

## Luzvimenda's Light

By Stephanie Meyen, Aysha Imtiaz, Jake Hunter, Beth Hunter, Grant Cowell and Nathan Price, PhD.

Illustrated by Bella and Jake Hunter.

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### **Light Allows Us to See: Luzvimenda's Light**

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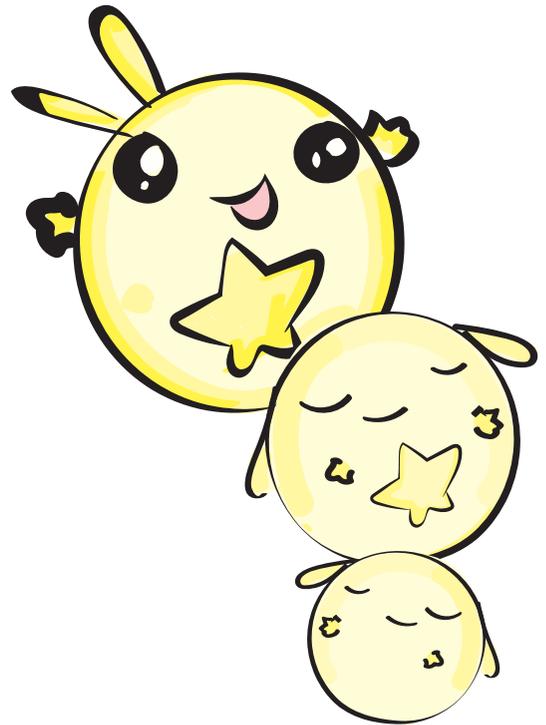
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**STEMtaught® Grade 4**  
**Next Generation Science**

**Waves and Their Applications in Technologies for Information Transfer 4-PS4-2:** Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.





# Luzvimenda's Light

## Part 1: Luz means light

My Tatay (father) works in the fields at the Sunbeam Farm Corporation. Sometimes, I bring him lunch and we eat together under a magnificent banyan tree. I love the way that light dances on the ground all around us as we sit in the shade. Light finds its way through and between the translucent leaves of the tree's canopy. Rays of light dance among the leaf shadows on the ground.

When I look at the light, I think of my name. My name, Luzvimenda, is a very old name, deeply rooted in my Filipino culture. My name comes from the three Philippine islands: Luzon, Visayas, and Mindanao. Maybe it's just a coincidence, but Luz means light in Spanish, and I think light is beautiful.

I eat my Kare-Kare and stare at the beautiful shadows and light. Kare-Kare is my mother's favorite meal to cook. It is a stew made from oxtail and vegetables cooked in a peanut sauce. Tail is the least expensive meat we can get from the marketplace because it is mostly bone, but I like how tail meat tastes.

As we eat, I can see Tatay's face crinkle up as he smiles. His smooth, tanned skin folds into a million well-worn crevices. I can't always see him this clearly when we eat together at home because it is quite dark inside my home.

Why do you think Luzvimenda can't see her Tatay clearly at home?



What material does sunlight shine through in this part of the story?



How does light interact with this material?

## Part 2:

# I live in gray shadows

I live in Sitio Malagaya which is a poor town right next to a railroad. We don't have electricity and our houses are crammed right up against one another, so windows cannot be used to let light into our homes. My home is made with thin metal walls and a thin corrugated metal roof. It's dark in my home because sunlight cannot pass through our metal roof. The walls are gray. The roof is gray. Because it is so dark, everywhere inside my house is gray—the dullest, dreariest shade of gray imaginable.

