

Students as nanodetectives in a variety of introductory science classes

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Individual teachers, equipped with materials they and their students can access via the web, are a developing force in the modernization of both pedagogy and content. Although inquiry-based learning is often considered a method for helping students master facts and algorithms, the perspective from the modern workplace is that empirical discovery and reporting skills in the subject matter of a given course deserve to be a goal in themselves. We show here how the nano-frontier provides a robust setting for challenges which put the student in the shoes of real nano-world detectives, and how the web offers a reliable means to deliver such challenges in a lecture setting, or even on timed tests.

We are currently developing two platforms to equip students with tools for open-ended exploration on a variety of size-scales. The first involves nanomicroscopy adaptation [1] of Martin Kraus' LiveGraphics3D Mathematica-based applet [2], as illustrated in Fig. 1. The second (Fig. 2) involves adaptation of *Atmosphere*, Adobe's recently released platform for three dimensional web development and interaction. One strategy for storyline implementation is based on the popular *webQuest* format for web explorations [3]. A generic nanoWorld webQuest rubric, using a forty-point scale, might look like...

Objective	Basic (3)	Cool (4)	Far Out (5)
Work Log: Storyline	at least a few whole sentences	readable but terse	fun and informative
Work Log: Detail	one or two dates	timeline is apparent	clearly unfolding account
Intro: Informative	conventional wisdom	a reference or two	literature well-considered
Method: With Style	some clues provided	tells others how	clear and original
Data: Testable by Others	a few observations	some reproducible data	lots of convincing facts
Interpretation: Clear/Useful	connects data to project goals	relevance is crystal clear	"aha!" experiences for the reader
Uncertainties: Realistic	a guess at the errors	reality check for the reader	well established report limits
Delivery: Clear to Many	readable whole sentences	short sentences with minimal jargon	understandable by anyone

References

- [1] <http://www.umsl.edu/~fraundorf/dtemspeg.html>
- [2] Martin Kraus "LiveGraphics3D homepage" (<http://www.vis.uni-stuttgart.de/~kraus/LiveGraphics3D/index.html>).
- [3] Bernie Dodge (1995) *Distance Educator* **1** (2) 10-13 (<http://webquest.org>).
- [4] Axel Mellinger private comm. (2002) <http://home.arcor-online.de/axel.mellinger/>.

