

CyberLab™, A New Paradigm in Distance Learning

**Lambertus Hesselink, Eric
Bjornson, Dharmarus Rizal**

**Departments of Electrical Engineering and
Applied Physics**

Stanford University

bert@kaos.stanford.edu

NSF Meeting

February 11, 2000

Content

- Educational needs
- Current status
- Cyberlab™
- Benefits
- Extensions
- Summary

Educational Observations

Demand for new educational tools:

- Experimental demonstrations in-class enhance the students learning experience
- Distance learning programs require laboratories for accreditation

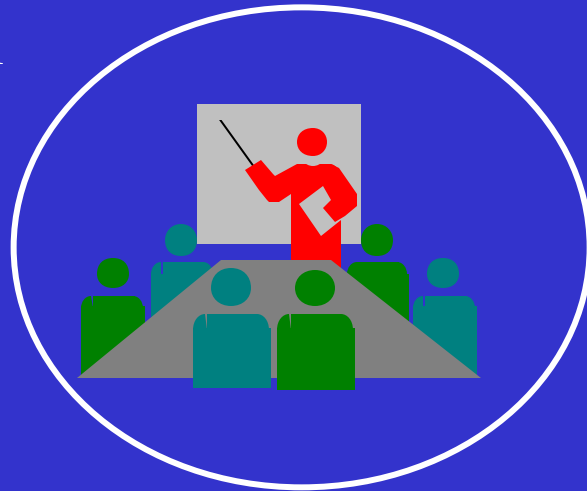
Obstacles:

- “Wet Lab” space is a very expensive, and inefficient use of space
- Lab creation & maintenance hampered by personnel issues
 - **Building a lab is hard work, with few rewards**

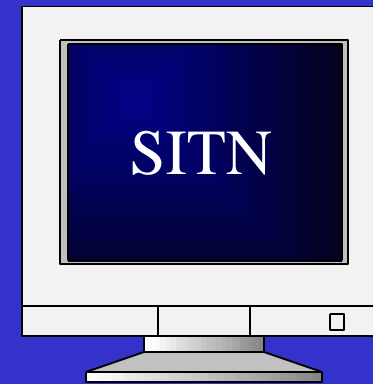
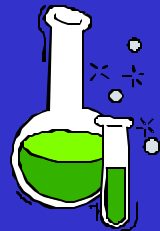
Improved Learning

