

## Fifth Grade: The Scientific Mystery of Light

### Standards:

**Physical Science 2:** Light and sound are forms of energy that behave in predictable ways.

**Science Inquiry and Applications:** Recognize and analyze alternative explanations and predictions

### Objectives

Students will...

Explain how light acts as both waves and particles

Engage in questioning and reasoning processes while observing short experiments

Write a short story about properties of light

### Vocabulary:

Waves

Particles

Energy

Pourquoi tale

### Materials

Laser pointer

Crayons

Poster board

Tape

Scissors

Thin wire

### **Session One**

- 1) Hook: Try the crayon watercolor craft! Grab a poster board and tape some crayons to the top. Then prop it up against a wall outside and let it sit in the hot sun for a day or two! The crayons will melt and make a beautiful piece of rainbow artwork.
- 2) Once you are satisfied with the creation, the class will bring it inside to admire. Ask the students to explain how the light from the sun melted the crayons.
- 3) Tell the students that they just proved the three hundred year old theory of Isaac Newton, who was curious about what light really is. He came up with the idea that light is made up of lots of tiny *particles* that are too small for us to see with our own eyes. Well, if light is really just a stream of tiny little particles, then these particles would do some damage to objects they smack into, right? If you pelt snowballs at someone's igloo, that igloo is eventually going to start to crack. So if light is made up of a stream of particles, we would expect something similar to happen to objects sitting in the glare of the sun. The

crayon experiment proved that! The streams of particles did do damage to the crayons: they melted them! So Newton was right: light is made up of particles. Talk about this with the students. Ask them whether they have ever noticed that their curtains or clothes become faded over time. Explain that this is because they have been in the sun, and the light has done some damage to the color of the fabric.

(10 minutes)

- 4) Watch this video of a laser cutting a sheet of metal:  
<https://www.youtube.com/watch?v=o-kZS40ITY8>. Explain how the laser works in terms of particle theory.
- 5) So clearly, light is made up of particles, right? Not quite, because another scientist who lived at the same time as Newton, Christiaan Huygen, had a different idea. He thought that light is made up of waves, like the ripples in a pond. Watch this video to demonstrate the concept: <https://www.youtube.com/watch?v=T9QwiBFN9gI>.
- 6) One hundred years later another scientist named Thomas Young developed the double slit experiment to test Huygen's hypothesis. (You can read about the experiment here: <https://plus.maths.org/content/physics-minute-double-slit-experiment-0>). Young made two little slits in a wall, shined a light on them, and observed what the light passing through the slits looked like on the other side of the wall.

(10 minutes)

- 7) The class will try Young's experiment. You will need a laser pointer (the kind you use with cats), tape, a piece of thin wire, and a dark room. Watch the video on how to do the experiment here: <https://www.youtube.com/watch?v=ny6fPSibyOo>. Before trying the experiment, explain to the students the two possible outcomes and have them make a prediction in their notebooks. Then, as you perform the experiment, have the students record their observations and findings in their notebooks.

(15 minutes)

- 8) Summarize to the students: Isaac Newton proved that light is made of particles, and Thomas Young proved that light is made of waves. Who is right, and who is wrong? Well, the answer to both questions is both! Sometimes light acts like waves, and sometimes it acts like particles. Scientists now describe light as a particle-wave. We still do not really know much about light, and we have not yet figured out why light has such mysterious properties. There is now an entire field of science dedicated to investigating these questions called quantum mechanics.

(5 minutes)

## Session Two

- 1) Read "How the Toad Got His Bruises" by Elsie Spicer Eells:  
<https://fairytalez.com/toad-got-bruises/>. This website has a number of these fables. Explain to students that this story is an example of a 'pourquoi tale,' or a story of how something came to be. Explain that 'pourquoi' means 'why' in French, and the stories

explain why something is the way it is. For hundreds of years, people from all over the world have been telling these stories to explain things for which they do not have answers. They are a way to use your imagination to come up with your own story about why something is the way it is.

- 2) Tell the class that yesterday, you explored light, which is something that scientists still do not completely understand. You learned that light sometimes acts like a wave, and sometimes like particles, and we are not sure why. Introduce the students to the next activity: they will write their own pourquoi tales explaining why light sometimes acts one way, and sometimes acts another way. Maybe light is a moody teenager who can never make up its mind, or maybe light is a secret spy who is really a wave, but acts like a particle around the enemy as a disguise. The students will use their imaginations to come up with an answer to the scientists' questions about light!



# How the **LIGHT PARTICLE WAVE** came to be



Your pourquoi tale will include:

1. A beginning, where you introduce the characters and the problem in the story
2. A middle, where the problem comes to a head
3. An ending, where the problem is solved and we find out your answer to why light acts two different ways
4. Two vocabulary words: *particle* and *wave*

Draw your characters:





# Brainstorming time!



What is the big problem in your story?

How is the problem solved?

And in the end, how does light end up with its particle-wave property?