**Teacher Notes for Learning to Use Micropipettes: Making Suncatchers**

This is a super fun and easy way to give your students pipetting practice while also helping them to understand what a serial dilution is. Icing on the cake…they get to practice those all-important math skills!

* Make up stock solutions of food coloring and water; red, blue, green and yellow. For a class of 24 students working in pairs, make up about 600 mL of each color and pour into 50 mL falcon tubes. Each class will only use a small portion of the 50 mL, so you can use these sets all day in all your classes, refilling as needed.
* Create a set of five falcon tubes, one of each color including a tube of plain water (no color), for each group of four students. They’ll work in pairs for the most part, but having each student create a dilution set to share in a group of 4 helps reduce the quantities used. You don’t need to label the falcon tubes…it’s obvious what’s what! A T.A. can easily do this for you. Here’s the ratio that gives a fairly decent dilution set:

10 drops food (500uL) coloring to 50 mL water

You can ramp it up: 6mL food coloring in 600 mL water is enough for 12 sets

If you store them in screw cap falcon tubes you can use them year to year and just refill as needed.

* Each lab group of 2 needs 16 falcon tubes split into two racks so each student has 8. Depending on how many micropipettes you have, they will probably need to share. They’ll need 1000uL and 100 or 200uL pipettes and tips to go with. Each student also needs a plastic or glass 10 mL pipette and controller.
* They’ll need old 96 well plates. I use old ELISA plates, but any old 96 well plate will do. Don’t use new!
* Laminating the coordinate instruction sheets makes it easy to use them year to year.
* I’ve written this for my class, where all their work goes into their notebook, but you could easily use it as a worksheet by eliminating that part of the instructions.
* There’s all kinds of variations on this idea. You can have students create their own designs and make a key for them to use the following year or for extra credit.

**Part 1**

**Coordinate Instructions for A**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Red #1 or 2 | A2 | B1 | C1 | D2 | E3 | F4 | G5 | H6 |
|  | A3 | B5 | C6 | D11 | E10 | F9 | G8 | H7 |
|  | A4 | B8 | C7 |  |  |  |  |  |
|  | A9 | B12 | C12 |  |  |  |  |  |
|  | A10 |  |  |  |  |  |  |  |
|  | A11 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Red #5 or 6 |  | B2 | C2 | D3 | E4 | F5 | G6 |  |
|  |  | B3 | C5 | D6 | E9 | F8 | G7 |  |
|  |  | B4 | C8 | D7 |  |  |  |  |
|  |  | B9 | C11 | D10 |  |  |  |  |
|  |  | B10 |  |  |  |  |  |  |
|  |  | B11 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #1 or 2 |  |  | C3 |  |  |  |  |  |
|  |  |  | C4 |  |  |  |  |  |
|  |  |  | C9 |  |  |  |  |  |
|  |  |  | C10 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #3 or 4 |  |  |  | D4 |  |  |  |  |
|  |  |  |  | D5 |  |  |  |  |
|  |  |  |  | D8 |  |  |  |  |
|  |  |  |  | D9 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #5 or 6 |  |  |  |  | E5 |  |  |  |
|  |  |  |  |  | E6 |  |  |  |
|  |  |  |  |  | E7 |  |  |  |
|  |  |  |  |  | E8 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #7 or 8 |  |  |  |  |  | F6 |  |  |
|  |  |  |  |  |  | F7 |  |  |

