Universal Design for Learning in the Science Classroom

Successful STEM Education Conference
San Francisco, CA – Feb. 1, 2016
Samantha Daley, EdD

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.

STEM Smart workshops are funded by the National Science Foundation grant #1449550. Any opinions, findings, and conclusions or recommendations at this event or in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

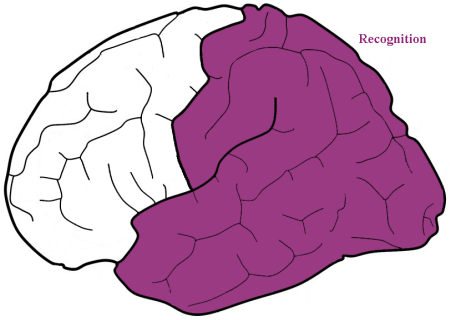
sdaley@cast.org @sami_daley

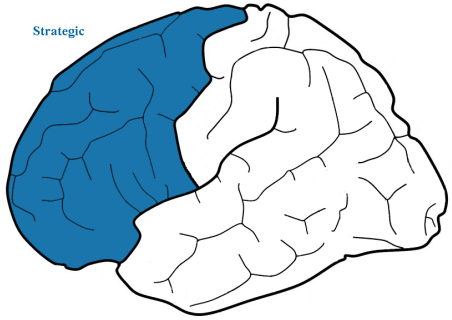

D4
Gates D5 - D13
D3
© Getty Images

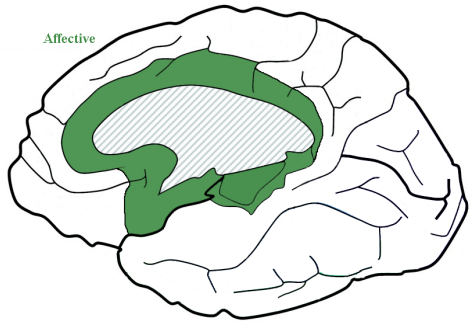
sdaley@cast.org @sami_daley

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

Three major dimensions of how learners vary

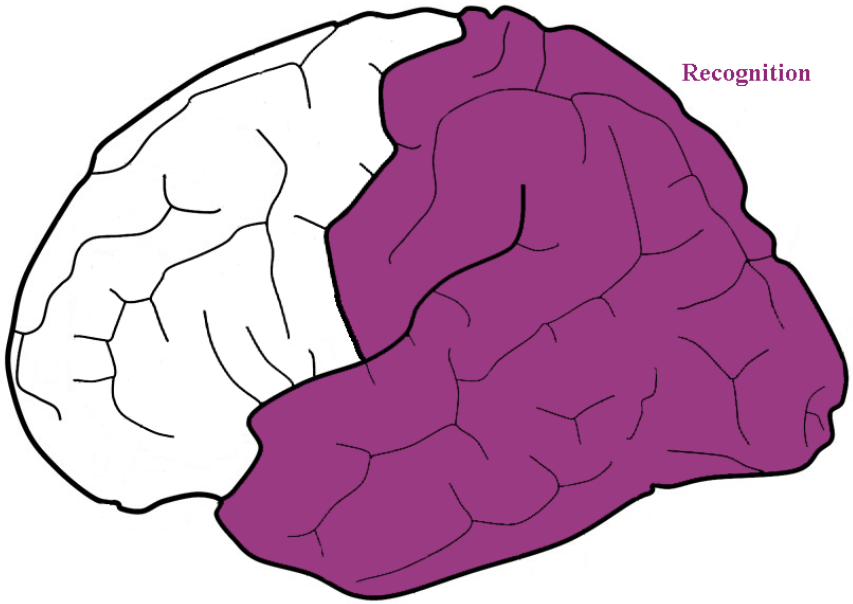






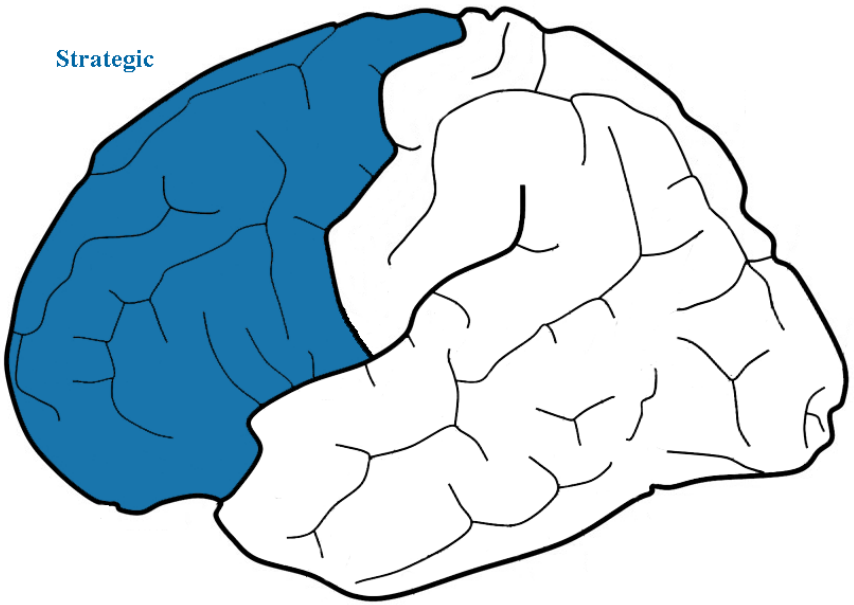
Recognition Network: "what of learning"

Identify & interpret patterns of sensory information from the environment.



