CSforCA

TRANSFORMING PUBLIC SCHOOLS
UCLA CENTER X

# COMPUTER SCIENCE(CS) + 1 = CONVERGENCE

## 2.2.22

## Integrating Computer Science with Math, Science, & Other Subjects

FEBRUARY 2, 2022

TRANSFORMING PUBLIC SCHOOLS

# UCLA CENTER X


UCLA COMPUTER SCIENCE
EQUITY PROJECT

# CSforCA

COMPUTER SCIENCE FOR CALIFORNIA

# SCALE-CA: Supporting Computing Access, Leadership and Equity in California

## CLASSROOM

### BUILDING CAPACITY FOR EDUCATORS

"Summer of CS" professional learning for teachers, counselors and administrators prototype to be replicated regionally.

## COUNTY/DISTRICT/SCHOOL

### SUPPORTING LEADERSHIP FOR SUSTAINABLE IMPLEMENTATION

CS Equity Guide for Administrators and accompanying workshop

## CAPITOL

### INFORMING POLICYMAKERS FOR SYSTEMATIC REFORM

Evidence-based research to inform policy and amplify voices of CSforCA, a multi-stakeholder coalition.

# INTRODUCTIONS

Sharisa Chan

Jonathan Rhodea

Ed Campos

Roxana Hadad

# INTEGRATION

# INTEGRATION

- Learning and applying a variety of subject matters in a lesson
  - CS can be integrated with other subjects
  - Clarifies how our society and economy work
  - Exposure to professions that use CS

# COMPUTATIONAL THINKING

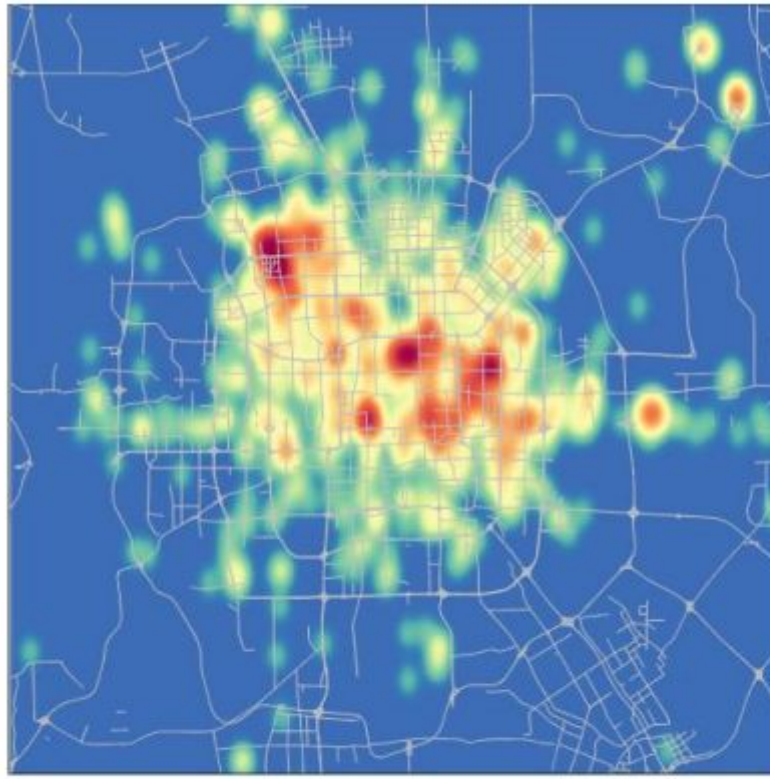

K12 COMPUTER SCIENCE

# SCIENCE AND MATH

- CS the “third pillar of science”
- NGSS Science and Engineering Practices - “using mathematics and computational thinking”
- CCSS math standards: use technology “to explore and deepen [students’] understanding of the concepts”

# NOT JUST STEM

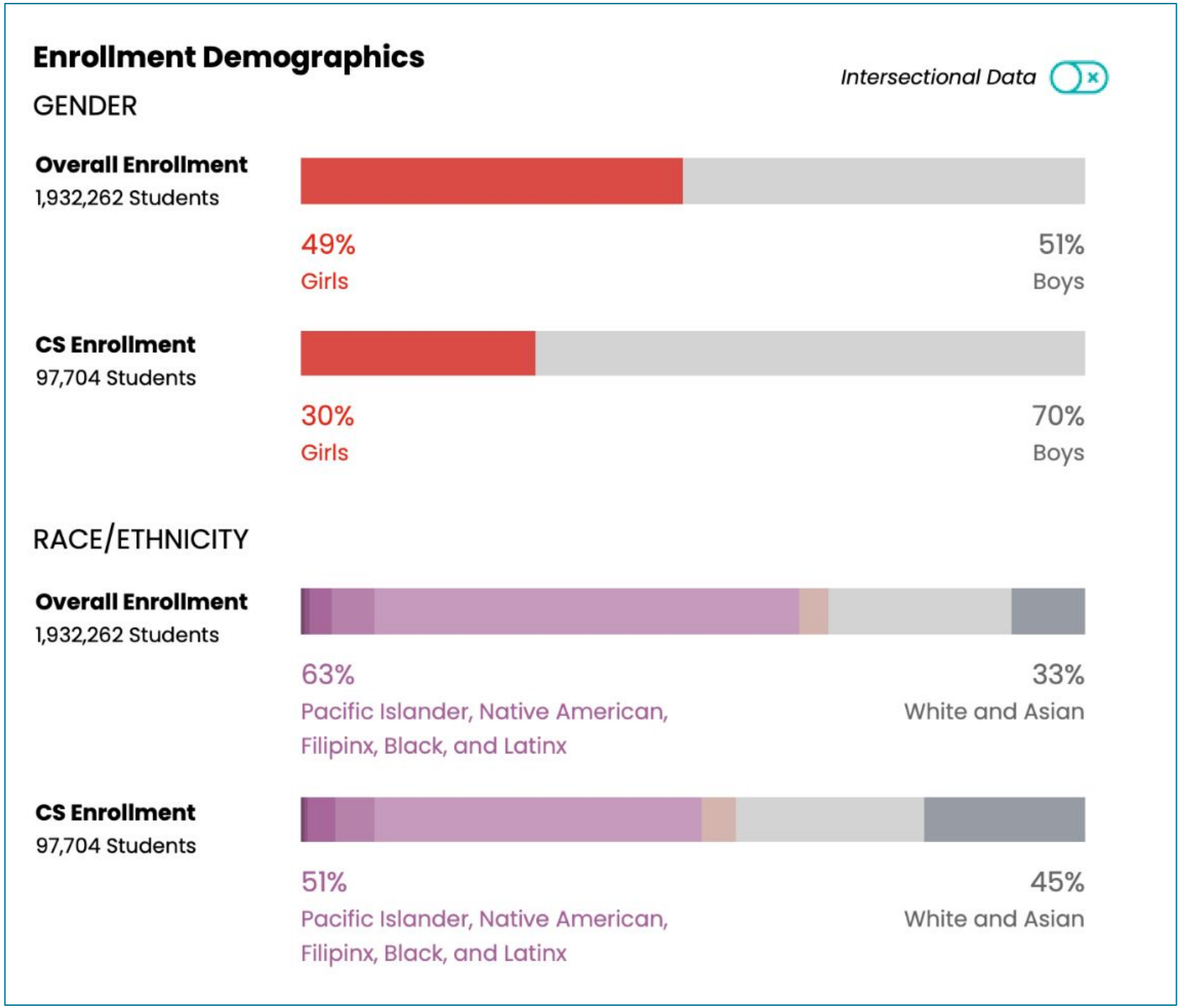
- computational anthropology
- computational journalism
- algorithmic music composition
- digital art and design



