DIFFERENTIATING FOR DIVERSITY:
USING UNIVERSAL DESIGN FOR LEARNING IN COMPUTER SCIENCE EDUCATION

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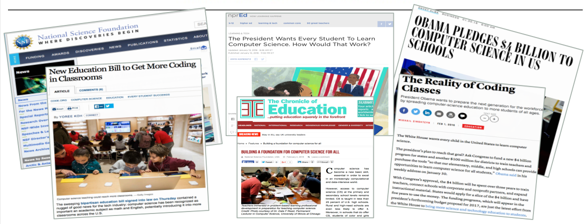
Computer Science for ALL

In the coming years, we should build on that progress, by … offering every student the hands-on computer science and math classes that make them job-ready on day one.
- President Obama in his 2016 State of the Union Address



National Science Foundation
WHERE DISCOVERIES BEGIN

New Education Bill to Get More Coding in Classrooms

By YOREE KOH

Computer science teaching could reach more classrooms. —Getty Images

The sweeping bipartisan education bill signed into law on Thursday contained a nugget of good news for the tech industry: computer science has been recognized as important an academic subject as math and English, potentially introducing it into more classrooms across the U.S.

nprEd

The President Wants Every Student To Learn Computer Science. How Would That Work?

The Chronicle of Education
...putting education squarely in the forefront

BUILDING A FOUNDATION FOR COMPUTER SCIENCE FOR ALL

Computer science has become a new basic skill, essential in order to excel in an increasingly computational and data-intensive world.

However, access to computer science (CS) at the primary and secondary school levels remains limited. CS is taught in less than 25 percent of U.S. high schools. Rural and high-need schools are even less likely to offer it. Moreover, in schools that do offer CS, students of color and girls

Teachers immersed in problem-based learning professional development in preparation for teaching computer science. Credit: Photo courtesy of Dr. Dale F. Reed, Permanent Lecturer in Computer Science, University of Illinois at Chicago

OBAMA PLEDGES $4 BILLION TO COMPUTER SCIENCE IN US SCHOOLS

The Reality of Coding Classes

President Obama wants to prepare the next generation for the workforce by spreading computer-science education to more students of all ages.

MIKHAIL ZINSHTEYN | FEB 1, 2016 | EDUCATION

The White House wants every child in the United States to learn computer science.

The president's plan to reach that goal? Ask Congress to fund a new $4 billion program for states and another $100 million for districts to train teachers and purchase the tools "so that our elementary, middle, and high schools can provide opportunities to learn computer science for all students," Obama said in his weekly address on January 30.

With Congress's approval, the $4 billion will be spent over three years to train teachers, connect schools with corporate and nonprofit partners, and expand instructional material. States would apply for a slice of the $4 billion and have five years to use the money. The funding programs, which will appear in the president's forthcoming budget proposal for 2017, are just the latest effort from the White House to bring more science and technology education to students.

What does FOR ALL really mean?

How do we actively support students who do not *already* have opportunities to learn computer science.

Populations left out:
Schools without computer labs or devices
No one is qualified to teach CS
Students unable to use mouse or keyboard
Visual impairments
Hearing impairments
ADHD
Autistic students

What does FOR ALL really mean?

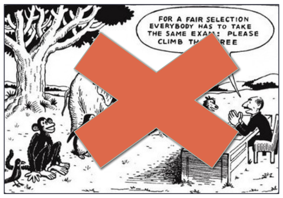
How do we actively support students who do not *already* have opportunities to learn computer science.

This includes, but is not limited to:

- Students learning English
- Students from underrepresented minority groups
- Students with learning differences
  (and/or diagnosed learning disabilities)
- Students below grade level
- Students raised in low-income families
- Without regular access to technology
- With low motivation or perseverance

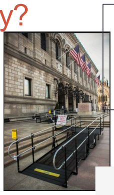
Differentiation

"A **flexible approach** to teaching in which the teacher plans and carries out **varied approaches** to **content**, **process**, and **product** in anticipation of and **in response to student differences** in readiness, interests, and learning needs" (Tomlinson 2001)


FOR A FAIR SELECTION EVERYBODY HAS TO TAKE THE SAME EXAM: PLEASE CLIMB THE TREE

What happens when you design for equity?

