

Ákos Lédeczi, Brian Broll

Tiffany Barnes and Shuchi Grover

#1949472

Beyond CS Principles:
Engaging Female High School
Students in New Frontiers of Computing

NSF ITEST PI Meeting
September 2021

CSF

Computer Science Frontiers

<http://csfrontiers.org>



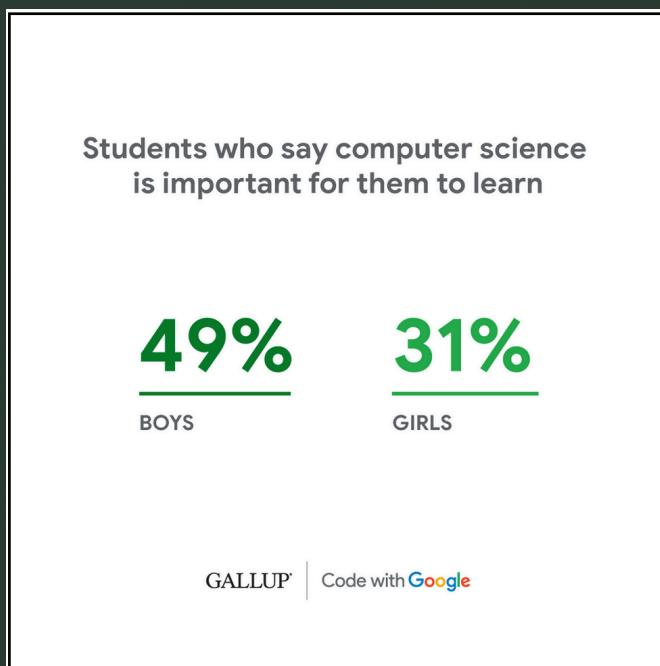
VANDERBILT
UNIVERSITY®

NC STATE
UNIVERSITY

LOOKING
GLASS VENTURES



Broaden Female Participation in Computing



	Males	Females
AP CS-A	52,752	17,767
AP CSP	76,955	39,570
AP Calc AB	134,174	132,062
AP Calc. BC	74,211	53,559

Challenge

- Life after AP CSP?
 - AP CSA:
 - Introductory college-level computer science course (Java)
 - Reputation for being dry and unengaging
 - Popular *only* among students who plan to major in CS or have a fair amount of prior coding experience
 - What can students take after their interest in CS have been raised by AP CSP?

Advanced Computing Utilized Daily

- Distributed Computing
- Computer Networking
- Cybersecurity
- Internet of Things
- Cloud Computing
- Machine Learning



Questions

- Can we teach the underlying advanced computing concepts in high school?
- Can we make the curriculum engaging and appealing especially to girls?

Selecting the Right Tool

The screenshot shows the NetsBlox website interface. At the top, there's a navigation bar with links like 'NetsBlox', 'Try Now', 'QuickStart', 'Resources', 'Community', 'RoboScape', and 'Phonelot'. A user profile icon indicates the session is 'Paused'.

The main content area features a large green banner titled 'Collaborative' which says: "Work with your friends sharing the same workspace or have your own two programs play each other; it's your choice." Below this, there's a description of what NetsBlox is: "NetsBlox is a visual programming language and cloud-based environment that enables novice programmers to create networked programs such as multi-player games. Its visual notation is based on Scratch and it uses the open source JavaScript code base of Snap! NetsBlox opens up the internet with its vast array of public domain scientific and other data sources making it possible to create STEM projects, such as displaying seismic activity anywhere on Earth using an interactive Google Maps background. Similarly, weather, air pollution, and many other data sources such as the Open Movie Database and the Sloan Digital Sky Server are available. NetsBlox also supports collaborative editing similar to Google Docs."

Below the description, there are five preview cards:

- StreetViewMap**: Shows a street view of a city intersection.
- Star Map**: Shows a star map with a central galaxy and coordinate axes.
- Hidden Figures**: Shows three historical figures: Dorothy Johnson Vaughan, Mary Jackson, and Katherine Johnson.
- CastShow**: Shows a search bar with a placeholder and a clear button.
- COVID-19Daily**: Shows a map of North America with COVID-19 data points and arrows indicating trends.

