Creating Pixel Art with Computers and Micropipettes

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Target Grade: 8th grade science STEAM

Time Required: 120 minutes (60 minutes each day for 2 days)

Standards

Next Generation Science Standards (NGSS)

- MS-ETS1-3 Engineering Design: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-PS4-2 Waves and their Applications in Technologies for Information Transfer: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

International Society for Technology in Education (ISTE) Standards

- 1.3 Knowledge Constructor: Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
- 1.4 Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

National Core Arts Standards

- Anchor Standard 1: Generate and conceptualize artistic ideas and work.

Lesson Objectives

Students will:

- Be able to use technology to create a pixelated design from their own imagination.
- Understand how to use a pipette by creating a design.
- Be able to use their design to explain how waves are reflected, absorbed, or transmitted through a transparent sheet.

Central Focus

This lesson plan integrates the principles of art and science by engaging students in the creation of pixel art using both digital tools and the hands-on scientific technique of micropipetting. Through this interdisciplinary approach, students will explore the concept of pixelation in digital images, understand the basics of color theory and the science of light waves, and apply these concepts practically through the design and execution of their own pixel art. This lesson aims to enhance students' appreciation for the intersection of technology and creativity, foster critical thinking and problem-solving skills, and encourage the application of scientific knowledge in artistic expression.

Key terms: computer science, scientific tools, measurements, wavelength, light, reflection, refraction, pipette, volume, micropipette

Background Information

Prior to this lesson, students should have a basic knowledge of the following:

- Basic Computer Skills: Familiarity with using a computer, navigating websites, and utilizing simple graphic design tools or drawing software will be essential. Students should know how to click, drag, and use basic interface elements like buttons and sliders.

- Understanding of Pixel Art: An introductory understanding of what pixel art is, including its history and its prominence in early video games and digital art. Knowing that pixel art is created through the placement of colored pixels to form an image will help students grasp the core concept of the lesson.

- Color Theory Fundamentals: Basic knowledge of color theory, including primary and secondary colors, and how colors can be mixed to create new hues. Understanding the color wheel and the concept of complementary colors will assist in the design process.

- Wave Physics and Light: A simple explanation of how light works, focusing on how different wavelengths correspond to different colors. An understanding that the colors we see are a result of light waves being absorbed or reflected by surfaces would be beneficial.

The teacher will need to have the knowledge of the basic properties of light and how a surface reflects a certain wavelength of light to produce color. Teachers should also explore and be able to use a pixel art program on the computer (a program is linked in this lesson plan). In addition, the teacher should understand how to use a micropipette.

Properties of Light

- Light has the properties of waves.
- Light has primary colors of red, green, and blue.
- Light always travels in a straight line.

(https://letstalkscience.ca/educational-resources/backgrounders/light-and-its-properties)

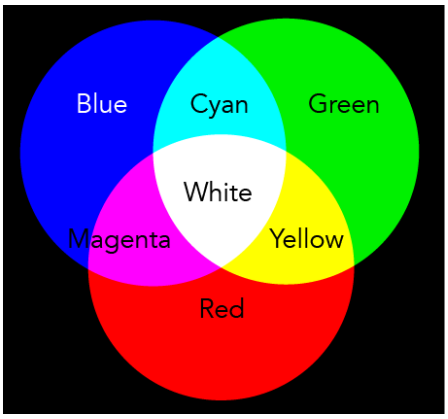


Figure 1: https://letstalkscience.ca/educational-resources/backgrounders/light-and-its-properties

Pixel Art

- Pixel art is a form of digital art wherein images are created and edited at the pixel level using a graphics editing software. (https://www.techopedia.com/definition/8884/pixel-art)

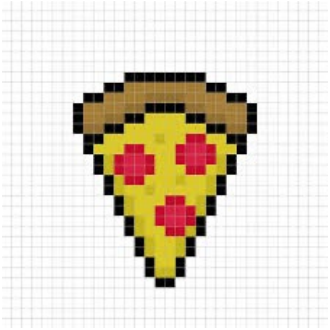


Figure 2: https://www.megavoxels.com/learn/how-to-make-a-pixel-art-pizza/

Materials

- Computers
- Color printer
  - If you don't have a printer, graph paper and colored pencils can be used
- Paper
- Clear plastic (transparency, saran wrap, page protector, etc.)
- Tape
- Sharpies
- Micropipettes and tips
- Food coloring
- Water
- Cups
- Paper towels
- Cotton swabs