**Coordinate Instructions for B**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Blue #1 | A1 |  |  |  |  |  |  |  |
|  | A2 |  |  |  |  |  |  |  |
|  | A3 |  |  |  |  |  |  |  |
|  | A4 |  |  |  |  |  |  |  |
|  | A5 |  |  |  |  |  |  |  |
|  | A6 |  |  |  |  |  |  |  |
|  | A7 |  |  |  |  |  |  |  |
|  | A8 |  |  |  |  |  |  |  |
|  | A9 |  |  |  |  |  |  |  |
|  | A10 |  |  |  |  |  |  |  |
|  | A11 |  |  |  |  |  |  |  |
|  | A12 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #2 |  | B1 |  |  |  |  |  |  |
|  |  | B2 |  |  |  |  |  |  |
|  |  | B3 |  |  |  |  |  |  |
|  |  | B4 |  |  |  |  |  |  |
|  |  | B6 |  |  |  |  |  |  |
|  |  | B8 |  |  |  |  |  |  |
|  |  | B10 |  |  |  |  |  |  |
|  |  | B11 |  |  |  |  |  |  |
|  |  | B12 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #3 |  |  | C1 |  |  |  |  |  |
|  |  |  | C2 |  |  |  |  |  |
|  |  |  | C3 |  |  |  |  |  |
|  |  |  | C4 |  |  |  |  |  |
|  |  |  | C5 |  |  |  |  |  |
|  |  |  | C9 |  |  |  |  |  |
|  |  |  | C10 |  |  |  |  |  |
|  |  |  | C11 |  |  |  |  |  |
|  |  |  | C12 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #4 |  |  |  | D1 |  |  |  |  |
|  |  |  |  | D2 |  |  |  |  |
|  |  |  |  | D3 |  |  |  |  |
|  |  |  |  | D4 |  |  |  |  |
|  |  |  |  | D10 |  |  |  |  |
|  |  |  |  | D11 |  |  |  |  |
|  |  |  |  | D12 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #5 |  |  |  |  | E1 |  |  |  |
|  |  |  |  |  | E2 |  |  |  |
|  |  |  |  |  | E3 |  |  |  |
|  |  |  |  |  | E4 |  |  |  |
|  |  |  |  |  | E5 |  |  |  |
|  |  |  |  |  | E9 |  |  |  |
|  |  |  |  |  | E10 |  |  |  |
|  |  |  |  |  | E11 |  |  |  |
|  |  |  |  |  | E12 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #6 |  |  |  |  |  | F1 |  |  |
|  |  |  |  |  |  | F2 |  |  |
|  |  |  |  |  |  | F3 |  |  |
|  |  |  |  |  |  | F4 |  |  |
|  |  |  |  |  |  | F6 |  |  |
|  |  |  |  |  |  | F8 |  |  |
|  |  |  |  |  |  | F10 |  |  |
|  |  |  |  |  |  | F11 |  |  |
|  |  |  |  |  |  | F12 |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue #7 |  |  |  |  |  |  | G1 |  |
|  |  |  |  |  |  |  | G2 |  |
|  |  |  |  |  |  |  | G3 |  |
|  |  |  |  |  |  |  | G4 |  |
|  |  |  |  |  |  |  | G5 |  |
|  |  |  |  |  |  |  | G9 |  |
|  |  |  |  |  |  |  | G10 |  |
|  |  |  |  |  |  |  | G11 |  |
|  |  |  |  |  |  |  | G12 |  |
|  |  |  |  |  |  |  |  |  |
| Blue #8 |  |  |  |  |  |  |  | H1 |
|  |  |  |  |  |  |  |  | H2 |
|  |  |  |  |  |  |  |  | H3 |
|  |  |  |  |  |  |  |  | H4 |
|  |  |  |  |  |  |  |  | H5 |
|  |  |  |  |  |  |  |  | H6 |
|  |  |  |  |  |  |  |  | H8 |
|  |  |  |  |  |  |  |  | H9 |
|  |  |  |  |  |  |  |  | H10 |
|  |  |  |  |  |  |  |  | H11 |
|  |  |  |  |  |  |  |  | H12 |
|  |  |  |  |  |  |  |  |  |
| Red # 9 |  | B5 |  | D5 |  | F5 |  |  |
|  |  | B7 |  | D9 |  | F9 |  |  |
|  |  | B9 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Yellow #2 |  |  |  | D7 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Red #4 |  |  | C6 | D6 | E6 |  |  |  |
|  |  |  | C7 | D8 | E7 |  |  |  |
|  |  |  | C8 |  | E8 |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Green #8 |  |  |  |  |  | F7 | G7 | H7 |
|  |  |  |  |  |  |  |  |  |
| Green #3 |  |  |  |  |  |  | G6 |  |
|  |  |  |  |  |  |  | G8 |  |