Highlights the need to design aspects of instruction that are:
-**Necessary** for SOME,
-**Beneficial** for ALL, and
-**Not detrimental** to ANY.



icons8.com

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Ways to Differentiate for ALL Students

1. **Universal Design for Learning (UDL)**

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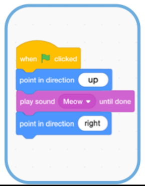

```
when 🏁 clicked
point in direction up
play sound Meow ▾ until done
point in direction right
```

Ways to Differentiate for ALL Students

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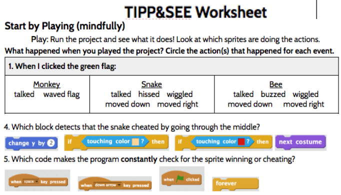

TIPP&SEE Worksheet

Start by Playing (mindfully)

Play: Run the project and see what it does! Look at which sprites are doing the actions.

What happened when you played the project? Circle the action(s) that happened for each event.

1. When I clicked the green flag:		
Monkey talked waved flag	Snake talked hissed wiggled moved down moved right	Bee talked buzzed wiggled moved down moved right

4. Which block detects that the snake cheated by going through the middle?

change y by 2 | if touching color ? then | if touching color ? then | next costume

5. Which code makes the program **constantly** check for the sprite winning or cheating?

when space key pressed | when down arrow key pressed | when 🏁 clicked | forever

Ways to Differentiate for ALL Students

1. **Universal Design for Learning (UDL)** → Highlights the need to design aspects of instruction that are:
-**Necessary** for SOME,
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2. **Accommodations** → Changes that allow students to complete the **same task** as others, but **in a different manner**.

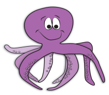
3. **Modifications** → Changes that involve a significant **adjustment** to the task based on **individual student need.**

KELP-CS

Kids Engaged in Learning Programming & Computer Science

Purpose

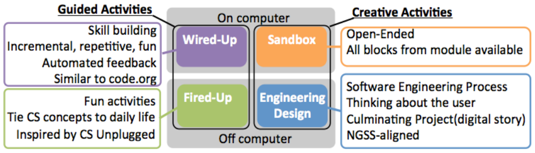
1. Teach **computational thinking, programming, and engineering design** in upper elementary classes during the academic day.
   - Programming Environment: La Playa
   - Module 1: Digital Storytelling
   - Module 2: Game Design
2. Develop and test **learning progressions** about how students engage with and learn computer science.
   - Algorithms, knowledge of computers, programming, thinking about the user, data and abstraction.



The Curriculum (Grades 4 – 6)

Module 1
Digital Storytelling

Module 2
Game Design



Guided Activities

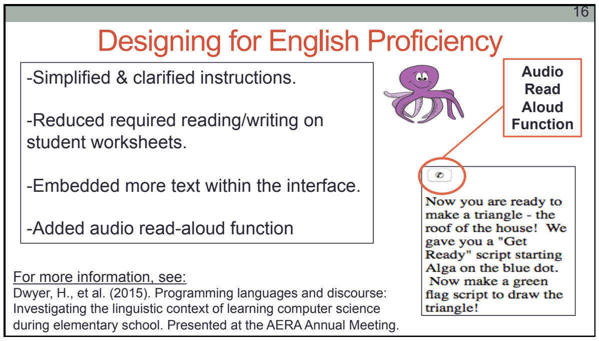
Skill building
Incremental, repetitive, fun
Automated feedback
Similar to code.org

Fun activities
Tie CS concepts to daily life
Inspired by CS Unplugged

Creative Activities

Open-Ended
All blocks from module available

Software Engineering Process
Thinking about the user
Culminating Project(digital story)
NGSS-aligned



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Designing for English Proficiency

-Simplified & clarified instructions.

-Reduced required reading/writing on student worksheets.

-Embedded more text within the interface.

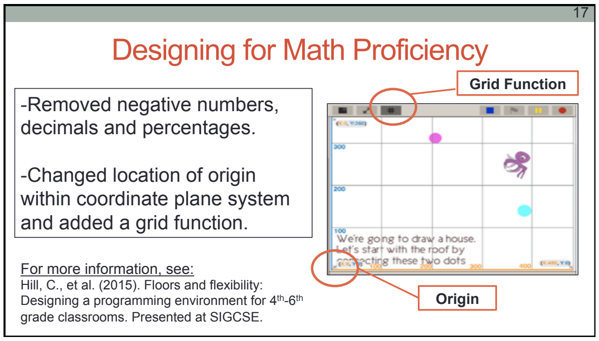
-Added audio read-aloud function

Audio Read Aloud Function

Now you are ready to make a triangle - the roof of the house! We gave you a "Get Ready" script starting Alga on the blue dot. Now make a green flag script to draw the triangle!