Yang et al., 2014
https://arxiv.org/abs/1405.7769

# INTEGRATION FOR EQUITY

- Exposure
- Preparation
- Relevance

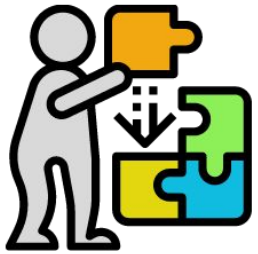


# SHARISA CHAN
# ELEMENTARY

# WHY CS INTEGRATION IN ELEMENTARY CLASSROOM?

CSforCA

- Student agency
- Social Emotional Well-being
- Critical thinking
- Computational thinking
- Smooth Integration
- Engaging
- Exposure
- Standard Alignment



# STANDARD CONNECTIONS

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## California K–12 Computer Science Standards

California Department of Education
August 1, 2018

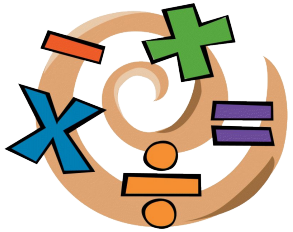
| Grade | Standard Identifier | Standard | Descriptive Statement | Framework Alignment: Concept | Framework Alignment: Subconcept | Framework Alignment: Practice(s) | Framework Alignn Sub- practice(s) |
|---|---|---|---|---|---|---|---|
| 3-5 | 3-5.AP.10 | **Compare and refine multiple algorithms for the same task and determine which is the most appropriate.** | Different algorithms can achieve the same result, though sometimes one algorithm might be more appropriate for a specific solution. Students examine different ways to solve the same task and decide which would be the better solution for the specific scenario.<br><br>For example, students could use a map and create multiple algorithms to model the early land and sea routes to and from European settlements in California. They could then compare and refine their algorithms to reflect faster travel times, shorter distances, or avoid specific characteristics, such as mountains, deserts, ocean currents, and wind patterns. (HSS.4.2.2)<br><br>Alternatively, students could identify multiple algorithms for decomposing a fraction into a sum of fractions with the same denominator and record each decomposition with an equation (e.g., 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8). Students could then select the most efficient algorithm (e.g., fewest number of steps). (CA CCSS for Mathematics 4.NF.3b)<br><br>Additionally, students could compare algorithms that describe how to get ready for school and modify them for supporting different goals including having time to care for a pet, being able to talk with a friend before classes start, or taking a longer route to school to accompany a younger sibling to their school first. Students could then write an opinion piece, justifying with reasons their selected algorithm is most appropriate. (CA CCSS for ELA/Literacy W.3.1, W.4.1, W.5.1) | Algorithms & Programming | Algorithms | Testing, Computational Problems | 6.3, 3.3 |

California K-12 CS Standards[CDE]

Computer Science Education Site [CDE]

# Interdisciplinary Examples

Grades 3-5 Standard: **Compare and refine multiple algorithms for the same task and determine which is the most appropriate.**

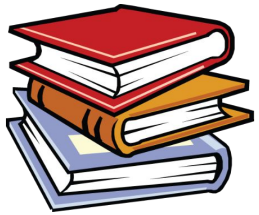


Students could identify multiple algorithms for **decomposing a fraction into a sum of fractions** with the same denominator and record each decomposition with an equation (e.g., 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8). Students could then select the most efficient algorithm (e.g., fewest number of steps).

*CA CCSS for Mathematics 4.NF.3b*

Students could use a map and create multiple algorithms to **model the early land and sea routes to and from European settlements in California**. They could then compare and refine their algorithms to reflect faster travel times, shorter distances, or avoid specific characteristics, such as mountains, deserts, ocean currents, and wind patterns.

*History & Social Studies 4.2.2*



Students could compare algorithms that describe **how to get ready for school** and modify them for supporting different goals including having time to care for a pet, being able to talk with a friend before classes start, or taking a longer route to school to accompany a younger sibling to their school first. Students could then **write an opinion piece**, justifying with reasons their selected algorithm is most appropriate.

*CA CCSS for ELA/Literacy W.3.1, W.4.1, W.5.1*

# SEL CONNECTION

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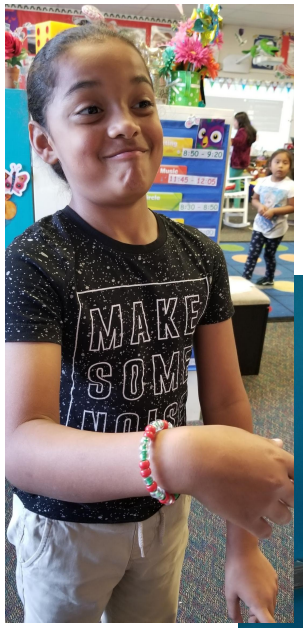
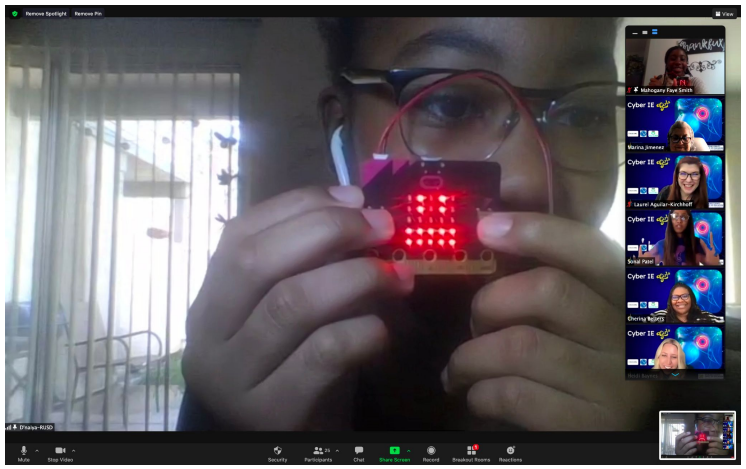