**Part 2**

**Coordinate Instructions for Picture #1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Purple | A5 | B4 | C3 | D3 | E3 | F3 | G4 | H5 |
|  | A6 | B5 | C4 | D4 | E4 | F4 | G5 | H6 |
|  | A7 | B6 | C5 | D9 | E9 | F5 | G6 | H7 |
|  | A8 | B7 | C8 | D10 | E10 | F8 | G7 | H8 |
|  |  | B8 | C9 |  |  | F9 | G8 |  |
|  |  | B9 | C10 |  |  | F10 | G9 |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Yellow |  |  | C6 | D5 | E5 | F6 |  |  |
|  |  |  | C7 | D6 | E6 | F7 |  |  |
|  |  |  |  | D7 | E7 |  |  |  |
|  |  |  |  | D8 | E8 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Green |  |  |  |  | E1 | F1 | G1 | H2 |
|  |  |  |  |  | E12 | F2 | G2 | H3 |
|  |  |  |  |  |  | F11 | G3 | H4 |
|  |  |  |  |  |  | F12 | G10 | H9 |
|  |  |  |  |  |  |  | G11 | H10 |
|  |  |  |  |  |  |  | G12 | H11 |

**Coordinate Instructions for Picture #2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Blue | A3 | B2 | C1 | D1 | E1 | F1 | G2 | H3 |
|  | A4 | B3 | C2 | D2 | E2 | F2 | G3 | H4 |
|  | A5 | B4 | C3 |  |  | F3 | G4 | H5 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Yellow | A6 | B7 | C8 | D6 | E8 | F8 | G7 | H6 |
|  | A9 | B9 | C9 | D7 | E9 | F9 | G9 | H9 |
|  | A12 | B11 | C10 | D8 | E10 | F10 | G11 | H12 |
|  |  |  |  | D9 |  |  |  |  |
|  |  |  |  | D10 |  |  |  |  |
|  |  |  |  | D11 |  |  |  |  |
|  |  |  |  | D12 |  |  |  |  |

**Coordinate Instructions for Picture #3**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Brown | A4 | B5 |  |  |  |  |  |  |
|  | A8 | B7 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Blue |  | B2 | C1 | D1 | E2 |  |  |  |
|  |  | B3 | C4 | D11 | E3 |  |  |  |
|  |  | B9 | C5 |  | E4 |  |  |  |
|  |  | B10 | C7 |  | E5 |  |  |  |
|  |  |  | C8 |  | E7 |  |  |  |
|  |  |  | C11 |  | E8 |  |  |  |
|  |  |  |  |  | E9 |  |  |  |
|  |  |  |  |  | E10 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Purple |  |  | C2 | D2 |  |  | G4 |  |
|  |  |  | C3 | D3 |  |  | G8 |  |
|  |  |  | C9 | D4 |  |  |  |  |
|  |  |  | C10 | D5 |  |  |  |  |
|  |  |  |  | D7 |  |  |  |  |
|  |  |  |  | D8 |  |  |  |  |
|  |  |  |  | D9 |  |  |  |  |
|  |  |  |  | D10 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Yellow |  |  | C6 | D6 | E6 | F6 | G6 |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Green |  |  |  |  |  | F4 | G3 | H3 |
|  |  |  |  |  |  | F5 | G5 | H4 |
|  |  |  |  |  |  | F7 | G7 | H8 |
|  |  |  |  |  |  | F8 | G9 | H9 |

