

SU
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california
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summer
school for
mathematics
and science

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BO
OK

University of California, San Diego

July 2021



Cluster 1A : Computers In Everyday Life

Austin Wang

Carter Kawaguchi

David Zhu

Edward Han

Elizabeth Lopez

Erin Huang

Hendrick Romero

Hyeongjung Joshua Kim

Iman Abumeri

Jennifer Yamashita

Jocelyn Zhang

Linus Lee

Paul Otterson

Poyuan Brad Chen

Ruiyi William Zhang

Sam Liu

Shane Black

Taylin Keiu

Tony Tran

Vidhi Kulkarni

Cluster 1B : Computers In Everyday Life



Anokhi Luthra

Brandon Choi

Brian Li

Christoper Li

Diya Desai

Don Tran

Harsha Venkatesh

Iris Li

Jacob Kim

Judy Truong

Junyi Johhny Zhong

Katherine Choi

Kyle Kim

Lakshana Viswa

Lauren Chan

Minjun Kim

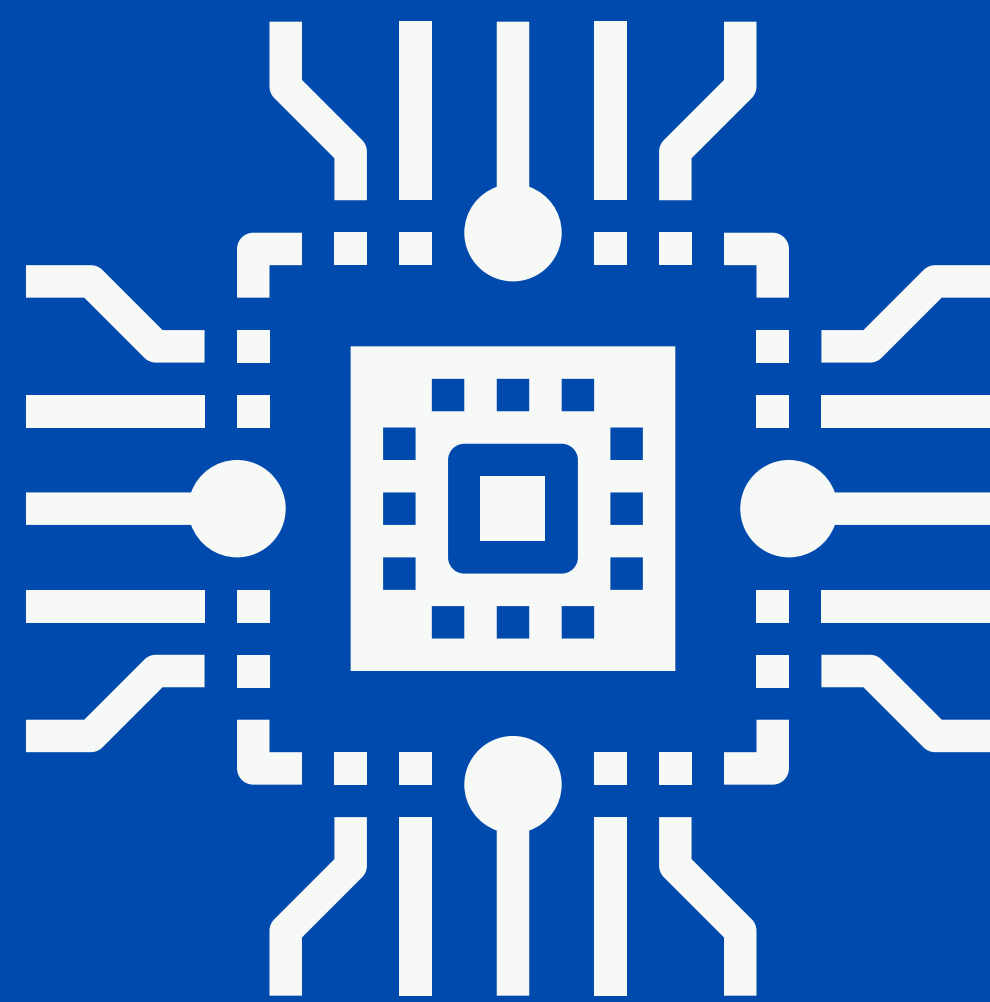
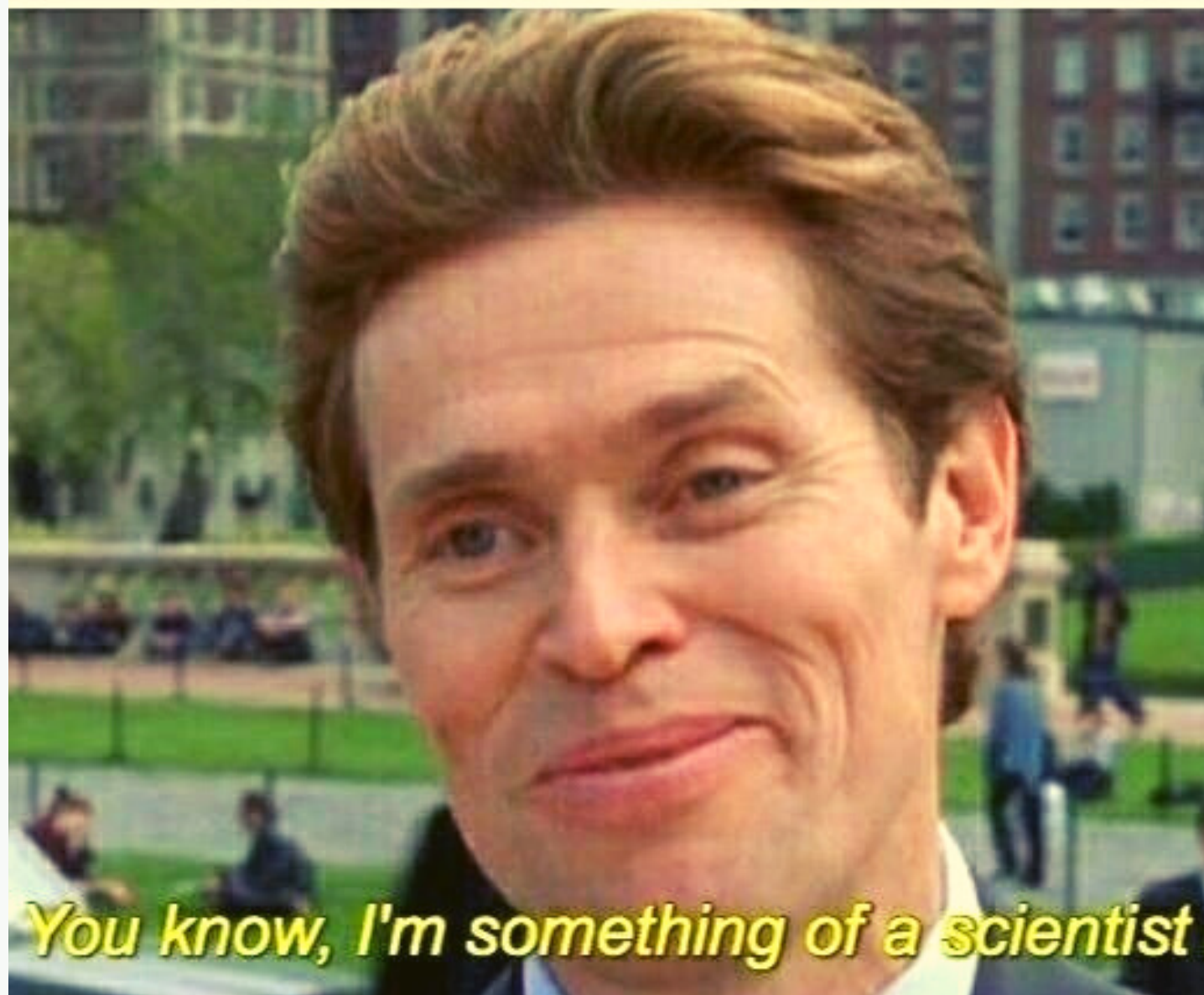
Misa Truong

Shreya Mohan

Shubham Marathe

Ying Tzu Chen

When you finish writing
program in MIT App Inve



WE ARE
COMPUTERS IN
EVERYDAY LIFE

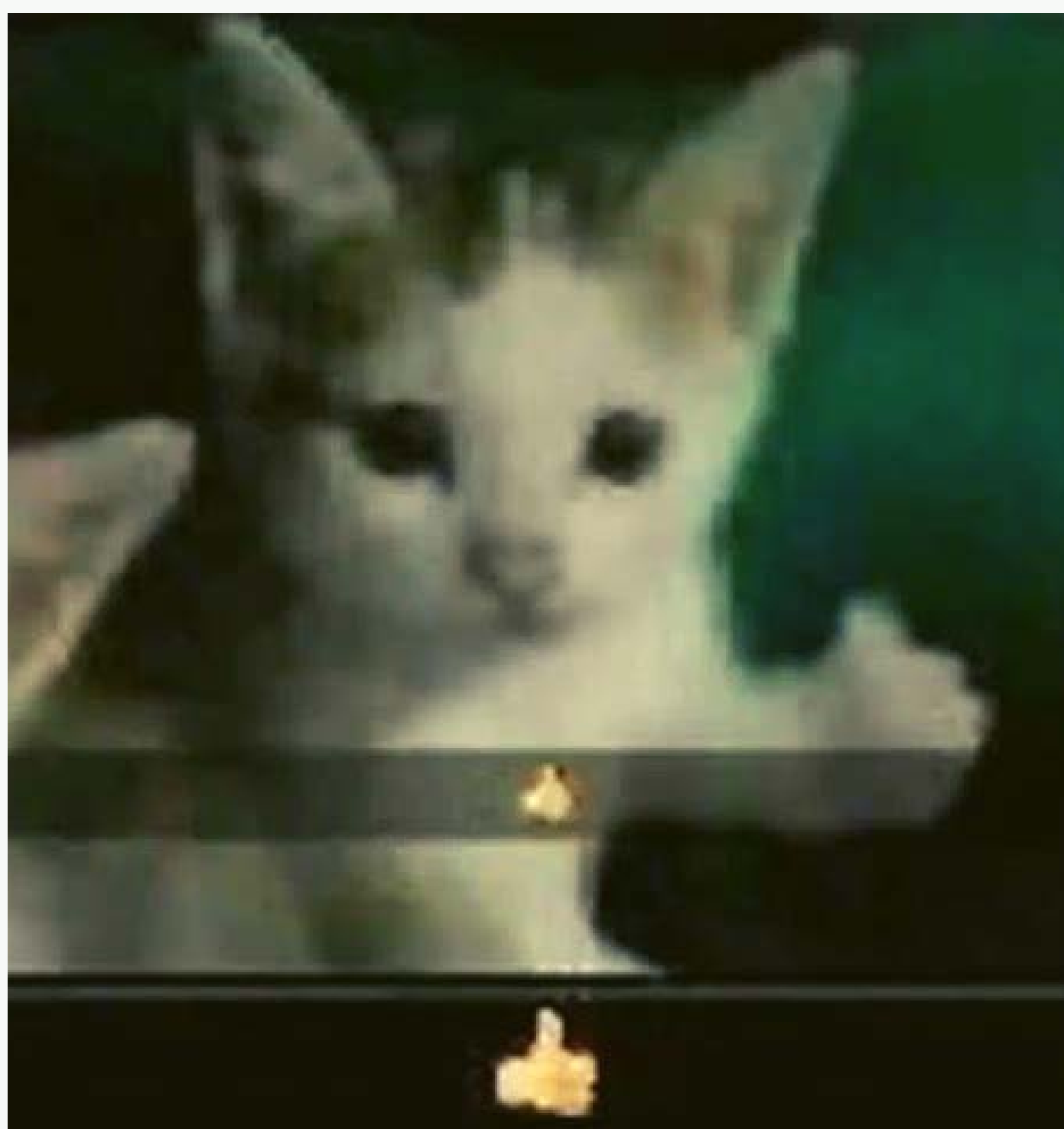
Computers are everywhere!

In Cluster 1, we focus on the basics of computing and coding. Students receive an introduction to computation through lectures, guest speakers, and projects. It starts by teaching the fundamentals of programming then students learn one of the most commonly used programming languages in the world, Python, and use it to perform image manipulation and later to author video games.

Photo 1: Meme about block coding in MIT App Inventor.

Photo 2: How Brian Li felt after the 3rd day of COSMOS.

Photo 3: Meme describing how Cluster 1 Gold is feeling at the end of their 3rd day of COSMOS.

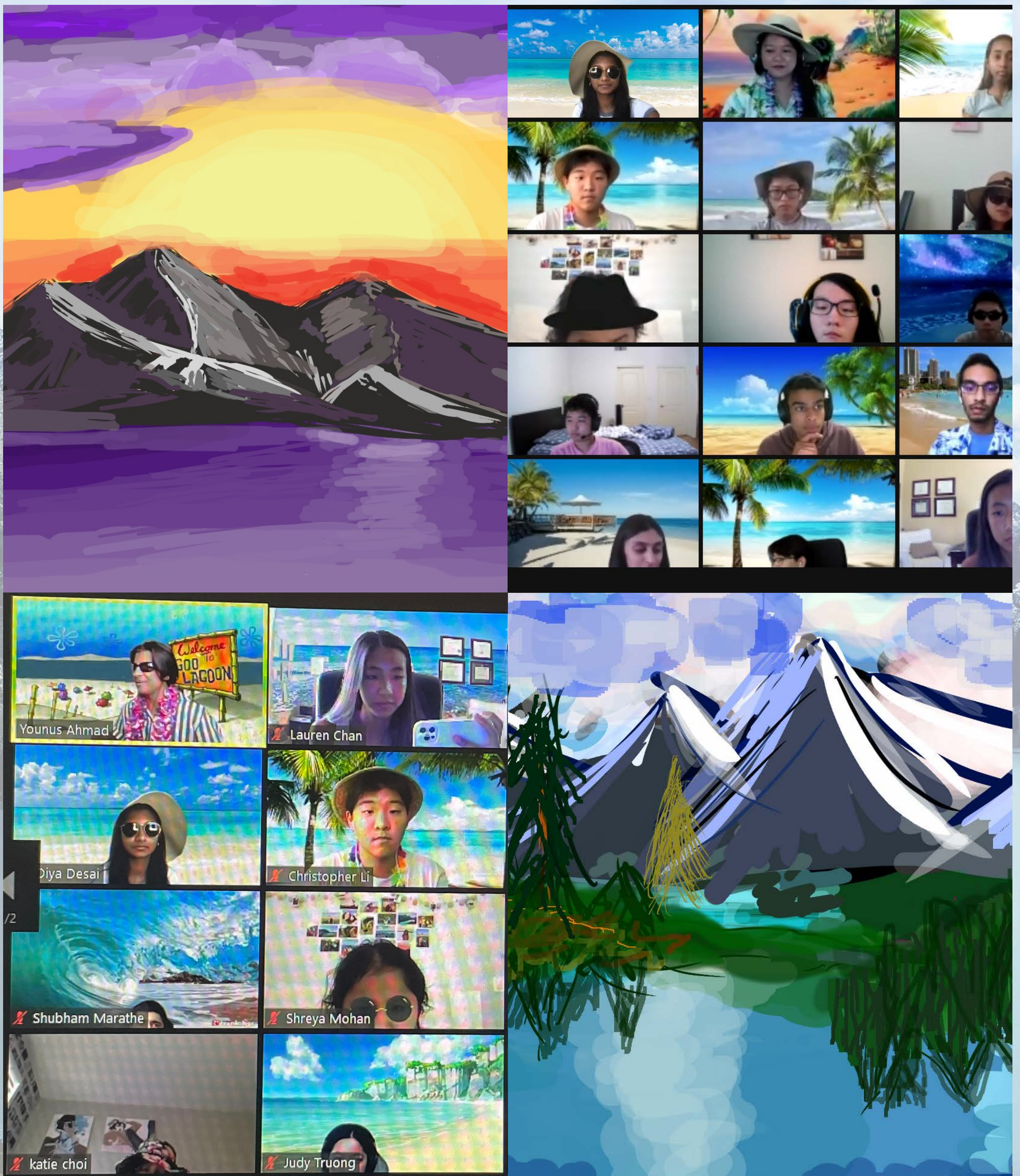


Look at all those

impressive
App Inventor
projects

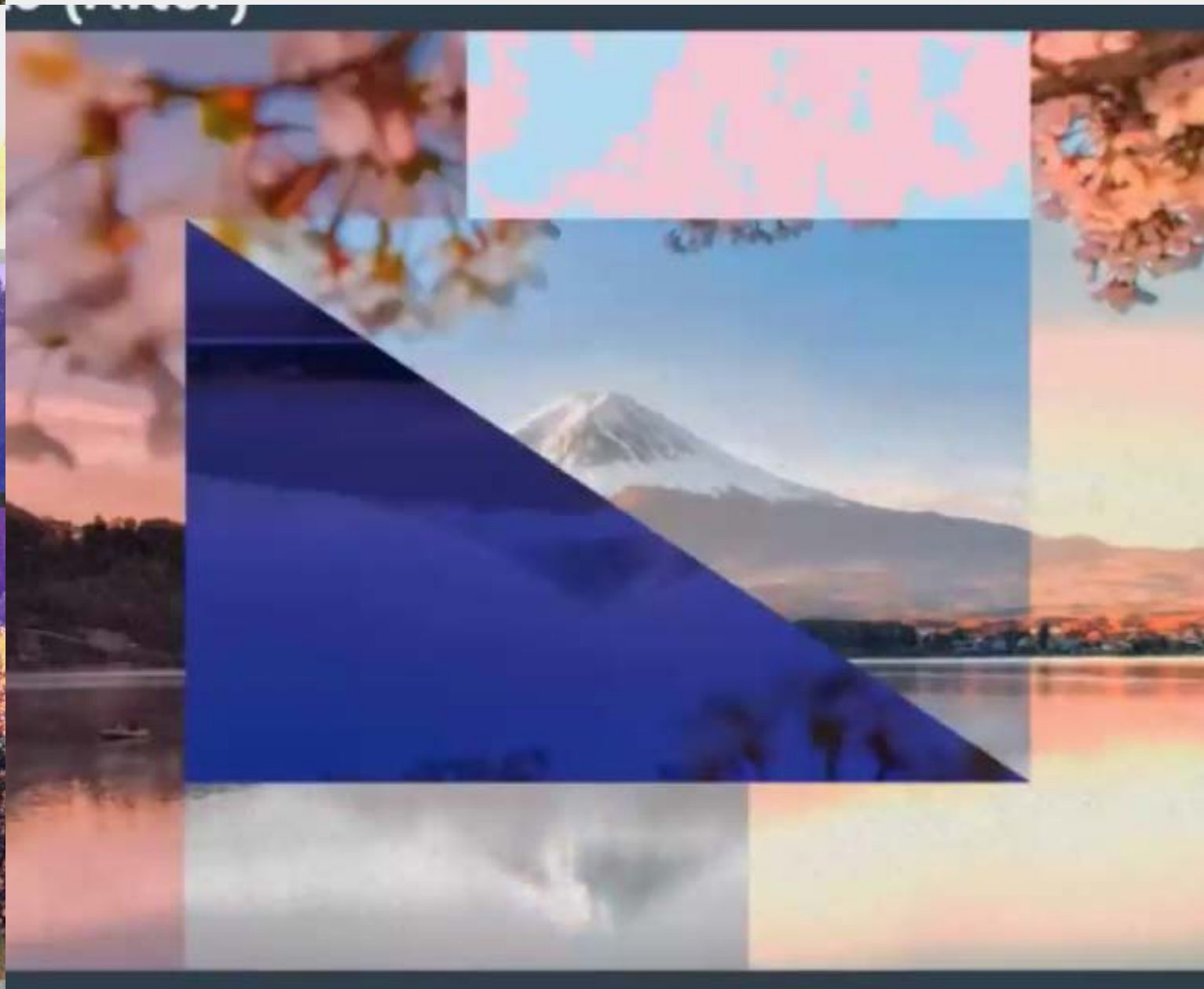
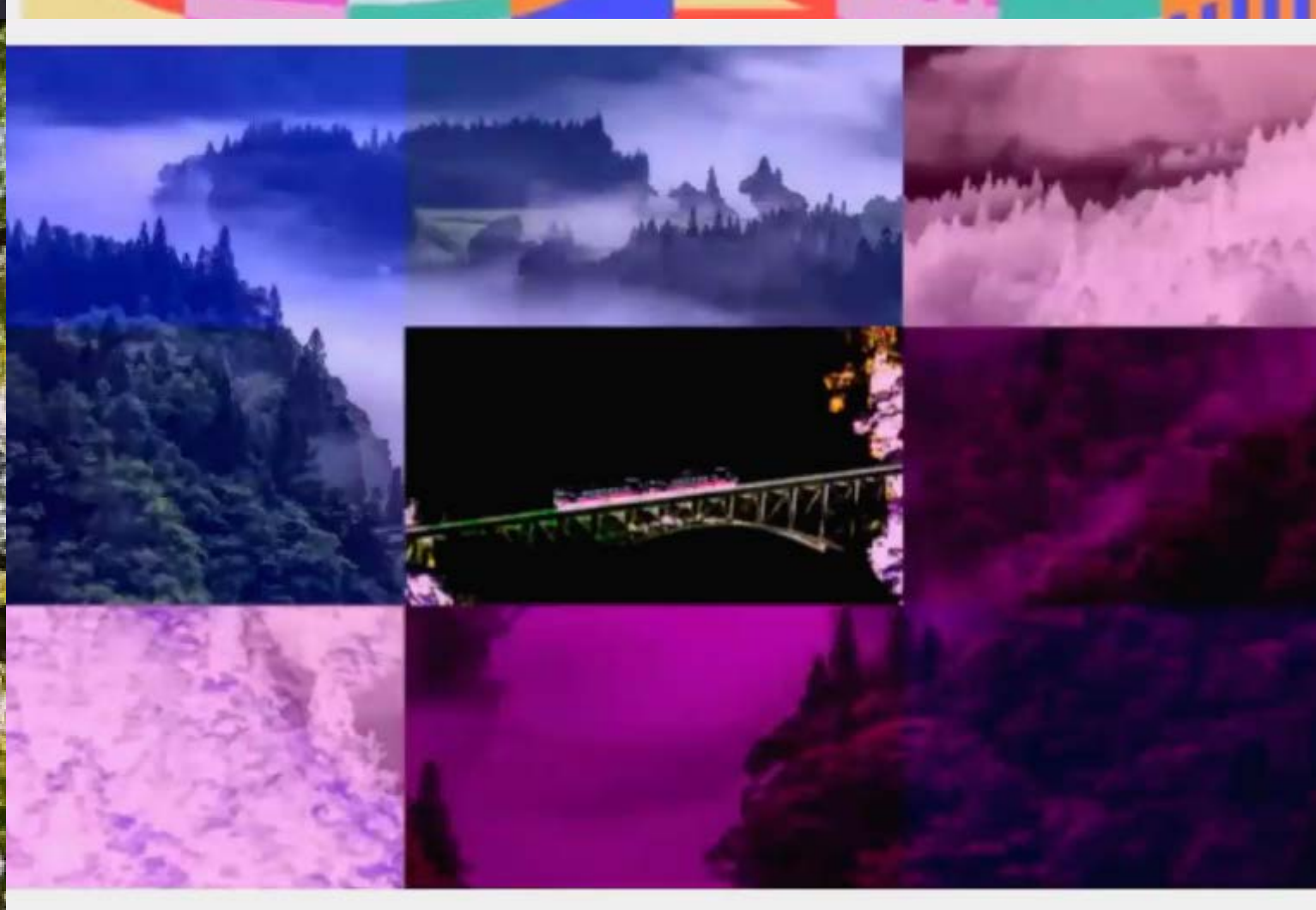
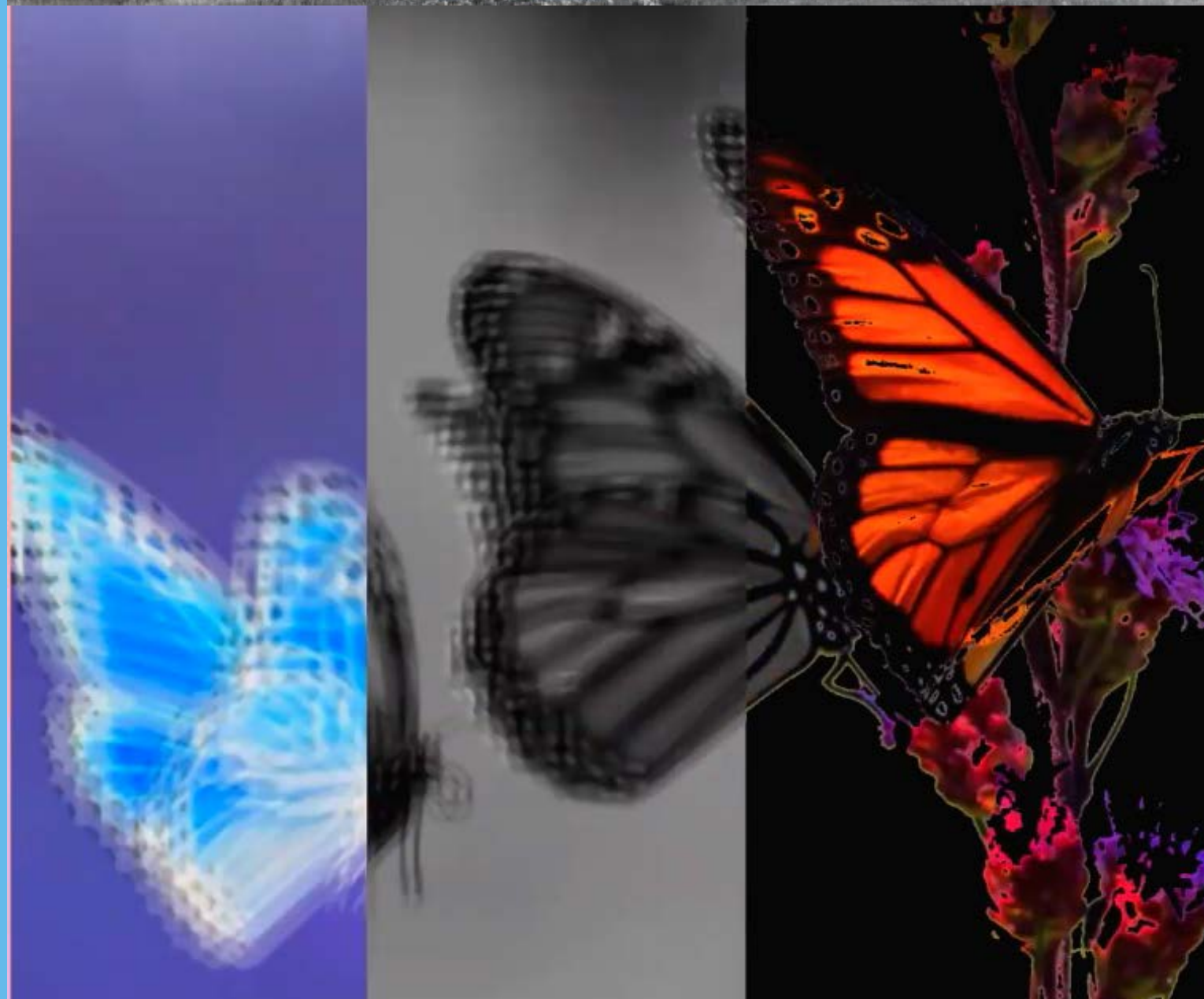
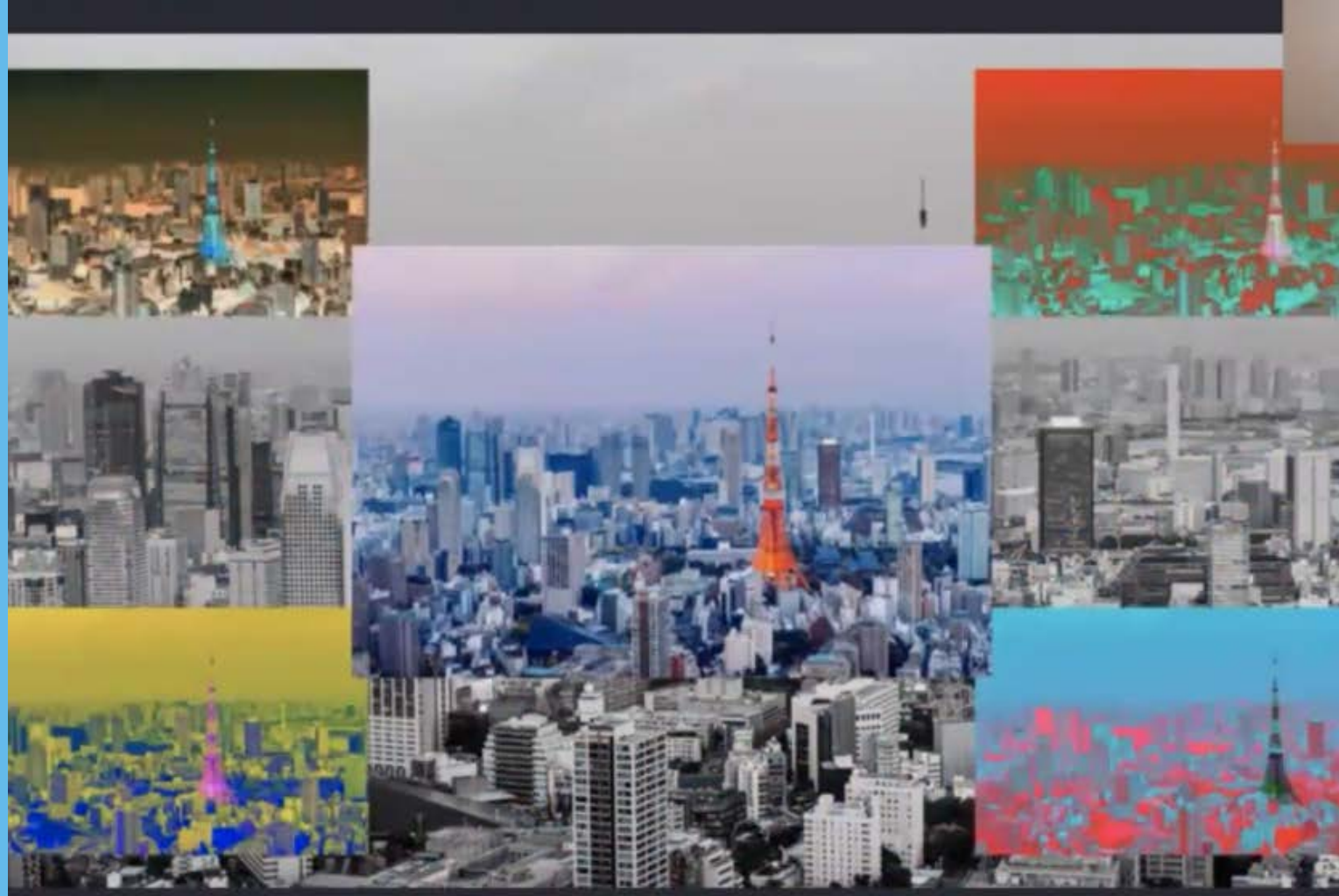


FUN FRIDAYS



PICTURED: FUN FRIDAY BEACH THEME AND PAINTINGS - SUNSET AGLOW(PURPLE) BY JOHNNY, JUDY, KATIE, SHUBHAM SARAYU AND TOWERING PEAKS BY SID, DIYA, BRIAN, ANOKHI, KYLE, LAUREN, AND BRANDON!

