@home
by miniPCR bio™

# Micropipetting @home

## MICROLITER MADNESS

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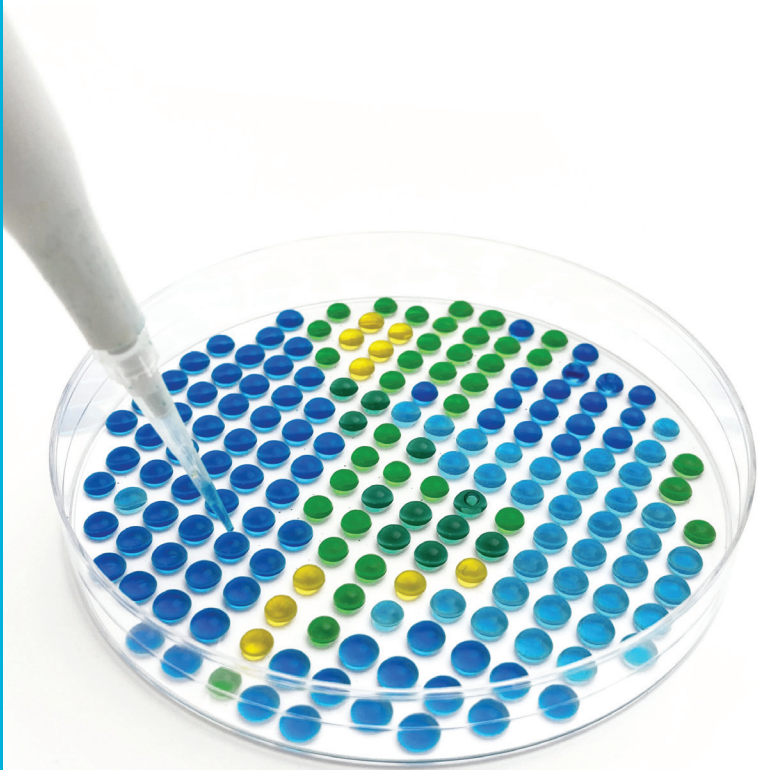


# Micropipetting @home

Whether determining the distance to a faraway star or weighing the correct dose of a drug for a test subject, accurate and precise measurements are a critical part of any scientific investigation. In your kitchen, you might make accurate and precise measurements using tools like measuring cups and measuring spoons. When scientists need to accurately measure small volumes of liquid, they use a tool called a micropipette (sometimes referred to as a "pipette" for short). By completing the activities included in this kit, you will prepare for your future career in the lab by becoming a micropipette expert!

**To get started, we encourage you to watch our 'How to Micropipette' video.** To find the video, you can search for "miniPCR bio How to Micropipette" on YouTube, or enter the following URL: https://www.minipcr.com/micropipetting/

## Overview of activities

### Micropipetting practice

This is the first step on your way to becoming a micropipette expert. Practice precisely measuring and mixing small volumes using a Pipette Practice Card and colored dyes.

### Gel loading practice

Next, learn the art of loading an electrophoresis gel, a critical tool in the molecular biology lab. Instead of the agarose gel you might encounter in the lab, you'll use a sturdy, reusable silicone practice gel.

### Micropipette art

Finally, put your micropipetting skills to the test and employ your creativity to create micropipette masterpieces. Afterwards, share your artwork with us on Instagram @minipcr for a chance to win a prize.

### Included in kit

| | |
|---|---|
| Reusable Pipette Practice Card | 1 |
| Reusable silicone practice gel | 1 |
| Blue, yellow, and red micropipetting practice dyes | 5 ml each |
| Micropipette tips (200 µl) | 20 |
| Petri dishes | 3 |
| Micropipette art patterns | 3 |

Also available for download at minipcr.com/micropipetting

# Micropipette use

Micropipettes come in two basic types: fixed volume micropipettes which only measure one volume, and variable micropipettes which can measure volumes within a certain range, for example 2-20 µl. Both types of micropipettes use similar principles for drawing up and dispensing samples.

