

# Mastering micropipetting

## Activity Guide

In this activity learners will become familiar with what a micropipette is, what it is used for and how to accurately micropipette small volumes of liquid. Learners can also practice their micropipetting skills through competitive or artistic activities.

Suitable for: age 9+

Estimated duration: 30-45 minutes

### You will need (per pair of learners):

- P20 or P200 micropipette
- Tubes of food dye
- Box of micropipette tips
- Printed copy of micropipetting instructions
- Waste disposal container

### Depending on the activity chosen, you will also need:

- Laminated micropipetting target practice sheet and non-permanent marker pen, **or**
- Laminated pipette pointillism template and filter paper, **or**
- Laminated micropipetting masterpiece coordinates sheets and 96-well plate

### Introduction

In a laboratory, scientists will regularly need to use tiny volumes of liquids in their experiments. These volumes are usually measured in microlitres ( $\mu\text{L}$ ), which is one thousandth ( $1/1000\text{th}$ ) of a millilitre (mL). Scientists use micropipettes to accurately and precisely measure and transfer these very small volumes in their daily work. Accurately using a micropipette is an essential skill for many scientists.

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### Activity Guide

These activities will allow learners to master the art of micropipetting, with each activity emphasising slightly different elements:

1. **Micropipetting target practice** will help learners to become familiar with a micropipette, how to change the volume and accurately dispense a specific volume onto a target. It also helps them to visualise small volumes and competition can be used as a strategy to encourage accuracy and precision.
2. **Pipette pointillism** motivates learners to become familiar with a micropipette and accurate dispensing of volumes, as they create pipette art. Templates and colours are provided, but students can use their creativity to make individual and different images in this task.
3. **Micropipetting masterpieces** combines gaining familiarity with a micropipette with communication skills and interpretation of simple coordinates. Successful teamwork is rewarded by production of an image.

### Setting up the activity

You will need to aliquot and label different food dyes (blue, red and yellow) into microfuge tubes, or other suitable small containers in advance. Printed copies of the micropipetting method will also be helpful for learners to refer to whilst micropipetting. In addition:

1. For **micropipetting target practice**, you need to print and laminate the target practice sheets. Non-permanent marker pens can be used to write student names on the laminated sheets.
2. For **pipette pointillism**, you need to print and laminate image templates and ensure that you have filter paper of a size that covers the template.
3. For **micropipetting masterpieces**, you need to print coordinate sheets and have a 96-well plate for each pair.

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## Activity Guide

Running an activity

### Warm up discussion

- Begin the activity by explaining that in a laboratory, scientists often use tiny volumes of liquids in their work. Discuss why these liquids need to be accurately and precisely measured and dispensed, before introducing the tool used to do this - a micropipette. Explain that using a micropipette is an essential skill for some laboratory scientists.
- Explain how the parts of a micropipette function and demonstrate how to change the volume, add a tip, aspirate and dispense a sample, and safely eject a used tip into a designated waste disposal container. You might like to use the PowerPoint slides, alongside the activity sheets, to show a diagram of a micropipette, and to demonstrate how to change the volume and use a micropipette.

How to complete an activity

- 1. Micropipetting target practice.** Learners work in pairs to practice pipetting different volumes of food dye into a target circle on the laminated micropipetting target practice sheet. Using a whiteboard marker, learners can write their names on the micropipetting target practice sheet before beginning their practice. After completing the practice, they can compare their accuracy and precision to one another.
- 2. Pipette pointillism.** Learners pipette given volumes of food dye onto a laminated template. Learners can choose which template and colours of food dye they would like to use, then pipette the volumes shown in the centre of each circle onto the template. Once pipetting is complete, a piece of filter paper is carefully placed onto the template to transfer the food dye and produce a picture on the filter paper.

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**3. Micropipetting masterpieces** involves teamwork to create a picture in a 96-well plate. Learners work in pairs, with the first reading coordinates and the second pipetting food dye into specific wells of a 96-well plate. Partners swap roles part way through. Once completed, learners can identify the image produced.

#### Risk assessment

Activities in mastering micropipetting use household food dye and a micropipette for a short period of time. The risks associated with these activities are extremely low, however assessment of these risks is given below for completeness.