Strategic Networks: "how of learning"

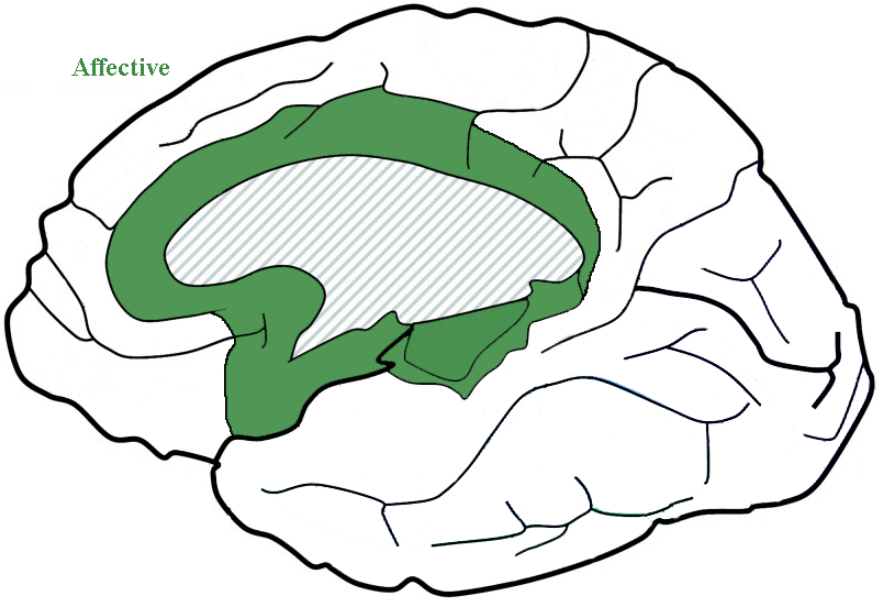
Plan, execute, and monitor actions on the environment.



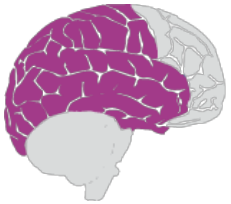
Affective Networks: "why of learning"

Evaluate & set priorities for attention

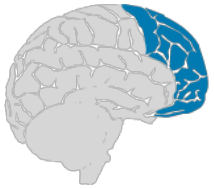
and action



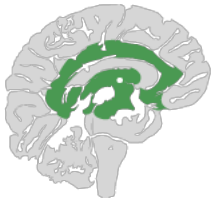
UDL Framework



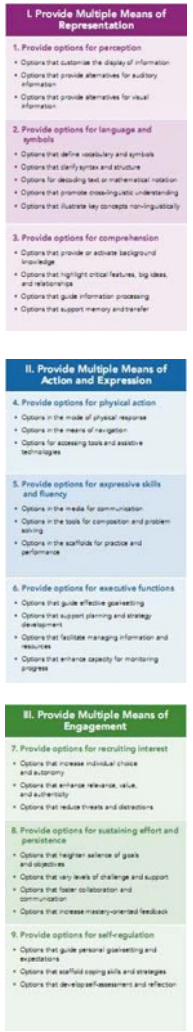
Provide Multiple Means of Representation



Provide Options for Action and Expression



Provide Multiple Means of Engagement



I. Provide Multiple Means of Representation

1: Provide options for perception

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

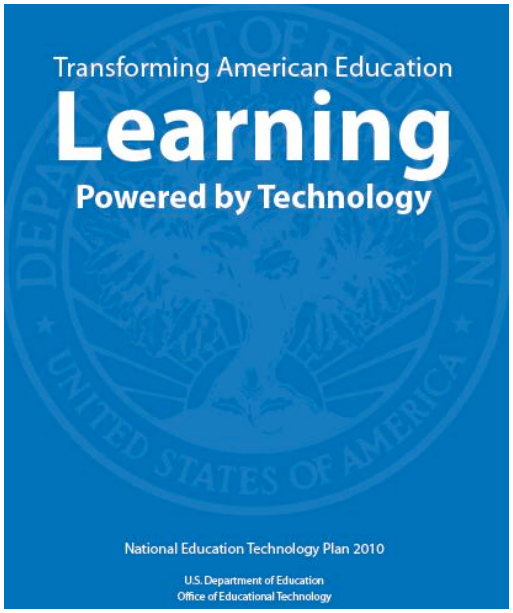
9: Provide options for self-regulation

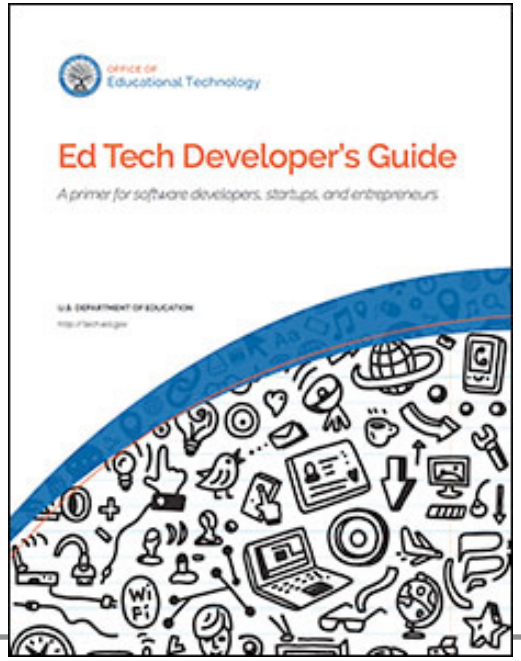
9.1 Promote expectations and beliefs that optimize motivation

9.2 Facilitate personal coping skills and strategies

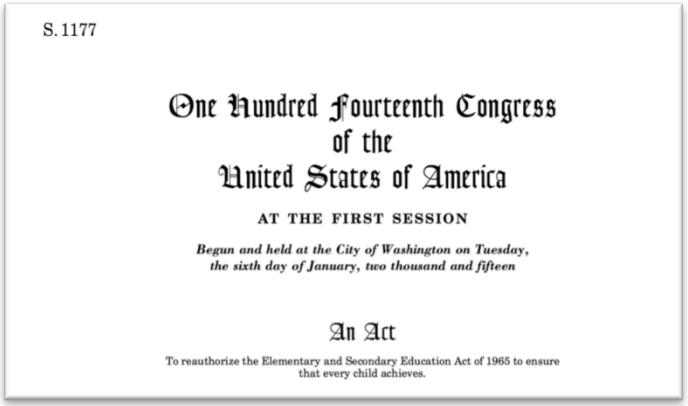
9.3 Develop self-assessment and reflection

Purposeful, motivated learners





Every Student Succeeds Act (ESSA)



S. 1177

One Hundred Fourteenth Congress
of the
United States of America

AT THE FIRST SESSION

Begun and held at the City of Washington on Tuesday, the sixth day of January, two thousand and fifteen

An Act

To reauthorize the Elementary and Secondary Education Act of 1965 to ensure that every child achieves.

