



## Optics Workshop




Apr. 27, 2012    Session A, 10:45am-noon    Time Room

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## This Workshop

- Every individual should have a stapled hand-out and a foldable voting card
- Please form teams of 3 or 4 – you will share a pile of apparatus and work together on the activities (share the mark!)
- Introduce yourselves

## Quick Survey (showing a blank means “E”)

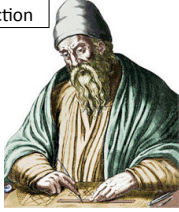
- I am here mostly because I teach:
  - A. Grade 10 Science
  - B. Grade 11 Physics
  - C. Grade 12 Physics
  - D. Other
  - E. University courses

## Some historical tidbits...

- 300 B.C. – Euclid of Alexandria noted that light travels in straight lines, and wrote down the Law of Reflection for plane mirrors:


The angle of incidence = The angle of reflection

- Unfortunately, Euclid believed that vision was due to our eyes emitting rays of light.



## History of Light

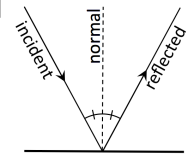
- 1000 A.D. – Alhazen of Basra considered the law of reflection in 3-D, noting that the angles of incidence and reflection are in the same plane normal to the interface.
- Alhazen proved experimentally that vision is due to light proceeding to our eyes, from each point on an object. He also investigated refraction, pinhole cameras, and lenses.



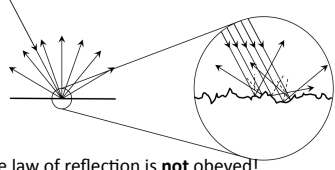
## Activity 1: How do we see?

### Background

- **Specular Reflection**
- Mirrors, shiny objects
- “The Law of Reflection”



- **Diffuse Reflection**
- When the surface is bumpy on the microscopic level
- Everything else!
- Macroscopically, the law of reflection is **not** obeyed!

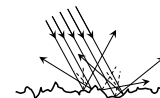


**Activity 1: Pre-activity Quick-Check**

- When considering a single mathematical ray of light (single photon), to what does the law of reflection apply?
- Specular reflection
  - Diffuse reflection
  - Both
  - Neither

**Activity 1: Pre-activity Quick-Check**

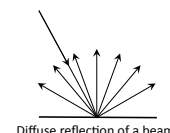
- When considering a single mathematical ray of light (single photon), to what does the law of reflection apply?
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  - C. Both**
  - Neither

**Activity 1: Pre-activity Quick-Check**

- When considering an actual beam of light, such as the beam from a laser pointer, to what does the law of reflection apply?
- Specular reflection
  - Diffuse reflection
  - Both
  - Neither

**Activity 1: Pre-activity Quick-Check**

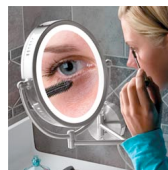
- When considering an actual beam of light, such as the beam from a laser pointer, to what does the law of reflection apply?
- A. Specular reflection**
  - Diffuse reflection
  - Both
  - Neither

**Activity 1: How do we see?  
Activity**

- ~ 10 Minutes
- Work together! Include all team members
- You will “turn in” only one hand-out for your team, so after discussion and practice make one your “good copy”

**Activity 2: Where is the Focal Point of a Concave Spherical Mirror?****Background**

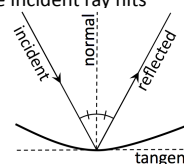
- The law of reflection also applies to *curved* surfaces
- The normal is the line which is perpendicular to the tangent plane at the point where the incident ray hits the surface



Concave



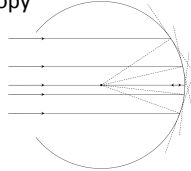
Convex



### Activity 2: Where is the Focal Point of a Concave Spherical Mirror?

#### Activity

- ~ 15 Minutes – Label C and F
- Work together! Include all team members
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### Activity 2: Post-activity Understanding Question

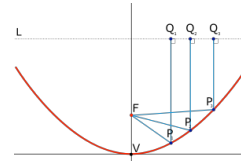
- When a beam of light, composed of many parallel rays, reflects from a concave mirror
  - A. The reflected rays spread out
  - B. The reflected rays are parallel to each other
  - C. The reflected rays converge towards a focus point
  - D. The reflected rays rays converge, but don't necessarily pass through a focus point

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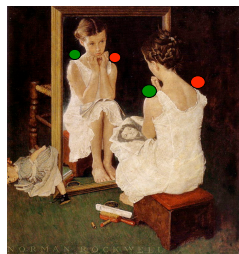
### Activity 2: Post-activity Note

- There is one particular type of concave surface that does reflect parallel rays to a single focus: a **parabola**
- A circle is similar to a parabola if you only use a small portion of it



### Activity 3

- “Why do mirrors reverse left-to-right and not up-to-down?”
- ~ 10 minutes



### Activity 3: Post-activity Understanding Question

- Which way does a mirror reverse the image?
  - A. Left-to-right
  - B. Up-to-down
  - C. Front-to-back

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### Activity 3: Post-activity Note

- Mirrors reverse the image front-to-back relative to the original object
- Bob needs to turn in order to face Alice, and he actually has two choices of how to do this: he can stand on his head or he can turn left or right 180 degrees
- Since it's easier to turn than stand on your head, we do it every time
- That's why we think mirror reverse left and right
- It is **Bob** that reverses that way, not the mirror.



### Activities 4 and 5 Lab Exercises

- ~ 15 Minutes each
- We may need to dim the lights a bit
- These ray boxes can shine a single ray (Activity 4) or a set of 5 parallel rays (Activity 5) on the table surface or a piece of paper
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