

# Conceptual Alignment, the Spiral Approach & Development of Reasoning

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## Conceptual Alignment Search

Google conceptual alignment physics Search

Web Show options... Results 1 - 10 of 10

[Energy has been Defined Inco](#)  
Because energy is so basic, a large  
as conceptual alignment for the c  
www.nov55.com/hist.html - [Cached](#)

**numerous conceptual errors in the logic of  
energy ... corrects the Leibniz analysis.**

[for Utah Core Curriculum Physics](#)  
File Format: PDF/Adobe Acrobat - [View](#) [Download](#)  
McDougal Littell Conceptual Phys  
Physics 2. STANDARD I: Students  
www.mcdougallittell.com/ml...alignment/UT248-Con\_Phy\_physics.pdf

**Textbook Alignment to the Utah Core – Physics**

[American Association of Physics Teachers](#)  
Vertical Alignment of Physics Conceptual Curriculum ... Conceptual Alignment,  
Approach and Development of Reasoning ...  
www.aapt.org/scheduler/wm2010/results.cfm?Cat=Code...GD - [Cached](#)

**My abstract**



## Vertically aligned university physics study

- First year course
  - All major topics
  - Once over lightly
- Undergrad upper level courses
  - All major topics
  - Increase depth
  - Higher level math
- Graduate core courses
  - All major topics
  - More math than physics



## Better way to do it

- Oregon State Paradigms in Physics
- Still vertically aligned
  - probably even better than traditional



## Spiral approach

- Treat a topic
- Go on to other topics
- Return to first topic
  - Increase depth
  - Use concepts from other topics
- Even applied to beginning courses
  - Albert Baez: *Physics: A Spiral Approach* (1967)

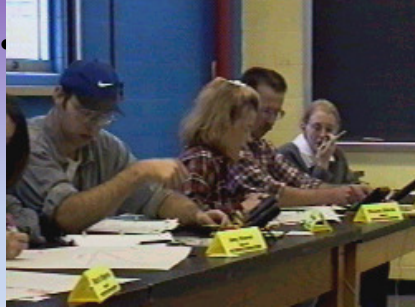


## Difficulties

- Compartmentalization
  - This is E and M; why do I need  $F=ma$
- Transfer of learning
  - Concepts learned in one context
  - Not easily used in another
  - In a single course
  - From one course to another
    - Math to physics to Engineering



## Education of Future Teachers



## Physics for Future Elementary Teachers

- 30 years experience
- Karplus learning cycles
  - Each week is a cycle
  - Learning focuses on activities
- All activities connected to National Standards
- Activities
  - Many can be done in grades 1-6
  - Some more advanced
    - Vertical look



## Measurement

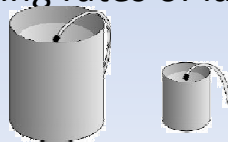
- Qualitatively Judge
  - Do you think a has more energy than b, just be looking
- Meter sticks, stop watches
- Data from video
- €Sense Interface
  - Elementary school
  - Primarily in Europe
- Pasco system
  - Usually interpreting graphs



## Example: Thermal Energy Application

In winter young animals are more likely to die from exposure their parents, Why?

- €uroSense Activity
  - ~4<sup>th</sup> Grade
- Model the animals as tin cans
  - “Consider a cylindrical lamb”
- Compare cooling rates of large and small cans



## Latent Heat of Fusion of the Wicked Witch of the West



## Vertical Nature

- Activities can be used a different levels
- Future teachers see techniques more advanced than they will use
  - Now!
- See what their students can do at grade level
  - also higher and lower grades
- But, we don't emphasize this enough
- Projects to adapt to classroom



## Future Secondary Science Teachers

- Not majoring in physics teaching
- Math, biology, chemistry teachers
  - Also want to be licensed in physics
- State Board requirement
  - Until last year: 3 physics courses
    - All must have lab experiences
  - Now just pass Physics PRAXIS
    - But, the PRAXIS has modern physics



## Contemporary Physics

- 20 years experience
- 20<sup>th</sup> and 21<sup>st</sup> Century Physics
- Prerequisite: Algebra-based physics
- Mostly a conceptual approach
  - Led to Visual Quantum Mechanics
- Also general education course



## Activities & Laboratory

- Multiple approaches to each experiment
- Analogies when possible
- High school version if available
- Physics major version
- Computer visualization
  - VQM. PhET, others
- Online real experiments
  - <http://rcl.physik.uni-kl.de/>



## Example: Rutherford Scattering

Display of digital counter:  
1. Countdown of chosen time interval  
2. Number of registered alpha particles

**Rutherford's Scattering Experiment Laboratory**

Remaining time to perform experiment: 262 s.

Scattering object:

Scattering angle (-50° - +50°):

Time interval (0 - 300 s):





## Vertical Nature

- Activities for
  - Secondary school
  - Intro college
  - ~ Advanced college
- Activities teachers can use
- Others to understand how physicists do them



## Concluding Comments

- Seems to fit the vertical alignment idea
- But was not built with that in mind
- No careful evaluation in terms of alignment
- Frequent contacts by former students to obtain information about using activities in class
  - For both classes
  - During student teaching
  - And beyond





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