

# Universal Design for Learning in the Science Classroom

Successful STEM Education Conference

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AFFECTIVE NETWORKS:  
THE **WHY** OF LEARNING



## Engagement

For purposeful, motivated learners, stimulate interest and motivation for learning.

RECOGNITION NETWORKS:  
THE **WHAT** OF LEARNING



## Representation

For resourceful, knowledgeable learners, present information and content in different ways.

STRATEGIC NETWORKS:  
THE **HOW** OF LEARNING



## Action & Expression

For strategic, goal-directed learners, differentiate the ways that students can express what they know.

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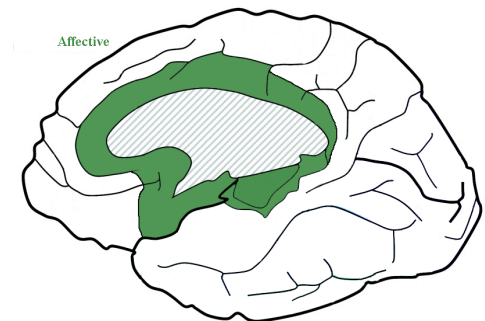
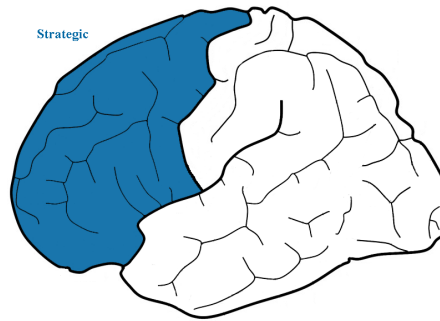
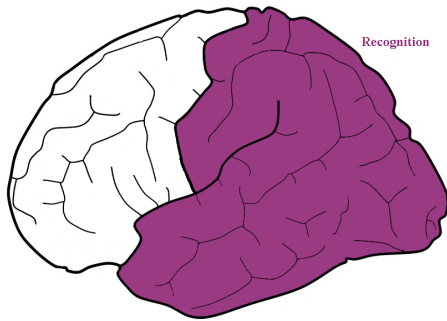


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We need a model to let  
us consider this infinite  
variability...

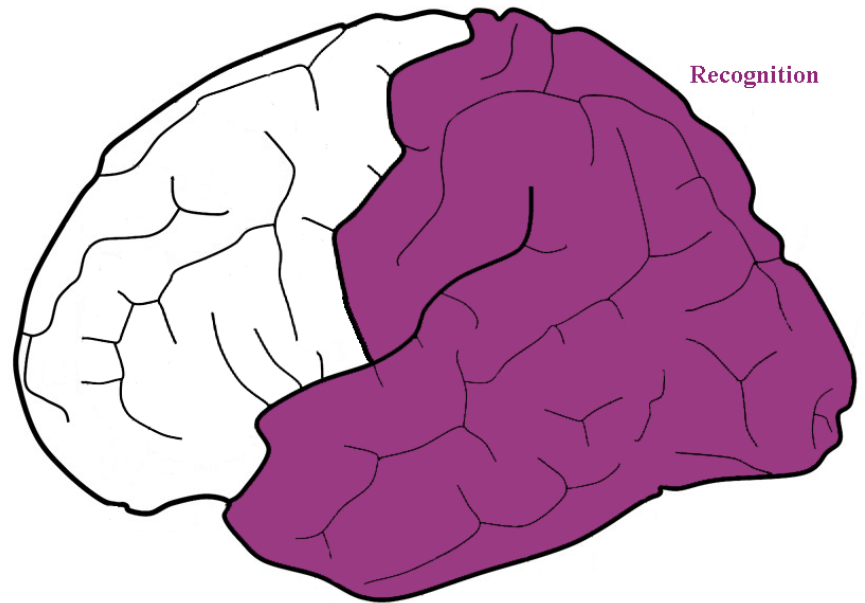
# Three major dimensions of how learners vary