Traditional learning

Classroom
teaching



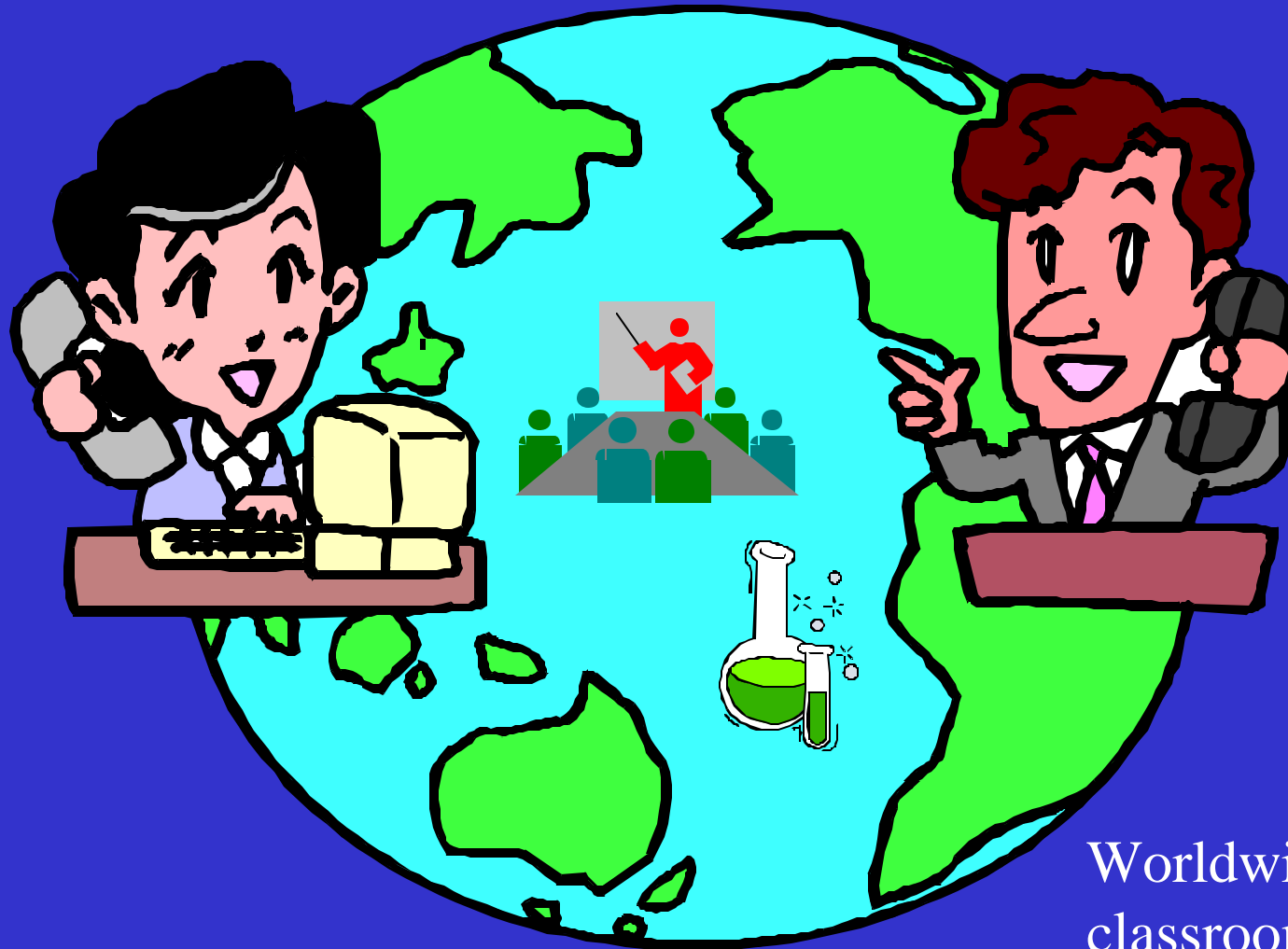
Laboratory



Classroom teaching
over the Internet

- **Laboratory experience still requires physical presence**

CyberLab™



Worldwide access to
classroom and laboratory
facilities

The Vision

Stanford University

CYBERLAB

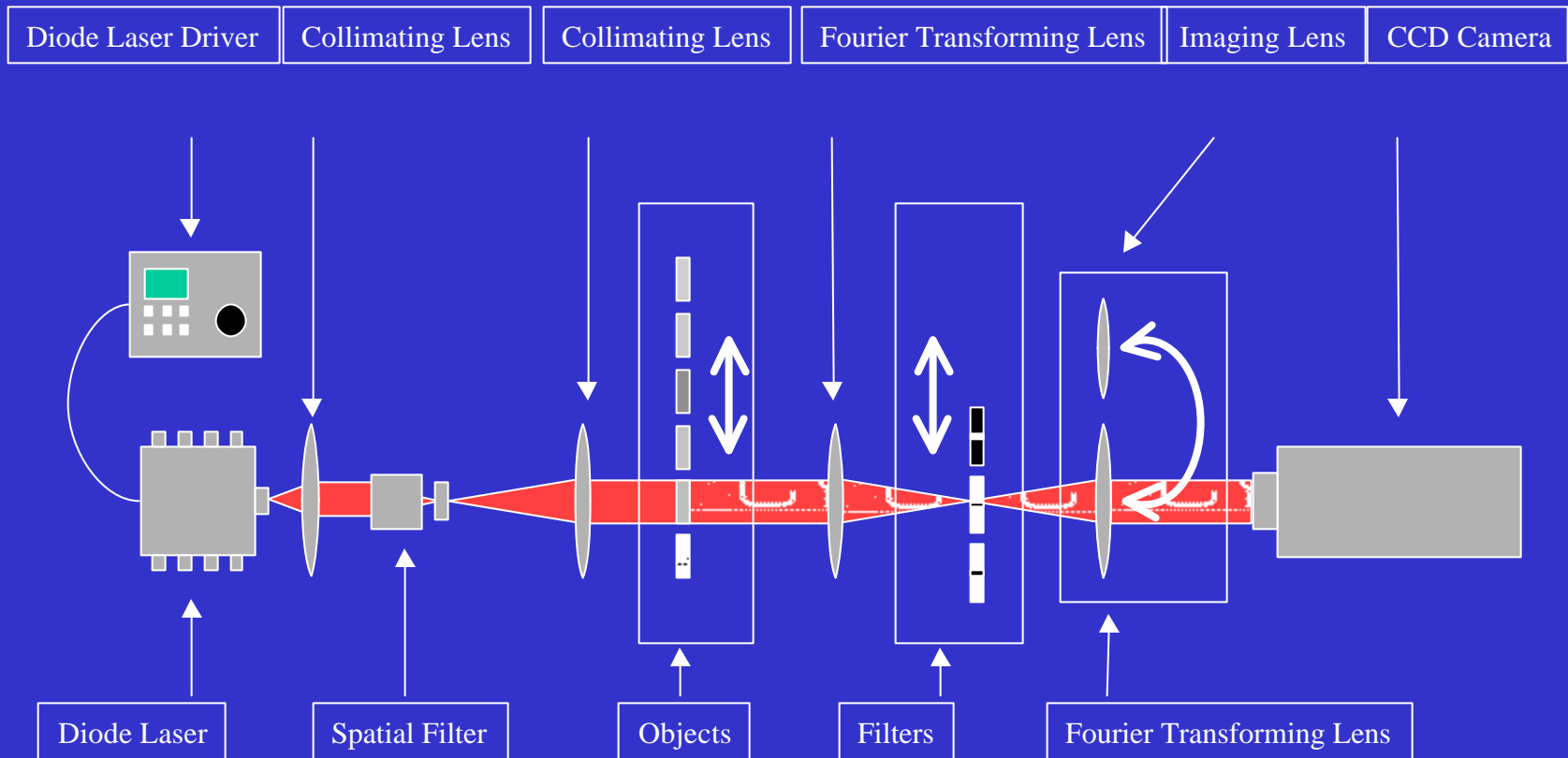


ENTER

Virtual Versus Remote Lab

- **Virtual (computational) Lab:**
 - Computations and simulations cannot capture full range of experimental phenomena
 - Real-life effects hard to model
- **CyberLabTM:**
 - Real live experience with physical laboratory
 - Physical effects can be explored
 - Remote access brings real-world learning experience
- **Combine Virtual and CyberLabTM**