Opening up Snap! to the internet opens up a world of possibilities...

Two Simple Abstractions

- Remote Procedure Calls (RPC)
 - RPC runs on the server
 - Related RPCs are grouped into services (Google Maps, Movie DB, Climate, Cloud Variables, Chart, etc.)
 - A single self-documenting block:



- Message Passing
 - Send data to other NetsBlox projects running anywhere on the internet
 - Two configurable blocks:



Low Floor

HawaiiCO2 - NetsBlox editor.netsblox.org/?

NetsBlox

Motion
Looks
Sound
Pen
Network
Control
Sensing
Operators
Variables
Custom

Sprite dragabble

Scripts Costumes Sounds Room

when I receive [send msg to]
send msg to [and wait
send response

call CloudVariables /
run CloudVariables /
error
all role names
role name
Make a message type
Make a block

when green flag clicked
switch to costume
call Chart / draw
call MaunaLoaCO2Data / getCO2Trend 1960 2020
list list title Atmospheric CO2 Concentrations <> list ylabel ppm <> <>

Atmospheric CO2 Concentrations

ppm

400
380
360
340
320

1960 1970 1980 1990 2000 2010 2020

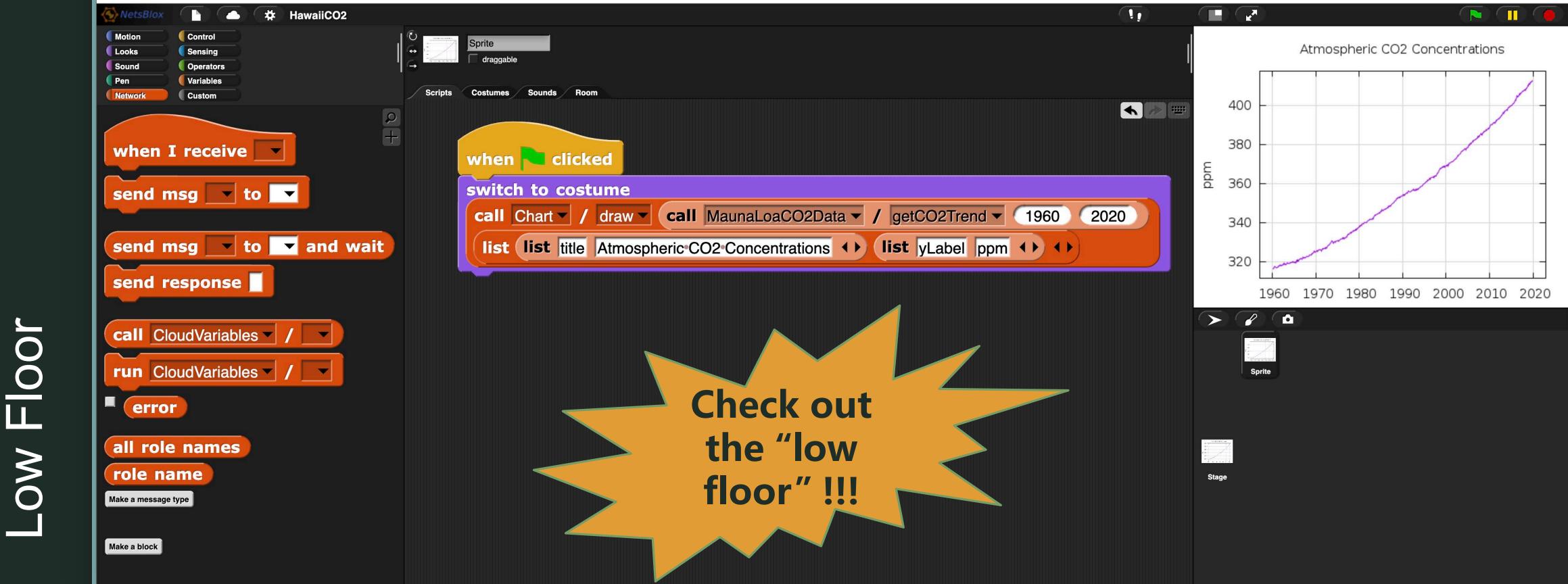
Check out the “low floor” !!!