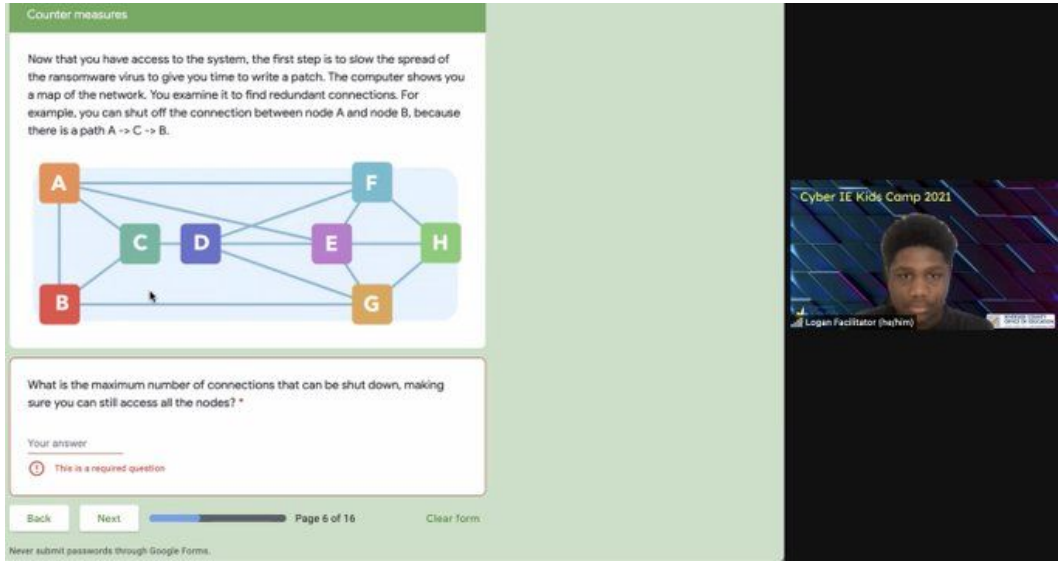

Confidence



Growth Mindset

@HiddenGeniusPro

Team Building

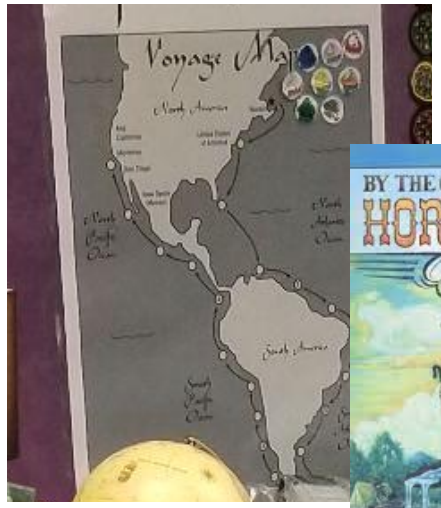


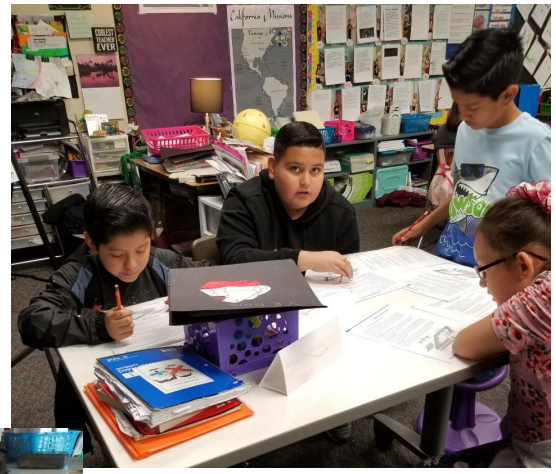

Leadership

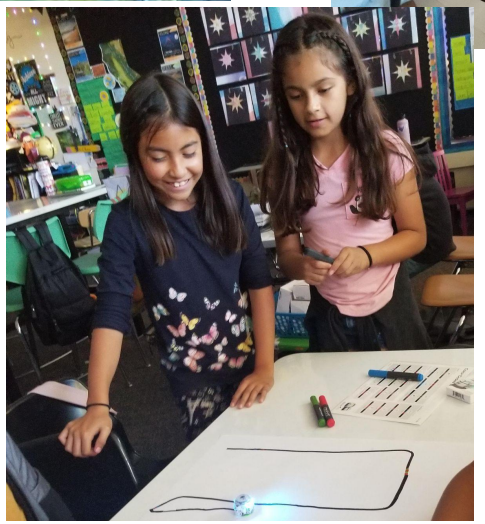
# CALIFORNIA VOYAGERS

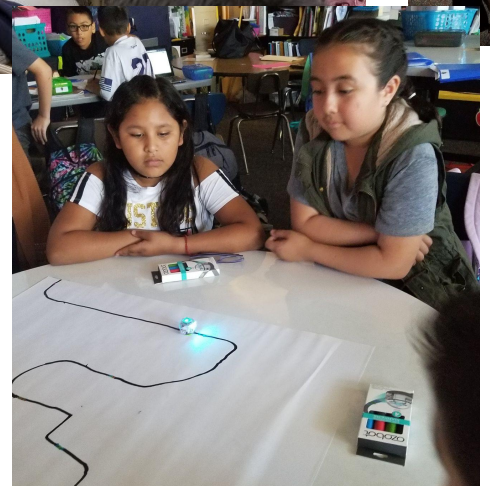
**3.5.AP.10 Compare and refine algorithms for the same task and determine which is the most appropriate.**

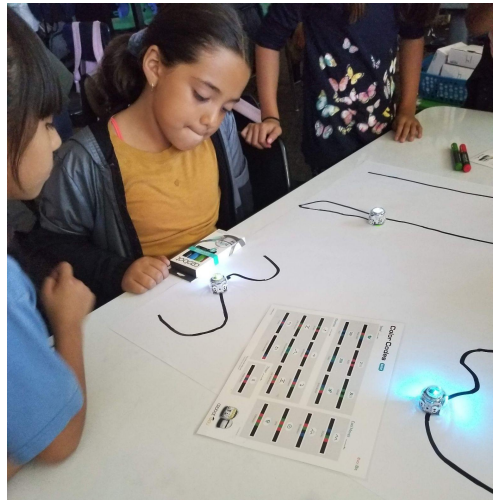
"You are an explorer in Boston and heard all about finding gold in California. What is the best way to California by ship?"