Experiment



CyberLab™ Building Blocks

Analysis tools

Message board

Professor

Experiment

Student notebook

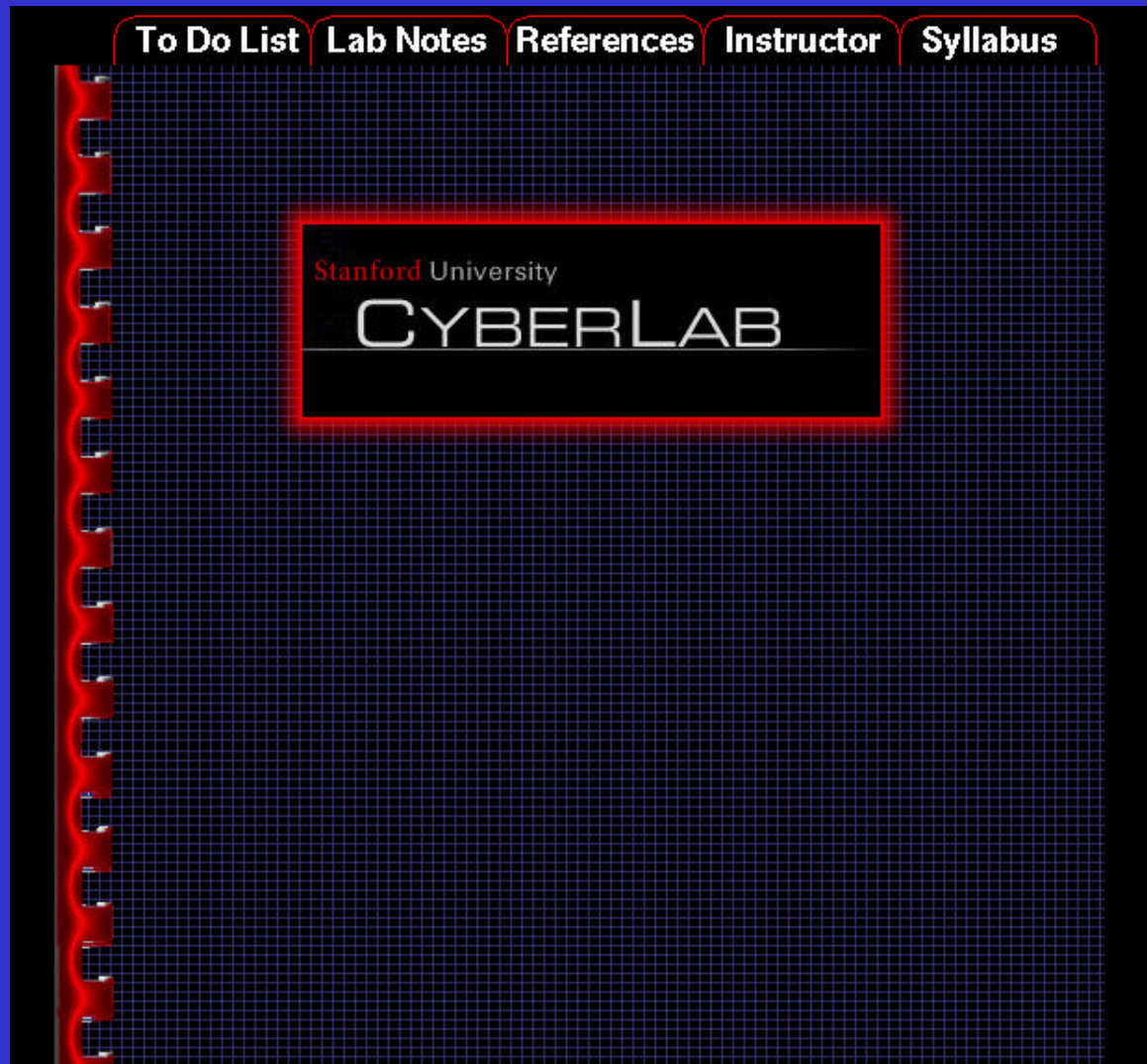


Reference materials

Scheduler

Lab information

Lab Notebook



Contains all information about the experiment:

- Handouts
- Correspondence
- Data
- Reports
- To do list

CyberLab Proto Demonstration

Notebook manages collected information

Schedule allows sharing of resources

Real-time laboratory

Information on lab equipment

Data Analysis

Instructor Correspondence

Main Navigation Tool

The screenshot displays the CyberLab interface with the following components:

- Navigation Panel (Left):** A vertical menu with buttons for NOTEBOOK, SCHEDULE, LABORATORY, EQUIPMENT, ANALYSIS, PROFESSOR, OFFICE, and EXIT.
- Time Remaining:** A status bar at the top center showing "5/14/99 12:20:30 PM".
- Lab Setup (Center):** A photograph of a laboratory bench with components labeled: Diode Laser Driver, Diode Laser, Collimating Lens, Spatial Filter, and Col. Below the photo is a "Image of CCD Detector" showing a hexagonal grid pattern.
- Control Panel (Right):**
 - CAMERA CONTROL:** Includes navigation arrows, a ZOOM slider, and a RESET button.
 - Goggles:** A checked checkbox.
 - Laser Power:** A slider set to 71.0.
 - Laser Current (mA):** A gauge showing 71.3.
 - CCD Power:** A slider.
 - CCD display:** A gauge showing 272.
 - FFT:** A slider set to 1.0.
 - FFT Zoom:** A gauge showing 10.0.
 - Text Box:** "The Laser Current is set to: 71.10mA".
 - Filter Position (mm):** A slider ranging from -1.00 to 1.00.
 - Object:** A dropdown menu set to "Hexagonal Grid".
 - Filter:** A dropdown menu set to "None".
 - Lens:** A dropdown menu set to "Fourier Lens".
 - Buttons:** "Save CCD Image" and "Save Note".
 - Text Area:** "Enter your lab notes below:" followed by a text box containing: "This image (Hexagonal Grid) is a result of double Fourier Transform. The letter L is inverted in both Ver. or Hor. axis".
- Refresh Live Animation:** A link at the bottom center of the interface.

