UCLA Signaling Systems Laboratory High School Outreach 2020/2021

The goal of this outreach activity was to connect with local Los Angeles high school students in order to offer more access to STEM opportunities and engage with people of different backgrounds that make up the racially diverse LA community. This was done by collaborating with Synergy Quantum Academy in Los Angeles and their 11th and 12th grade students enrolled in the Principles of Biomedical Science course taught by Dr. Barbara Shannon. We exposed them to different STEM-related career paths and taught them different aspects of modern life science research, including computational components. This was all done to inspire and motivate them as they approach college applications.

This activity was performed during remote teaching and campus closure, so designing an engaging set of sessions to be implemented via Zoom was a challenge. The outreach consisted of 3 sessions:

Session 1: Career Panel

Session 2: Virology/ Immunology session: "Immunological Assays to Detect Viral Infections"

Session 3: Computational Modeling: "Predicting a Pandemic (from your own computer)"

If you have any questions about these outreach activities or are interested in joining the Outreach Committee to organize future events, please contact:

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Preparation for volunteers

- In a preparatory session for the participating lab members:
    - Synergy Quantum Academy alumna, UCLA Undergrad Researcher, and lab member Alma Zuniga Munoz gave an overview about Synergy Quantum Academy and on the history of LAUSD, redlining, and the intersection of race and education (LINK).
    - We also had a discussion about providing more inclusive classrooms by acknowledging and affirming students' identities based on Jeewan Chanicka's Ted-Ed Educator Talk (LINK).

Figure 1. Volunteers attending a preparation meeting for the Virology/ Immunology session.

Figure 2. Volunteers and Synergy Quantum Academy students during the Virology/ Immunology class session.

Session 1: Career Panel

- **Overview.**
    - LINK to event outline
    - LINK to event slides
    - Representing the diverse educational paths, career stages, and specializations (experimentalists, computationalists, medical doctors) in the lab, 14 lab members participated (3 undergrads, 2 MD/PhD students, 2 PhD students, 4 postdocs, 2 staff members, 1 faculty member)
    - In preparation, the students filled out a survey (LINK) about their career aspirations, questions for the panelists, and their breakout room preference. Based on this, we distributed breakout room participation and prepared panel questions.
    - The session consisted of:
        - an ice breaker (a guessing game about the participants using 'Kahoot') (LINK) and a brief introduction by the lab members,
            - The lab members provided one fun fact about themselves in advance (LINK to examples). Based on this, the students would guess which one fun fact connected to which one of four lab members (based on their pictures). Following each guessing round, the four lab members shown on the slide would briefly present themselves (<1 min) and share their fun fact, if it wasn't the one mentioned in the game.
        - a student reflection and share-out on their career dreams,
        - informational slides on educational paths in science and diverse careers possible with a science education,
        - a panel discussion with the entire class with student questions (both spontaneous and presented by moderator based on student survey (LINK)),
        - Breakout rooms with 2-5 lab members and 4-6 students based on STEM disciplines, with students freely asking questions about education and career.
            - Biology/Life Sciences
            - Math/Computer Science
            - Engineering/Physics
            - Medicine/Health Sciences
- **Our Conclusions.**
    - Many students were interested, interacted, asked questions, and seemed to appreciate the session; some were not so interactive.
    - It was very valuable to have the undergrad researchers participate, since many of the students' questions referred to applying to and attending college/UCLA.
    - Attending USC seemed to be a common aspiration → potentially collaborate with students/researchers from there next time?

