# Science Outreach

for

Elementary and Middle School Students

by the

OSA Chapter at Stanford University

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# Outline

- Outreach activities at Stanford University
  - Weekly OSA outreach to East Palo Alto 4th grade science class
  - Lyceum
  - EPACS science program
- Starting an Outreach
  - How to get volunteers
  - Science lessons
  - How to contact school/set up program
  - General philosophy on teaching science

# Background on OSA outreach in East Palo Alto

- *1995* Flood Elementary School after school program
  - Built science projects
- *1996* Start of Adopt a Class - official sponsorship by OSA
  - structure
- *1998* Moved to Edison-McNair
  - Greater teacher support

# Weekly preparation for 1.5 hour class

- Before meeting people
  - Notify people
    - meeting time
    - previous week's lesson
  - Plan lesson
    - Photocopying
    - Gathering materials
  - Confirm attendance and carpooling
- Before arriving at school
  - explain for 15-30 minutes what we plan to cover and the general experiments.



# Topics that we covered this year

| Mystery Powders | Skeletons | Ecosystems |
|---|---|---|
| **Chemical reactions**<br>Mystery Powders<br>• (Calcium Carbonate, Baking Soda, Salt, Sugar, Citric Acid, Corn Starch)<br>Mystery Liquids<br>• (Vinegar, Iodine, Water, Oil)<br>Tests<br>• solubility<br>• starch test<br>• acid/base<br>• acid base reaction | Owl Pellet<br><br>Hokey-Pokey<br><br>Real human bones<br>• joints (hands)<br>• femur<br>• borrowed from the anatomy lab<br><br>Model human skeleton<br>• borrowed from the orthopedic clinic | Food/energy chains<br><br>Environmental complexity<br><br>San Francisco Zoo field trip |

Basic observation and recording skills.

# Spending a day showing the students that optics exist in everyday life

- Optics
  - Demonstrations
    - Snell's law
    - mirrors/reflection
    - additive vs. subtractive color
    - prisms and diffraction

