|  |
| --- |
| **Sometimes You Behave like a WAVE, Sometimes You Don’t! - An Exploration of EM Radiation** |
| **Author:**  Charlie Wilson |
| **Date Created:** 8/11/16 |
| **Subject:** Physics |
| **Grade Level:** 10th-12th grade |
| **Standards: Next Generation Science Standards (**[**www.nextgenscience.org**](http://www.nextgenscience.org)**)**  **HS-PS4-3.** Evaluate the claims, evidence, and reasoning behind the idea that  electromagnetic radiation can be described either by a wave model or a  particle model, and that for some situations one model is more useful  than the other. |
| **Schedule:** 1-80 minute lab period |
| **CCMR Lending Library Connected Activities:** |

|  |  |
| --- | --- |
| **Objectives:**   1. Explain the duality of EM radiation with simple intelligence. (non-scientist would understand) 2. Express an interest in further studies of Quantum Mechanics including matter waves. 3. Consider research as a component of their future education and careers. | **Vocabulary:**  Quantum Mechanics  Electromagnetic Spectrum  Constructive Interference  Destructive Interference  Diffraction  Photon  DeBroglie Wavelength (Matter Waves)  Heisenberg Uncertainty Principle |
| **Students Will:**   * Create an optical interference pattern on glass slides and explore the dual nature of the electromagnetic spectrum. * Share results as a team with the rest of the class. * Complete an Exit Survey | **Materials:**  Glass slide  Candle  Matches  Laser pointer  Laser pointer mount  Digital vernier calipers  Safety pin |
| **Safety** | Be cautious with the candle and the glass. Assume glass is HOT because it looks the same hot or cold! |

**Resources:**

"Golf Ball hitting steel super slo mo - YouTube." 2009. 17 Aug. 2016 <<https://www.youtube.com/watch?v=aMqM13EUSKw>>

"Richard Feynman - The Character of Physical Law - Part 6 - YouTube." 2011. 17 Aug. 2016 <<https://www.youtube.com/watch?v=aAgcqgDc-YM>>

**Classroom Procedure:**

1. Setup lab stations for 3-4 students each with the materials listed.

2. Present the lesson objectives to the class.

3. View and discuss the two resource videos with student teams.

4. Students complete the Lab Activity Sheet completely, safely, and thoughtfully.

5. Student teams present and explain results with the entire class.

6. Students complete an Exit Survey.

**Assessment:** Lab Report from Individual Students

Survey will be completed as an exit ticket.

1. Explain the duality of EM radiation.

2. On a scale of 1 to 10, how interested are you in further studies of Quantum

Mechanics?

3. On a scale of 1 to 10, how likely are you to consider research as a component of your future education and careers?

**Acknowledgements:** I would like to gratefully acknowledge the National Science Foundation, Cornell University, and the Cornell Center for Materials Research for sharing resources, personnel, and inspiration. A special personal thanks to Nev Singhota and Mark Walsh for their support and high expectations.