

ETP Cover Sheet

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|---------------------------------|--|
| Title of ETP | “Probes for Measurement”: It’s the Way It’s Done |
| Name of IISME Fellow | Kevin J. Doyle |
| Fellow’s year-round email | kdoyle@smuhds.k12.ca.us |
| Sponsor Company | Northrop Grumman Marine Systems |
| Name of Mentor | Raymond Perez |
| National Board Certificate Area | Adolescent/Young Adult----Science |

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| Category | <p><i>Curriculum</i> Subject: Math <u>Science</u> Technology _____ Level: Elem <u>Middle</u> <u>High</u> Other</p> <p><i>Staff Development</i> Training Workshop for New Equipment Use.</p> |
| | Support for the IISME Programs |
| Objectives | <ol style="list-style-type: none"> 1. Demonstrate to teachers that the traditional manual measurement methods of the classroom, while valuable, are not preparing students for the types of measurements that they might actually be using in their future professions. 2. Incorporate at least one probe-based activity per semester into the curriculum of each of the teachers involved with a follow-up survey/meeting to assess the costs and benefits of the change. |
| Abstract (50 words or less) | Measurements in the classroom are usually taken using traditional manual instruments (rulers, mechanical balances, thermometers, etc). In industry however, measurements are made using electronic probes of various sorts. Through a 2-day training and supported integration of probe measurement into the curriculum, this plan coordinates science education more closely with the practices students may use in their future careers and lives |
| Describe how your ETP aligns with the National Board Standard stated in your proposal. | This project addresses NB Standards 3, 4, and 9 by showing teachers some way in which their subjects are actually measured in the industrial world. Teachers are then encouraged to use this to engage the students in the measurements they are taking. Finally, the generally more consistent measurement possible with electronic probes will enhance the probability that a student will be able to observe the trends in data that the activity is supposed to demonstrate. |
| Resources Needed | ?? 2-days to present workshop ?? laboratory facilities equipped with electronic probeware and the software interfaces to allow its use (e.g. Vernier LabPro) ?? Presentation facilities (either electronic or overhead) |
| Evaluation/Assessment Measures Used | ?? Successful Completion of Workshop ?? Submitted Plans for Implementation by Participating Teachers ?? Report from Teachers regarding their use of the probes. |
| Formatting specifications | PC __ x__ or Mac____ Software used. __MSWord 2000 & PowerPoint |
| Submitted Copy | 08 AUG 2002 |

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| Mentor Signature and comments | |
| Administrators' Signature and comments | |

“Probes for Measurement”: It’s the Way It’s Done

Industry Initiatives for Science and Mathematics Education Education Transfer Plan

Kevin J. Doyle

Northrop Grumman Marine Systems
Summer 2002

Objectives:

1. Demonstrate to teachers that the traditional manual measurement methods of the classroom, while valuable, are not preparing students for the types of measurements that they might actually be using in their future professions.
2. Incorporate at least one probe-based activity per semester into the curriculum of each of the teachers involved with a follow-up survey/meeting to assess the costs and benefits of the change.

Goals:

Host a technology integration workshop/staff development including a Power Point presentation illustrating scientific measurement as currently performed in industry. (Drawing on multiple industries to show the ubiquitous use of probes for measurement)

Materials Required:

- ?? 2-days to present workshop scheduling window/opportunity
- ?? laboratory facilities equipped with electronic probeware and the software interfaces to allow its use (e.g. Vernier LabPro)
- ?? Presentation facilities (either electronic or overhead)
- ?? Documentation in the form of pictures and/or procedures from a variety of industries that show the way they make their measurements.

Action Plan:

20-21 August run a 2-day workshop for teachers at Aragon High School in San Mateo with the aim of both introducing the Vernier ProbeWare Lab Equipment to the Science Department as a whole. The workshop should proceed along the schedule on the next page.

During the semester after the workshop regularly check in with the participating teachers. Assist in implementation/administration of the lab/projects using the probes. Release time may be available for this. Take time during each department meeting to discuss progress/problems/achievements with the integration of the new equipment.