- Pixel density example websites: example 1, example 2 (more in-depth)
- Pixel art website
    - https://www.abcya.com/games/pixel_art
        - *Note: this website requires turning off adblockers
    - https://www.pixilart.com/draw
        - Alternative website
- Using a Micropipette Video
    - https://illinois.pbslearningmedia.org/resource/biot11.sci.life.gen.usingmicro/using-a-micropipette/
    - This video shows how to use a micropipette.
- Tips & Techniques of Micropipetting
    - https://www.youtube.com/watch?v=LFFyYN9blKM
    - This video demonstrates how to use a micropipette in the life science laboratory.
- Pixel Art Reflection Worksheet (attached to this lesson plan)
- Pixel Art Critique Worksheet (attached to this lesson plan)

Optional Materials for Early Finishers

- Washable colored markers
- Coffee Filters
- Black Permanent markers
- Shallow plate or dish for water
- Chromatography project instructions
    - https://cintaandco.com/2020/09/13/chromatography-science-for-kids/

Instruction

Day 1

Introduction (15 minutes)

- Ask students if they are familiar with pixel art.
- Discuss Minecraft or Roblox and the way they look “blocky” compared to other games or images.
- Explain to students the definition of PPI (pixels per inch) when referencing the resolution of a screen.
    - Share the example websites with the students to visualize this information.
        - example 1
        - example 2
- Review wave physics with the students by explaining that certain wavelengths of light appear to us as different colors, depending on what waves are reflected off a surface. Use this website to review this information as a class.
    - https://letstalkscience.ca/educational-resources/backgrounders/light-and-its-properties

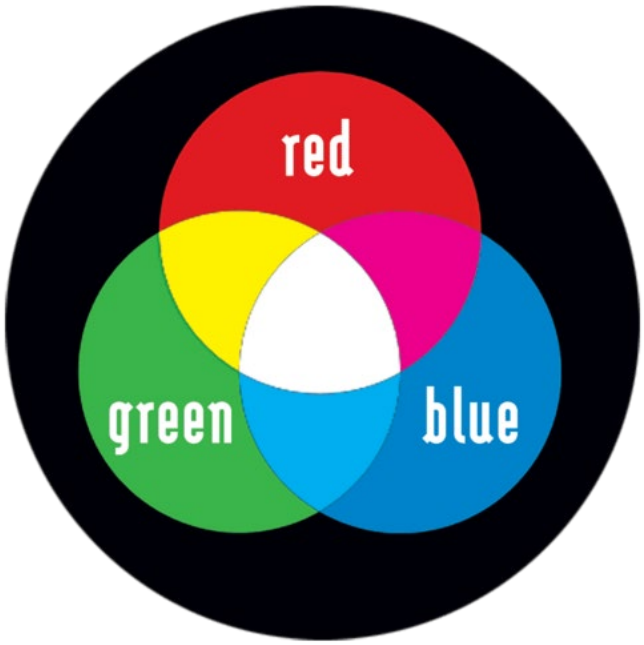


Figure 3: https://www.amnh.org/explore/ology/physics/see-the-light2/the-color-of-light

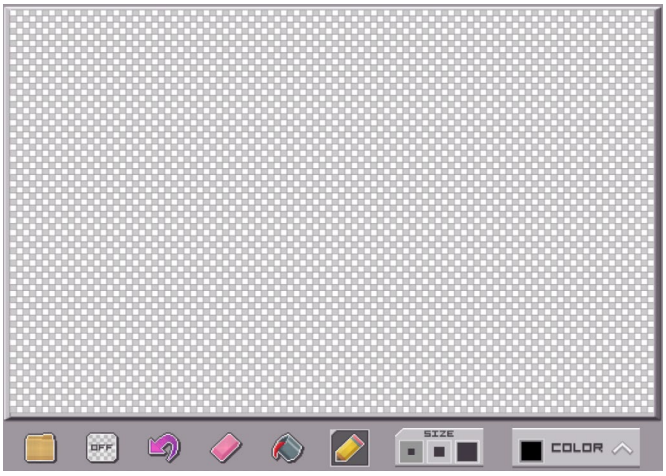
- Note: The above information could be provided in an LMS, or online classroom and students explore the three websites on their own to gain the information required for the activity.
- Tell students they will be using all of this information to make their own pixel art!