For more information, see:

Dwyer, H., et al. (2015). Programming languages and discourse: Investigating the linguistic context of learning computer science during elementary school. Presented at the AERA Annual Meeting.



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Designing for Math Proficiency

-Removed negative numbers, decimals and percentages.

-Changed location of origin within coordinate plane system and added a grid function.

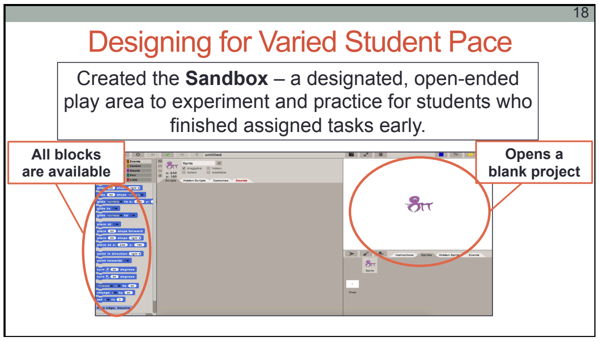
Grid Function

Origin

We're going to draw a house. Let's start with the roof by connecting these two dots

For more information, see:

Hill, C., et al (2015). Floors and flexibility: Designing a programming environment for 4th-6th grade classrooms. Presented at SIGCSE.



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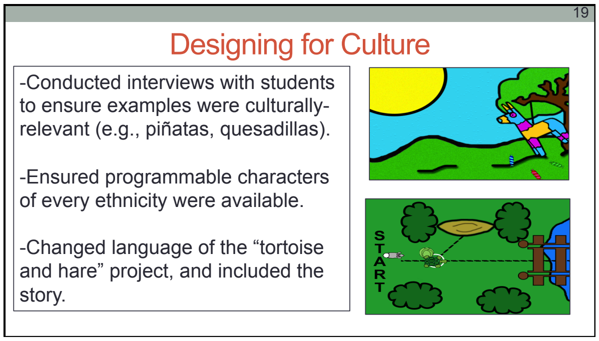
Designing for Varied Student Pace

Created the **Sandbox** – a designated, open-ended play area to experiment and practice for students who finished assigned tasks early.

All blocks are available

Opens a blank project



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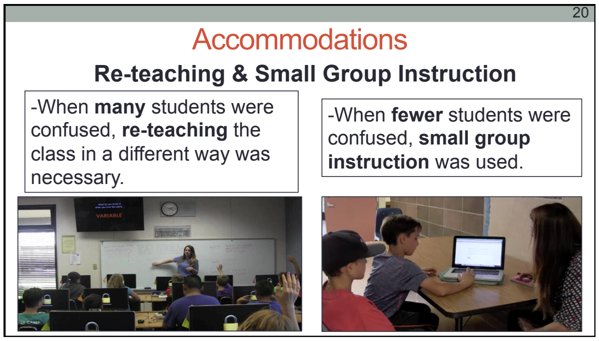
Designing for Culture

-Conducted interviews with students to ensure examples were culturally-relevant (e.g., piñatas, quesadillas).

-Ensured programmable characters of every ethnicity were available.

-Changed language of the “tortoise and hare” project, and included the story.



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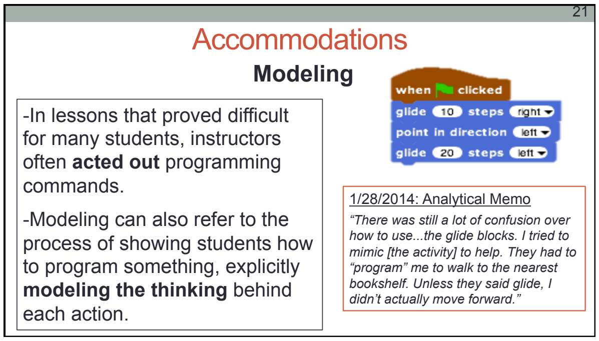
Accommodations

Re-teaching & Small Group Instruction

-When **many** students were confused, **re-teaching** the class in a different way was necessary.

-When **fewer** students were confused, **small group instruction** was used.



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Accommodations

Modeling

-In lessons that proved difficult for many students, instructors often **acted out** programming commands.