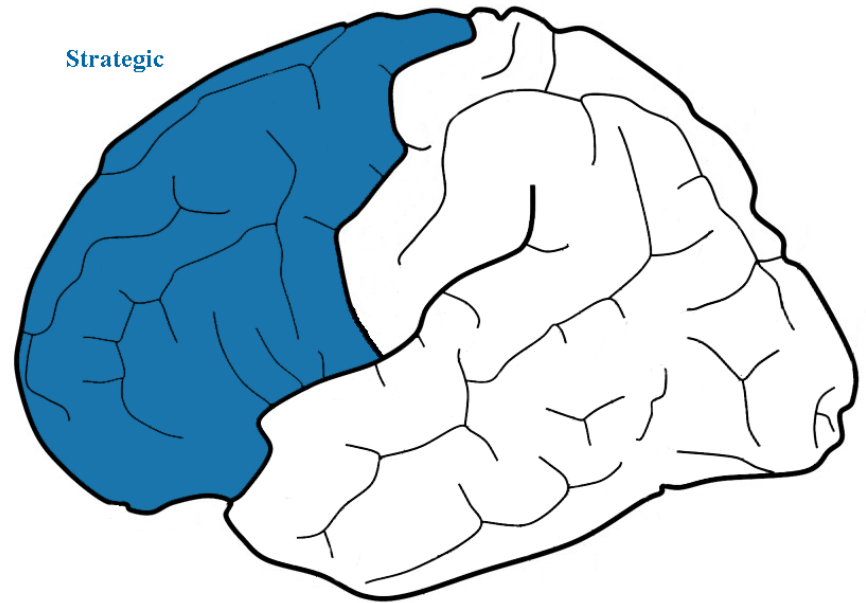
# Recognition Network: “what of learning”

Identify & interpret  
patterns of sensory  
information from  
the environment.



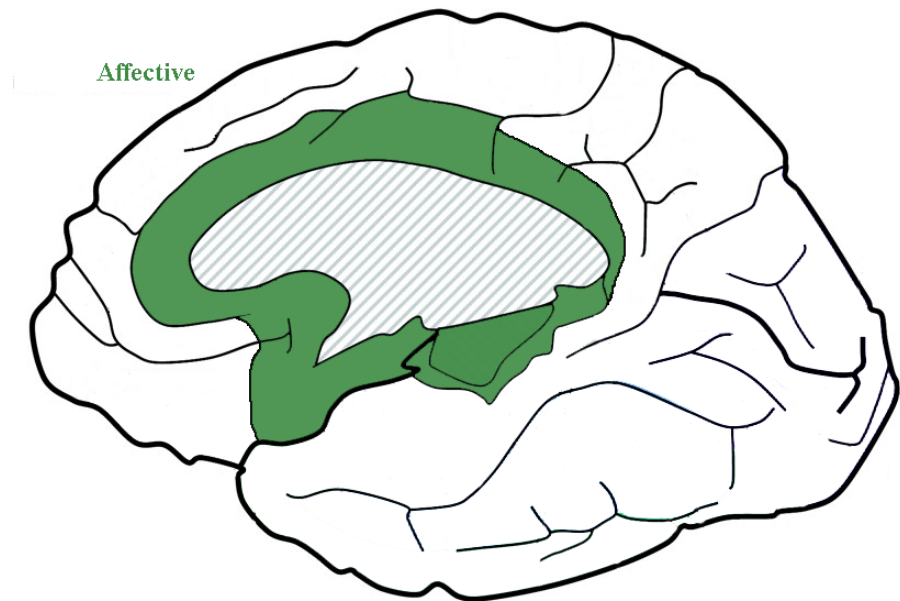
# Strategic Networks: “how of learning”

Plan, execute, and  
monitor actions on  
the environment.



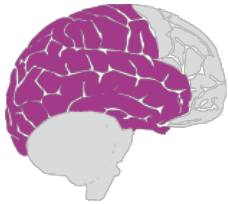
# Affective Networks: “why of learning”