At the end of the semester request that each teacher fill out an Implementation Evaluation (Appendix D) that covers the costs and benefits observed by the teachers in using these facilities.

WORKSHOP SCHEDULE (Tentative)

Tuesday 20 August 2002

8:30 Arrival connection and distribution of materials (Breakfast? depending on funding)

9:00 Group Discussion of Goals for the workshop as envisioned by the different teachers.

10:00 Break

10:15 PowerPoint Presentation showing the myriad different measurement methods used in industry as compared to those used in the classroom.

11:00 Demonstration of one or two of the “canned” lab activities that Vernier provides.

12:00 Lunch (provided)

1:00 Reconvene and group by subject area to discuss how to integrate and what Q’s to ask Vernier rep when he arrives.

2:45 As a whole department create a list of topics and issues to query Mr. Bakken

3:15 Wrap-up and Evaluation of First Day

Wednesday 21 August 2002 (This day is more dependent on Mr. Bakken’s plan)

8:30 Introduce Clarence Bakken representing Vernier and present desires of group.

9:00 Mr. Bakken introduces us to capability of Vernier LabPro software and Probes

10:00 Break

10:15 Describe Desires as Determined on Tuesday to Mr. Bakken and start questions.

12:00 Lunch (provided)

12:45 Continued Sessions to take advantage of Mr. Bakken’s expertise

2:45 Break out to write quick implementation proposals and evaluation. (Appendices B&C)

Things to Consider if You Want to Do This:

- ~~✍~~ Availability of the actual probes: Some schools have laboratories that are equipped with electronic computer-interfaced probes some are not. When you decide to embark on something like this you need to check with current equipment and also into funds for buying new equipment. Our school was lucky as we are in the process of implementing California’s Digital High School program so we had funding to purchase the technology. You may have to write some grants to get this funding if you don’t already have the equipment.
- ~~✍~~ The company representatives will come to your school for a fee (or “free” if you purchase enough equipment). Vernier’s fee is approximately \$1000. However, if you already have equipment, several of the probe manufacturers sponsor free workshops throughout the year. Get on their mailing list.
- ~~✍~~ You will probably have to provide some incentive for your fellow teachers to come to the workshop. There are enough demands made on a teachers time that without incentives it’s almost impossible to get them to come. Again this might

require some grant writing. We are using Digital High School money as stated earlier. However, there are organizations (e.g. The Peninsula Foundation) that may fund programs such as this if asked nicely and formally.

~~✍~~ Most vendors will sell or provide a compilation of ready-made lab activities that work well with their probes. These activities are a great platform from which to start a group's development of their own curriculum. Notice that in the workshop schedule the first day is given over to demonstration of one or two of these published labs and some time to search through them collaboratively to find the ones that would easily replace labs that are already done.

Resources:

Vernier Software and Technology corporate web page. This page contains information about probes and

educational software/services offered by this company.

<http://www.vernier.com/>

PASCO corporate web page. This page contains information about probes and educational software/services offered by this company.

<http://www.pasco.com/>

Aculabs Product Group. This page contains information about probes and educational software/services offered by this company.

<http://www.sensornet.com/>

Photographs of National Missile Defense Program testing facilities courtesy of Northrop-Grumman

Marine Systems of Sunnyvale California

Probe images from a variety of web pages

<http://www.securityideas.com/motdet.html>

www.finishlynx.com/.../horse_racing/images/close_finish.jpg

www.mda.state.mi.us/food/images/brochfront.jpg

<http://www.che.utexas.edu/~etuke/>

www.physicalscienceseries.com/.../labs/fallingobjectlab.htm

<http://www.k12.nf.ca/roncallips/projects/Physics/meterstick/pictures.htm>

www.cleanindia.org/resoucewatch/water_kidsay.htm

accept.la.asu.edu/courses/phs110/ds3/chapter3b.html

physics.usc.edu/Undergraduate/Labs/Experiments/dcc.htm

Appendices:

Appendix A: PowerPoint Presentation

Appendix B: Participant Evaluation

Appendix C: Implementation Proposal

Appendix D: Implementation Evaluation.