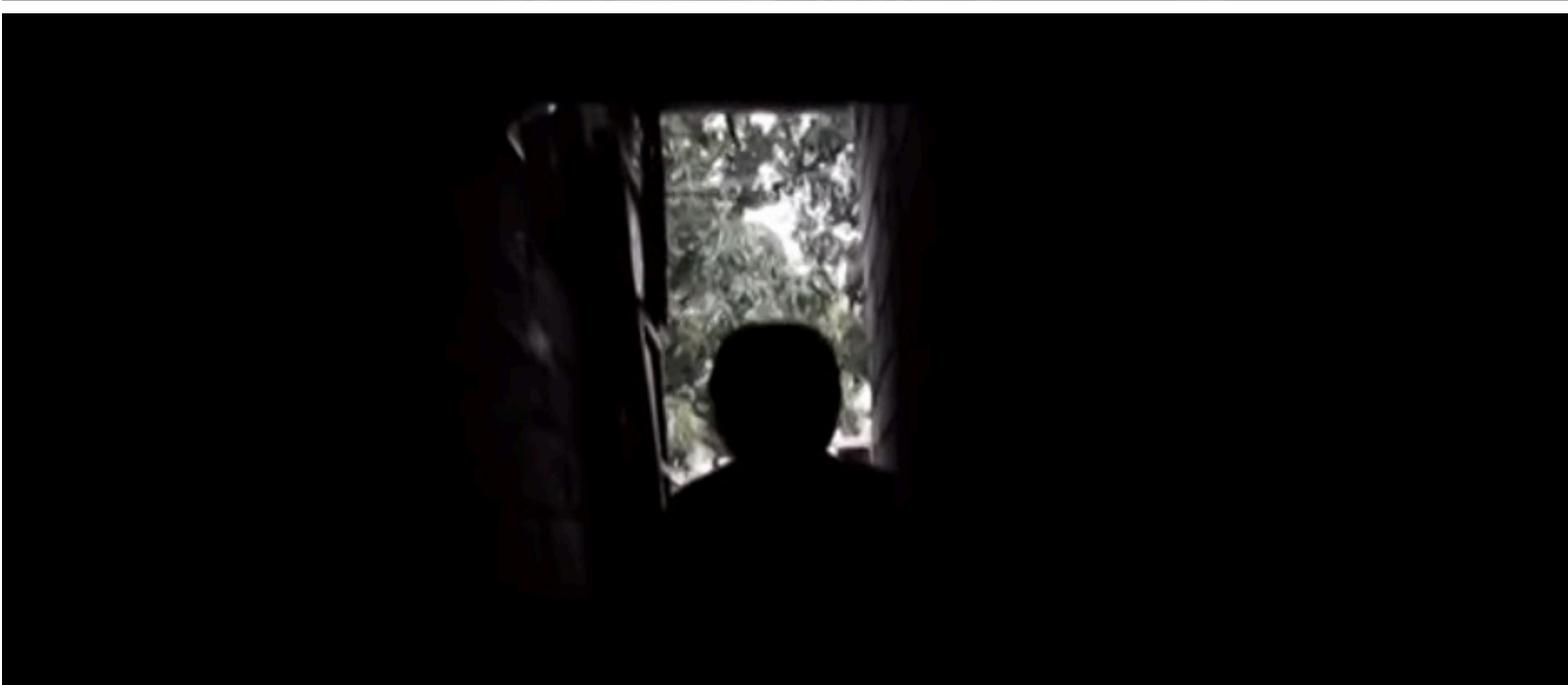
My family lives in just one large room. The room becomes the kitchen when we cook, the dining room when we eat, and our bedroom when we sleep. My brothers and sisters share a bed mattress but I like sleeping in my very own hammock. I make myself swing back and forth while I fall asleep. At night, I like the darkness inside our home and the pitter-patter of rain on our metal roof puts me to sleep.

During the day, we leave the door open all the time to let light in. My Nanay (mom) chops food near the door where there is more light. When she cooks over a fire, the room is dimly lit. The cooking pot, however, absorbs most of the fire-light. I think the pot looks like an angry black blob sitting on the cheerful orange flames. Eventually, the fire burns down to red coals that don't really light the room at all.

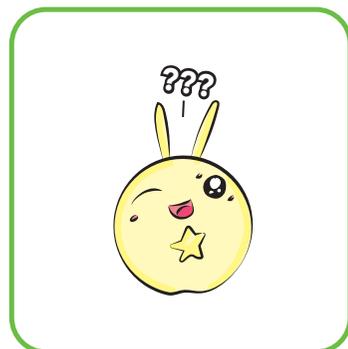
What stops light from entering Luzvimenda's house?



How does light interact with that material?



What object blocks the light of the fire?



How does light interact with that object?

My grandmother Lola tells me stories about the time there was an abundance of land, and not an abundance of houses. Each family had a large patch of sky to call their own, she'd say. Bright rays of sunlight came in through clear glass windows. They could see everything inside their houses.

Grandmother used to weave beautiful baskets with elaborate patterns, but now, because it is so dark inside our home, she just sleeps all day. Sometimes, at night, I can hear her singing basket weaving songs in her sleep and her fingers twitch with her memories as she dreams. The only thing I go to sleep wishing for each night is a little light—a little patch of sky or ray of sunshine to call my own.



How did light enter houses in the past before Luzvimenda's community became crowded?



How does light interact with that material?



### Part 3: Crunch, crunch, curiosity

Since it is so dark in my home, I just play outside all the time. I guess it's not a bad thing because I like to play outside anyway. Football (soccer) is my favorite sport. Unlike baseball or basketball, you don't need a hoop or special playing field. All you need is a ball and an alley wide enough to run up and down. In our alley, we made two goals by piling up boxes and put them on either end of the lane.