PYTHON IMAGE PROCESSING PROJECT



PROJECTS FROM TOP LEFT:
LAKSHANA VISWA &
JACOB KIM, JUDY TRUONG
& MISA TRUONG, IRIS LI &
SHUBHAM MARATHE,
HARSHA VENKATESH &
MIN KIM, DIYA DESAI &
CANDICE CHEN, DON
TRAN & BRIAN LI, ANOKHI
LUTHRA & LAUREN CHAN



UCSD COSMOS

CLUSTER 1 -
BLUE &
GOLD



Cluster 2: Engineering Design & Control of Kinetic Sculptures

Aanika Jain

Anelauioakalani Akiona

Boran Brant Yang

Chanji Gaelan

Christopher Nie

Daniel Rasas

Derek Shi

Georgia Adams

Jennifer Diep

Jet Li

Jiatian Yuan

Jose Reyes

Justin Choi

Katherine Chen

Kyle Chen

Lizette Hernandez

Maggie Du

Matthew Lee

Michael Duperly

Nhu Nguyen

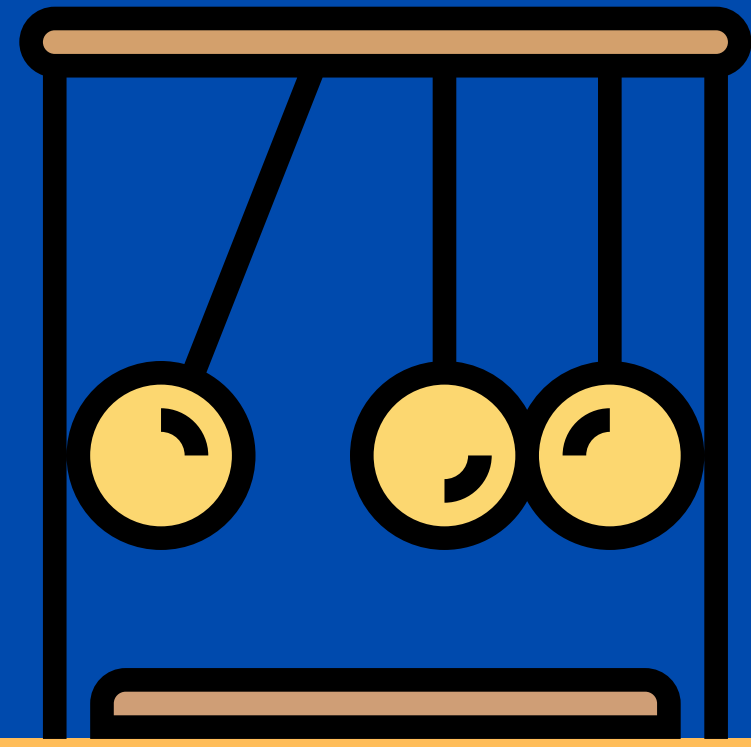
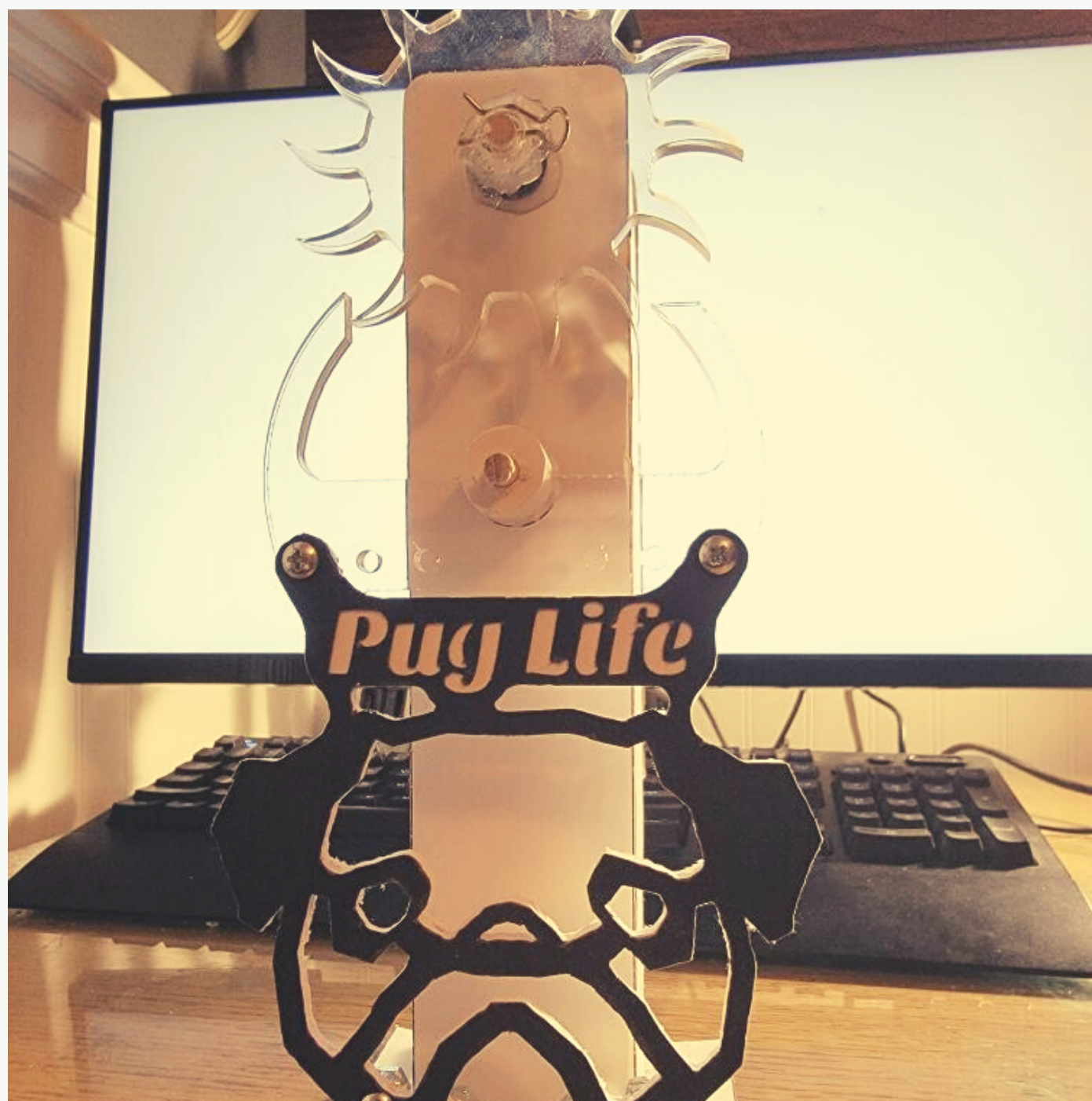
Sanjith Menon

Shine Park

Sophia Lau

Stanley Shen





WE ARE ENGINEERING DESIGN & CONTROL OF KINETIC SCULPTURES

Cars, drones,
vacuum
cleaners, oh
my!

Mechanical Engineering and Computer Control are brought together in many modern products that have moving parts. In Cluster 2, students will analyze, design and build Kinetic (Moving) Sculptures operated under Automatic Control to get a comprehensive introduction to mixed disciplines in the field of engineering.

Photo 1: Computer drawing of a part we will use on our clock project by Maggie Du.

Photo 2: Jennifer Diep showing her progress while building her pendulum clock.

Photo 3: Completed pendulum clock project with a pug design by Michael Duperly

PENDULUM CLOCKS

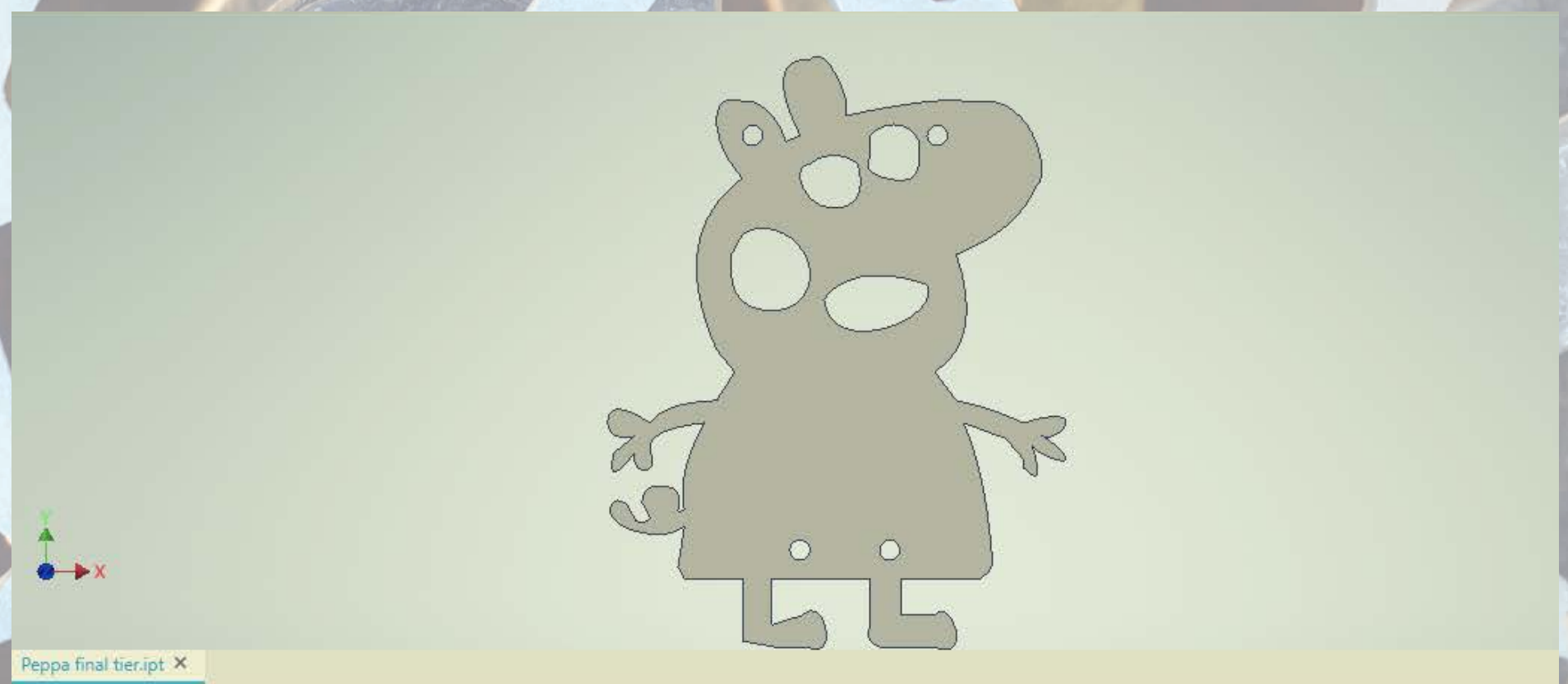
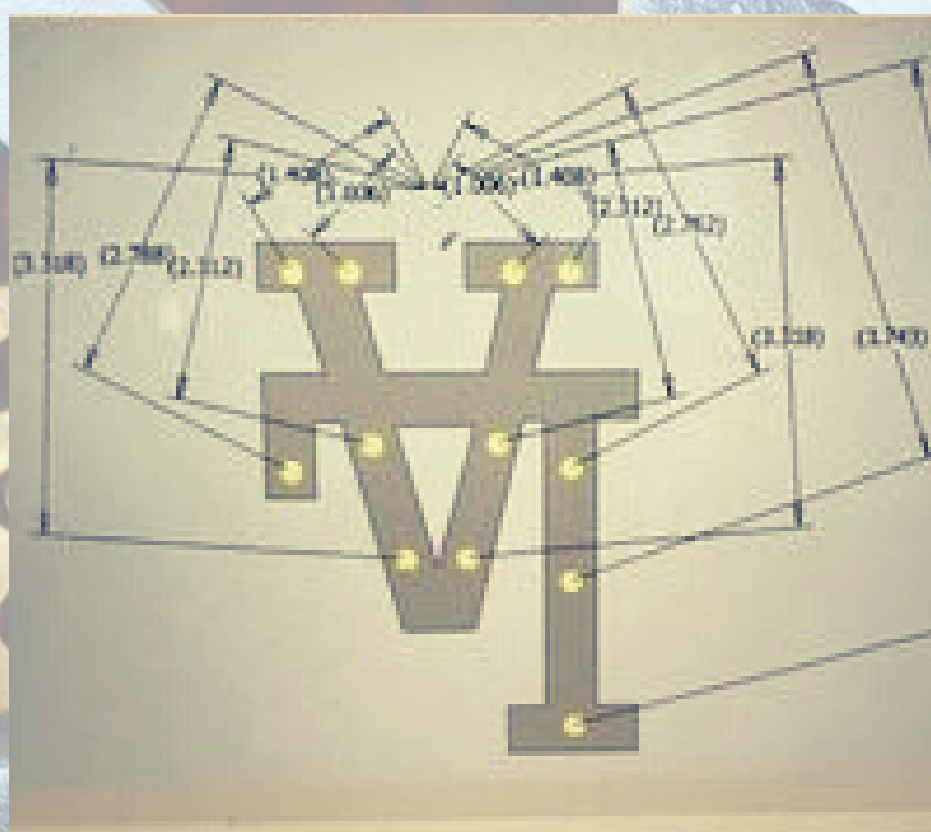
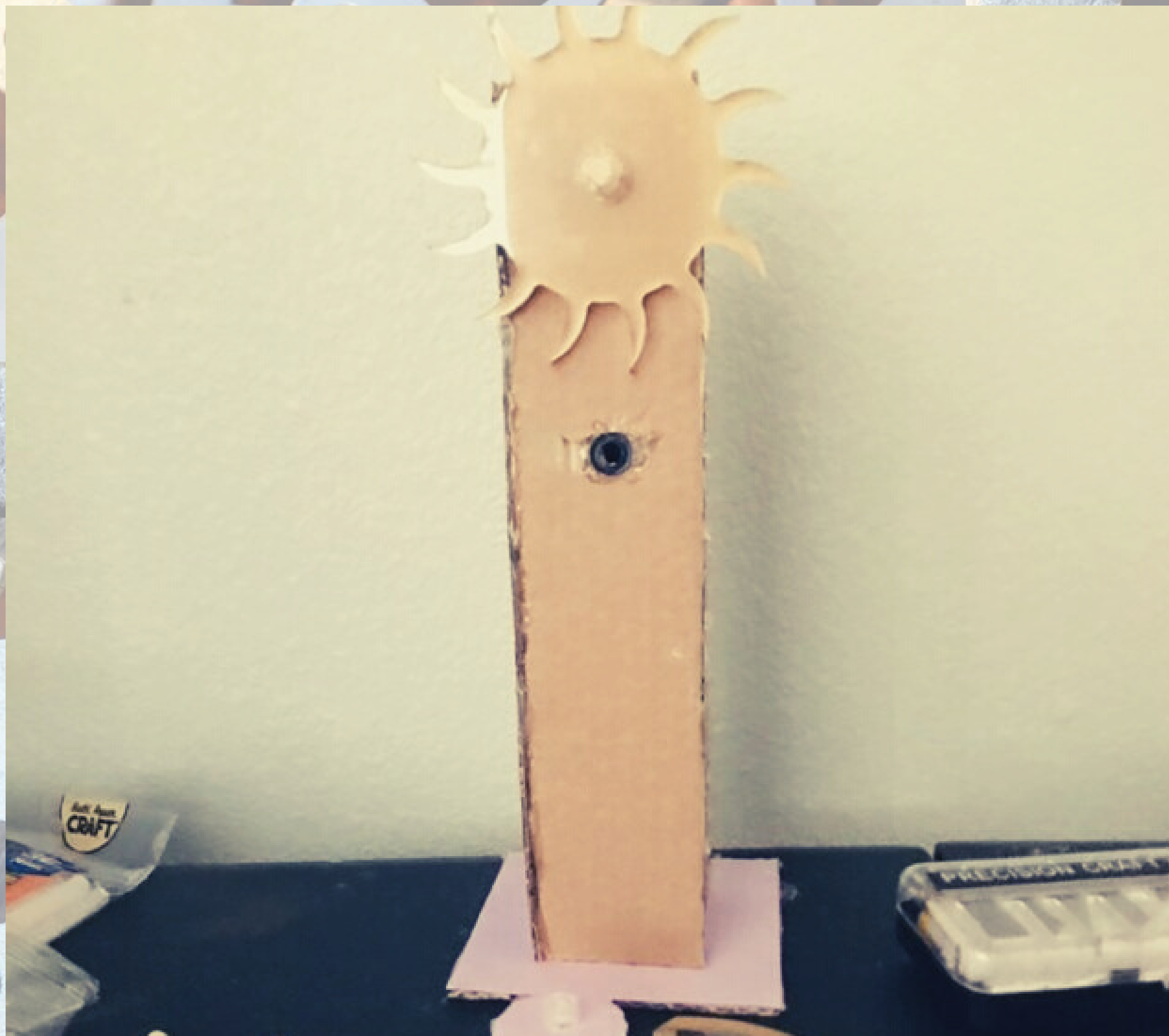


Photo 1:
pendulum
clock using
foam core,
cardboard,
and acrylic. By
Matthew Lee.

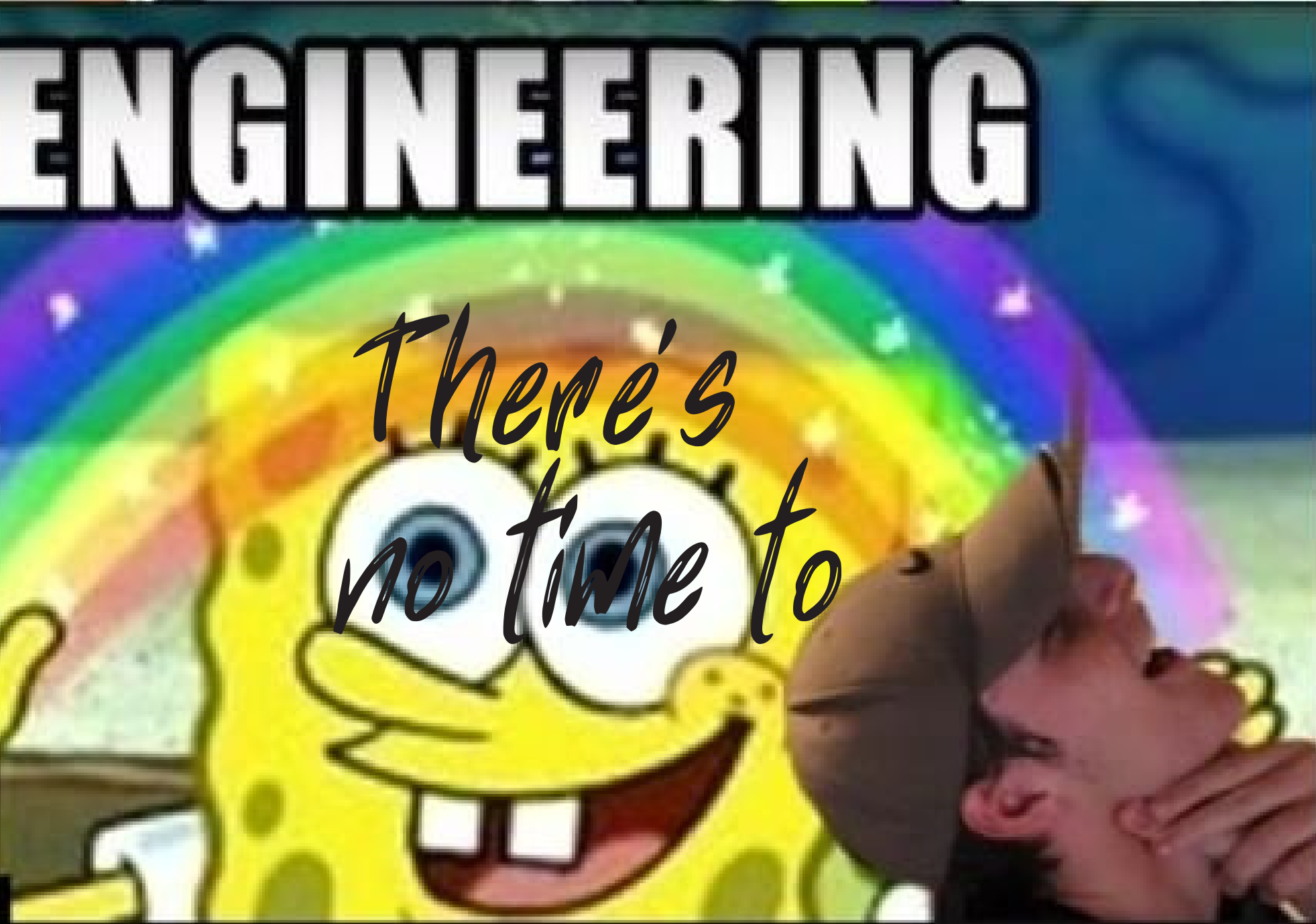
Photo 2:
Finished
pendulum
clock project
by Maggie Du.

Photo 3:
Computer aided
design of Matthew
Lee's pendulum
project.

Photo 4: Derek
Shi's pendulum
design of Peppa
Fig.



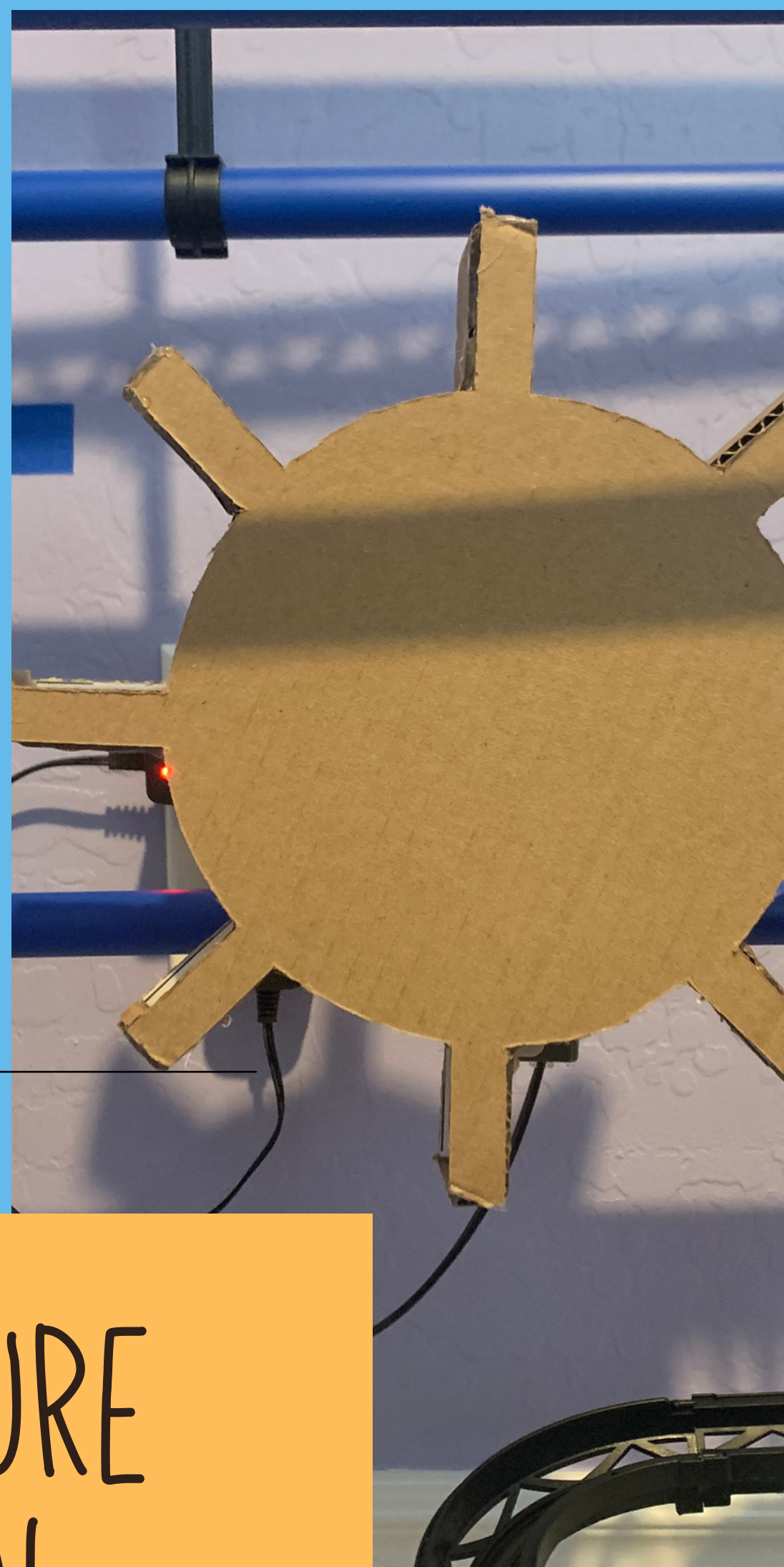
Matthew |



Jiatian

team bonding

THE DREAM TEAM HARD AT WORK ON THEIR
MATLAB ASSIGNMENT! PHOTO BY JIATIAN
YUAN.



SCULPTURE DESIGN

DESIGN BY TEAM
GHOST MONKEYS



Cluster 3A - Climate Change

Aditi Purandare

Aditya Karthik

Anna Liu

Colette Chankai

Collin Ross

Emma Zhang

Esther Rodriguez

Iona Xia

Joana De La Torre

Jonathan Fung

Klara Parang

Marcus Hsieh

Rithvik Siddam

Rohan Rawat

Sanjna Mizar

Sofia Diaz

Sophia Qin

Taneesha Panda

Vivienne Chankai

Yuting Emily Ma

Cluster 3B - Climate Change

Alex Li

Alexis Tan

Brianna Bortoluzzi

Christopher Long

David Kim

Emily Nguyen

Esin Demiray

Hunter Kim-Turnoff

Katherine Kricorian

Luchia Torro

Luke Spencer

Margaret Spencer

Nithish Chakravarthy

Selina Yang

Sofia Flom

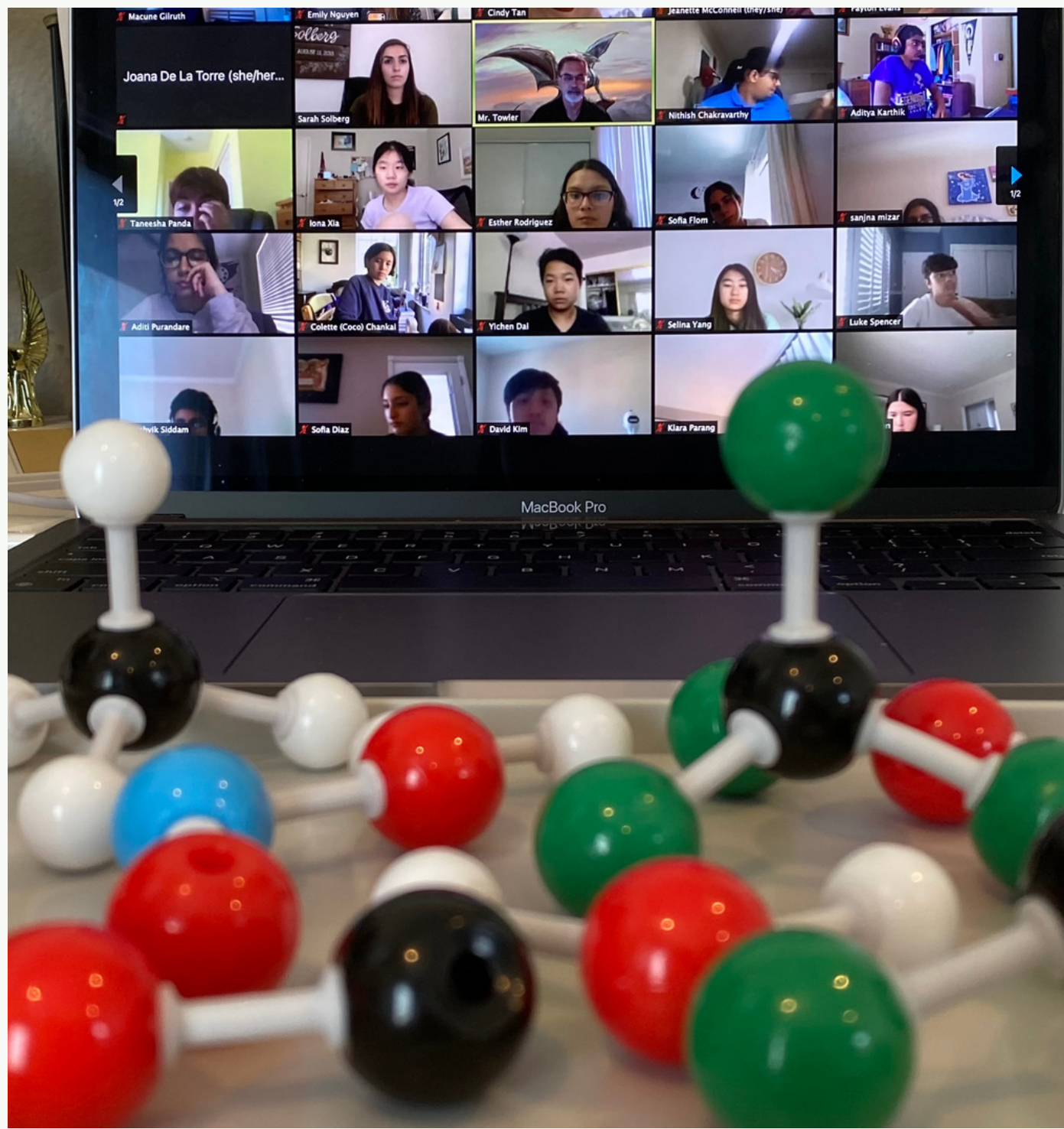
Stella Winn

Tiffany Vega

Yichen Dai

Yu Mi Eunice Kang

Zara Tahir



WE ARE
CLIMATE CHANGE

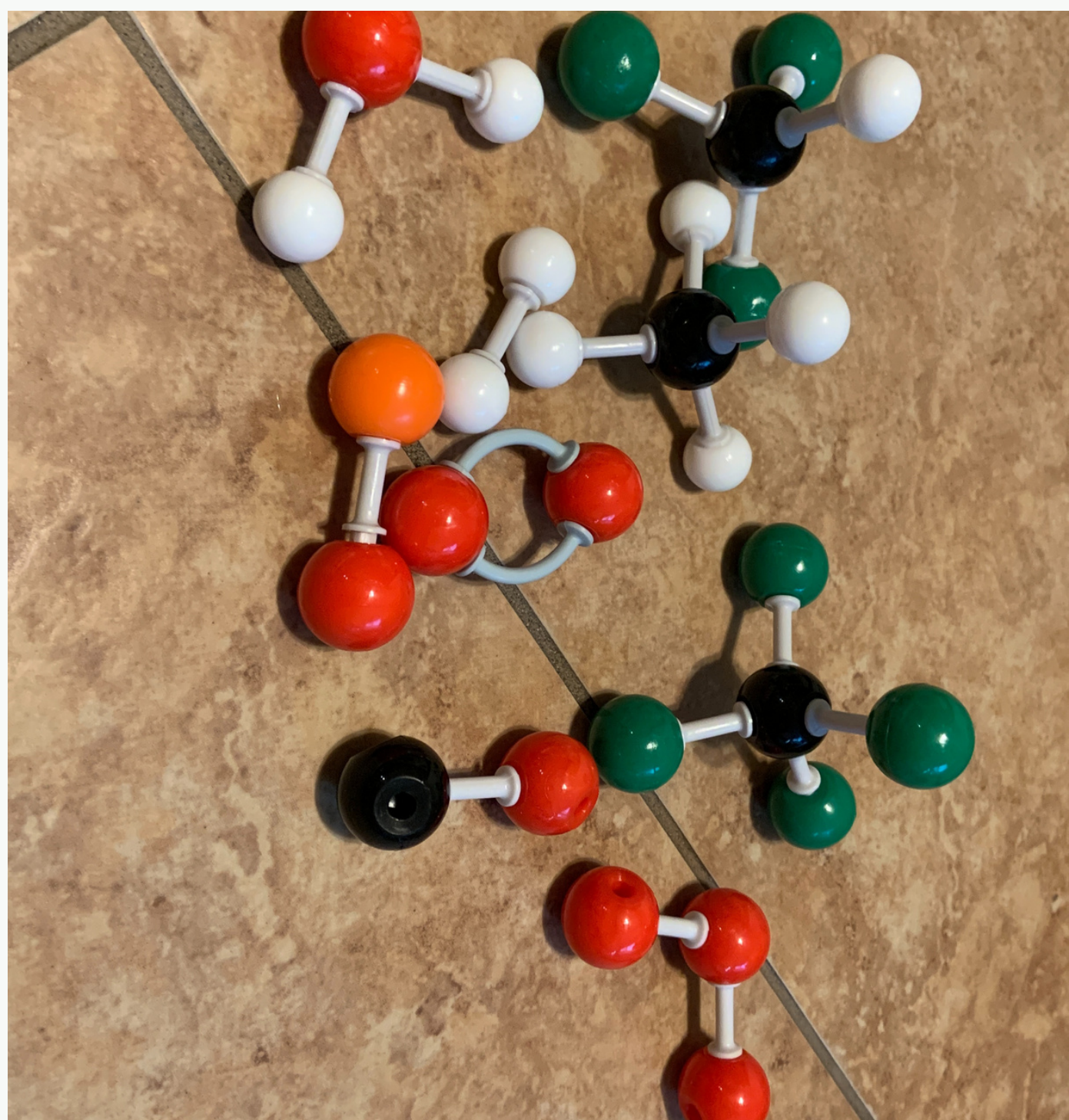
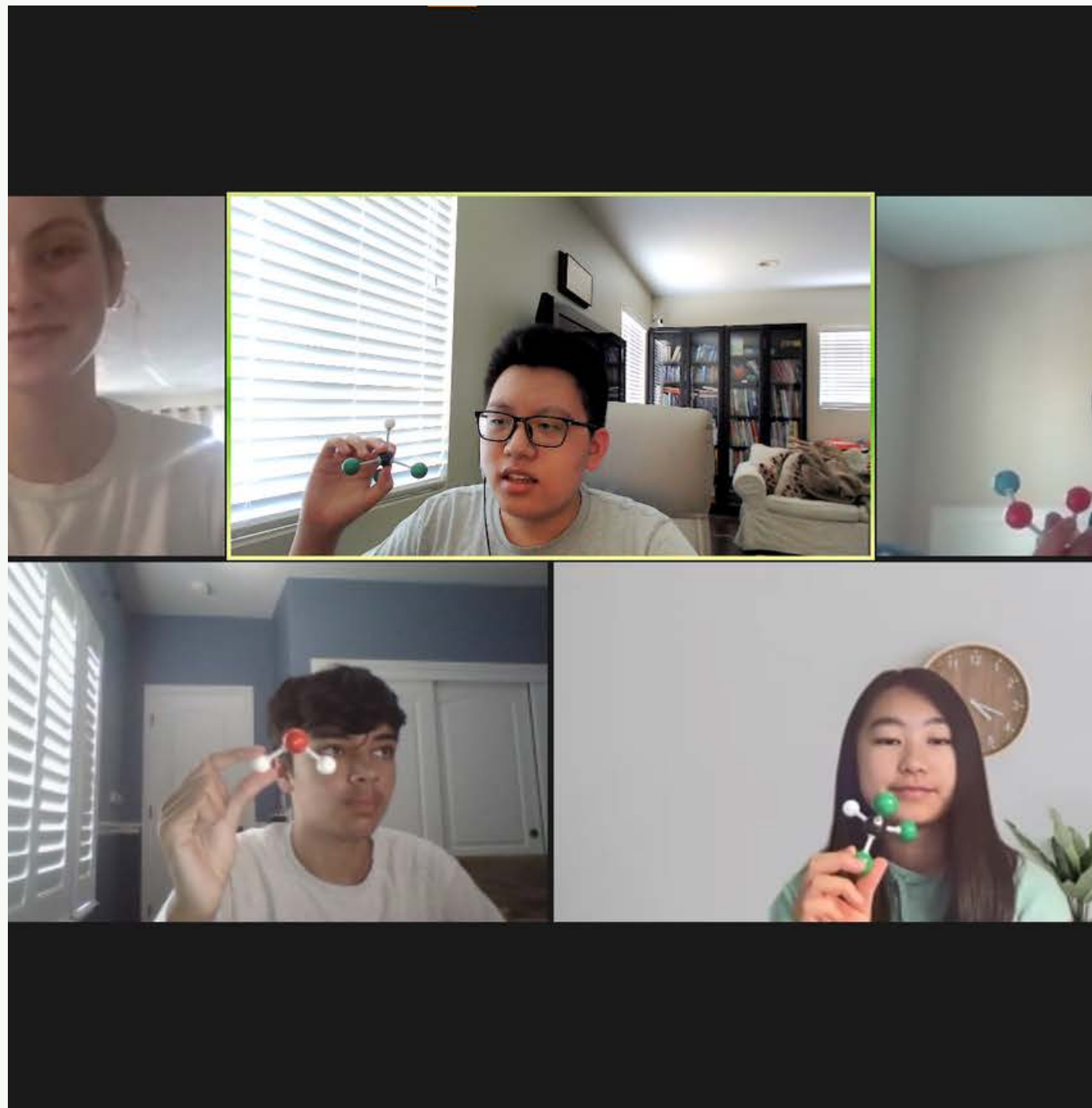
Together we can save the planet.

