

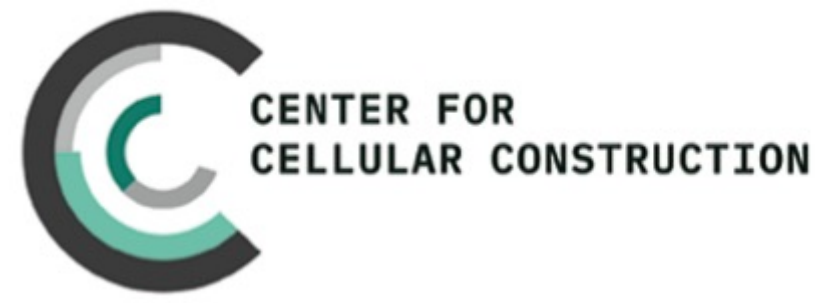
# How is a Cell like a Robot?

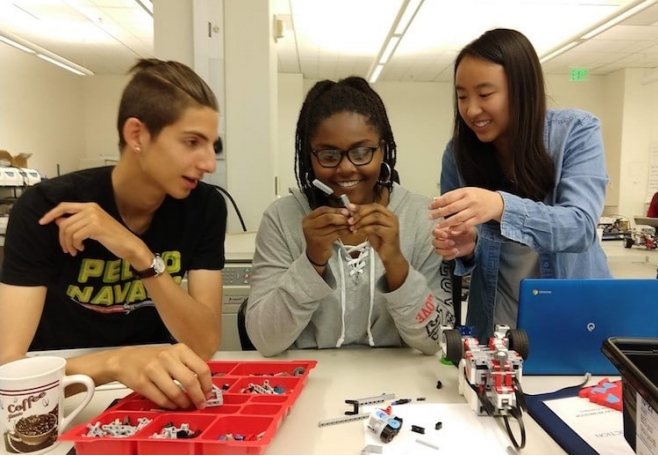
## Incorporating Engineering into High School Biology

Jessica Allen, Katherine Nielsen  
UCSF Science &  
Health Education Partnership



University of California  
San Francisco





# UCSF - SEP Science & Health Education Partnership



Mission: To help UCSF support and promote science learning and engagement in San Francisco public schools (SFUSD) and with the Bay Area public.



# UCSF - SEP

Summer  
Programs for  
High School  
Students



Bay Area  
Science  
Festival



Other  
Resources for  
Outreach



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Summer  
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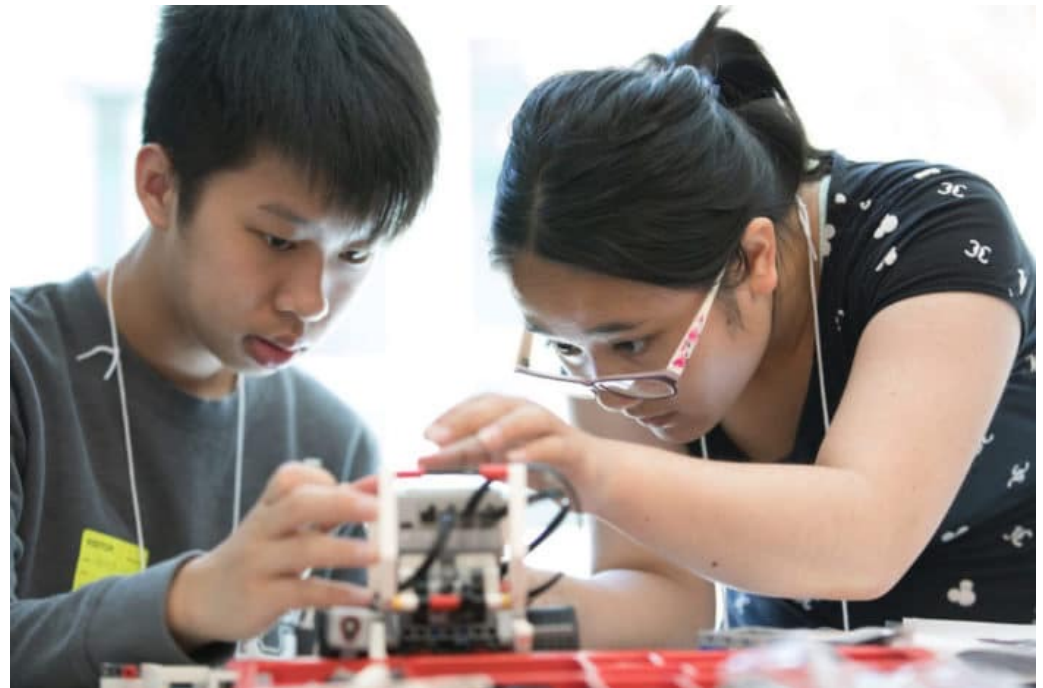
Other  
Resources for  
Outreach