Meng Demi, our neighborhood uncle, helped us. He's always making things to help people. Not everybody realizes how important his work is, but it's important to help other people, even if it's just helping some kids make a pile of boxes.

When I play football, I play very, very hard! As we play you can hear the crunch, crunch beneath our feet since there is so much litter on the ground. Travelers throw their trash from the train. The brightest colors in my neighborhood come from the colored plastic packaging and the grocery bags strewn around by the wind. All the junk food wrappers and the soda bottles get in our way! Sometimes, the litter gets so bad that I feel like I am wading through a sea of trash.

Crunch, crunch, pop, kick—Goaaaaal!

My friends and I decided to clean up our neighborhood together. We sorted out piles of garbage and recyclable materials. We had one pile of icky plastic bags, another of junk food wrappers, and a third pile of soda pop bottles. We were getting ready to carry it along the railway to a garbage disposal site, when Meng Demi walked by. As they say, one man's trash is another man's treasure! Uncle Demi had a beautiful idea when he saw one of the plain soda bottles still half full of orange soda glistening in the sunlight. We saw a spark in his eyes. We didn't know it then, but it was a spark we would never forget.

That day, Meng Demi collected all our bottles and took them back to his alley. Out of curiosity, we followed him.

Do you have any ideas to help bring light to Luzvimenda's home? What are some important things to consider to make your plan work?

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## Part 4:

### Meng Demi's brilliant idea

Meng Demi's bottle collection would be considered trash by anyone else. He held an empty bottle almost as if it were a treasure. Unscrewing the cap, he filled it with water and a little bleach, then he screwed the cap back on. Crouching to get the sunlight to hit it right, he angled it to make refracted light dance on the gray wall in front of him. Satisfied, he nodded his head in affirmation and walked towards his makeshift workshop.

As the village fix-it-man, he had all the tools he needed. They were organized and hanging from rusty nails on his wall. He had hammers, pliers, sealant and sheets of metal he used to help people fix their roofs. He never threw anything away, because he knew he could make something new and useful out of his old things.

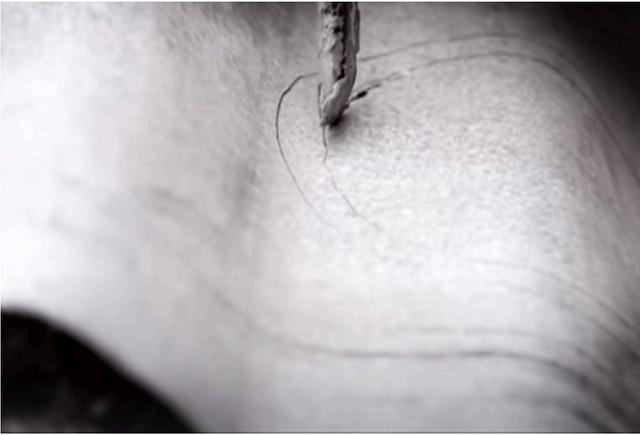
Entranced, we watched Meng Demi take a piece of old sheet metal roofing—he used the base of the bottle to draw a perfect circle. Placing the small sheet of metal over a brick, he then started using his hammer and chisel to create a perfectly round hole.

"He might be making a basketball hoop," whispered my friend.

But something about the way he used pliers to pull back parts of the metal, like small rays of sunshine, told me it was much more than that.

Why do you think it will be important to use sealant around the bottle?





He inserted the bottle into the hole in the metal sheet and then used his sealant around the edges. Meng Demi didn't even have a paintbrush. He just used his smallest chisel to slather on the sealant. Afterwards, he scrambled up onto his rooftop. To our surprise, he started cutting a hole in his roof! He slipped his new invention into the newly made hole, sealed it and fastened it tightly in place with his drill.

He motioned for us to come inside. When he opened his creaky door, what we saw amazed us. We could see the soda bottle sticking right down through his ceiling. The bottle was radiant! It was a shining star! Glowing brightly, it lit the whole one-room house! More light seemed to be streaming through the bottle than seemed possible.

I had never seen a hole let that much light through before. We even had a small hole in our roof. At best, it allowed a lonely shaft of light to pass inside, which made one bright spot on the floor but the rest of the room stayed dark.

The light from Meng Demi's soda bottle was much brighter! Its soft, refracted light reached all the corners of the room. It reminded me of the softly dappled sunlight underneath the banyan tree. My house was about the size as Meng Demi's! I quickly grabbed his hand and pulled him all the way to my home. My Nanay and Tatay would be so excited to hear about Meng Demi's ingenious soda bottle solar light!