Probes: The Way Measurement is Done

Aragon High School: DHS
Science Integration



Traditional Measurement Techniques

- Rulers, Calipers
- Thermometers
- Voltmeters and Ammeters
- Springs and Balances
- pH paper and Indicators
- Stopwatches
- Dimensions
- Temperature
- Electrical Properties
- Forces and Mass
- Solution Properties
- Time

Dimensions: Rulers and Metersticks

- Distance measured vs. force to bend meterstick– a work experiment



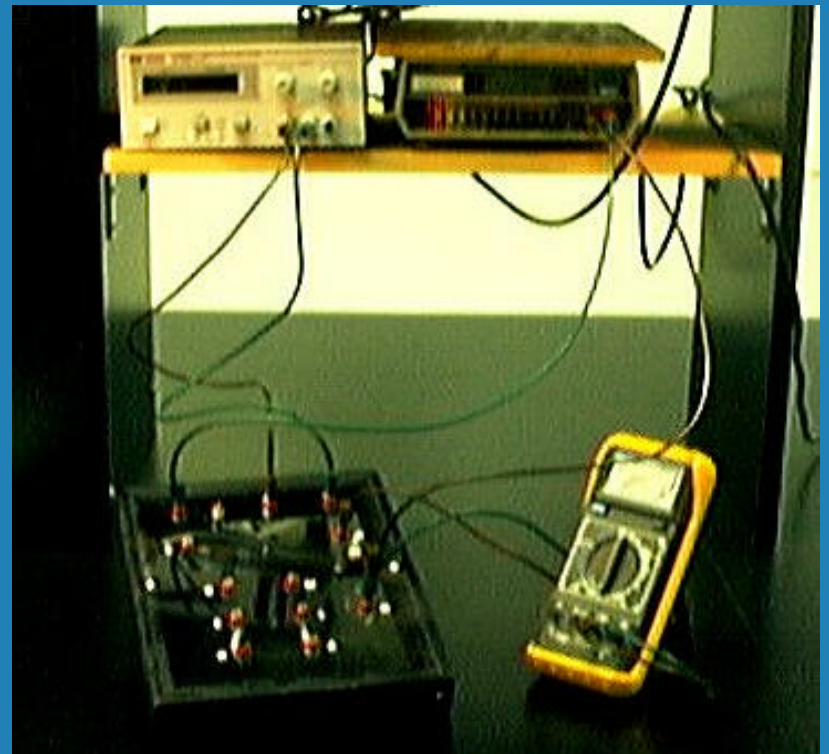
Temperature: Thermometers

- Student measuring outdoor temperature



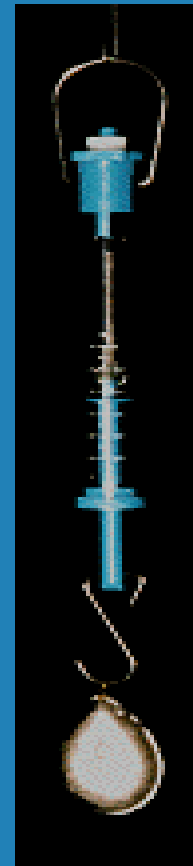
Electrical: Voltmeters and Ammeters

- Typical DC Circuit measuring setup using a multimeter.



Force: Springs and Scales

- Weight force being measured by a spring scale.



Solution Qualities: pH Paper and Indicators

- Students in India uses pH paper to test acidity of water samples.



Time: Stopwatches

- Students time falling object in Mr. Gilliland's physics class





Benefits of Traditional Methods

- Students often get a “feel” for the properties they are measuring.
- Connect to historical developments
- Generally less expensive than probes (although this is becoming less valid)



Downfalls of Traditional Methods

- Time spent measuring may detract from ability to observe.
- Special measuring skills needed which may impede results.
- Can't measure continuously
- Measurement is very difficult within some environments.



