# SmartGraphs

## NSTA Conference – March 11, 2011

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http://www.concord.org/projects/smartgraphs

This material is based upon work supported by the National Science Foundation under Grant No. DRL-918522. ~~Any~~ opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

# Concord Consortium

- Nonprofit research and development organization
- Dedicated to transforming education through technology
- Pioneers of learning innovations for STEM
- Dedicated to Open Source software
- Primarily funded by NSF since starting in 1994

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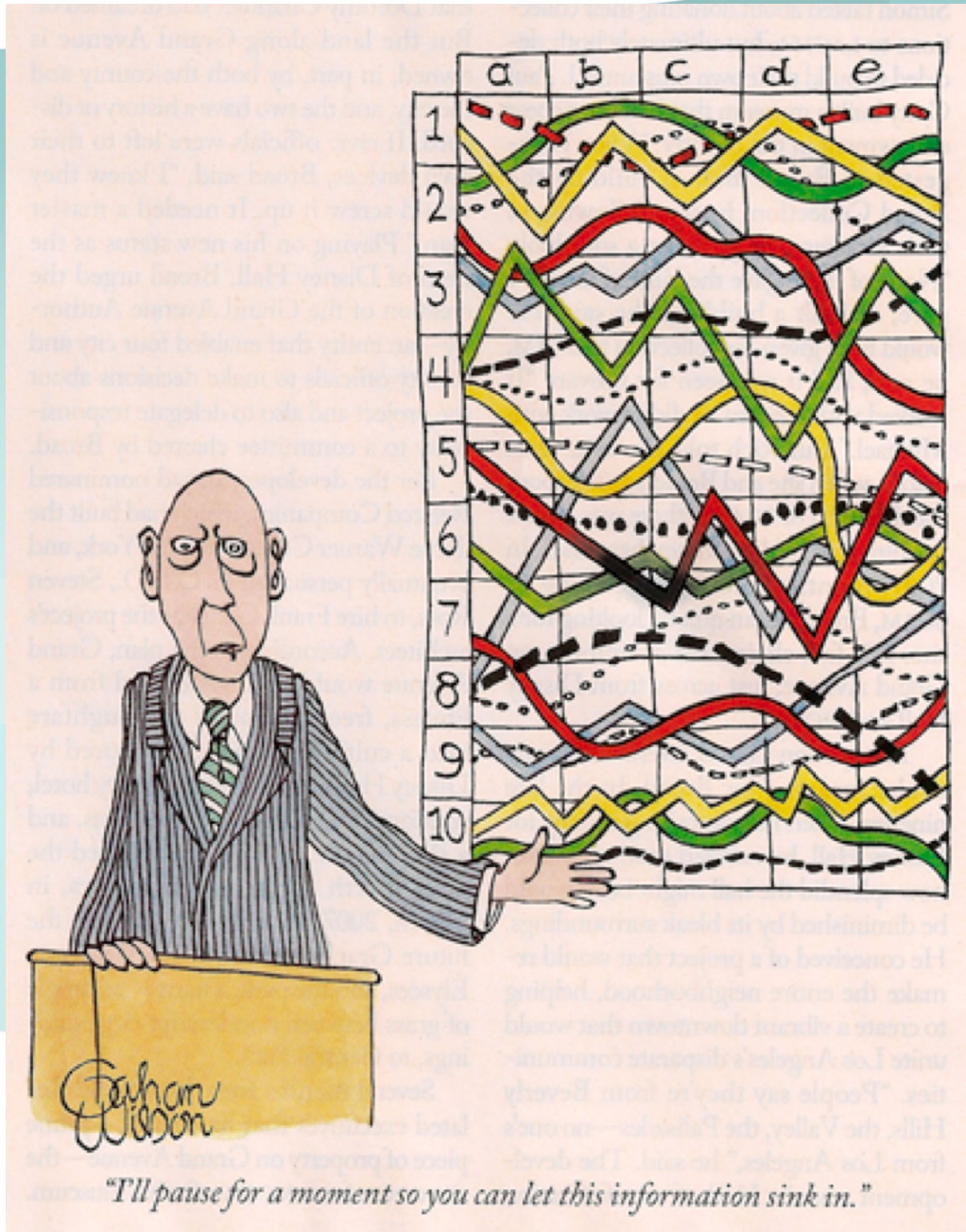
# Graphs and Meaning

"A 'smart graph' will be able to recognize the features of a graph that an expert graph user would recognize. In addition, it will be able to connect these features to the context that is represented by the graph" (Tinker, 2006).