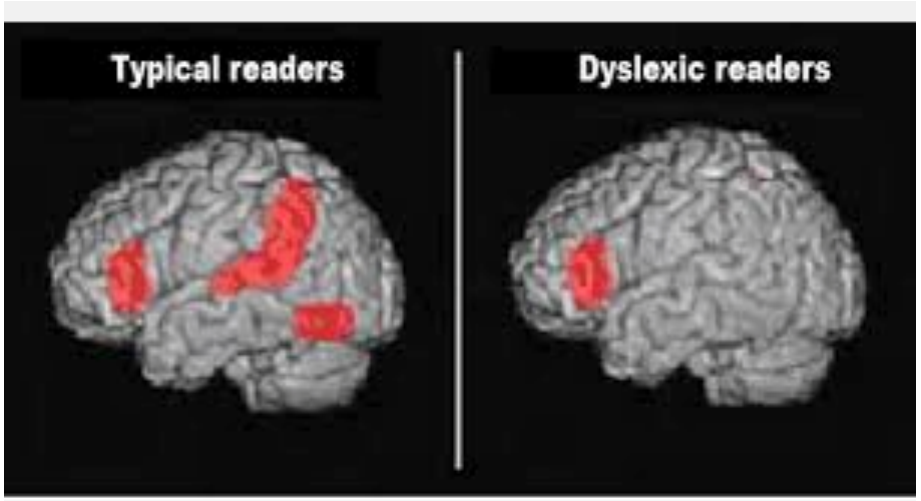
"**Universal Design for Learning (UDL)** means a scientifically valid framework for guiding educational practice that —

(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

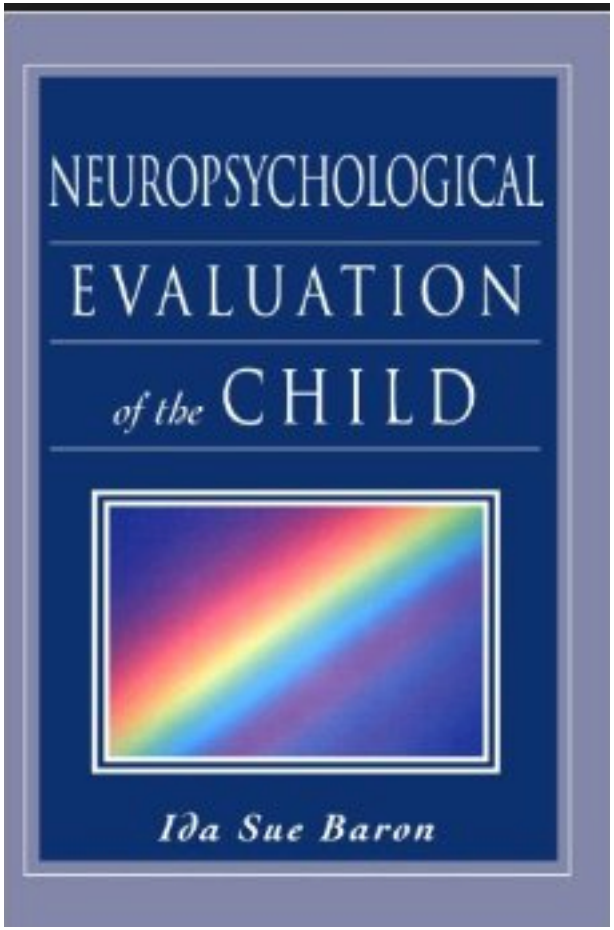
(B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient."

Fixed, uniform, learning technologies

Diverse, varied, learners.