call MaunaLoaCO2Data / getCO2Trend startyear endyear

call Chart / draw lines options

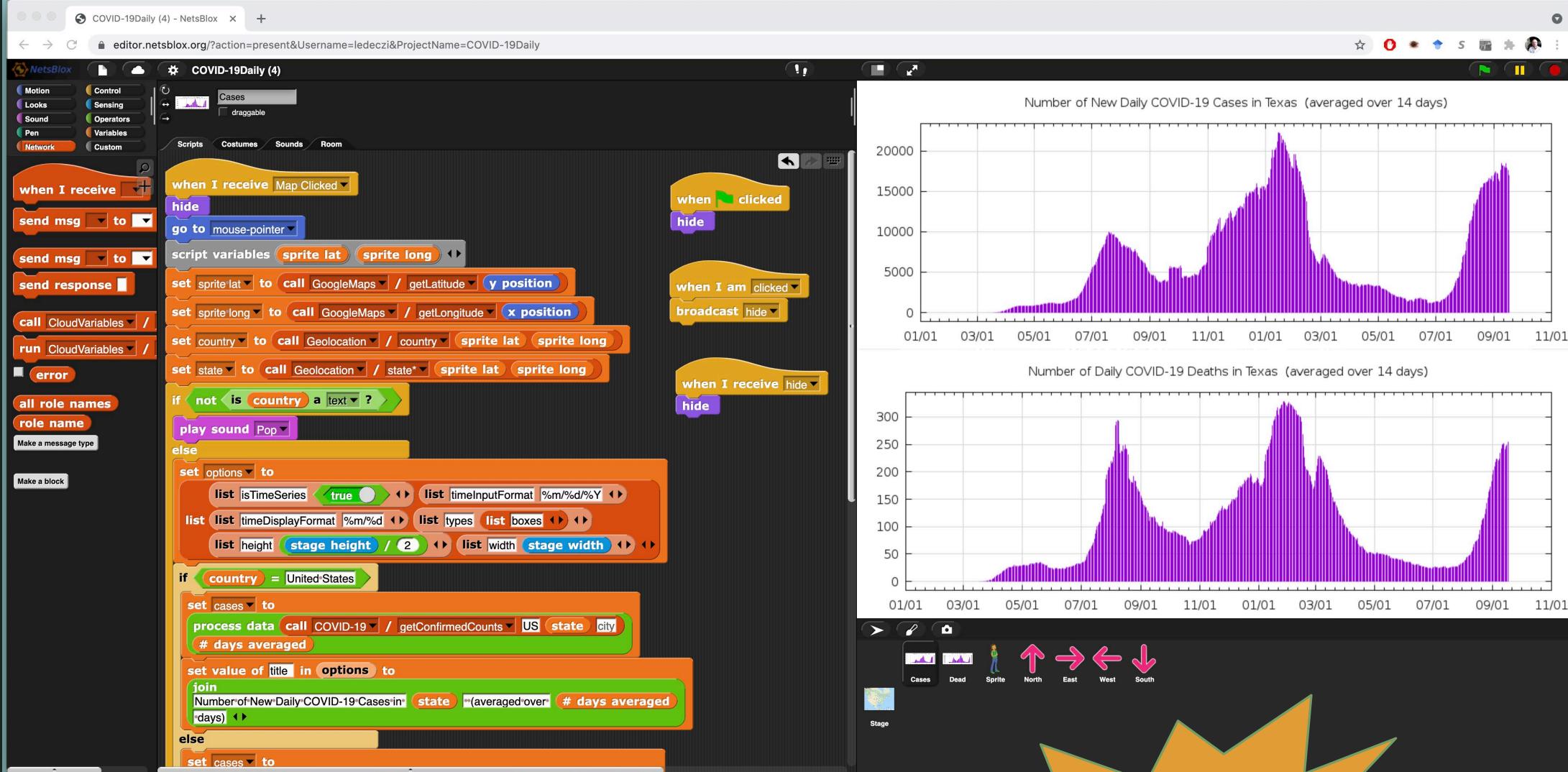
Sprite

Stage



The screenshot shows a Scratch-like programming environment titled "HawaiiCO2 - NetsBlox". On the left, a sidebar lists various blocks categorized by color: Motion (orange), Looks (yellow), Sound (purple), Pen (green), Network (blue), Control (red), Sensing (teal), Operators (light blue), and Variables (pink). The main workspace contains a script for a "Sprite" named "Chart". The script starts with a "when green flag clicked" hat block, followed by a "switch to costume" block. Inside the costume switch, there is a "call" block for "MaunaLoaCO2Data" with the sub-command "getCO2Trend" and arguments "1960" and "2020". Below this, there is another "call" block for "Chart" with the sub-command "draw" and a "list" block. The "list" block has a "title" of "Atmospheric CO2 Concentrations", a "ylabel" of "ppm", and two "list" arrows indicating it's a scrollable list. A large orange starburst graphic with the text "Check out the ‘low floor’ !!!" is overlaid on the workspace. In the bottom right corner, there