CyberLab™: A new Paradigm!

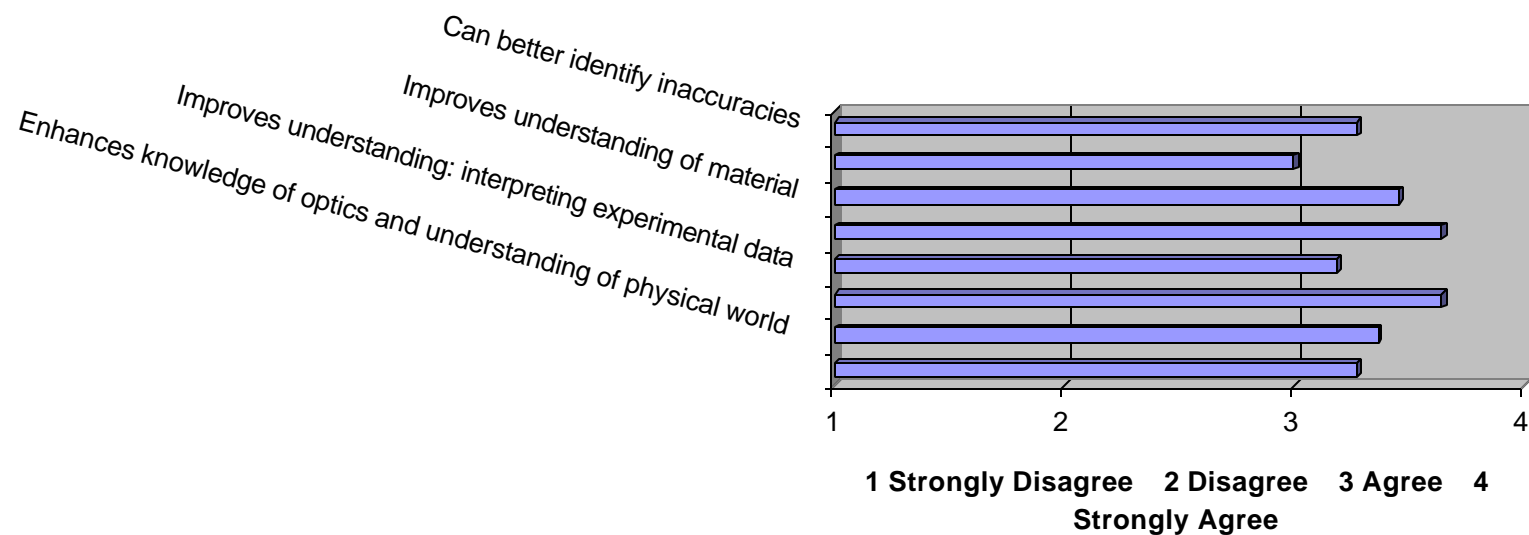
- Remote **quantitative** observation of student behavior
- **Computer assisted** learning
- **Cost effective** sharing of experimental facilities
- **Impact:** Professional evaluation from School of Education at Stanford

Professional Evaluation

- **School of education evaluation:**
 - Pre-laboratory questionnaire (anonymous)
 - Observation of 1/2 the students by independent observer (designer of the questionnaire, Sandy Paik)
 - Post-laboratory questionnaire
 - Evaluation of results
 - Report to Principal Investigator

