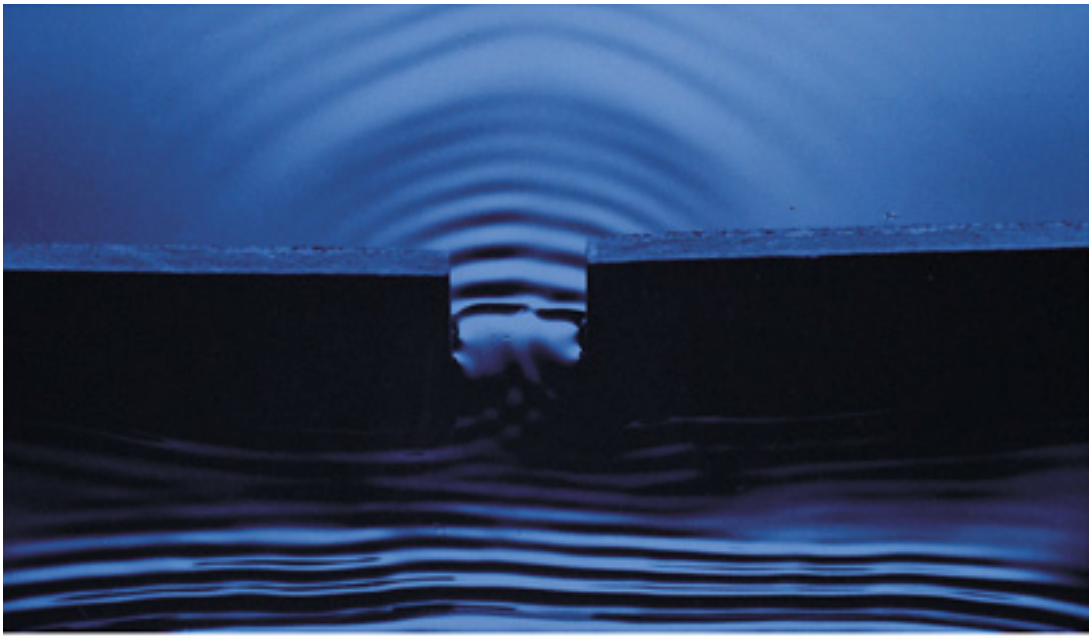
## Critical Thinking

### Diffraction of Light Waves

Reflection involves a change in direction of waves when they bounce off a barrier. Refraction of waves involves a change in the direction of waves as they pass from one medium to another. And **diffraction** involves a change in direction of waves as they pass through an opening or around an obstacle in their path. When a wave diffracts due to a small opening, the small opening acts like a point source (like a pebble dropped in a lake) for a series of new concentric waves. Water waves have the ability to travel around corners, around obstacles and through openings. Sound waves do the same. But what about light? Do light waves bend around obstacles and through openings? If they do, then it would provide still more evidence to support the belief that light behaves as a wave.



*example of the diffraction of water waves through a small opening*

When light encounters an obstacle in its path, the obstacle blocks the light and tends to cause the formation of a shadow in the region behind the obstacle. Light does not exhibit a very noticeable ability to bend around the obstacle and fill in the region behind it with light. Nonetheless, light does diffract around obstacles. In fact, if you observe a shadow carefully, you will notice that its edges are extremely fuzzy.[1]