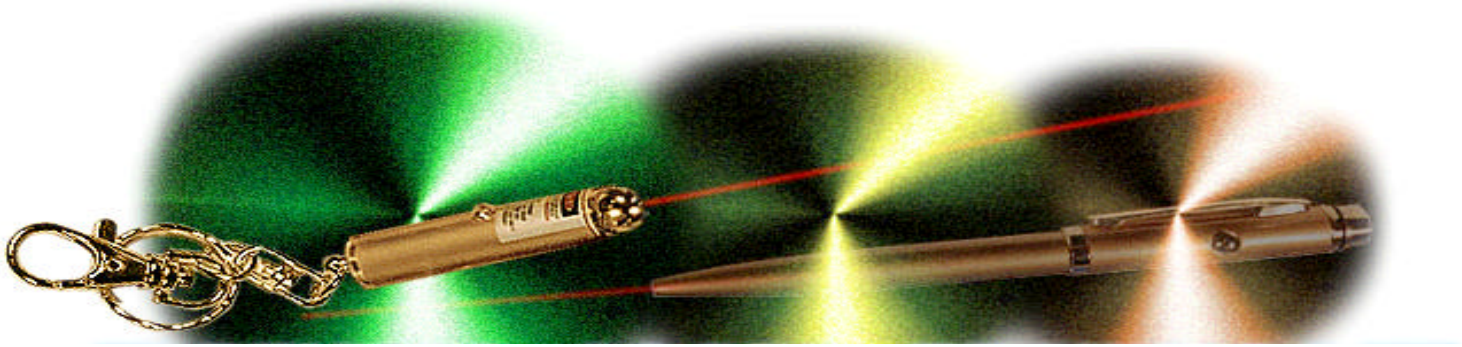
# Lyceum background

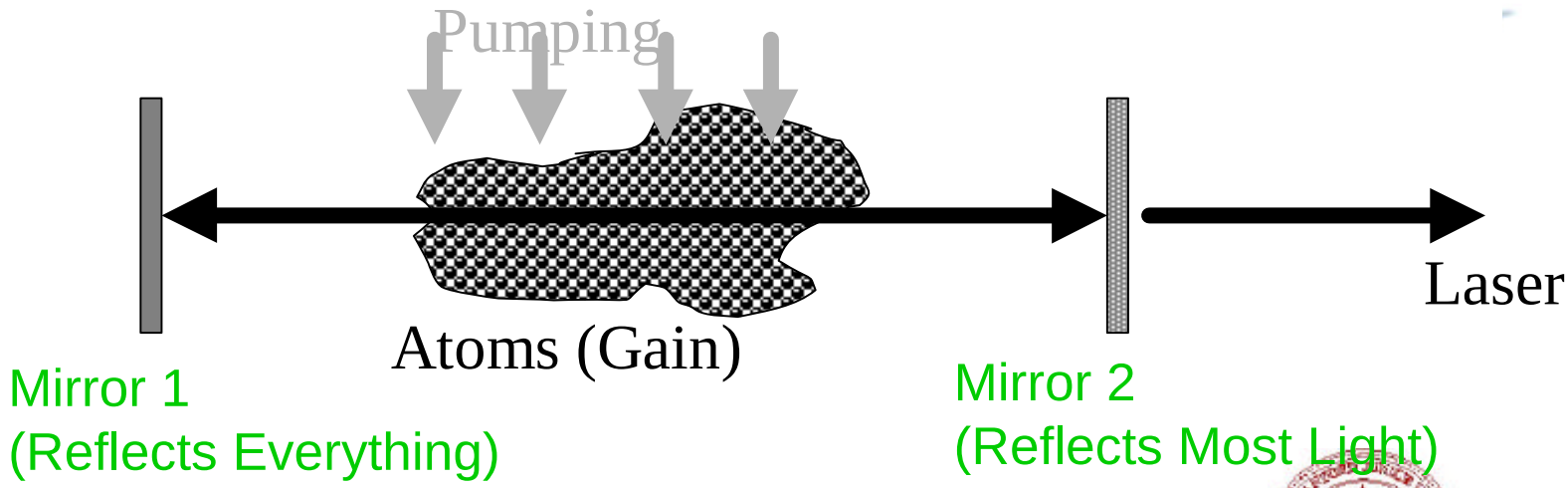
- Non-profit
- Lyceum was founded in 1971 by parents and educators to provide enrichment seminars for intellectually gifted children from grade 2-8.
- Seminars are developed and taught by any qualified person in the following areas:Art and Music, Humanities, Natural Science and Physical Science
- This year Stanford's OSA prepared a seminar on optics and lasers.
- More info can be found at www.lyceum-scv.org

# Advanced Planning Lyceum

- Deciding what we would do with the students for the day
  - Morning Lecture and simple demonstrations
    - Arrange people to lecture about each of the following topics
      - Laser Safety
      - All about Light (wave vs particle, speed of light, types of light sources)
      - mirrors and reflection
      - lens, prisms and refraction
      - lasers
      - fiber optics and detectors

