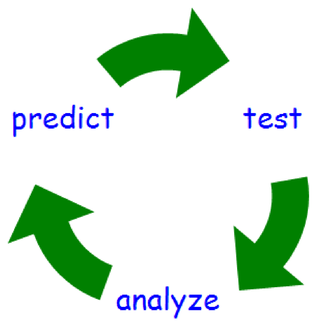
Fostering a Conceptual Understanding in Undergraduate Materials Education: A Multivariable Animated Spreadsheet Approach

Scott A. Sinex[1] and Joshua B. Halpern[2]
[1]Physical Sciences & Engineering, Prince George's Community College, Largo, Maryland
[2]Chemistry, Howard University, Washington, District of Columbia

Develop an engaging pedagogy in the classroom

In the classroom: What if… ?



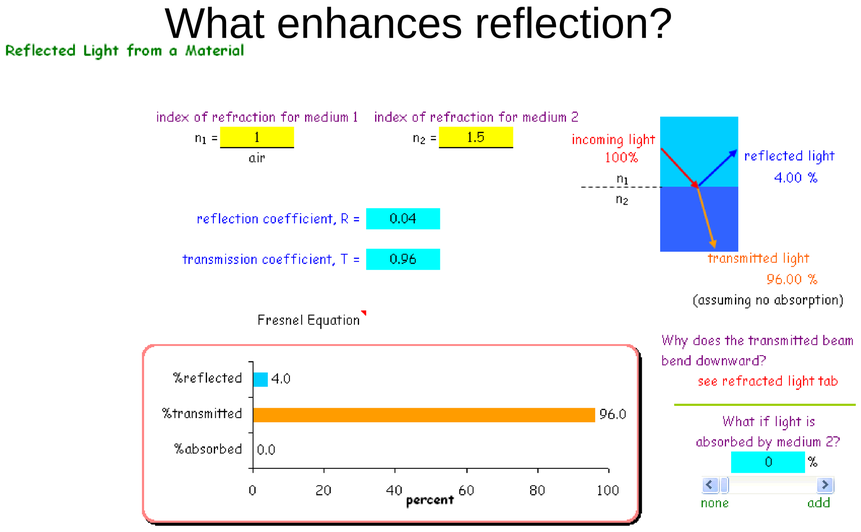
and explain !

All by adjusting variables with a variety of interactive features

Behavior of Light at the Interface between Materials

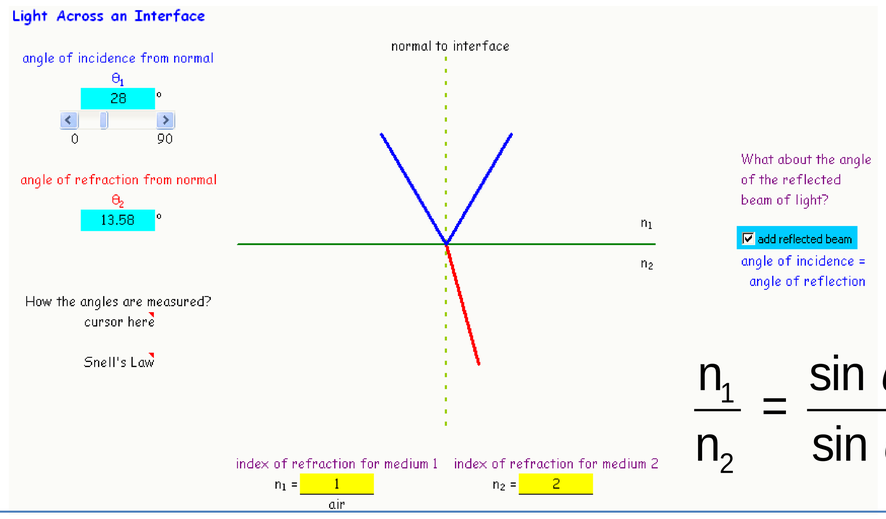
Discover the behavior of the reflection coefficient and transmission of light through a medium

What enhances reflection?