In Cluster 3, we know that climate change is one of the most important and controversial issues facing our world. This cluster breaks Climate Change into four parts: green house gases, the role of aerosols, global industrial human activity, and how we might mitigate climate change through reduced utilization, alternate energy sources, carbon abatement and geoengineering.

Photo 1: Creating chemical models.

Photo 2: Selina Yang, Luke Spencer, Marcus Hsieh, and David Kim under the guidance of Payton Evans hold up their atomic models of greenhouse gases.

Photo 3: Greenhouse gases molecular models activity.



Let there be light



An activity called Measuring Albedo where we calculated percent reflectivity of various colored papers using a light meter and temperature probe.

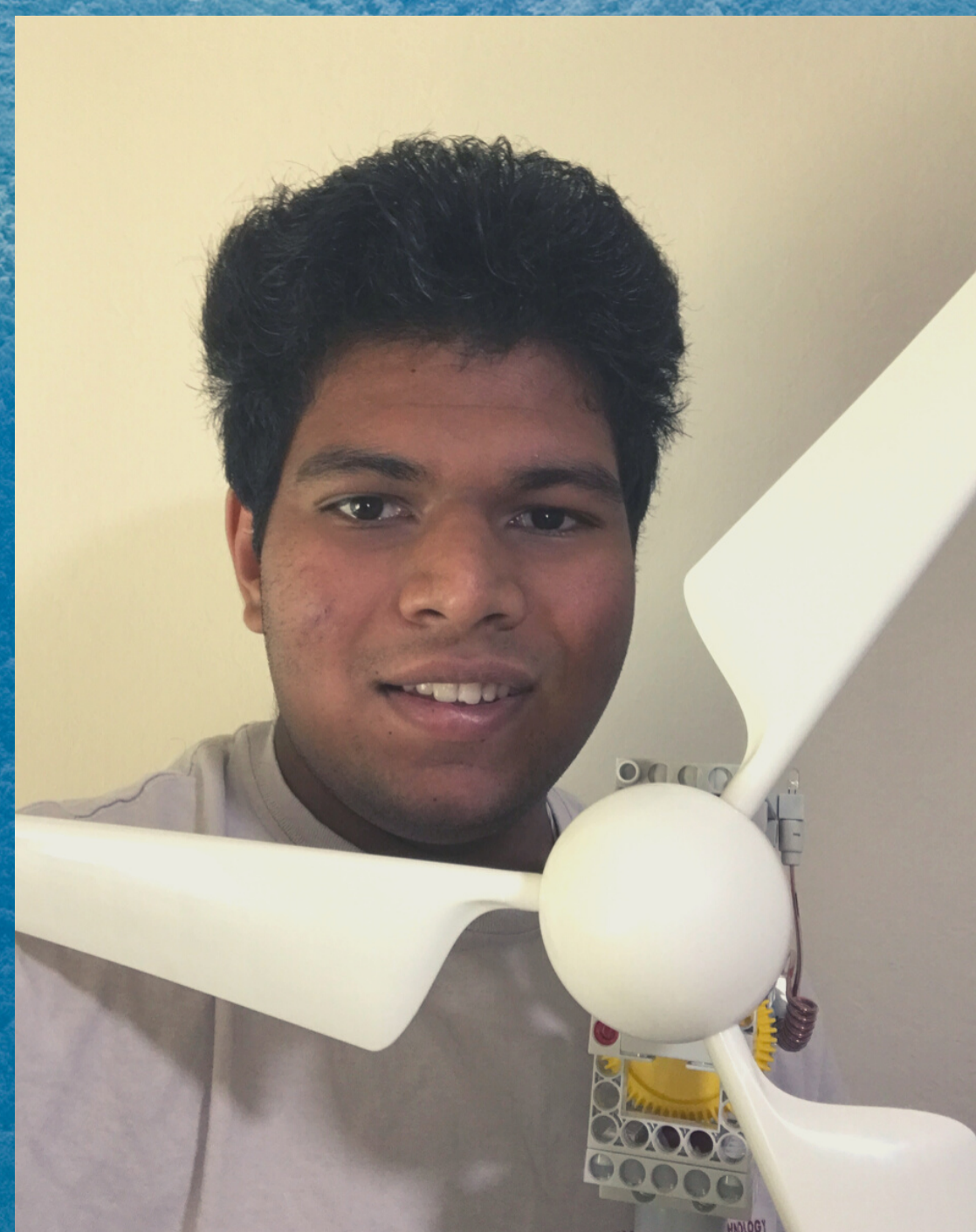
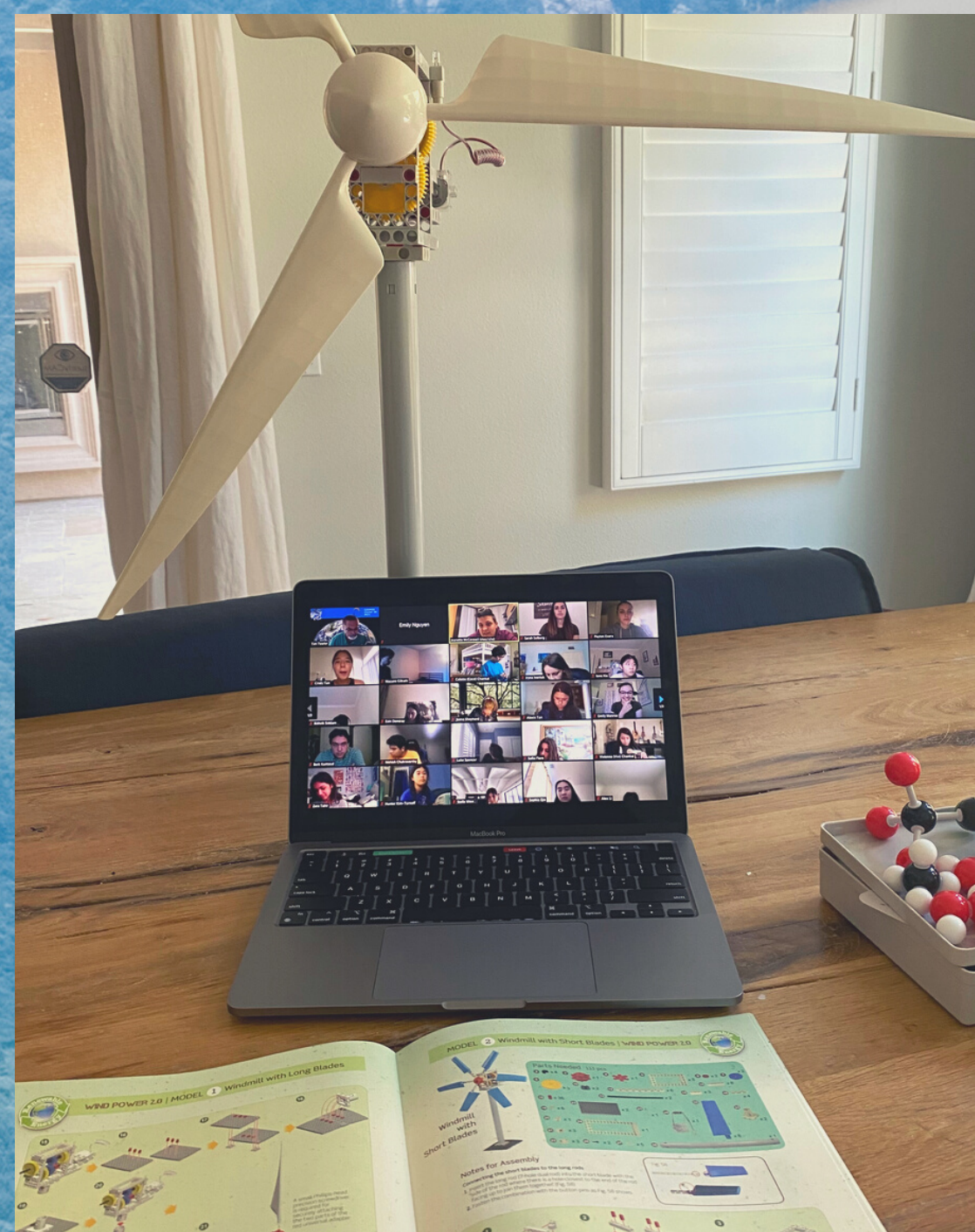


To look more into the phenomenon of light scattering we worked on the Milk Sunset Activity. We compared the intensity and color of light across water and water and milk mixture.



Installing Purple Air sensors.





PROJECT: BUILD A WIND TURBINE TO CREATE POWER TO LIGHT UP AN LED

PICTURED: (TOP) EMILY NGUYEN'S
WINDMILL, (BOTTOM) NITHISH
CHAKRAVARTHY'S WINDMILL.

Cluster 4 - Structural Engineering: Building Better



Aaron Chang

Andres Salgado

Anika Tiku

Ariane De Guzman

Brandon Wong

Edgar Reyes

Edward Liu

Erin Sun

Eshaan Shanbhag

Fiora Beratahani

Francisco Silva

Gael Herrera

Hana Sweatt

Jordan Luo

Kaitlyn Wang

Luc Chone

Luke Qiao

Matthew Mao

Naomi Lee

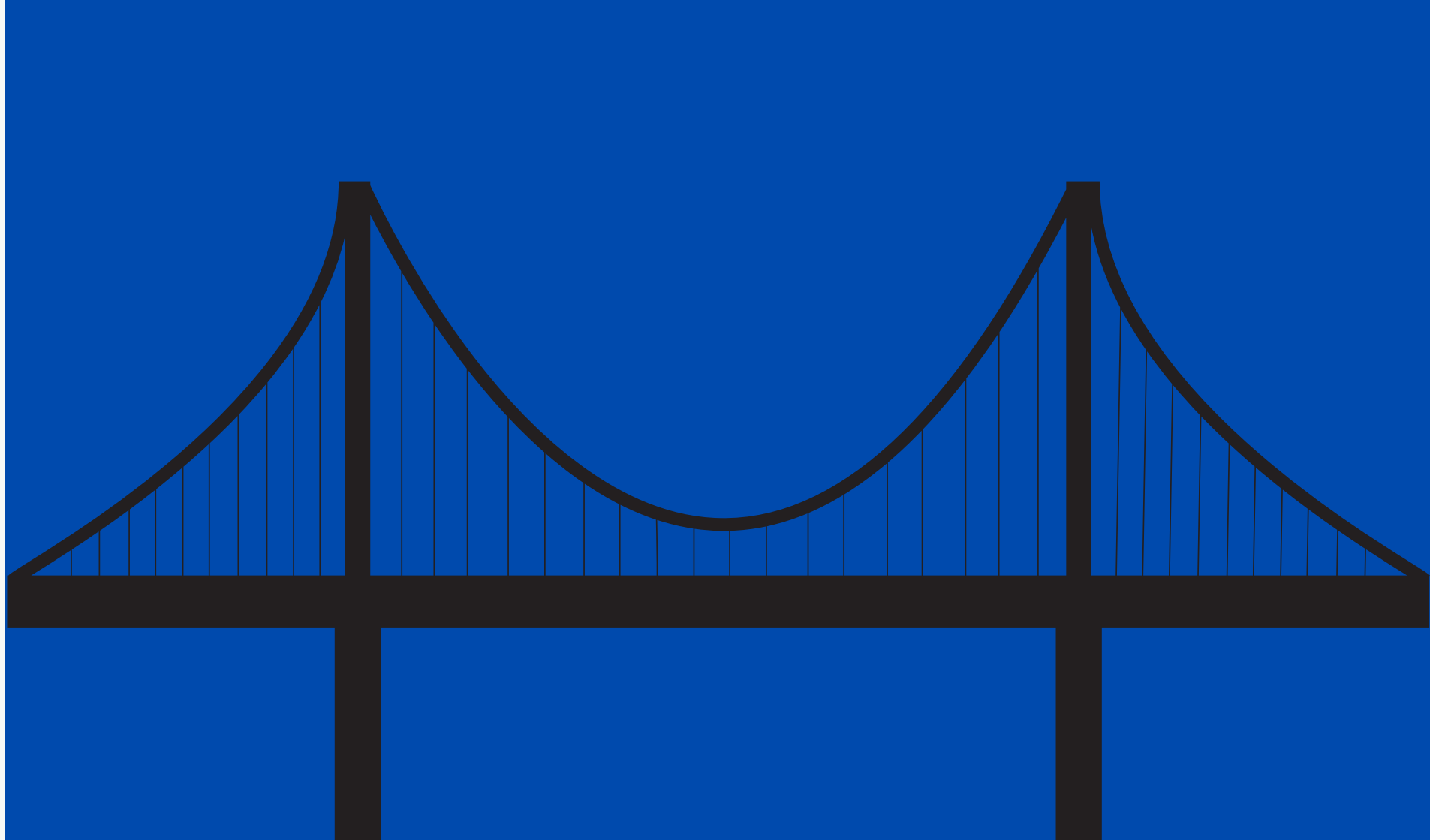
Natalia Marshall

Noah Lim

Sabrina Yeung

Vivian Ong

Zachary Chung



WE ARE
STRUCTURAL
ENGINEERING



Every snap &
crack is
exciting!

In Cluster 4, we like to build AND break things. We build small scale models of all types of structures (bridges, buildings, foundations, soils, underground pipes, aerospace structures, wind turbines, automobiles, human body, etc.) to see how we as engineers can put together different components to build strong structural systems.

Photo 1: Scissor lift holds up \$14.49 in coins.

Photo 2: Popsicle stick scissor lift to experiment with demand versus capacity.

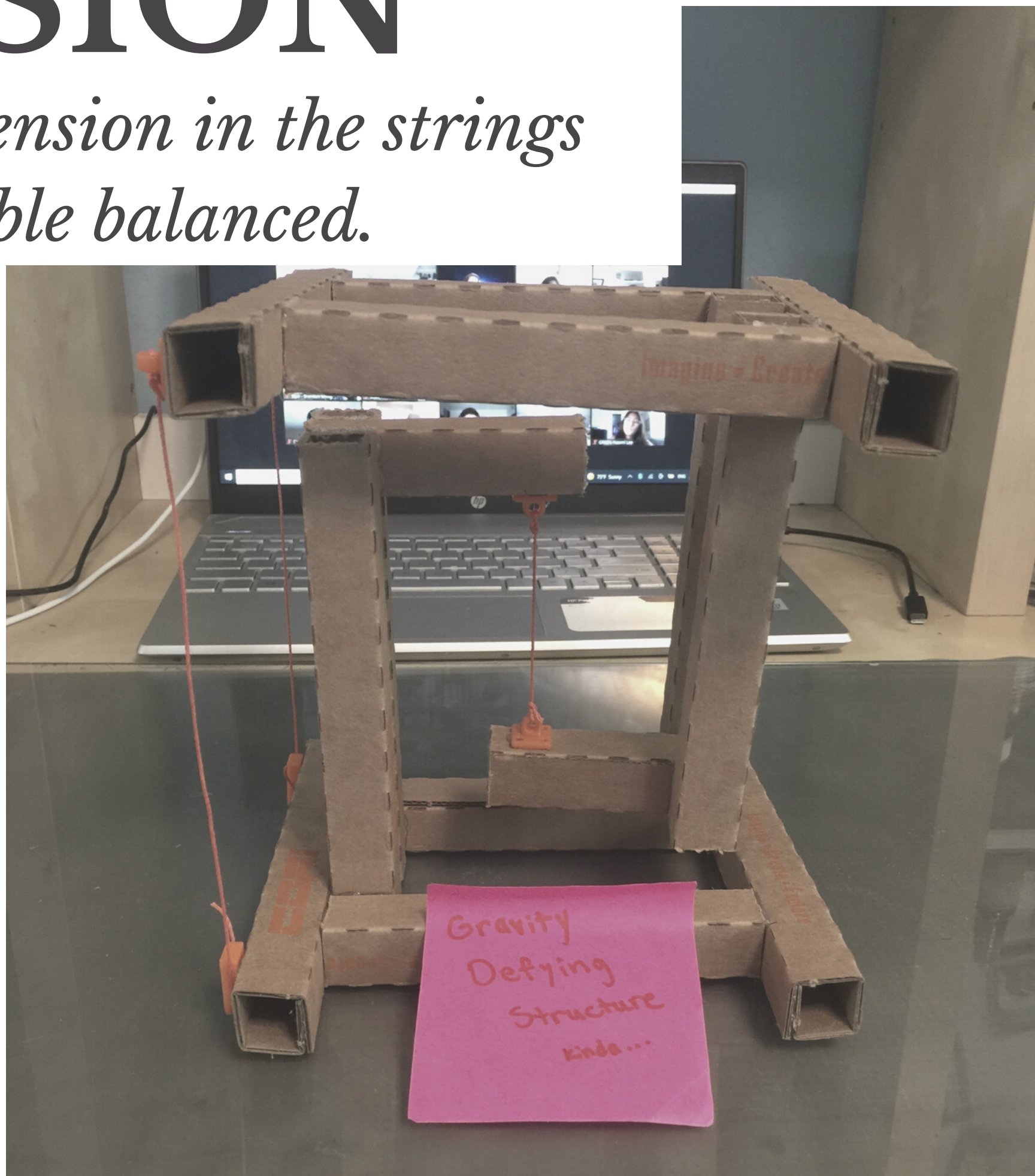
Photo 3: DIY scissor lift with objects balancing on it created by Ariane De Guzman.





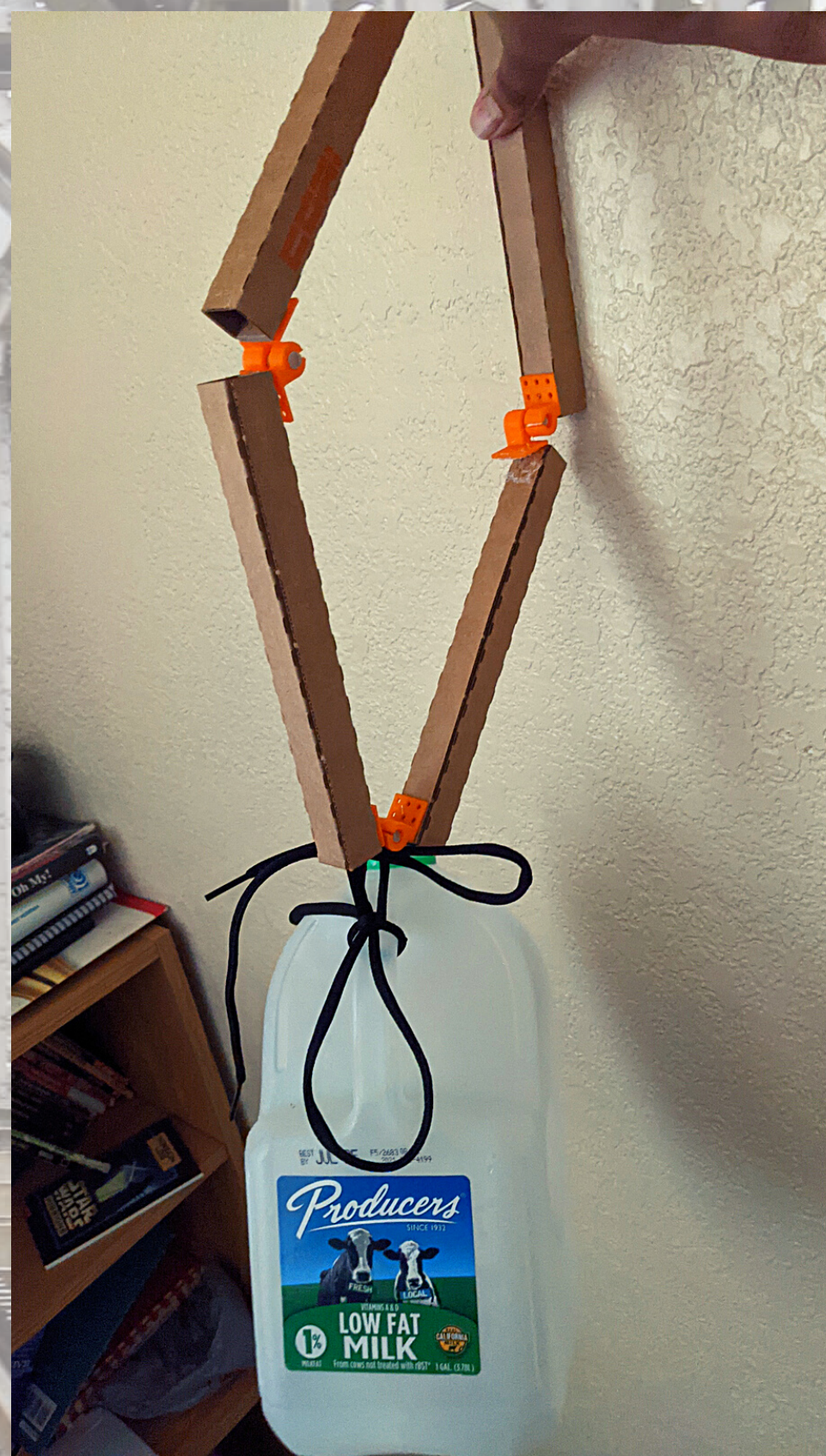
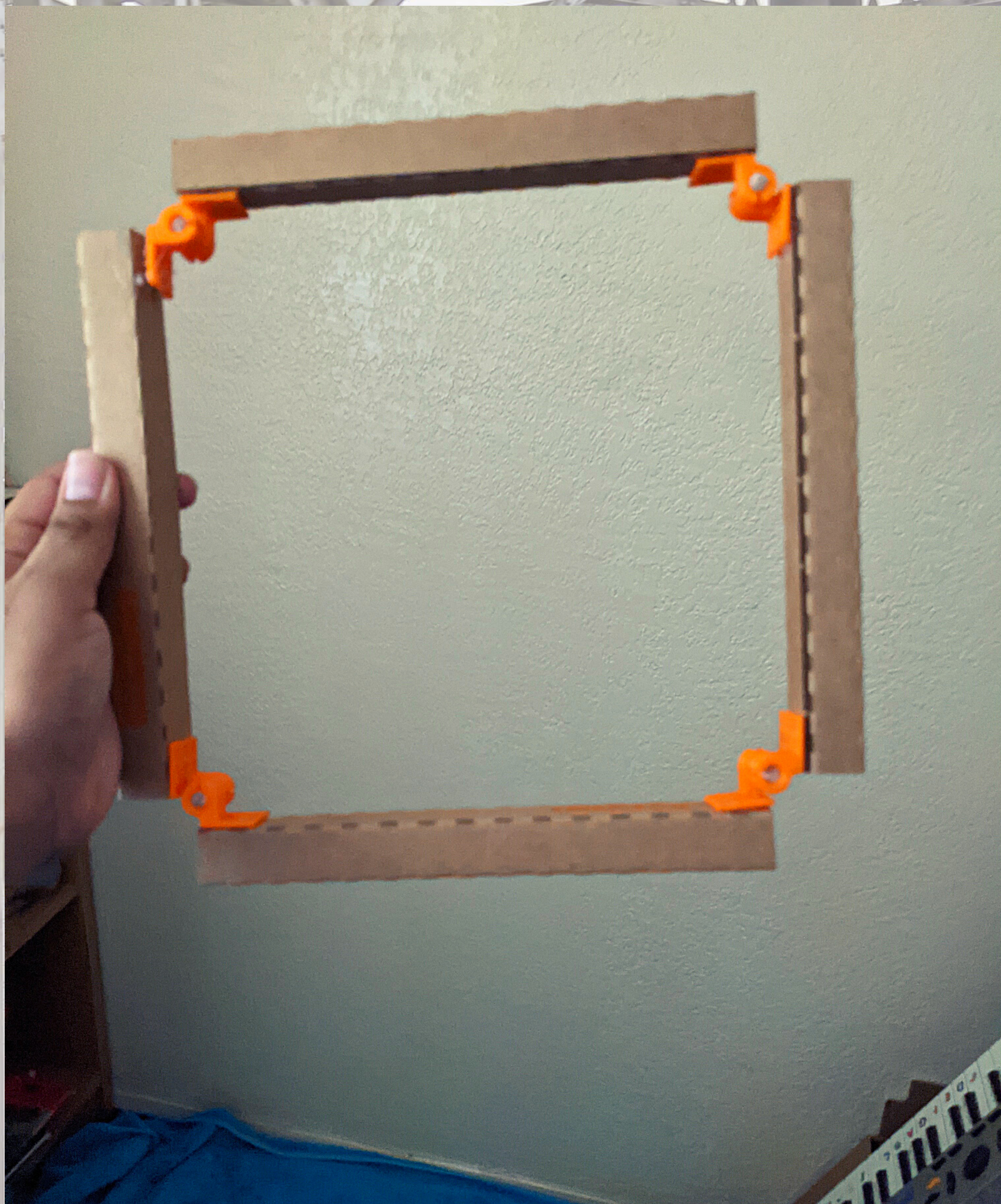
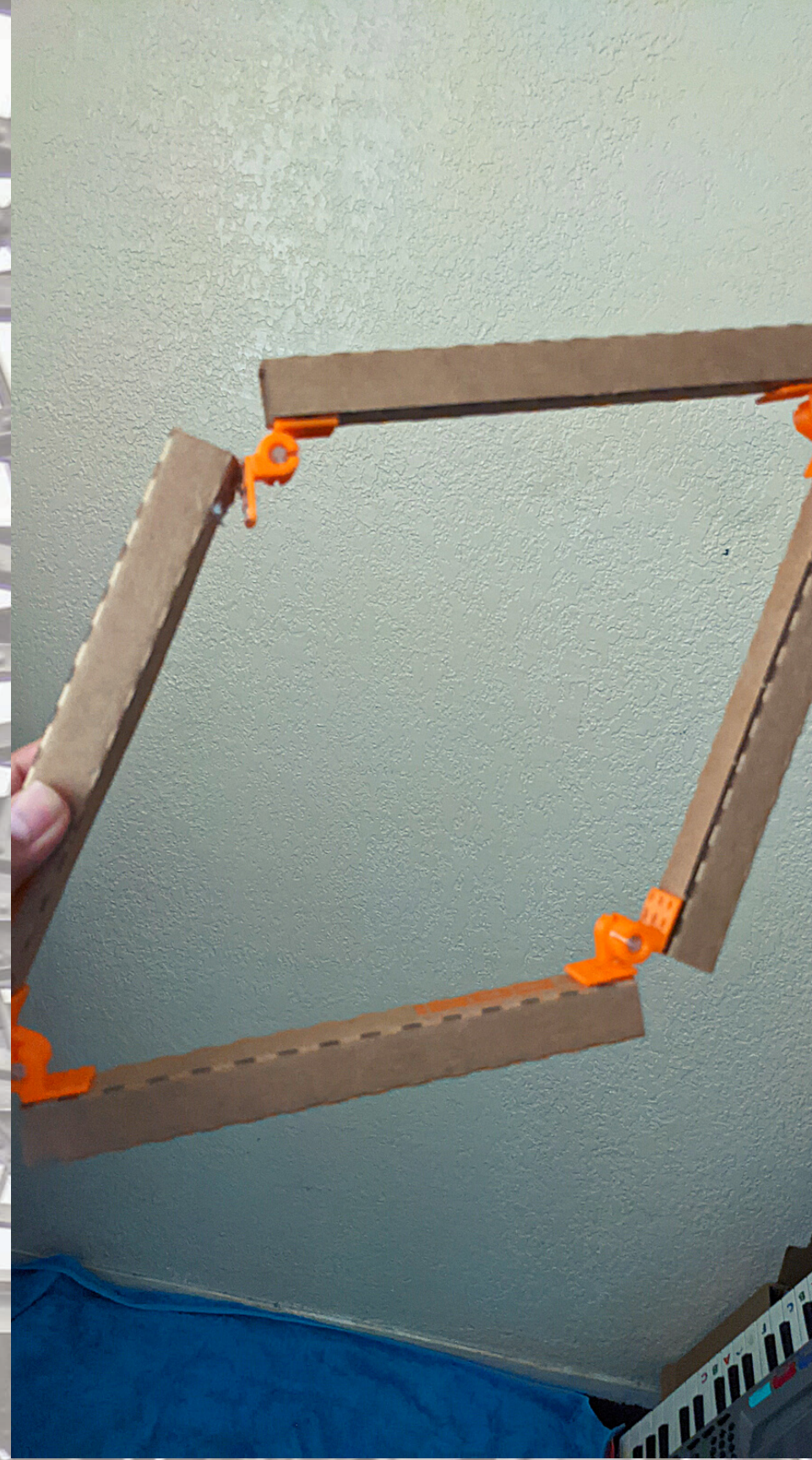
FEEL THE TENSION

Tensegrity table, tension in the strings keeps the table balanced.