**Hazard:** Chemical substances - food dye

**Description:** Purchased from a supermarket and meets food safety standards

**Risks:** Contact with food dye

**Safety precautions:** Use good laboratory practice to avoid contact with skin and eyes

**Emergency procedures:** Wash hands under tap or eye using an eye bath

**Likelihood:** Possible

**Severity:** Minor

**Overall risk:** Low

**Hazard:** Ergonomics – micropipetting posture

**Description:** Using a micropipette involves using shoulder, wrist and hand movements that could cause muscular injury if used repeatedly over at least 2 consecutive hours per working day

**Risks:** Shoulders / wrists / hands sore from micropipette use

**Safety precautions:** Don't micropipette for long periods (>2 hours) without a break, and stretch every 20 minutes to minimise risk

**Emergency procedures:** If shoulders, wrists or hands become sore, stop pipetting and stretch

**Likelihood:** Unlikely

**Severity:** Minor

**Overall risk:** Low

# Mastering micropipetting

## Instructions

In a laboratory, scientists will often need to use tiny volumes of liquids in their experiments. These volumes are usually measured in microlitres ( $\mu\text{L}$ ), which is one thousandth ( $1/1000\text{th}$ ) of a millilitre ( $\text{mL}$ ). Scientists use micropipettes to accurately and precisely measure and transfer these very small volumes in their daily work.

Accurately using a micropipette is an essential skill for many laboratory scientists. This activity will allow you to master micropipetting so that you are ready to enter the lab!

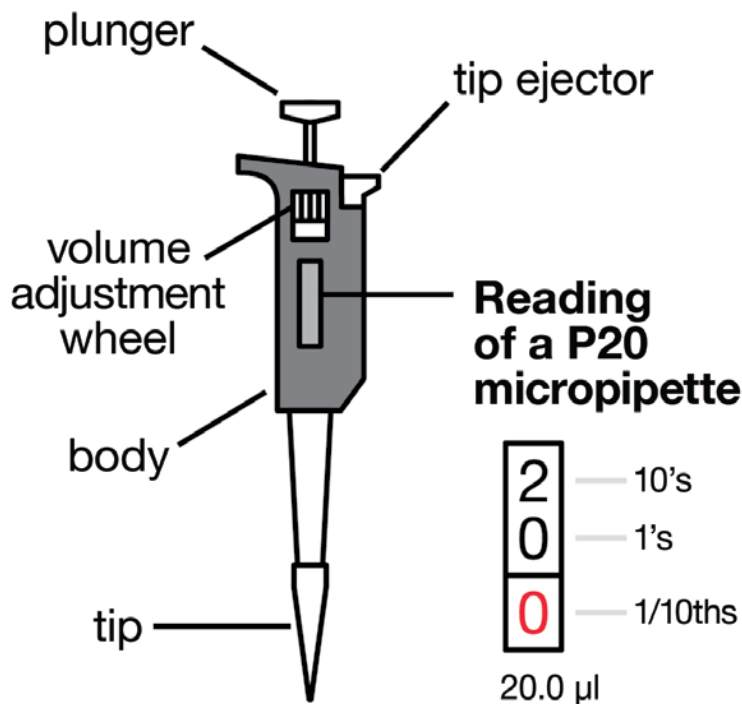
### Micropipettes

Micropipettes come in different shapes and sizes, but they all work in the same way:

- A **disposable tip** – used for each individual sample and then disposed of in a designated waste disposal container, prevents contamination
- The **body** – this includes the handle grip to hold and manipulate the micropipette
- A **volume adjustment wheel** – used to alter the specific volume that the micropipette will aspirate (suck up) and dispense, which is shown in the display window
- A **display window** – allows you to read the volume the pipette is set to
- A **plunger** – used to aspirate and then dispense the required volume
- A **tip ejector** – used to eject the used tip into the designated waste disposal container

## Mastering micropipetting

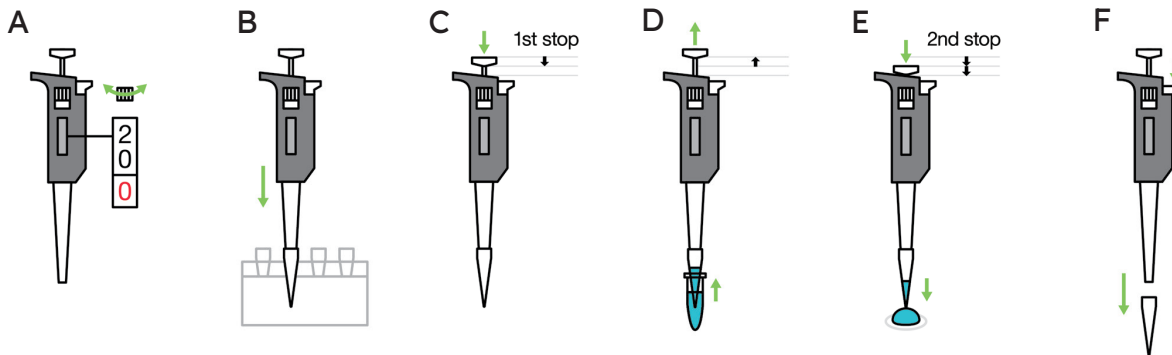
### Instructions



The volumes that a micropipette can accurately dispense are written on it. In this activity you will be using either a P20 or P200 micropipette, which can accurately dispense between 2 and 20 µL (P20), or 20 and 200 µL (P200), of liquid. Setting the volume outside of this range can damage the accurately calibrated mechanisms inside the micropipette.

