KLASS
Kennedy Launch Academy Simulation System

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Overview

- NASA Vision for Space Exploration
- Education Standards
- KLASS
  - s/w description
  - s/w overview
- Background materials
  - Flexibility of use in classroom
Vision for Space Exploration

- The current generation of high school and college students will solve the problems to allow future explorers to travel to the moon, Mars, and beyond.

- According to our President, the fundamental goal of NASA directive is:
  - "to advance U.S. scientific, security, and economic interests through a robust space exploration program."

- Space exploration requires and resolves five critical problems — water, waste, propulsion, radiation, energy.
  - Same critical problems on earth.
- Strategic goals cannot be accomplished without education.
Inspire, Engage, Educate, Employ

• Evolving electronic world:

  • Portion of NASA’s learning materials must be technology-enabled.
  • Our future astronauts are the 6th graders of today.
  • Available online without cost: science classrooms, computer labs, teachers.
Supports Educational Standards

- National Science Education Standards (NSES)
  - An inquiry-based approach to science
  - Student learning that is guided and facilitated
  - Emphasis on the assessment of student learning
  - The development of environments that enable students to learn science
Supports Educational Standards

- International Society for Technology in Education’s (ISTE) National Educational Technology Standards (NETS)
  - Design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
  - Facilitate technology-enhanced experiences that address content standards and student technology standards.
  - Use technology to support learner-centered strategies that address the diverse needs of students.

- [http://cnets.iste.org/](http://cnets.iste.org/)
Supports Educational Standards

- **NETS** met through teacher support

  - Apply technology to develop students' higher order skills and creativity.
  - Apply technology in assessing student learning of subject matter using a variety of assessment techniques.
  - Use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
  - Apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.
### KLASS Description

- KLASS is a CD based program designed to run on networked computers.
  - downloadable
  - free
  - extremely versatile

- It allows students to command and control a launch countdown simulation.
  - Teachers select simulations that correlate to their curriculum
  - Students solve countdown related problems in order to get to a successful launch
  - Engaging launch video
  - Promotes critical thinking and team work (collaborative engineering)

- Based on the Shuttle Ground Operations Simulator (SGOS), the simulation software used at KSC for testing, training and launch readiness.
KLASS Background

- Target audience: middle schools
  - Software designed to run on low end machines
  - All required s/w is freeware/shareware - provided with the CD/DVD or download
  - Teacher guides contain required information for setup

- Scenarios aligned with the national math, science, and technology standards, as well as supporting state assessment testing preparation.
  - Teachers defined these standards

- KLASS provides real-life scenarios
  - relevancy to understand the subject matter being taught and its importance
  - mechanism for students to use and reinforce concepts learned in class
KLASS Overview

- KLASS ported the SGOS version to run on a PC
- Simplified Shuttle and ground systems models:
  - Main Engines
  - External Tank/SRB
  - Astronaut Biomedical Systems
  - Weather
  - Environmental Control System
- Launch Video
- Student applications will communicate with the model running on the teacher’s computer.
- Documentation: Student worksheets, Teacher guide, software installation instructions

Math Models
\[ T = 2\pi \sqrt{\frac{L}{g}} \]

Math Models
\[ H = h_0 - 0.5gT^2 \]

Math Models
\[ P^*V = nR^*T \]
KLASS User Interface

- 3D and 2D views
- Allows the student direct control of commands
- Visually shows actions such as the tank filling
KLASS User Interface

- Various weather views
- Lightning, cloud cover, wind speed
- Realistic biomedical systems
Schools needed for beta testing

- Networked system of computers
- One Linux based machine (teacher computer)
- Student PCs – Win2000 or WinXP
- Version 1 available by summer '07
- Current beta testing feedback:
  - Curriculum flexibility – from 1 day run to a 1 to 3 year curriculum
  - "Did we really launch the shuttle?"
KLASS Background Materials

- Student worksheets
- KLASS systems materials
- Student KLASS intro
- Shuttle Background
- NASA photos
- Assignments
Inspiring the Next Generation of Explorers

KLASS lets students experience first hand why the science and math they are learning is important and how it can lead them to a career at NASA.

