LASER SESSION

HI-TECH WEEKEND #1

FVTI, APPLETON, WI

I. LASERS IN COMMUNICATIONS CURRICULUM
   A. WHAT ARE LASERS?
   B. WHY LASERS?
   C. DOES IT REALLY INVOLVE COMMUNICATIONS?
   D. IS IT PRACTICAL?

II. USES OF LASERS IN COMMUNICATIONS
   A. INTRODUCTION TO LASERS AND HOW THEY WORK
   B. EXPLAINATIONS OF PRACTICAL USES OF LASERS
   C. STUDENT ACTIVITIES INVOLVING LASERS

III. DEMONSTRATION OF STUDENT ACTIVITIES
   A. SCATTERING OF LIGHT
   B. BEAM DIVERGENCE
   C. VOICE TRANSMISSION
   D. HOLOGRAM TRANSMISSION (NOT DEMONSTRATED HERE)
   E. FIBER OPTICS

IV. CONCLUSION/SUMMARY
   A. REVIEW LASER
   B. CITE EXAMPLES/ACTIVITIES THAT CAN BE USED
   C. ANSWER QUESTIONS
   D. NEW EXPERIMENTS/ACTIVITIES BRAINSTORM

Thirty years ago lasers were just a futuristic dream. Today they are very real and becoming an increasingly important part of our lives.[1] Lasers (the word is an acronym, meaning light amplification by stimulated emission of radiation) were theoretically developed in 1917 by Albert Einstein, but were impossible to build until after World War II. The first laser was built in 1960 by Theodore Maiman and other scientists at the research laboratories of the Hughes Aircraft Company in California.

The first lasers were developed for industrial uses such as cutting and aligning materials to very precision tolerances. As the technologies related to lasers grew, so did the applications for lasers.

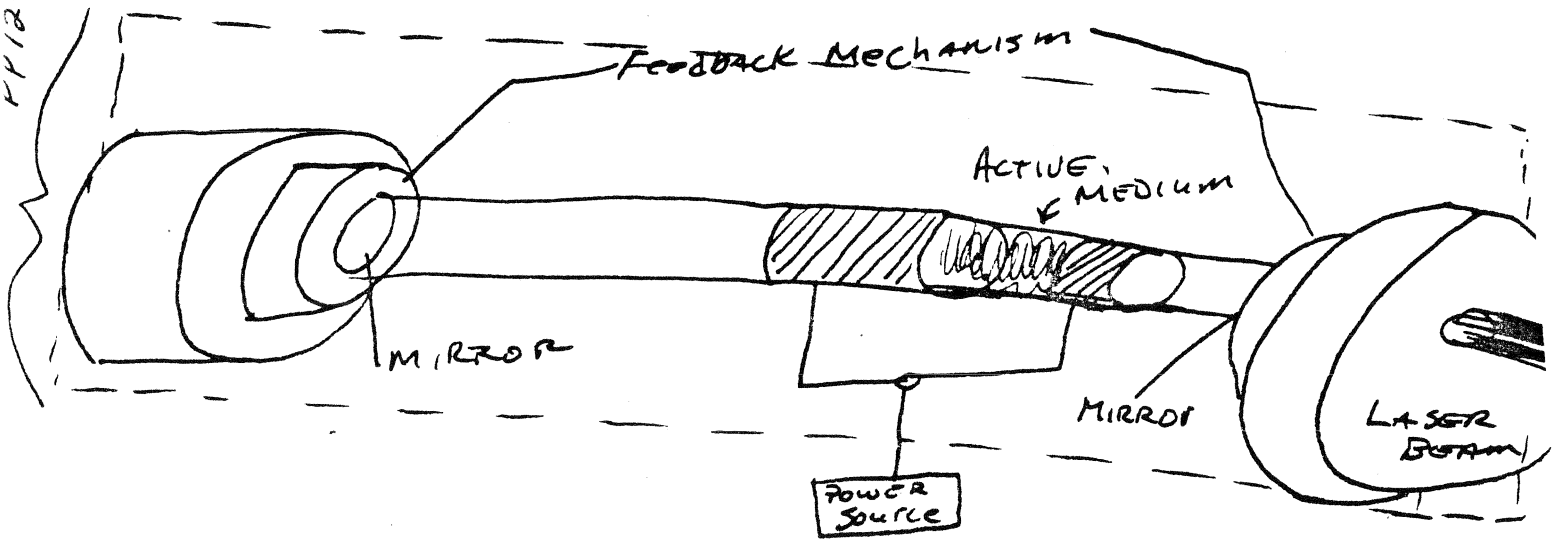
Today, the communications industry uses the laser in ways never thought of in the 1960's. Today lasers are used to transmit messages in much the same way as we would use a wire to transmit the same message. We also can use the laser to measure distances to more precise figures and also transmit three dimensional holograms, or pictures.

