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BioTrekker: A 90-minute immersive biotechnology experience for high school students

On February 21st, 2024, twenty-two students from several high schools registered for a science workshop as part of their attendance to the 4th Annual Youth Leadership Conference. The science workshop consisted in a 90-minute immersive biotechnology experience named "BioTrekker", designed to 1) introduce students to one of the most fundamental separation techniques used in biotechnology, and 2) demystify biotechnology and show how it is part of everyday life. The session also aimed to inform students about the Biotechnology Laboratory Technician Program at Triton College, and how they could take advantage of enrolling in Dual Credit courses at their high school to earn early college credits and shorten their program completion.

During the 90-minute session, the students listen to a short introduction of the topic of electrophoresis, the separation of particles using an electrical field, one of the most powerful techniques used in biotechnology to separate molecules from DNA to proteins, to sugars and lipids. To make it easier to understand, one of the students volunteered for an interactive explanation of the physical bases of the technique. The student and the instructor played the role of molecules and in about 10 minutes, they enacted how those molecules are separated based on their intrinsic charge (positive or negative) as well as their individual size.

After the brief introduction and orientation of the activity, the students moved into the hands-on part, which is where they spent the majority of the time. Guided by two program ambassadors, the hands-on part of the session consisted of student learning how to use the typical tools used in a biotechnology laboratory. They learned how to use micropipettes, and how to handle very small volumes, in the range of microliters, to conduct an experiment that would illustrate how and why electrophoresis works.

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After a short period of practice, the student proceeded to conduct an experiment named “Molecular Rainbow” using colored substances so that they could observe how those are separated based on their electrical charge as well as their relative size. Once they had a chance to analyze their results and visualize/make the connection between the electrical charge of the substances and their migration in an electrophoresis experiment, they performed the second part of the experience.

The second part of the experience consisted on analyzing simulated samples of DNA obtained from the different habitable modules of the International Space Station (ISS) in an experiment named “Microbe Hunters.” By using electrophoresis, they separated the samples, analyzed their results and were able to conclude whether some or all the habitable environments were clear of pathogens or needed to be thoroughly sanitized. The background story is based on real events where an astronaut fell ill with a respiratory infection. Although the astronaut recovered, the question remained whether there were still traces of the pathogen that could infect other astronauts. Microbiological examination of samples obtained from the ISS is done by NASA every time a crew or a service vehicle returns to Earth and the results are communicated promptly to the ISS crew so that they can take appropriate actions. At the end of the experiment, the students were able to identify whether there were pathogens still present in the ISS and determined which habitable environments needed to be thoroughly sanitized.

All throughout the 90-minute experience, students were informed of the different opportunities available at their high schools for them to begin their higher education journey earlier, while still attending high school, as a viable and affordable way to earn early college credits and shorten their time of degree completion. The next steps involve bringing the BioTrekker to the high school campuses to replicate this engaging experience.

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BioTrekker: Biotechnology Immersive Experience

TIME	ACTIVITY	NOTES
5 minutes	Short orientation	Short introductions and overview of the activity.
15 minutes	Molecular Rainbow Electrophoresis Lab	Explanation (PowerPoint assisted).
10 minutes	Prepare and pour agarose gels	These gels could also be prepared the day before to save time (or if there is no microwave oven available) and allow more time to practice pipetting with colors. We could pour one or two gels as a demonstration.
10 minutes	Practice pipetting with colors (use silicon gels)	While gels get set, use 10 µl pipette.
30 minutes	Load and run agarose gels with rainbow samples and load gels with the microbe hunter samples Load and run gels with samples for the microbe hunter experiment.	Load 10 µl/well of rainbow samples (run for 20 minutes). This gel could be prepared the day before to save time, or if there is no microwave oven available. Load 10 µl/well of microbe hunter samples (run for 20 minutes). This gel could be prepared the day before to save time, or if there is no microwave oven available.
15 minutes	Analyze results	Students fill in their worksheets. The results of the rainbow lab will be visible before the 20-minute run. To save time, students could start filling in their worksheets.
5 minutes	Show Biotech Program promotional video	

Total: 90 minutes (does not include the time spent preparing each station by the presenters, which could take 30-40 minutes).

Requirements if the experience is done at a high school:

- Space for a maximum of 24-32 students. Students work in groups of 4 students (maximum, ideal is 3 students per group).
- Electrical outlets to connect 8 electrophoresis chambers. This will be different for each high school, depending on the space.
- A way to project PowerPoints (ideal but not indispensable).
- Microwave oven (ideal but not indispensable).
- Distilled water (ideal but not indispensable).