Evaluate & set  
priorities for  
attention  
and action

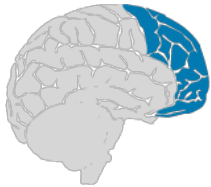




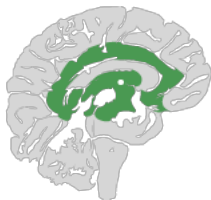
# UDL Framework



Provide Multiple Means of Representation



Provide Options for Action and Expression



Provide Multiple Means of Engagement

I. Provide Multiple Means of Representation
1. Provide options for perception <ul style="list-style-type: none"><li>Options that customize the display of information</li><li>Options that provide alternatives for auditory information</li><li>Options that provide alternatives for visual information</li></ul>
2. Provide options for language and symbols <ul style="list-style-type: none"><li>Options that define vocabulary and symbols</li><li>Options that clarify syntax and structure</li><li>Options for reading text or mathematical notation</li><li>Options that promote crosslinguistic understanding</li><li>Options that illustrate key concepts non-linguistically</li></ul>
3. Provide options for comprehension <ul style="list-style-type: none"><li>Options that provide or activate background knowledge</li><li>Options that highlight critical features, big ideas, and relationships</li><li>Options that guide information processing</li><li>Options that support memory and transfer</li></ul>
II. Provide Multiple Means of Action and Expression
4. Provide options for physical action <ul style="list-style-type: none"><li>Options in the mode of physical response</li><li>Options in the means of navigation</li><li>Options for accessing tools and assistive technologies</li></ul>
5. Provide options for expressive skills and fluency <ul style="list-style-type: none"><li>Options in the mode for communication</li><li>Options in the tools for composition and problem solving</li><li>Options in the scaffold for practice and performance</li></ul>
6. Provide options for executive functions <ul style="list-style-type: none"><li>Options that guide effective goalsetting</li><li>Options that support planning and strategy development</li><li>Options that facilitate managing information and resources</li><li>Options that enhance capacity for monitoring progress</li></ul>
III. Provide Multiple Means of Engagement
7. Provide options for recruiting interest <ul style="list-style-type: none"><li>Options that increase individual choice and autonomy</li><li>Options that enhance relevance, value, and authenticity</li><li>Options that reduce threats and distractions</li></ul>
8. Provide options for sustaining effort and persistence <ul style="list-style-type: none"><li>Options that heighten sense of goals and challenge</li><li>Options that vary levels of challenge and support</li><li>Options that foster collaboration and communication</li><li>Options that increase mastery-oriented feedback</li></ul>
9. Provide options for self-regulation <ul style="list-style-type: none"><li>Options that guide personal goalsetting and expectations</li><li>Options that scaffold coping skills and strategies</li><li>Options that develop self-assessment and reflection</li></ul>

## I. Provide Multiple Means of Representation

### 1: Provide options for perception

- 1.1 Offer ways of customizing the display of information
- 1.2 Offer alternatives for auditory information
- 1.3 Offer alternatives for visual information

### 2: Provide options for language, mathematical expressions, and symbols

- 2.1 Clarify vocabulary and symbols
- 2.2 Clarify syntax and structure
- 2.3 Support decoding of text, mathematical notation, and symbols
- 2.4 Promote understanding across languages
- 2.5 Illustrate through multiple media

### 3: Provide options for comprehension

- 3.1 Activate or supply background knowledge
- 3.2 Highlight patterns, critical features, big ideas, and relationships
- 3.3 Guide information processing, visualization, and manipulation
- 3.4 Maximize transfer and generalization

**Resourceful, knowledgeable learners**

## II. Provide Multiple Means of Action and Expression

### 4: Provide options for physical action

- 4.1 Vary the methods for response and navigation
- 4.2 Optimize access to tools and assistive technologies

### 5: Provide options for expression and communication

- 5.1 Use multiple media for communication
- 5.2 Use multiple tools for construction and composition
- 5.3 Build fluencies with graduated levels of support for practice and performance

### 6: Provide options for executive functions

- 6.1 Guide appropriate goal-setting
- 6.2 Support planning and strategy development
- 6.3 Facilitate managing information and resources
- 6.4 Enhance capacity for monitoring progress

**Strategic, goal-directed learners**

## III. Provide Multiple Means of Engagement

### 7: Provide options for recruiting interest

- 7.1 Optimize individual choice and autonomy
- 7.2 Optimize relevance, value, and authenticity
- 7.3 Minimize threats and distractions