-Modeling can also refer to the process of showing students how to program something, explicitly **modeling the thinking** behind each action.

```
when clicked
glide 10 steps right
point in direction left
glide 20 steps left
```

1/28/2014: Analytical Memo

“There was still a lot of confusion over how to use...the glide blocks. I tried to mimic [the activity] to help. They had to “program” me to walk to the nearest bookshelf. Unless they said glide, I didn’t actually move forward.”

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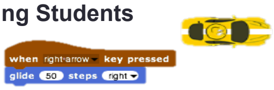
Modifications

For Struggling Students

-The **Sandbox** was also a great differentiation tool for struggling students who needed a break.

-It also allowed teachers to create small, individualized assignments that better aligned to a student's current skill level.



4/30/2015: Teacher Interview

"The Sandbox was great because I could direct my struggling students there. If a student had a difficult time completing the lesson, they could take a break in the Sandbox and play. Or….I could create smaller, personalized assignments in the Sandbox. Instead of making the car go up, down, right, and left with arrow keys, maybe we only try to get the car to move right."

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Modifications

For Advanced Students

-Some students were identified as **computer helpers.**

-These students finished work early and enjoyed helping others.

-They were free to walk around the classroom, helping peers.

Hearing impaired:

- https://www.hearinglikeme.com/hearing-loss-simulator/

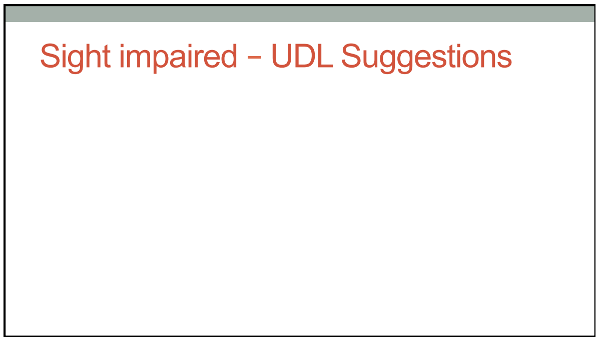
Hearing impaired – UDL Suggestions

Hearing impaired – UDL Suggestions

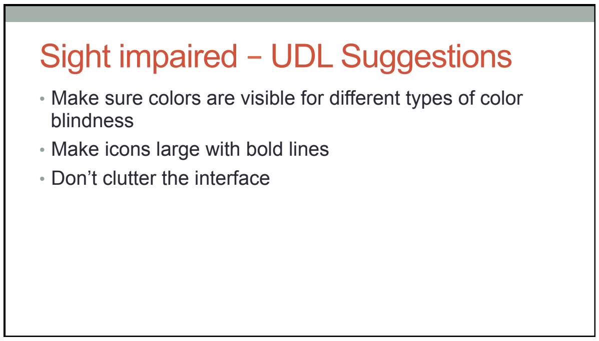
- Don't depend only on music for mood – change coloring or provide other visual cues as context
- Provide text for speech that occurs in game

Sight impaired:

- https://simulator.seenow.org/
- http://www.color-blindness.com/coblis-color-blindness-simulator/

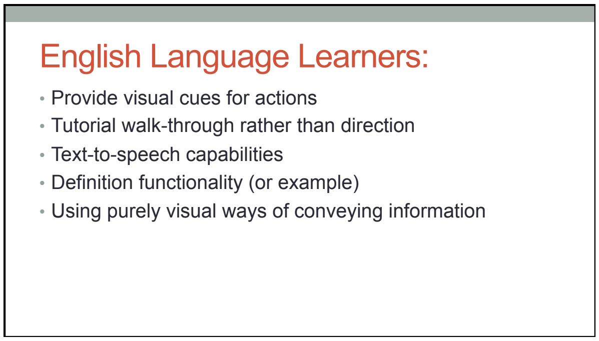


Sight impaired – UDL Suggestions



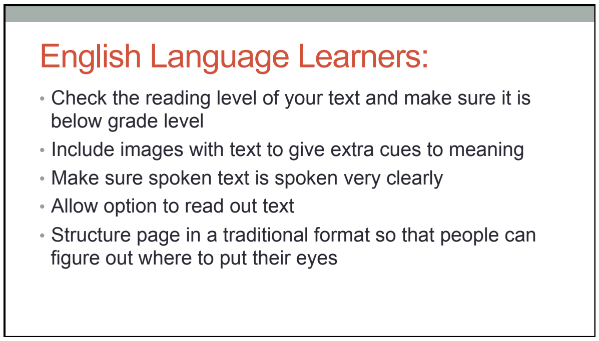
Sight impaired – UDL Suggestions

- Make sure colors are visible for different types of color blindness
- Make icons large with bold lines
- Don't clutter the interface