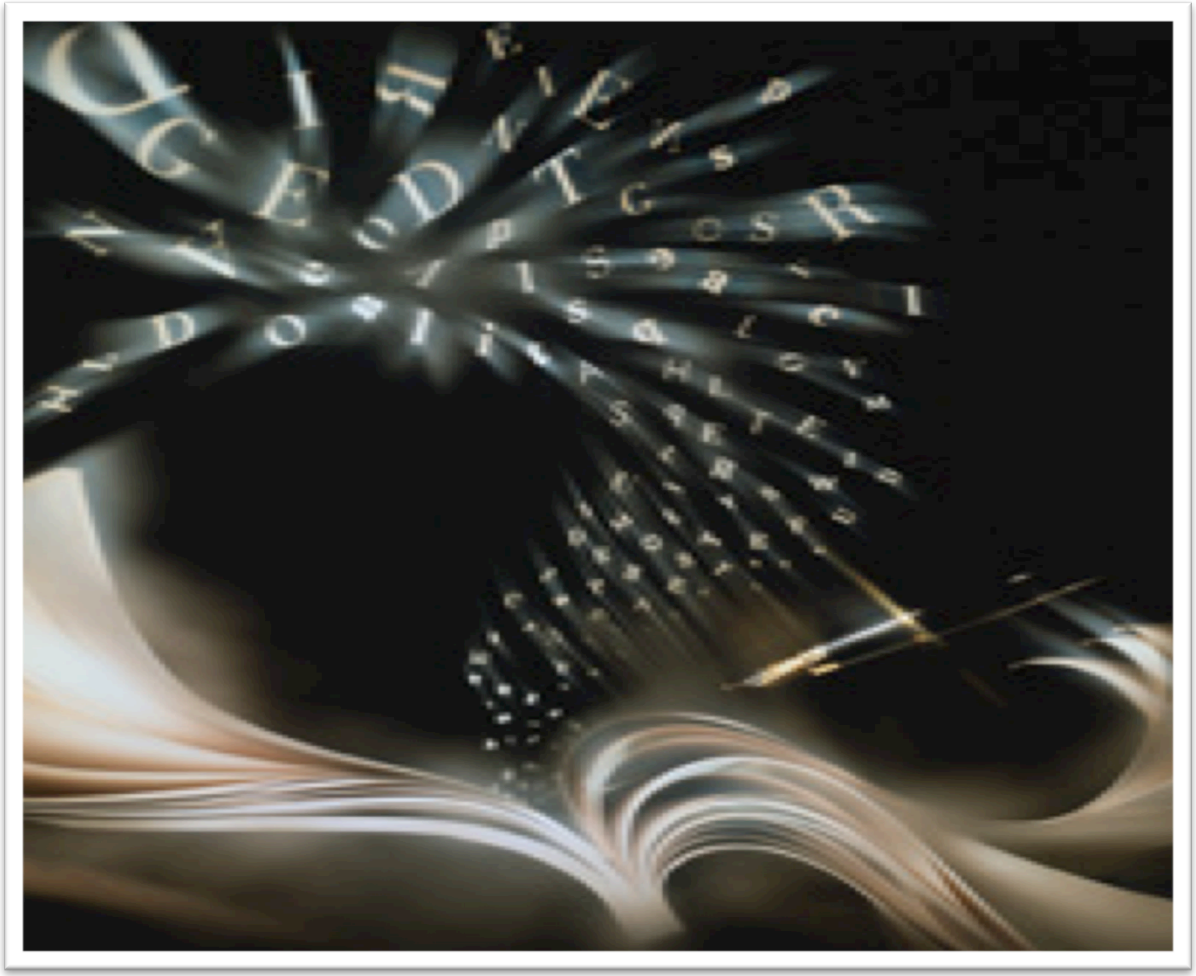


The Result?



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

sdaley@cast.org @sami_daley

The nature of the task is critical

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

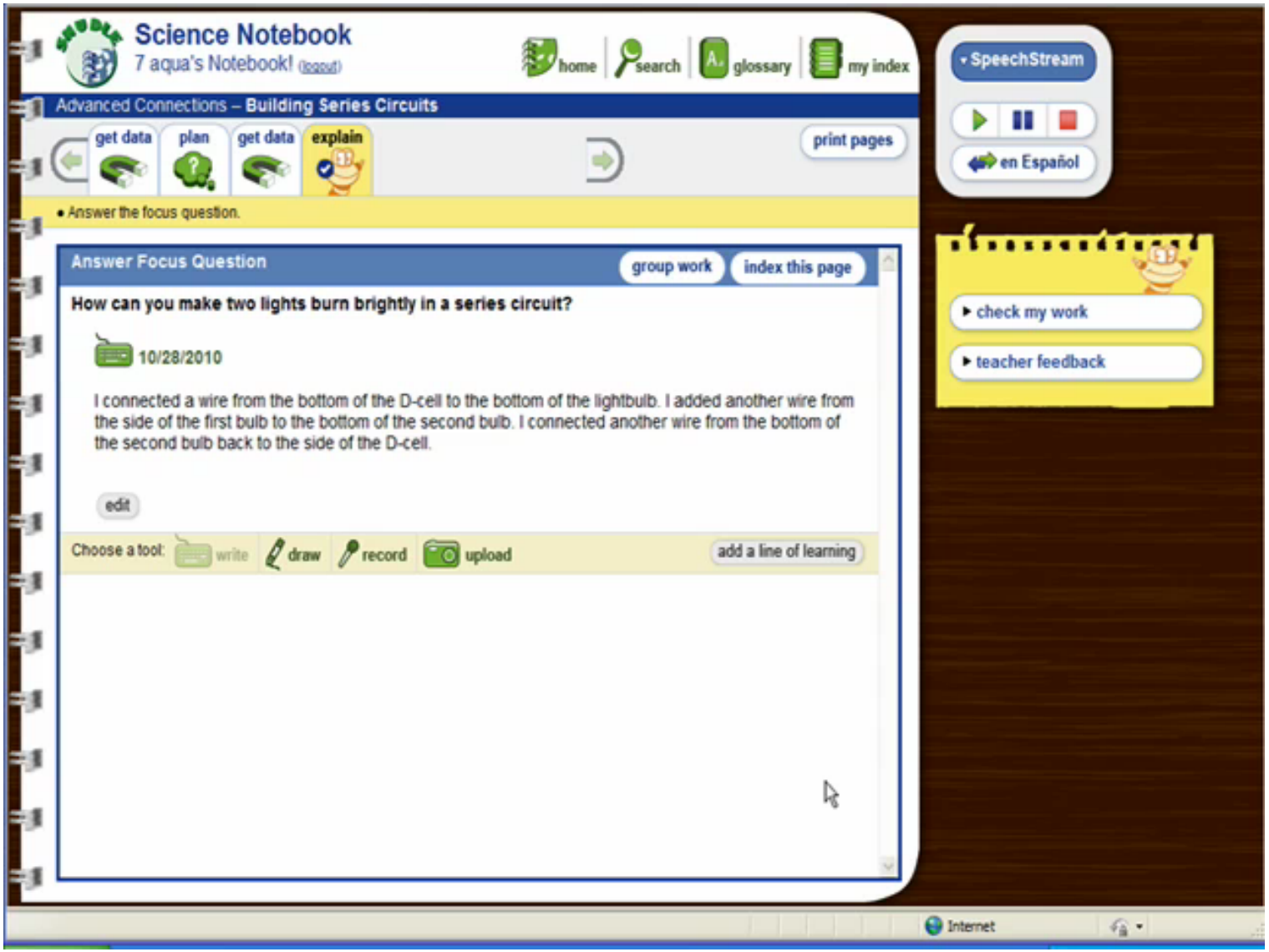
9: Provide options for self-regulation

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


Science Notebook
7 aqua's Notebook! (logout)
home
search
glossary
my index
SpeechStream
Advanced Connections – Building Series Circuits
get data
plan
get data
explain
print pages
en Español
• 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
check my work
teacher feedback
Internet

SNUDLE vs Traditional Paper Notebooks in inclusive 4th-grade science classrooms (n=621)

- There was a significant impact of SNUDLE (γ = . 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]

This content was produced under U.S. Department of Education, Office of Special Education Programs, Award No H327S150011
Michael Slade serves as the project officer. The views expressed herein do not necessarily represent the positions or policies of the U.S. Department of Education. No official endorsement by the U.S. Department of Education of any product, commodity, service, or enterprise mentioned in this website is intended or should be inferred.

