

Measure the width of a human hair with laser *diffraction*

Overview

Students will determine width of human hair using diffraction and a LASER Blox of known wavelength.

Time: 45 minutes

Grades: 9-12

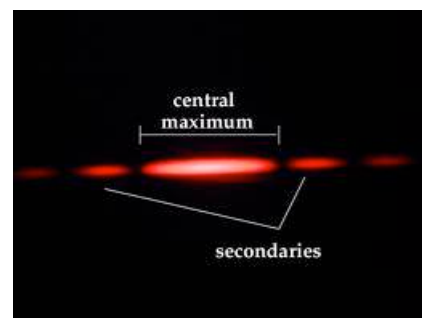
Materials

- Red Laser Blox
- Green Laser Blox
- Tape
- Blank Wall or Screen
- Ruler/Meter Stick
- Human Hair



Discussion and Background

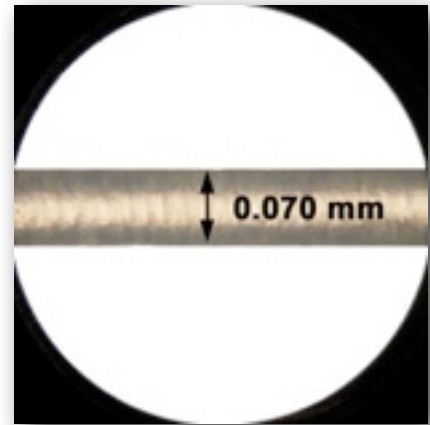
Diffraction is a phenomenon that describes how light bends as it passes through very narrow slits or around a very small barrier (like a hair). See image to the right showing diffraction (bending) of waves around a “corner”. Thinking of light as a wave, consider that as light passes a very small barrier (like a hair), two distinct wave patterns are formed. Those waves interfere with each other to either amplify the wave pattern (constructive interference) or dampen the wave pattern (destructive interference).



Observing and Investigating

1. Divide class into two groups
2. Give each group a Laser Blox, a ruler or meter stick, a white sheet of paper and some tape
3. Have each group choose someone to donate a strand of hair to measure. The hair should be at least 25cm long.
4. Introduce the formula

$$\text{Hair Width} = (\text{wavelength}) (\text{distance to wall}) / \text{distance between first dark spots}$$



5. Tape the hair to the LASER Blox so that the hair crosses the beam aperture (as pictured)
6. Set the Laser Blox on a table or other surface approximately 1m from a blank wall or screen
7. Show students how to measure the distance between the first two areas of destructive interference on either side of the central maximum (distance between the first two dark spots)
8. Have students take measurements and fill in the data sheet and calculate the width of the hair for at least 5 different pieces of hair.
9. Have students calculate the average width of human hair. Then have students research, via the internet, commonly accepted values of the width of human hair and compare their average value with the commonly accepted value.

Student Data Sheet

Measurement #	Wavelength of Laser Blox	Distance to wall (W)	Distance Between First 2 Dark Spots (D)
1			
2			
3			
4			
5			
6			
7			
8			

Enter at least 5 sets of measurements in the table above; calculate and record the width for each measurement in the table below

Measurement	Hair Width = (wavelength) (W) / D
1	
2	
3	
4	
5	
6	
7	
8	

Calculate and Record the Average Hair Width

How does this value compare to the “accepted value” for the width of human hair?