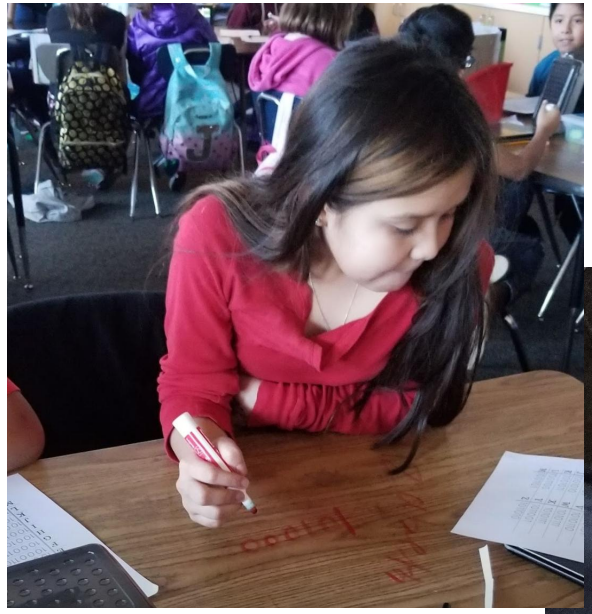


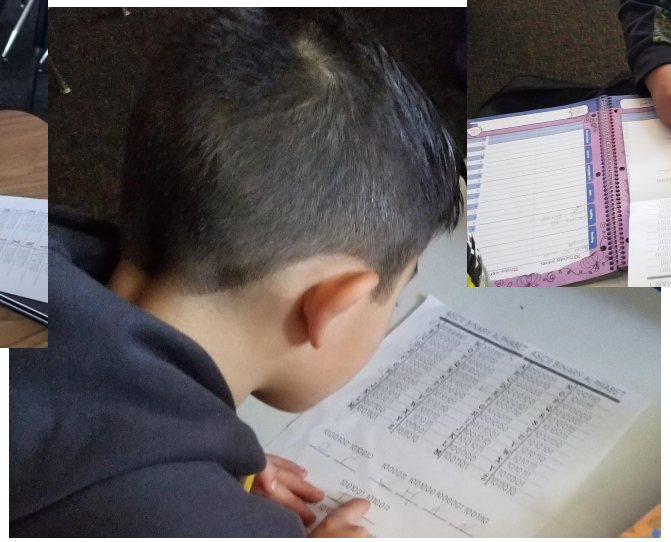


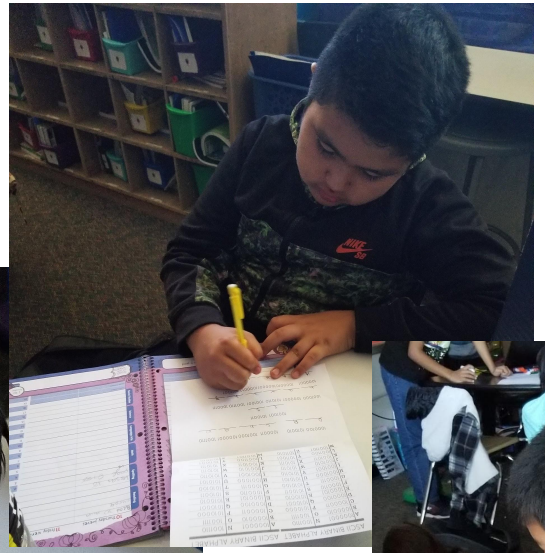


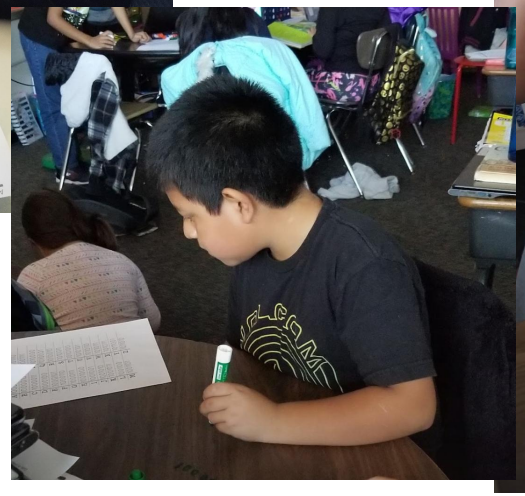
# UNPLUGGED BINARY CODING ACTIVITY

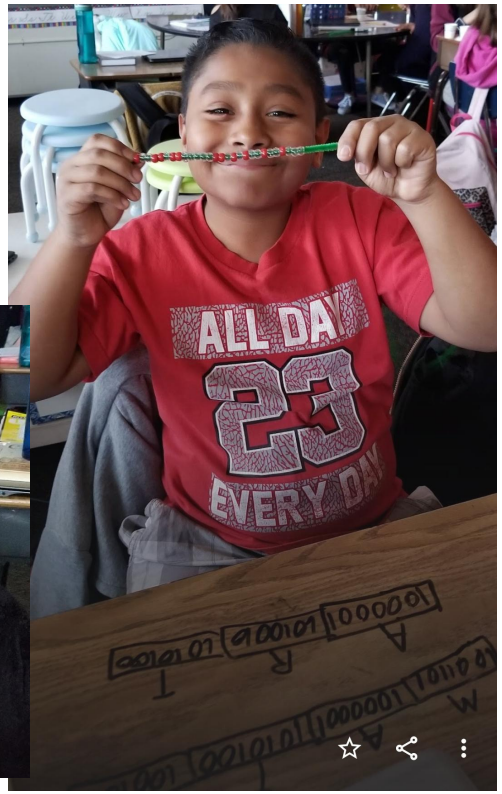
**3-5.NI.6 Create patterns to protect information from unauthorized access (digital citizenship and cyber security connection).**











# CS WITH THE LITTLES

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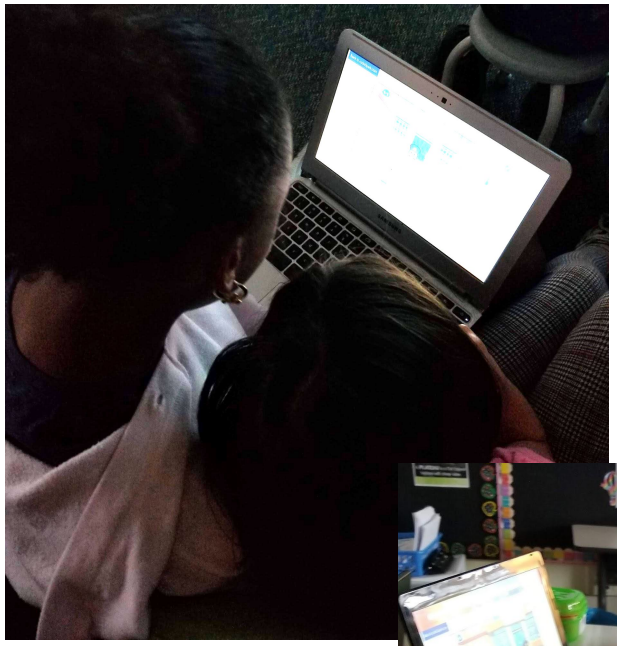
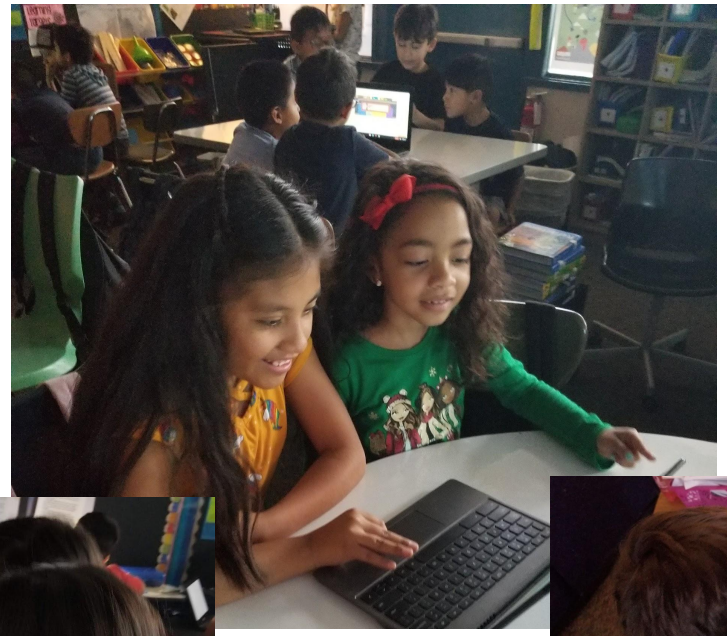




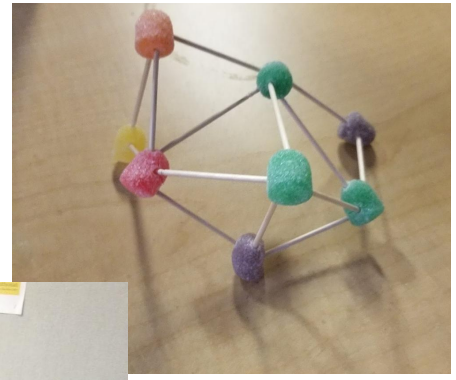
# GETTING STARTED

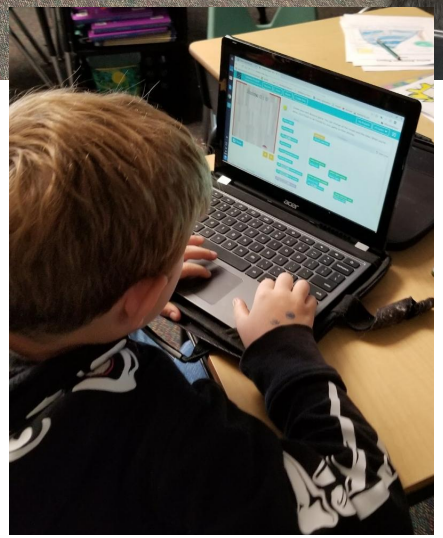
Let the students play!

Test drive it yourself!

Unplugged Coding

You do not have to be an expert…





HOUR OF CODE

# WAKELET

CSforCA


**CLICK HERE**

# JONATHAN RHODEA MIDDLE SCHOOL

# INTEGRATION VERSUS CONVERGENCE

- **Integration lesson** - takes a subject matter with select grade level standards and matches up another subject matter with particular grade level standards that seem to dovetail and uses these combined standards to make a lesson.
- **Convergence lesson** - chooses a real world phenomenon to explore as the focus of the lesson and the standards that happen to be touched on are made relevant through exploration and understanding of the phenomenon.

# ANCHOR PHENOMENON: Low Tech Solutions to Real World Problems

- This exploration activity was originally designed for teacher professional development for NGSS to learn about the practice Model with Mathematics
- Teachers who attended the training used it in their 6th grade science classrooms
- The lesson/activity has evolved over time as I continue to try to improve it, feel free to continue to improve it to fit your students

# EXPLORATORY PHENOMENON: The Wello Water Wheel

- **Engage:** What problem does this solve?
- **Explore through a 3-Reads Activity:** What question would a (career field professional) ask about (low tech solution)
- **Explain:** Use modeling with mathematics to support a suggestion to improve the low tech solution

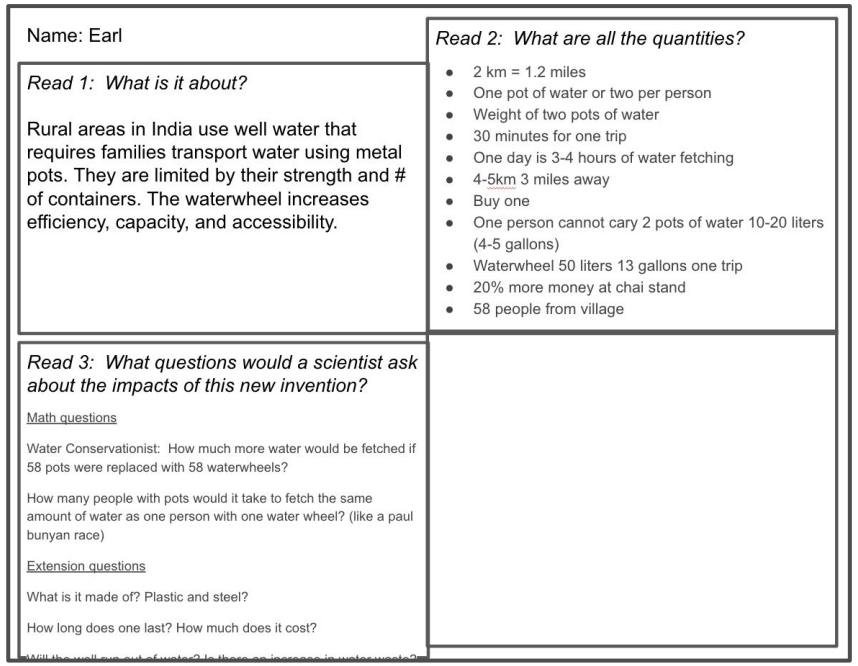
Click Picture for Video!