The following activities in this unit will aid the student in knowing more about what lasers are, how they work, and how they can be used. Activities will include an introduction to how a laser works, measuring divergence of a laser beam, transmitting audio signals with a laser, fiber optics in laser use, and finally hollography.

References

Lasers, McKie. Robin, Franklin Watts
Publisher, 1983
How Lasers Work -- Lecture

I. Three basic parts of a laser
   1. Power Source
      A. Electrical current or
      B. Light energy
   2. Active Medium
      A. Ruby - solid
      B. Dyes - Liquid
      C. Neon - Gas
   3. Feedback Mechanism
      A. Mirrors



[1] Burroughs, William Lasers c. 1982, Warwich Press

II. Three stages of creating a beam
1. Excitation
2. Amplification
3. Output of laser beam

Excitation

Process by which atoms absorb energy and then give it out as light.

In the neon gas laser that is used in class, excitation occurs when the power switch is turned to the "on" position. At this time, electricity comes in contact with the neon atoms, causing them to move. The initial movement of the gas is very erratic.

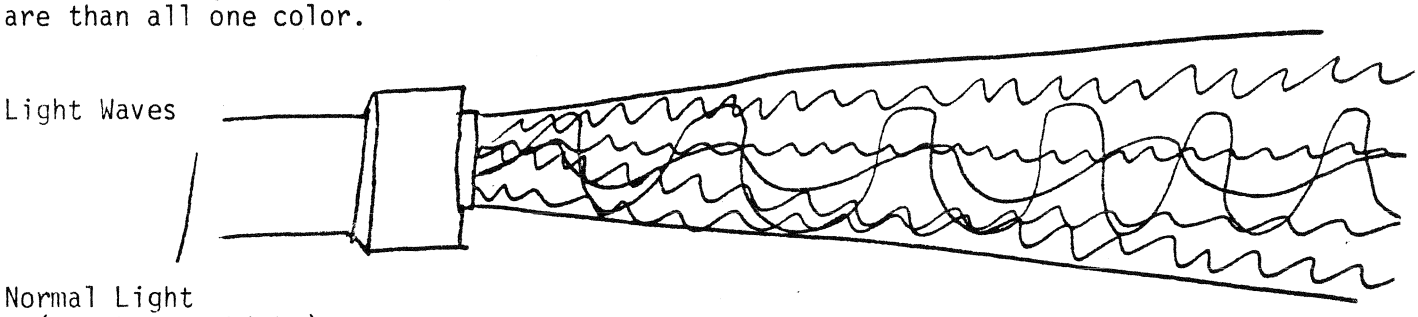
The erratic motion of the gas is eventually made uniform by the reflection of the light produced off of mirrors at the ends of the tube. These mirrors reflect the light back and forth in perfect parallel beams that eventually grow in intensity. This stage is known as amplification.