## How to use a micropipette

**To draw up sample:**

1. Set volume using the volume adjustment wheel on your variable micropipette or select the appropriate fixed volume micropipette.
2. Press a new tip onto the shaft.
3. Press plunger to FIRST STOP.
4. Dip tip into liquid.
5. Slowly release plunger to collect liquid.

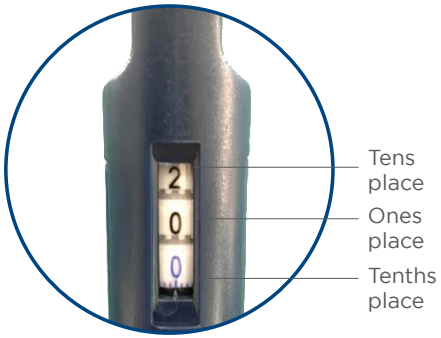
**To dispense sample:**

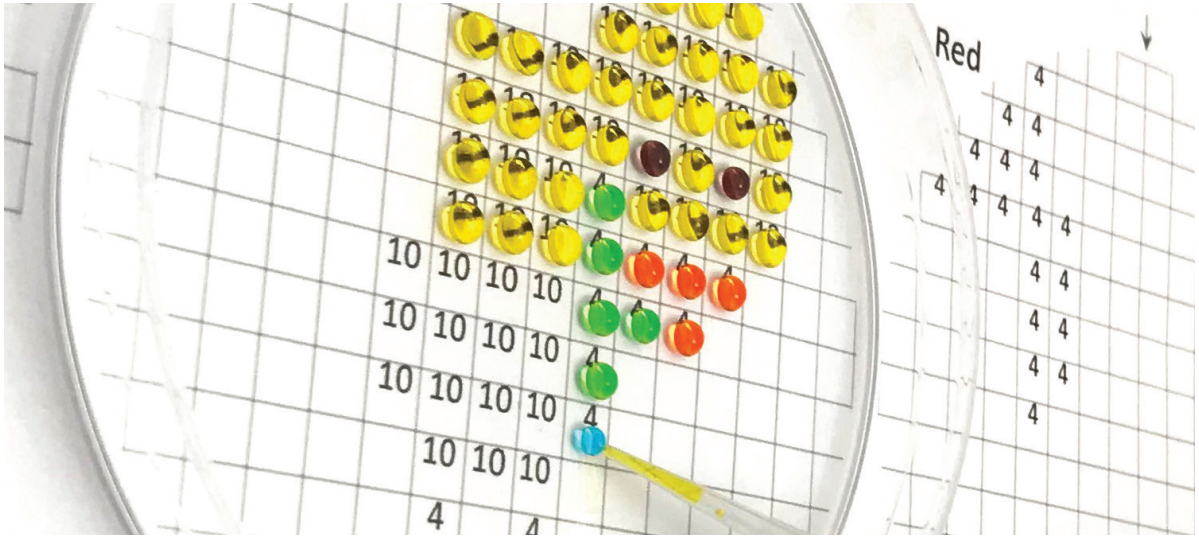
6. Touch tip to dispensing surface.
7. Press plunger to SECOND STOP.
8. Remove tip from liquid then release plunger.



# Parts of a micropipette


2-20 µl variable micropipette set to 20 µl




# Notes

**This kit is intended for multiple uses. Follow these instructions to care for and replace the materials.**

**Replacing micropipette practice dyes:** This activity comes with blue, yellow and red practice dyes to be used for the included activities. If you wish to make more dye, you may use store-bought food coloring and other common household ingredients. Dissolve 1/4 teaspoon of table sugar in 1 tablespoon of water. Divide mixture by measuring roughly 1 teaspoon into each of 3 containers (you may re-use the containers the dyes originally came in). Add 1 drop of food coloring to each container and swirl to mix.

