

# HANDOUT

## Student Assessment Questions/Answers

- 1 Vocabulary**  
Refraction - change in direction of light wave after change in speed.
- Incident rays** - the light wave which hits the surface of a medium.
- Refractive rays** - the light wave which reacts to a new speed due to new medium.
- Emergence** - this is the light wave emerging from the new medium back to the original one.
- Angles of incidence** - angle between where the ray hits the surface of a new medium and a line at right angle with that surface.
- 2** What hypothesis might you form about what is occurring, and whether or not the phenomenon can be measured?
- 3 Notes:**  
Describe how a change in matter or density of matter affects light.
- Answers might include: when a ray hits a medium that is denser than what it was originally in, the ray's speed decreases, which changes the direction that it has energy to shine.
- Explain why it is hard to locate and pick up an item you see through water.
- Due to refraction, the location you see the item is not the actual location of the item.
- Check your hypothesis. How close were you to being correct?
- 4 Bonus:**  
Use your group and the internet to brainstorm other ways to use this knowledge.



# TEACHERS GUIDE



## LIGHT AND COLOR - DEMONSTRATION DEVICES

- If I drop my ring on the bottom of a clear pool, why is it hard to locate it to pick it up?
- You can run faster in air than in water. How does this fact relate to light refraction?
- How can manipulation of light be useful to today's needs?

Easily demonstrate and measure refraction of light. A built-in light creates incident and refractive rays from any point on a round, graduated scale. Tank can be leveled for measurement accuracy.

# Materials

- Refraction tank with laser
- handout
- liquid nitrogen
- encyclopedia or internet (HowStuffWorks.com)

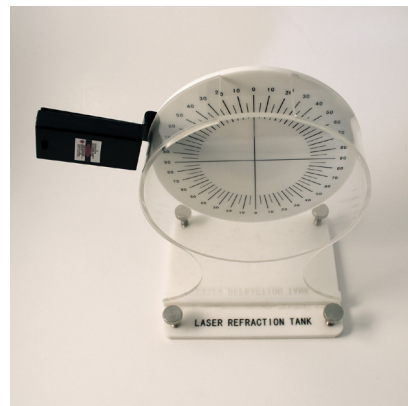
# Goals & Objectives

## Students will:

- describe how a change in matter or density of matter affects light.
- trace historical development of the knowledge of refraction.
- apply this fact to current needs.

# ASSESSMENT

- 1 Participation in class discussion (formative, informal).
- 2 Presentation (It's valuable to decide as a class what the rubric or expectations will be for the presentation, and assign points for each expectation.),
- 3 Handout



# ACTIVITIES

- 1 Ask students if they've ever tried to pick up an object they've dropped to the bottom of a pool, or tried to run in water. Why are both tasks difficult?
- 2 Ask how that might affect light going from air to water.
- 3 Show the light through an empty refraction tank. (It will show up better if you "smoke" it with liquid nitrogen.) Point out how the laser travels straight across the scale from the laser source, as nothing obstructs it.
- 4 Now show the laser through a water-filled tank. Measure the angle that the laser light "bends".
- 5 Ask why this happens. Why does the water create a reaction that air does not? (Consider the pool and running in water scenarios.)
- 6 Pass out the handout to students; define terms together.
- 7 Allow students to create a hypothesis about what is occurring, and whether or not the phenomenon can be measured.
- 8 Group students into 4 groups. Each group must research one of the following:
  - Claudius Ptolemaeus or Ptolemy, Willebrord Snellius,
  - Christiaan Huygens,
  - How Fingerprint Scanners Work.
- 9 Students should take notes on presentations, and use findings to finish the handout.

## Note

It is always best to DO an experiment ahead of time to be able to best present it to the class.



They should find out what these people/things have to do with refraction. They might divide work amongst themselves to look for journalistic answers to who, what, when, why, where, and how, and to create a visual. This should be shared with the class.

**(Depending on class time, this could take 3-5 days.)**



# HANDOUTS

Student Name: \_\_\_\_\_

**1** **Vocabulary**  
**Define the following terms:**

Refraction

*Incident rays*

*Refractive rays*

*Emergence*

*Angles of incidence*

**2** What hypothesis might you form about what is occurring, and whether or not the phenomenon can be measured?

**3** **Notes:**  
Describe how a change in matter or density of matter affects light.

Explain why it is hard to locate and pick up an item you see through water.

Due to refraction, the location you see the item is not the actual location of the item.

Check your hypothesis. How close were you to being correct?

**4** **Bonus:**  
Use your group and the internet to brainstorm other ways to use this knowledge.