Student Evaluation EE366

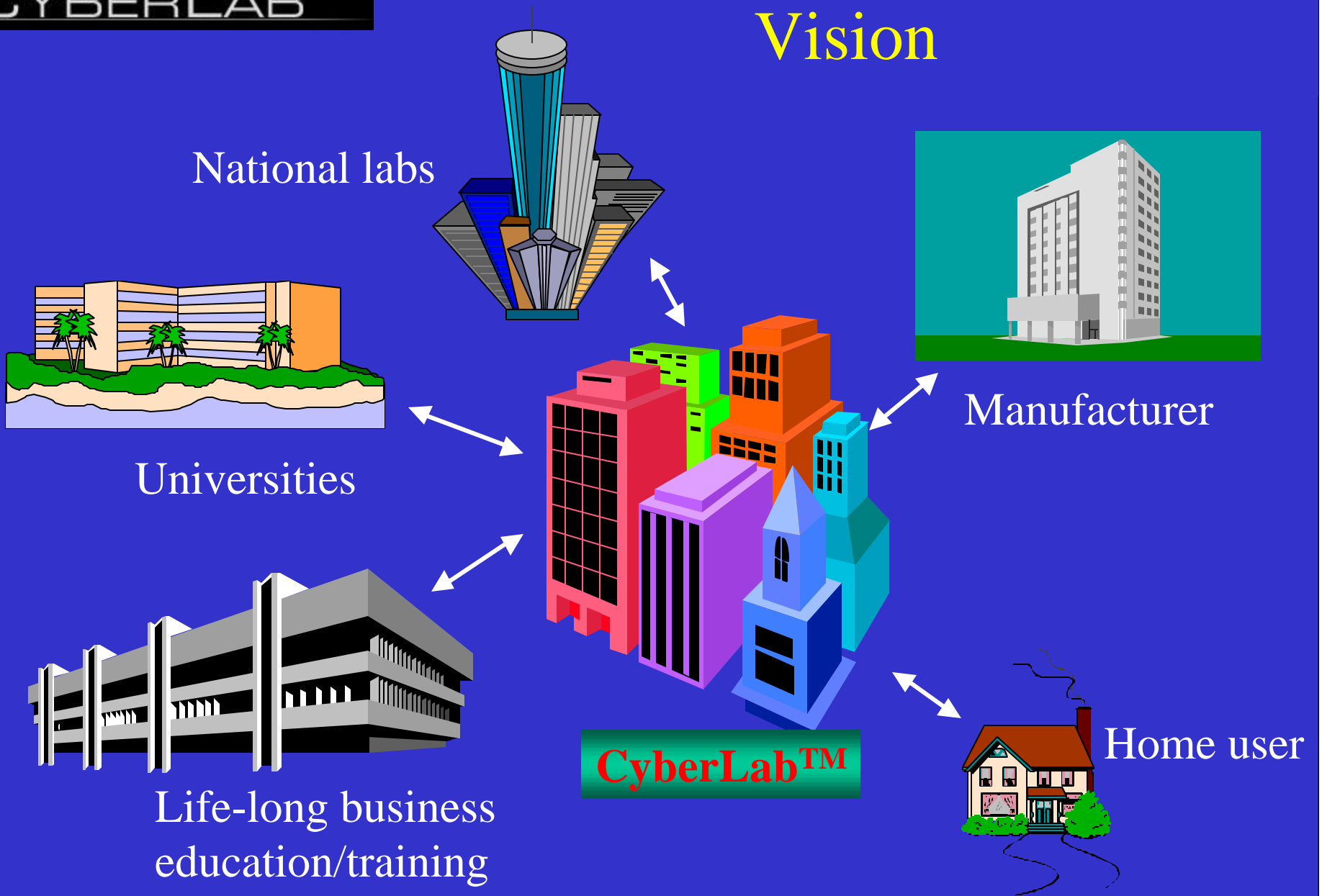
Key Questions - Educational Value of CyberLab



Benefits

- Instill good laboratory practices
- Student excitement stimulates learning
- Provide access to laboratory, computational, and reference facilities worldwide
- Cost effective learning tool
- Sharing of resources
- **Convenient and fun**

Vision



Summary

- CyberLab™ provides a **new paradigm** for life-long learning: *At the users schedule and location*
- Application to many scientific, educational and entertainment fields
- Pilot program in 1998 was very successful
- Extensible to remote training, remote research collaboration, remote data collection, etc.
- **Most importantly: It is *convenient and fun!***

Acknowledgments

- Stanford CTTL-98 grant for pilot project
- Intel for donation of computers



Donny Effrien
Anthony Wong
Sandy Paik
SITN