**Coordinate Instructions for Picture #4**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Green |  | B7 | C6 | D1 | E5 | F6 | G6 | H7 |
|  |  |  | C7 | D2 | E6 | F7 | G7 |  |
|  |  |  |  | D3 | E7 |  |  |  |
|  |  |  |  | D4 | E8 |  |  |  |
|  |  |  |  | D5 |  |  |  |  |
|  |  |  |  | D6 |  |  |  |  |
|  |  |  |  | D7 |  |  |  |  |
|  |  |  |  | D8 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Red |  |  | C11 | D10 | E9 | F10 | G11 |  |
|  |  |  |  |  | E10 |  |  |  |
|  |  |  |  |  | E11 |  |  |  |
|  |  |  |  |  | E12 |  |  |  |

**Coordinate Instructions for Picture #5**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Red |  | B5 | C4 | D4 | E2 | F2 |  |  |
|  |  | B6 | C5 | D6 | E3 | F3 |  |  |
|  |  | B7 | C6 | D7 | E4 | F4 |  |  |
|  |  | B8 | C7 | D9 | E5 | F5 |  |  |
|  |  |  | C8 |  | E6 | F6 |  |  |
|  |  |  | C9 |  | E7 | F7 |  |  |
|  |  |  |  |  | E8 | F8 |  |  |
|  |  |  |  |  | E9 | F9 |  |  |
|  |  |  |  |  | E10 | F10 |  |  |
|  |  |  |  |  | E11 | F11 |  |  |
|  |  |  |  |  |  | F12 |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Yellow |  |  |  |  | E1 |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Brown |  |  |  |  |  |  | G3 | H4 |
|  |  |  |  |  |  |  | G5 | H10 |
|  |  |  |  |  |  |  | G9 |  |
|  |  |  |  |  |  |  | G11 |  |

**Coordinate Instructions for Picture #6**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Green |  |  | C9 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Purple | A6 | B7 | C4 | D4 | E4 | F4 | G6 |  |
|  |  |  | C7 | D6 | E7 | F7 | H6 |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Orange | A2 | B3 | C3 | D3 | E3 | F3 | G3 | H2 |
|  | A5 | B6 | C5 | D5 | E5 | F5 | G7 | H5 |
|  | A7 | B8 | C6 | D7 | E6 | F6 | G8 | H7 |
|  |  | B9 | C8 | D8 | E8 | F8 |  |  |
|  |  |  | C10 | D9 | E9 | F9 |  |  |
|  |  |  |  | D10 | E10 |  |  |  |
|  |  |  |  | D11 |  |  |  |  |

**Coordinate Instructions for Picture #7**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Orange | A2 | B1 | C3 |  |  |  |  |  |
|  | A11 | B2 | C5 |  |  |  |  |  |
|  |  | B11 | C6 |  |  |  |  |  |
|  |  | B12 | C7 |  |  |  |  |  |
|  |  |  | C8 |  |  |  |  |  |
|  |  |  | C10 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Brown |  |  |  |  |  |  |  | H3 |
|  |  |  |  |  |  |  |  | H9 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Red |  |  |  | D4 | E3 | F3 | G4 |  |
|  |  |  |  | D5 | E4 | F4 | G5 |  |
|  |  |  |  | D6 | E5 | F5 | G6 |  |
|  |  |  |  | D7 | E6 | F6 | G7 |  |
|  |  |  |  | D8 | E7 | F7 | G8 |  |
|  |  |  |  | D9 | E8 | F8 | G9 |  |
|  |  |  |  |  | E9 | F9 |  |  |
|  |  |  |  |  | E10 | F10 |  |  |

**Coordinate Instructions for Picture #8**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Brown |  |  |  |  | E4 | F5 | G6 | H6 |
|  |  |  |  |  | E6 | F6 |  |  |
|  |  |  |  |  | E8 | F7 |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Green |  | B5 | C4 | D3 | E3 | F4 |  |  |
|  |  | B6 | C5 | D4 | E5 | F8 |  |  |
|  |  | B7 | C6 | D5 | E7 |  |  |  |
|  |  |  | C7 | D6 | E9 |  |  |  |
|  |  |  | C8 | D7 |  |  |  |  |
|  |  |  |  | D8 |  |  |  |  |
|  |  |  |  | D9 |  |  |  |  |