# Cellular Construction Workshop



- Two week-long summer course on cellular engineering
  - 15 high school students
  - 5 high school science teachers



# Our Approach



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CELLULAR  
CONSTRUCTION

# Who is Attending the Workshop?



- 5 high school science teachers
  - SF and Bay Area
- 15 - 10<sup>th</sup> 11<sup>th</sup> Grade Students:
  - Selected by SFUSD
    - Low income (50% in 2021)
      - Stipend \$1100
    - First gen to college (41%)
    - Students with IEP (9%)
    - Budding interest in science

Workshop is often the first exposure to engineering/robotics/programming/biotech.

# Our Approach

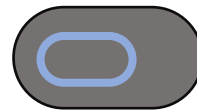
Oscillate between Biology and Engineering

## Center Educational Framework

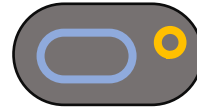
- Cells are machines
- Engineering Approach to Biological Problems
- Working Across Interfaces

### Biology (Cells)

DNA plasmid → 



Inserted DNA alters bacteria's behavior ↓



Observe organism preferential selection using chemotaxis



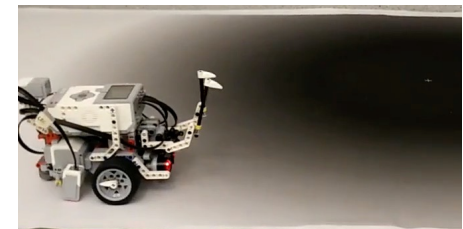
### Engineering (Robotics)