# 3-READS STRATEGY PEDIGREE

ELA Common Core Reading Strategy called Close Reading

Close Reading Strategy for Mathematics and Maybe Science: 3-Read Protocol

Foldable/virtual Foldable Link



Name: Earl

*Read 1: What is it about?*

Rural areas in India use well water that requires families transport water using metal pots. They are limited by their strength and # of containers. The waterwheel increases efficiency, capacity, and accessibility.

*Read 2: What are all the quantities?*

- 2 km = 1.2 miles
- One pot of water or two per person
- Weight of two pots of water
- 30 minutes for one trip
- One day is 3-4 hours of water fetching
- 4-5km 3 miles away
- Buy one
- One person cannot cary 2 pots of water 10-20 liters (4-5 gallons)
- Waterwheel 50 liters 13 gallons one trip
- 20% more money at chai stand
- 58 people from village

*Read 3: What questions would a scientist ask about the impacts of this new invention?*

Math questions

Water Conservationist: How much more water would be fetched if 58 pots were replaced with 58 waterwheels?

How many people with pots would it take to fetch the same amount of water as one person with one water wheel? (like a paul bunyan race)

Extension questions

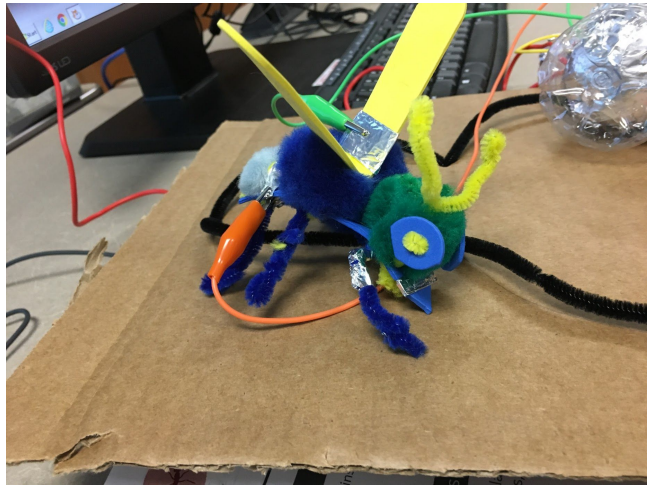
What is it made of? Plastic and steel?

How long does one last? How much does it cost?

# EXPLAIN: Using Interactive Devices

Using Makey Makey and SCRATCH as a tool for communication can enhance students ability to explain concepts.

For Wello Water Wheel we had students create an interactive map of the village that communicated their ideas for adding to the low tech solution making it a more high tech solution.



# STANDARDS

## Building Toward NGSS Performance Expectation(s):

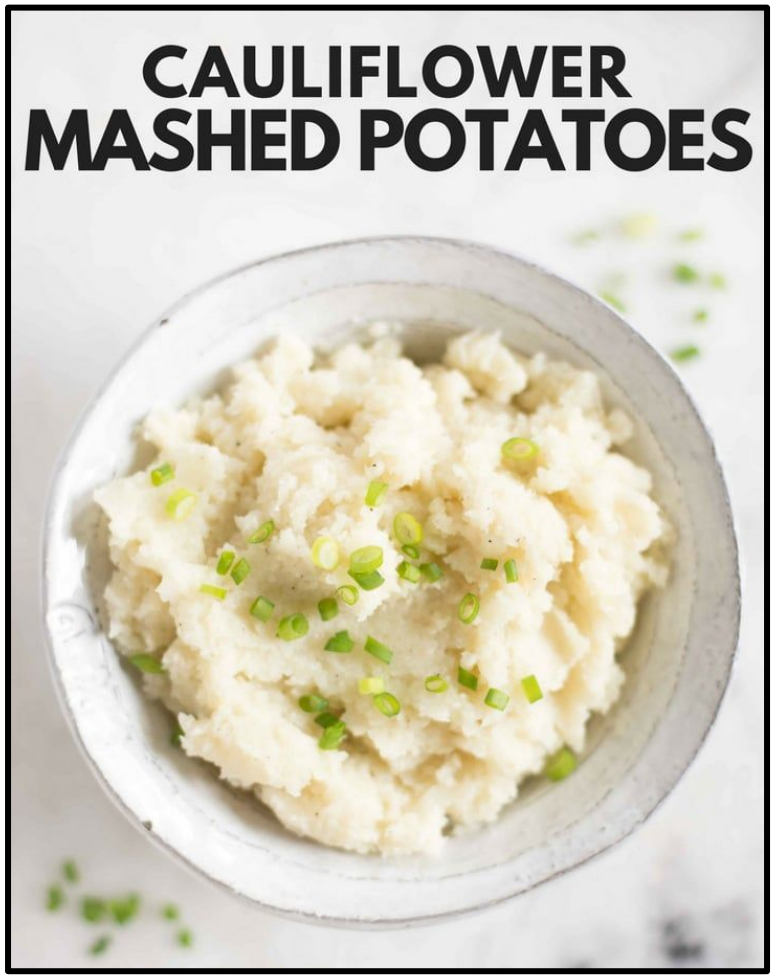
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

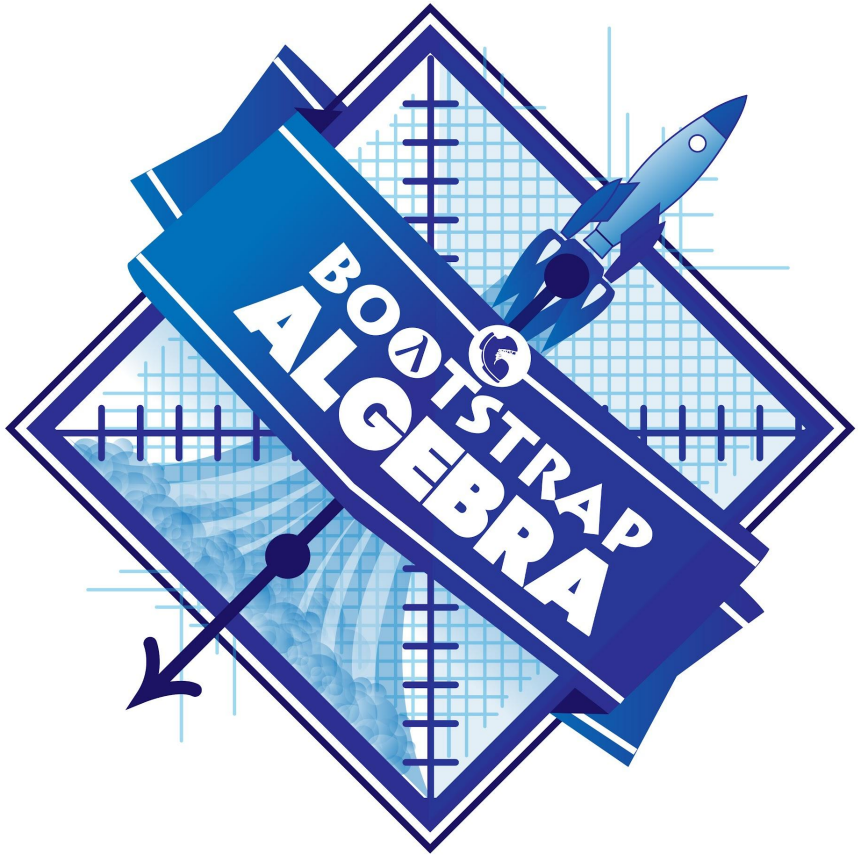
CSforCA

# ED CAMPOS HIGH SCHOOL

# CS INTEGRATION IS...



# CS INTEGRATION WITH MIDDLE & H.S. MATHEMATICS




Programming Video Games using Algebra

# WHAT'S MATH GOT TO DO WITH IT?

Coordinate Plane
Order of Operations
Functions(Interpreting/Building)
Domain/Range
Compound Inequalities
Piecewise Functions
Distance Formula
Pythagorean Theorem
Transformational Geometry
Function Composition

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"I want to create the headache where math is the aspirin."