is a preview window showing a line graph titled "Atmospheric CO2 Concentrations" with the y-axis labeled "ppm" ranging from 320 to 400 and the x-axis labeled with years from 1960 to 2020. The graph shows a clear upward trend in CO2 levels over time.

High Ceiling



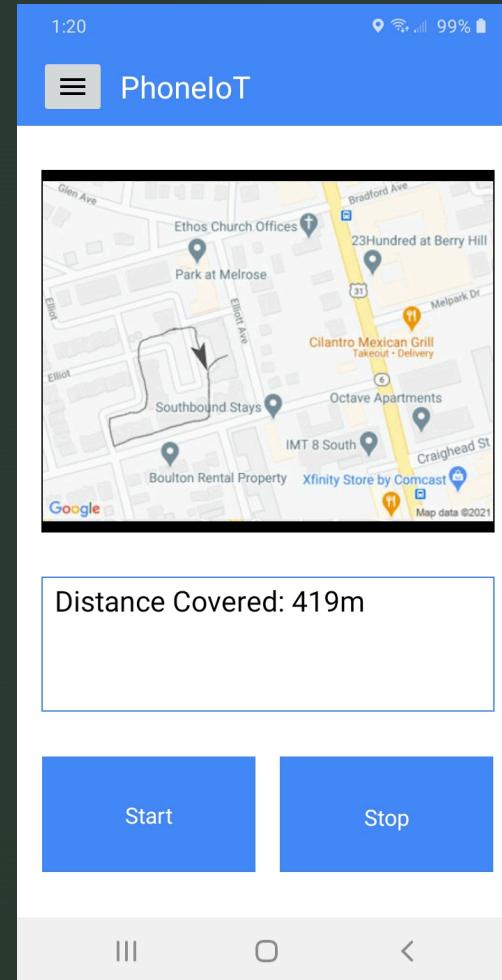
- Interactive map of the World
- Click on any country or state
- Process and plot COVID-19 data

Check out
the “high
ceiling” !!!

Watch our 5-min Tech Demo video on the PI Meeting site!

Additional NetsBlox Features

- Collaboration support (synchronous and asynchronous enabling team projects in-person or virtual),
- Create multi-player games or social apps with message passing,
- Robot programming including hacking and hijacking each others' robots,
- Cybersecurity: how to defend your robots,
- 3D Virtual robotic environment enabling remote learning without access to physical hardware,
- PhoneloT mobile app: access all the sensors on your phone and configure a GUI on its screen from your NetsBlox program,
- Make your own service/RPCs from within NetsBlox for all,
- Voice Assistant: write your own Alexa skills in NetsBlox.