Amplification

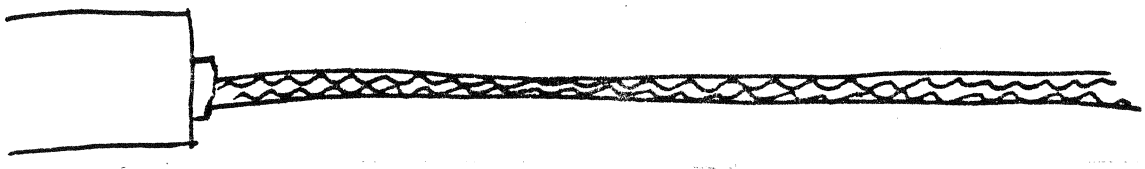
As mentioned above, amplification is the gain of intensity in the light beam. As the light beam is reflected between the mirrors, it gains intensity or strength. This process enables the beam to develop a constant wave length that is stronger than ordinary light. By having such a beam, the light becomes capable of being usable as a laser beam.

Output of the Beam

After a certain point, the amplification is great enough to allow the beam to leave the tube as laser light. In contrast to normal light, which have many different light waves, the laser produces only one length of light wave. Seeing that a laser produces a light with a constant wave, the beams are than all one color.



Normal Light
(Incoherent Light)



Laser Light
(Coherent Light)

Laser light is ideally a beam in perfect parallel, which is impossible to accomplish with the lasers of today. Laser light is eventually absorbed into ordinary light and the beam therefore spreads. This spreading or growing is known as divergence. This concept will be discussed and demonstrated in the next laser activity.

ACTIVITY: Lasers: Beam Divergence
Class Periods Required: Two

Materials

1- Metrologic helium-neon laser
1- Tri-pod for laser
1- Target on 1/8" graph paper
100 feet of unobstructed hallway
Power source (115V AC)
Paper and pencil to record results

Objectives

The students will:
1. graph the diameter of the beam vs. distance of travel.
2. explain in writing the characteristics of this particular laser.
3. generate ideas on how to reduce the divergence problem.

Teacher Activities

-lead discussion on divergence
-demonstrate equipment
-demonstrate safety
-class structure-groups of 3 or 4

Student Activities

-measure divergence over 100 feet
-graph results
-interpet graph
-generate ideas on how to reduce divergence