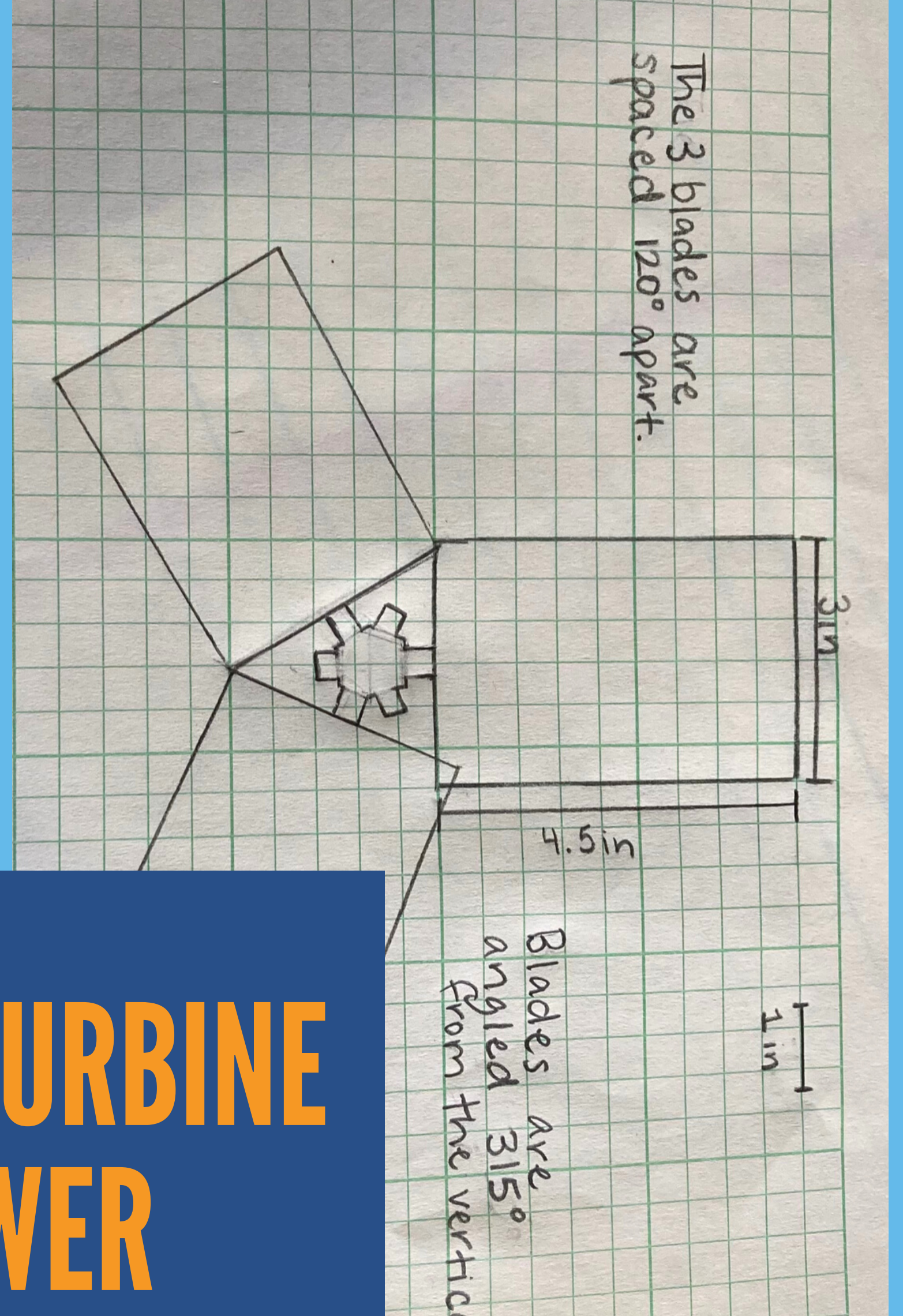
(CLOCKWISE FROM TOP LEFT) TABLES BY FIORA BERATAHANI, LUKE QIAO, ERIN SUN, AND AARON CHANG.





FRAME TESTING

(FROM BOTTOM LEFT, COUNTERCLOCKWISE):
ANDRES SALGADO TESTS HIS FRAME UNTIL IT
BREAKS. (TOP LEFT): ZACHARY CHUNG TESTS HIS
FRAME ON ZOOM.



WIND TURBINE TOWER

**Cluster 4 Design-Build Project
(Wind Turbine Tower): Final
Blades Design for Company 7
(We Doodle More Than Just
Purple Poodles)**



Cluster 5 : Photonics: Light-based Technologies in Everyday Life

Abigail Rapada

Aidan Kelley-Thackray

Alexander Atienza

Candis Wu

Emma Ka

Ezra Kim

Ishaan Gupta

Jack Chang

Jonathan Wang

Kara Fan

Neela Mohanpuhr

Pallavi Das

Rishi Halker

Rishi Kodavati

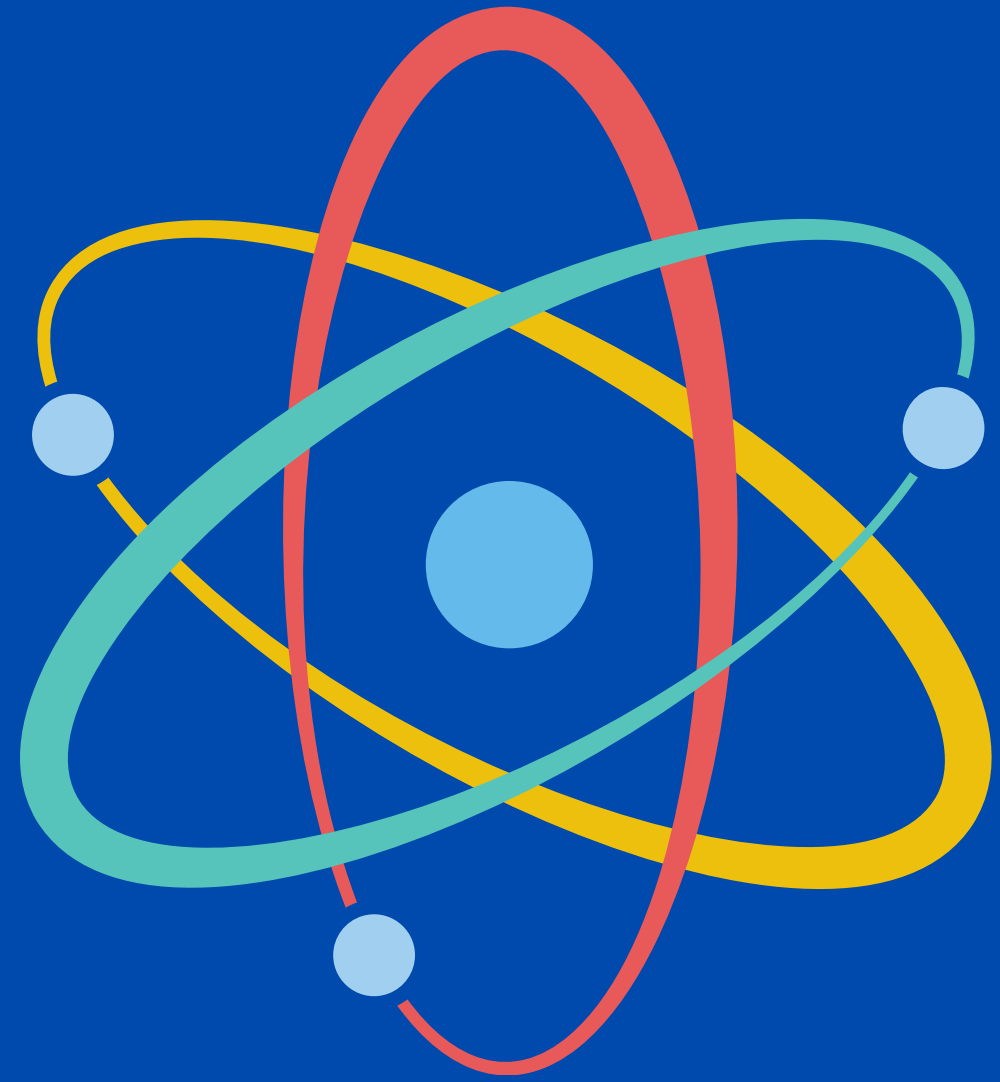
Rohini Iyer

Sanjit Sarda

Sarah Yoo

Victor Zhou

Yang Hill Zhang



WE ARE
PHOTONICS

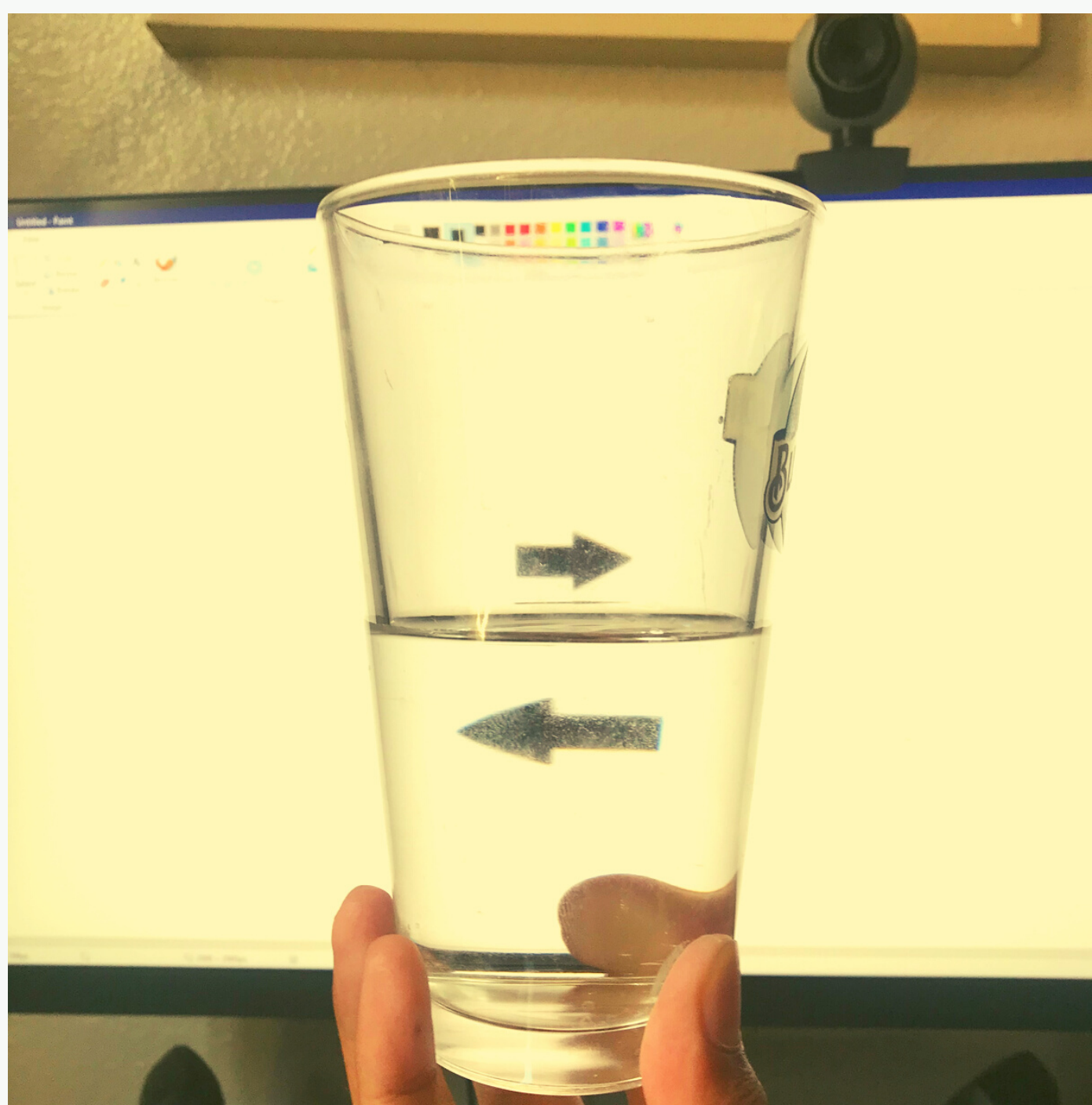
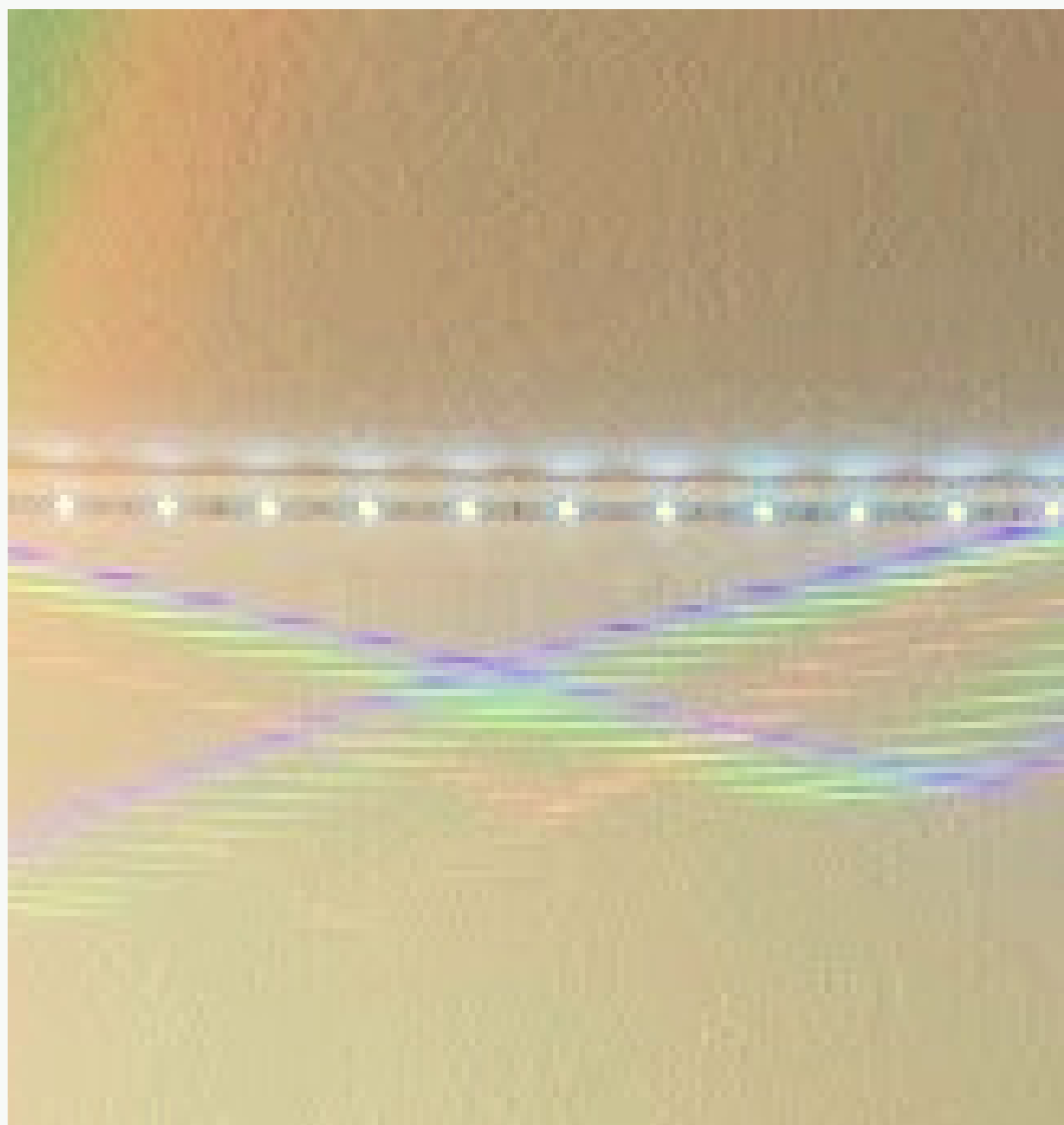
The economic driver for the 21st century is photonics.

In Cluster 5, we study the generation, manipulation, transmission, detection, and applications of light. Students conduct experiments with LED, laser, prism, lens, and spectrometers to study wave properties of light, such as polarization, diffraction, and interference, and also particle properties of light, such as photoelectric effect/solar cell.

Photo 1: optical illusion that illustrates the fundamental property of diffraction by changing the path of light.

Photo 2: a picture of LED lights to observe colors that show up from looking through a diffraction grating.

Photo 3: Light refraction is occurring causing the arrow to mirror the other way.



SPECTROPHOTOMETER

USES VERY SMALL SLITS TO BREAK UP
LIGHT INTO DIFFERENT WAVELENGTHS.



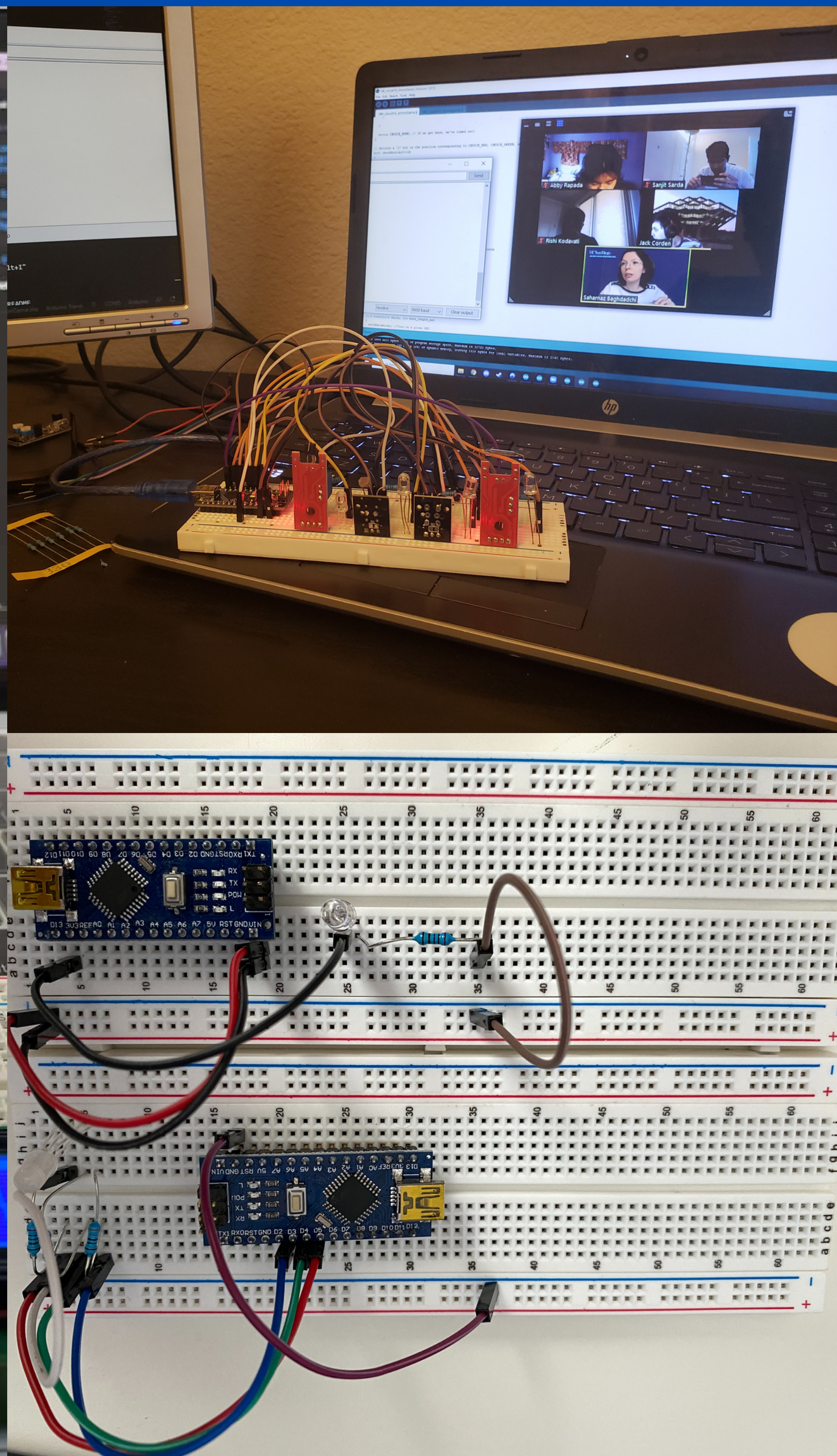
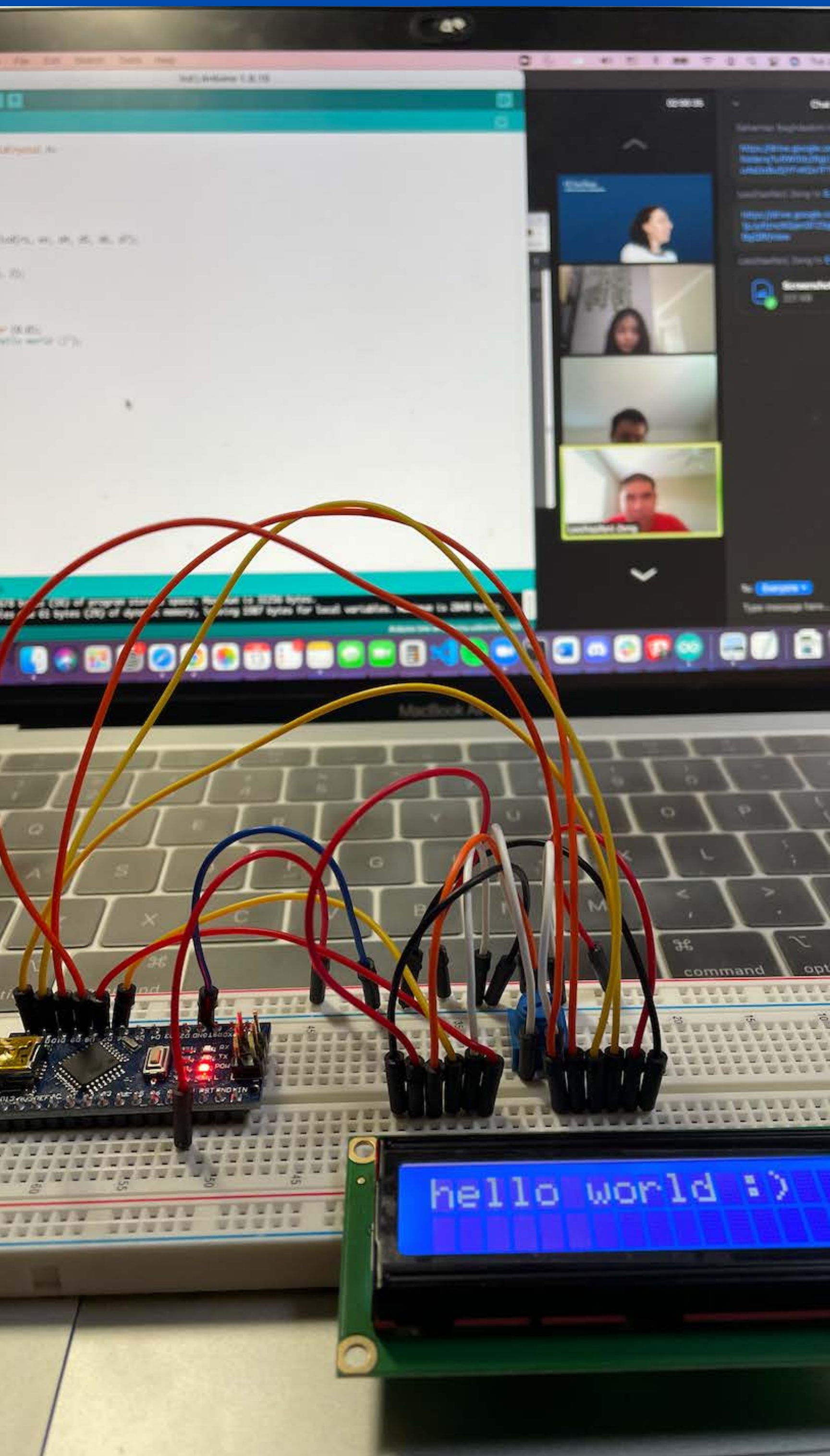
INSIDE OF THE
SPECTROSCOPE.
LIGHT SOURCE IS
FROM A
FLUORESCENT
LIGHT BULB BY
ABBY RAPADA.

SANJIT SARDA:
IMAGE TAKEN
FROM A
SPECTROMETER

AT HOME
SPECTROPHOTOMETER

ARDUINOS

(From left, clockwise): Prof Saharnaz Baghdadchi, TA Leo Zeng, students Candis Wu, Student Victor Zhou Candis' LCD display with Arduino along with the code; Sanjit Sarda, Rishi Kodavati, Pallavi Das, Jack Cordan playing Simon Says Game with an Arduino; turning on LED lights of different colors on Arduinos.



Cluster 7: Synthetic Biology

Adaleiz Ore

Andrea Lou

Aneesh Garg

Brooke Holmstrom

Charlotte Lewis

Christopher Woolson

Dylan Choi

Ellie Kim

Gianna Ysabel Besmonte

Ibrahim Alnahhal

Jacob Lei

Julisse Moreno

Kailee Kee

Maximus Neal

Naya Fullerton

Nicholas Kvale

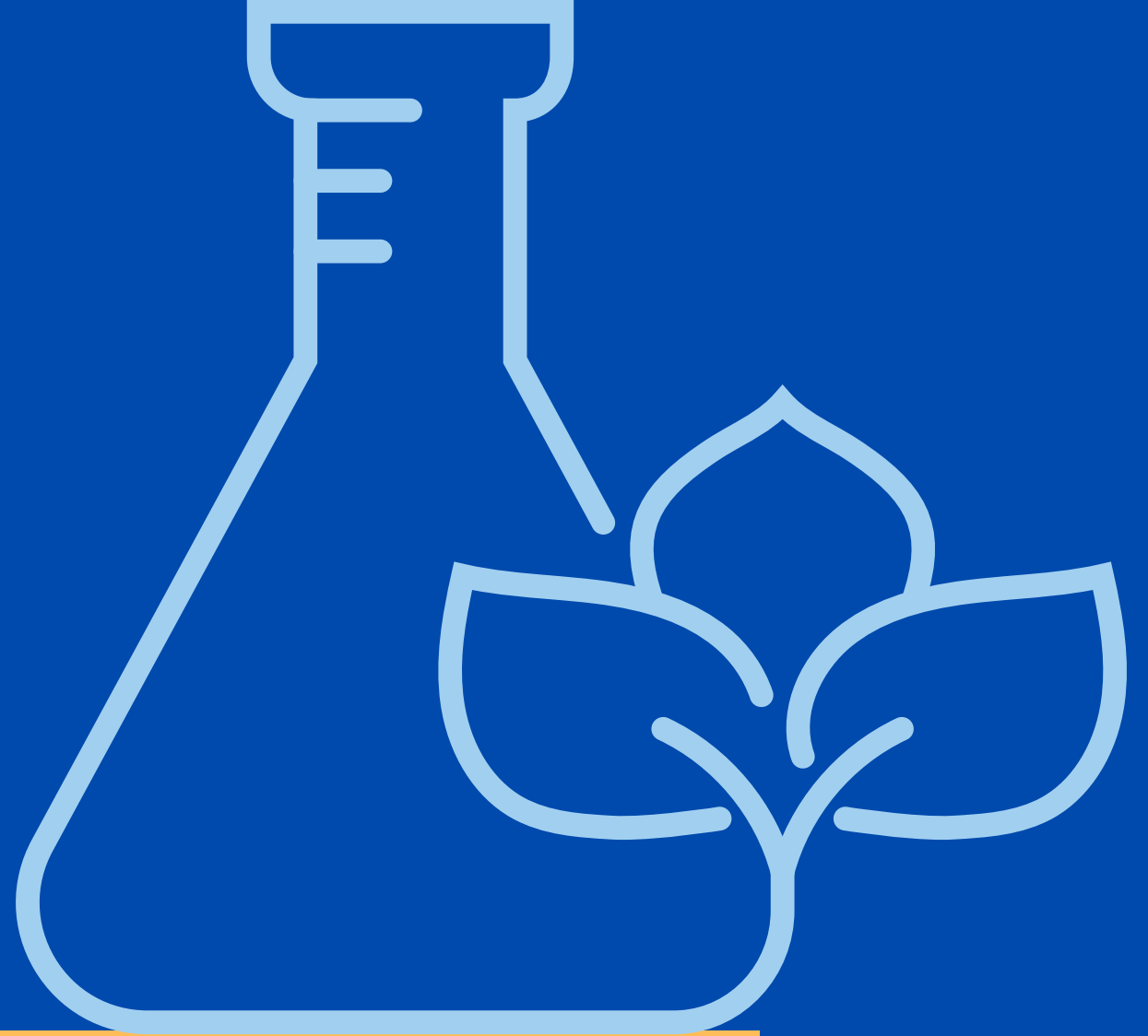
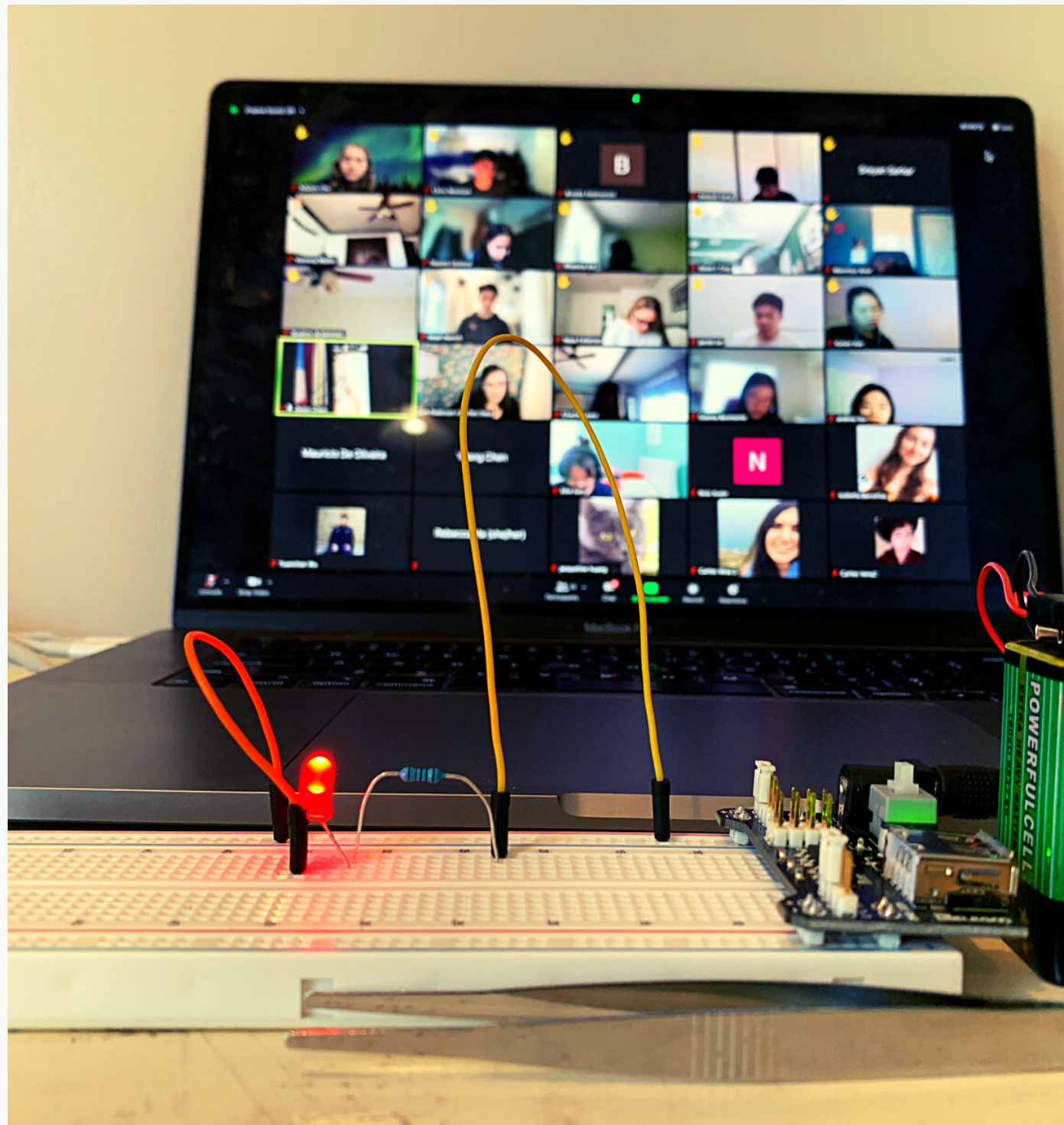
Noah Novick

