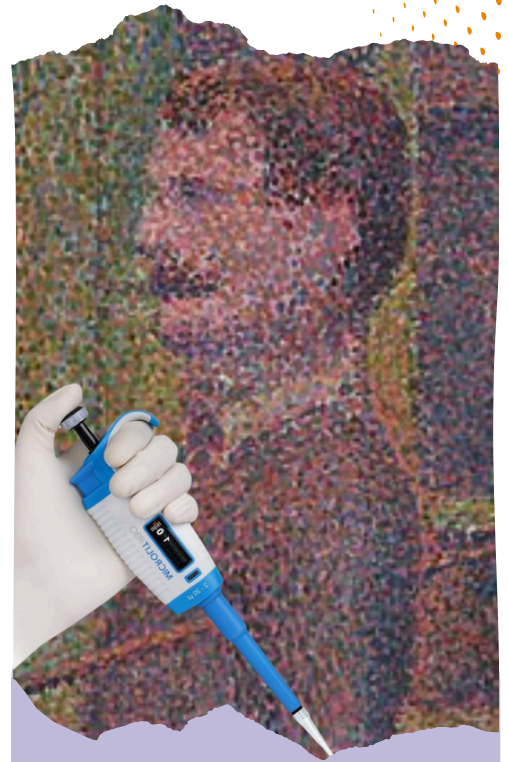


# Pipette Pointillism

## NGSS Alignment:

- Science and Engineering Practices:
  - Asking questions and defining problems
    - Why do I see a complete image when I look at a pointillist painting made of dots?
    - How do biologists use this tool?
  - Developing and using models
    - What is the difference between what we are doing today and what biologists do?
    - A pointillist painting is made up of many small distinct points that come together to make an image, much like our skin is made up of many distinct cells.
- Crosscutting Concepts:
  - Systems and System Models
    - Matter is made of particles and living things are made of cells; in our paintings, the dots come together to make a whole picture just like our cells come together to make a whole person
  - Scale, Proportion, and Quantity
    - The micropipettes allow us to measure very exact quantities
    - These tools are used to study things on a microscopic scale
    - The dots in the painting are interpreted into images by our brain
- Disciplinary Core Ideas:
  - Physical Science
    - 2-PS1-3, 5-PS1-1,
  - Life Science
    - 4-LS1-2, MS-LS1-1, MS-LS1-3, MS-LS1-8,



## Materials:

- Liquid watercolors
- Test tubes (or another container for paints)
- Micropipettes
- Micropipette Tips
- Pointillism paint-by-numbers grids
- Blank Pointillism grids

## Recommended Procedure:

- Prep:
  - Print out the paint-by-number grids and the micropipette user guides.
    - We recommend printing on watercolor paper, which will absorb the paint better (cardstock will do alright in a pinch).
  - Dilute your liquid watercolors so that the darker colors don't just show up as black.
  - Label your containers with numbers, and pour liquid watercolor into the containers, making sure each color goes into the numbered container that matches its number on the paint-by-numbers sheet.
    - 1 - Red; 2 - Orange; 3 - Yellow; 4 - Green; 5 - Turquoise; 6 - Blue; 7 - Purple; 8 - Pink; 9 - Brown; 10 - Black
  - Adjust the volume on your micropipettes to display 25  $\mu\text{L}$  (one standard drop of water is about 50  $\mu\text{L}$ ; in order to avoid color bleed, we will use about half that. Feel free to experiment with different amounts to find what works!)
- During the lesson:
  - Use the Pipette Pointillism Presentation to introduce the activity and lead a discussion to encourage your learners to think about the topics you want to focus on.
    - If you're focusing on color theory and vision, ask questions about how Seurat's paintings work physically. Seurat used a limited pallet and didn't mix his colors, so how are we perceiving so much?
    - If you're focusing on microbiology, point out how all of the subjects in Seurat's paintings are made up of tiny components and draw connections to the composition of matter.
  - Demonstrate use of the micropipettes for your learners
  - Have them use the micropipettes to draw up paint and fill in the paint-by-numbers grid.
    - You may choose to have them work together in groups, with each group collaborating on one paint-by-numbers grid.
  - As learners finish, hand out blank grids and encourage them to create their own pointillist pieces.

## Questions for Reflection:

- Pointillist paintings create images from many small parts; what small parts are our bodies made of? How far can you zoom in? (body is made up of organs; organs are made up of tissues; tissues are made up of cells, etc)
- When might it be important for biologists to measure very exact very small quantities? What can we learn at such a small scale?
- Can you use primary colors to make your eye see a secondary color without mixing them? How many dots of each color do you need to use? How close together do they need to be?