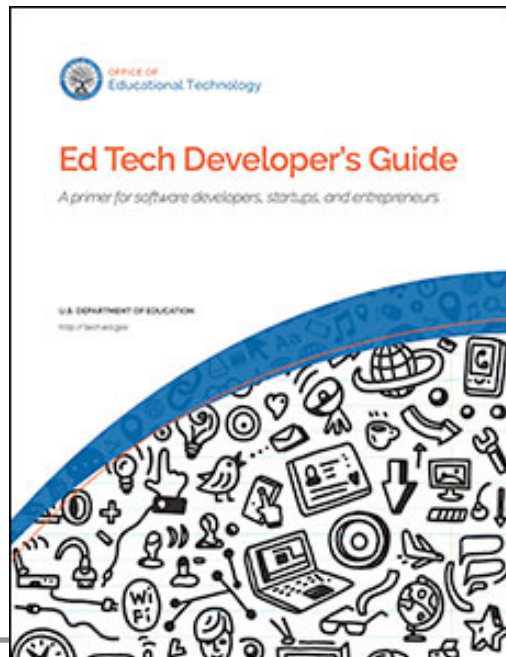
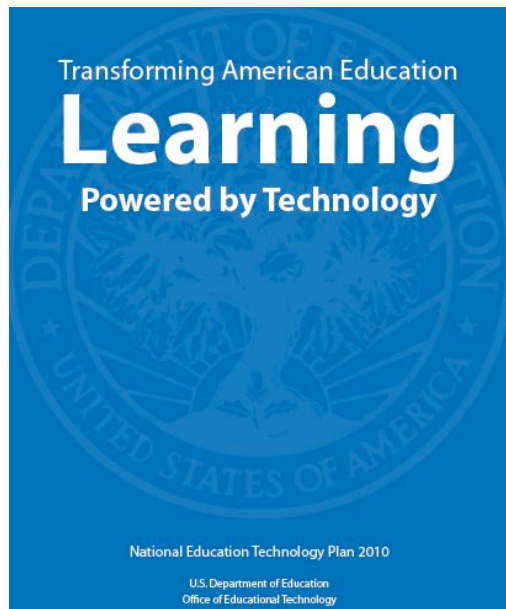
### 8: Provide options for sustaining effort and persistence

- 8.1 Heighten salience of goals and objectives
- 8.2 Vary demands and resources to optimize challenge
- 8.3 Foster collaboration and community
- 8.4 Increase mastery-oriented feedback

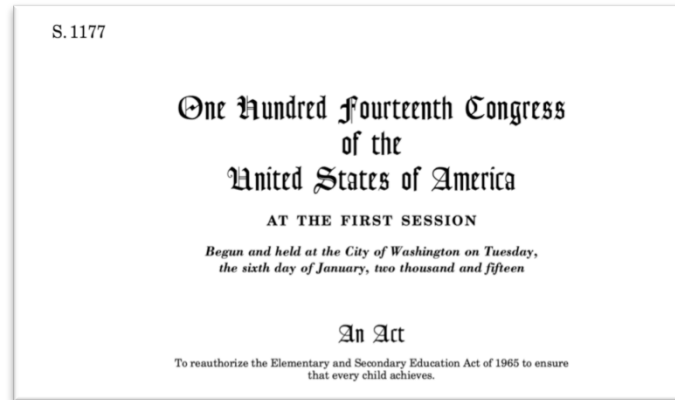
### 9: Provide options for self-regulation

- 9.1 Promote expectations and beliefs that optimize motivation
- 9.2 Facilitate personal coping skills and strategies
- 9.3 Develop self-assessment and reflection

**Purposeful, motivated learners**



## Every Student Succeeds Act (ESSA)



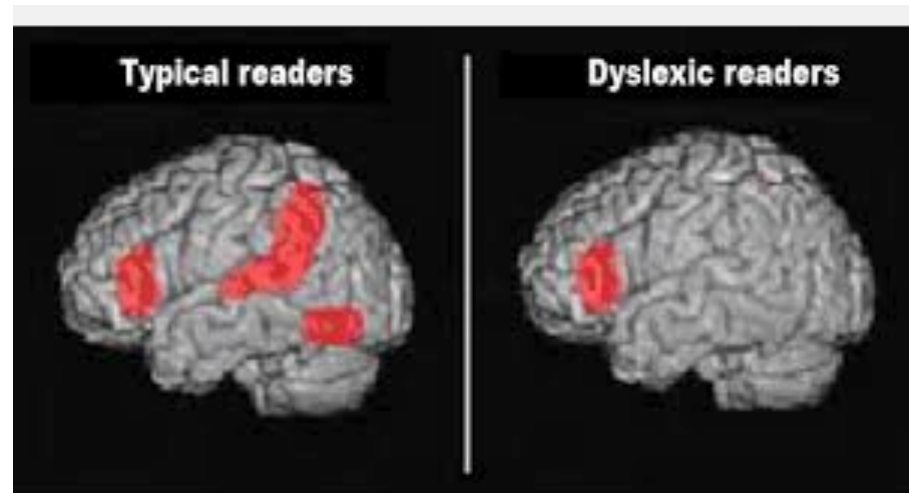
**“Universal Design for Learning (UDL)** means a scientifically valid framework for guiding educational practice that —

- (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and
- (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient.”