Exercise Tracker on
Mobile Devices

Guiding Principles

Project-based
Learning

Structured
Initial Activities

Collaborative
Learning



Relevant &
Meaningful

Multidisciplinary
Topics

Interactions with
Role Models

Computer Science Frontiers

- High School Course (under development)
- Follow-on to AP CSP or other intro CS courses
- Project-based
- Modular: Four 9-week modules
- Full year
- Topics Covered:
 - Distributed Computing
 - Internet of Things
 - Cybersecurity
 - Machine Learning
 - Software Engineering

CSF

Computer Science Frontiers

<http://csfrontiers.org>



VANDERBILT
UNIVERSITY®

NC STATE
UNIVERSITY

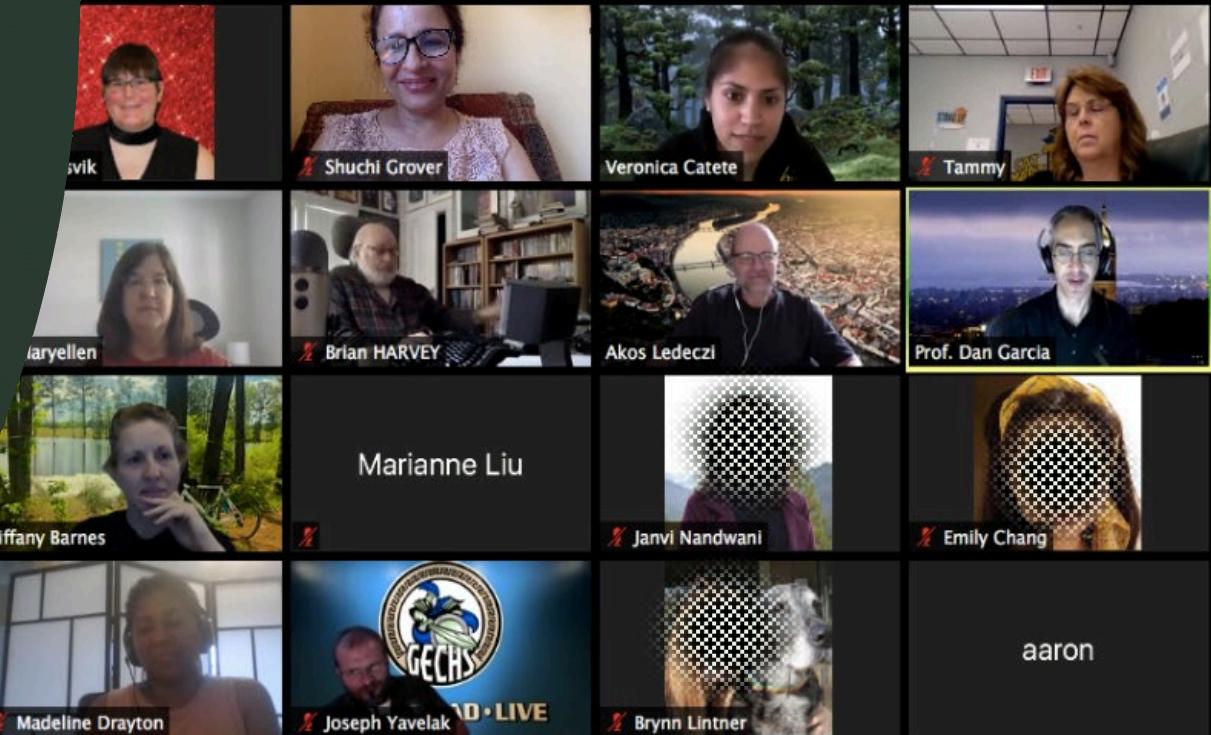