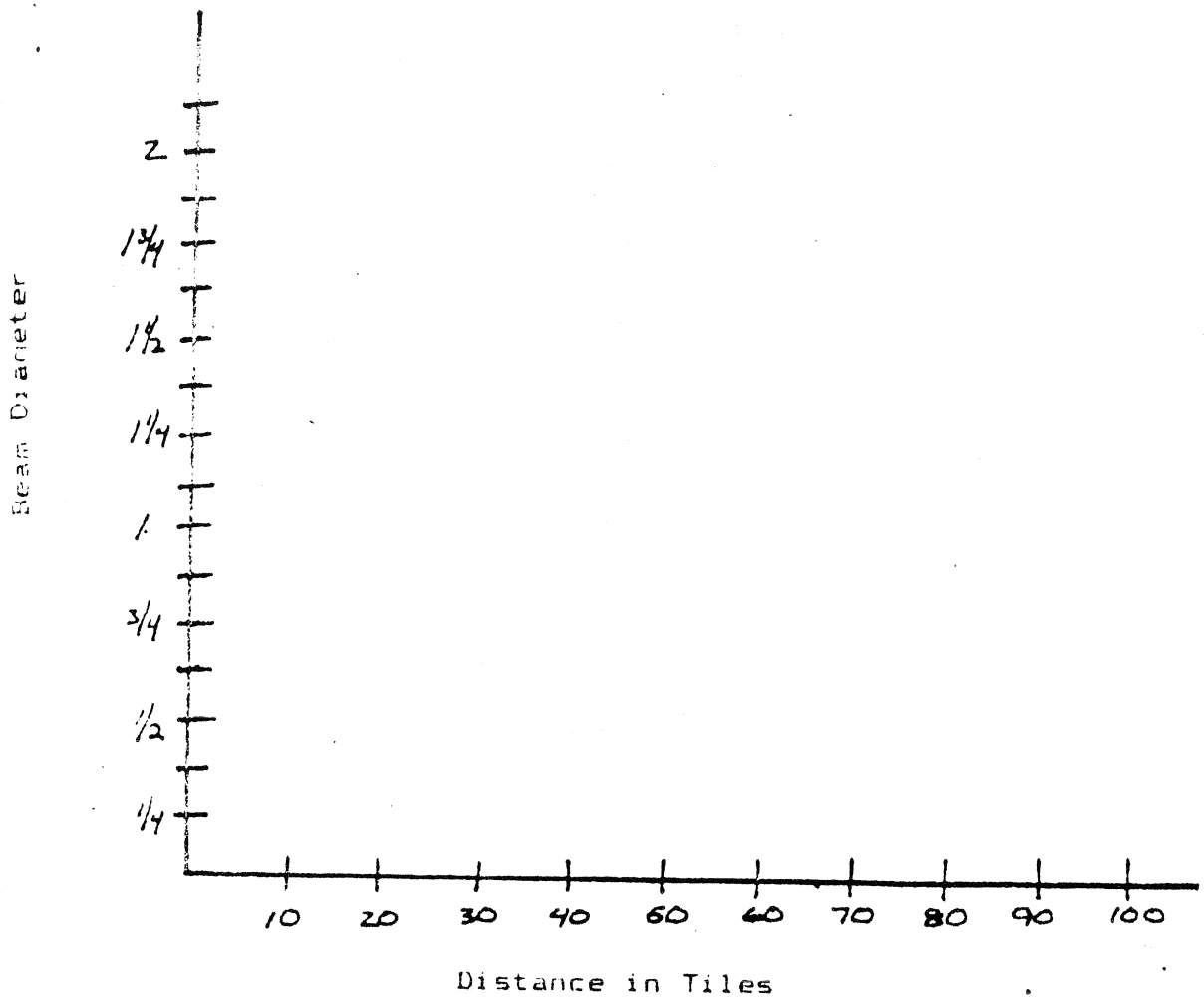
Reference

Communication & Information Technology Packet on INFORMATION TRANSMISSION, U.W.-STOUT.

