

02-761

Lab Methods for Automated Biology

2024 - 2025 Fall



Lab 1 Report

Group Four Musketeers

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Introduction

This report is created by Four Musketeers group to discuss the learnings and progress in the first lab report in the 02-761 Lab Methods for Automated Biology class.

Our lab files are located at Box Drive in the following path:

```
Automation Lab Shared Data\LMAB 24_25\Four Muskeeters\Lab 1 Files
```

Or it can be accessed using AL5 machine in the lab with the following path:

```
C:\Users\AutomatedScience4\Box\Automation Lab Shared Data\LMAB 24_25\Four Muskeeters\Lab 1 Files
```

During the following experiments that we will discuss, we designed liquid handling protocols for various purposes using programmatic controls on CyBio Felix and Opentrons OP-2. We will first show us our experiments with their methods and results, then we will discuss our findings and give us our final thoughts in the conclusion.

Experiments

Plate 1

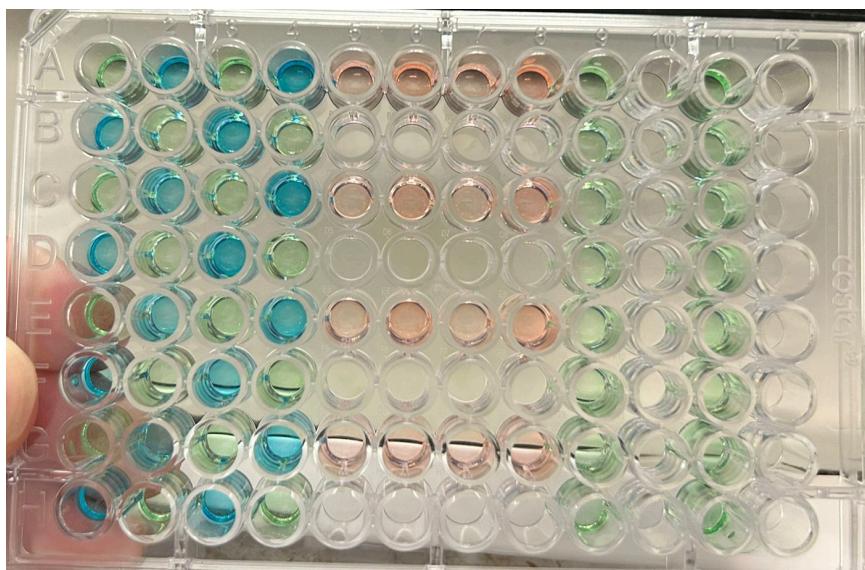


Figure 1. End result of plate 1

For this part of the experimentation, we have tried not to re-use the tips for different colors in order to avoid decontamination of colors. However, we tried to reuse the same layout of tips in order not to waste too many tips, leading us to think of an efficient solution for this lab.

First we picked up tips for green in the first column, and used it for columns 1, 3, 9, 11 in multi-dispense. Then we dropped the tips to pick up in the layout of column 2, again for green. We have used those tips to multi-dispense on columns 2, 4, 9, 11, thus completing all work for green.

Then, we used the layout in column 1 for blue, where we dispensed in multi-dispense setting for columns 1 and 3. After dropping the tips, we have used the layout in column 2 for blue again to dispense for columns 2 and 4 in multi-dispense, concluding our blue dispensal.

Lastly, we have picked up the tips for red in the fifth column layout. Then we used multi-dispense to dispense on columns 5-8.

Plate 2

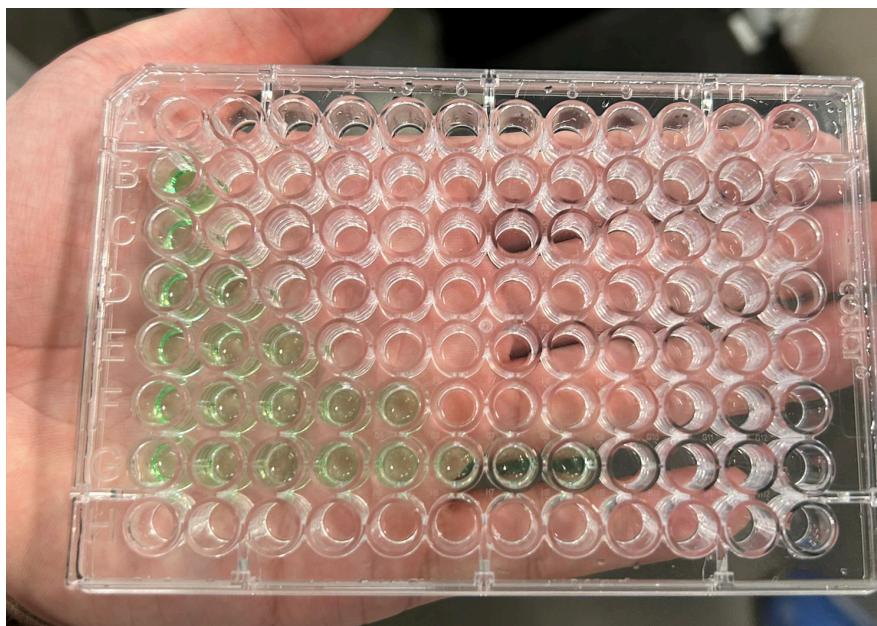


Figure 2. End result of plate 2

In plate 2, we generate the Fibonacci numbers plate using a loop.