**Reducing waste - pipette tips:** General pipette best practices dictate that a new micropipette tip should be used every time you pipette a new volume of liquid. This can be very important in avoiding contamination in molecular biology use. Unfortunately, this also creates a considerable amount of plastic waste. For this activity, to reduce unnecessary waste, we recommend reusing tips between activities. Should dye become stuck inside the tip, simply rinse it and allow it to dry completely before the next use. Tips can also be rinsed during use by pipetting up and down in a cup of clean water. If you run out of pipette tips, replacements can be ordered at minipcr.com (item number CM-1001-01).

**Reducing waste – Petri dishes:** The plastic Petri dishes included in this kit can be washed and reused multiple times to allow you to create all the pipette art your heart desires. Simply rinse and dry thoroughly between uses. Take care when storing the Petri dishes as they tend to crack easily.

**Caring for your Pipette Practice Card:** Pipette Practice Cards are intended for unlimited micropipetting practice. If you wish to retry an exercise simply wipe the card dry with a paper towel.

**Caring for your silicone gel:** Silicone gels are an inexpensive, durable tool for practicing loading gels. Because silicone gels are made of a hydrophobic material, air bubbles will tend to stick in the wells of a submerged gel much more firmly than in an agarose gel. This can interfere with loading the gel. To remove bubbles from the gel, hold the gel under a running faucet before submerging the gel. This will force water into the wells. To clean used loading dye out of the gel simply hold the gel under a running faucet until the dye is no longer visible. Allow to dry before storing.

# Micropipetting practice

## Today's activity

Scientists use micropipettes to measure small volumes of liquid, but to do so accurately requires proper technique. In this activity you will begin to hone your micropipetting skills by practicing measuring precise volumes and mixing liquids.

### Tips for mixing two liquids with a micropipette

- After adding your second liquid, only press the plunger to the first stop.
- When you reach the first stop, without moving your tip, slowly release the plunger and pick the same volume back up again from where you just dispensed it.
- Repeat this up and down motion several times until the two solutions look well mixed.
- When you think the solutions are well mixed, press the plunger to the second stop and remove the tip from the liquid as you normally would.
- If done well, you shouldn't have added bubbles to your sample.

## Materials

- A 2-20 µl variable micropipette OR 4 µl and 10 µl fixed volume micropipettes
- One Pipette Practice Card
- Micropipette tips
- Micropipetting practice dyes (blue, yellow, and red)

## A. Practice your technique

1. **Add the correct amount of liquid to each circle on the Pipette Practice Card. Try to be precise so that the liquid stays in the circle.**

   - If you have trouble, dry the spot with a paper towel and try again.
   - If you are using fixed volume micropipettes, pipette the closest volume you can without exceeding the specified value.

2. **Try to pick up all of the liquid without leaving any behind.**

   - Set your pipette to the same volume of water that is on one of your drops or select the correct fixed volume micropipette.
   - See if you can pick up all of the dye without leaving any behind. There should be no air inside the end of your micropipette tip.

**Note:** When picking up liquids off of the Pipette Practice Card expect that a very small amount will always remain behind. Despite the small amount left on the card, if done correctly, the liquid should fill the entire tip, with no space containing air at the end of the tip. Additionally, small drops of liquid left in open air for even a few minutes may lose volume due to evaporation. If you see space at the end of your micropipette tip after picking up the dye, try again, working faster.

There should be no space at the end of the micropipette tip

3. **In the blank space at the bottom of the card, pipette several drops of 4 µl.**

   - Change your pipette tip between drops. Save discarded tips to rinse and re-use later.

   How similar do the drops look in size? If they do not look exactly the same, what could be some sources of error?

4. **On a dry place on your card place 4 µl dye. Add 4 µl to the same place four more times.**

   - Change your pipette tip between drops. Save discarded tips to rinse and re-use later.