Science in the Learning Gardens

SciLG

Factors that Support Ethnic and Racial Minority Students' Success in Low-Income Middle Schools, 2014-2017

Dilafruz Williams & Sybil Kelley

STEM smart: Lessons learned from successful schools
San Francisco. February 1, 2016
Project funded by NSF Grant: DR K-12: DRL 1418270

STEM Smart workshops are funded by the National Science Foundation grant #1449550. Any opinions, findings, and conclusions or recommendations at this event or in these materials are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Overall Goals of SciLG

- **Advance equity in STEM**
- **Strengthen pipeline to higher education**
- **Honor diversity and inclusivity**

Our Core BELIEFS and VALUES

Unyielding commitment

- **to diversity and inclusion**
- **to non-marginalization**

Reject deficit-based models of education

Students do not have to give up who they are and what defines their identity

For culturally and linguistically diverse students, the garden has potential to empower and to encourage pride and respect in their cultural heritage.

Karen Payne, Program Director of the American Community Garden Association

Curriculum:

NGSS/Culturally responsive

Instruction:

Garden as milieu/

Hands-on, experiential, holistic

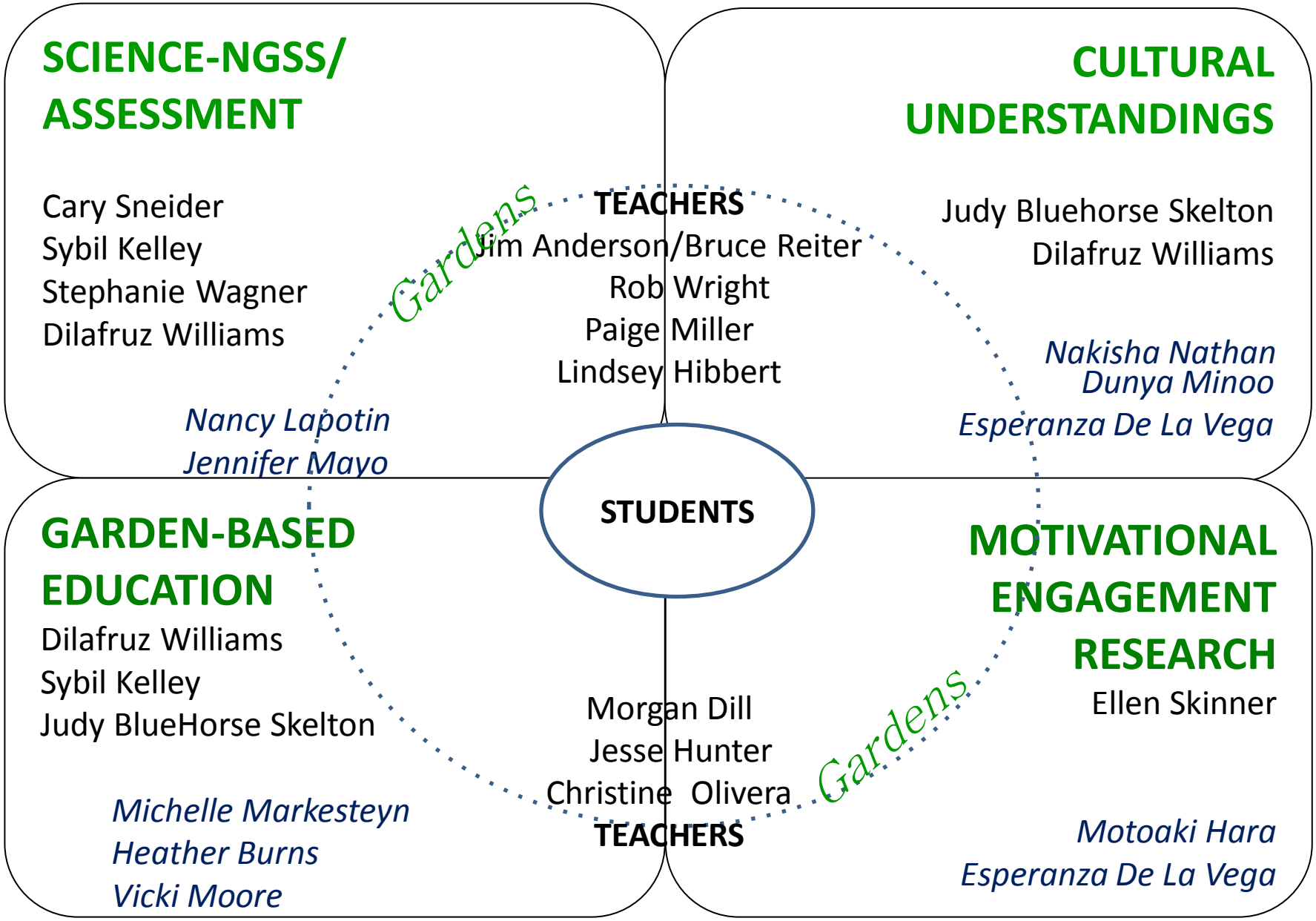
Research:

Motivational engagement

Science learning outcome

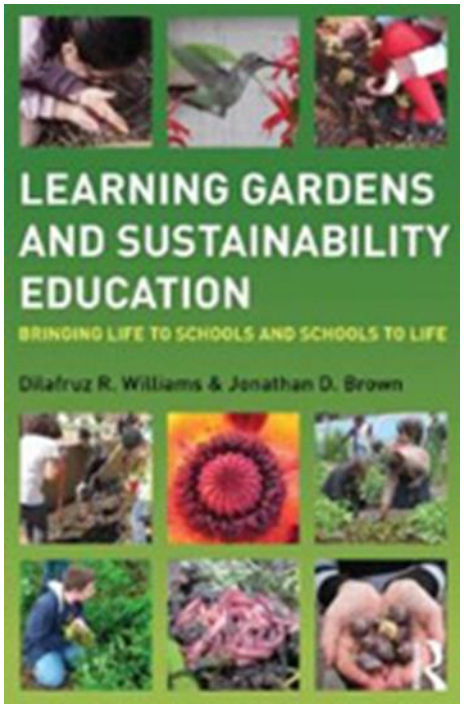
Grade 6: 2014-2015 | **Grade 7: 2015-2016** | **Grade 8: 2016-2017**

	LANE (Grades 6-8)	LENT (Grades K-8) SciLG: (grades 6-8)
NON-WHITE	58% (Hispanic 27%; Asian 17%; African-American 6%)	76% (Hispanic 44%; Asian 15%; African-American 10%)
SPED	20%	15%
TAG	5%	0.9%
LEP	10%	33%
FRL	82%	85%
TOTAL	480	564