Activity (30 minutes)

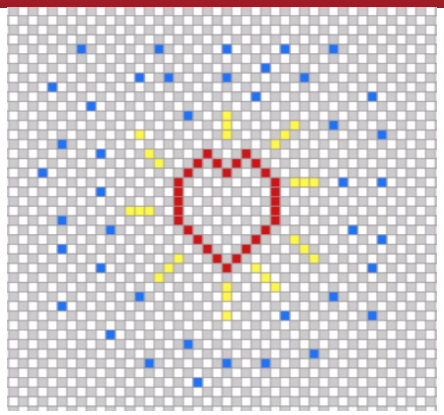
- Allow students to brainstorm ideas for what they would like to make as pixel art.
    - Let students know they will only be given primary colors but can mix those to create secondary colors.
    - The sky is the limit for what they may design. Remind students that designs should be school appropriate.
    - Simpler designs where the pixels are further apart will be easier for the students to execute in day 2.

Figure 4: https://medium.com/rutgers-creative-x/understanding-color-for-ui-design-ec53719e880e

- Students will use the pixel art website and click "play" on the screen.
    - https://www.abcya.com/games/pixel_art



- They will use the pencil tool to create their design.
- Model how to create pixels with the pencil, fill the canvas with the paint bucket, change colors using the menu on the bottom right, undo with the purple arrow, or reset by clicking the file folder on the bottom left and clicking "New".
- Once students are happy with their designs, they will print them in color.
- Students will go to the file folder on the bottom left of the screen and click "Print".
    - If you don't have access to a color printer, students can print their designs in black and white and color the squares with markers or colored pencils. Students can color their designs in using graph paper.



Conclusion (10 minutes)

- Have the students describe their design process.
    - They will share how and why they made adjustments along the way from their original idea.
    - They should explain that the reason they can see their pixels in different colors is because the material is reflecting that color wavelength of light.
    - They will discuss challenges and successes.
- Use the Pixel Art Critique worksheet for students to show each other their designs and provide feedback.
    - This can be done in small groups or pairs. Students can share verbally or fill out the worksheet. This serves as a progress check.

Day 2

Introduction (10 minutes)

- Ask students if they have ever drunk through a straw, or if they have ever put their finger on the end of a straw, lifted it out of the liquid, and then released their finger to let the liquid come out.
- Demonstrate this with a straw and liquid.
- Explain that they will be doing this same process with micropipettes.
    - Micropipetting is used in a lot of scientific fields, but they will most likely use them in future life science classes.

Activity (40 minutes)

- Model for students how to use micropipettes.
    - This may vary depending on the type of pipette you have access to.
    - Model for students how to set the volume (if adjustable volume), insert the tip into the liquid, press to the first stop, remove the micropipette, put it where you want to dispense the liquid, press it to the bottom stop.
        - Model how to use two hands to steady the pipette.

- Describe the process of creating the pixel art.
    - Students will put their printed design on their desk with a clear plastic sheet over the top of their design.
    - Tape the sheet to the desk or mark the edges with marker so if the sheet moves, it can be realigned with the design.
    - Students will set their pipettes to 10 microliters if using adjustable volume pipettes.
    - They will carefully draw up 10 microliters of the primary color they need, then steadily release it over the appropriate square on their design.
    - If they would like to mix a secondary color, they will pick up 5 microliters of each primary color. The best way to do this would be to adjust your pipette to 5 microliters, pick up one color and dispense it on the plastic. Then, pick up 5 microliters of the second color and dispense it on top of the first color. If the colors don't mix well, you can adjust back to 10 microliters and pick up the mixed color into the micropipette and re-dispense the liquid.