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# Key Features of the SmartGraphs Project

1. Users interact with graphs to learn "the story" of some type of graph
2. Lessons use visual hints and annotations on graphs
3. Scaffolding (hints) revealed only as necessary
4. Software runs directly in a modern web browser (using Javascript)
5. Teachers can assign particular activities to their students via a portal
6. Authorable by non-programmers
7. Project is conducting a sizeable randomized experimental field trial
8. Software permits use of probes/sensors (within the web browser)
9. Experiments under way to automate "smartness" for graph analysis


# SmartGraph Activities

- We embed SmartGraphs in instructional *activities* to help students meet specific learning goals
- Like Google Docs, activities are "cloud" software that runs in web browser itself
- Like mobile apps, activities hide extraneous UI to keep the student focused on the task at hand
- Activities can ask students to enter text or manipulate the graph, and they respond to the student with textual and graphical feedback

http://smartgraphs.concord.org/demo.html

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# Physical Science Activities


- Searched existing software
- Researched textbooks in PA
- Aligned to standards (SAS)
- Developed learning goals
- Created prototypes
- Determined and prioritized specifications for software
- Designed and piloted activities locally and in PA

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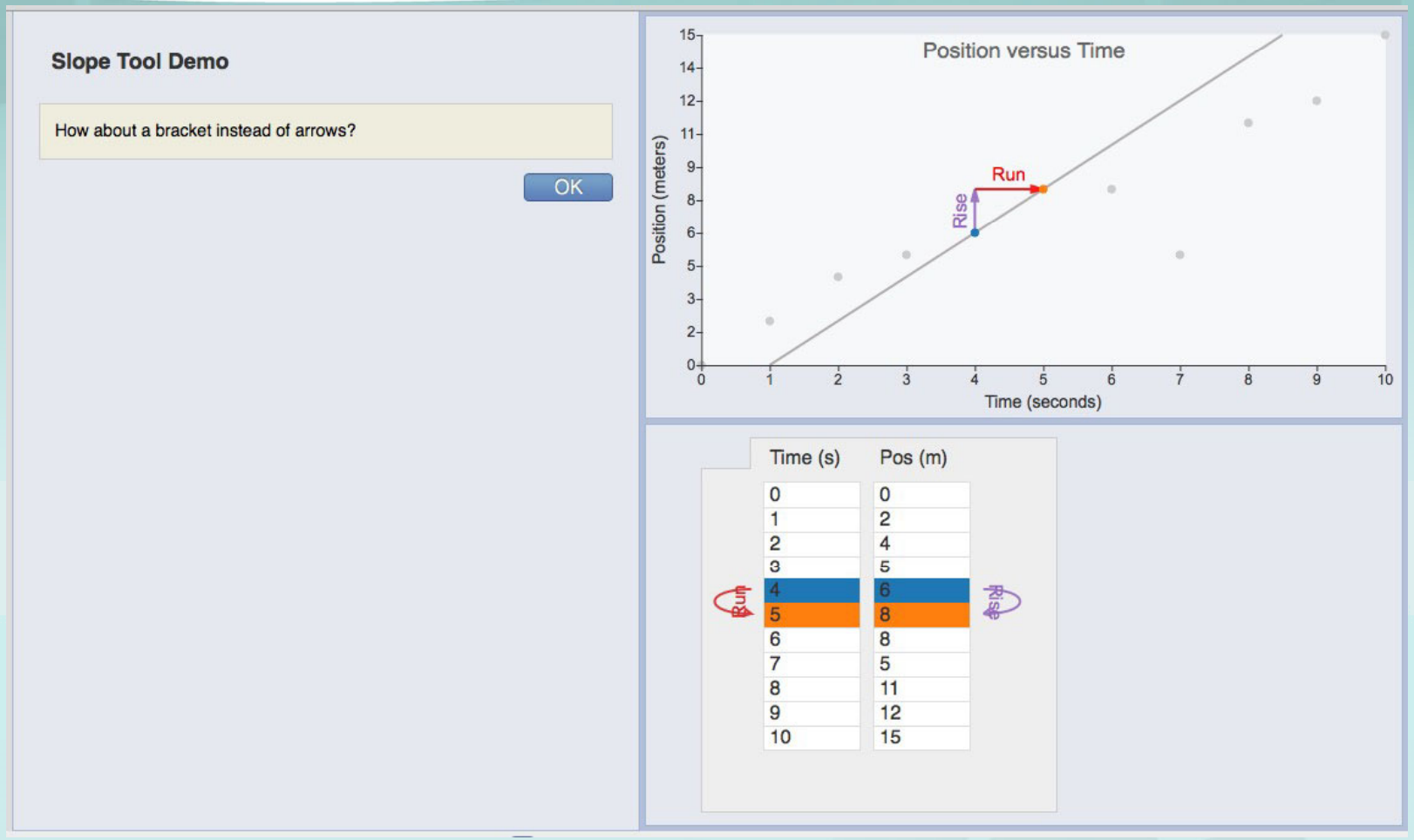
# Force and Motion Learning Goals

- Identify axes (coordinates, scaling, origin, etc.)
- Determine the shape of a graph (max, min, trends, etc.)
- Interpret realtime data from probes (patterns, noise, etc.)
- Describe direction and amount of motion (contextual stories)
- Understand rate of change (velocity and acceleration)