Pauline General

Phoenix Xinyu He

Sreyan Sarkar

Vanessa Muller



WE ARE
SYNTHETIC
BIOLOGY

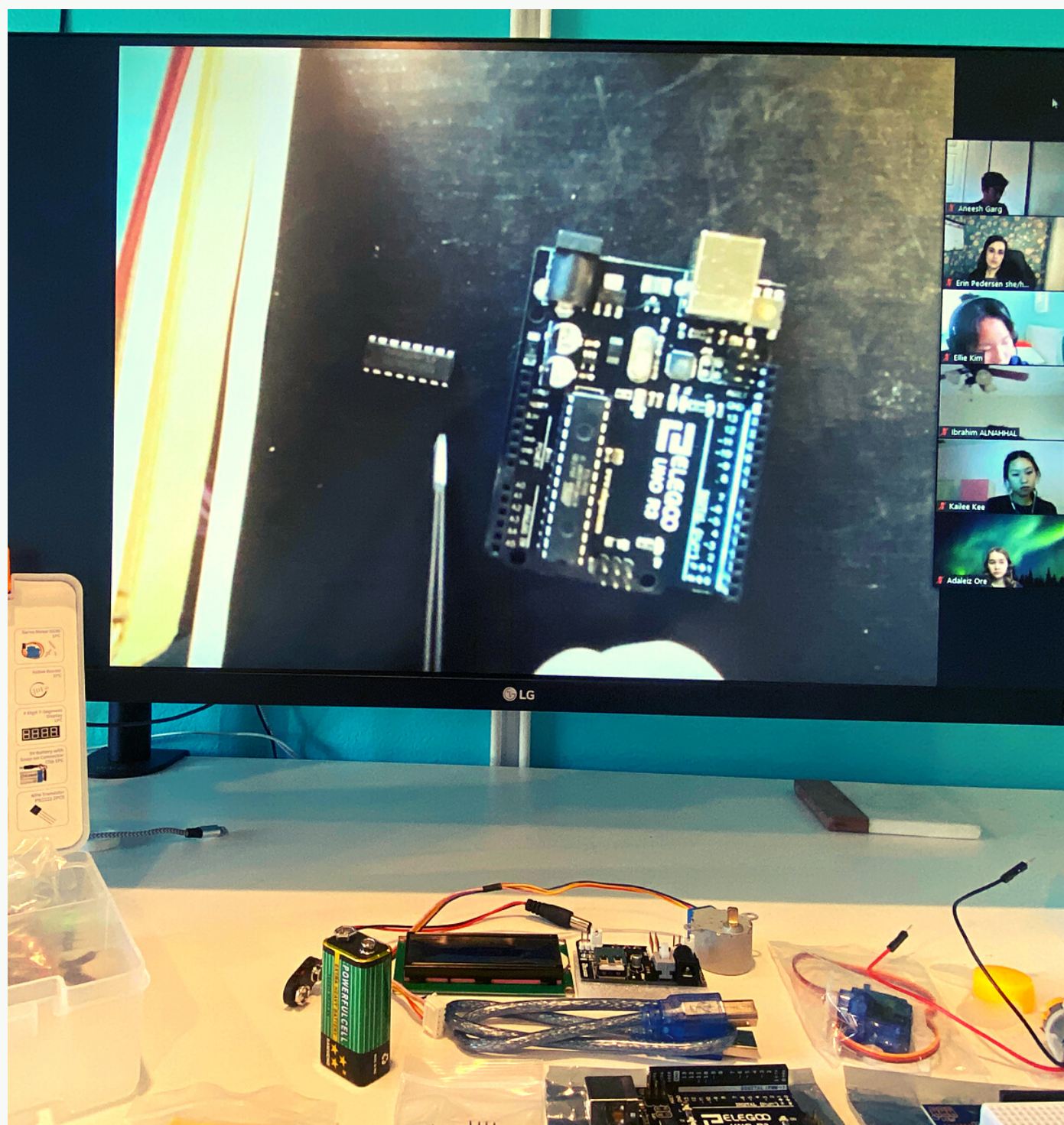
Producing novel organisms in scalable & reliable ways

In Cluster 7, students learn about the basic concepts and techniques of synthetic biology, apply engineering principles to design, build and test modified organisms, and develop mathematical models that quantitatively describe their behavior.

Photo 1: The class is working together on connecting their first circuit on the bread board!

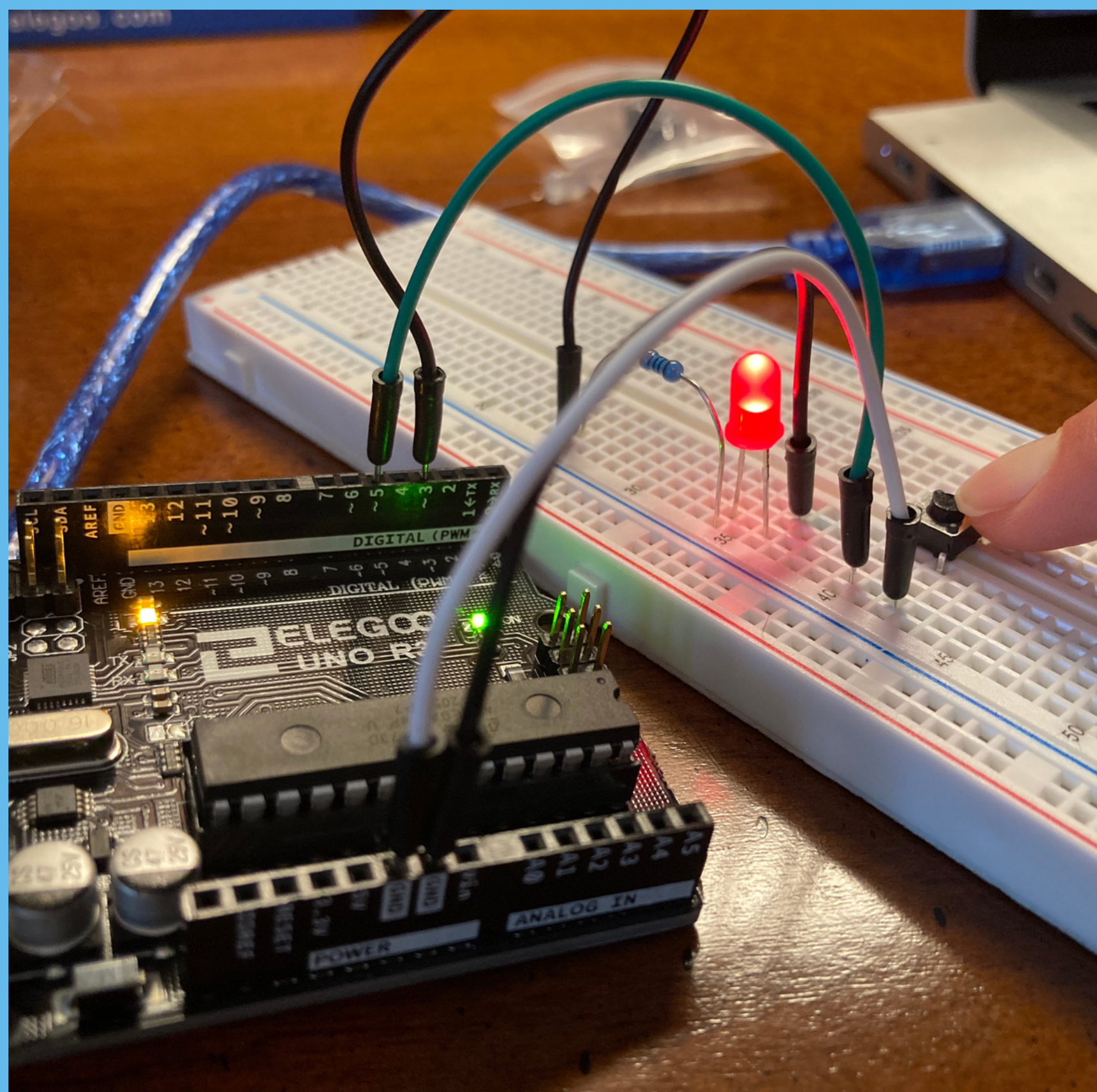
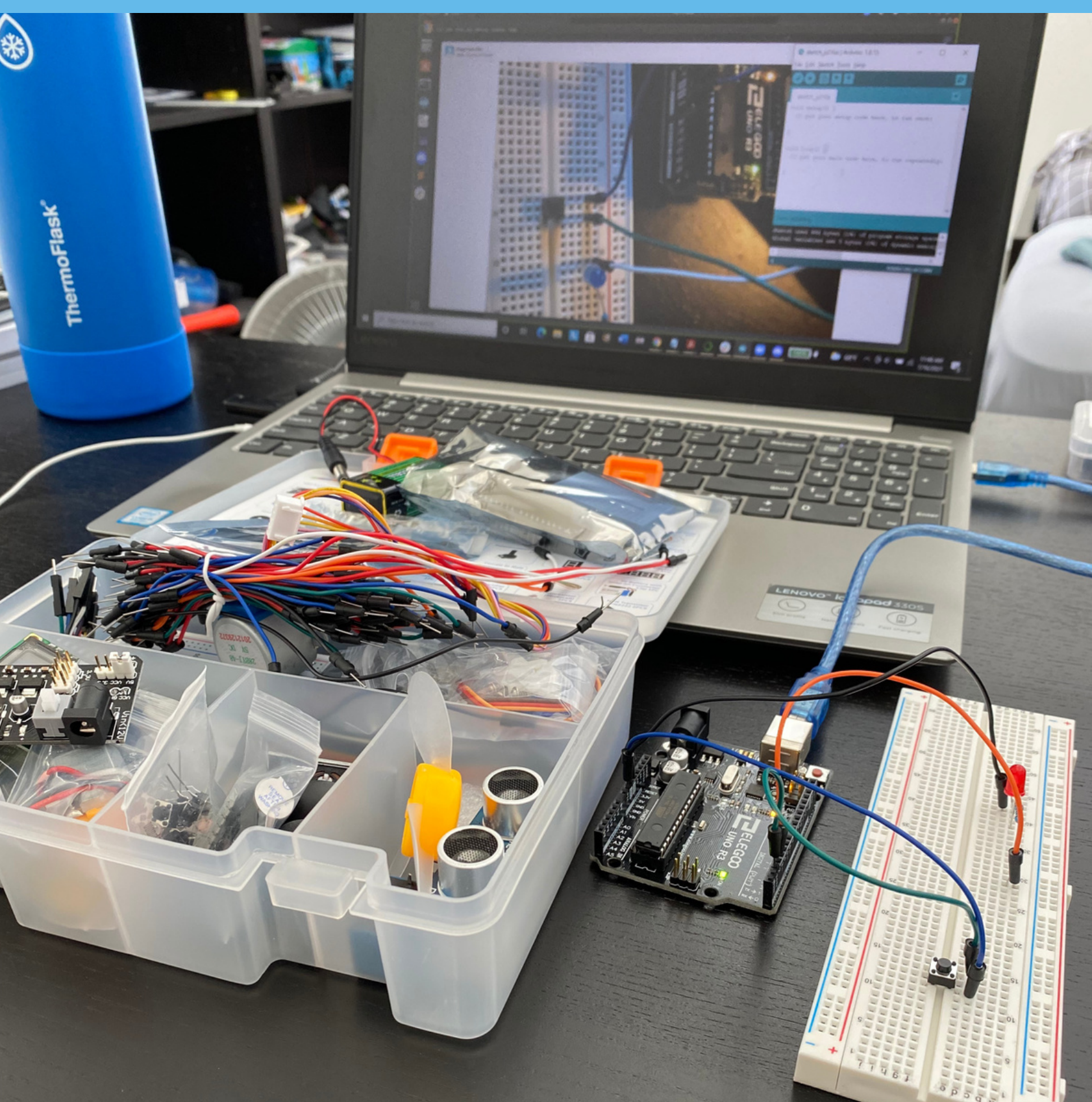
Photo 2: The instructor is going over the function of the arduino.

Photo 3: The group is learning about the arduino, with all the materials laid out.



CODING & CIRCUIT BOARDS

USING THE ARDUINO SOFTWARE AND THE CIRCUIT BOARDS IN OUR KIT TO TURN AN LED ON AND OFF BASED ON A GIVEN INPUT. PHOTOS BY JACOB LEI. (BOTTOM RIGHT) CODING FOR A LIGHT BY CHRIS KRIS ORE.

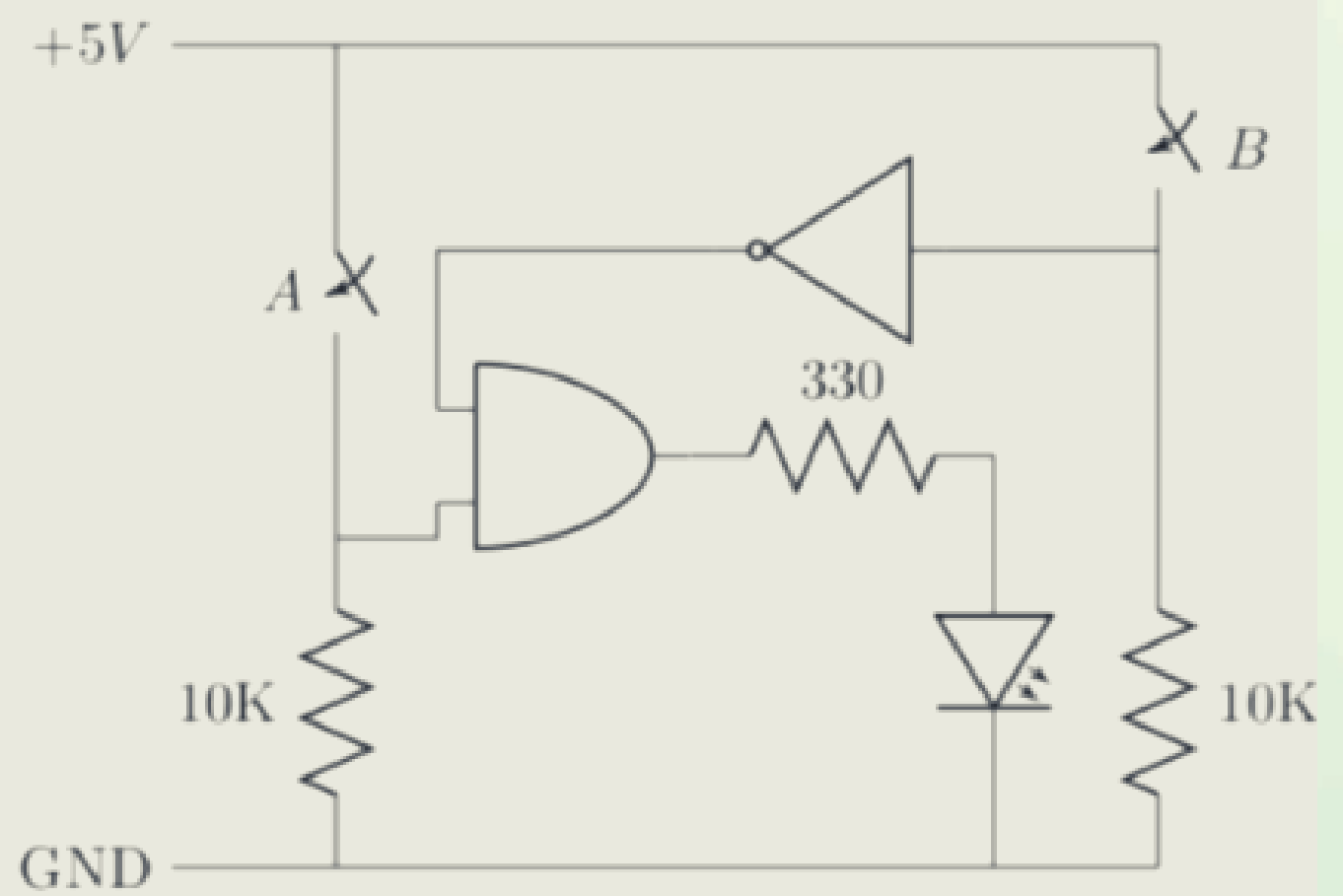


SYNTHETIC BIOLOGY

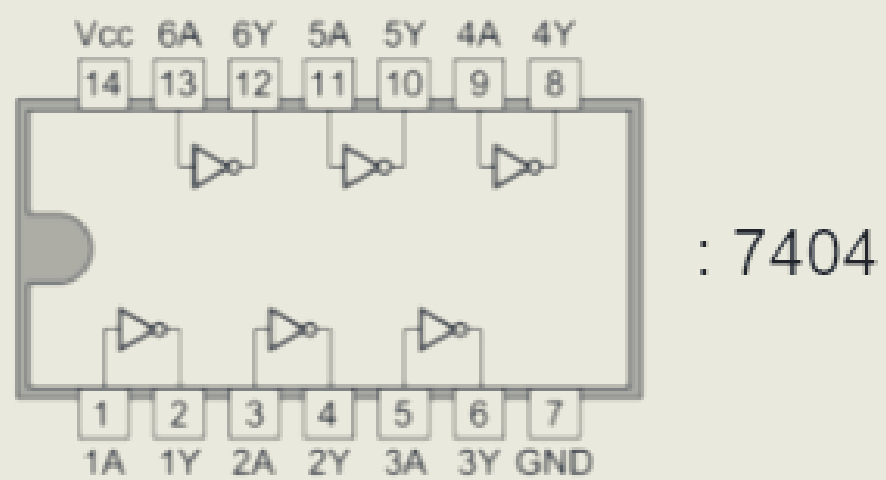
Basic Circuits

Circuit 5: LED + 2 switches + NOT + AND

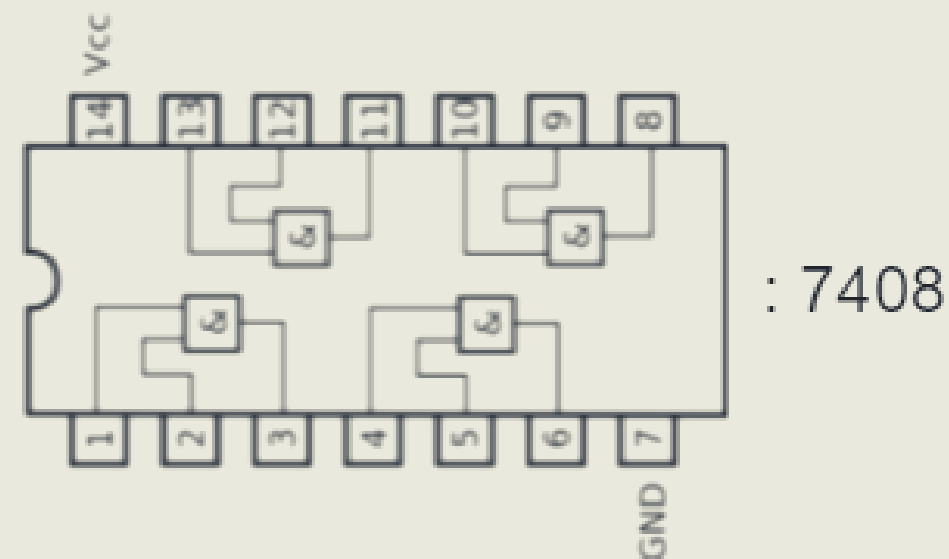
A	B	f(A,B)
0	0	0
0	1	0
1	0	1
1	1	0



Parts:

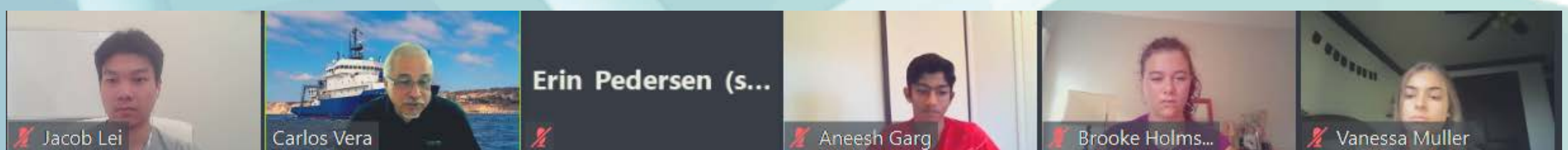


: 7404



: 7408

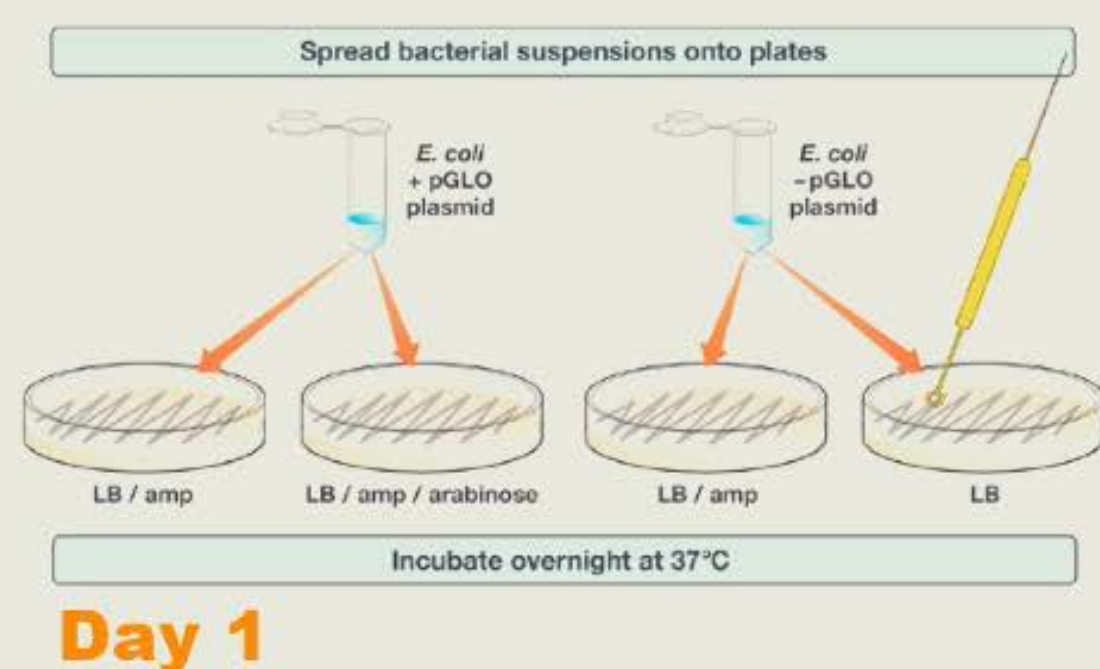
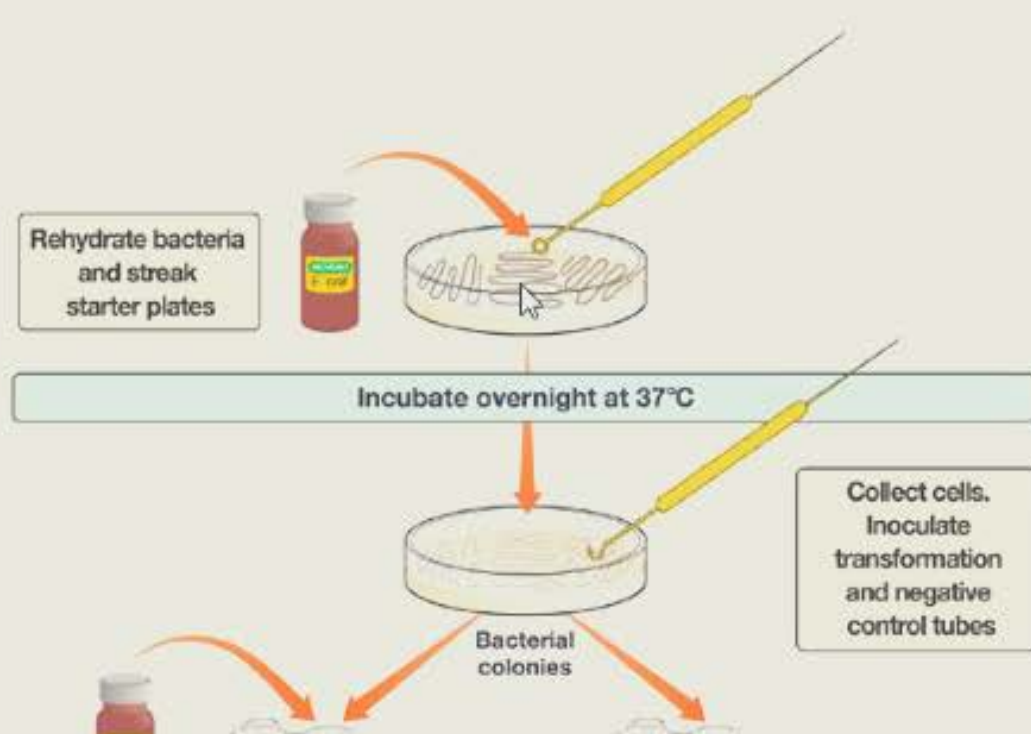
(TOP) PROBLEM DESCRIPTION FOR "IMG_1642.HEIC", (BOTTOM) ONE OF OUR BIOLOGY LECTURES ABOUT THE BACTERIAL TRANSFORMATION PROCESS, A KEY PROCESS IN SYNTHETIC BIOLOGY AND ENGINEERING BACTERIA. PHOTOS BY JACOB LEI.



Biotechnology
Explor[™]