 Program

Downloaded program controls robot's behavior



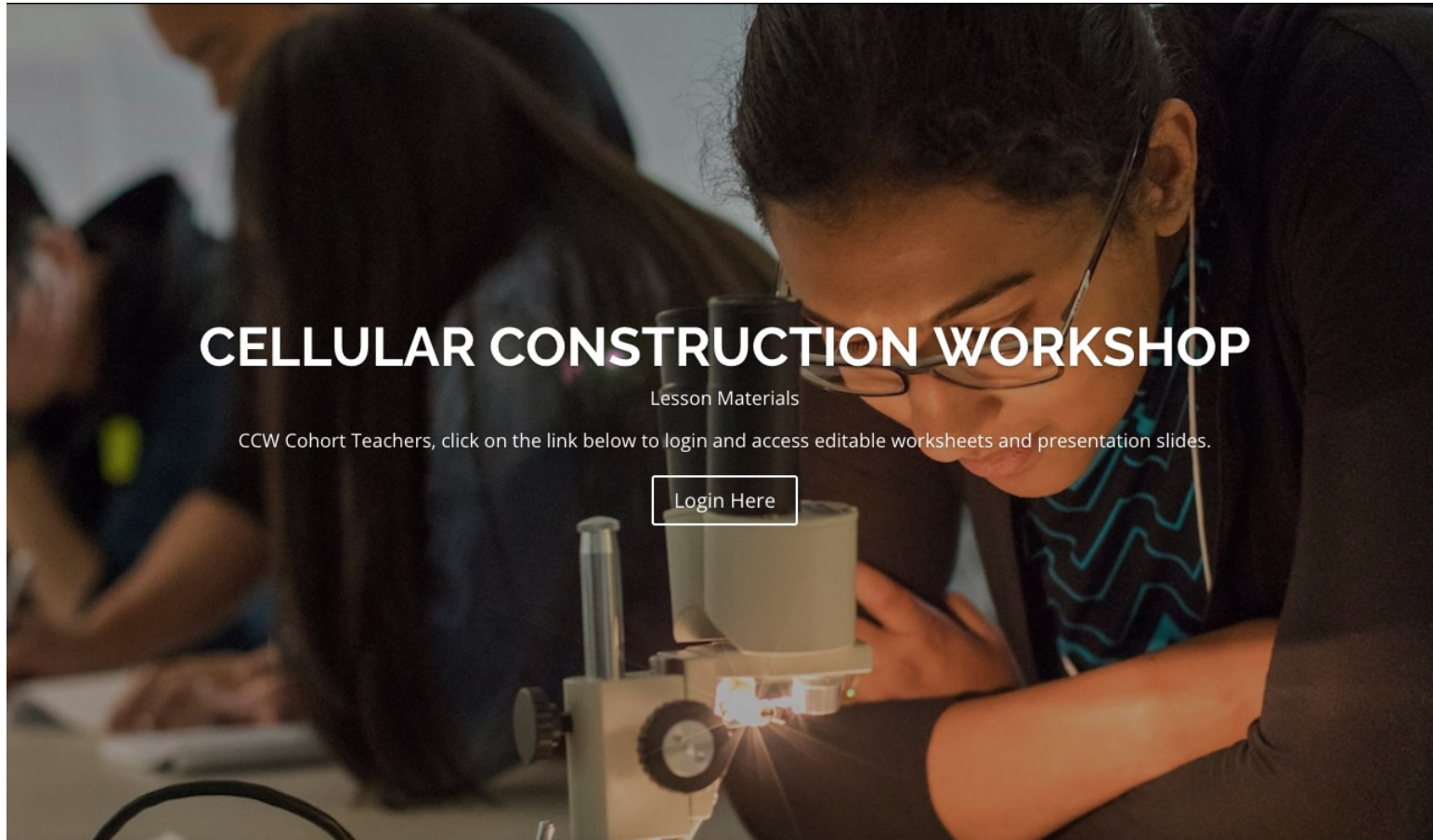
Program preferential selection ("chemotaxis") in a robot





# Lesson Materials on CCC Website

[centerforcellularconstruction.org/ccw-lesson-materials](https://centerforcellularconstruction.org/ccw-lesson-materials)



## CELLULAR CONSTRUCTION WORKSHOP

Lesson Materials

CCW Cohort Teachers, click on the link below to login and access editable worksheets and presentation slides.

[Login Here](#)

# Lesson Materials on CCC Website

[centerforcellularconstruction.org/ccw-lesson-materials](http://centerforcellularconstruction.org/ccw-lesson-materials)

## Teacher's Guide

### Materials Guide

A list of all materials used in the Cellular Construction Workshop, including purchasing source, item number, and price. Also contains a list of materials available to borrow at the SEP Resource Center.

[CLICK HERE](#)

### EV3 Robot Setup

If your school site already has EV3 robots, this guide walks you through set up to connect them to Open Roberta.

[CLICK HERE](#)

### Grants for Classroom Supplies

To help teachers purchase materials to do the Cellular Construction Lessons, we included a list of grant resources that may help secure funds for robots or other classroom materials.

[CLICK HERE](#)

### Building Instructions

EV3 default robot building instructions found here.

[CLICK HERE](#)

### Tech Resource Website

Resource website to help students with EV3 robots, Open Roberta, wifi issues, and more.