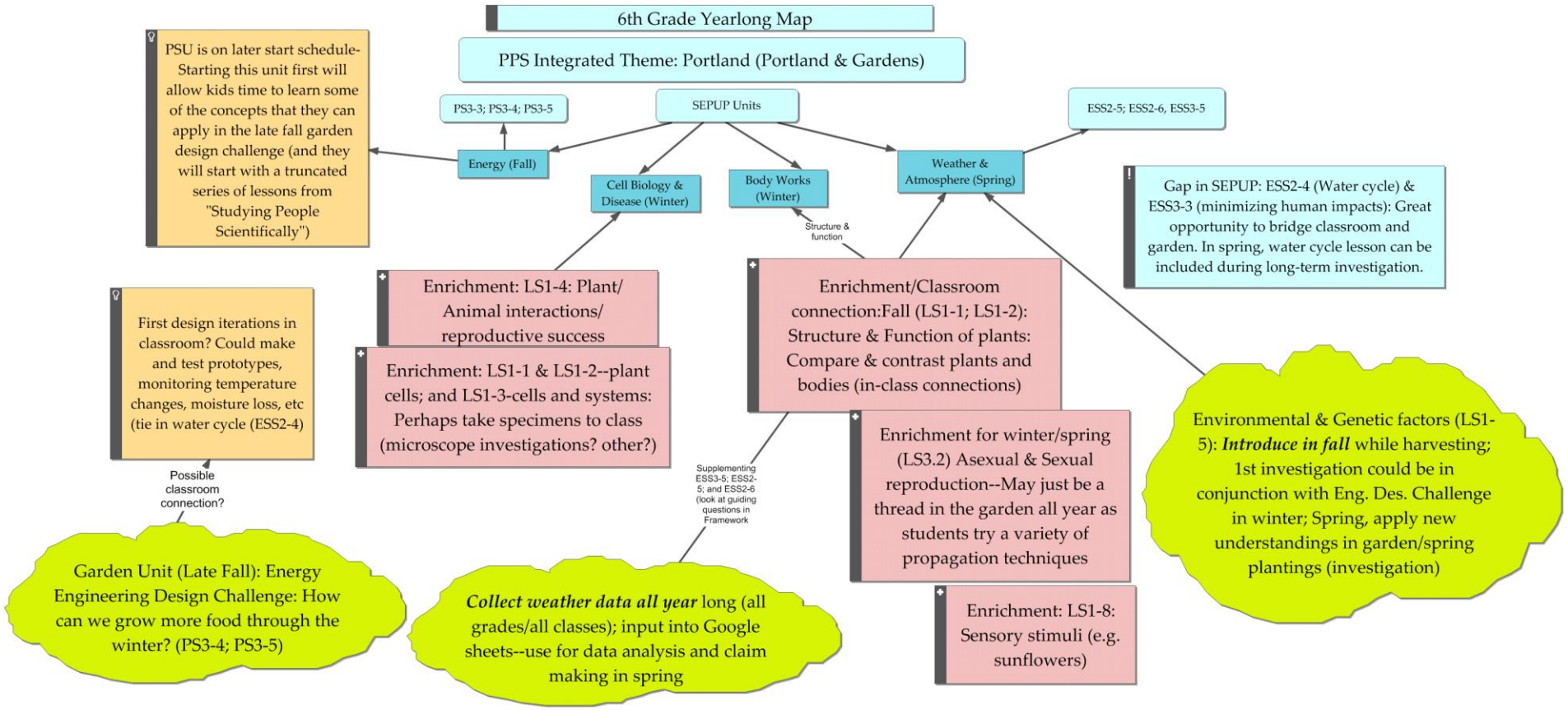


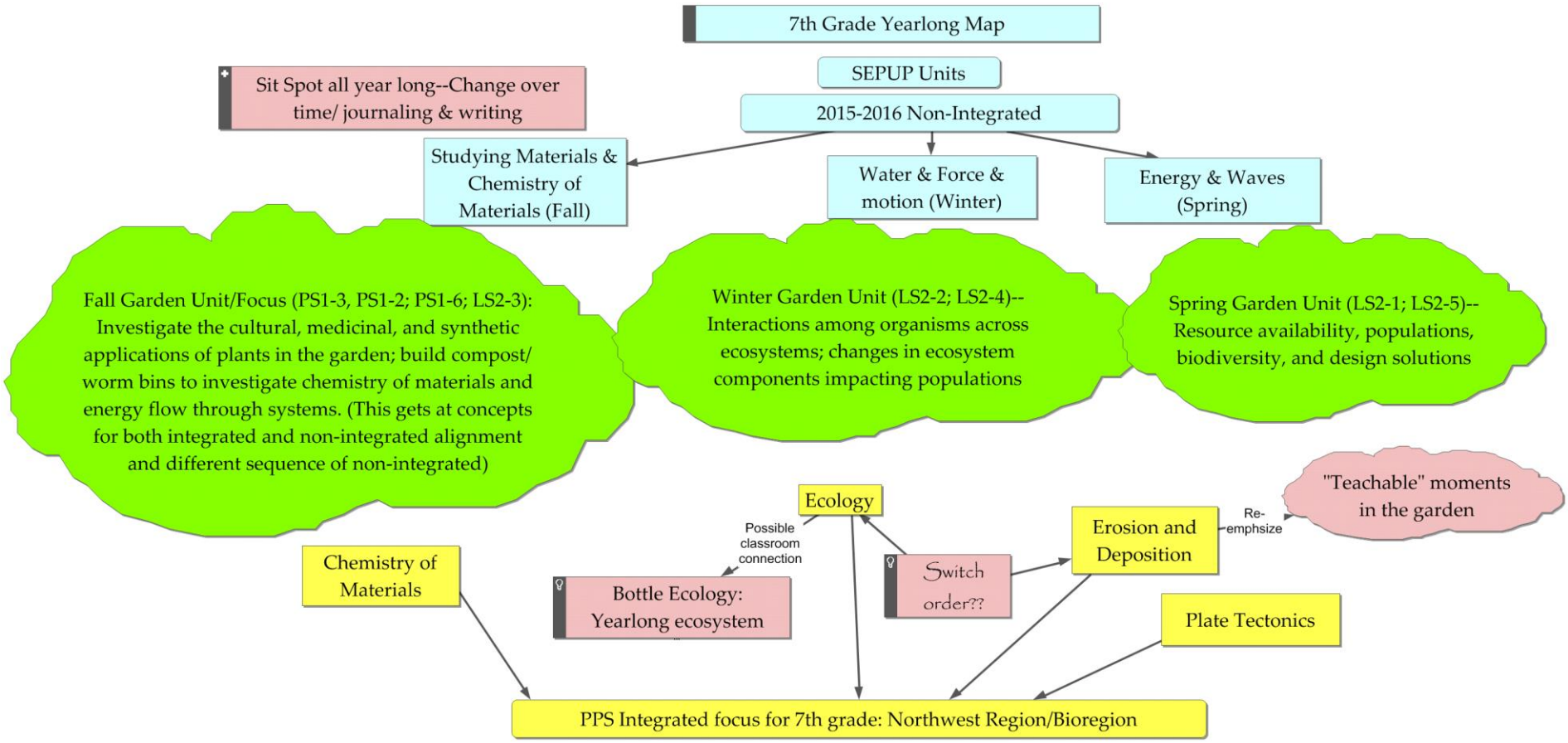
Graduate Assistants: Heather Brule, Garrett Hirsch, Linda Hoppes, Claire Lagerwey, Caitlyn Maceli, Shea Mcwhorter, Katie Rixon, Dana Utroske, Rhea Webb.