BIO-RAD

Transformation Procedure



Day 1

Cluster 8 - Tissue Engineering & Regenerative Medicine

Andersen Cheong

AshlyInn Chen

Audrey Wu

Callie Chen

Cata Cattano

Cecilia Trinh

Chelsea An

Devon Darley

Eunice Kim

Jayita Mukunda

Jennifer Chang

Kata Nickel

Kate Sanchez

Madeline Goldsmith

Melina Moreno

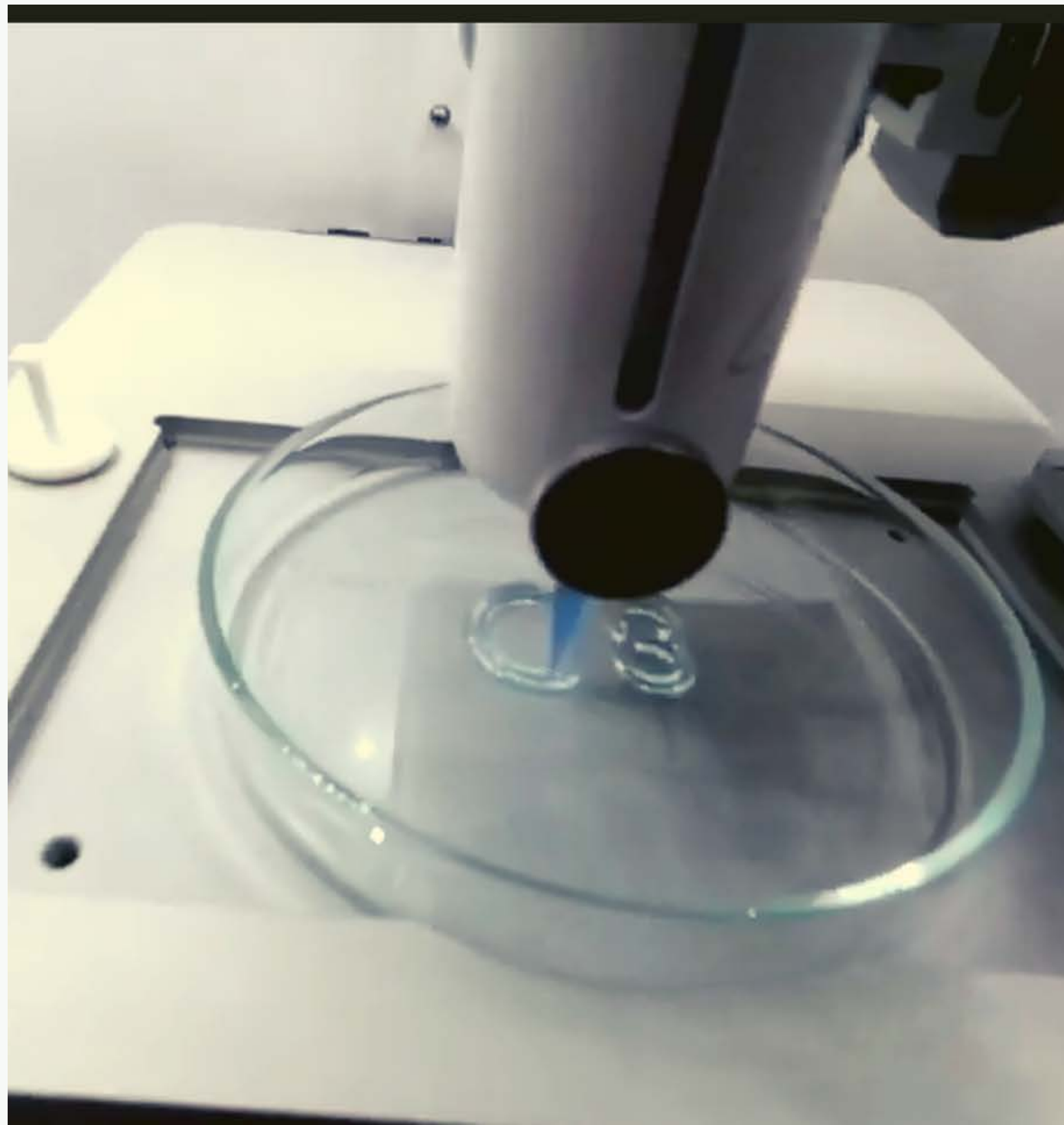
Michael Egan

Renee Kou

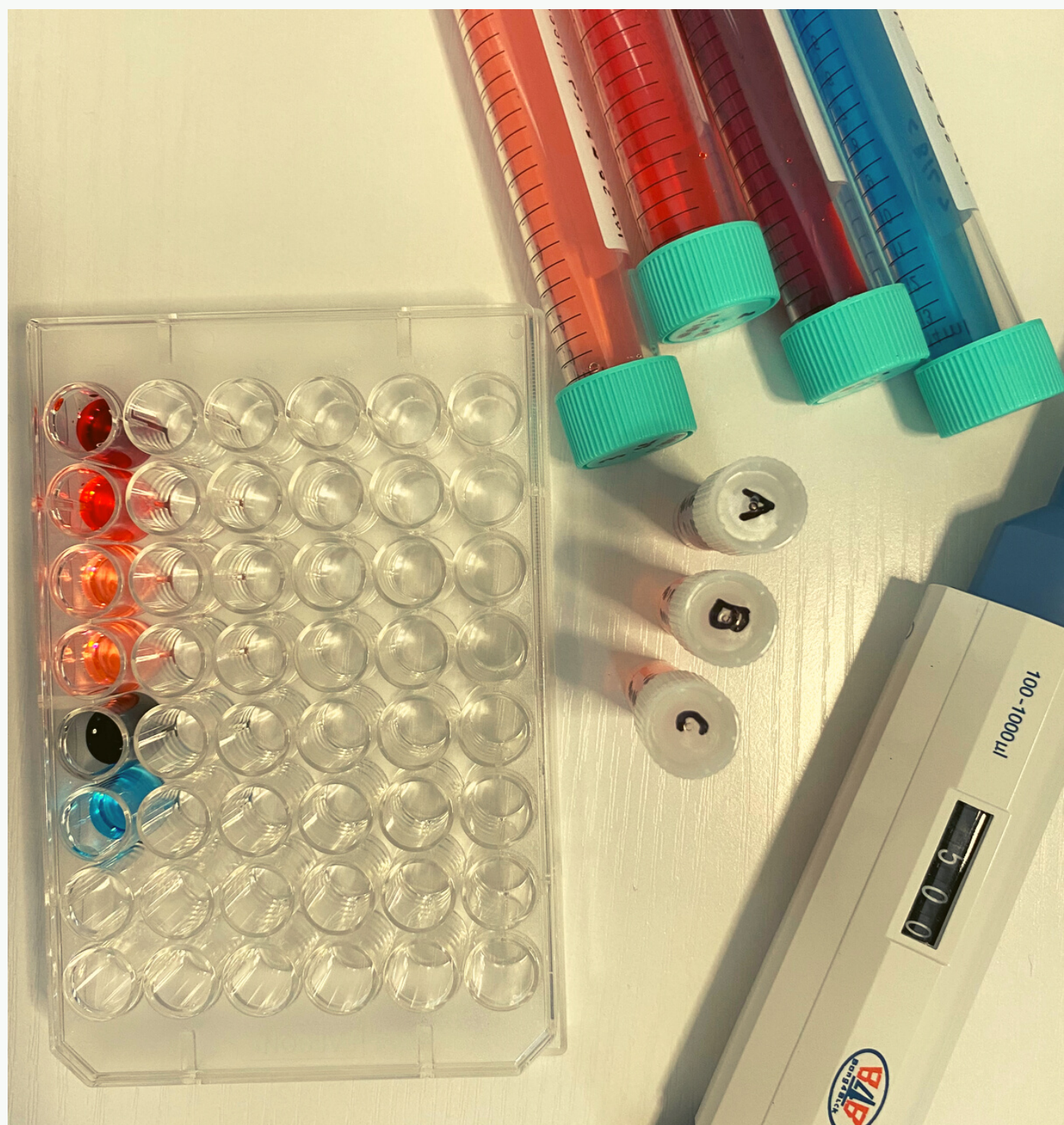
Suhas Yarra

Victoria Ko

Yi Ren Samuel
Chen



WE ARE TISSUE ENGINEERING & REGENERATIVE MEDICINE



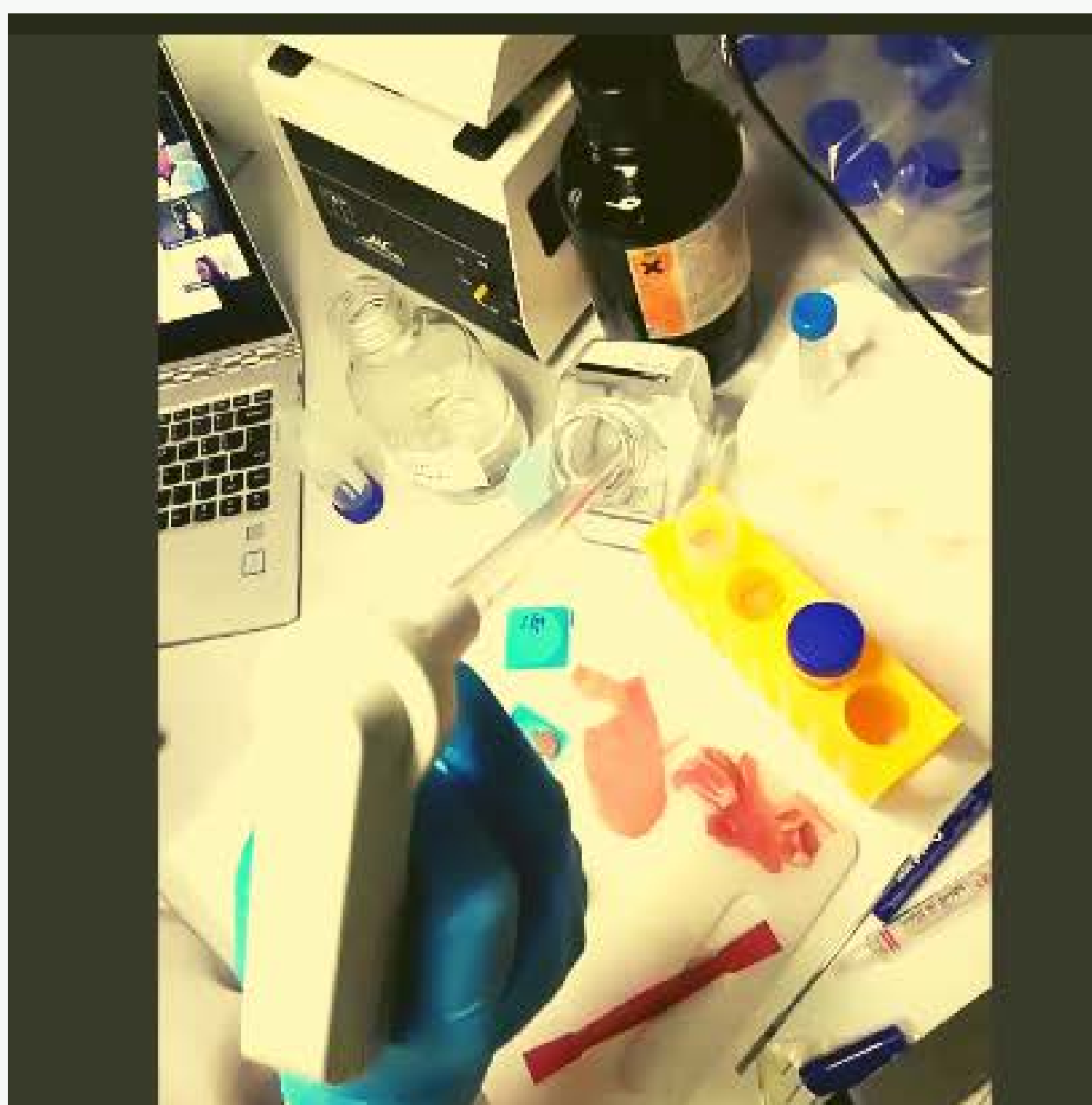
Restoring, maintaining, or improving tissue functions

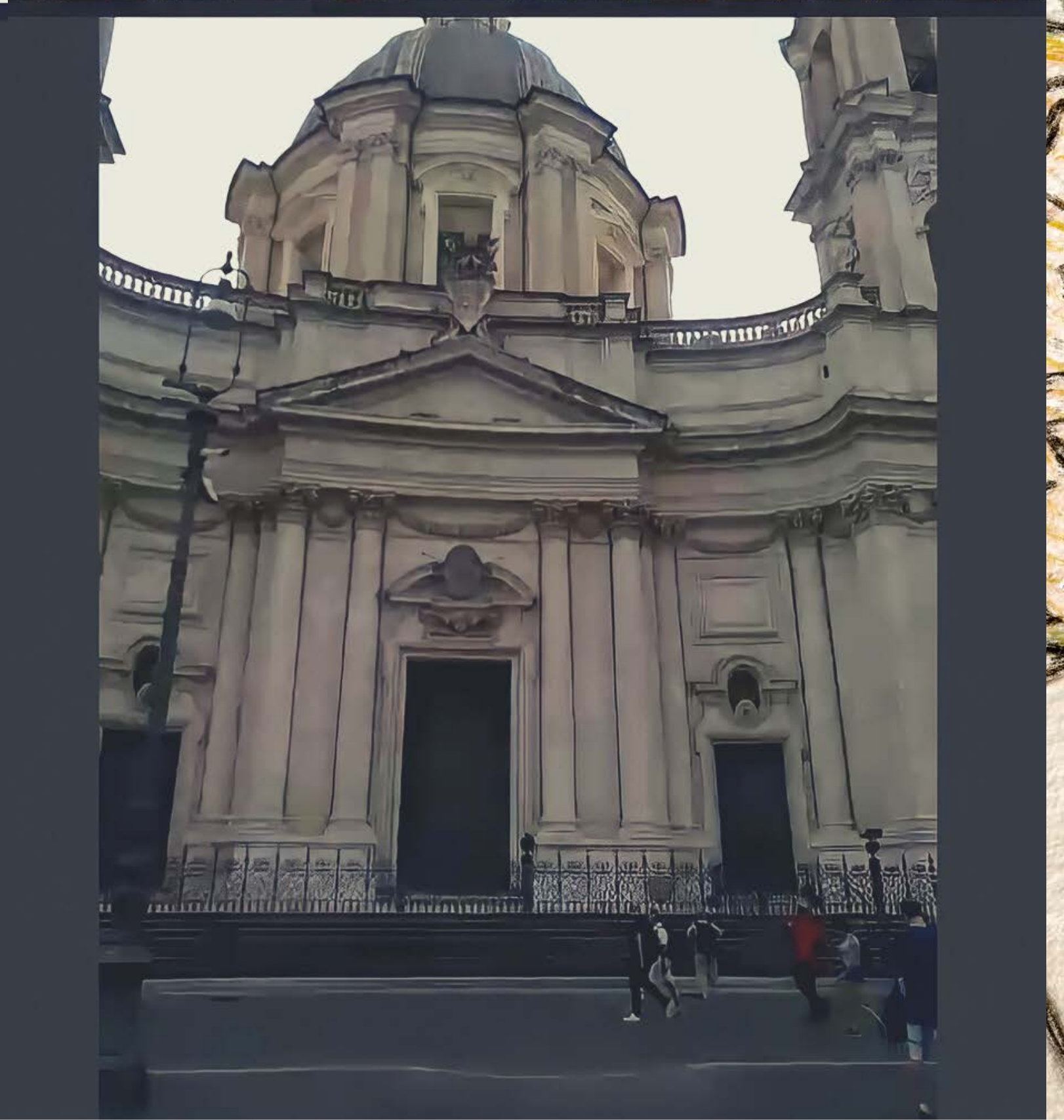
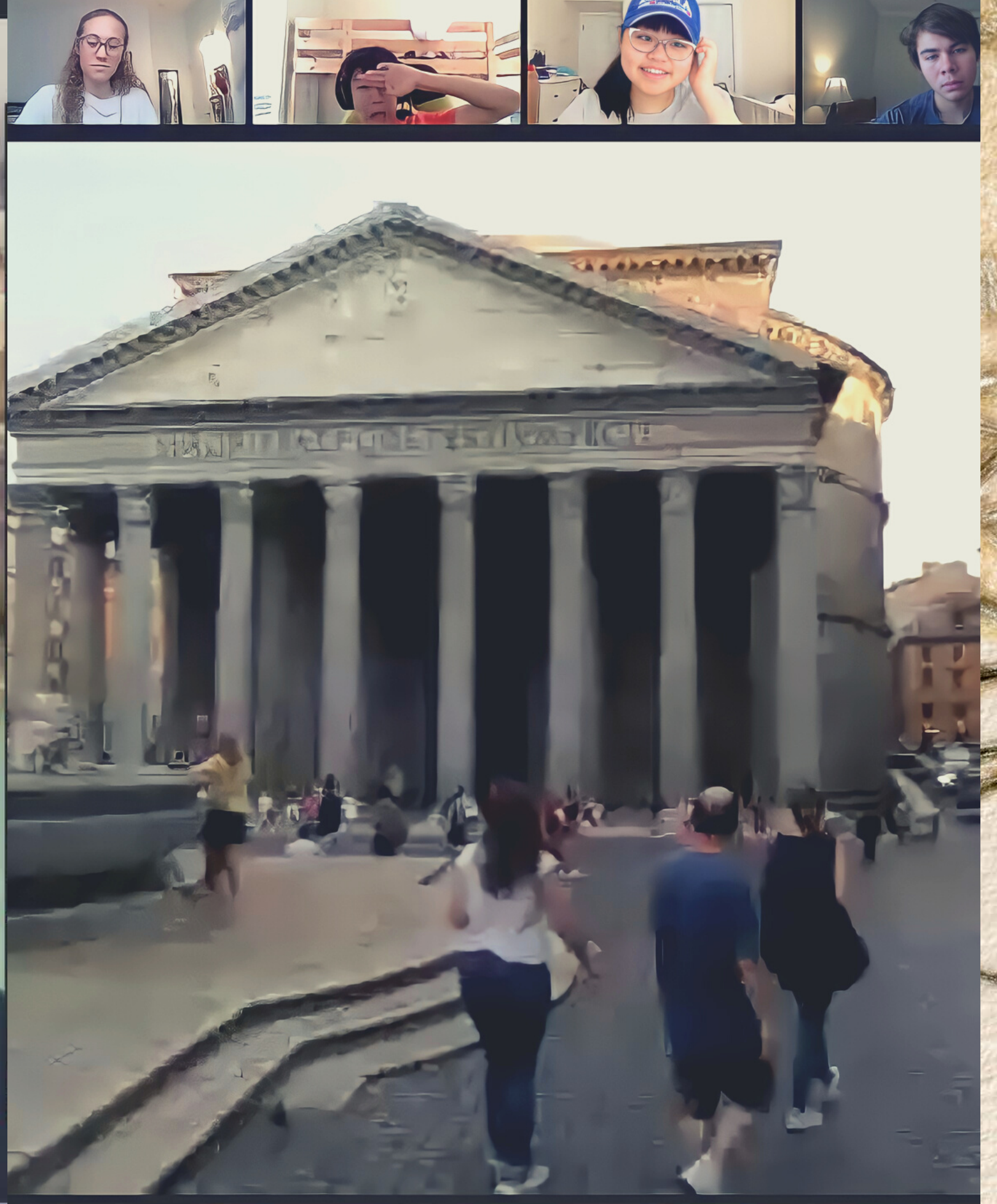
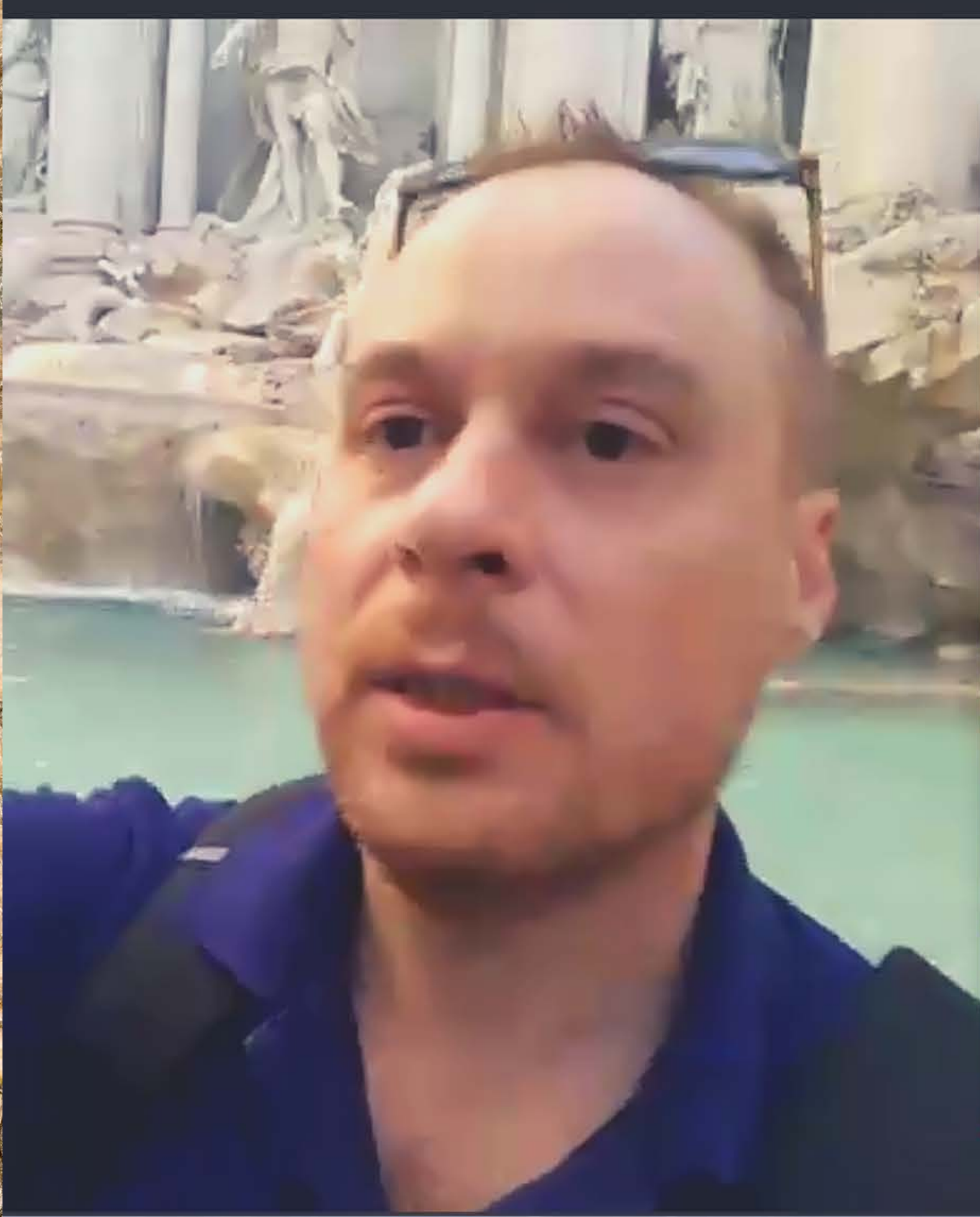
TE-RM are exciting and interdisciplinary fields involving engineers, biologists, chemists, material scientists, and doctors. TE-RM are increasingly providing alternative treatments for medical conditions where traditional treatments such as drugs, medical devices, or transplants face limitations.

Photo 1: Watching Dr.Gaetani and Laura bioprint "C8" as part of a bioinks and bioprinting lesson.

Photo 2: The results of a lab where we learned how to use serological pipets (not pictured) and micropipettes to create food dye dilutions.

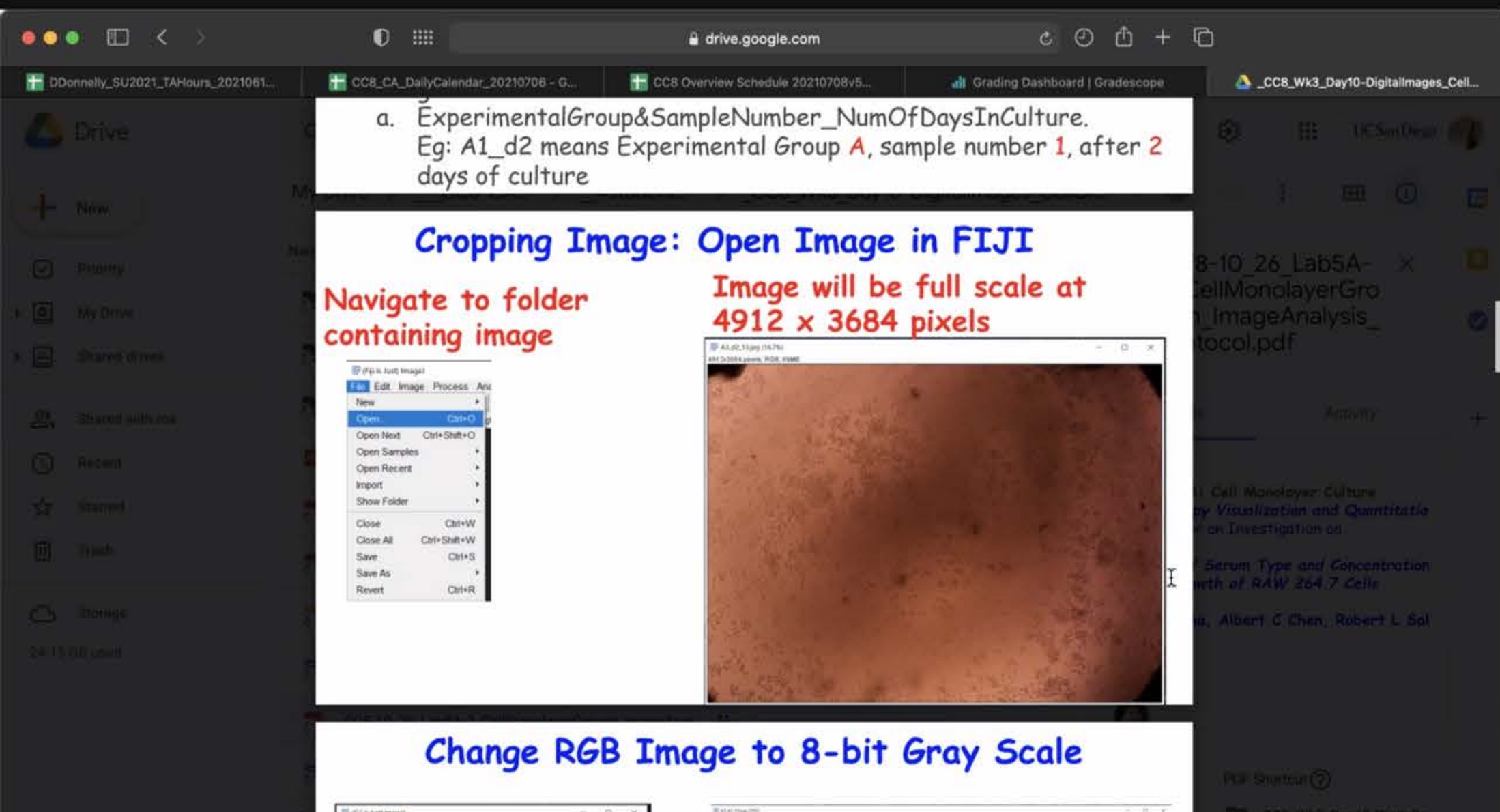
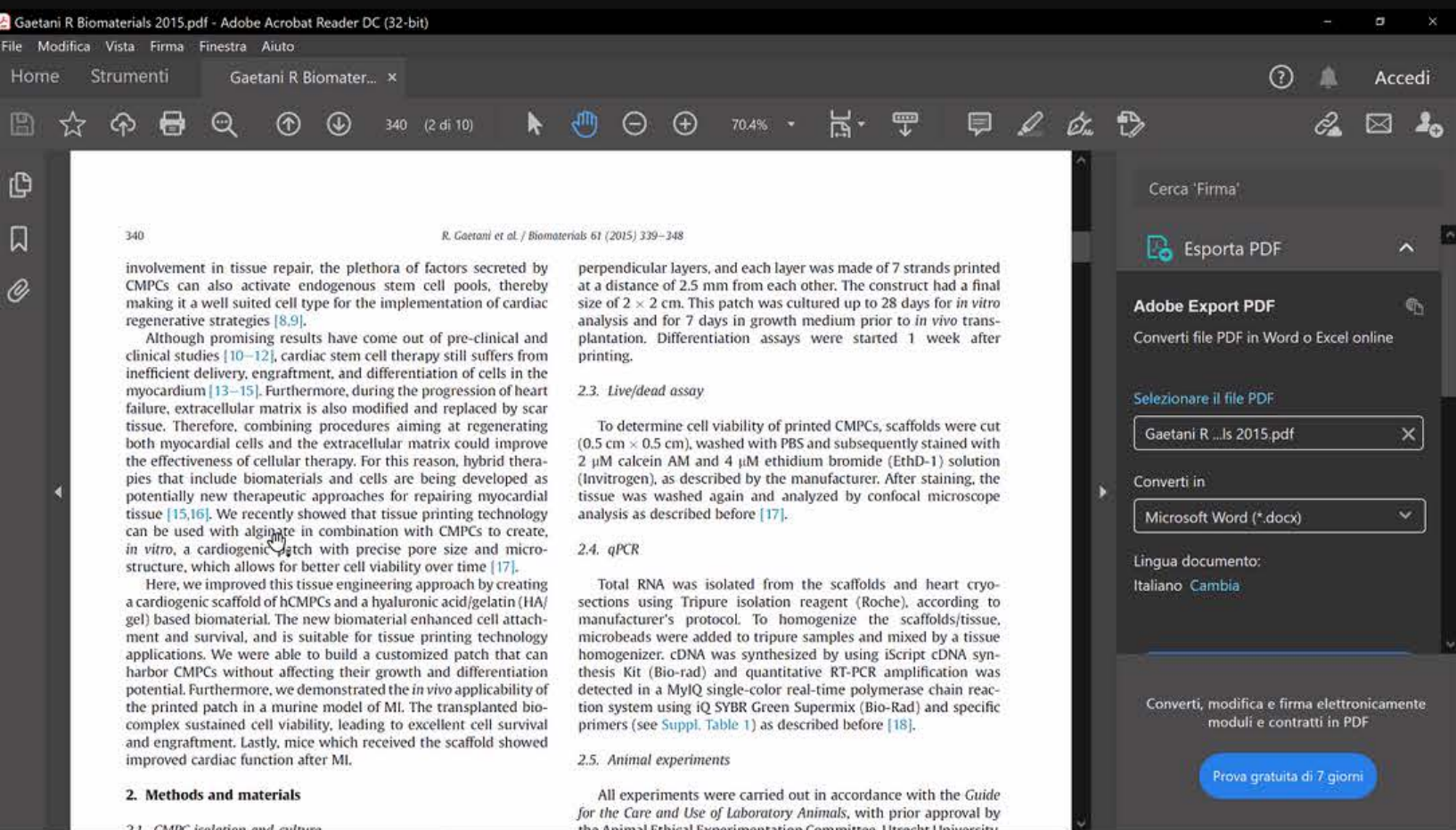
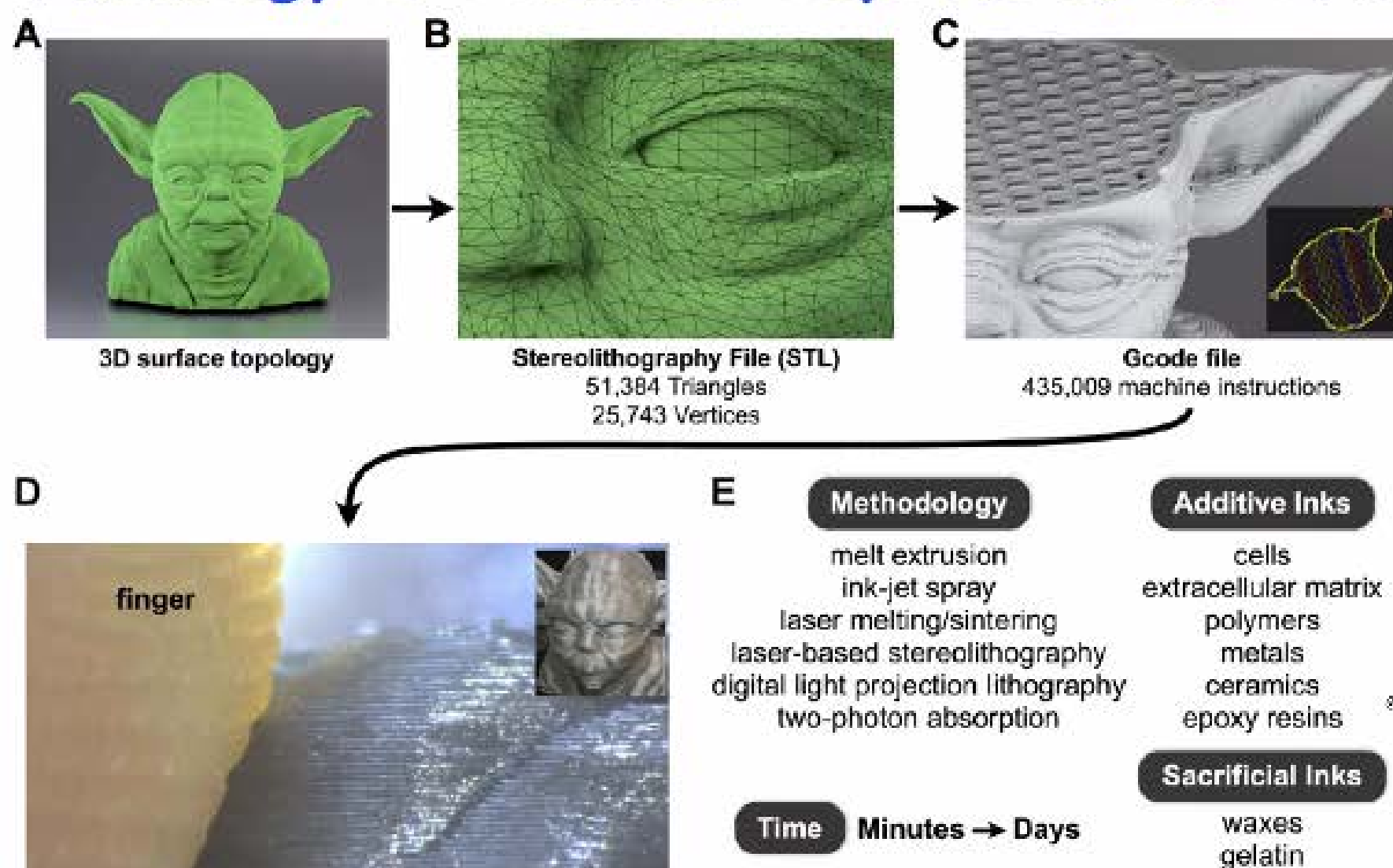
Photo 3: Dr.Gaetani begins a decellularization lab on a piece of pork tenderloin.





**Virtual field trips to Italy
with Dr. Gaetani. Sites
pictured: Trevi Fountain,
the Pantheon, Fountain of
Neptune, and Piazza Navona.**

Terminology & Technical Aspects of 3D Printing



ZOOM SCHOOL

Photo 1: Dr. Sah teaches Cluster 8 about 3D printing.

Photo 2: During Journal Club, Dr. Gaetani explains the parts of a formal, scientific research paper.

Photo 3: Cluster Assistant Arya goes over a prelab for "Light Microscopy Visualization and Quantitation for an Investigation on the Effect of Serum Type and Concentration on Growth of RAW 264.7 Cells".