$$R = \frac{(n_1 - n_2)^2}{(n_1 + n_2)^2} \qquad T = 1 - R$$

Discover the behavior of light as it passes from one medium to another

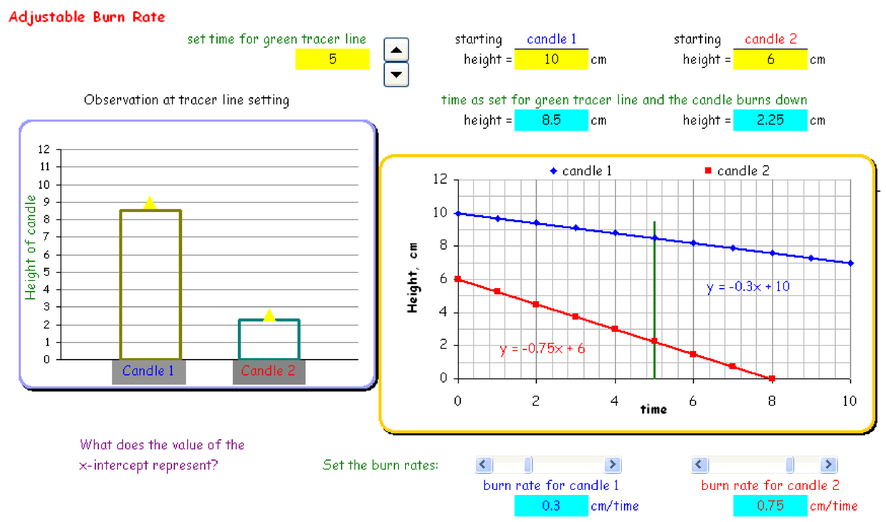


$$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1}$$

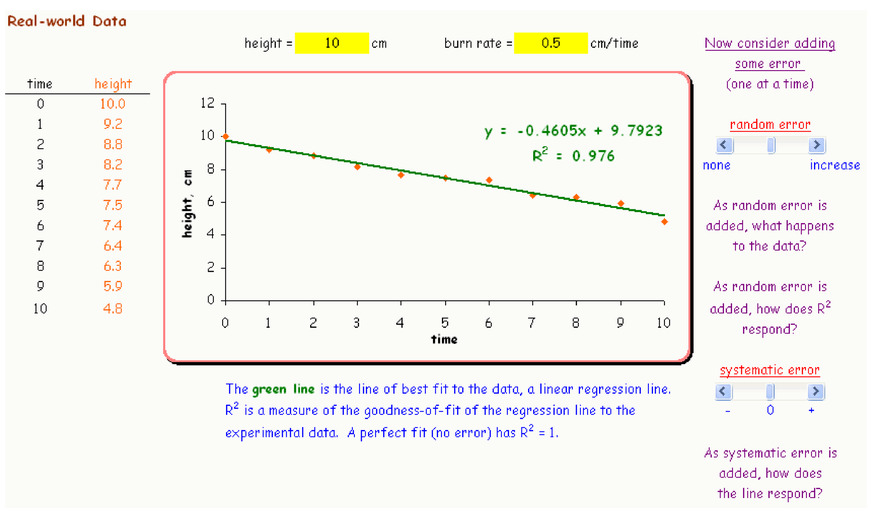
Burning of a Virtual Candle

Discover the behavior of a burning candle (zero-order kinetics)

What do the slope and x- and y-intercepts represent?



Add random and systematic error to make it real world behavior



Derive the rate equations from the simulation

differential form

$$\frac{-d(A)}{dt} = k(A)^0 = k$$

integrated form

$$(A)_t = (A)_o - kt$$

The computational process for many of the Excelets:

simulation
- ideal model
  - noise
    - error analysis

Student Feedback

for the Burning Candle Excelet
(n = 16 students)

Students like the dynamic visual aspects.

How would you characterize the use of the interactive Excel spreadsheet for this activity?

very easy | easy | so, so | difficult | very difficult

50% (8) | 50% (8)

Excelets offer a more visual experience with graphs instead of using just the mathematical equations.

most definitely | I think so | just barely | not at all | don't know

88% (14) | 12% (2)

Did the mathematics in the model seem easier?

most definitely | I think so | just barely | not at all | don't know

56% (9) | 38% (6) | 6% (1)

Excelets make it easier to grasp or learn a concept.

most definitely | I think so | just barely | not at all | don't know

69% (11) | 25% (4) | 6% (1)

Conclusions

1. Develop higher-order thinking questions
2. Enhance scientific and algebraic thinking
3. Students develop a deeper understanding of concepts
4. Develop a more multivariable approach
5. Computational and mathematical modeling skills are enriched
6. Easy to modify
7. Operate on PC or Mac platforms and most in OpenOffice Calc

Over 30 animated interactive spreadsheets for use in sophomore materials science and introductory chemistry and physics, at the URL below.

PREM Howard Johns Hopkins Prince George's CC
Partnership for Research and Education in Materials

Materials Science Excelets are available for download at
http://academic.pgcc.edu/~ssinex/excelets/matsci_excelets.htm

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