Name:_____Date:_____Class:_____

# Student Worksheet

## *Jell-O® Waveguide and Power Loss*

**Safety**
Never shine laser light or reflected laser light into anyone's eyes—it will harm a person's retina and can cause permanent blindness. Boiling water and water vapor can cause serious burns.

As you do the procedure, write 3 of your own questions.

**Materials**
- pan with Jell-O®
- photodetector on an index card
- laser light pen
- multimeter with wires
- 2 wires with alligator clips at each end
- 4 sheets of graph paper
- protractor
- metric ruler
- pencil
- stirring rod
- sugar or salt
- masking tape

**Question #1:** _____

_____

_____

**Question #2:** _____

_____

_____

**Question #3:** _____

_____

_____

What do you think are the answers to your questions? Write your predictions below.

Remember: A prediction has the form: I think _____ will happen because _____.

**Prediction #1:** _____

_____

_____



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**Prediction #2:** _____

_____

_____

**Prediction #3:** _____

_____

_____

**Procedure**

1. Attach the alligator clips to the photo detector wires and plug the other ends into the multimeter. The photo detector wires should NOT touch each other. Set the multimeter to measure resistance (Ohms, Ω). Turn the knob on the meter to 20 kΩ.
2. Cover the photodetector. On the data table on the next page, record the resistance with no light on the detector.
3. Record it again while **NOT** covered.
4. Shine the laser directly on the detector. Record the result.
5. Place one section of Jell-O® on paper. Hold the photodetector at one end. Shine light through the long length of one piece of Jell-O® and record the result.
6. Put two Jell-O® pieces end-to-end to make a length of about 14 inches. Shine the laser through and record the resistance. Try three pieces end-to-end. Repeat. How long can you make the Jell-O® waveguide until you can't get a reading anymore?
7. Now repeat steps 5 and 6 but through the short side (the narrow width) and measure its thickness and resistance, then try two and then three. Record your measurements in the table below.
8. Draw an *x*-axis and *y*-axis on graph paper. Place a straight section of waveguide along the *x*-axis with the line along its edge.
9. Shine the laser into the intersection of these lines. Trace the path of the incident light beam. Mark where the refracted beam comes out of the Jell-O® waveguide on the other side.
10. Use a protractor to measure the incident angle, $\theta_1$, and the refracted angle, $\theta_2$, and record.



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**Record Your Observations**

**Table 1**

| No light | Ambient light | Direct laser light |
|---|---|---|
| | | |

**Table 2**

| | One long side of Jell-O® | Two long pieces of Jell-O® | Three long pieces of Jell-O® |
|---|---|---|---|
| **Resistance** | | | |
| **Length** | | | |
| | **One short side of Jell-O®** | **Two short pieces of Jell-O®** | **Three short pieces of Jell-O®** |
| **Resistance** | | | |
| **Length** | | | |

**Incident angle, $\theta_1$** _____ **Refracted angle, $\theta_2$** _____

**Analyze the Results**

1. On a sheet of graph paper, graph your answers in the second data table to show how the resistance changes in relationship to the thickness of the Jell-O®.
2. What happened to the beam of light as the Jell-O® waveguide got longer?

   _____

   _____

3. Calculate the index of refraction of the Jell-O® $n_2$, using Snell's law:

4. When did the resistance seem to change the most?

   _____

   _____

5. When did the resistance seem not to change much at all?

   _____

   _____

6. When does the graph seem to rise in resistance?



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## Draw Conclusions

Can you suggest other ideas about how beams of light can be used to make the internet work?



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