**TECAN / ECHO Full Experiment (5,10,16,24,48,96+ Assembly Samples)**

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**STEM Pathways**

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**Introduction:**

To fully ensure that the TECAN / ECHO conversion is fully complete, I (along with Luis and Eric and Mary) made a total of 35 experiments using 12 plates, with up to 125 Assembly Samples and also up to 750 aspirate / dispense commands (ignoring reservoir, reagent, and wash commands). Here are the following results below:

1. **Procedure:**
2. Create a sample using a combination of 5 various parts:

* Promoter
* RBS (5’ UTR)
* Gene
* Destination Vector (DVA / DVK)
* Terminator

1. Use the following website: https:www.mocloassembly.com/ (Spice Rack Dashboard) to create the assemblies. If successful, the website will generate 3 main features:

* A PDF file detailing the summary of the experiment: including reservoir well volume (in microliters), Master Mix Reagent Plate volume, and the number of plates used plus reactions and output assemblies (combinations of the parts)
* A TECAN. gwl input file (Macbook reads the. gwl file as a textfile (.txt))
* ZIP File (that one can “unzip” in the Finder Folder or in Terminal)

1. Terminal Command (as long as the TECAN.gwl file is put exactly in the directory of either tecan\_converter\_final.py or echo\_converter\_final.py):

Conversion from TECAN to ECHO (provided no errors exist in the file or in the conversion):

user$ python tecan\_converter\_final.py [Assembly\_n\_Tecan.gwl] [Assembly\_n\_Tecan.csv]

Conversion from ECHO to TECAN (provided no errors exist in the file or in the conversion):

user$ python echo\_converter\_final.py [Assembly\_n\_Tecan.csv] [Assembly\_Tecan.gwl]

1. If the conversion is still successful, then the respective CSV or TECAN GWL file will be created.
2. **Experiment:**

\*\* Note: The experiment is so far only made for up to 750 commands, since another Setup Plate will be required to create a sample with more 96 wells. Generally, the samples are built en-sillico (in bulk) \*\*

**Tier 1: 5/96 Wells Tested (only 1 assembly created)**

Part Diagram of Plates 1-5:

Terminator

CDS

5’ UTR / RBS

Promoter

Destination Vector

Plate 1)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0040\_CD | 2.0 μL | 3 |
| B1 | DVK\_AE | 2.0 μL | Destination Vector |
| C1 | B0015\_DE | 2.0 μL | 4 |
| D1 | B0032m\_BC | 2.0 μL | 2 |
| E1 | J23100\_AB | 2.0 μL | 1 |
|  |  | Σ = 10.0 μL |  |

Statistics:

Reservoir: 14.0 μL

Master Mix 6.0 μL (Reagent Plate 1)

4 plates used / 1 reaction reagent

Coordinate Conversions:

5 commands total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |

Result: 5/5 commands passed!

Plate 2)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0062\_CD | 2.0 μL | 3 |
| B1 | DVK\_AE | 2.0 μL | Destination Vector |
| C1 | B0015\_DE | 2.0 μL | 4 |
| D1 | B0033m\_BC | 2.0 μL | 2 |
| E1 | J23102\_AB | 2.0 μL | 1 |
|  |  | Σ = 10.0 μL |  |

Statistics:

Reservoir: 14.0 μL

Master Mix 6.0 μL (Reagent Plate 1)

4 plates used / 1 reaction reagent

Coordinate Conversions:

5 commands total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |

Plate 3)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | cre\_CD | 2.0 μL | 3 |
| B1 | DVK\_AF | 2.0 μL | Destination Vector |
| C1 | B0015\_DF | 2.0 μL | 4 |
| D1 | BCD2\_BC | 2.0 μL | 2 |
| E1 | J23103\_AB | 2.0 μL | 1 |
|  |  | Σ = 10.0 μL |  |

Statistics:

Reservoir: 14.0 μL

Master Mix 6.0 μL (Reagent Plate 1)

4 plates used / 1 reaction reagent

Coordinate Conversions:

5 commands total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |

Plate 4)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0062\_CD | 2.0 μL | 3 |
| B1 | DVK\_AE | 2.0 μL | Destination Vector |
| C1 | B0015\_DE | 2.0 μL | 4 |
| D1 | B0033m\_BC | 2.0 μL | 2 |
| E1 | J23100\_AB | 2.0 μL | 1 |
|  |  | Σ = 10.0 μL |  |

Statistics:

Reservoir: 14.0 μL

Master Mix 6.0 μL (Reagent Plate 1)

4 plates used / 1 reaction reagent

Coordinate Conversions:

5 Commands Total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |

Plate 5) [FAILED due to excess amount of promoters [user input error]]

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | N/A | 0.0 μL | N/A |
| B1 | N/A | 0.0 μL | N/A |
| C1 | N/A | 0.0 μL | N/A |
| D1 | N/A | 0.0 μL | N/A |
| E1 | N/A | 0.0 μL | N/A |
| F1 | N/A | 0.0 μL | N/A |
|  |  | Σ = 0.0 μL |  |

Statistics:

Reservoir: 0.0 μL

Master Mix 0.0 μL (Reagent Plate 1)

0 plates used / 0 reaction reagent

Coordinate Conversions:

0 Commands Total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |

(Not Applicable since the MoClo Assembly Failed)

**Tier 2: 10/96 Wells Tested (2+ assemblies created)**

Plate 6)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0062\_CD | 4.0 μL | 3 |
| B1 | DVK\_AE | 4.0 μL | Destination Vector |
| C1 | B0015\_DE | 4.0 μL | 4 |
| D1 | B0033m\_BC | 4.0 μL | 2 |
| E1 | J23100\_AB | 2.0 μL | 1a |
| F1 | J23102\_AB | 2.0 μL | 1b |
|  |  | Σ = 20.0 μL |  |

Statistics:

Reservoir: 28.0 μL (water tank capacity)

Master Mix 12.0 μL (Reagent Plate 1)

4 plates used / 2 reactions reagent

Coordinate Conversions:

10 Commands total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |
| 2 | 2 | B1 | B1 |
| 6 | 2 | F1 | B1 |
| 4 | 2 | D1 | B1 |
| 1 | 2 | A1 | B1 |
| 3 | 2 | C1 | B1 |

Plate 7)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | B0034m\_BC | 4.0 μL | 3 |
| B1 | C0080\_CD | 4.0 μL | Destination Vector |
| C1 | DVK\_AE | 4.0 μL | 4 |
| D1 | B0015\_DE | 4.0 μL | 2 |
| E1 | J23103\_AB | 2.0 μL | 1a |
| F1 | J23106\_AB | 2.0 μL | 1b |
|  |  | Σ = 20.0 μL |  |

Statistics:

Reservoir: 28.0 μL (water tank capacity)

Master Mix 12.0 μL (Reagent Plate 1)

4 plates used / 2 reactions reagent

Coordinate Conversions:

10 Commands Total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 3 | 1 | C1 | A1 |
| 5 | 1 | E1 | A1 |
| 1 | 1 | A1 | A1 |
| 2 | 1 | B1 | A1 |
| 4 | 1 | D1 | A1 |
| 3 | 2 | C1 | B1 |
| 6 | 2 | F1 | B1 |
| 1 | 2 | A1 | B1 |
| 2 | 2 | B1 | B1 |
| 4 | 2 | D1 | B1 |

Plate 8)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0040\_CD | 4.0 μL | 3 |
| B1 | DVK\_AF | 4.0 μL | Destination Vector |
| C1 | B0015\_DF | 4.0 μL | 4 |
| D1 | B0033m\_BC | 4.0 μL | 2 |
| E1 | J23100\_AB | 2.0 μL | 1a |
| F1 | J23107\_AB | 2.0 μL | 1b |
|  |  | Σ = 20.0 μL |  |

Statistics:

Reservoir: 28.0 μL (water tank capacity)

Master Mix 12.0 μL (Reagent Plate 1)

4 plates used / 2 reactions reagent

Coordinate Conversions:

10 Commands Total

|  |  |  |  |
| --- | --- | --- | --- |
| TECAN |  |  | ECHO |
| Source | **Destination** | **Source** | **Destination** |
| 2 | 1 | B1 | A1 |
| 5 | 1 | E1 | A1 |
| 4 | 1 | D1 | A1 |
| 1 | 1 | A1 | A1 |
| 3 | 1 | C1 | A1 |
| 2 | 2 | B1 | B1 |
| 6 | 2 | F1 | B1 |
| 4 | 2 | D1 | B1 |
| 1 | 2 | A1 | B1 |
| 3 | 2 | C1 | B1 |

Plate 9) (increased to 9 total parts)

Part Diagram of Plate 9:

CDS

Terminators

Promoter

5’ (UTR) / RBS

Destination Vector

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0040\_CD | 12.0 μL | 3a |
| B1 | C0062\_CD | 12.0 μL | 3b |
| C1 | DVK\_AF | 24.0 μL | Destination Vector |
| D1 | B0015\_DF | 24.0 μL | 4 |
| E1 | B0032m\_BC | 12.0 μL | 2a |
| F1 | B0033m\_BC | 12.0 μL | 2b |
| G1 | J23100\_AB | 8.0 μL | 1a |
| H1 | J23103\_AB | 8.0 μL | 1b |
| A2 | J23106\_AB | 8.0 μL | 1c |
|  |  | Σ = 120.0 μL |  |