Probe Measurements

- Laser Interferometers
- Thermocouples
- Basic Voltage Probes
- Accelerometers
- pH, CO₂, and O₂ Sensors
- Photogates
- Motion Detectors
- Pressure Probes
- Dimensions
- Temperature
- Electrical Properties
- Forces and Mass
- Solution Properties
- Time
- Velocity and Acceleration
- Gas and Liquid Pressures

Dimensions: Laser Interference

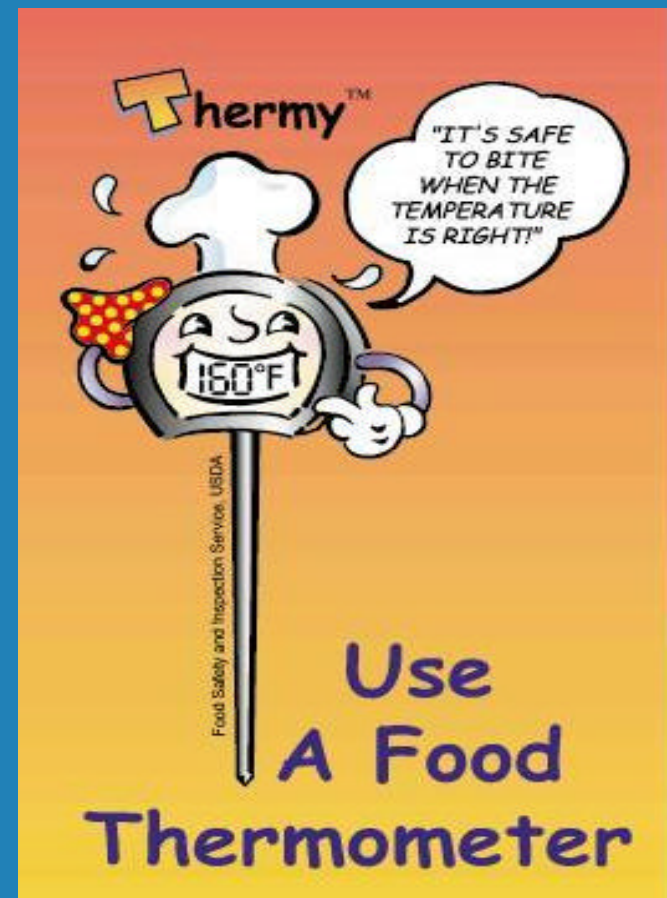
- Differences in laser travel time give a precise indication of dimensions.
- Used in automated manufacturing.



Temperature: Thermocouple Probes

Conductivity difference in two materials gives a voltage difference.

Used in everything from thermometers to engines.



Electrical: Direct I-V Probes

- Current and Resistivity measured with probes to determine pulp properties in paper manufacture.



Forces: Accelerometers

- Converts the acceleration to a voltage which in turn can be used to calculate forces.
- Work at high Frequency
- Remote measurement



Solution Qualities: pH, O₂, CO₂ Probes

- In-line CO₂ Probe used to monitor the water quality in a chemical plant.
- Used in water treatment, chemical processing, microchip manufacture



Time: Photogates

- Photogates use a light that is broken to start a timer and then a second that's broken to stop
- Horseracing, NASCAR, swimming, etc.



Velocity/Acceleration: Motion Detectors

- Uses sonar or radar to detect and track objects. Changing return times indicate change in position
- Numerous uses.



Pressure: Pressure Probes

- Essentially force sensors with a known area.
- Used in weather measurement
- Used in Chemical Processing





Sensor Probe Benefits

- More Consistent Measurements.
- Can Measure continuously while allowing experimenter to make other observations.
- Can often measure in conditions a human wouldn't be safe.
- Forced to learn computer interfacing skills



Probe Downfalls

- Expense
- Must learn software skills as well

NMD Testing



- Launch of Ground-based missile to test capability.
- Produces testing conditions that make traditional methods highly unfavorable.