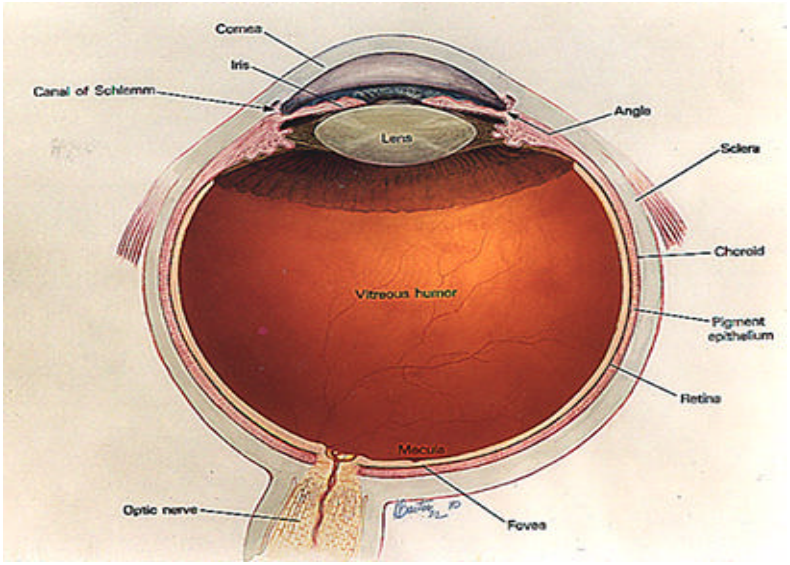
# How a Laser Works



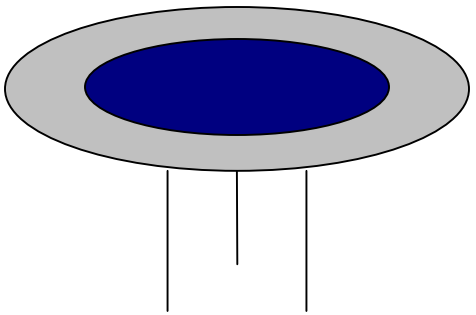


# Optical Detectors

Human eye




Photodiode



To Brain

Light In, Electricity Out!

