

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

## Student Worksheet 3

### *Make your own gratings*

#### Safety

Never shine a laser into a person's eyes, as permanent damage may occur. Be aware that the laser will reflect off of the transparency. Be sure that the manila folders catch both the reflected beam and the beam passing straight through.

#### Introduction

Ever wonder how we know what small things (those on the nanoscale; 1-100nm) like DNA or a crystal lattice actually look like? The answer is that we shine light (specifically X-rays which are .01 to 10nm in wavelength) on them and look at the interference pattern that is created. Shining light on a real molecule is a lot more complicated than shining light on some slits, but the same basic rules apply. Today, you are going to investigate the interference patterns created by more complex gratings. The goal will be to use what you learn today to make an accurate description of the contents of the black box. This is how nanoscale researchers determine the structure of nanoscale materials - both natural and man-made. They use a method called X-ray diffraction which you will simulate in this activity.

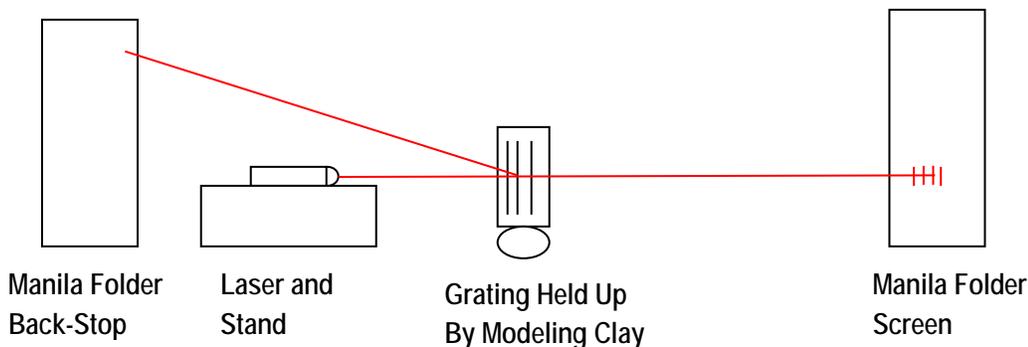
#### Materials:

- 2 manila folders
- laser pointer and stand
- diffraction gratings that you printed in the computer lab
- modeling clay
- meter stick

**Question:** What kind of interference patterns are created by more complex gratings?

#### Procedure:

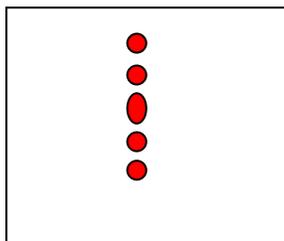
1. Set up your materials as described on *Student Worksheet 2*.
2. Cut out your different gratings so that you can test them individually.
3. Place one grating in the modeling clay so that it projects an interference pattern onto the manila folder screen, and the reflected beam is caught by the manila folder back-stop.
4. Adjust the distance between the transparency and the screen until you get a clear interference pattern.
5. The distance between the grating and the screen is \_\_\_\_\_. Now DO NOT CHANGE IT!



- Record your data by either drawing the interference pattern directly onto the manila folder, or taking a picture of the pattern with your phone.

### Analyze the Results

- In the boxes below, draw three different patterns that you saw. Explain how the gratings were different, and the effect they had on the interference pattern that was created. Describe both the **shape** of the pattern and the **spacing** of the pattern.



Which grating was this? \_\_\_\_\_ *G* \_\_\_\_\_

What was special about that grating that caused this pattern to be created?

*This pattern was created because the grating had only horizontal lines. Also, the lines were evenly spaced.*



Which grating was this? \_\_\_\_\_

What was special about that grating that caused this pattern to be created?

\_\_\_\_\_  
\_\_\_\_\_



Which grating was this? \_\_\_\_\_

What was special about that grating that caused this pattern to be created?

\_\_\_\_\_  
\_\_\_\_\_



Which grating was this? \_\_\_\_\_

What was special about that grating that caused this pattern to be created?

\_\_\_\_\_  
\_\_\_\_\_

### Draw Conclusions

- Describe with **as much detail as possible** what was inside the black box. It may help to compare the interference patterns you saw today with what you saw from the black box.

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