## **Refraction Lab (Student Guide)**

**Purpose**

The purpose of this investigation is to determine how much a light ray will be refracted at the interface between media with different indices of refraction.

**Hypothesis:** Please write 2 hypotheses.

Example : If the first medium is \_\_\_\_ (less, more) \_\_\_\_ refractive than the second medium, the angle of refraction will be \_\_\_ (smaller, greater) \_\_\_\_ than the angle of incidence.

**Hypothesis 1**:  
*If the first medium is less refractive than the…*

**Hypothesis 2:**

*If the first medium is more refractive than the…*

**Material**

Bending light interactive simulation found at :[PhET Bending light](https://phet.colorado.edu/sims/html/bending-light/latest/bending-light_en.html). Select the **Intro** option.

**Procedure**

**Scenario 1** – Going from a low index of refraction to a high index of refraction.

1. Use the slider on the application to set n2 and n1 to the values given in Table A. The index n1 is the control variable and should not be changed.

2. Using the protractor, set Θ1 to the value specified in the table.

3. Use the protractor to measure and record the angle of refraction Θ2 generated for each n1 and Θ1 in Table A.

4. For each set of values in the table, calculate the ratio of sin Θ1/sin Θ2.

**Scenario 2** – Going from a high index of refraction to a low index of refraction.

1. Use the slider on the application to set n2 and n1 to the values given in Table A. The index n1 is the control variable and should not be changed.

2. Using the protractor, set Θ1 to the value specified in the table.

3. Use the protractor to measure and record the angle of refraction Θ2 generated for each n1 and Θ1 in Table A.

4. For each set of values in the table, calculate the ratio of sin Θ1/sin Θ2.

**Observations**

**Table A: Scenario 1** – Going from a low index of refraction to a high index of refraction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Air | | Glass | |  |
| Angle of incidence Θ1 (degrees) | Index of refraction n1 | Angle of refraction Θ2 (degrees) | Index of refraction n2 | Calculations of sinΘ1/sinΘ2 |
| 15 | 1.00 |  | 1.25 |  |
| 30 | 1.00 |  | 1.25 |  |
| 45 | 1.00 |  | 1.25 |  |
| 60 | 1.00 |  | 1.25 |  |
| 75 | 1.00 |  | 1.25 |  |
| 15 | 1.00 |  | 1.50 |  |
| 30 | 1.00 |  | 1.50 |  |
| 45 | 1.00 |  | 1.50 |  |
| 60 | 1.00 |  | 1.50 |  |
| 75 | 1.00 |  | 1.50 |  |
| 15 | 1.00 |  | 1.75 |  |
| 30 | 1.00 |  | 1.75 |  |
| 45 | 1.00 |  | 1.75 |  |
| 60 | 1.00 |  | 1.75 |  |
| 75 | 1.00 |  | 1.75 |  |

**Table B: Scenario 2** – Going from a high index of refraction to a low index of refraction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Glass | | Air | |  |
| Angle of incidence Θ1 (degrees) | Index of refraction n1 | Angle of refraction Θ2 (degrees) | Index of refraction n2 | Calculations of  sin Θ1/sin Θ2 |
| 15 | 1.25 |  | 1.00 |  |
| 30 | 1.25 |  | 1.00 |  |
| 45 | 1.25 |  | 1.00 |  |
| 60 | 1.25 |  | 1.00 |  |
| 75 | 1.25 |  | 1.00 |  |
| 15 | 1.50 |  | 1.00 |  |
| 30 | 1.50 |  | 1.00 |  |
| 45 | 1.50 |  | 1.00 |  |
| 60 | 1.50 |  | 1.00 |  |
| 75 | 1.50 |  | 1.00 |  |
| 15 | 1.75 |  | 1.00 |  |
| 30 | 1.75 |  | 1.00 |  |
| 45 | 1.75 |  | 1.00 |  |
| 60 | 1.75 |  | 1.00 |  |
| 75 | 1.75 |  | 1.00 |  |

**Analysis**

1. What trends did you notice in Table A of your Observations?

2. Do you notice any mathematical relationships between sin Θ1/sin Θ2, n1 and n2 in Table A?

3. What trends did you notice in Table B of your Observations?

4. What is the critical angle for each value of n1 in scenario 2? Use the application to determine the exact value for each case.

|  |  |
| --- | --- |
| When n1 = | Critical angle value |
| 1.25 |  |
| 1.50 |  |
| 1.75 |  |

5. What happens to the refracted ray when Θ1 is greater than the critical angle?

6. As the value of n1 increases, what happens to the critical angle? Why?

7. Does the same mathematical relationship you found in question #2 work when Θ1 is **less than the critical angle** for the data you collected in Table B? If not, can you suggest a new mathematical relationship between sin Θ1/sin Θ2, n1 and n2 for angles less than the critical angle?

**Conclusion**

What did you learn in this investigation? What can you conclude from this investigation? Were your hypotheses correct?

Please make use of these optic terms in your conclusion: incident ray, reflected ray, angle of incidence, angle of refraction, smaller than, larger than, index of refraction, medium, behavior of refracted ray, normal, closer to, farther from…