To Meter

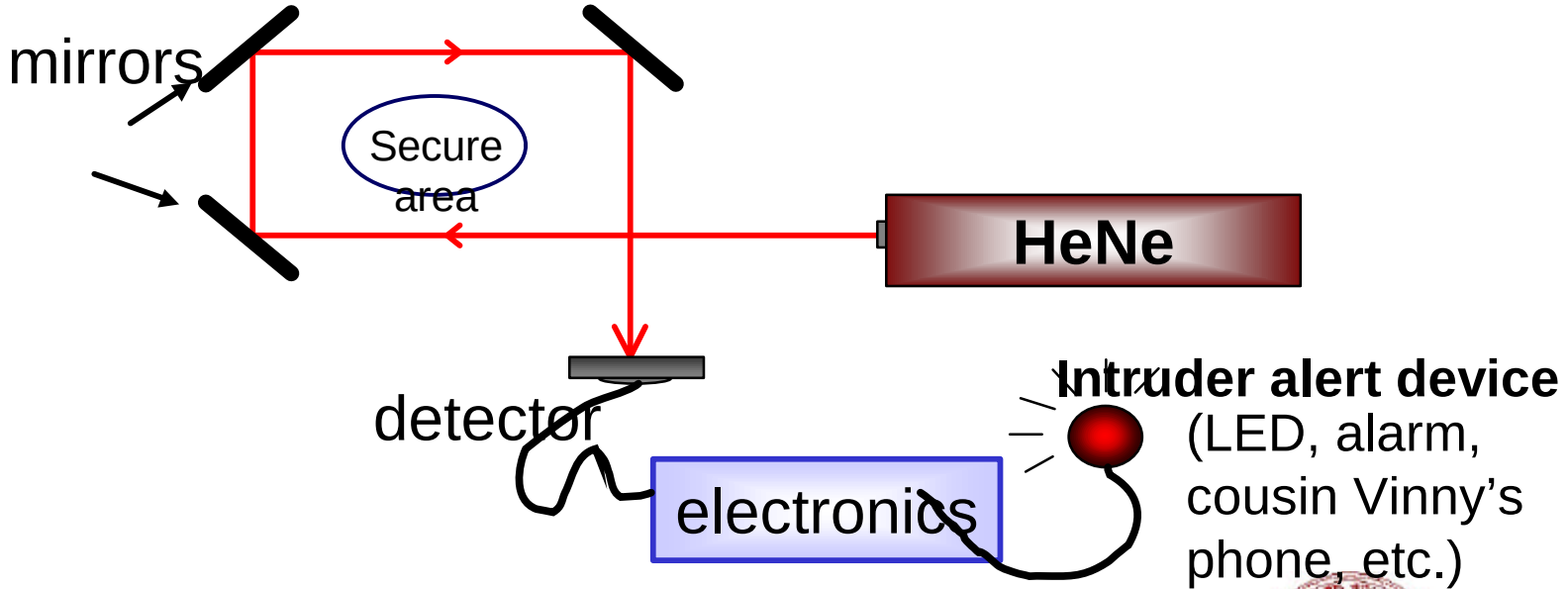
# Some of the demonstrations

Demonstration of fiber optics

Demonstration of Snell's law

# Planning the afternoon session

- Laser Security System
  - find and borrow the parts (HeNe lasers, post holders, mirror mounts, bread boards, photodetectors)
  - Buy electronic components



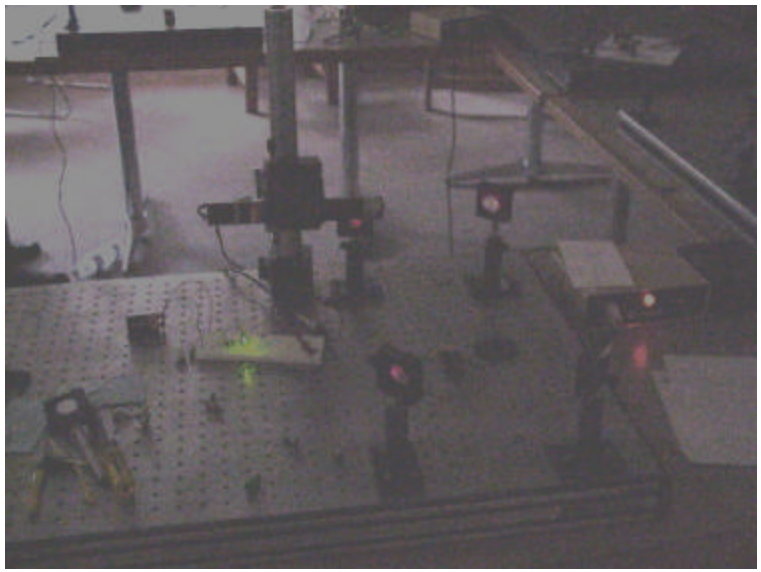
# Laser security system project in the making

Working together to achieve a common goal

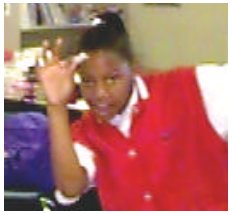
# Asking questions helps to achieve quicker success

- General problems that were encountered
  - Faulty photodetectors
  - Bad electrical wiring
  - Fried batteries

# The laser security system that was working



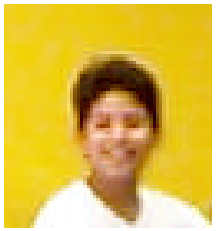
finally, SUCCESS!



# EPA Charter School
# Science Enrichment Program

*Why does a balloon rise?*
*How does a jacket keep us warm?*
*Why does water come out of a fountain when we push the button?*
*What building design can withstand an earthquake?*
*What is inside a computer?*
*How do rockets propel themselves?*
*Where can you find a picture of a hyena on the internet?*
*How do you email a message to the President?*

These are some of the questions elementary school students answer in a series of hands-on experiments designed and taught by Stanford graduate students.



## Mission

To encourage student interest in science and technology through exploration of examples from our everyday life in a weekly series of hands-on demonstrations, experiments, and projects.

## Organization

- Started in the fall of 1998 by Stanford University graduate students
- 55 elementary school students are involved from grades 2-7
- 17 graduate students are involved as tutors
- Students and tutors are assigned to one of 4 after-school sessions
- Sessions are grouped by grade/skill level and last 1.5 hours