   What volume should you now have? _____

5. **Set your micropipette to that volume and try to pick up the entire drop or use your 10 µl fixed volume micropipette to try to move the entire drop to a new location.**

   Was there any liquid left on the card or was there space left in the tip of your micropipette? _____

**Based on your performance so far, how would you rate your pipetting skill? (Circle one.)**

**A. Amateur**
**B. Intermediate**
**C. Pro**
**D. Micropipette Expert!**

## B. Volume and mixing challenge

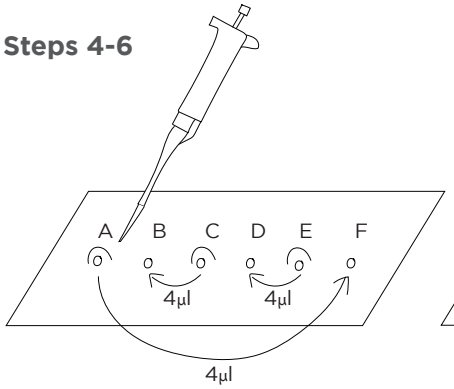
**Your goal is to add and mix the correct volumes, pipetting precisely onto the dots on your Pipette Practice Card.**

1. Add 14 µl of red dye to dot A
2. Add 14 µl of yellow dye to dot C
3. Add 14 µl of blue dye to dot E
4. From dot A, pick up 4 µl and place it on dot F
5. From dot C, pick up 4 µl and place it on dot B
6. From dot E, pick up 4 µl and place it on dot D

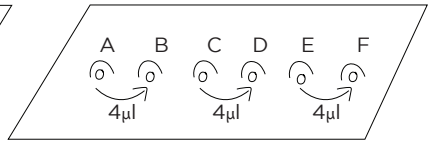
**Now that you have set up your card and got some micropipetting practice, your goal is to mix these dyes with great care and precision. Follow the guidance below:**

7. From dot E, pick up 4 µl and place it on dot F. Mix well
8. From dot A, pick up 4 µl and place it on dot B. Mix well
9. From dot C, pick up 4 µl and place it on dot D. Mix well

**Steps 4-6**




**Steps 7-9**




Did you make any bubbles while mixing? _____

**Calculate how much volume should now be on each dot:**

| Drop | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Volume | | | | | | |

Do the drops that are supposed to be the same volume seem the same size? _____

**Optional if using a variable micropipette:** Set your micropipette to the expected volume, pick up each drop one by one, and move to the open space at the bottom of your card. Each time you pick up a drop, check to see if liquid was left behind, or if there is any space at the end of your micropipette tip.

**Now how would you rate your micropipetting skill? (Circle one.)**

**A. Amateur**
**B. Intermediate**
**C. Pro**
**D. Micropipette Expert!**

# Gel loading practice

## Background

Scientists use agarose gels to separate molecules. In order to get molecules into an agarose gel, scientists use micropipettes to add, or load, them into a small well in the gel. To learn more about the science of electrophoresis you can search for “miniPCR bio Gel Electrophoresis” on YouTube, or enter the following URL: https://www.minipcr.com/gel-electrophoresis/

## Today’s activity

Today we will be practicing gel loading, a critical skill on your way to micropipetting mastery. Loading a sample into a gel requires some skill.

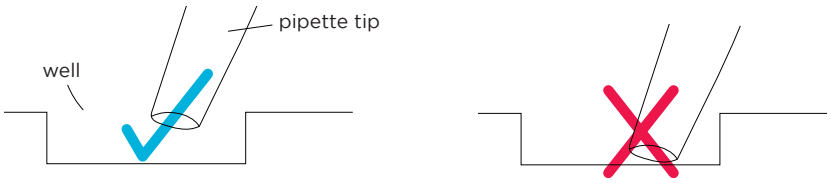
The wells that you load the sample into are small and a typical agarose gel can be easily punctured or torn. Today, you will be using a puncture-resistant silicone practice gel to get a feel for how to successfully load a gel. Because it is made of silicone, you cannot run your samples on this gel, but it is durable and reusable making it a good tool to practice with.