# Tutorial Slope Tool

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# Summative Research

- This year (2010-2011): preparation of assessments and research plan
- Next year (2011-2012): First stage completed in fall with control and experimental classrooms
  - if we are able to recruit 25 experimental and 25 control teachers
  - should be able to detect .3 effect size.
- Last year (2012-2013): Second stage completed with same classrooms, all using SmartGraphs

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# Goals for Advanced Work

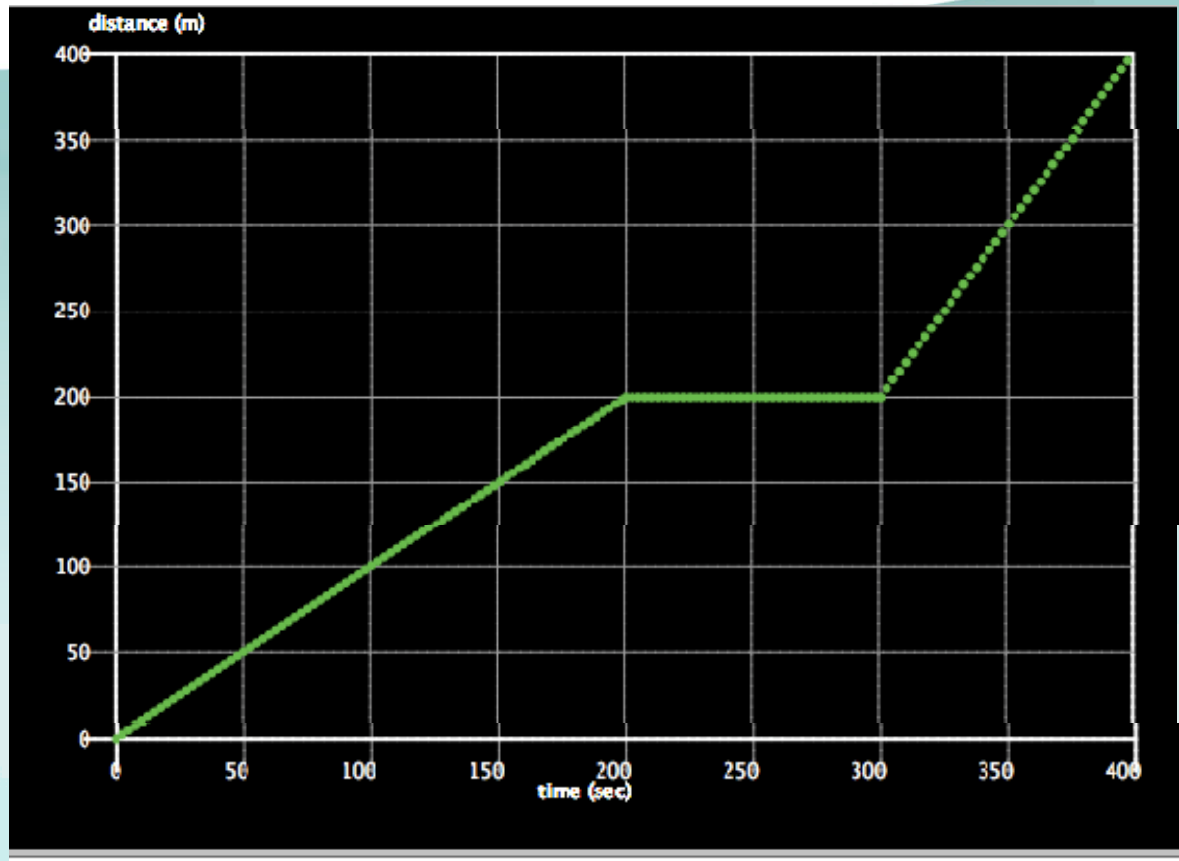
- Create a robust, flexible grapher
- Support inputs for *any* content area graphs
- Generate contextualized graphs that allow prediction, data input (sensors and models)
- Develop a software-based assessment

# Generate Contextualized Graphs

Context can be helpful for students, providing that they can generalize to multiple contexts.

This experiment developed algorithms for generating multiple contexts that could match graphs.

The green graph is the right answer, which would be hidden from students.




Charlene was in the mall on a rainy afternoon
She strolled along slowly looking in windows for 200 seconds at 1 meters per second.
Next, Charlene stopped to chat for 100 seconds.
Finally, she walked quickly for 100 seconds at 2 meters per second.

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# Scaling Up SmartGraphs

Some important considerations:

- A variety of activities and topics (Algebra, Chemistry, etc.) is needed to attract users
- Quality control is essential; new activities must be vetted
- Multiple communication channels needed to reach users
- External collaborators can increase dissemination
- Online PD (e.g. short movies) could help users
- In time, “open source” can mean shared development

# SmartGraphs PA Pilot Teacher

*I like that the kids can choose points on the graph and do the math, seeing which points the math correlates to. I think the activity does a better job of this than I do.*

*Melinda M. Morgan*

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