




 <b>SUBJECT</b>	<b>Physics</b>
 <b>LESSON TOPIC</b>	The Double Slit Experiment/Wave Particle Duality
 <b>GRADE</b>	15-18 years old
 <b>LEARNING OBJECTIVES</b>	<p>Students will be introduced to the concept of wave-particle duality and learn about the famous double slit experiment performed by Thomas Young in 1801.</p> <p><b>Students will be able to:</b></p> <ul style="list-style-type: none"> <li>• Understand the nature of light and electrons.</li> <li>• Identify Thomas Young and explain the double slit experiment.</li> <li>• Explain notions such as diffraction, interference patterns.</li> <li>• Understand the concept of wave particle duality and how measurement (observation) affects the behavior of electrons.</li> </ul>
 <b>TIME REQUIRED</b>	90 minutes
 <b>PREPARATION</b>	30 minutes

**MATERIALS**

- Interactive board
- Device with Internet connection for each student
- Account with [Playposit](#)
- Account with [Socrative](#)
- 1 Laser pointer
- 3 pencil leads
- Handout
- Resources:
  - [History of light part 2: Thomas Young and the wave theory of light - YouTube](#)
  - [Dr Quantum Double Slit Experiment - YouTube](#)
  - [Double Slit Interference - YouTube](#)
- Quiz

**TECHNIQUES**

- General Discussion with students.
- With computer – interactive videos and online quiz.
- Observation/Experiment

**FORM OF WORK**

- Group Work

 **LESSON PLAN OVERVIEW****Preparation:**

- Gather relevant resources and videos for the lesson.
- Set up instructional videos with [Playposit](#) (see explanatory tool sheet n°20)
- Prepare online quiz with [Socrative](#) (see explanatory tool sheet n°25)
- Prepare Handout for homework.

**Introduction:**

Thomas Young was an English scientist and polymath who famously performed the double slit experiment in 1801 in an attempt to resolve whether light is a particle or wave. His milestone experiment solidified Young's wave theory of light and laid the groundwork for further observations in quantum mechanics.

**Implementation**

Engage students by quoting Heisenberg: "Light and matter are both single entities and the apparent duality arises in the limitations of our language" and ask students what could be the meaning of this quote. Ask students what kind of waves do they know and what happens when waves interfere?

- Load up the instructional video about Thomas Young and the double slit experiment you have created on Playposit and have students watch.
- Stop video when necessary to discuss the "interactions" you have added on Playposit and provide explanation about key concepts by discussing the "interactions" together with the students: diffraction, interference, double slit experiment.

- Load up visual graphic video of interference to students on Playposit and discuss the “interaction”. Explain to students that interference pattern of light is a result of the superposition of two or more light waves that overlap in space.
- Ask students to express their ideas and to make some initial hypothesis about electrons: should they behave like light or like the marbles?
- Observation/Experiment: Demonstrate to students in class the double slit experiment by using a laser pen and 3 pencil leads. First, hold up 2 pencil leads in order to create a slit and flash the laser beam through the slit. Then, hold up 3 pencil leads and flash the laser beam between them (2 slits). Have students observe the patterns that are created on the wall when the laser passes through one or two slits.
- Explain to students that when the experiment is repeated using single photons, an interference pattern is also seen and highlight the fact that when light sometimes behaves as a wave and sometimes as a particle is known as the wave-particle duality.
- Load up the instructional video you have prepared on Playposit “Dr Quantum – Double slit experiment” and stop the video when necessary to discuss the “interactions” you have added. -- Wave particle Duality – Wave function collapse - Measurement
- Engage students in discussion:
  - Why does wave function collapse occur?
  - What is the role of observation (measurement) in the experiment?

**Summary:**

- Summarize the content of the lesson.
- Ask students what they think about the experiment and the overall observation.
- Take questions/concerns from students.
- Have students complete the quiz you have created on Socrative.
- Provide feedback and clear out any misconceptions.

**Homework: “Letter to Newton”**

Write a letter to Newton and inform him about the evidences regarding the wave nature of light (including experiment) then highlight the conceptual key words in this letter. Then, try to explain each key word to one of your family members in a simple way.