In the example shown above, the P20 micropipette is set to a volume of 20.0 µL. In the display window the largest number will be tens of microlitres, the second digit will be single units of microlitres and the third digit (in red) will show tenths of a microlitre.

### Micropipetting method



- To use a micropipette, turn the volume adjustment wheel to set the correct volume in the display window.
- Once the volume is set, hold the body comfortably in your hand with your thumb on the plunger. Place a tip on the micropipette, by bringing it down gently into a tip in the tip box.
- Next, push the plunger down gently until you meet resistance. This is known as the first stop. A volume of air equal to the volume of liquid to be dispensed will be pushed out of the tip.
- Place the tip in the liquid to be aspirated (sucked up). Move your thumb slowly upwards to aspirate the correct volume of liquid. Moving your thumb upwards too fast can result in liquid being distributed up the inside of the tip.
- Now place your tip where the sample is to be dispensed. This time push the plunger gently, but firmly beyond the first stop until it can't go any further. This is the second stop and will dispense all of the liquid from the tip. Take care to remove the tip from the liquid before releasing the pressure from your thumb, or the liquid will be aspirated again.
- Position the micropipette over the waste disposal container and press the tip ejector button to remove the tip. When dispensing different quantities of the same food dye, the same tip can be used multiple times.

# Mastering micropipetting

## Micropipetting target practice

You will need (per pair of learners):

- P20 micropipette
- Tube of food dye
- Box of micropipette tips
- Laminated micropipetting target practice sheet
- Waste disposal container
- Non-permanent marker pen

1. In pairs, using a non-permanent marker pen, write your names on the lines on the laminated micropipetting target practice sheet.
2. Take it in turns to use the micropipette to accurately dispense the volumes of food dye shown into the centre of the circles on the laminated micropipetting target practice sheet.
3. Dispose of the used pipette tip in the designated waste disposal container.
4. Compare your results with your partner's to see if you have both mastered the skill of micropipetting!

Micropipetting target practice					
Name	20 µl	15 µl	10 µl	5 µl	2 µl
	○	○	○	○	○
	○	○	○	○	○



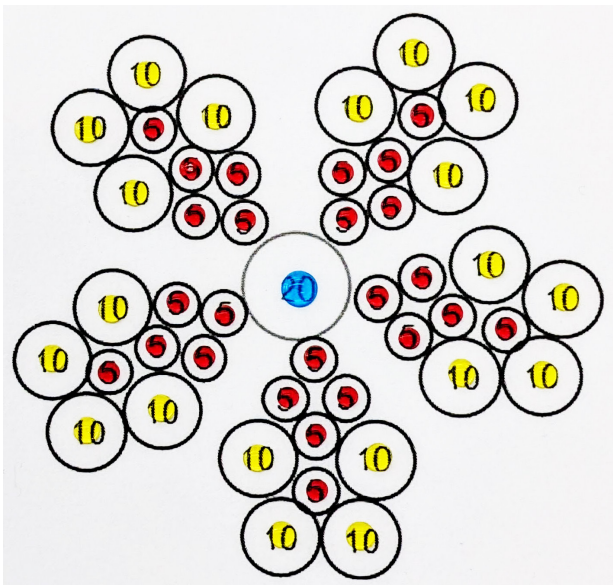
# Mastering micropipetting

## Pipette pointillism

### You will need:

- P20 micropipette
- Tubes of blue, red and yellow food dye
- Box of micropipette tips
- Laminated pipette pointillism template
- Waste disposal container
- Filter paper

1. Choose the colours you would like to use. Set the micropipette and dispense the volume shown into the centre of each circle on your chosen template. Make sure to change the pipette tip between different colours to stop cross-contamination (unwanted mixing of colours). Used pipette tips should be disposed of in the designated waste disposal container.
2. Carefully place a piece of filter paper over the design to transfer the food dye and produce a picture on the filter paper. Allow to dry.



# Mastering micropipetting

## Micropipetting masterpiece

You will need (per pair of learners):

- P200 micropipette
- Tubes of blue, red and yellow food dye
- Box of micropipette tips
- 96-well plate
- Waste disposal container
- Coordinates sheet A

Work in pairs to complete the micropipetting masterpiece using the coordinates from coordinates sheet A for the blue, red and yellow colours in the 96-well plate.

**Person 1:** Give the coordinates and colours for half of the wells to your partner, ticking off the coordinates once your partner has filled the wells. Then use a micropipette to dispense the correct coloured liquid into the remaining wells in the plate, following your partner's instructions.