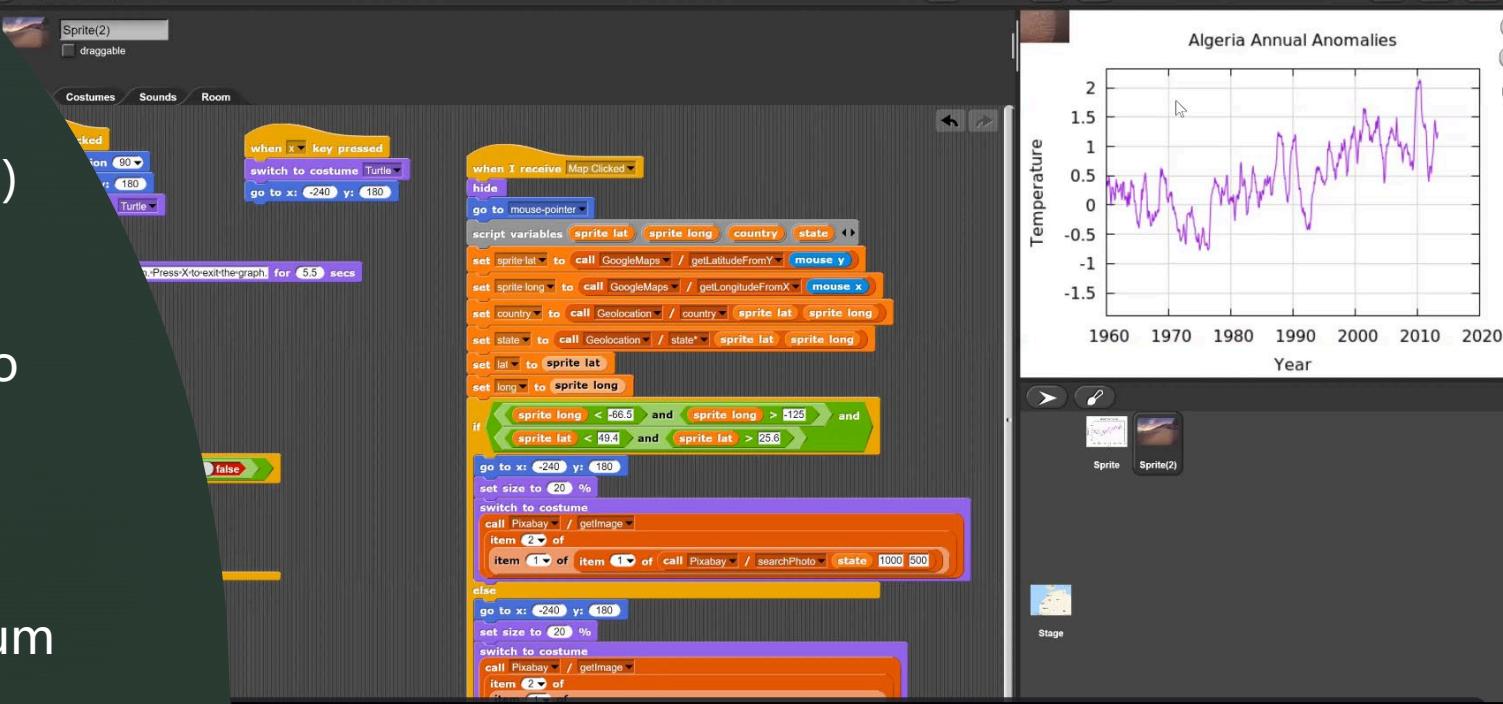
LOOKING
GLASS VENTURES



Pilots

Summer 2020 Pilot

- 1-week PD and co-design (virtual)
- 1-week virtual summer camp
- Distributed Computing Module
- Sample: 27 students; 25 agreed to participate
 - 19 girls and 6 boys
- Final project showcase
 - Invited creators of Snap! (Berkeley) & the BJC curriculum
 - Interesting mix of student projects
 - Many projects related to Covid-19, climate change, movies.



Summer 2021 Pilots

- 1-week PD and co-design (virtual)
- Four 2-week virtual summer camps
- IoT and ML Modules
- 80 students (incl. additional camps)

Algeria Annual Anomalies