Dan Meyer,
Director of Research, Desmos

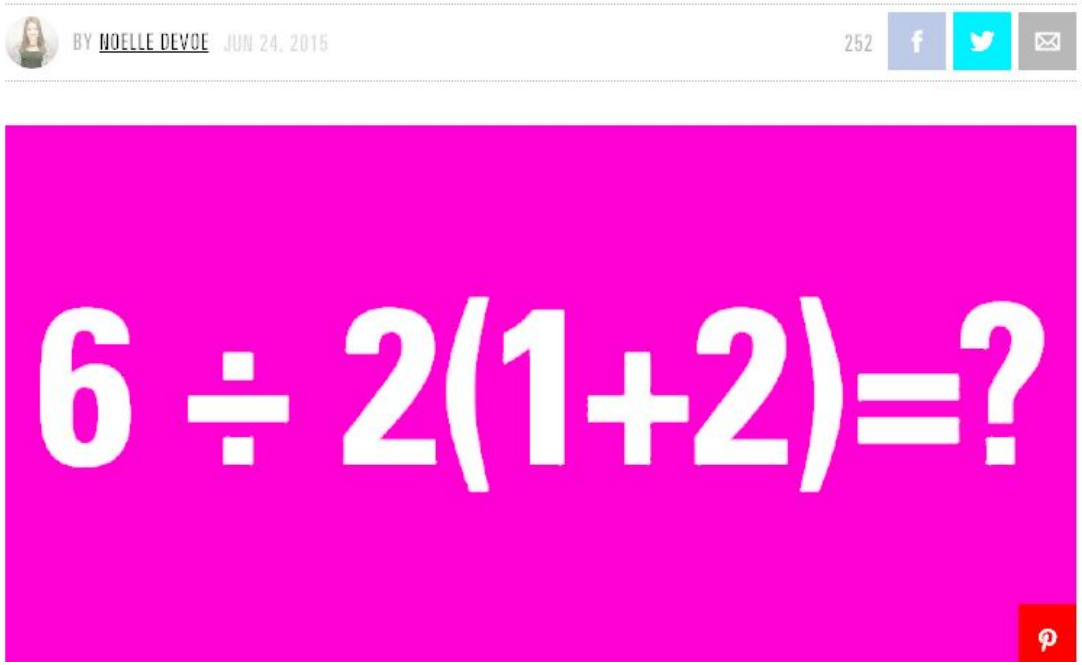
CSforCA

"I want to create the headache where math & CS is the aspirin."

-Bootstrap Teachers

# 5 Grade School Math Problems That Are So Hard, You'll Wonder How You Ever Made it To High School

How can they be so easy and so not at the same time?!