**Person 2:** Use a micropipette to dispense the coloured liquids into the correct wells in the plate, following your partner's instructions. Then give the coordinates and colours for the remaining wells to your partner, ticking off the coordinates once your partner has filled the wells.

Make sure to change the pipette tip between different colours to stop cross-contamination (unwanted mixing of colours). The used pipette tip should be disposed of in the designated waste disposal container.

Once you have pipetted into all the correct wells of the plate, identify the image in your masterpiece.

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## Micropipetting masterpiece coordinates

### Coordinates sheet A

Blue		Red		Yellow
B2	E4	C2	F8	A4
B3	E5	C3	F9	A9
B10	E8	C10	G3	B5
B11	E9	C11	G5	B8
C1	E10	D2	G8	C6
C4	E11	D3	G10	C7
C5	G4	D4	H3	D6
C8	G9	D5	H4	D7
C9		D8	H9	E6
C12		D9	H10	E7
D1		D10		F6
D12		D11		F7
E2		F4		G6
E3		F5		G7

# Mastering micropipetting

## Micropipetting masterpiece

You will need (per pair of learners):

- P200 micropipette
- Tubes of blue, red and yellow food dye
- Box of micropipette tips
- 96-well plate
- Waste disposal container
- Coordinates sheet B

Work in pairs to complete the micropipetting masterpiece using the coordinates from coordinates sheet B for the blue, red and yellow colours in the 96-well plate.

**Person 1:** Give the coordinates and colours for half of the wells to your partner, ticking off the coordinates once your partner has filled the wells. Then use a micropipette to dispense the correct coloured liquid into the remaining wells in the plate, following your partner's instructions.

**Person 2:** Use a micropipette to dispense the coloured liquids into the correct wells in the plate, following your partner's instructions. Then give the coordinates and colours for the remaining wells to your partner, ticking off the coordinates once your partner has filled the wells.

Make sure to change the pipette tip between different colours to stop cross-contamination (unwanted mixing of colours). The used pipette tip should be disposed of in the designated waste disposal container.

Once you have pipetted into all the correct wells of the plate, identify the image in your masterpiece.

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## Micropipetting masterpiece coordinates

### Coordinates sheet B

Blue	Red				Yellow
G3	A6	D2	E5	F8	C6
G5	A7	D3	E6	F9	C9
G9	A8	D4	E7	F10	E1
G11	A9	D5	E8	F11	
H4	B5	D6	E9	F12	
H10	B6	D7	E10		
	B7	D8	E11		
	B8	D9	E12		
	B9	D10	F2		
	B10	D11	F3		
	C5	D12	F4		
	C7	E2	F5		
	C8	E3	F6		
	C10	E4	F7		

# Mastering micropipetting

## Micropipetting masterpiece

You will need (per pair of learners):

- P200 micropipette
- Tubes of blue, red and yellow food dye
- Box of micropipette tips
- 96-well plate
- Waste disposal container
- Coordinates sheet C

Work in pairs to complete the micropipetting masterpiece using the coordinates from coordinates sheet C for the blue, red and yellow colours in the 96-well plate.

**Person 1:** Give the coordinates and colours for half of the wells to your partner, ticking off the coordinates once your partner has filled the wells. Then use a micropipette to dispense the correct coloured liquid into the remaining wells in the plate, following your partner's instructions.

**Person 2:** Use a micropipette to dispense the coloured liquids into the correct wells in the plate, following your partner's instructions. Then give the coordinates and colours for the remaining wells to your partner, ticking off the coordinates once your partner has filled the wells.

Make sure to change the pipette tip between different colours to stop cross-contamination (unwanted mixing of colours). The used pipette tip should be disposed of in the designated waste disposal container.

Once you have pipetted into all the correct wells of the plate, identify the image in your masterpiece.

# Mastering micropipetting

## Micropipetting masterpiece coordinates

### Coordinates sheet C

Blue		
C3	E4	G5
C4	E5	G11
C5	E6	G12
C6	E7	
D1	E8	
D2	E9	
D4	F2	
D5	F3	
D6	F4	
D7	F5	
D8	F6	
E1	F7	
E2	F10	
E3	G3	

Red	
A5	G4
A6	H4
A7	H5
A8	H6
A12	
B4	
B5	
B11	
B12	
C10	
D9	
D10	
E10	
F11	

Yellow
D3

## Micropipetting target practice

Name	20 µl	15 µl	10 µl	5 µl	2 µl
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Micropipetting target practice

Name	20 µl	15 µl	10 µl	5 µl	2 µl
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Micropipetting target practice

Name	20 µl	15 µl	10 µl	5 µl	2 µl
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