Cluster 9 - Music and Technology

Amanda Xu

Andrew Liu

Andy Wang

Annie Hu

Anshul Gupta

Ashley Chen

Atishay Lalgudi

Casey Chen

Daly Gibson

Daylin Atwood

Elizabeth Yoon

Flora Yuan

Japleen Kaur

Jeanie Chan

Joel Kim

Katherine Guo

Nithin Chilakapati

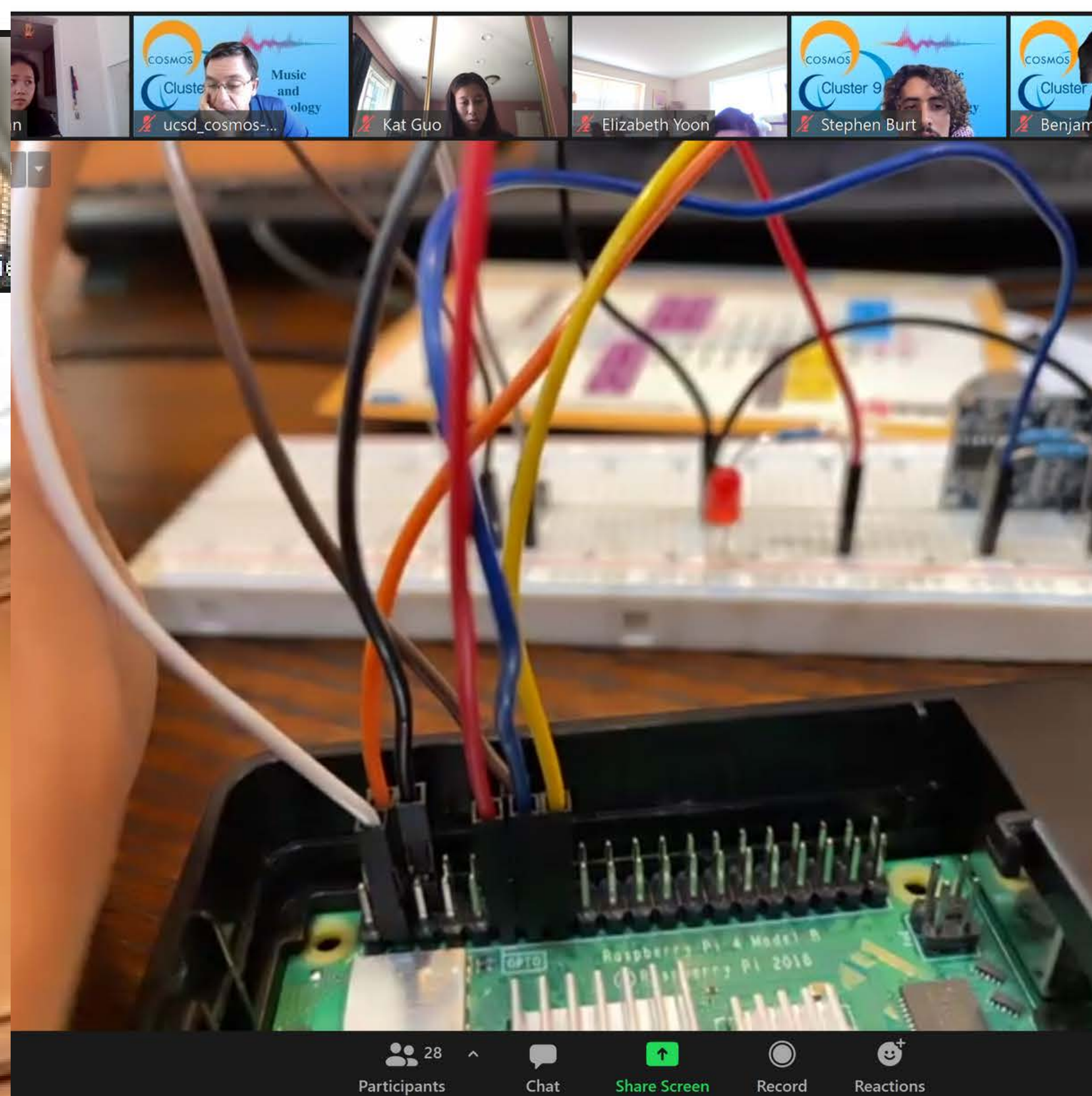
Paurush Pandey

Tejas Bharadwaj

Trinav Chaudhuri

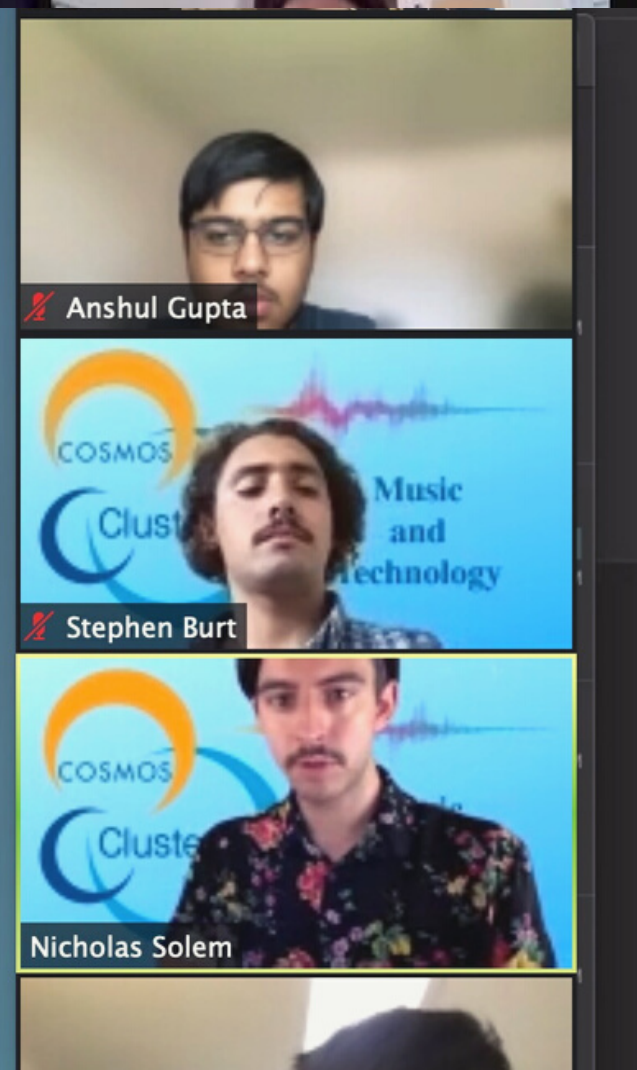
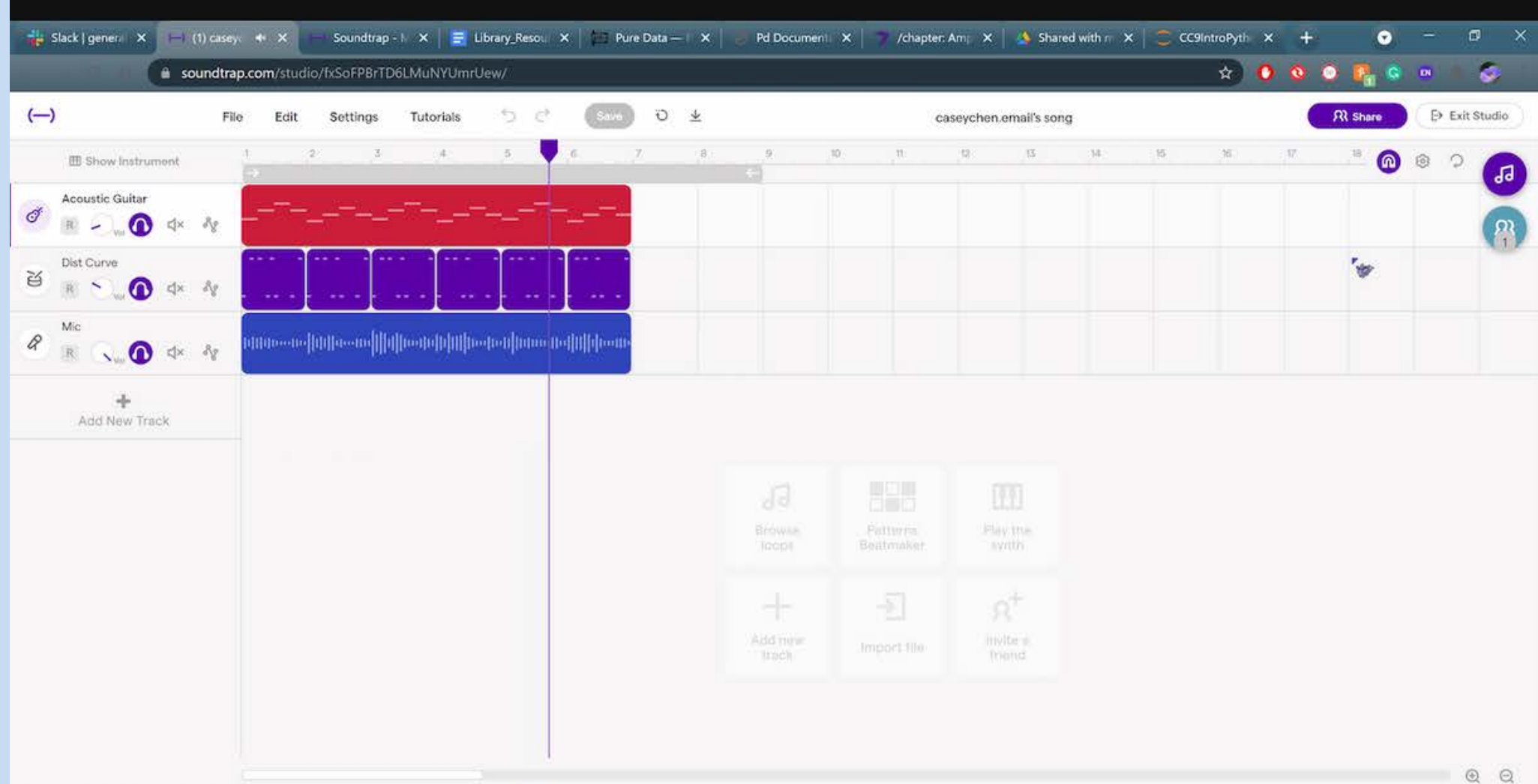
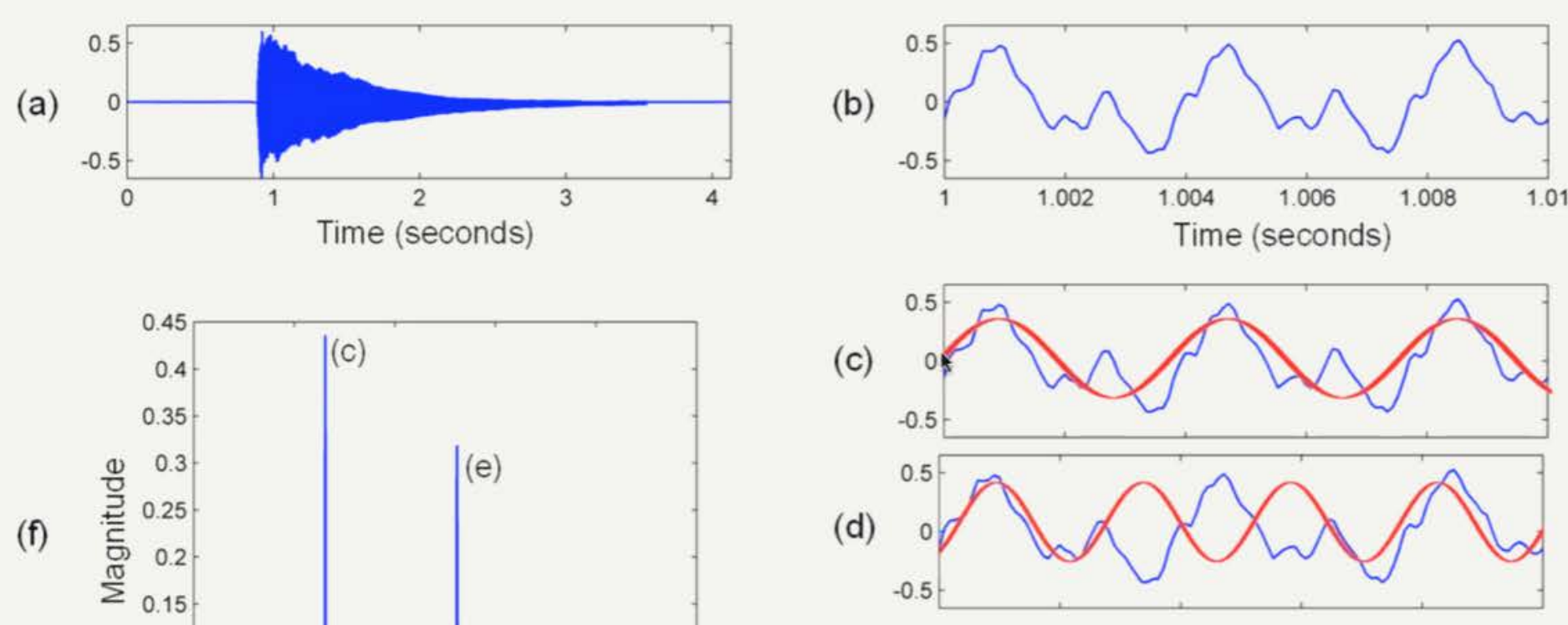
Vivian Zhu

Cluster 9 Project: RASPBERRY PI



**(CLOCKWISE FROM LEFT) ASSEMBLING OUR RASPBERRY PIS,
WORKING WITH THE RASPBERRY PI AND PYTHON CODING,
CLUSTER 9 GROUP PHOTO. PHOTOS BY FLORA YUAN.**

The Fourier Transform in a Nutshell



ONLINE LEARNING

PHOTO 1: DR. SHLOMO DUBNOV TEACHES US THE BASIC APPLICATIONS OF FOURIER TRANSFORMS WITHIN AUDIO WAVES AND MUSIC.

PHOTO 2: FLORA YUAN SHARES THE MUSIC HER GROUP CREATED ON SOUNDTRAP.

PHOTO 3: TAS NICHOLAS AND STEPHEN HELP OUR GROUP (ANSHUL, ANDREW, AND KAT) WITH AUDIO COMPOSITION USING THE SOFTWARE LANGUAGE PURE DATA.



Cluster 10 - Robot Inventors

Aden Jo

Aditi Borra

Aiden Deffner

Akul Dhawan

Annie Ping

Arvin Zhang

Ashwin Prakash

Ethan Can

Ethan Zhang

Harper Johnston

Isabelle Layon

Joshua Nam

Julie Wu

Justin Wang

Kaitlin Divinsky

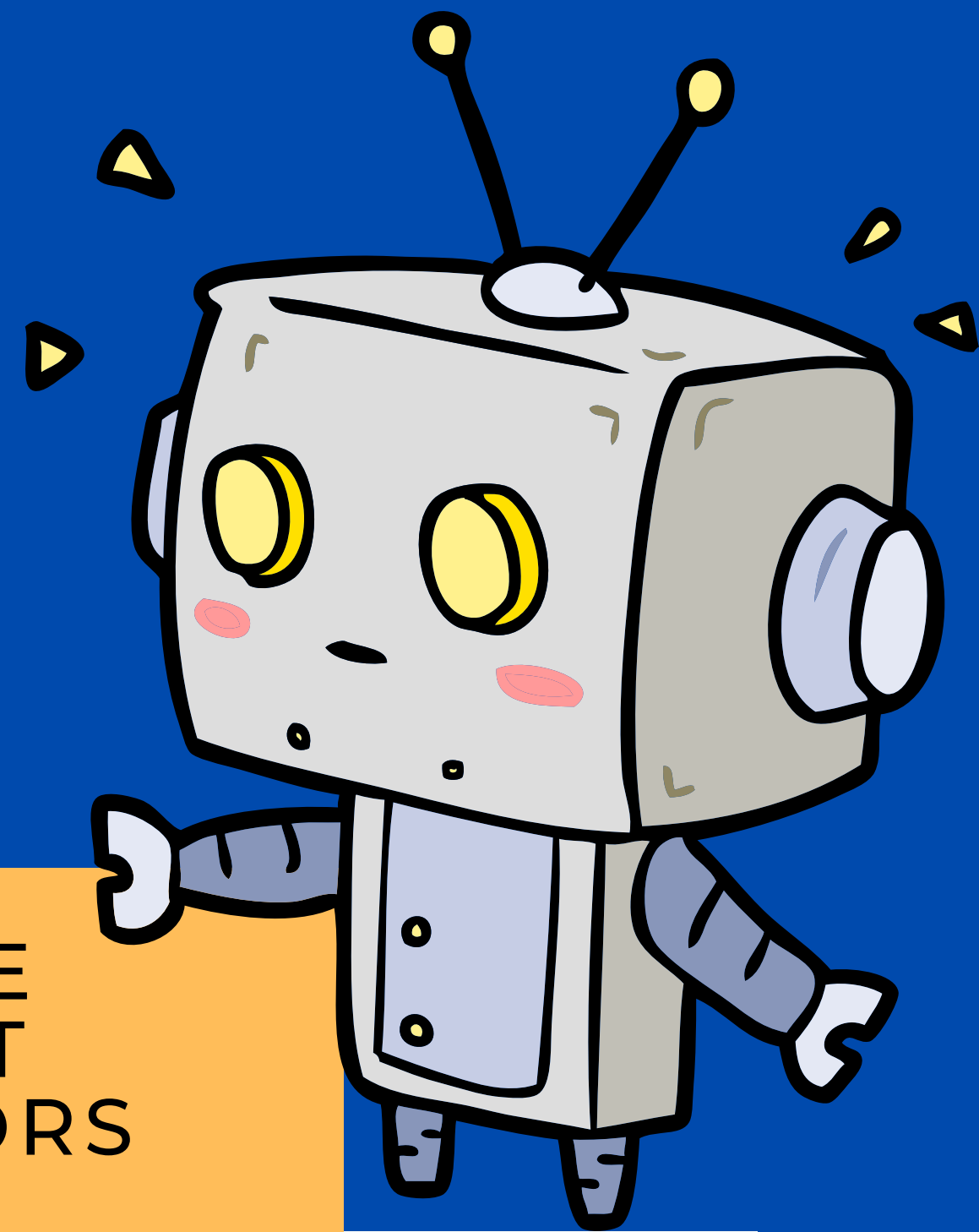
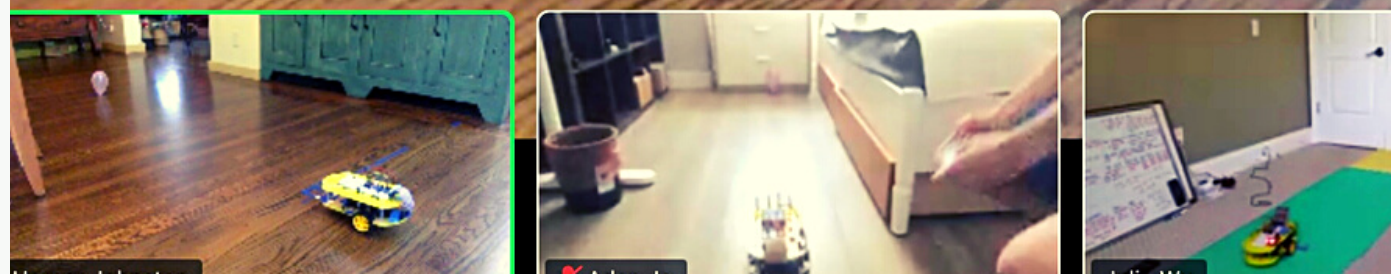
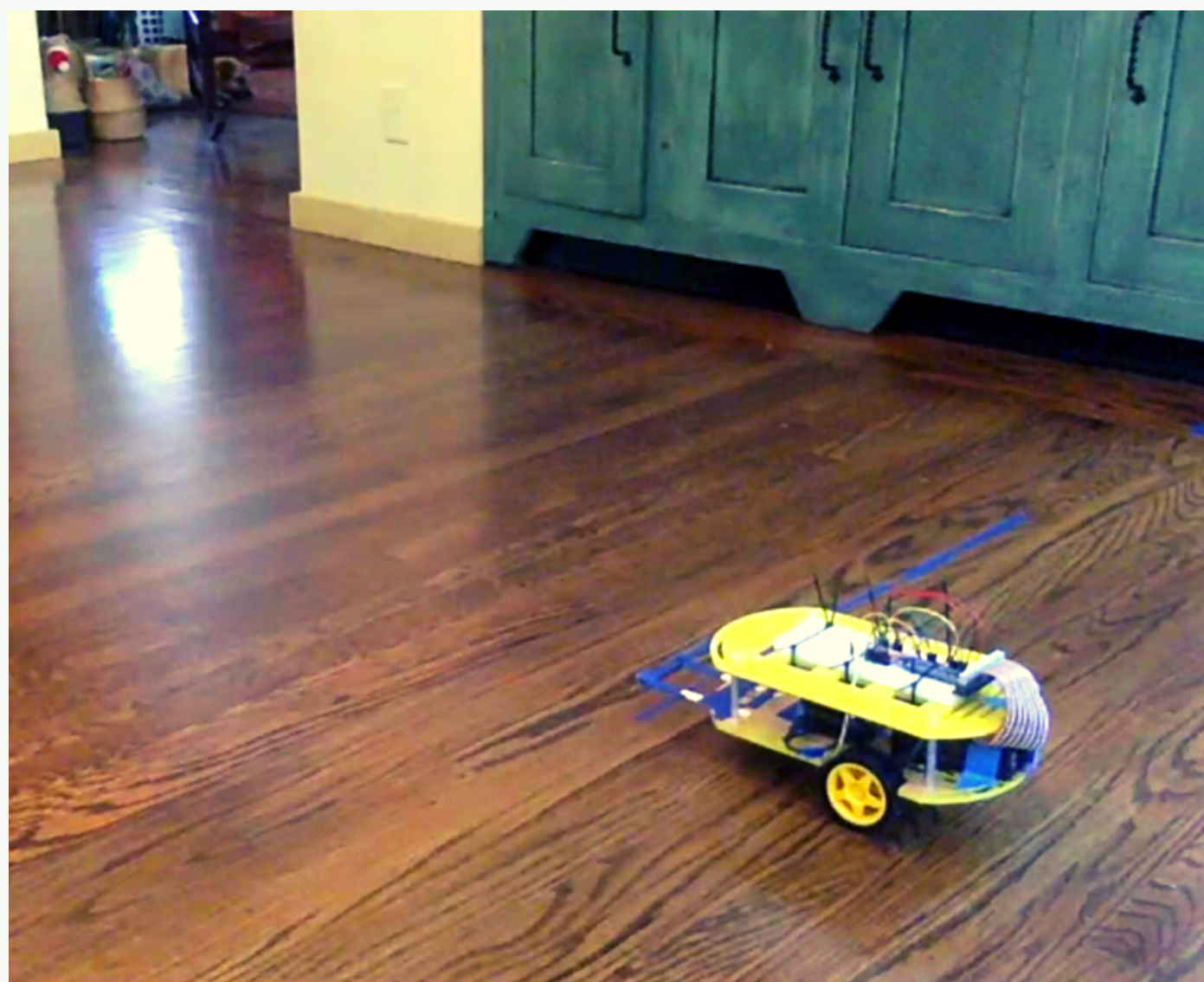
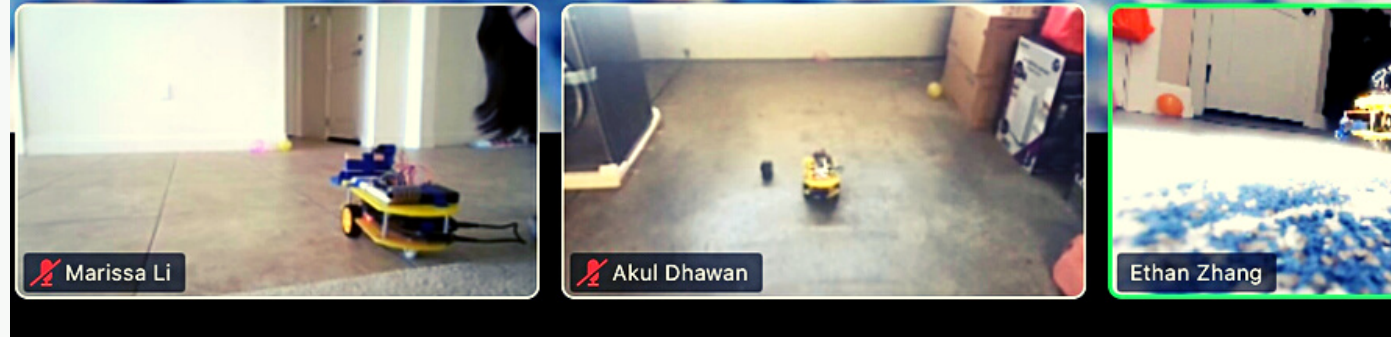
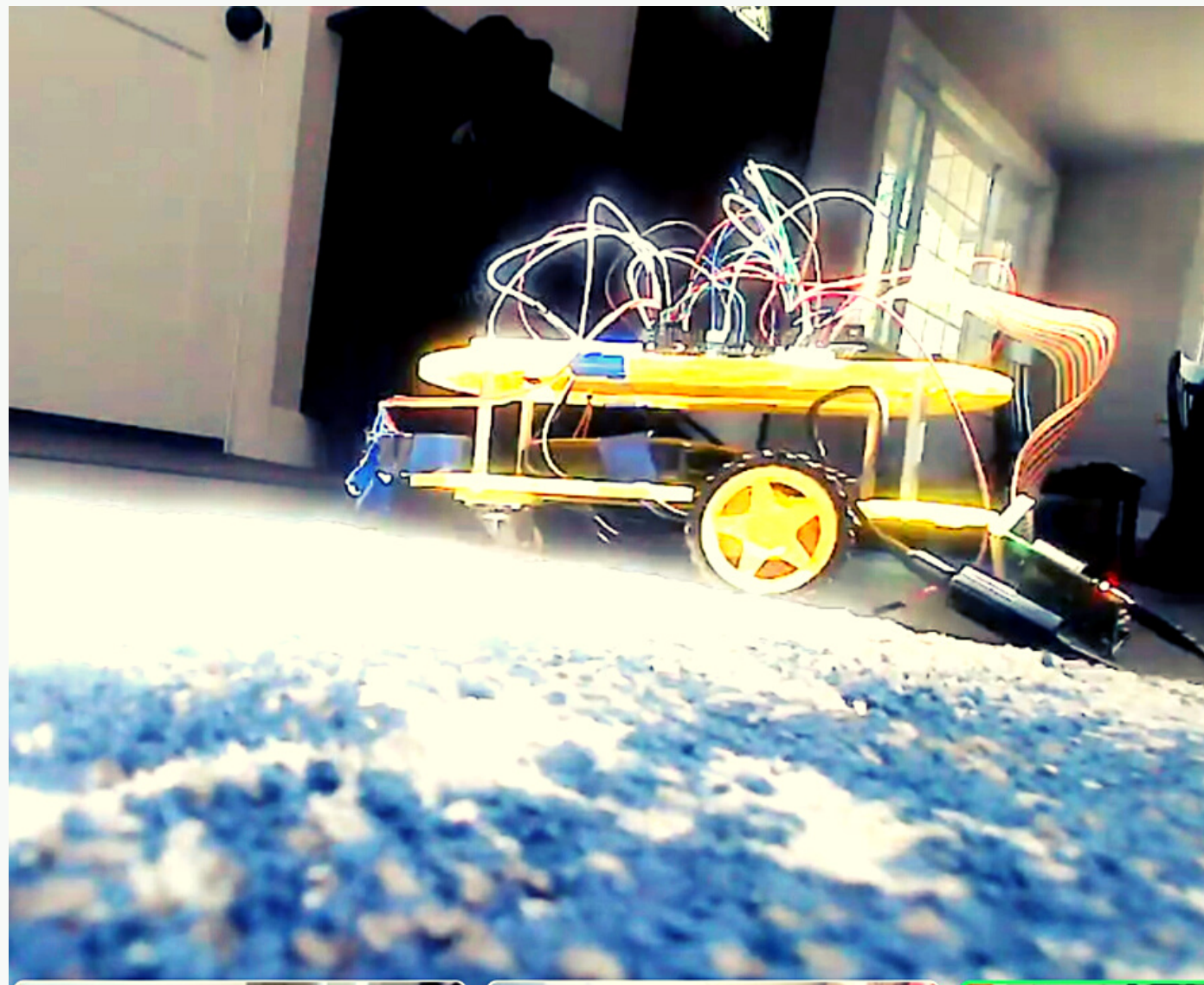
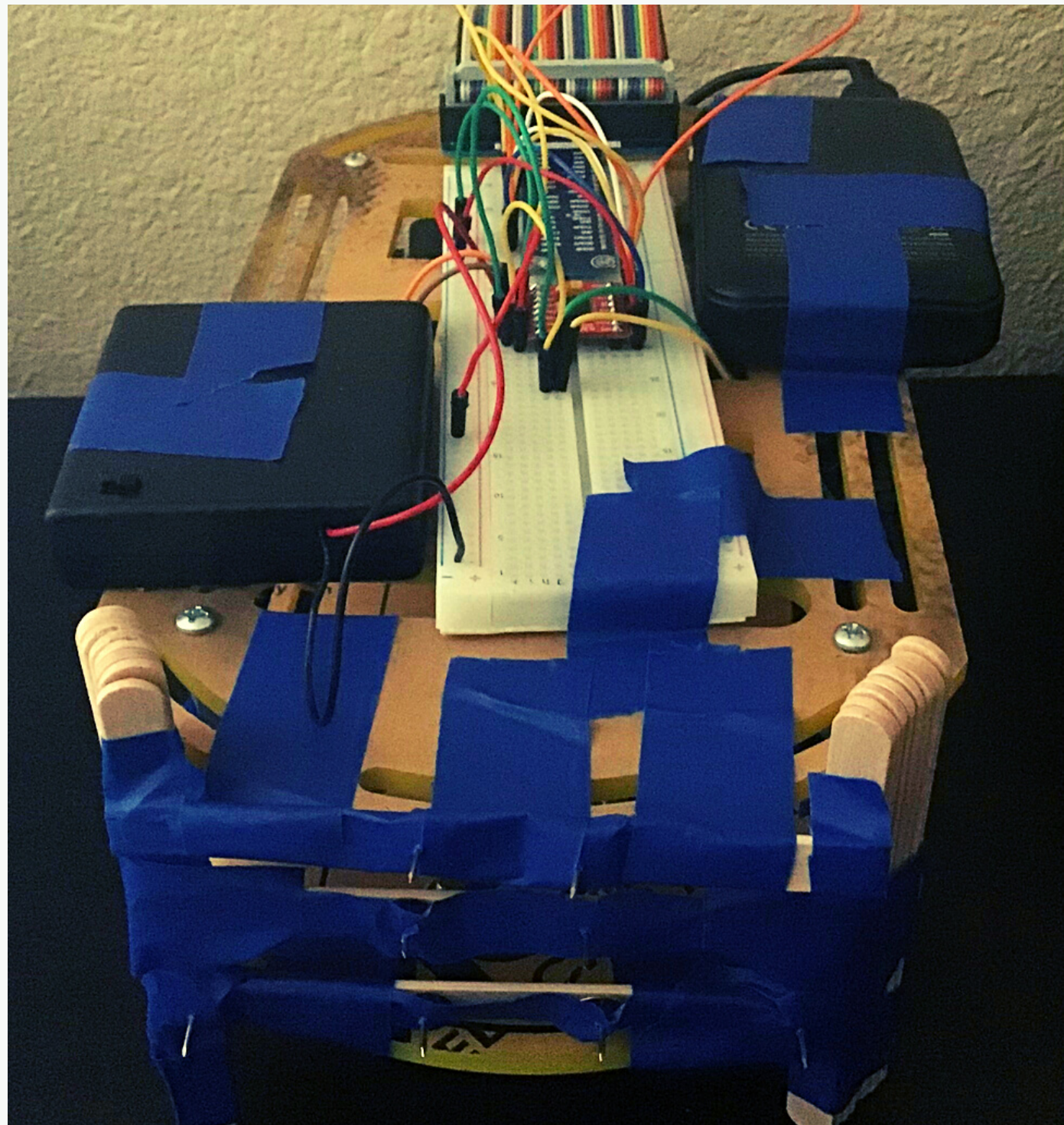
Maitreyi Patel

Marissa Li

Pranjal Chatterjee

Satvik Talchuru

Ying Jenny Chen



WE ARE
ROBOT
INVENTORS

TARS, R2D2, WALL-E

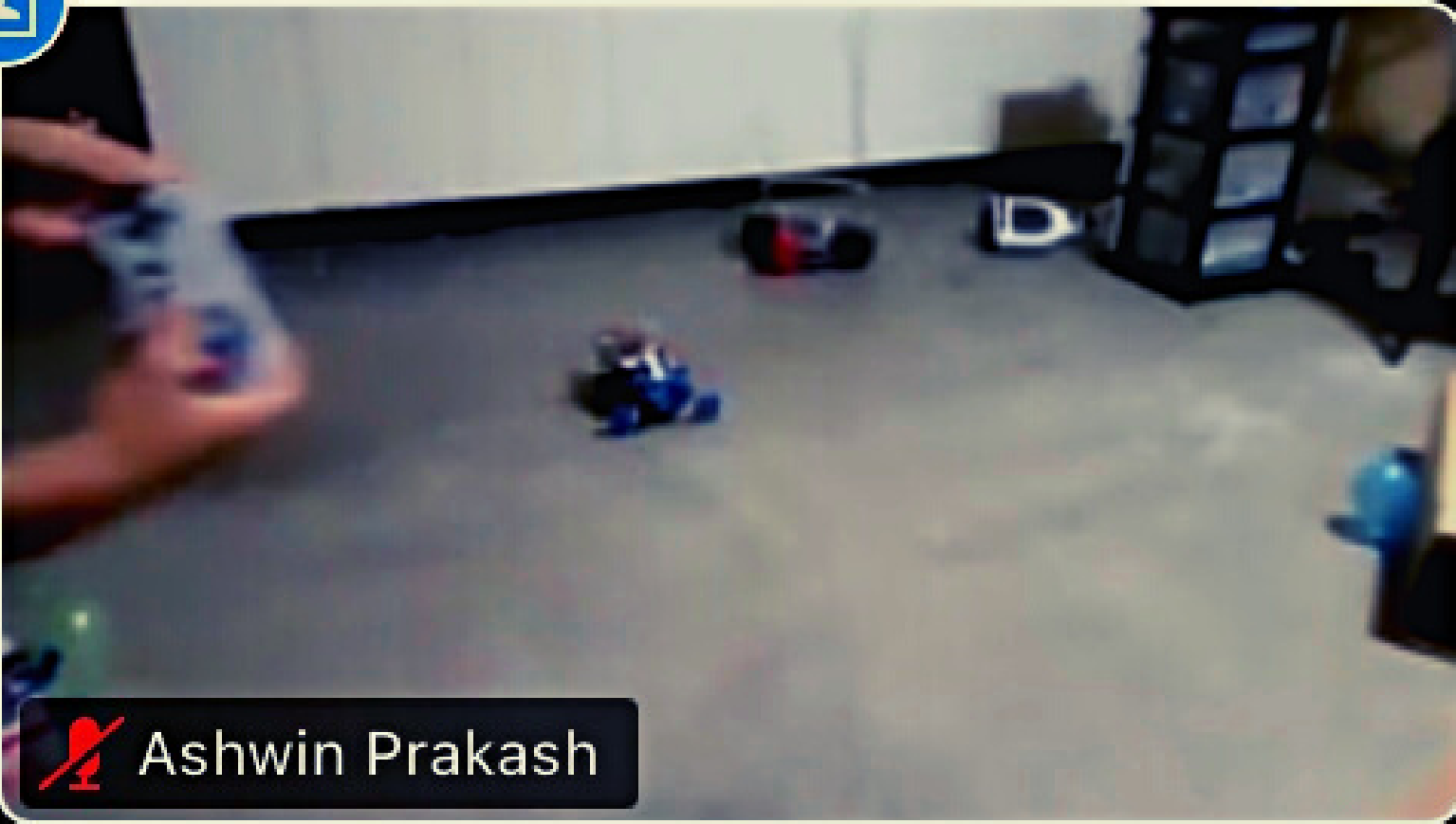
Robotics is a highly diverse field, bringing together skills of mechanical design, electronics, artificial intelligence, programming, mechatronics, and even social sciences. In Cluster 10, we will introduce the students to this exciting field and will focus on teaching students how to conceptualize, design, and create a custom robot.