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Exploration Vision

- The current generation of high school and college students will solve the problems to allow future explorers to travel to the moon, Mars, and beyond.
- According to our President, the fundamental goal of NASA directive is:
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Supporting NASA strategic plan

Higher Education

Employ

Outcome 1: Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of investments.

Informal Education

Engage

Outcome 3: Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

Inspire

Outcome 2: Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty.

Educate

Elementary/Secondary Education
Inspire, Engage, Educate, Employ

- Evolving electronic world:
  - portion of NASA’s learning materials must be technology-enabled
  - within this scope Virtual Lab was funded. It was
  - initiated out of a educator desire for access to expensive equipment

- High fidelity simulations of a suite of microscopes
  - developed by Beckman Institute Univ of IL Urbana-Champaign
  - brings extremely expensive hardware directly into the classroom
  - open source software, downloadable from the internet, easily accessible at no charge
  - defined in XML code, can be easily expanded by the developer community as well
Software provides access to many sophisticated scientific instrumentation (Scanning Electron Microscope (SEM), a Light Microscope, a Scanning Probe Microscope (covering Scanning Tunneling, Atomic Force, and Magnetic Force microscopy), and an Energy Dispersive Spectrometer for the SEM).

- Flash animation videos explain how each of the instruments work
- Videos on how they are used at NASA and the sample preparation
- Measuring and labeling tools provided with each instrument
- Hands on experience of controlling the virtual instrument to conduct investigations, much like the real scientists at NASA do.

- Very open architecture
  - Open source on SourceForge
  - Extensive use of XML

- Target audience is high school and entry-level college students

“Many beginning students never get closer to an electron microscope than the photos in their textbooks. But anyone can get a sense of what the instrument can do by downloading this simulator from NASA's Kennedy Space Center.” Science Magazine, April 8th, 2005
Virtual Lab

How its used at NASA

How it works

Scanning Electron Microscope

Specimen Preparation
Supports Educational Standards

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# Different Audience Use

<table>
<thead>
<tr>
<th>K-12</th>
<th>College</th>
<th>Professional</th>
<th>Informal</th>
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<tbody>
<tr>
<td>Science and Math class use to demonstrate concepts on real specimens.</td>
<td>Training vehicle Analysis Tool</td>
<td>Collaborative tool for scientists Sharing of Information</td>
<td>Museums sharing rare samples (example, echinoderms) “Who done it” books</td>
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Lesson Plan Example

http://www.nasa-inspired.org
Transfer of Tools from NASA into Education

- Concept: The application of units of measurement (microns) and conversion.

- Training (from NASA): Investigating and documenting details of an unknown specimen.

- Tools (from NASA): The SEM, Microscopy.
Example of Standards Used

Virtual Lab: Metric Measurement Lesson
Using the Scanning Electron Microscope (SEM) Simulation

Sunshine State Standards
SC.H.1.4.1 Knows that investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.

SC.F.1.4.2 Knows that body structures are uniquely designed and adapted for their function

MA.B.1.4.3 Relates the concepts of measurement to similarity and proportionality in real-world situations.

MA.B.2.4.1 Selects and uses direct (measured) or indirect (not measured) methods of measurement as appropriate.

LA.A.1.4.4 Applies a variety of response strategies, including rereading, note taking, summarizing, outlining, writing a formal report, and relating what is read to his or her own experiences and feelings.
The lesson plan focuses on specific objectives...