### Double Slit Activity

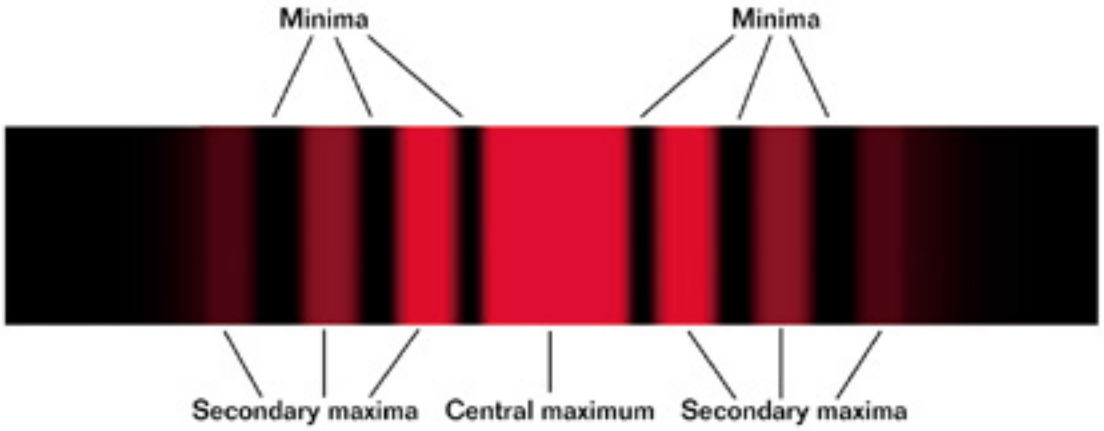
You have been provided with a plate of glass that contains, among other things, several double slits; that is, two very narrow slits that allow light to pass through that are varying distances apart.

- Look at the tall lamp through each of the double slits and record your observations.
- Look at the tall lamp, covered with a red filter, through the narrowest double slit and record your observations.
- Look at the tall lamp, covered with a blue filter, through the narrowest double slit and record your observations.

[1] *text from the Physics Classroom: http://www.physicsclassroom.com/*

**Analysis**

You should have observed something similar to the following. The bright bands are called maxima and the dark bands are called minima.




Based on your existing knowledge of physics, the above introduction to diffraction, and your observations, propose an explanation of the observed phenomenon. Support your explanation with as much detail as possible.

**Guiding Questions**

1. In the above photo of water waves diffracting through a small opening, why does the wave have light and dark parts? What are the light and dark parts? What type of a wave is a water wave?

2. Draw a diagram of the double slit and the two light waves as they exit the double slit. Remember how diffraction was described as creating a new point source of the wave at the small opening.

3. In your diagram, where the lines of the concentric circles from each slit overlap, what would occur there?

4. In your diagram, where the lines of a concentric circle from one slit aligns with the midpoint between two lines of the concentric circle form the other slit, what would occur there?

5. Here is what your diagram should look like for two slits. What do the straight lines represent? How does the diagram on the left differ from the diagram on the right?

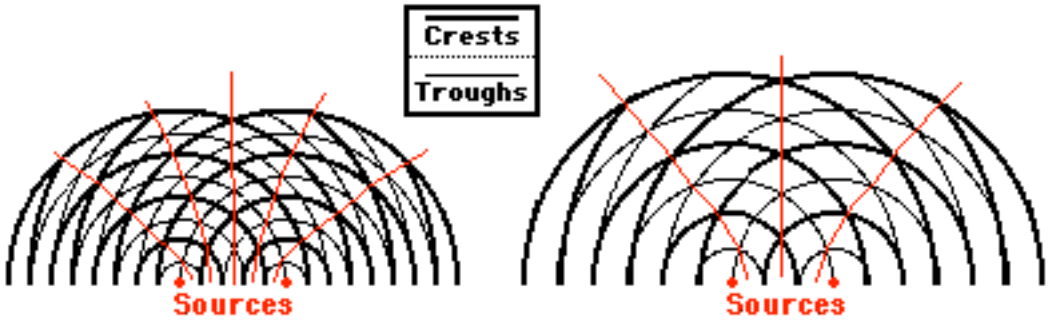



*diagram from the Physics Classroom: http://www.physicsclassroom.com/*

6. In order for the two waves to constructively interfere at the first secondary maximum, what is the minimum distance that one wave must travel further than the other?

**Extension Questions**

1. As the distance between the slits is increased, you observed that the distance between the maxima is decreased. Explain why in as much detail as possible.

2. The maxima of the light when passed through the red filter were farther apart than the maxima of the light when passed through the blue filter. Explain why in as much detail as possible.