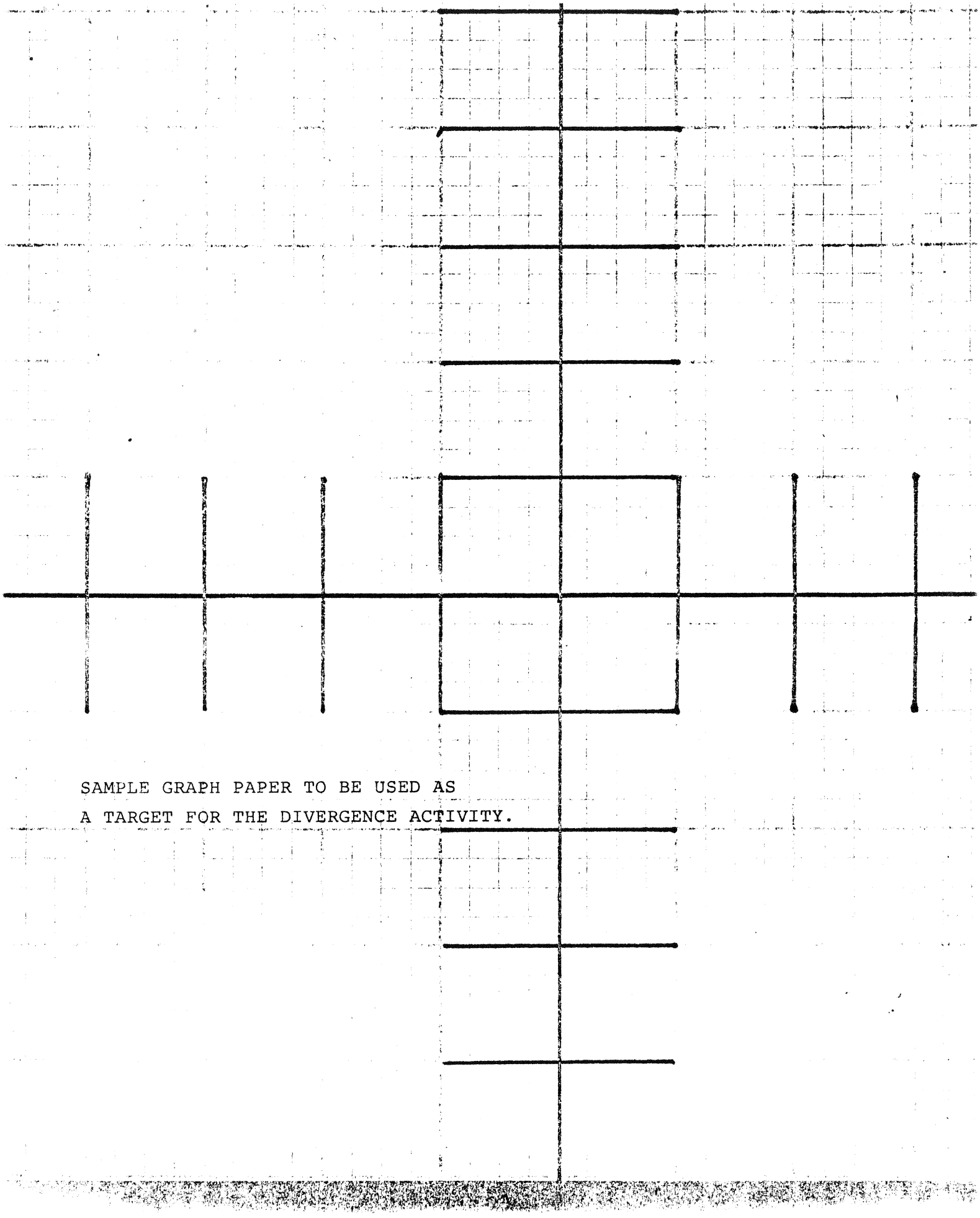
Supply Source

Metrologic

Procedure	Equipment	Notes
1. Mount laser onto tripod and place in hallway.	1. Metrologic Helium-Neon laser, tripod.	1. Hallway should be marked every 10 feet for 100 feet.
2. Pointing down the hall. Plug in the laser and turn it on.	2. 115v AC	2. Aim about chest high to avoid contact with students eye.
3. Measure the diameter of the beam at the 0 feet mark and record the width.		
4. Measure the diameter of the beam at the 10 foot mark and record the width.		
5. Repeat the above procedure every 10 feet until you reach 100 feet and record the data.		
6. Make a graph of beam diameter versus distance and connect the points.		
7. Answer questions in reference to the graph and activity		7. Questions are in direct relationship to the Objectives for this activity.



SAMPLE GRAPH TO BE USED IN PLOTTING BEAM DIAMETER VS. DISTANCE IN FEET TO BE USED WITH THE DIVERGENCE ACTIVITY.



SAMPLE GRAPH PAPER TO BE USED AS
A TARGET FOR THE DIVERGENCE ACTIVITY.

Activity: Lasers: Scattering of light

Class Periods Required: One

Materials :

1- Metrologic Helium-Neon Laser
2- Glasses of water (clear glass container)
- Chalk eraser with chalk dust
- Ice
- Salt or sugar

Objective :

The student will:

1) Explain in writing what effect each substance has on the beam.

Teacher Activities :

- Class structure, group
- Lead discussion on laser beam characteristics
- Demonstrate activity

Student Activity :

- Observe demonstration
- Explain the effects of each substance on the beam

Reference :

Communications & Information Technology pkt. on Information Transmission , UW-STOUT

Procedure	Equipment	Notes
1) Turn on laser and turn off all lights in the room.	1) Laser	
2) Shake the chalk dust from the eraser in front of the laser and observe the effects.	2) Laser, eraser with chalk dust	
3) Pour some water into a clear glass container. Observe the effects of air bubbles on the laser.	3) Clear glass container, water, laser	
4) Hold some clear ice in front of the laser beam and observe what effects it has on the laser beam when it encounters any imperfections in the crystalline structure of the ice.	4) Ice cube, laser	
5) Shine the beam into a clear glass filled with water. Add salt or sugar to the water in small amounts and observe the results.	5) Clear glass container, water, salt or sugar, laser	