PEDAGOGICAL PRINCIPLES



Williams, D. R. & Brown, J. D. (2011). *Learning Gardens and Sustainability Education: Bringing Life to Schools and Schools to Life.* New York, NY: Routledge.


6th Grade Yearlong Map
PPS Integrated Theme: Portland (Portland & Gardens)
PSU is on later start schedule- Starting this unit first will allow kids time to learn some of the concepts that they can apply in the late fall garden design challenge (and they will start with a truncated series of lessons from "Studying People Scientifically")
SEPUP Units
PS3-3; PS3-4; PS3-5
ESS2-5; ESS2-6, ESS3-5
Energy (Fall)
Cell Biology & Disease (Winter)
Body Works (Winter)
Weather & Atmosphere (Spring)
Structure & function
Gap in SEPUP: ESS2-4 (Water cycle) & ESS3-3 (minimizing human impacts): Great opportunity to bridge classroom and garden. In spring, water cycle lesson can be included during long-term investigation.
Enrichment: LS1-4: Plant/ Animal interactions/ reproductive success
Enrichment: LS1-1 & LS1-2--plant cells; and LS1-3-cells and systems: Perhaps take specimens to class (microscope investigations? other?)
Enrichment/Classroom connection:Fall (LS1-1; LS1-2): Structure & Function of plants: Compare & contrast plants and bodies (in-class connections)
First design iterations in classroom? Could make and test prototypes, monitoring temperature changes, moisture loss, etc (tie in water cycle (ESS2-4)
Possible classroom connection?
Garden Unit (Late Fall): Energy Engineering Design Challenge: How can we grow more food through the winter? (PS3-4; PS3-5)
Supplementing ESS3-5; ESS2-5; and ESS2-6 (look at guiding questions in Framework
Collect weather data all year long (all grades/all classes); input into Google sheets--use for data analysis and claim making in spring
Enrichment for winter/spring (LS3.2) Asexual & Sexual reproduction--May just be a thread in the garden all year as students try a variety of propagation techniques
Enrichment: LS1-8: Sensory stimuli (e.g. sunflowers)
Environmental & Genetic factors (LS1-5): Introduce in fall while harvesting; 1st investigation could be in conjunction with Eng. Des. Challenge in winter; Spring, apply new understandings in garden/spring plantings (investigation)


7th Grade Yearlong Map
SEPUP Units
2015-2016 Non-Integrated
Sit Spot all year long--Change over time/ journaling & writing
Studying Materials & Chemistry of Materials (Fall)
Water & Force & motion (Winter)
Energy & Waves (Spring)
Fall Garden Unit/Focus (PS1-3, PS1-2; PS1-6; LS2-3): Investigate the cultural, medicinal, and synthetic applications of plants in the garden; build compost/ worm bins to investigate chemistry of materials and energy flow through systems. (This gets at concepts for both integrated and non-integrated alignment and different sequence of non-integrated)
Winter Garden Unit (LS2-2; LS2-4)-- Interactions among organisms across ecosystems; changes in ecosystem components impacting populations
Spring Garden Unit (LS2-1; LS2-5)-- Resource availability, populations, biodiversity, and design solutions
"Teachable" moments in the garden
Re-emphsize
Ecology
Possible classroom connection
Erosion and Deposition
Chemistry of Materials
Bottle Ecology: Yearlong ecosystem
Switch order??
Plate Tectonics
PPS Integrated focus for 7th grade: Northwest Region/Bioregion

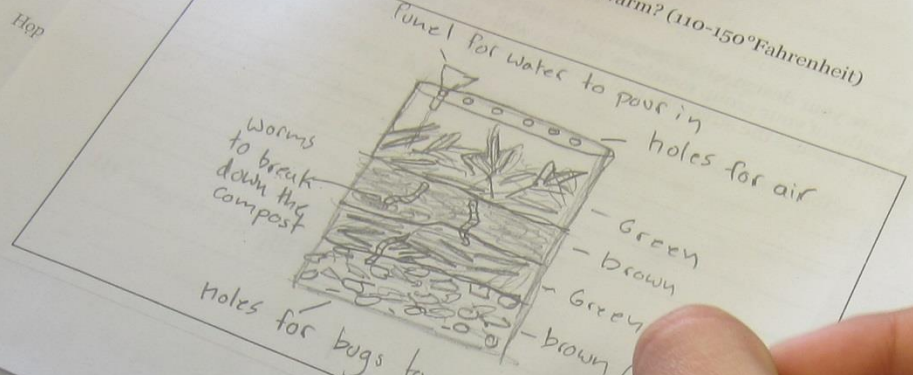
Per: 3

your own words.