Photo 1: Isabelle Layon's finished remote controlled car.

Photo 2: Team 1 (Jenny Chen, Marissa Li, Akul Dhawan, Ethan Zhang) using their remote controlled cars to pop balloons.

Photo 3: Team 4 (Annie Ping, Harper Johnston, Aden Jo, Julie Wu) using their remote controlled cars to pop balloons.

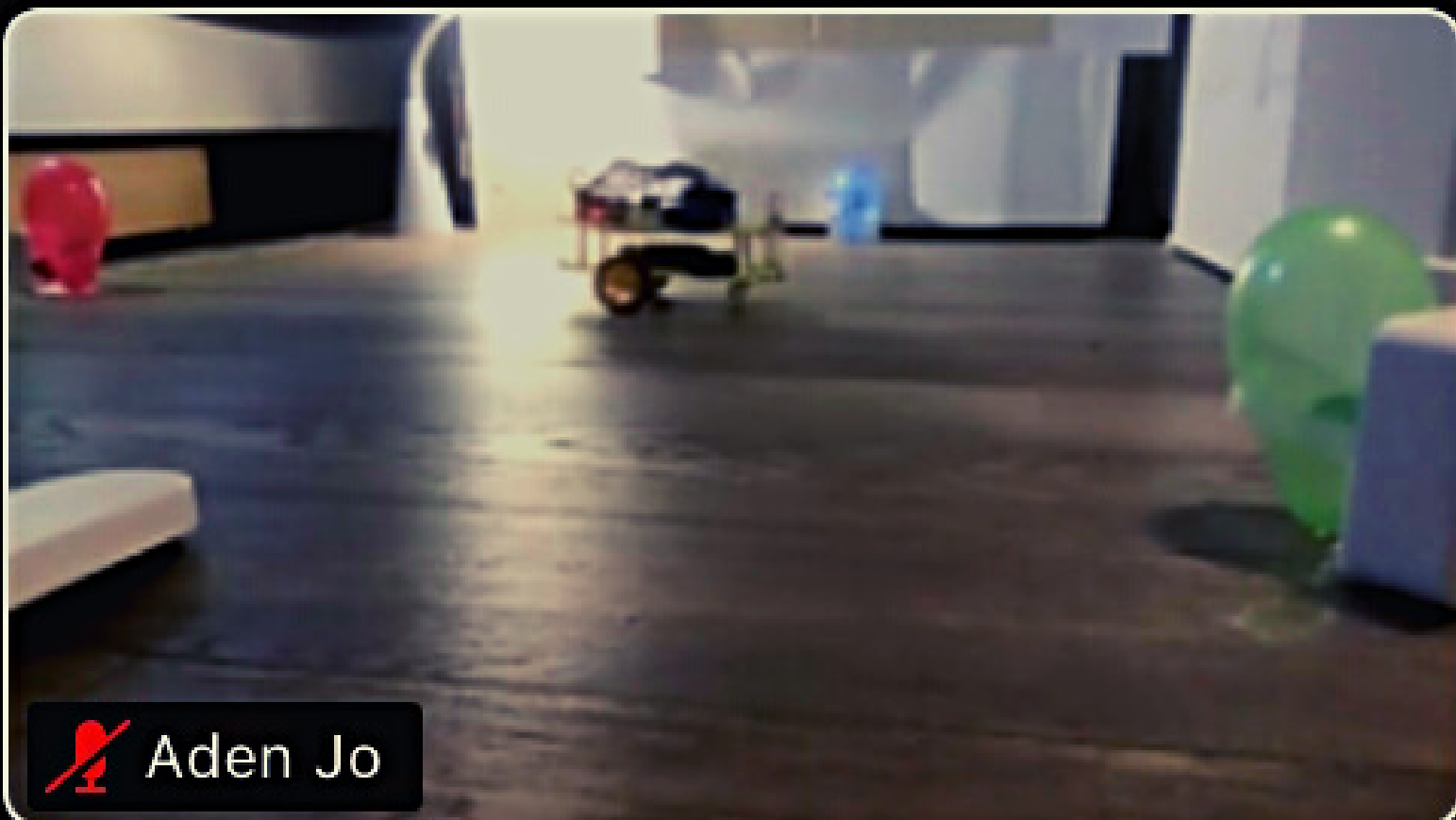
REMOTE CONTROLLED CARS



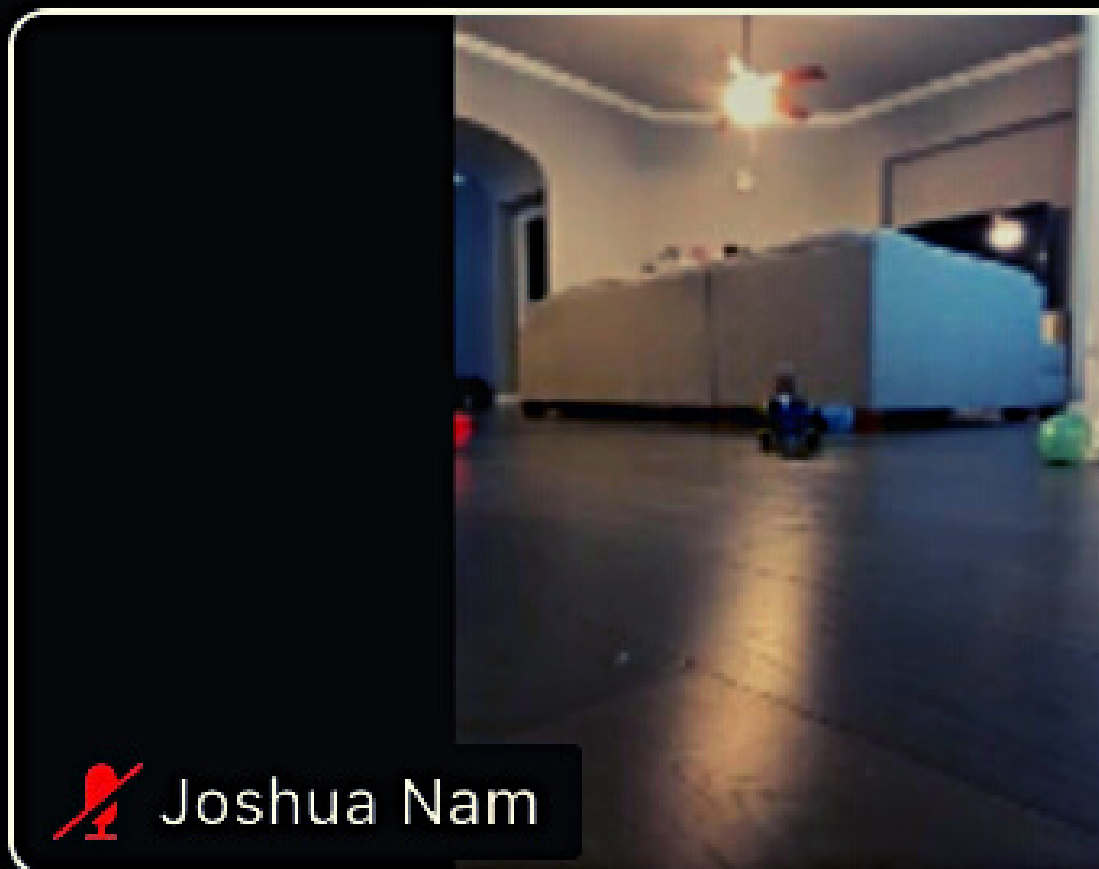
Ashwin Prakash



Marissa Li



Aden Jo



Joshua Nam



Team 5 (Ashwin Prakash, Marissa Li, Aden Jo, Joshua Nam) and Team 1 (Pranjal Chatterjee, Aditi Borra, Harper Johnston, Satvik Talchuru) using their remote controlled cars with color tracking camera to pop balloons on July 16, 2021. (Taken by Isabelle Layon).



SOCIAL HOUR

(Top left, clockwise): Ashwin Prakash, Maitreyi Patel, Annie Ping, and Ethan Can acting out a Zoom skit during social; Aiden Deffner, Satvik Talchuru, Aden Jo, and Pranjal Chatterjee acting out a Zoom skit; Joshua Nam, Kaitlin Divinsky, and Marissa Li acting out a Zoom skit. Photos by Isabelle Layon.

Cluster 11: Introduction to Autonomous Vehicles

Aditi Pattanshetti

Sinchana Nama

Amisha Kandi

Swasti Jain

Anushree Atmakuri

Timothy Wang

Areeba Balkhi

Venkata Sai Saketh
Korrapolu

Arthur Chan

Bernice Lau

Eddy Rao

Gavin Goyal

Ingi Helgason

Ipsita Bhattacharjee

Justin Chou

Kaihsin Wang

Maximillian Raney

Melody Chien

Michael Ferolito

Michelle Lee

Raj Khera

Rishabh Pandey

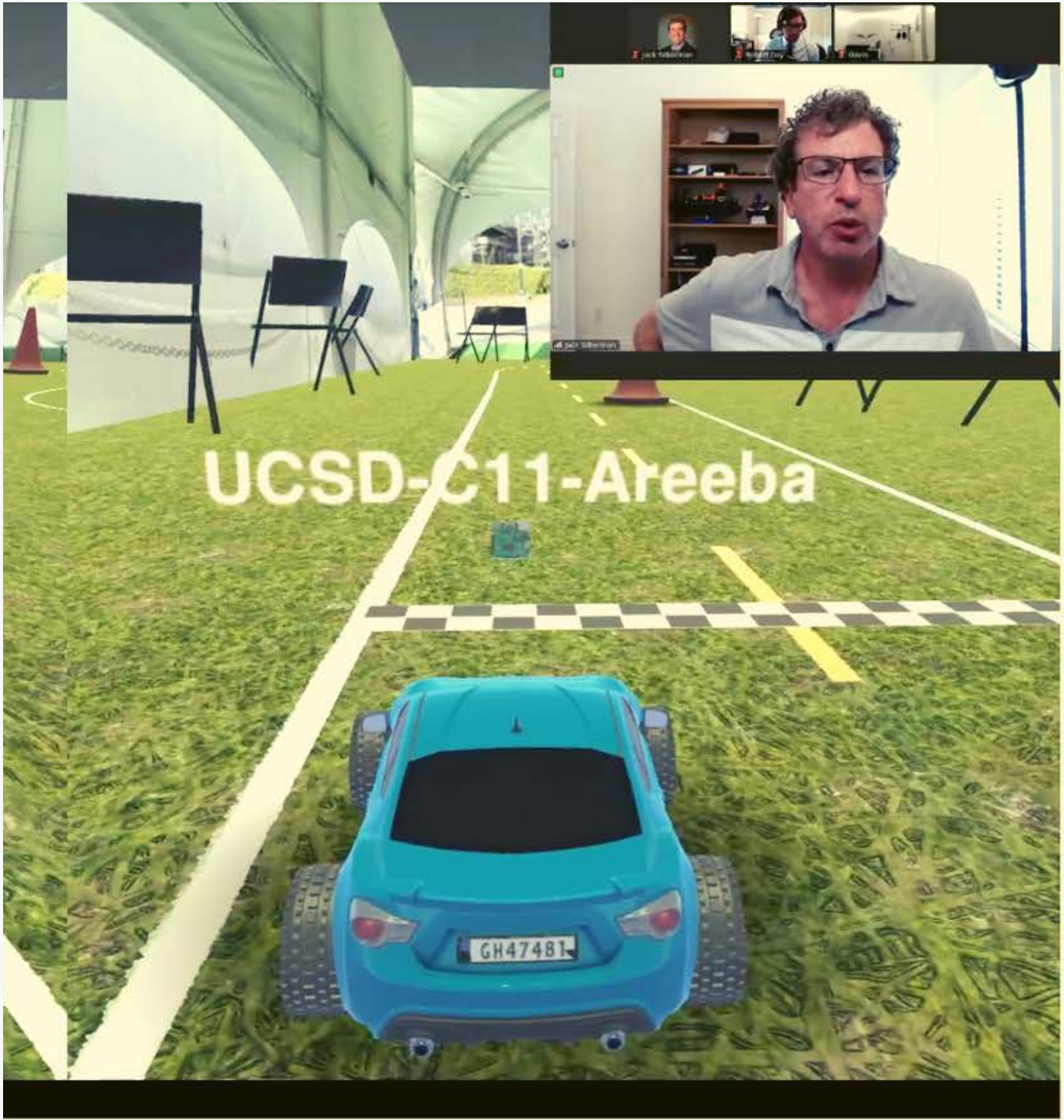
Rithwik Seth

Rohan Ganguli

Samantha Au

Samantha Flores

Shin Yu Melody Hu



WE ARE
AUTONOMOUS VEHICLES



Drivers license not required

In Cluster 11, we incorporate engineering theory and good practice in the development of scale autonomous cars that must perform on a realistic robotics simulator then replicated at the student's home with her or his own scale autonomous car using GPU Accelerate Artificial Intelligence models running at the robot.

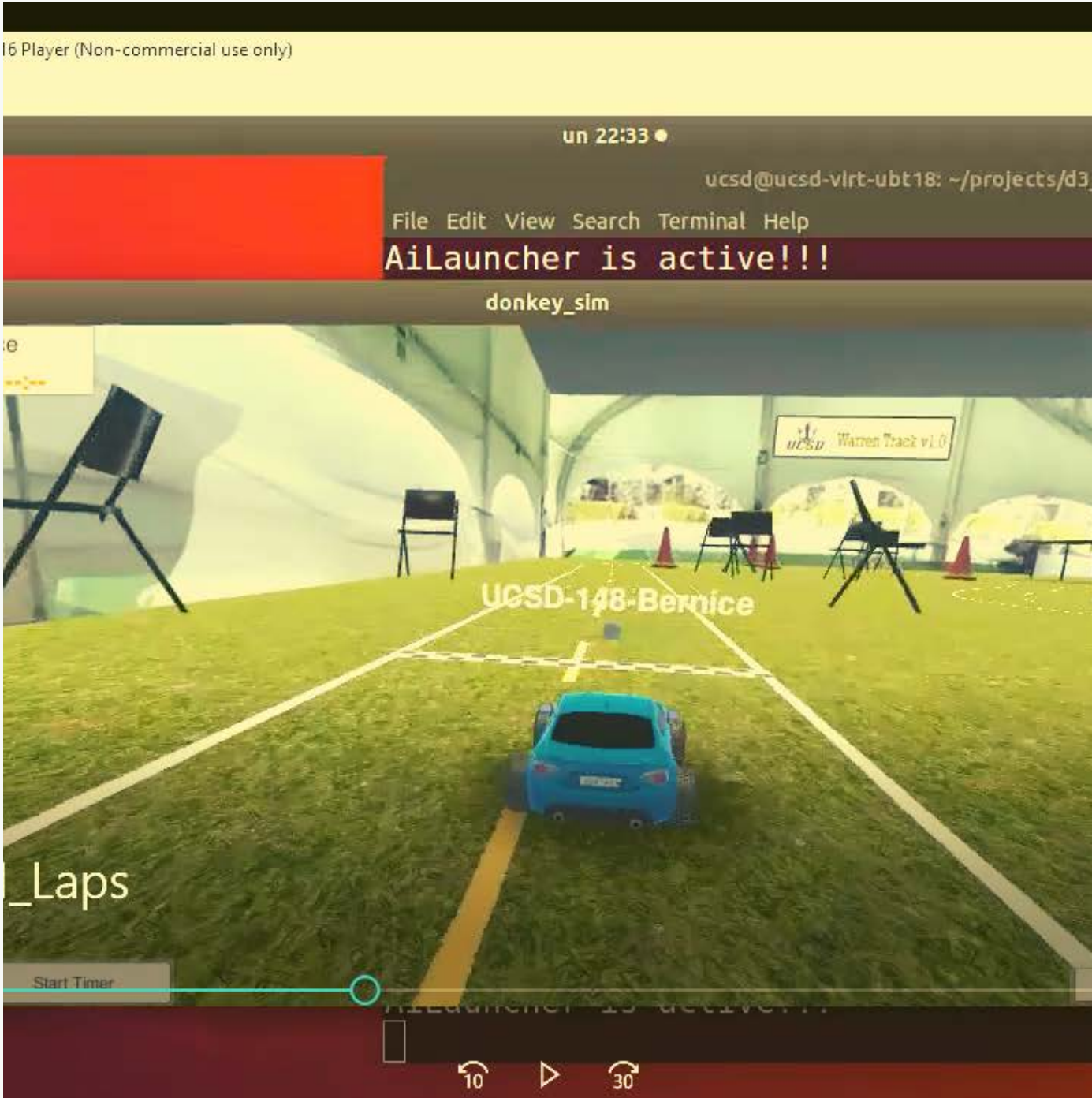
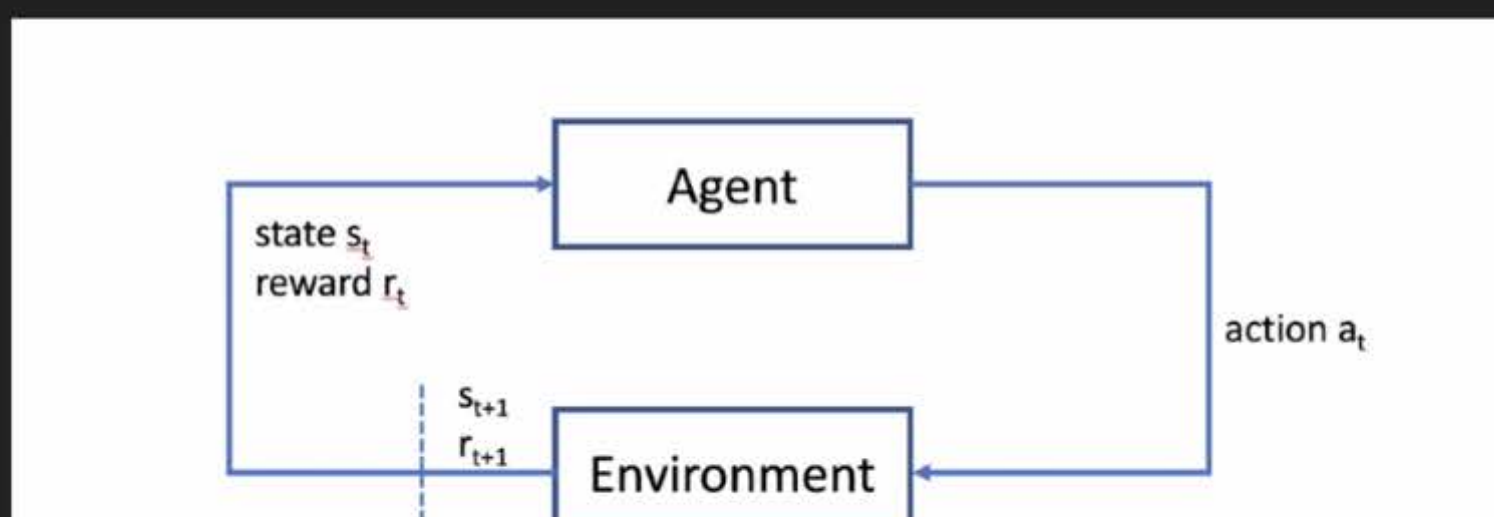


Photo 1 & 2: Samantha and Areeba racing their self-trained autonomous cars!

Photo 3: During the first week of Cluster #11, students collected data from a car simulation and used it to train their own AI models! Here, Bernice Lau's car is racing autonomously towards the finish line after 3 laps!

Reinforcement Learning

- Agent
- Environment



(Above) A TA was giving us an overview of reinforcement learning.

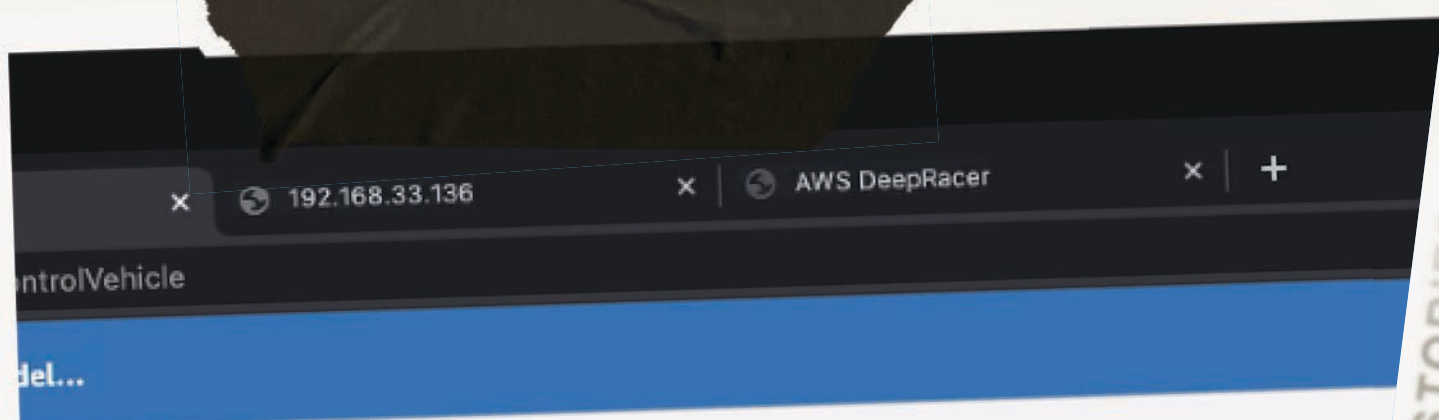


We were training the AWS DeepRacer models using reinforcement learning.



Racing the jet sim that we trained in class.

deepracer track



Control vehicle



Autonomous mode

Models

Choose a model to autonomously drive

Bernice-Training-v3-model

Sensor and vehicle configurations must match.

Stop vehicle

Start vehicle

Speed

Adjust maximum speed

60 %

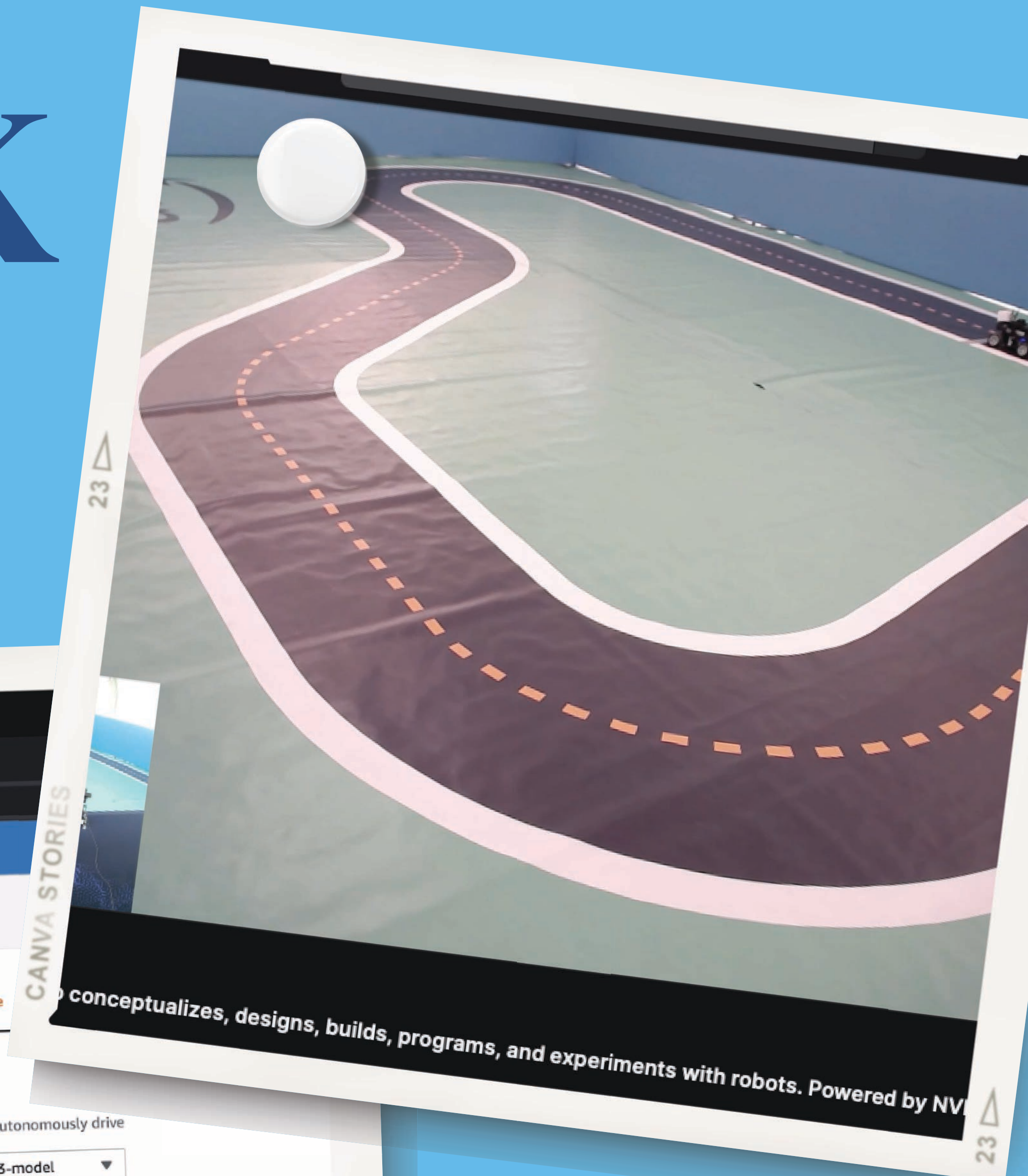


Decrease

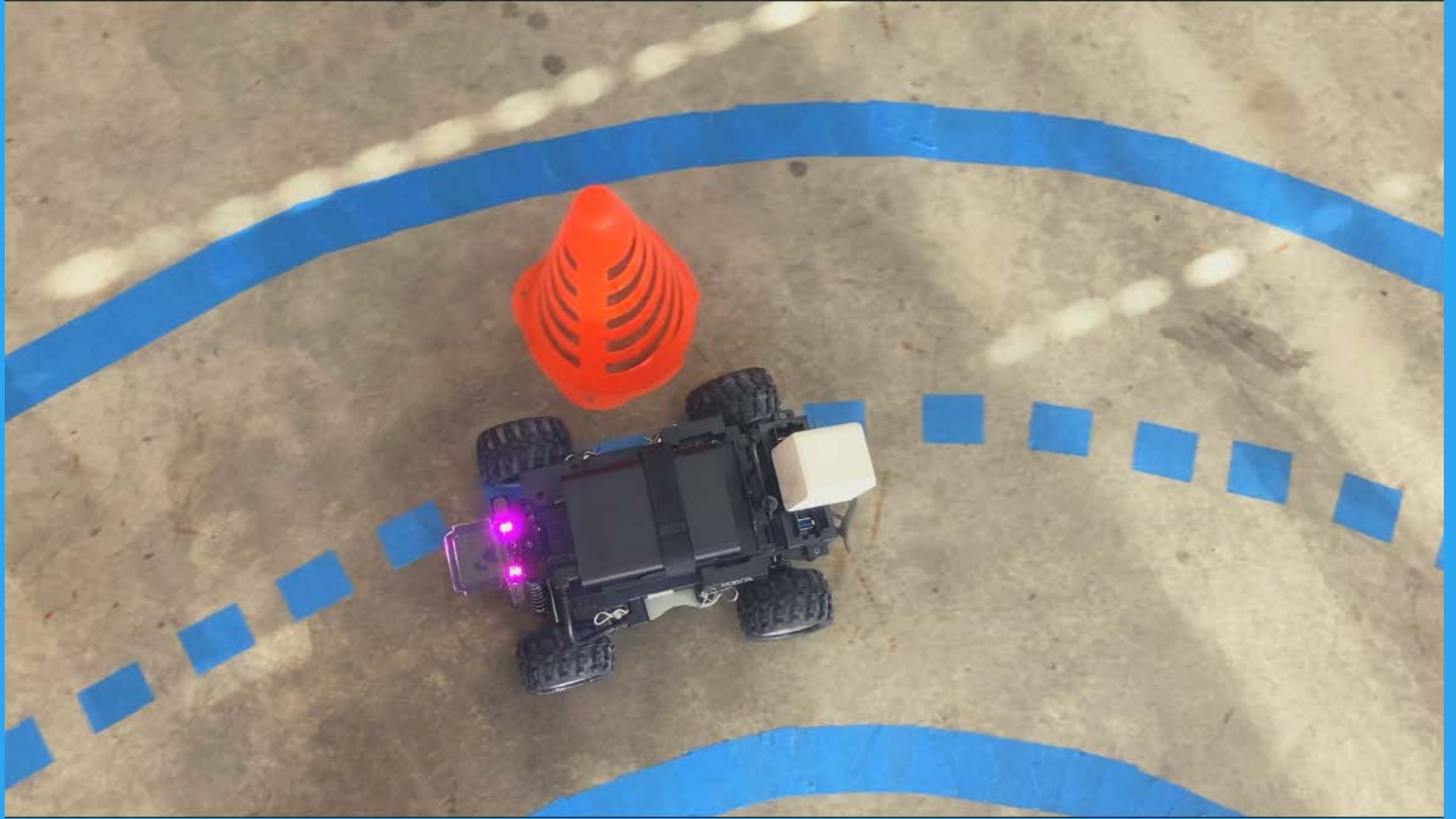
Increase

Stereo camera
Not connected

LIDAR
Not connected



Dr. Silberman and the other cluster TAs set up a physical deepracer track at UCSD. We trained our own models on the AWS website and uploaded them to Basecamp. The TAs then loaded the models onto the physical robots to race.



CLUSTER 11

DEEPRACER ROBOT

TEAM 2 OF CLUSTER 11'S
DEEPRACER ROBOT
(COMPOSED OF [BUT NOT
PICTURED] SAMANTHA
FLORES, GAVIN GUYAL, AND
MICHELLE LEE).