Statistics:

Reservoir: 163.0 μL (water tank capacity)

Master Mix 72.0 μL (Reagent Plate 1)

4 plates used / 12 reactions

Coordinate Conversions:

62 Commands Total

source plate,source well,destination plate name,destination well,Transfer

Volume

SetupPlate1,C1,Output1,A1,100

SetupPlate1,G1,Output1,A1,100

SetupPlate1,E1,Output1,A1,100

SetupPlate1,A1,Output1,A1,100

SetupPlate1,D1,Output1,A1,100

SetupPlate1,C1,Output1,B1,100

SetupPlate1,G1,Output1,B1,100

SetupPlate1,E1,Output1,B1,100

SetupPlate1,B1,Output1,B1,100

SetupPlate1,D1,Output1,B1,100

SetupPlate1,C1,Output1,C1,100

SetupPlate1,G1,Output1,C1,100

SetupPlate1,F1,Output1,C1,100

SetupPlate1,A1,Output1,C1,100

SetupPlate1,D1,Output1,C1,100

SetupPlate1,C1,Output1,D1,100

SetupPlate1,G1,Output1,D1,100

SetupPlate1,F1,Output1,D1,100

SetupPlate1,B1,Output1,D1,100

SetupPlate1,D1,Output1,D1,100

SetupPlate1,C1,Output1,E1,100

SetupPlate1,H1,Output1,E1,100

SetupPlate1,E1,Output1,E1,100

SetupPlate1,A1,Output1,E1,100

SetupPlate1,D1,Output1,E1,100

SetupPlate1,C1,Output1,F1,100

SetupPlate1,H1,Output1,F1,100

SetupPlate1,E1,Output1,F1,100

SetupPlate1,B1,Output1,F1,100

SetupPlate1,D1,Output1,F1,100

SetupPlate1,C1,Output1,G1,100

SetupPlate1,H1,Output1,G1,100

SetupPlate1,F1,Output1,G1,100

SetupPlate1,A1,Output1,G1,100

SetupPlate1,D1,Output1,G1,100

SetupPlate1,C1,Output1,H1,100

SetupPlate1,H1,Output1,H1,100

SetupPlate1,F1,Output1,H1,100

SetupPlate1,B1,Output1,H1,100

SetupPlate1,D1,Output1,H1,100

SetupPlate1,C1,Output1,A2,100

SetupPlate1,A2,Output1,A2,100

SetupPlate1,E1,Output1,A2,100

SetupPlate1,A1,Output1,A2,100

SetupPlate1,D1,Output1,A2,100

SetupPlate1,C1,Output1,B2,100

SetupPlate1,A2,Output1,B2,100

SetupPlate1,E1,Output1,B2,100

SetupPlate1,B1,Output1,B2,100

SetupPlate1,D1,Output1,B2,100

SetupPlate1,C1,Output1,C2,100

SetupPlate1,A2,Output1,C2,100

SetupPlate1,F1,Output1,C2,100

SetupPlate1,A1,Output1,C2,100

SetupPlate1,D1,Output1,C2,100

SetupPlate1,C1,Output1,D2,100

SetupPlate1,A2,Output1,D2,100

SetupPlate1,F1,Output1,D2,100

SetupPlate1,B1,Output1,D2,100

SetupPlate1,D1,Output1,D2,100

**Tier 3: 24/96 Wells Tested (up to 125 assemblies created)**

Plate 10)

Part Diagram of Plate 10:

5’ (UTR) / RBS (3x)

CDS (3x)

Terminators (3x)

Promoter (3x)

Destination Vector (2x)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0040\_CD | 18.0 μL | 3a |
| B1 | C0062\_CD | 18.0 μL | 3b |
| C1 | DVK\_AF | 36.0 μL | Destination Vector |
| D1 | B0015\_DF | 36.0 μL | 4 |
| E1 | B0032m\_BC | 12.0 μL | 2a |
| F1 | B0033m\_BC | 12.0 μL | 2b |
| G1 | BCD2\_BC | 12.0 μL | 2c |
| H1 | J23100\_AB | 12.0 μL | 1a |
| A2 | J23102\_AB | 12.0 μL | 1b |
| B2 | J23103\_AB | 12.0 μL | 1c |
|  |  | Σ = 180.0 μL |  |

Statistics:

Reservoir: 244.0 μL (water tank capacity)