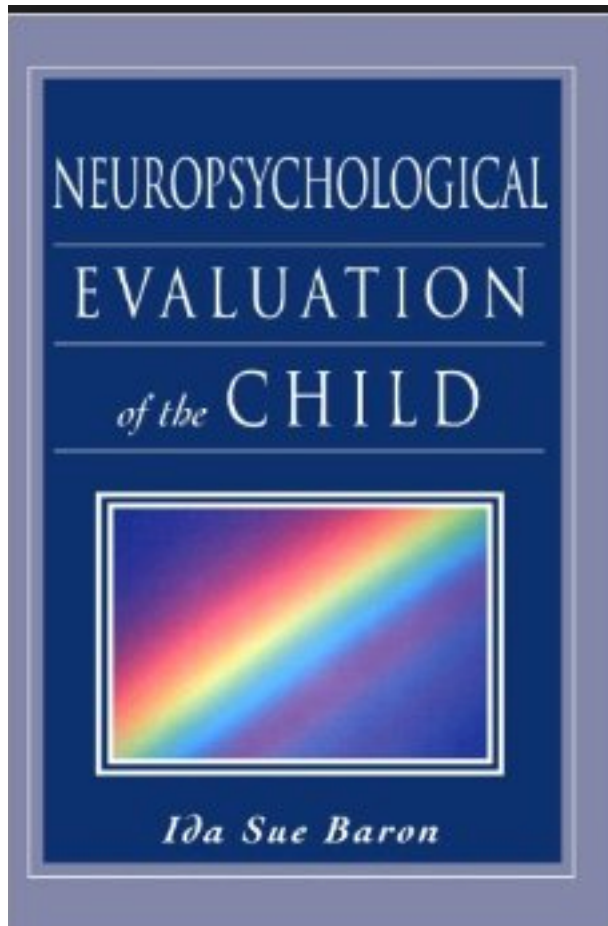
# Fixed, uniform, learning technologies



## Diverse, varied, learners.



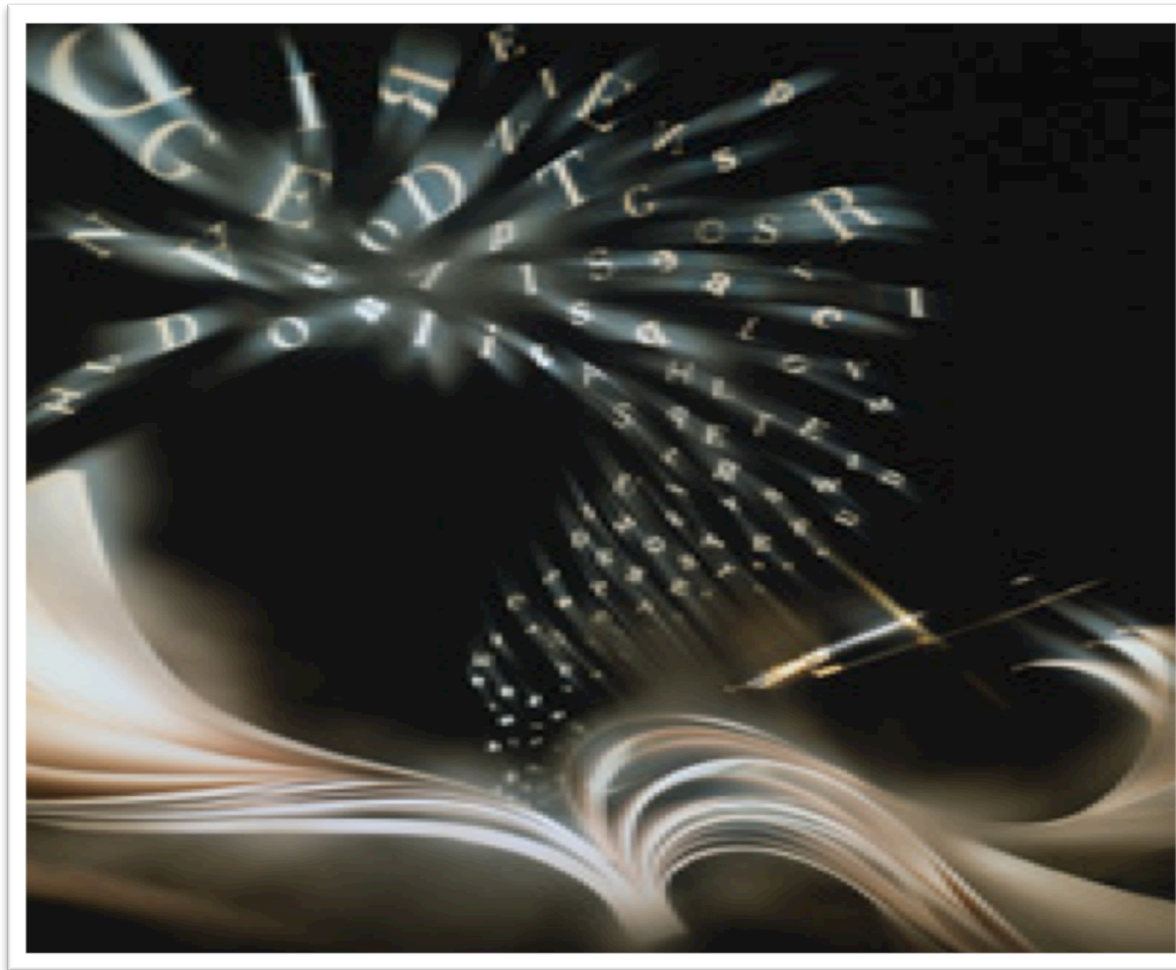
# The Result?