## Materials

- A 2-20 µl variable micropipette OR 4 µl and 10 µl fixed volume micropipettes
- A silicone practice gel
- Micropipette tips
- Red micropipetting practice dye
- Petri dish

## How to load a gel

- Select the volume you wish to load and pick up a sample using your micropipette.
- Place the micropipette tip just inside the opening of the well. There is no need to try to get your tip near the bottom of the well (see image below).
- When dispensing liquid into a well, press the plunger slowly and only press the plunger to the first stop. Pressing to the second stop will add bubbles to the well and may displace your sample.
- After dispensing your sample, remove the micropipette tip from the buffer before releasing the plunger.




## Tricks of the trade

- Loading dye such as the practice dye included in this kit is denser than the buffer your gel sits in. This means that your sample will sink when it is added to the well and will displace the liquid that is already there. There is no need to get your tip to the bottom of the well.
- Don't stab the gel. Putting your tip too deep in a well or against the side of the well can result in stabbing the gel. In an agarose gel, this can damage the gel and create a hole that your sample may leak out. You will know that you have stabbed the silicone if the sample does not leave the pipette tip when you press the plunger.
- Two hands on the pipette! You are aiming for a small target. Use your dominant hand to operate the pipette. Use your other hand to steady your pipette by placing a finger on the pipette shaft near where it meets the pipette tip.
- Steady your arms by resting your elbows on your table or the lab bench.

## Directions

**1. Dry run:**
Normally when you load a gel it is submerged in buffer. As a practice, you will first try loading a dry gel. This can be a little easier because you can better see what you are doing.

- Place your silicone gel on your table or lab bench.
- Place a new tip on your micropipette and pick up 10 µl of practice dye.
- Add 10 µl of dye to one of the wells. Don't worry if the dye sticks to the side of the well or does not go all the way to the bottom of the well.
- Now try adding dye to two more wells.

**Self-assessment score: _____**

**Self-assessment scoring guide**

**0.** I didn't just miss the well, I missed the gel.
**1.** That was very difficult, I stabbed the well or missed the well on most of my tries.
**2.** That wasn't easy, but by my third try I got the hang of it.
**3.** Easy. All of my sample is in the well with no spillover. Ready for the next challenge!

**2. Getting smaller:**
The larger size wells are what you will likely use when loading an agarose gel, but smaller wells are also an option. Once you've gotten the hang of the larger wells, try the smaller wells in the second row.

- Add 4 µl of dye to one of the small wells. Don't worry if the dye sticks to the side of the well or does not go all the way to the bottom of the well.
- Now try adding dye to two more wells.

**Self-assessment score: _____**



**3. Adding buffer:**
Typically, when loading a gel, it is submerged in buffer. Because we are only practicing, you can use tap water today.

- Hold your silicone practice gel under a running faucet for a few seconds to force water into the wells to prevent bubble formation.
- Place your gel in the base of your Petri dish (the base has the smaller diameter) or, if available, a gel electrophoresis chamber.
- Add just enough water so the entire gel is barely submerged.
- Add 10 µl of dye to three of the larger wells at the top of the gel.

**Self-assessment score: _____**

**4. Final challenge:**
Once you feel comfortable with the larger wells, test your micropipetting skill with the smaller wells.

- Add 4 µl of dye to three of the smaller wells.
- Now try adding 10 µl of dye to one the smaller wells. Did the dye spill out into the water?

**Self-assessment score: _____**

**Final assessment**

**Add up your self-assessment scores to determine your true skill at gel loading: _____**
**0-5 Amateur** I should practice a few more times before trying on a real gel.
**6-8 Intermediate** I'm starting to get the hang of things.
**9-11 Pro** I'm ready for the real thing!
**12 Gel Loading Expert!** I was born with a micropipette in one hand and a gel in the other!