# 1998-99 Projects

| Theme | Science and Technology of Transportation | Science and Technology in the Home | MESA Competition | Computers and the Internet |
|---|---|---|---|---|
| Quarter | Fall 1998 | Winter 1999 | Spring 1999 | Summer 1999 |
| Projects | Straw Bridge<br>Paper Boats<br>Hot-Air Balloon<br>Balloon Rocket<br>Steam Engine<br>Sail Boats<br>Flight Fundamentals<br>Model Airplanes | Insulation Materials<br>Earthquake!<br>Water Pressure<br>Sense of Smell<br>Electricity<br>Inside Computers<br>Robots<br>Light and Optics | Macaroni Mechanics<br>Egg Drop<br>Original Music<br>Tongue Depressor Bridge<br>Tetrahedron Kites<br>Sail Cars | Computer Hardware<br>Computer Software<br>Email I<br>Email II<br>Searching the Web I<br>Searching the Web II<br>Web Scavenger Hunt |
| Field Trips | | Tech Museum<br>Stanford Robots | MESA competition<br>Stanford Machine Shop | |

# Future Plans

Fall 1999: Life Sciences

*Bugscope*: electron beam microscope operated over the internet

NASA *Connect*: aerospace project series

# Searching the Web (Summer '99)

Objectives: Teach the students how to find information on the web

Preparation: Set up an internet browser on each computer

Outline: (1) Students should start their browsers and go to *Yahooligans*.
(2) Describe how *Yahooligans* is a web site that keeps lists of other web sites and put them in categories. Find a web page about clouds by using the index (Science and Nature > Weather > Clouds) and by searching.
(3) Have the kids use the search engines to find the following items.

- *Find a picture of the actual landscape on Mars.*
- *Find a satallite picture of a hurricane.*
- *Find a picture of a hyena.*
- *Find when humans first walked on the moon. What did Neil Armstrong say (bonus for finding a recording)?*
- *Find a recording of a lion's roar.*
- *Find a picture of the Mona Lisa.*
- *Find a picture of the Alaskan flag.*
- *Find a map of your school.*

**Stanford University**

Jessica Barzilai
Tristan Burton
Krista Donaldson
Dan Fletcher
Scot Haire
Ned Hammond
Amy Herr
Marcela Karpuj
Brian Kirby
Ken Crozier
Karla Miller
Josh Molho
Judy Segura
Lester Su
Todd Sulchek
Julia Webber
Michael Webber
Sharon West
Kathy Wilder

**EPA Charter School**

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Donald Evans
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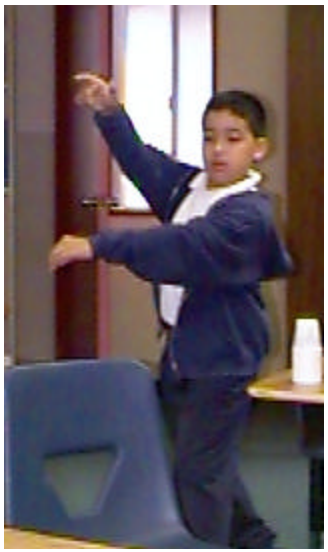
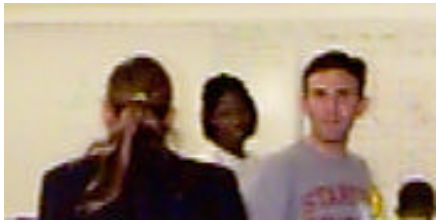




# How to set up a program

1 Establish Educator and Science Contact

- Educator Contact starting places:
  - Principles
  - High school science departments
  - Park districts


- Science Contact starting places:
  - OSA, IEEE, professional science organizations and student chapters
  - Student government associations at universities
  - Technical companies
  - Rotary Club, other service organizations

# Setting up a program, cont.

2 Determine volunteers' interest and availability and students' needs
  - Is this a good fit?
  - Do both "sides" seem excited?!?!