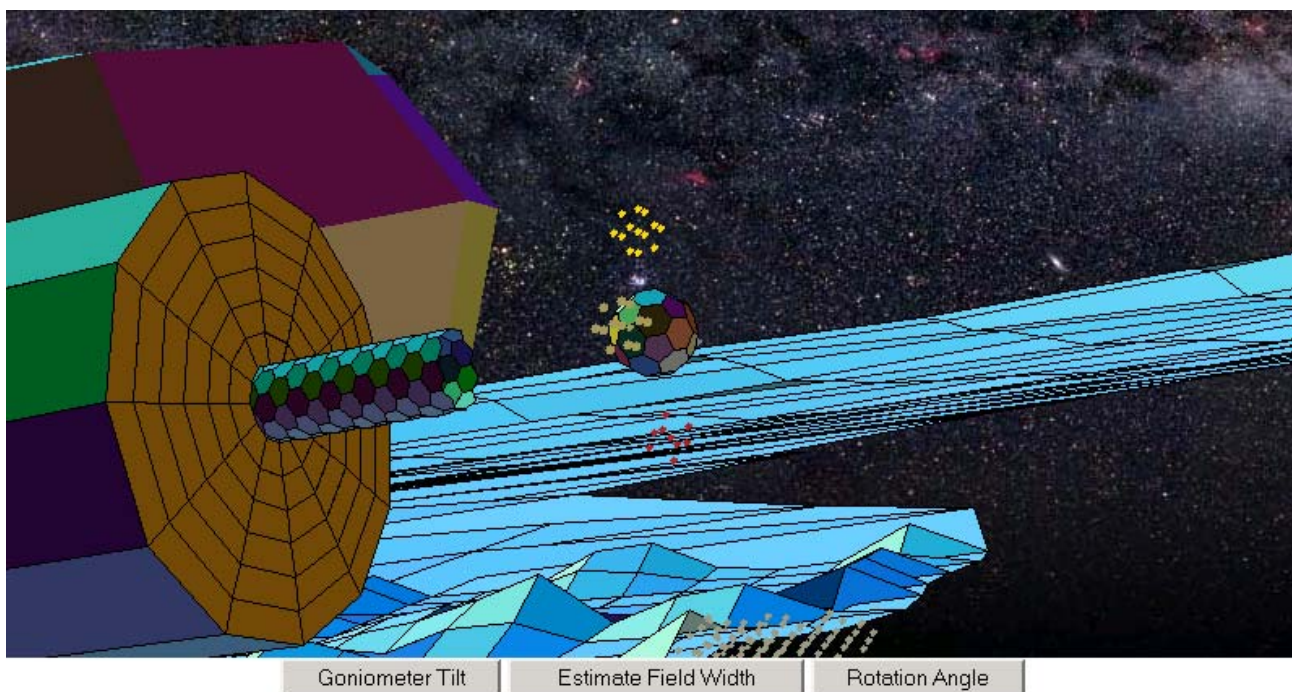


FIG. 1. Interactive view of some metal clusters and a buckyball via Kraus' applet, with nanotube and blood cell to the right as Andromeda galaxy [4] sets over the horizon of a perforated 3mm silicon disc in development for intro science & materials astronomy adventures [1].

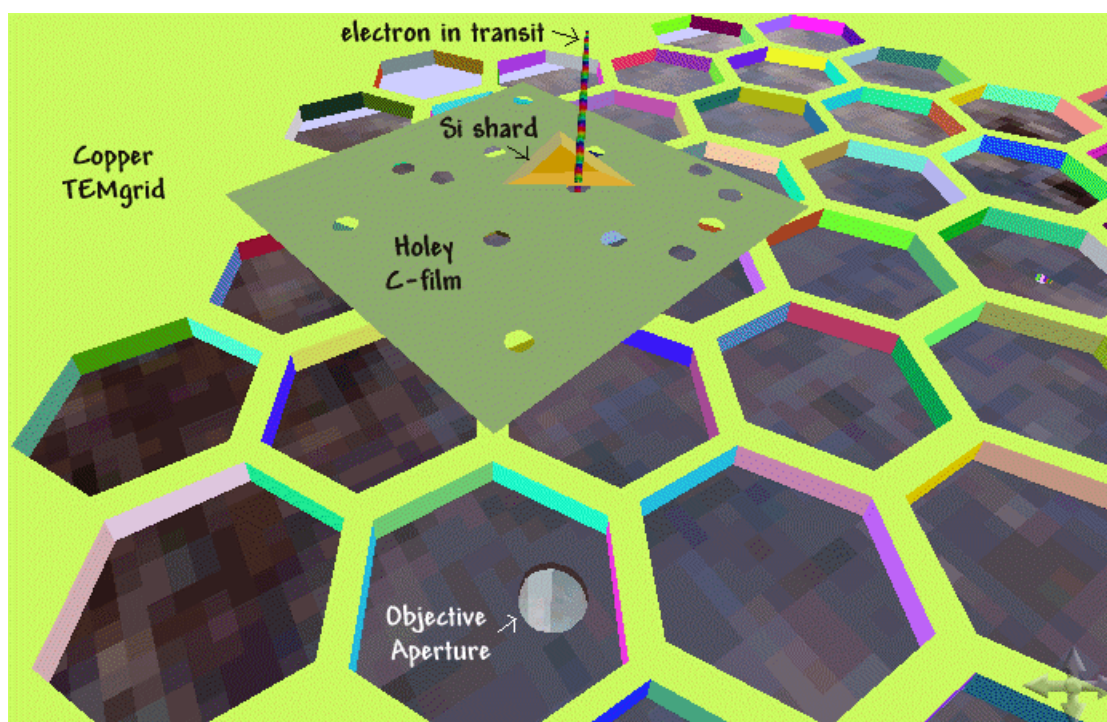


FIG. 2. View of a TEM specimen, encountered by the web surfer's 100-micron high avatar after falling down a virtual transmission electron microscope column from the electron gun Wehnelt in our Adobe Atmosphere weblab.