NMD Pressure Sensors



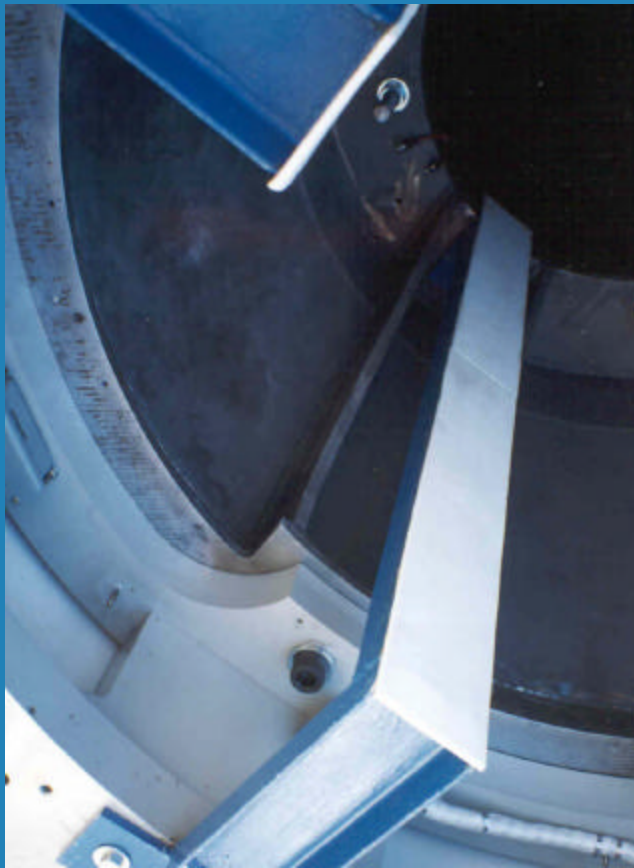
- Probe inside Launch Tube to monitor launch pressure.

NMD Accelerometers



- Shock accelerometers
- Mounted on vehicle (missile) to assist with trajectory measurement

NMD Thermocouples



- Measure temperature insided launch tube.

Appendix B: Participant Evaluation

Aragon High School: DHS Science Integration Workshop
20-21 August 2002

The purpose of this workshop was to introduce us all to the capabilities of our new lab equipment and to assist in our understanding of how we can integrate that equipment into our current curriculum. Please fill out the following evaluation.

1. How well did the workshop fulfill your expectations?
2. What was done well?
3. What do you feel could have been done better? If you have specific suggestions please add them here as well.
4. What would you like to have spent more time on or had more information?
5. Is there anything that you were exposed to that you would like further assistance with in the coming semester?

Appendix C: Implementation Proposal

Aragon High School: DHS Science Integration Workshop
20-21 August 2002

The purpose of the workshop was to introduce us to the new probeware equipment here at Aragon and encourage us all to find ways to integrate it into our current curriculum. Based on what we've done, please give some indication as to how you will use this equipment this semester or year. Remember we have a goal that each course should offer at least one probe based lab per semester. Please fill in the form below so that we can coordinate equipment usage and support the efforts to assist you in integrating this new equipment into your plans.

Lab 1

Title or Subject: _____ Pg.# (if from book) _____

Probes Needed: _____

Approximate Date of Lab: _____

Requests for Preparation Assistance:

Lab 2

Title or Subject: _____ Pg.# (if from book) _____

Probes Needed: _____

Approximate Date of Lab: _____

Requests for Preparation Assistance:

Lab 3

Title or Subject: _____ Pg.# (if from book) _____

Probes Needed: _____

Approximate Date of Lab: _____

Requests for Preparation Assistance:

Please write any other ideas you may have for using this or things we need to consider upgrading on the back of this sheet.

Appendix D: Implementation Evaluation.

Aragon High School: DHS Science Integration Workshop
20-21 August 2002

Before school started we got together to explore the possibilities of incorporating the new Vernier Probeware into our curriculum. Please indicate below what activities you have done with this equipment and give some evaluation of the activity. Please also indicate if there is any extra assistance you can foresee a need for next semester.

Lab 1

Title or Subject: _____ Pg.# (if from book) _____

Probes Used: _____

Date of Lab Done: _____

Evaluation and Requests for Future Assistance:

Lab 2

Title or Subject: _____ Pg.# (if from book) _____

Probes Used: _____

Date of Lab Done: _____

Evaluation and Requests for Future Assistance:

Lab 3

Title or Subject: _____ Pg.# (if from book) _____

Probes Used: _____

Date of Lab Done: _____

Evaluation and Requests for Future Assistance: