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# Outreach at LIGO Hanford Observatory



Fred Raab





# Outline

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- Needs assessment near LHO
- Accomplishments
  - » K-12
    - Student outreach
      - Tours, lectures, hands-on activities
    - Teacher outreach
      - Teacher enhancement
      - Development of standards based classroom enrichment activities
  - » College
    - Students
      - SURF and REU programs
    - Faculty
      - Visitor program
  - » Informal outreach
    - Group tours and community lectures
  - » Minority outreach
- Future plans



# Needs assessment near LHO

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- Rural communities of Eastern Washington, Eastern Oregon, Idaho and the Inland Northwest
  - » Typically higher unemployment rates than metropolitan areas
  - » Majority of students in several school districts are in free/reduced lunch programs
  - » Many migrant farm-worker families; not uncommon for children to move several times each year
  - » Nearest science/technology center several hours drive away
- High “minority” populations traditionally underserved in science education and opportunities
  - » Latinos are actually the largest ethnic group in much of eastern WA
  - » Sizable Native-American populations surround LHO
  - » Growing communities from former Soviet Union
- Workshops & contacts with area teachers have clarified needs



## K-12 Students and Teachers

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- K-12 programs in collaboration with Pacific Northwest National Laboratory (PNNL) and Educational Service District (ESD) 123 in southeast Washington, Gladstone School District in Oregon, Columbia River Exhibition of History, Science & Technology.
- Scientist-Student-Teacher program started in 1999, involved ~70 students on projects related to LIGO research in AY2002
- LHO featured in “The Scientific Method on the Job” video for Middle/High School science resource
- Distance learning initiative with ESD 123 developed interactive science program for WA K-20 teleconferencing network
- Teacher interns developed exhibit guide, lesson plans, K20 scripts and internet resources during summers of 2001, 2002
- District-level workshops for science teachers



# Scientist-Student-Teacher Program with Gladstone High

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- Objective: address the Essential Academic Learning Requirement (EALR) on “the nature and methods of scientific inquiry” by involving classes in real scientific research
- Problem: analyze seismic data taken at LIGO Hanford Observatory (LHO) and produce long-term study of microseism
- Why? The microseism produces the fastest changes of the LIGO baseline, but there are no historical records of microseism near the Hanford site
- Instrumentation: LIGO has 5 triple-axis seismometers on site connected to a data acquisition system and significant high-speed computing capacity
- Gladstone High School supplies commitment to long-term monitoring & data trending



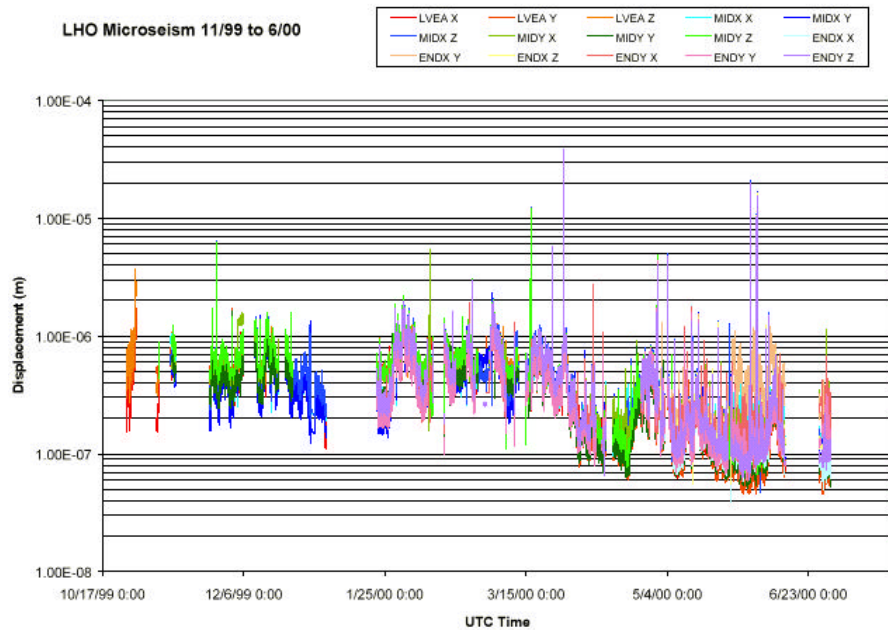
# Gladstone High School Contributions to LIGO Research

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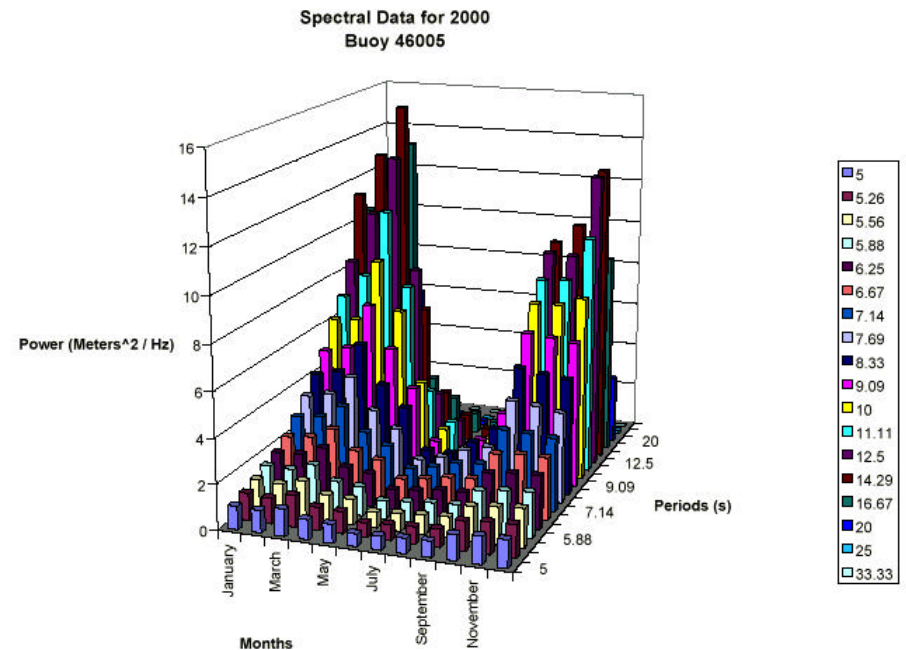
- Now have multiple-year record of microseism
- Seasonal variability on high end traced to ocean wave activity using specific NOAA buoys
  - » students also measured the wave propagation velocity between buoys by using a cross-correlation technique
- During quiet season, searched for potential correlation with local weather patterns
- Demonstrated general insensitivity of microseism band to human-generated noise by studying day/night statistics
- Reports on Gladstone High School physics web page at <http://www.gladstone.k12.or.us/ghs/users/ingramd/Physics>
- Annual community science night draws about 100 parents, 50-70 student presenters



# Long-term microseism connection to ocean-wave activity



Seasonal trend in microseism identified in early analysis (left) found to agree qualitatively with ocean-buoy wave-height data (below)

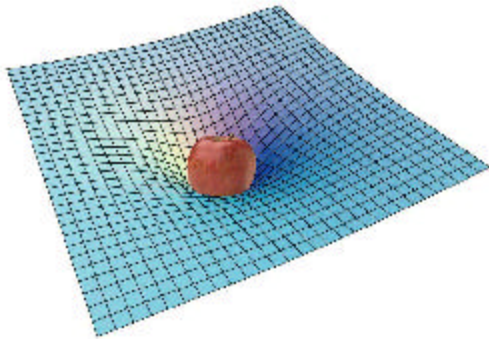




# Internet-Accessible Resources for Teachers, by Teachers



## Hanford Observatory Teachers Corner



Have a look at the resources and programs for teachers available through the LIGO Hanford Observatory.

- [Research Opportunities for Schools](#)
- [Internships in Public Science Education](#)
- **Classroom Resources**
  - [An Overview of LIGO \(.pdf format\)](#)
  - [Observatory Tours for Classes](#)
  - [Classroom Activities, Lessons, and Projects Related to LIGO Science](#)

*Last modified July 8, 2002*

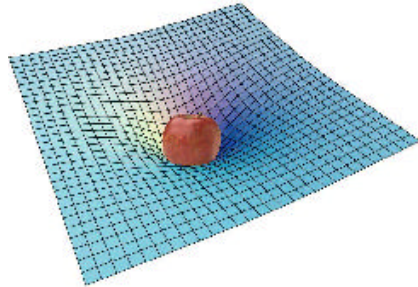
*For comments or suggestions about Web material, contact [webmaster@ligo-wa.caltech.edu](mailto:webmaster@ligo-wa.caltech.edu)*

*For information about LIGO, contact [info@ligo.caltech.edu](mailto:info@ligo.caltech.edu)*





# Web Lesson Plans Tied to State Standards in WA & OR



## Classroom Activities, Lessons and Projects Related to LIGO Science

The links in the table below will take you to packages of lessons whose outcomes are referenced to science standards in both Washington and Oregon. The grade range for each package can be determined from the table. Some have versions for both middle and high school levels. The packages are linked to [a set of additional activities](#) that students would do at the LIGO Hanford site as part of a field trip. The on-site LIGO activities will hopefully provide an avenue for students to apply what they have learned in the classroom lessons to the 'real world' of science research. The classroom packages are also written to be meaningful as stand-alones in the event that a field trip to LIGO does not occur.

Package	Grades 5-8	Grades 9-12
<a href="#">Helpful Hints for Using these Packages</a>		
<a href="#">The Scientific Method with a Pendulum</a>		
<a href="#">Build and Use Your Own Michelson Interferometer</a>		
<a href="#">Build and Use a Simple Spectroscope</a>		
<a href="#">Powers of Two</a>		
<a href="#">Scaling the Earth's Atmosphere</a>		



# Integrated In-Class and Field Trip Activities



## Swing Into the Scientific Method

**SUBJECT AREA:** Scientific processes, physical science and mathematics

**Grade Level:** 5-8

[Learning objectives for the lessons](#)

[State science standards addressed by the lessons](#)

[The procedures for the lessons](#)

[Student handouts and worksheets \(two items\)](#)

[A set of LIGO field trip activities](#)

[A downloadable MS Word version of the package](#)

### OVERVIEW

**This short unit was designed to help teachers guide students on how to conduct and evaluate a scientific investigation using a pendulum as the experiment apparatus. The unit is presented in a way that allows for inquiry-based learning. Students learn to identify variables, then to simplify the experimental process by controlling those variables in the tests. These concepts are explored while addressing several Washington and Oregon State Standards in science and mathematics.**

### OBJECTIVES

- To develop an understanding of variables
- To understand the need to change only one variable at a time
- To collect and analyze data



# College Students and Faculty

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- REU/SURF program involves ~4 undergrad research interns/yr at LHO + hosting SURF field trip from CIT
  - » Betsy Weaver developed/commissioned vac-prep facility
  - » Eric Morganson wrote earth-tides prediction software
  - » Tom Corbitt developed automated laser sideband analyzer
  - » Brian Cameron simulated periodic source analysis
- Typically 2-4 grad students doing research
  - » U.Rochester, U. Oregon, U. Michigan, Caltech, MIT, Penn.St.
- Visitors program
  - » U. Michigan, U. Oregon collaborators on long-term appointments
  - » Oregon Institute of Technology visiting professor developed ideas for Laser Institute courses



# Informal Education

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- Observatory tours draw approx. 800-1000 visitors/yr
  - » Einstein, interferometers and the work that we do.
  - » Audience comes from professional groups, boy scouts, families, bicycle club, etc.
  - » Hosted WA State Science Teachers in Nov 01
- Public talks and LIGO Public Lectures
  - » Wheeler/Thorne lecture (00) drew > 350 people
  - » Kamionkowski lecture on cosmology (01)
  - » Adelberger lecture on extra dimensions (02)
  - » Rotary/Kiwanis clubs & professional societies
  - » Adler Planetarium lecture as part of “Cosmic Happenings” series
- Cooperative “happenings” w/ other outreach groups
  - » Wheeler book signing at CREHST
  - » B-Reactor reunion



# Underserved Populations

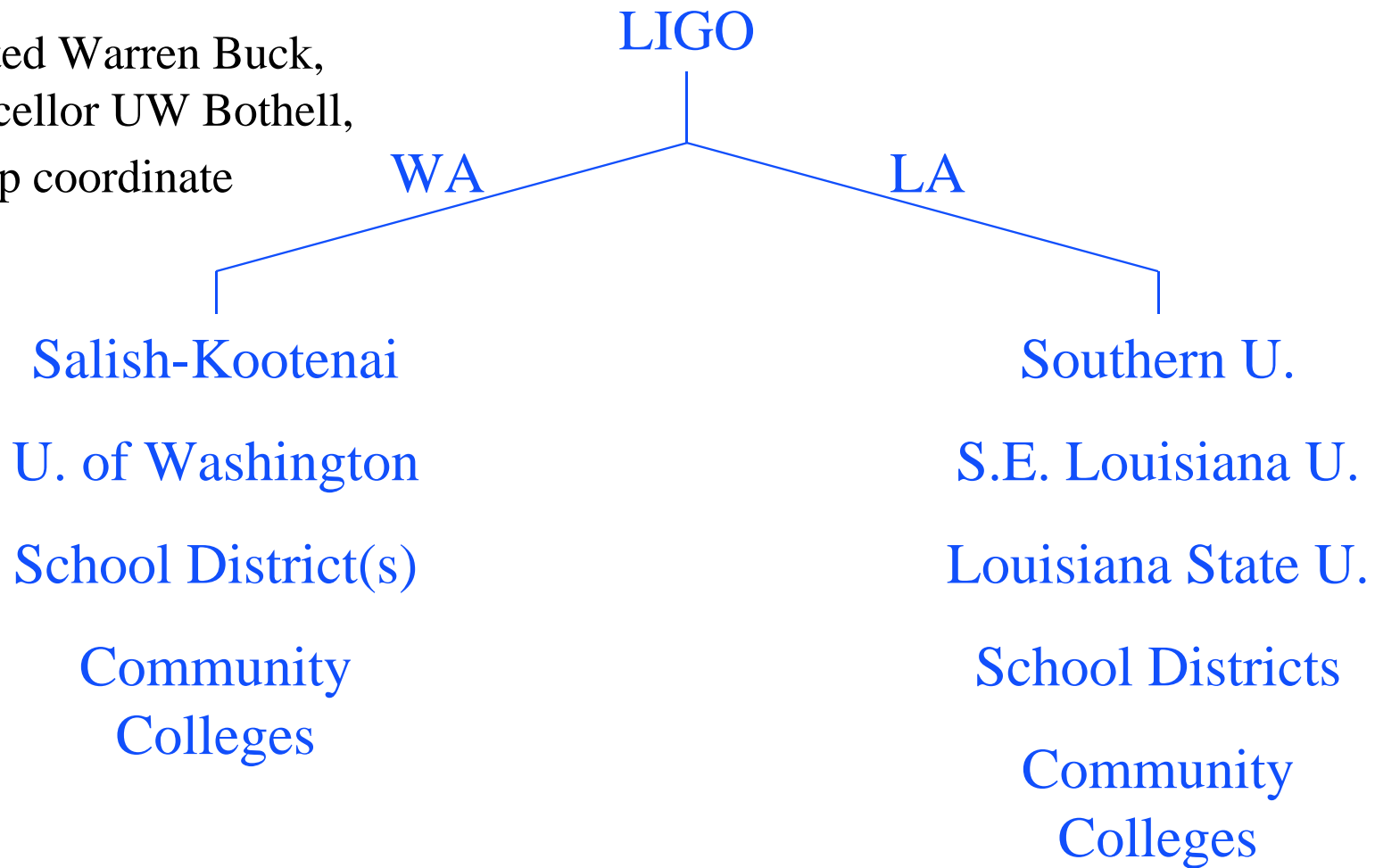
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- Hispanics and Native Americans are largest groups near LHO that are typically underserved by science education and underrepresented in technical fields
- LHO's location is encircled by a constellation of tribal colleges and reservations
- Salish-Kootenai College (SKC) - near Flathead Lake, Montana - has now joined LIGO Science Collaboration
- SKC will provide software for detector characterization, operate a Tier-3 GRID center for data analysis
- LHO and SKC have entered discussions on a program to widen the doorway for Indian students to enter the physical sciences
- Heritage College (on Yakama Rez) also interested in working with LIGO



# LIGO Partnership to Create Doorway into Science for Native- & African-Americans

Enlisted Warren Buck,  
Chancellor UW Bothell,  
to help coordinate





# Future Plans

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- Formalize educator inputs through advisory and user groups
- Expand SST participation to more schools and more sites throughout nation via LIGO Scientific Collaboration.
- Expand “distance learning” initiative through K20
  - » More interactive programming
  - » More teacher involvement through summer internships
- University-level programs
  - » Continue current scope through REU program
  - » Goal to increase “breadth” of graduate-level students from other fields
- Improve informal educational program within current envelope
  - » More exhibits with “hands-on/minds-on” content
  - » Teacher-developed “use” plans and classroom materials



# Work toward a regional science center for the inland Northwest

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- Partners/Resources

- » Columbia River Exhibition of History, Science & Technology
  - Access to non-classified Hanford DOE artifacts
  - Active K-6, summer & “latchkey” programs in science & environment
  - Museum at ‘gateway’ to Hanford Works & Nat’l Monument
- » Alliance for Science Teaching Through Astronomy
  - Robot 0.8-m observatory atop Rattlesnake Mountain for internet use in classrooms
- » B-Reactor Museum Society
  - World’s 1<sup>st</sup> production nuclear reactor
- » Economic, Community and Tourism Development Agencies
  - Hungry to develop economic independence from D.O.E.

- Develop alliance, proposal over next few years





# LHO Selected Targets

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- Improve local informal education program
  - » Expand exhibits
  - » Programs for visiting classes (principally HS/MS) with website guide
  - » Expand to K-6 (in cooperation with CREHST)
- Widen doorway for Native American and Hispanic American students into physical science
  - » Science programs for families at their place
  - » LIGO workshop for HS teachers and students (~1 week)
  - » RET summer program for 6-8 weeks