Will you use
How will you mix air
How will you water your
How will you help your
How will helpful bugs get in?

you use?
your container?
ompost?
t?
stay warm? (110-150°Fahrenheit)

Solution #1



Hop

¡Esperamos ver lo ahí!

Estaremos atrás, en el lado norte de la escuela, por el campo grande de futbol.

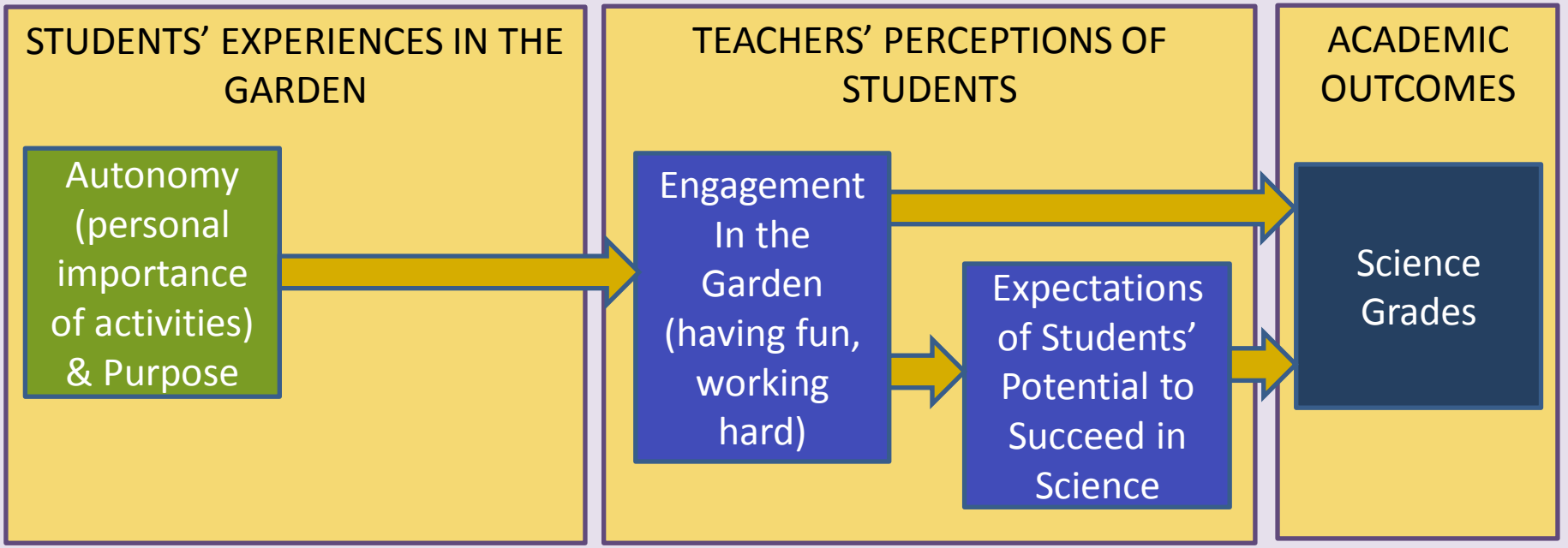
Habrá café y bocadillos

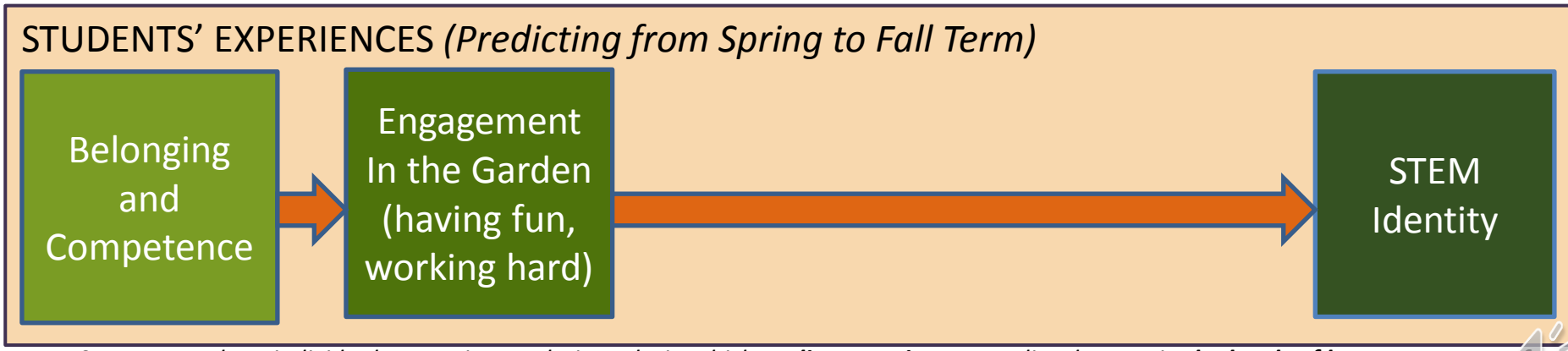
Sábado, 7 de noviembre de 9am- 12pm

Lent SUN Community School is a collaboration of Multnomah County Department of Human Services, the City of Portland Parks & Recreation, the Portland Public Schools District and IRCO.

GARDENS AS A MOTIVATIONAL MILIEU

(Predicting from Winter to Spring Term)





*n = 104. Arrows show individual regression analysis paths in which **earlier experiences** predict changes in **the levels of later outcomes,** after **controlling for the prior effects of those outcome** variables. Survey items used 1-5 scale where higher levels showed stronger agreement with statements. Science grades were converted to a standard 4.0 scale. Mean of Autonomy & Purpose = 4.08, SD = 81. Mean of Belonging & Competence = 3.77, SD,. 77.*

Student voices

What do you feel?

“I feel safe at the Learning Gardens.”

“It releases stress from me. I feel really happy.”

“No one (is) judging me for who I am. It is a circle of life, of friendship.”

“It's like I'm a member. I'm home. I'm safe. I'm comfortable.”

“I feel smart. I feel like a better learner.”

Student voices

“It's hands-on (with) plants. You actually get to touch them, see them, when we learn about plants. There's fresh air. At school, we just sit on our butt on our desk and write. It's more interesting here. We get to walk around and learn stuff. We get to get dirty.”