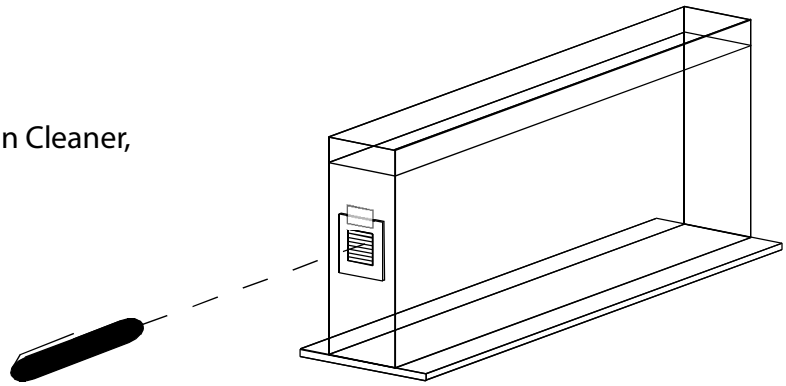
PhyzLab Springboard: Diffraction Variations

• Apparatus •

___laser tank
___access to water (use a pitcher or equivalent to transport water)
___scattering agent (Mop-N-Glo, Boston Cleaner, Pine-Sol, or equivalent)
___red-light laser pointer
___green-light laser pointer
___twist-tie (optional)
___diffraction grating (high-density)
___diffraction grating (low-density)
___access to paper towel
___access to adhesive tape



• Set-Up •

1. Prepare the tank: Fill the tank with water (leave about an inch at the top empty) and add the scattering agent.

2. Tape the high line density diffraction grating to the center of an end face of the tank as shown in the diagram. **The grating lines must have a horizontal orientation.**

• Procedure •

1. HIGH-DENSITY GRATING AND SHORT-WAVELENGTH LIGHT

a. Shine the green-light laser through the high-density diffraction grating. Draw the resulting interference pattern in the space below.

b. The equation describing the pattern is $m\lambda = d\sin\theta$.

i. Rearrange the equation, solving for $\sin\theta$.

ii. What happens to the value of $\sin\theta$ as θ goes from 0 to 90°?

__it increases __it decreases __it remains constant

iii. Which proportionality better expresses the result from the previous question?

__$\theta \propto \sin\theta$ __$\theta \propto 1/\sin\theta$ __no relationship exists

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c. Rewrite the equation you developed in b. i. above as a proportionality, substituting sinq with q.

d. What does each variable in the expression represent"

θ

m

d

λ

2. HIGH-DENSITY GRATING AND LONG-WAVELENGTH LIGHT

a. Shine the red-light laser through the diffraction grating.

i. Is the resulting pattern wider or narrower?

ii. That observation was predicted by the proportionality. How?

3. LOW-DENSITY GRATING AND LONG-WAVELENGTH LIGHT

a. Prediction. What kind of pattern will result if the red-light laser is shown through a lower-density diffraction grating (i. e., one in which the lines are farther apart)? Use the proportionality to justify your prediction.

b. Observation.

i. Remove the high-density grating and replace it with the low-density grating.

ii. Shine the red-light laser through the diffraction grating.

iii. How does this pattern compare to the one produced by shining the red-light laser through the high-density grating?

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4. LOW-DENSITY GRATING AND SHORT-WAVELENGTH LIGHT

a. Prediction. What will happen to the pattern id the red light is replaced with green light?

b. Observation. What does happen when the red light is replaced with green light?

5. POST-ACTIVITY QUESTIONS

a. Which two patterns are most like each other? (Connect the two with a line.)

RED LASER + LOW DENSITY GRATING • • RED LASER + HIGH DENSITY GRATING

GREEN LASER + LOW DENSITY GRATING • • GREEN LASER + HIGH DENSITY GRATING

b. Which combination would give the widest pattern (greatest angle between central maximum and first-order maximum)? Connect the laser and the grating.

RED LASER • • HIGH DENSITY-GRATING

VIOLET LASER • • LOW-DENSITY GRATING

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