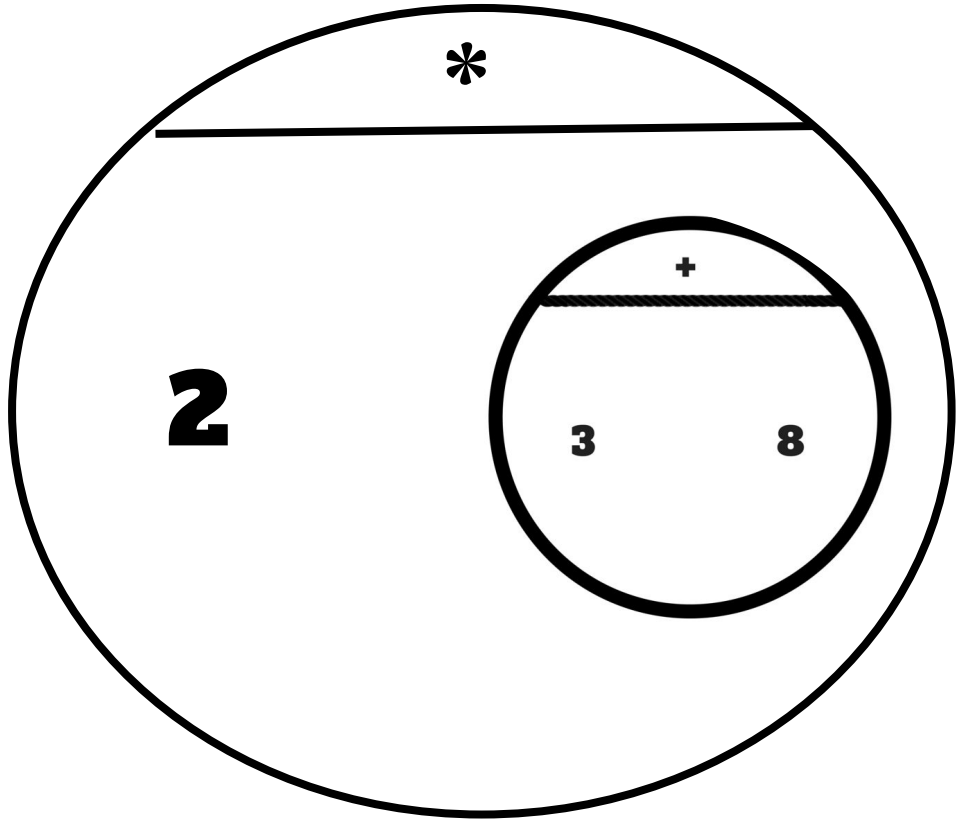

BY NOELLE DEVOE JUN 24, 2015 252

MORE FROM SCHOOL & CAMPUS LIFE

23 Yearbook Quotes That Are Funny AF

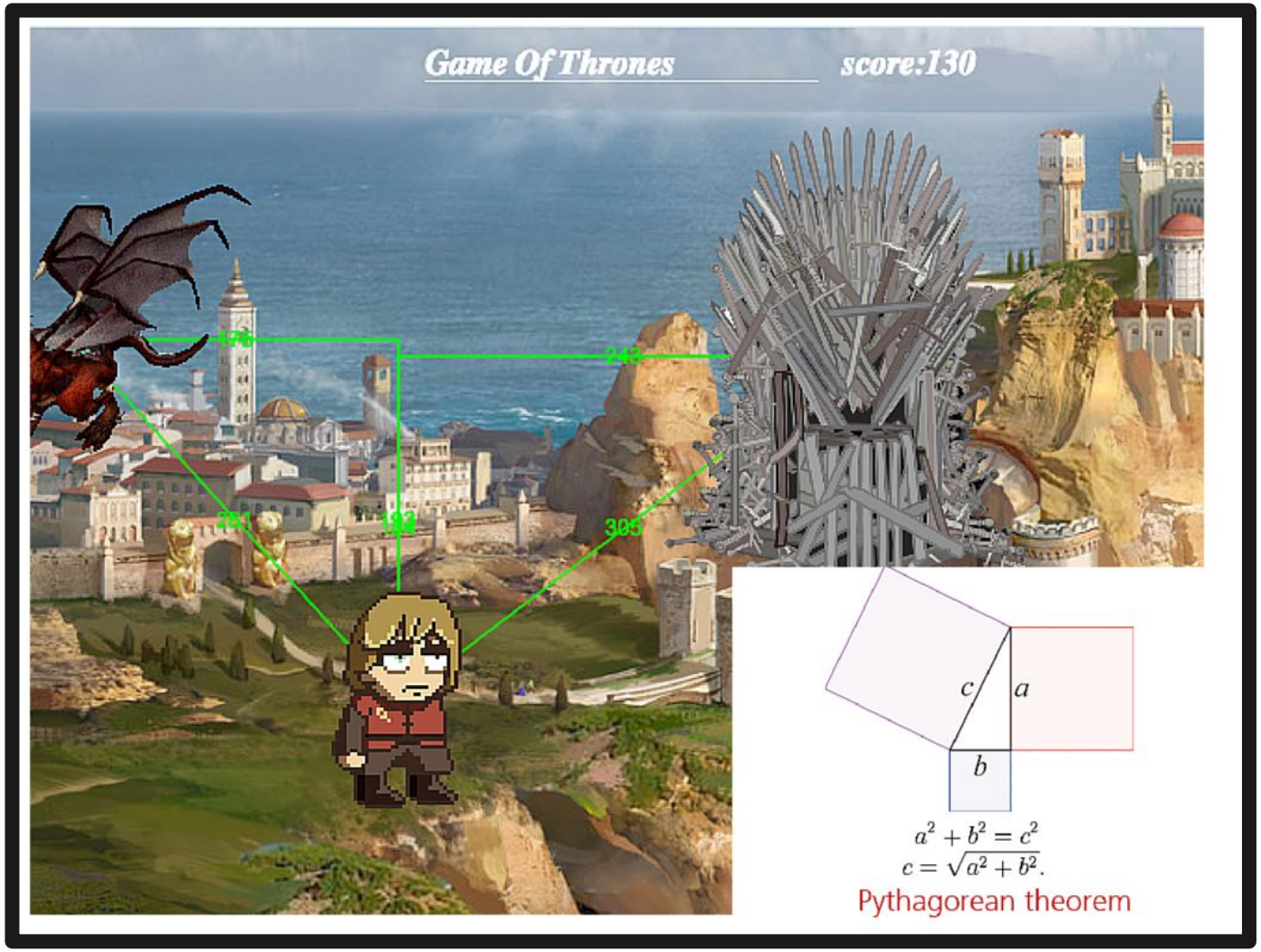
Expression → $2*(3+8)$

Circle Of Evaluation →




Code → (* 2 (+ 3 8))

# PYTHAGOREAN THEOREM/DISTANCE FORMULA



# Choose Your Own Adventure

# QUESTIONS FOR THE PANEL

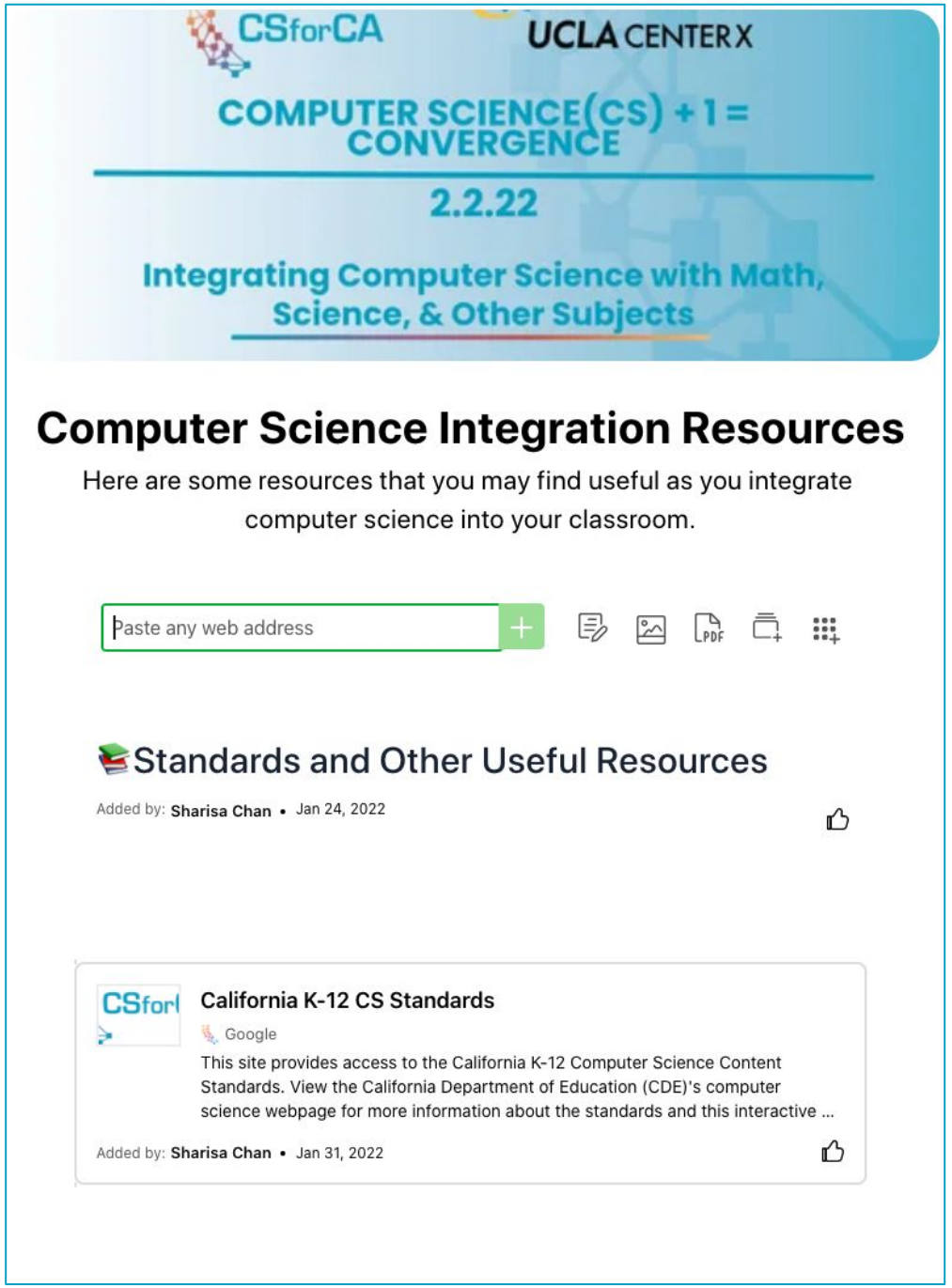
# Q&A

# CHECKLIST - HOW TO START

- ❑ Download briefs from CSforCA.org
- ❑ Follow CSforCA on Twitter and sign up for newsletter
- ❑ Check out the CSforCA Equity Dashboard
- ❑ Register for the Summer of CS
- ❑ Explore resources on the wakelet

