets (they're kind of like plastic eyedroppers, but for a lab)

What students should have ready
Clear desks
Inquisitive minds

Classroom Set-up:
Need access to water – approx ½ cup for every 2 students.
Students should be in groups of 2-4.

Classroom Visit

1. Personal Introduction: 5 Minutes
Who are you? What do you want to share with students and why? How will you connect this with students' interests?
I'm Gautham, I study bioengineering. My job is to study very small cells. Cells are really small so your eyes need help to be able to see them. In the lab we use fancy microscopes help us see small things, taking advantage of some interesting properties of light. This branch of science is called optics. [Write optics on the board]

Topic Introduction: 10 Minutes
Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?
Light allows us to see things. [Write light on the board.] Light is a form of energy. Light travels in rays from a source. (Demonstrate with a flashlight) Who can think of a source of light? [Stars/sun, light bulbs (various types),

monitors/TVs, lightning, fireworks, fireflies, glowsticks, etc.] Is the moon a source of light? Who says yes? Who says no? Those of you who said no, how come we can see the moon at night when it is dark? The moon reflects light from the sun to us. [Draw a picture on the board showing reflection, write reflection on the board and define] A reflection is when light travels from a source and bounces off of an object in a different direction. This is how we see objects which are not sources of light. Light travels from a source, reflects off of an object, and enters our eye. It's also how mirrors work. [Write mirror on the board]

2. Learning Experience(s): 30 Minutes

Demonstrations, hands-on activities, images, games, discussion, writing, measuring… What will you do, what will kids do? Describe in order, including instructions to kids.

Disappearing Penny:
Raise your hand if you like to go swimming. Have you ever looked down in a pool to see the bottom? What does an object on the bottom of the pool look like? [Clear or fuzzy image? Looks closer or further?] How does this compare to what the object looks like on land? Does anyone have a hypothesis to explain this? We're going to do an experiment now to find out.

Pair students up and pass out one plastic cup and one penny to each pair. Place the penny under the cup. Looking through the side of the cup, can you see the penny? Now fill the cup with water while looking through the side of the cup. What happens to the penny? [An image forms at a different location (It may disappear completely depending on the viewing angle.)] Let each member of the team look through the side of the cup and try it out.

Why did the penny move/disappear? When light comes out of water into the air, it bends, making things look different underwater than they do on land. This is called refraction. [Write refraction on the board. Draw a picture on the board. Explain the difference between reflection and refraction.] This is also how a lens works. [Write lens on the board] When you look through a lens, it changes the way things look. Lenses can make things look bigger or smaller than they really are. Can anyone think of a time they used a lens? [Answers like microscopes, telescopes, eyeglasses, binoculars, magnifying glasses, cameras. Have a couple of lenses for display after class if there is time.]

Water Lens:
Instead of using refraction to make things disappear, we can also use it to help us see things better, like in a lens. Making lenses is a very precise science. There are three things which are important in making a lens. The material that the lens is made out of, the material that is around the lens, and most importantly the shape of the lens.
In the last activity we learned that light passing through water will refract by the time it gets to your eye. This time we are going to control the shape of the water to make a simple lens. Every group needs to have a newspaper, some plastic wrap and a transfer pipet. [Pass out plastic wrap and newspaper and transfer pipets] Take the newspaper and lay the plastic wrap on top of it. Now make a small drop of water on top of the plastic wrap using the transfer pipet, in a place where there is some text beneath it. Look at the writing through the drop. Does it get bigger or smaller? What happens when you change the size of the drop? How does the shape of the drop change when it gets bigger or smaller? How does this affect the magnification?

3. Wrap-up: Sharing Experiences and Building Connections 10 Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?
What is optics?
Who can tell me in their own words - what is light?
Why can we see things which are not sources of light? (reflection)
How does a mirror work? (reflection)
How does a lens work? (refraction)
What is the difference between reflection and refraction?

4. Close: 5 Minutes

How can kids learn more? Thanks and good-bye! Clean-up.
Next time you are in a car, look at the passenger side rearview mirror. It says "Objects in the mirror are closer than they appear." Think about why this would happen. (The shape of a mirror and the viewing angle affects the size of the image).
Next time you're outside on a sunny day, observe your shadow. Why do you have a shadow? Does the shadow change depending on the time of day?

TOTAL 60 Minutes

Follow-up – After Presentation

Suggest students write a letter explaining "How we learned about _____?"
List or attach examples of activities, websites, connections for additional learning.
Attach worksheets, hand-outs, visuals used in classroom presentation.

Ask kids to summarize what they learned in a letter. Also I'm not a good artist, so I like it when people give me drawings.

Links:
The Exploratorium has optics and light resources:
http://www.exploratorium.edu/snacks/iconlight.html

More information and activities demonstrating microscopes is available here:
http://microscope.fsu.edu/optics/activities/students/

A fun ray tracing tool to experiment with lenses, mirrors, and lots of other stuff:
http://silver.neep.wisc.edu/~shock/tools/ray.html

Follow up activity:
The shadows activity attached is a good way to combine optics and light with astronomy. Students will learn about how the sun changes position throughout the day as well as how sunlight can create shadows.

Shadows Activity:
Supplies needed: chalk, a sunny day

1) Pair the students in groups of two.
2) Take them outside and have them trace each others' shadows on the ground.
3) Write their names in their shadows and mark where their feet were and which direction they faced when they traced.
4) Repeat steps 2 and 3 throughout the day.
5) Observe how the shadow changes shape and direction as the day passes. Why does this happen? The light source is changing position relative to you because of the Earth's rotation. This makes the shadow change size and direction.