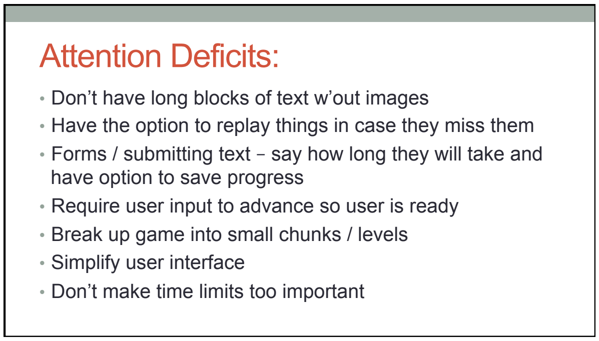
English Language Learners:

- Provide visual cues for actions
- Tutorial walk-through rather than direction
- Text-to-speech capabilities
- Definition functionality (or example)
- Using purely visual ways of conveying information



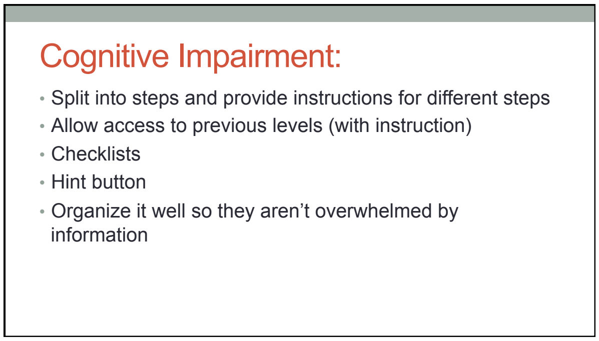
English Language Learners:

- Check the reading level of your text and make sure it is below grade level
- Include images with text to give extra cues to meaning
- Make sure spoken text is spoken very clearly
- Allow option to read out text
- Structure page in a traditional format so that people can figure out where to put their eyes



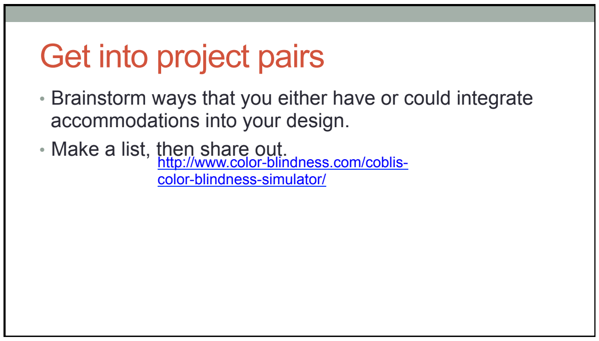
Attention Deficits:

- Don't have long blocks of text w'out images
- Have the option to replay things in case they miss them
- Forms / submitting text – say how long they will take and have option to save progress
- Require user input to advance so user is ready
- Break up game into small chunks / levels
- Simplify user interface
- Don't make time limits too important



Cognitive Impairment:

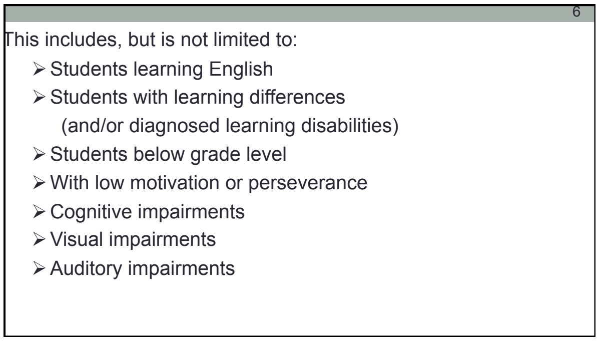
- Split into steps and provide instructions for different steps
- Allow access to previous levels (with instruction)
- Checklists
- Hint button
- Organize it well so they aren't overwhelmed by information



Get into project pairs

- Brainstorm ways that you either have or could integrate accommodations into your design.
- Make a list, then share out.

http://www.color-blindness.com/coblis-color-blindness-simulator/



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- ➢ Students learning English
- ➢ Students with learning differences (and/or diagnosed learning disabilities)
- ➢ Students below grade level
- ➢ With low motivation or perseverance
- ➢ Cognitive impairments
- ➢ Visual impairments
- ➢ Auditory impairments