[CLICK HERE](#)

### Misc. Robot Set-up

Worksheets for Open Roberta student account set-up, Robot Quick Start Guide, and more.

[CLICK HERE](#)

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Use the toggle menu below to filter lesson data base by topic or classroom style (in-person/virtual):

All	Biology	In-Person	Modeling	Programming	Virtual
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### Virtual Physarum Chemotaxis

Biology, Virtual

### Intro to Bacterial Biosensors

Biology, Virtual

### Bioethics (Portobello Colegio and the UCSF Biosensor)

Biology, Virtual

### Find Yellow

Modeling, Programming, Virtual

# Lesson Materials on CCC Website

[centerforcellularconstruction.org/ccw-lesson-materials](http://centerforcellularconstruction.org/ccw-lesson-materials)

## Lesson Overview

### Summary

This lesson offers students an introduction into biosensors, which is a sensor that uses a living organism or biological components to detect the presence of chemicals. In this activity we focus on bacterial biosensors made by manipulating the genetic code of a bacterium to change what they sense and how they behave or respond. Students will read articles and watch videos about bacterial biosensors to help them develop their own understanding of what a bacterial biosensor is and how it can be used as a tool to solve problems.

[Printable Lesson Guide](#)

[Worksheets and Slides](#)

Big Idea(s)	●
Vocabulary words	●
Materials	●
Grouping	●
Timing	●
Prerequisites for students	●
Learning goals/objectives for students	●
Content background for instructor	●

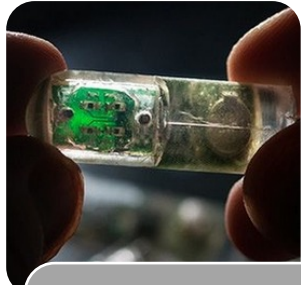
## Lesson Implementation/Outline

Activity	●
Checking for student understanding	●

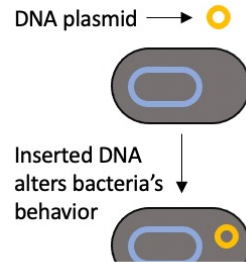
## Extensions/Reflections

Extensions	●
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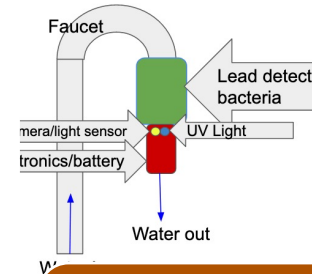
# Biosensors to Bioethics