Master Mix 108.0 μL (Reagent Plate 1)

4 plates used / 18 reactions

Coordinate Conversions: (final feasible conversion command to print out)

90 Commands Total

source plate,source well,destination plate name,destination well,Transfer Volume

SetupPlate1,C1,Output1,A1,100

SetupPlate1,H1,Output1,A1,100

SetupPlate1,E1,Output1,A1,100

SetupPlate1,A1,Output1,A1,100

SetupPlate1,D1,Output1,A1,100

SetupPlate1,C1,Output1,B1,100

SetupPlate1,H1,Output1,B1,100

SetupPlate1,E1,Output1,B1,100

SetupPlate1,B1,Output1,B1,100

SetupPlate1,D1,Output1,B1,100

SetupPlate1,C1,Output1,C1,100

SetupPlate1,H1,Output1,C1,100

SetupPlate1,F1,Output1,C1,100

SetupPlate1,A1,Output1,C1,100

SetupPlate1,D1,Output1,C1,100

SetupPlate1,C1,Output1,D1,100

SetupPlate1,H1,Output1,D1,100

SetupPlate1,F1,Output1,D1,100

SetupPlate1,B1,Output1,D1,100

SetupPlate1,D1,Output1,D1,100

SetupPlate1,C1,Output1,E1,100

SetupPlate1,H1,Output1,E1,100

SetupPlate1,G1,Output1,E1,100

SetupPlate1,A1,Output1,E1,100

SetupPlate1,D1,Output1,E1,100

SetupPlate1,C1,Output1,F1,100

SetupPlate1,H1,Output1,F1,100

SetupPlate1,G1,Output1,F1,100

SetupPlate1,B1,Output1,F1,100

SetupPlate1,D1,Output1,F1,100

SetupPlate1,C1,Output1,G1,100

SetupPlate1,A2,Output1,G1,100

SetupPlate1,E1,Output1,G1,100

SetupPlate1,A1,Output1,G1,100

SetupPlate1,D1,Output1,G1,100

SetupPlate1,C1,Output1,H1,100

SetupPlate1,A2,Output1,H1,100

SetupPlate1,E1,Output1,H1,100

SetupPlate1,B1,Output1,H1,100

SetupPlate1,D1,Output1,H1,100

SetupPlate1,C1,Output1,A2,100

SetupPlate1,A2,Output1,A2,100

SetupPlate1,F1,Output1,A2,100

SetupPlate1,A1,Output1,A2,100

SetupPlate1,D1,Output1,A2,100

SetupPlate1,C1,Output1,B2,100

SetupPlate1,A2,Output1,B2,100

SetupPlate1,F1,Output1,B2,100

SetupPlate1,B1,Output1,B2,100

SetupPlate1,D1,Output1,B2,100

SetupPlate1,C1,Output1,C2,100

SetupPlate1,A2,Output1,C2,100

SetupPlate1,G1,Output1,C2,100

SetupPlate1,A1,Output1,C2,100

SetupPlate1,D1,Output1,C2,100

SetupPlate1,C1,Output1,D2,100

SetupPlate1,A2,Output1,D2,100

SetupPlate1,G1,Output1,D2,100

SetupPlate1,B1,Output1,D2,100

SetupPlate1,D1,Output1,D2,100

SetupPlate1,C1,Output1,E2,100

SetupPlate1,B2,Output1,E2,100

SetupPlate1,E1,Output1,E2,100

SetupPlate1,A1,Output1,E2,100

SetupPlate1,D1,Output1,E2,100

SetupPlate1,C1,Output1,F2,100

SetupPlate1,B2,Output1,F2,100

SetupPlate1,E1,Output1,F2,100

SetupPlate1,B1,Output1,F2,100

SetupPlate1,D1,Output1,F2,100

SetupPlate1,C1,Output1,G2,100

SetupPlate1,B2,Output1,G2,100

SetupPlate1,F1,Output1,G2,100

SetupPlate1,A1,Output1,G2,100

SetupPlate1,D1,Output1,G2,100

SetupPlate1,C1,Output1,H2,100

SetupPlate1,B2,Output1,H2,100

SetupPlate1,F1,Output1,H2,100

SetupPlate1,B1,Output1,H2,100

SetupPlate1,D1,Output1,H2,100

SetupPlate1,C1,Output1,A3,100

SetupPlate1,B2,Output1,A3,100

SetupPlate1,G1,Output1,A3,100

SetupPlate1,A1,Output1,A3,100

SetupPlate1,D1,Output1,A3,100

SetupPlate1,C1,Output1,B3,100

SetupPlate1,B2,Output1,B3,100

SetupPlate1,G1,Output1,B3,100

SetupPlate1,B1,Output1,B3,100

SetupPlate1,D1,Output1,B3,100

