

IS LIGHT A WAVE OR A PARTICLE TEACHER GUIDE

- Play the Dr. Quantum Video: <https://www.youtube.com/watch?v=Q1YggPAzho>
- Have students fill out the I Notice / I Wonder table:
 1. Create a table with two columns labeled “I Notice” and “I Wonder.”
 2. As students watch the video, have them write their observations in the I Notice column and questions in the I Wonder column.
- Watch the Dr. Quantum Video a second time and ask student the following questions:
 1. Which claims of the video support that light is a wave as in Lesson 1?
(0:40-1:03) Waves through one slit gives one band with the brightest spot in the middle.
(1:03-1:32) Waves through two slits create an interference pattern.
 2. Which claims of the video support that light is a particle as in Lesson 2?
(0:12-0:40) Particles through one slit and then two slits create bright spots across from the opening.
(1:51-2:13) Go to the quantum level (very small) and shoot electrons (particles) at a single slit to get one band.
 3. Which claims of the video are new?
(2:13-2:45) Shoot electrons (particles) at two slits. Creates the surprising result that it is an interference pattern.
(2:45-3:09) Scientists try shooting one electron (particle) at a time so that electrons cannot interfere with other electrons creating the interference pattern. However, even one at a time, the interference pattern still shows up.
(3:09-3:42) Wave function predicts that an electron goes through both slits to interfere with itself, or one, or the other, or neither. The inescapable conclusion is that a single electron is interfering with itself.
(3:42-4:36) When scientists add a detector on one slit to determine which slit it is passing through, it causes the electron to go back to behaving like a particle and just two bands are created. The interference pattern disappears, and the result is changed just by observing.
(4:36-5:03) Overview of the question of if things are waves or particles and how the act of observing collapses the wave function.

Have a class discussion to share answers to the questions. If any of the parts are not brought up by the students, cue the video to that section because students will be reproducing the results in the next section. Students do not need to have any explanation at this point. They just need to understand the experiments and what unpredicted results were observed from each one.

Breakdown of Dr. Quantum Video:

- Lesson 2: (0:12-0:40) Particles through one slit and then two slits create bright spots across from openings.
- Lesson 1: (0:40-1:03) Waves through one slit gives one band with the brightest spot in the middle.
- Lesson 1: (1:03-1:32) Waves through two slits create an interference pattern.
- Lesson 1 & 2: (1:32-1:51) Quick review of classical result of wave vs. particle.
- Lesson 2: (1:51-2:13) Go to the quantum level (very small) and shoot electrons (particles) at a single slit to get one band.
- Lesson 3: (2:13-2:45) Shoot electrons (particles) at two slits. Creates the surprising result that it is an interference pattern.
- Lesson 3: (2:45-3:09) Scientists try shooting one electron (particle) at a time so that electrons cannot interfere with other electrons creating the interference pattern. However, even one at a time the interference pattern still shows up.
- Lesson 4: (3:09-3:42) Wave function predicts that an electron goes through both slits to interfere with itself, or one, or the other, or neither. The inescapable conclusion is that a single electron is interfering with itself.
- (3:42-4:36) When scientists add a detector on one slit to determine which slit it is passing through, it causes the electron to go back to behaving like a particle and just two bands are created. The interference pattern disappears, and the result is changed just by observing.
- (4:36-5:03) Overview of the question of whether things are waves or particles and how the act of observing collapses the wave function.