From that day on, we called him Solar Demi. He was the fixer of much more than leaky rooftops. He was a genius! My house was the next to get a soda bottle light!

Why wouldn't a simple hole in the roof be a good idea to bring light inside?





What illuminated  
Luzvimenda's  
home?



How does light  
interact with that  
material?

## Part 5:

# Solar Demi's science

Once he started, there was no stopping him. Our village has over 643 lights now—all lovingly installed by Solar Demi and all made by the materials we already had.

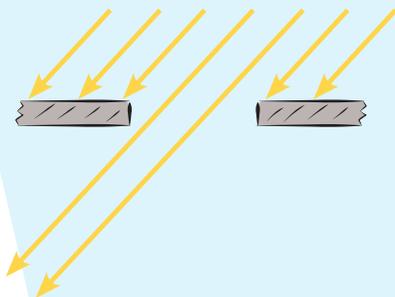
Here are the genius things about these soda bottle lights.

### The soda bottle acts as a light-funnel:

Do you know what surface area is? I am sure you have calculated the surface area of shapes at school. Remember? Length times width? The surface area of a hole that a soda bottle could fit through is pretty small. Very little light can enter through a small hole like that. The clear bottle acts as a light collector because it has a larger surface area than the hole that it fits through. The light that touches the entire surface area of the bottle is then bent by the water, and that light travels down through the hole and it lights up the room!

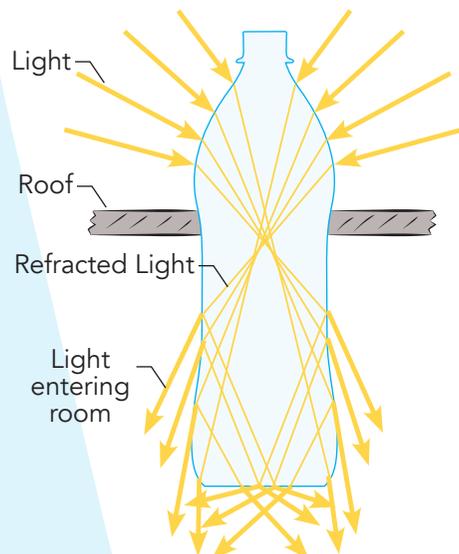
### A hole in the ceiling

When light travels through a simple hole, a light shaft enters the room in a straight line.



### Soda bottle light

The water in the bottle bends light to bring more light into the room.



Did you know that water can bend light like that? Pretty cool, huh? So, the bottle of water acts as a light-funnel, funneling light right down into our home. Here's another thing to think about.

**Refracted light shines from the bottle in all directions:**

All light travels in straight lines, so when light passes through a hole, it doesn't spread around the room very well. Instead, it just goes straight through the hole and creates a bright spot on the floor. The rest of the room stays relatively dark.

When light moving through air enters a new material, such as water or glass, it changes direction slightly. This is called refraction. It still moves in a straight line, just in a new direction. The light changes direction when it enters the bottle and when it exits the bottle. When light comes out of Solar Demi's water filled bottle, rays of light are scattered to all parts of the room. Compared to a simple hole, the solar light seems to illuminate everything very well!

And the bleach? That's just to help prevent gunk, or algae, from growing inside the bottle because that would turn the water green.



## Part 6:

### A light to brighten the darkness

When I look at the soda bottle in our ceiling, it glows brightly in the darkness. My Nanay can cook now. And Grandmother Lola can weave her beautiful baskets. In fact, at certain times of day, our solar lights shine so brightly that Lola and the other women have started making handicrafts together. With 643 lights to beautify our homes, everyone is happier. Tatay can bring flowers home for mother, and I can see both of them smile when we eat Kare-Kare together. My siblings and I are able to study, and finally we have colors in our home instead of grim shades of gray. Solar Demi may never know the many ways he has helped my family. I have a feeling that this is only the beginning.

I love all the subjects I study in school, but I especially enjoy my STEM Taught science activities. I ask lots of questions and I like to doodle or write down my thoughts in the margins of my book. The other day, I asked my teacher how light is measured. She told me that light is measured in units called lumens. Lumens are a measure of brightness, or dimness.

We now have four soda bottles installed in our rooftop. Each solar light is made from a one-liter bottle. Although I know you can't measure light using a measuring spoon or a bowl, I like to think of measuring light using liters—liters of light.

What do you think the purpose of the bleach was?





Why does the soda bottle filled with water help spread the light around the room?





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