Plate 3

https://youtu.be/uQP_-WAnc0c

In this experiment, we experimented with different aspiration and dispense settings. As the end result of the plate does not show useful information about the experimentation, we have decided to record a video and upload it to YouTube.

Plate 4

<https://youtu.be/QCao-M6Ci98>

For this experiment, we have observed the differences between multi-dispense and single-dispense. Similar to plate 3, instead of taking the picture of the end result, we have decided to record a video and upload it to demonstrate the difference between different dispense settings.

Plate 5

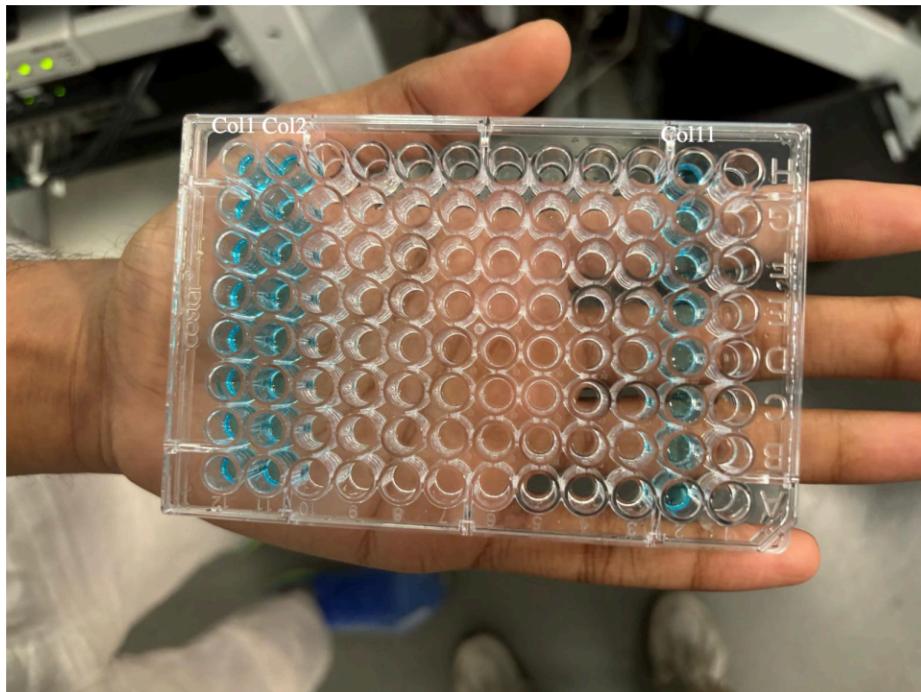


Figure 3. End result of plate 5

For this experiment, we put our well plate upside down but as the figure shows, our patterns and the columns we want to dispense which are column 1, 2 and 11 are correct. And in this experiment, we have learned that we can write our target wells using csv file, to finish our mission.