Children are the problem



# New media changes the equations





## An example

# Science Notebooks

- Can effectively support active science learning and development of scientific literacy (Hargrove & Nesbit, 2003; Klentschy, 2005)
- Opportunity for students to engage in authentic scientific practice
- Support students to reflect, revise their thinking, focus on “big ideas”
- Provide formative assessment data for teachers

# The nature of the task is critical



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**Purposeful, motivated learners**

The screenshot displays the 'Science Notebook' application interface. At the top, the title 'Science Notebook' is followed by '7 aqua's Notebook! (3323d)'. Navigation links include 'home', 'search', 'glossary', and 'my index'. The main section is titled 'Advanced Connections - Building Series Circuits' and features icons for 'get data', 'plan', 'get data', and 'explain', along with a 'print pages' button. A yellow banner prompts the user to 'Answer the focus question.' Below this, the 'Answer Focus Question' section contains the question: 'How can you make two lights burn brightly in a series circuit?'. A timestamp '10/28/2010' is shown. The user's response describes connecting a D-cell to two lightbulbs in series. An 'edit' button is present. A toolbar at the bottom of the response area offers options: 'write', 'draw', 'record', 'upload', and 'add a line of learning'. On the right side, a 'SpeechStream' section includes play, pause, and stop buttons, and a link to 'en Español'. Below that, a yellow sticky-note-like box contains 'check my work' and 'teacher feedback' buttons. The bottom of the screen shows a Windows taskbar with an 'Internet' icon.

Science Notebook  
7 aqua's Notebook! (3323d)

home search glossary my index

Advanced Connections - Building Series Circuits

get data plan get data explain print pages

• Answer the focus question.

Answer Focus Question group work index this page

How can you make two lights burn brightly in a series circuit?

10/28/2010

I connected a wire from the bottom of the D-cell to the bottom of the lightbulb. I added another wire from the side of the first bulb to the bottom of the second bulb. I connected another wire from the bottom of the second bulb back to the side of the D-cell.

edit

Choose a tool: write draw record upload add a line of learning

SpeechStream

en Español

check my work teacher feedback

Internet

## *SNUDLE vs Traditional Paper Notebooks in inclusive 4<sup>th</sup>-grade science classrooms (n=621)*

- There was a significant impact of SNUDLE ( $\gamma = .34$ ,  $p < .01$ ) use over and above that of traditional science notebooks – representing a 10% difference on average between treatment and control.
- SNUDLE raised the floor and the ceiling on content and process knowledge for all students
- Students of teachers who had more experience with science notebooking tended to use SNUDLE features more productively.



# In their own words...

[video removed for permission reasons]





**Science Notebook**  
Universal Design for Learning Environment



THE LAWRENCE  
HALL OF SCIENCE  
UNIVERSITY OF CALIFORNIA, BERKELEY



Full Option  
Science System™



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