Session 2: Virology/ Immunology session: "Immunological Assays to Detect Viral Infections"

- **Overview.**
  - LINK to event outline
  - LINK to event slides
  - In this session, the students learned about viruses, viral infections, and laboratory methods for detecting viruses, taking on the role of a doctor diagnosing the virus causing an infection in their patient.
  - In preparation:
    - In groups of 2-4, the students prepared a brief presentation on one of 8 viruses (1 slide/2-3 minutes) to be presented at the beginning of the session. They were encouraged to use HHMI Biointeractive's 'virus explorer' to obtain information.
      - LINK to student preparatory handout
      - LINK to 'virus explorer'
  - In this session:
    - Dr. Shannon, the teacher, showed a video about the general principles of viral composition and infection.
    - In groups of 2-4, the students presented briefly on one of 8 viruses (1 slide/2-3 minutes).
    - A case study of a patient with a viral infection was introduced briefly.
    - In 6 breakout rooms with 4 students each and 1-2 lab members, the students worked on identifying the virus infecting the patients by learning about mechanisms of viral detection assays (ELISA, qPCR, viral neutralization assay), 'ordering' assays to be performed based on critical thinking about the symptoms, and critically interpreting the results of the assays. A discussion about the advantages and with help by the mentor was encouraged.
      - LINK to mentor guidelines, incl. suggestions for critical discussion
      - LINK to 'assay results' to be presented by mentor when students 'order' an assay
      - LINK to student handout, incl. the case study and material explaining the assays
    - The results of the case study were discussed with the entire class, with the students sharing their experiences within the breakout rooms.
- **Our Conclusions.**
  - The student presentations included very little images, lots of text →a specific training session on scientific presentations might be useful in the future.
  - The students guessed the correct virus quickly in many cases, but were very willing to still double-check and learn about other assays as well.
  - Time in the breakout rooms was too short for some groups. Critical discussion of the assays was not always completed due to time constraints. Assays were often explained by the mentors, rather than the students reading and discussing the materials themselves for time reasons.
- **Student Feedback.**
  - Slides of compiled responses (LINK)

Session 3: Computational Modeling: "Predicting a Pandemic (from your own computer)"

- **Overview.**
  - LINK to event outline, incl. discussion notes for mentors
  - LINK to event slides
  - In this session, the students took on the role of a public health researcher and used SIR models to understand the spread of a virus in a population and explore the effect of public health interventions.
  - In preparation, the students were sent a Google Colab notebook (LINK) to familiarize themselves with this tool, and a YouTube video by Duane Nykamp on SIR models (LINK) for a first exposure to this concept.
  - In this session:
    - We very briefly introduced the Hoffmann lab.
    - We explained the concept of SIR models and briefly introduced the form of the system of differential equations and rate parameters.
    - In 6 breakout rooms, 3-4 students worked with 1-2 lab members in Google Collab Python notebooks on adjusting parameters in a SIR model to show when the peak of infection is reached and what parameters that depends on (NOTEBOOK VIRAL SPREAD). Using adjusted model versions, each group also worked on answering a question about one of the public health interventions listed below. They prepared to briefly present the results to the rest of the group by compiling copied graphs of their simulation results in a PowerPoint slide or directly showing their CoLab notebook. The assumptions, limitations, and strength of the model were discussed.
      - Quarantining (NOTEBOOK)
      - Lockdown (NOTEBOOK)
      - Traveling (NOTEBOOK)
      - Vaccination (NOTEBOOK)
    - Back in the large group, the students shared the results of their analysis with the rest of the class.
- **Our Conclusions.**
  - Half of the breakout groups found 1 hour to be a good amount of time to complete the basic SIR model exercise discussion questions as well as one of the public health intervention model exercises and discussion questions in the interactive notebook. The other breakout groups spent most of the time focused on the basic SIR model and felt rushed when trying to complete and discuss one of the public health intervention models.
  - There was a wide range of background, interest, participation, and understanding among the students.
  - Some students found the session too easy and others found it too difficult. Perhaps in the future we could break up students into groups based on their mathematical/computational backgrounds so that some groups could move faster while others focus on understanding the fundamentals.

    - Sending the SIR video and introductory Google CoLab notebook to Dr. Shannon to discuss with the students in the class time before our meeting was helpful in introducing the concepts to the students.
- **Student Feedback.**
    - Slides of compiled responses (LINK)