Plate 6

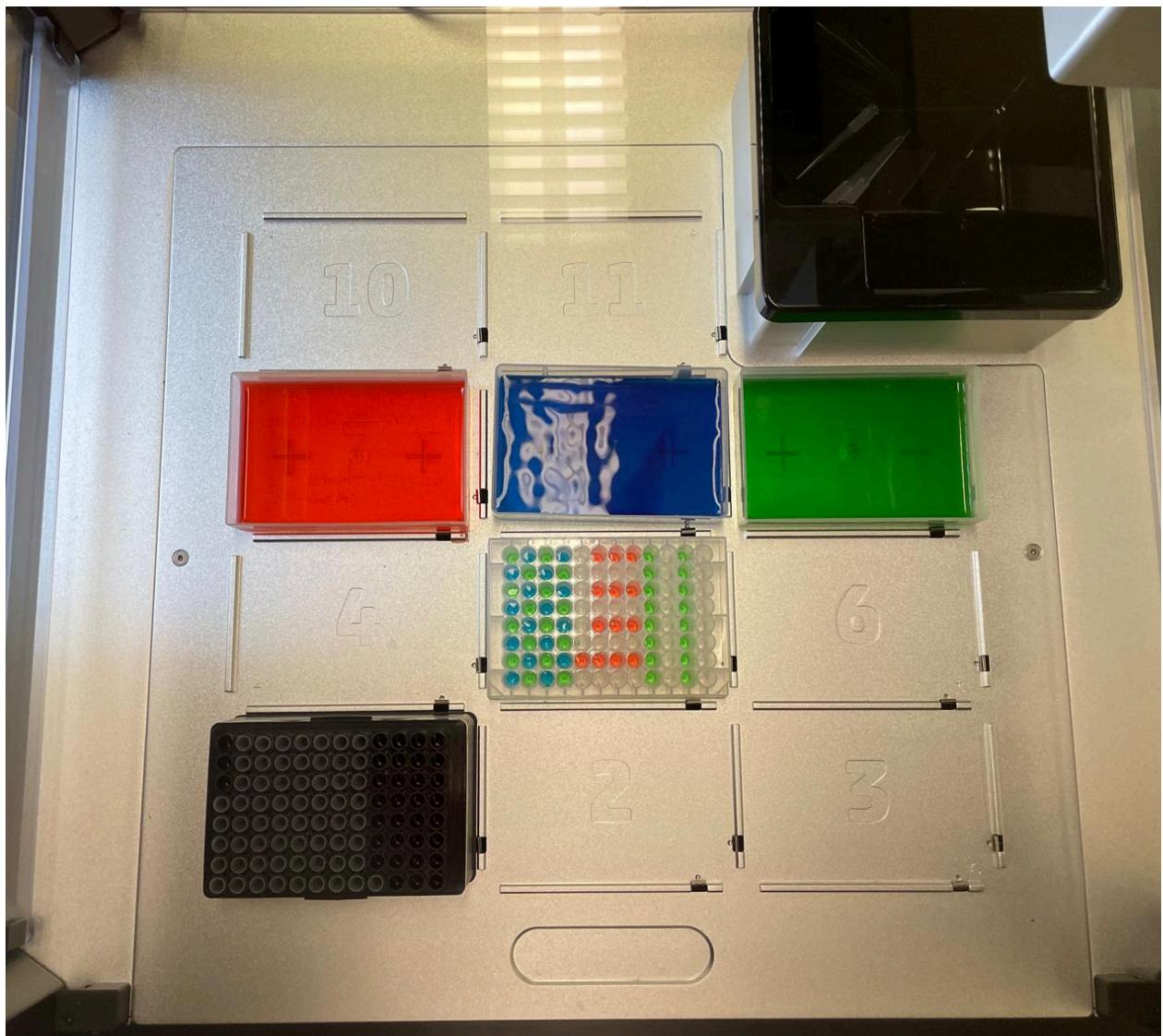


Figure 4. End result of Plate 6

In Plate 6, we missed three red dots as the container with the red colored water was not filled high enough for the pipette to aspire. After observing this, we have changed the Z-offset of aspiration to be lower, and solved the issue on the go. We were told by Dr. Kangas to upload this picture as is without running the lab again and explain why we were missing the three red dots.

Discussion

Here, we will be comparing and contrasting the protocol development process between the Opentrons OT-2 and the Analytic Jena Cybio Felix. Further, we will describe situations in which each device would be better suited to a task than the other.

Opentrons OT-2 has a really good user interface where it is easier to navigate without having any prior knowledge about the software, or without having to refer to the documentation too much. Most of the functionality that is required from the machine is easy to access, and the repetitive tasks are abstracted from the user to the system. The user can simply give the expected end result to the system, only for the system to create the intermediate steps. For these reasons, we have concluded OT-2 to be more user friendly to develop protocols compared to Cybio Felix. Moreover, as OT-2 can carry 2 pipettes of choice at one time whereas Cybio can only operate with one adapter, we believe it gives much more freedom for different types of operation. For single tip dispensing, OT-2 system would be preferable, provided it's a single batch operation.

For multi-dispense and loop operations, we believe that Cybio Felix is a preferable option. For example, for plate 2, if the Fibonacci series had to be done for more than ten steps, it would be pretty hard to navigate OT-2 for this task. However, in Cybio Felix, due to its resemblance to the programming languages, one can easily develop a protocol which would have a general rule that would work for any number of steps. On the other hand, OT-2 has to be given the end result of the plate in order to work, which would require a lot of manual work. Furthermore, Cybio can also read data files such as csv for selecting coordinates whereas it is not possible for OT-2, and also SQL commands can be provided, giving more choices for the user. Pipette tips need to be arranged for Cybio Felix for multi dispense of alternate tips. On the other hand, the same can be done for OT-2 or it can work with a single tip and take more running time.

To sum up, we believe that OT-2 abstracts a big part of the development process, helping the user have a fast and easy development process. However, Cybio Felix gives the user more choices on each step while making the process slower but more controlled. One can conclude that for fast development and beginner tasks it is best to use OT-2, while it is better to use Cybio Felix for more complex tasks or tasks requiring more navigation from the user.

Conclusion

We have experimented with Opentrons OT-2 and Cybio Felix during this experiment. We have seen that while it is easier to develop lab protocols with OT-2, we have much more flexibility with Cybio Felix. Cybio Felix gives us an opportunity to develop protocols as if we are writing code, thus allowing us to create more complex methods that involve miscellaneous commands such as using a for loop to create Fibonacci sequence instead of manually drawing the sequence.

Furthermore, we have observed the differences between single-dispense and multi-dispense settings, and also the difference between slow/fast aspiration and dispense sequences. We believe that we have obtained a good knowledge of designing efficient and correct protocols for automated biological lab machines.