Intro to  
Bacterial  
Biosensors



Bacterial  
Transformation



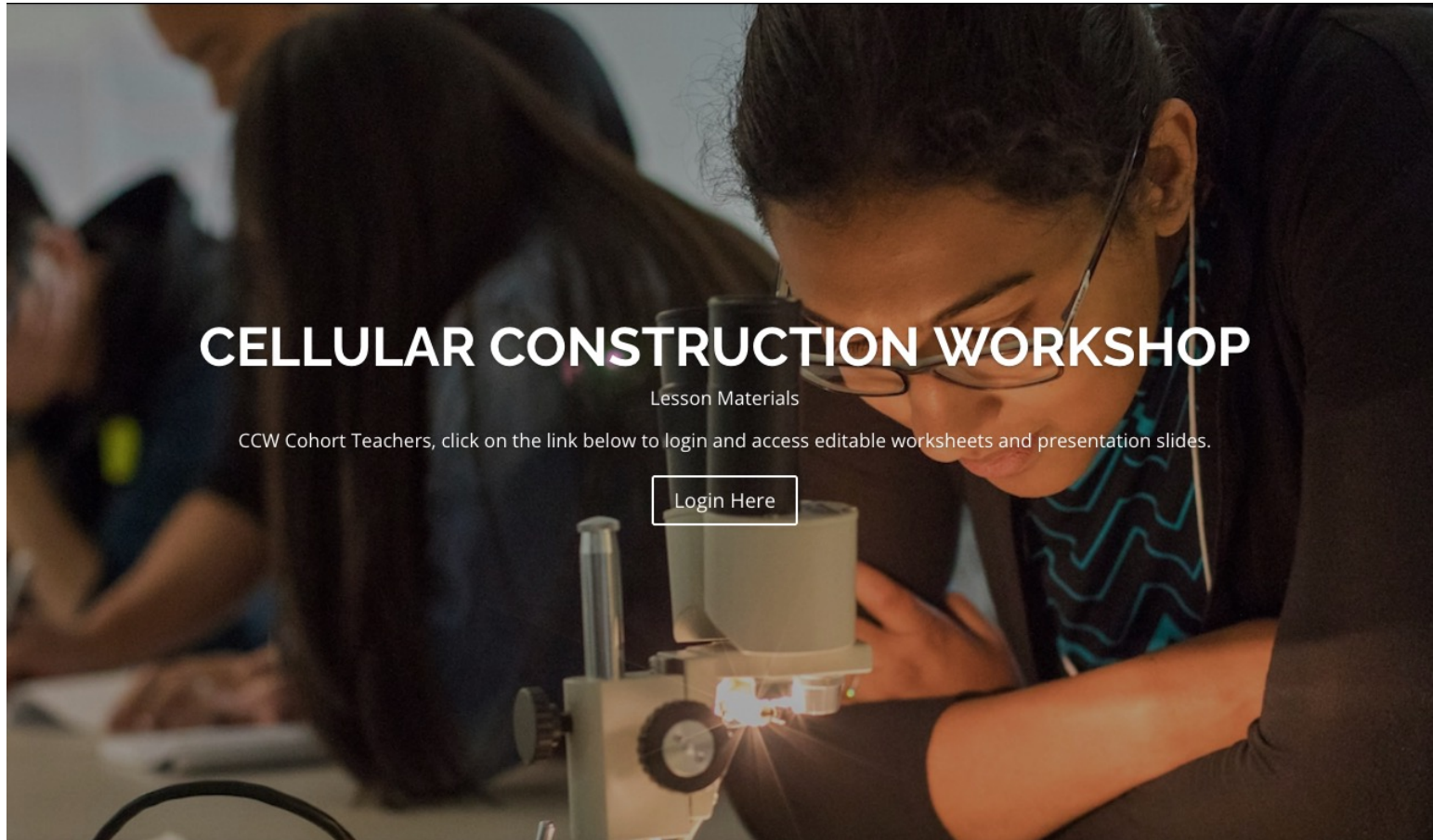
Design a  
Bacterial  
Biosensor



Biosensor  
Bioethics

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The workshop is enhanced by Center Member support and involvement



Teaching Assistants



Guest Scientists



# Cellular Construction Workshop



College Panels



Lab Tours

# UCSF - SEP

Summer  
Programs for  
High School  
Students



Bay Area  
Science  
Festival



Other  
Resources for  
Outreach





- SEP has organized the Bay Area Science Festival for over a decade.
- This year it's been moved to end of April 2022!





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Bay Area  
**SCIENCE  
FESTIVAL**

- Both volunteers and science activities needed at CCC hosted booths!
  - Stentor learning device
  - Lego Robots
  - Lensless microscope (IBM, Tom Zimmerman)





# Daly Ralston Resource Center

- Open to UCSF students, faculty, and staff and Center Members
- Kits in a box, science equipment, samples, posters, books, and more.

Excellent resource for public education events or school visits

# Acknowledgements

[jessica.allen@ucsf.edu](mailto:jessica.allen@ucsf.edu)



Wallace Marshall



Rebecca Smith



Katherine Nielsen



Vasudha Srivastava



María  
Díaz de León Derby



Angeline Chemel



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(P.I. Wallace Marshall)