3 Plan out TOGETHER the first program
  - make sure everyone knows what to expect

4 Lay out general calendar

# How to get volunteers

- NOT just optics people
  - Physics, Applied Physics
  - Engineering, Chemistry, Biology
  - Education
- Approaches for creating a volunteer force
  - Large group with a few volunteer each week
  - Small group of same group each week

# Sources of Science

- Pre-made projects
  - Foss kits
  - Insights kits
- Internet
- Exploratorium, Berkeley Hall of Science
- Local colleges and universities
- Everyday items and experiences

# Ways to teach science with many volunteers

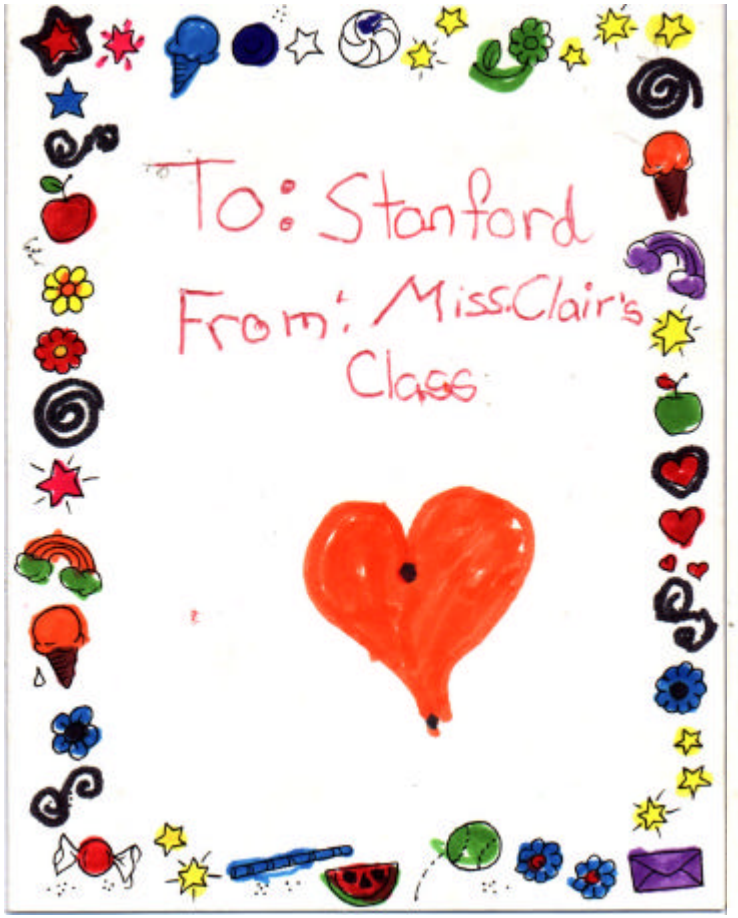
- What worked
  - Stations
  - Small groups
  - Field trips
- What did not work
  - Presentations
  - Arbitrary project topics

# Science principles for elementary school students

- Cause and effect
- General science note taking/question asking
- Observation skills
- Science in everyday life
- Experimental research vs. reading
- Reproducibility of results

- HAVING FUN!!!!!!!!!

# Conclusion




Dear Stanford friend,

Hello, how are you? We are fine. We wanted to tell you how much we appreciate you.

We love it when you come to our class to teach us Science. I never knew science could be so fun! We will never forget you.

Sincerely,
Miss. Clair 4th grade class

Teaching science is very rewarding!

# Topics we covered this year

- Chemical reactions and basic observation
  - Mystery powders (Calcium Carbonate, Baking Soda, Salt, Sugar, Citric Acid, and Corn Starch)
  - Mystery Liquids (Vinegar, Iodine, Water and Oil)
  - Tests
    - General observational and note taking skills
    - Solubility
    - Starch test
    - Acid/ Base
    - Acid Base reaction

# Topics we covered this year, cont.

- Bones and Skeletons
  - Owl Pellets
  - Memorizing bones by singing the Hokey-Pokey
  - Studying real bones borrowed from the anatomy lab at Stanford University
  - Labeling bones names in relationship to a miniature human skeleton (borrowed for Orthopedic clinic)

# Topics we covered this year cont.

- Ecosystems
  - Food/energy chains
    - Sun is the basic source of energy
    - Everything returns to the earth
  - Environmental complexity
    - natural observation
    - Interaction between different organisms
  - San Francisco Zoo field trip