

Reflection – wave or particle

Student Activity



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7 8 9 10 11 12



TI-Nspire



Navigator



Student



30min

Introduction

Which model, particle or wave, provides the best representation for the behaviour of light? History is scattered with famous mathematicians and philosophers (Physicists) that have supported either the wave or particle model for light; Isaac Newton, Rene DesCartes, Robert Hooke, Augustin-Jean Fresnel, Christiaan Huygens, James Clerk Maxwell and Thomas Young to name a few. This investigation looks at the subject of reflection to see if it is best suited to a particular model. The purpose of a model is to provide a tool to help conceptualise what is happening and potentially predict other behaviour, most models however have their limitations.

Time for Reflection

In this activity the reflection of light is examined to see how well the wave and particle models accommodate observations.

Open the TI-Nspire file: **Reflection Wave or Particle**

Navigate to page 1.2 and respond to the question, select your response by pressing enter. Your teacher will collect your response later. The purpose of this initial question is to establish your current view.

1.1 1.2 1.3 Reflection wa... cle

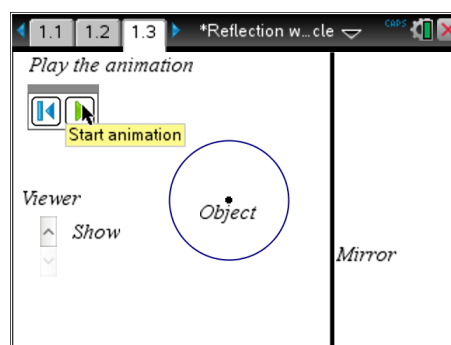
Does the reflection of light support the wave or particle model for light?

- Particle
- Wave
- Both
- Neither

Navigate to page 1.3 to investigate the interactive model available for the reflection of an object in a mirror.

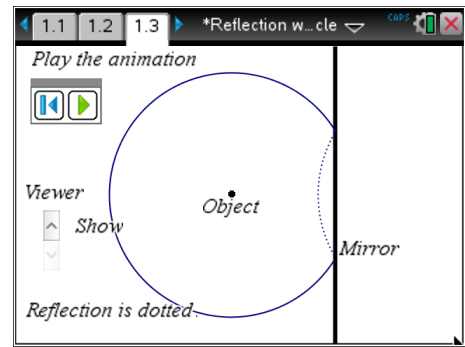
The animation shows an object with a wave (circle) moving away from the object in much the same way as ripples move outward from a disturbance in a pond. This wave represents the movement of light coming from the object travelling out in all directions.

Click on the animation button to observe the wave as it progresses towards the mirror.



Once the wave hits the mirror it is reflected back. Allow the animation to continue, it will restart once the wave becomes too big to display.

Once you have finished observing the wave, click on the pause button.

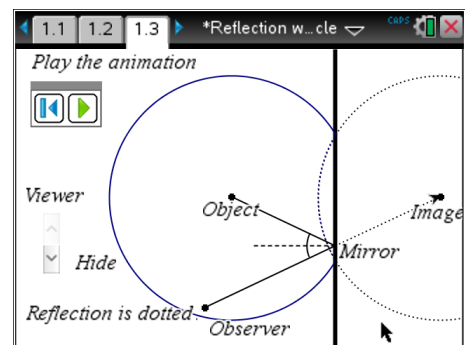


Question 1. Does the reflection accurately model how a wave is reflected when it strikes a wall? (Explain)

The next thing to consider is whether this model describes how light behaves when it is reflected from a surface.

To see a more familiar diagram of the reflection of light add in the viewer by clicking on the show option next to 'Viewer'.

The position of the viewer can be changed by dragging the point to a new location. The normal to the mirror is shown as a dotted line and the apparent location of the wave source is shown as 'image'.



Note: The animation is still available whilst the viewer is displayed.

Question 2. Is the image located the same distance from the mirror as the object?
Distances can be measured using the geometry tools.

Question 3. Is the angle between the incident light ray and the normal the same as the angle between the reflected ray and the normal?
Angles can be measured using the geometry tools.

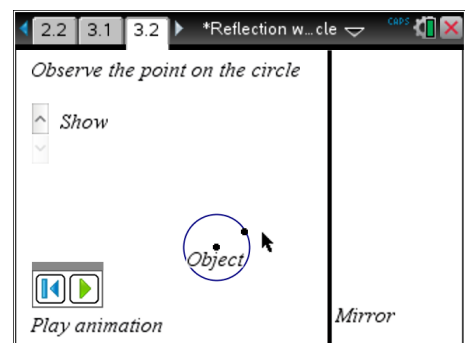
Question 4. Explain how the reflected wave can be used to locate the image.

Question 5. Do the light rays (particle model) concur with the wave model?

Navigate to page 3.1, read the instructions and then move to page 3.2.

Activate the animation button and observe the movement of a point (particle model) that is located on a wave propagating from the object.

To see this from a viewer's perspective click on the 'show' option.



Question 6. In this animation the particle appears to be 'riding the crest of a wave'. In the context of this animation, explain the 'duality' principal in relation to the reflection of light from a mirror (smooth surface).

Question 7. What would it mean practically if a different point on the wave was displayed?