Objectives:

1. The student will be able to determine the metric units being used to measure the object or parts of the object.
2. The student will be able to demonstrate proficiency in manipulating the computer technology software.
3. The student will be able to use the computer measurement bar to measure various objects in the Virtual SEM.
4. The student will use the scientific method to solve a problem.
5. The student will be able to convert between millimeters and micrometers.
Virtual Lab Lesson 1 Pre-test

1. What metric unit would you use to measure the following specimen?

A. meters  B. kilometers  C. millimeters  D. micro-

2. One millimeter equals _________ meters.
   A. 10  B. 0.001  C. 100  D. 0.01

3. What does the symbol "µ" represent?
   A. milli-  B. micro-  C. minutae-  D. macro-

4. What is magnification?
   A. The ability to enlarge an object.
   B. The ability to distinguish between very small objects.
   C. The working distance between the lens and the specimen.
   D. The contrast between different parts of an object.

5. 7.20 micrometers equals _________ millimeters.
   A. 0.0072  B. 0.072  C. 7200  D. 72,000
Virtual Lab’s Response

- To support teacher integration of the Virtual Lab into their science classrooms we developed a website this summer to provide tools to support instruction and assessment.

- The site brings together the work of some of the most well-known scholars in the field of assessment, like the work of Grant Wiggins and Jay McTighe who together have authored Understanding by Design.

- Under “Teaching Materials” we offer teachers links to content about recent NASA research using the microscopes.
The Virtual Microscope

The Virtual Microscope is a NASA-funded project that provides simulated scientific instrumentation for students and researchers worldwide as part of NASA's Virtual Laboratory initiative. This site serves as a home base for the Imaging Technology Group's contributions to that project—namely virtual microscopes and the multi-dimensional, high-resolution image datasets they view. Currently we offer a Virtual Scanning Electron Microscope (Virtual SEM or VSEM) and a Virtual Light Microscope (VLM), datasets for both, animated microscopy tutorials, and other related tools. The project is open source and the code is available on Sourceforge.

Our Virtual Instruments

Our virtual instrument code currently supports data from two different instruments in our Microscopy Suite: a Philips Environmental Scanning Electron Microscope (ESEM), and a Fluorescence Light Microscope.

The virtual microscope aims to present the user with a method for exploring...
Present (Build Support)

- Partnerships
  - Beckman Institute (http://virtual.itg.uiuc.edu)
  - University of Central Florida (http://nasa.ed.ucf.edu/main.html)
  - Lehigh University
  - NSF Nanoscale Science and Engineering Center
  - NSF Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems (Nano-CEMMS)
  - ARC NASA Quest "Here today gone to Mars"
  - Field Museum Chicago
  - Central Queensland University, Australia
  - Nanyang Technological University, Singapore
  - The Advanced Learning Technologies in Education Consortia (ALTEC) at the University of Kansas Center for Research on Learning (http://www.4teachers.org)
Future (Self Sustaining)

For these e-products to flourish beyond NASA funding, however, there is a need for partnerships with education and with the user/developer community.

In support of this goal, NASA has initiated partnerships with universities, medical centers, and museums.

Virtual Lab is being used:
- to share rare specimens of a new species of echinoderm with scientists worldwide, it is being
- considered for use with a series of children's books, it is being
- considered for use by various non-profit education curriculum developers, and
- will be used for the study of the 3.5 billion year old Australian Pilbara structures by students worldwide through a Virtual Field Trip. The study of these ancient structures ties directly into the study for life on other planets, as they are also billions of years old.
Future (Self Sustaining)

- Continued goals that must be considered:
  - increasing the library of electronic specimens
  - increasing the library of microscopes
  - increasing the exposure of Virtual Lab to the medical and educational user community
- Continue developing partnerships and collaborations to expand base of developers and users
- Continue to strategically develop mechanisms that enable community to grow in the absence of NASA funding

Accomplishment of these goals feeds directly back into our strategic goal: To the Moon, Mars and beyond.
Contacts

- http://virtual.itg.uiuc.edu
- http://learn.arc.nasa.gov/vlab
- http://www.nasa-inspired.org
- http://education.ksc.nasa.gov

Please contact us if you are interested in partnering with NASA on any of our e-Education products:

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