Plate 11)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | C0012m\_CD | 16.0 μL | 3a |
| B1 | C0062\_CD | 16.0 μL | 3b |
| C1 | DVK\_AF | 16.0 μL | 3c |
| D1 | B0015\_DF | 16.0 μL | 3d |
| E1 | B0032m\_BC | 64.0 μL | Destination Vector |
| F1 | B0033m\_BC | 64.0 μL | 4 |
| G1 | BCD2\_BC | 32.0 μL | 2a |
| H1 | J23100\_AB | 32.0 μL | 2b |
| A2 | J23102\_AB | 16.0 μL | 1a |
| B2 | J23103\_AB | 16.0 μL | 1b |
| C2 |  | 16.0 μL | 1c |
| D2 |  | 16.0 μL | 1d |
|  |  | Σ = 320.0 μL |  |

Statistics:

Reservoir: 433.0 μL (water tank capacity)

Master Mix 192.0 μL (Reagent Plate 1)

4 plates used / 32 reactions

Coordinate Conversions:

160 Commands Total

Plate 12)

|  |  |  |  |
| --- | --- | --- | --- |
| Coordinate | Part | Volume | Order |
| A1 | B0034m\_BC | 50.0 μL | 4 |
| B1 | C0012m\_CD | 50.0 μL | 5a |
| C1 | C0040\_CD | 50.0 μL | 5b |
| D1 | C0062\_CD | 50.0 μL | 5c |
| E1 | C0080\_CD | 50.0 μL | 5d |
| F1 | cre\_CD | 50.0 μL | 5e |
| G1 | DVK\_AF | 200.0 μL | Destination Vector |
| H1 | DVK\_AF | 50.0 μL | Destination Vector |
| A2 | B0015\_DF | 200.0 μL | 6a |
| B2 | B0015\_DF | 50.0 μL | 6b |
| C2 | B0032m\_BC | 50.0 μL | 2a |
| D2 | B0033m\_BC | 50.0 μL | 2b |
| E2 | BCD2\_BC | 50.0 μL | 3a |
| F2 | BCD8\_BC | 50.0 μL | 3b |
| G2 | J23100\_AB | 50.0 μL | 1a |
| H2 | J23100\_AB | 50.0 μL | 1b |
| A3 | J23103\_AB | 50.0 μL | 1c |
| B3 | J23106\_AB | 50.0 μL | 1d |
| C3 | J23107\_AB | 50.0 μL | 1e |
|  |  | Σ = 1250.0 μL |  |

Statistics:

Reservoir: 1691.0 μL (water tank capacity)

Master Mix 1: 198.0 μL (Reagent Plate 1)

Master Mix 2: 198.0 μL (Reagent Plate 1)

Master Mix 3: 198.0 μL (Reagent Plate 1)

Master Mix 4: 198.0 μL (Reagent Plate 1)

Total (Σ): 750.0 μL

4 plates used / 32 reactions

Coordinate Conversions:

626 Commands Total

1. **Conclusions:**

**Thresholds / Testing Benchmarks**

**Using R Program / Prism Software (collaboration with Eric and Luis)**

* **Remarks:**
* **No failed tests (without human error) up to 48 wells in SetupPlate.**
* **1 failed test (Plate 5, Test 3) due to improper user input (extra amount of promoter for a 5-well reaction)**
* **Passed 34/35 tests (97%, with margin of error less than 5%)**
* **Overall:** 
  + **12 plates, 35 tests total**
  + **Up to 750 aspirate / dispense commands converted successfully (in terms of source well, destination well, and transfer volume)**
  + **twice the number of JoVe Article 2017**
* **Mathematical Intuition / Pseudocode:**

c1) Converting from TECAN Coordinates to ECHO (with floating arithmetic and modulo operators):

f(E) =

conversion dictionary = {[“0”, “A”],[“1”, “B”], [“2”, “C”], [“3”, “D”], [“4”, “E”], [“5”, “F”], [“6”, “G”], [“7”, “H”]}

# concatenate (or put together the strings)

s = convert to string(conv[int(column number])] + str(row)

Example run:

tecan\_to\_echo(20) -> “D3”

c2) Converting from ECHO to TECAN (with floating arithmetic and mod operators):

conversion dictionary = {[“1”, “A”],[“2”, “B”], [“3”, “C”], [“4”, “D”], [“5”, “E”], [“6”, “F”], [“7”, “G”], [“8”, “H”]}

Example run:

echo\_to\_tecan(“D3”) -> 20