Name: _____ Date: _____ Class: _____

Student Worksheet

Gelatin Waveguides: Guided Inquiry

Safety
Never shine a laser into anyone's eyes. It can cause permanent blindness.

Before you begin: Make sure you and your parents have read and signed the laboratory safety contract.

Introduction

Now that you understand how light can be contained and guided, you will be describing and designing your own optical waveguide that will bend a ray of light 180°!

Part I: Design Your Own Optical Waveguide

Materials
- gelatin square
- laser pointer
- graph paper
- protractor
- plastic knife
- 1/2 teaspoon of sugar
- 1 in. square of sandpaper

Question

What factors affect how well light can be contained and guided in a material?

Make a Prediction

_____

_____

_____

_____

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Procedure

1. Place your piece of gelatin on your graph paper.

2. Shine your laser beam through the piece of gelatin parallel to the graph paper. Use the graph paper and protractor to measure angles of incidence and refraction as the beam enters the gelatin from air.

3. Use the sandpaper to roughen one side of the gelatin piece to examine the effect of roughness on the total internal reflection of the laser beam.

4. Sprinkle a few crystals of sugar on the roughened site and observe the effect of large particles on the total internal reflection of the laser beam.

5. Use the plastic knife to create vertical grooves along the side of the gelatin and observe the effect of the grooves on the total internal reflection of the laser beam.

Record Your Observations

Material:		Effect of sandpaper	Effect of sugar crystals	Effect of grooves
Angle of Incidence				
Angle of refraction				

1. Experiment with your piece of gelatin and describe at least two more ways to positively or negatively affect the total internal reflection or light containment.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

Analyze the Results

1. Small optical waveguides are beneficial for they take up less space, thereby increasing the number of waveguides that can be placed on a computer chip. What is the surface area called that an optical waveguide occupies? _____

2. Using the observations you have made, design a gelatin optical waveguide that will:

   a. turn a beam of light 180°

   b. occupy the smallest footprint possible

3. Draw your design below and describe at least two aspects of your design that you feel will allow you to meet the above criteria.

<u>**Design Features:**</u>

a. _____

_____

_____

b. _____

_____

_____

Name: _____ Date: _____ Class: _____

Student Worksheet

Gelatin Waveguides: Guided Inquiry

Part II: Making and Testing Your Optical Waveguide

Materials
- 4" × 5" gelatin piece
- laser pointer
- graph paper

Procedure

1. Place your piece of gelatin on your graph paper.

2. Using the design that you developed, create an optical waveguide. You may use the laser pointer to test the waveguide as you make it.

3. Demonstrate your optical waveguide to your teacher.

4. When approved, calculate your optical waveguide's footprint.

Record Your Observations

1. Sketch a diagram of your working gelatin optical waveguide.

2. Calculate the footprint of your gelatin optical waveguide.

   Total length (cm) _____ Total width (cm) _____

   Footprint _____

3. Review the design features that you described yesterday. Describe how well or poorly each design feature worked. If you discovered new features today, describe those as well.

   Design Features:

   a. _____

   _____

   _____

   b. _____

   _____

   _____

   c. _____

   _____

   _____