# Micropipette art

## Today's activity

This is your chance to test all the micropipette skills you've built so far: to make picture-perfect micropipette art, you will need to micropipette different volumes accurately, deposit liquids precisely, and mix samples with great delicacy. Try your hand at the exercises below, and share the fruits of your labor with us on Instagram @miniPCR.

## Materials

- A 2-20 µl variable micropipette OR 4 µl and 10 µl fixed volume micropipettes
- Micropipette tips
- Petri dish
- Red, blue, and yellow micropipetting practice dyes
- Micropipette art patterns handout (included in kit or available for download at minipcr.com/micropipetting)
- Permanent marker

## A. 'Pette-by-Number

1. Remove lid from Petri dish (the lid has a larger diameter than the base).

2. Lay the 'Pette-by-Number template flat on your table or bench. Place the base of the Petri dish over the grid labeled "Blue" for your selected design. Where the arrows at the top and bottom of the grid meet your Petri dish, use a permanent marker to mark the walls of your Petri dish (see image at right).

3. Add the stated volume of blue dye into the center of each cell in the grid. For example, if a cell is labeled "4," add 4 µL of blue dye into its center. Note: your micropipette tip may become clogged with dye as you re-use it. If this occurs, flush the tip with running water to unclog it.

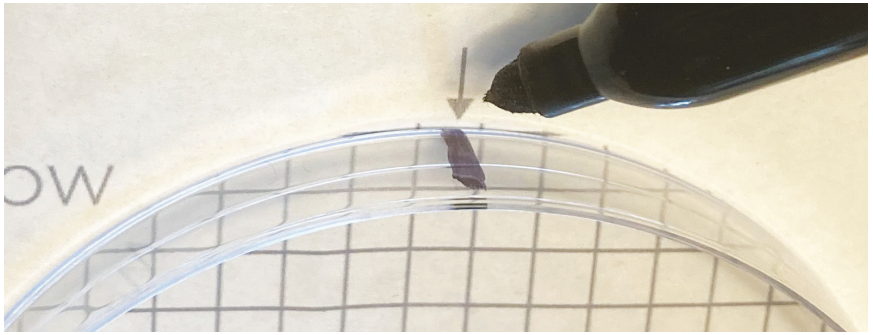
4. When all labeled cells in the "Blue" grid have been filled, carefully slide the Petri dish to the grid labeled "Yellow." Align the lines on your Petri dish to the arrows at the top and bottom of the grid.

5. Add the stated volume of yellow dye into the center of each labeled cell in the grid. If there is already a drop of blue dye in a given cell, add the yellow dye into the blue dye. Mix yellow into blue thoroughly by pipetting up and down a few times.

6. When all labeled cells in the grid have been filled, repeat steps 4 and 5 for red dye, using the "Red" grid.

7. When you are finished, admire your work and take a picture. Afterwards, your Petri dish can be rinsed with water and reused.





## B. Mimic Mine

1. Place the base of a Petri dish over the colored pattern. Where the arrows at the top and bottom of the grid meet your Petri dish, use a permanent marker to mark the walls of your Petri dish.

2. Pipette over the pattern, using the palette and recipes provided.

    - It may be helpful to carefully slide your Petri dish over to the blank grid from time to time to see how your art looks against a neutral background.

    - Alternatively, you may wish to stabilize the colored pattern by cutting it out and nesting it in the lid of your Petri dish as depicted in diagram on template.

3. How well were you able to match the template? If you were successful, your drops should be the same size, should line up in neat rows and columns, and beads of the same color should match.

## C. Your Choice

Here's your chance to get creative! Use the blank grid to generate your own design. Use the recipes provided or experiment with your own mixes. Have a design you love? Share it with us @miniPCR on Instagram for a chance to win a prize!