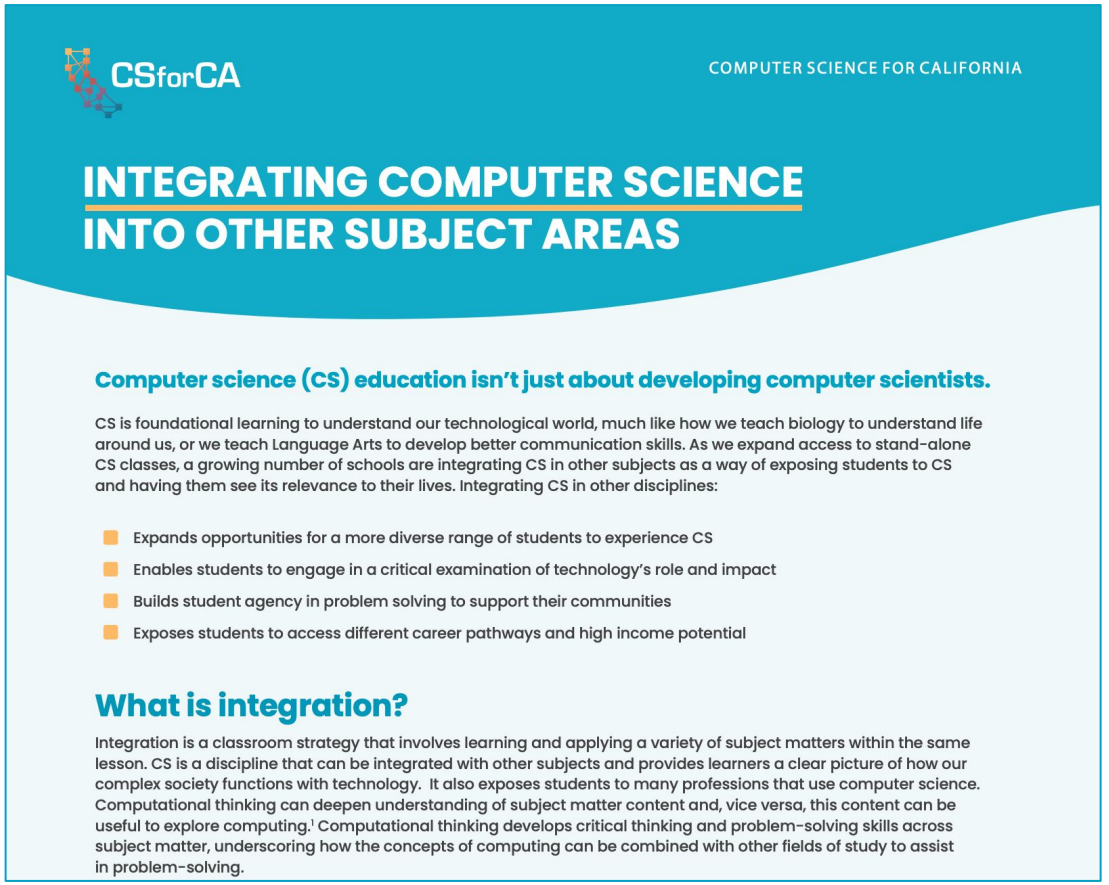
# MORE INFORMATION

- Wakelet



# MORE INFORMATION

- CSforCA.org - Resource page
  - Integrating Computer Science Into Other Subject Areas
  - What Is Computational Thinking and What Does It Have To Do With K-12 Education?



CSforCA

COMPUTER SCIENCE FOR CALIFORNIA

## INTEGRATING COMPUTER SCIENCE INTO OTHER SUBJECT AREAS

**Computer science (CS) education isn't just about developing computer scientists.**

CS is foundational learning to understand our technological world, much like how we teach biology to understand life around us, or we teach Language Arts to develop better communication skills. As we expand access to stand-alone CS classes, a growing number of schools are integrating CS in other subjects as a way of exposing students to CS and having them see its relevance to their lives. Integrating CS in other disciplines:

- Expands opportunities for a more diverse range of students to experience CS
- Enables students to engage in a critical examination of technology's role and impact
- Builds student agency in problem solving to support their communities
- Exposes students to access different career pathways and high income potential

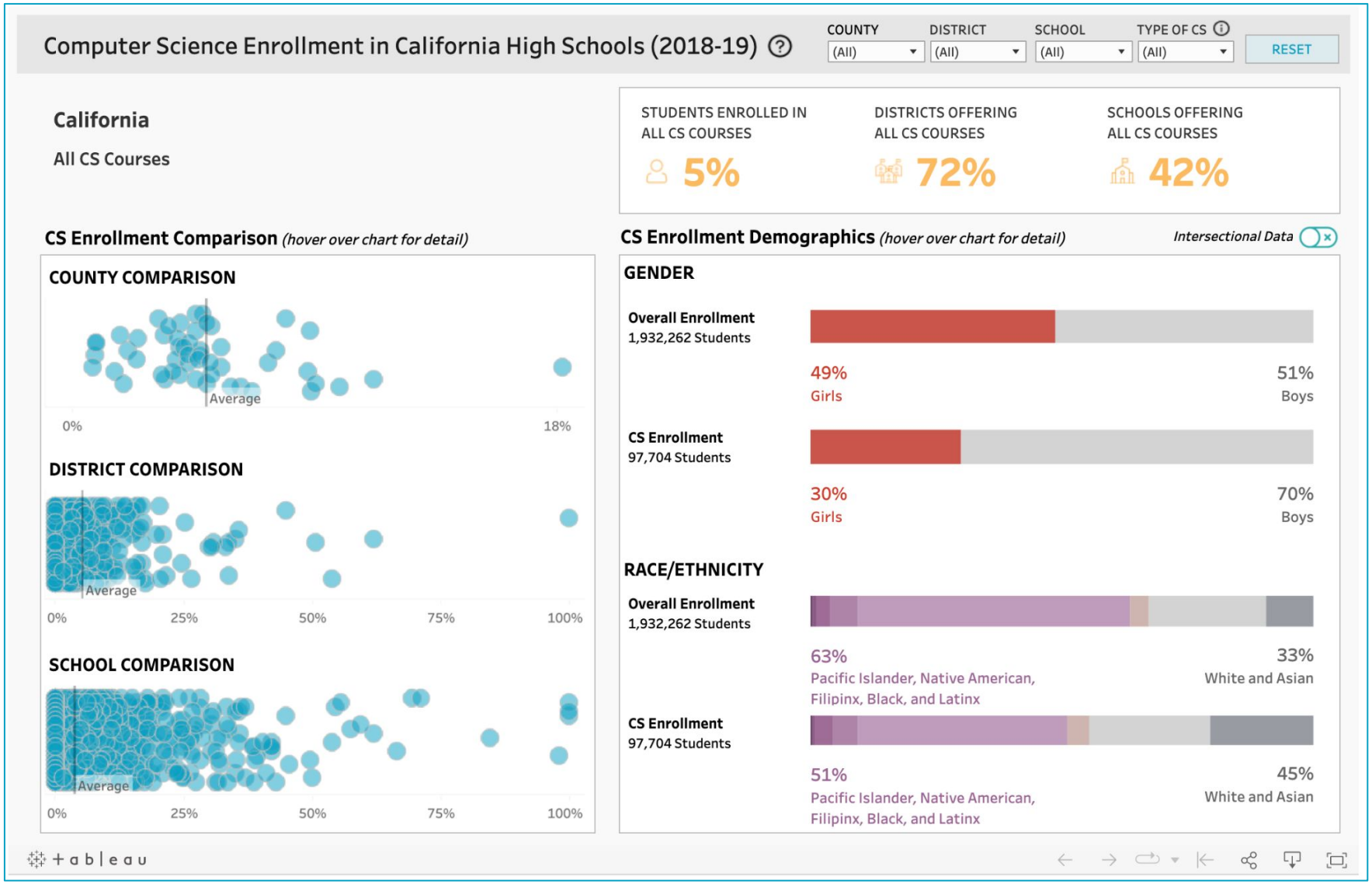
### What is integration?

Integration is a classroom strategy that involves learning and applying a variety of subject matters within the same lesson. CS is a discipline that can be integrated with other subjects and provides learners a clear picture of how our complex society functions with technology. It also exposes students to many professions that use computer science. Computational thinking can deepen understanding of subject matter content and, vice versa, this content can be useful to explore computing.[1] Computational thinking develops critical thinking and problem-solving skills across subject matter, underscoring how the concepts of computing can be combined with other fields of study to assist in problem-solving.

# FOLLOW US!

- @CSforCA
- www.CSforCA.org

# CSforCA CS EQUITY DASHBOARD



# SUMMER OF CS

**California Middle School and High School Math Teachers:**

Interested in taking a "deep dive" into CS + math integration? Register for the Bootstrap: Algebra and Data Science Workshop (June 13-17, 9:00 AM-3:30 PM PT)


# THANK YOU!

csforca.org
@csforca

**Sharisa Chan**
Sharisa.Chan@sbcss.net
@ChanSharisa

**Jonathan Rhodea**
jrhodea@scoe.net

**Ed Campos**
edward.campos@kingscoe.org
@edcampOSjr

**Roxana Hadad**
rhadad@ucla.edu
@rhadad