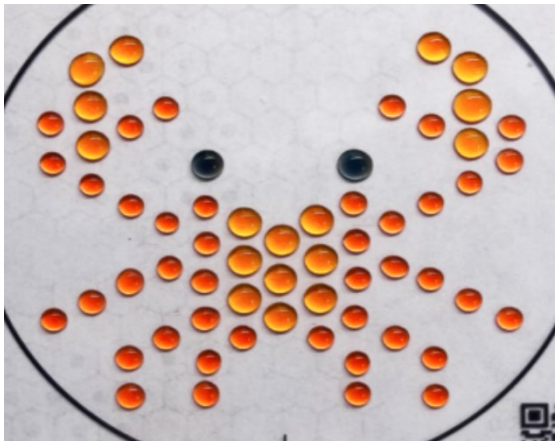


Figure 5: https://www.minipcr.com/product/micropipette-art/

    - They will repeat this process for all colors and all squares until their design is complete.
    - If they make a mistake, they can use a cotton swab to pick up the drop of water that was misplaced.
    - Remind students to work slowly and carefully.
- After instruction, allow students to begin their art. Circulate to check student progress and provide assistance with pipette technique as needed.
- As students finish, assess their work and take photographs if desired.

Conclusion (10 minutes)

- Once students have finished pipetting and you have assessed the image, have students gently lay a paper towel over the wet image.
    - This will transfer the image to a color blot design.
    - They can still see the image, but it won't be perfectly pixelated anymore since the liquid will spread slightly on the paper towel.
- Ask students to discuss their strengths and challenges in small groups.
    - Students can share how they worked through those challenges.
    - Alternatively, provide the students with the Pixel Art Reflection worksheet.

Differentiation

Students who are struggling

- Schedule regular check-ins with each group to assess progress and provide additional support where needed.
- Pair students who grasp concepts quickly with those who might need more time, promoting peer learning.
- If students wish to use secondary colors but are struggling to use the pipette, allow them to mix the water in a separate container rather than mixing within the pipette.
- Students who are not as comfortable or work slower should use smaller and simpler designs. They can also view the instructional videos linked under materials.

ELL students

- Provide the students with a translation of the terms used in the lesson.
- Allow the students to use an online translator.
- Students may draw pictures instead of written or typed answers.

Advanced students

- Pair students who grasp concepts quickly with those who might need more time, promoting peer learning.
- Students who tend to work quickly and/or are more comfortable with the technology should aim to have larger and more complicated designs.
- Students mastering mixing of secondary colors could also experiment with value by diluting their desired color with more water to get a lighter shade.
- Early finishers could experiment with chromatography; provide students with different colored markers and coffee filters. This can be tied into the spread of their design on the paper towel or the makeup of primary and secondary colors.
    - Chromatography project instructions
        - https://funlearningforkids.com/chromatography-science-experiment-for-kids/
    - Materials:
        - Washable colored markers
        - Coffee filters
        - Black permanent markers
        - See-through plastic cups or beakers
        - Water

Assessment

Formative Assessment:

- Introduction Discussion (Day 1 and Day 2): Asking students about their familiarity with pixel art and their experiences with using straws or micropipettes serves as an initial gauge of their prior knowledge and sets the stage for new learning. This helps the instructor tailor the lesson's depth and pace.

- Design Process Description: Having students describe their design process, including the adjustments made and the reasoning behind their choices, allows for real-time feedback on their understanding of the concepts being taught, such as pixel art creation, color theory, and the practical application of wave physics in visual perception.

- Peer Sharing and Critique: When students share their designs and participate in critiques, they engage in reflective thinking and receive immediate feedback from peers. This collaborative review fosters a deeper understanding of the lesson's objectives and encourages the application of critical thinking skills.

Summative Assessment:

- Completed Pixel Art Design (Digital): The finished digital pixel art design, created using the specified website and tools, serves as a tangible product that demonstrates the student's ability to apply concepts of design, color theory, and digital creation tools in line with the lesson's objectives.

- Physical Pixel Art Creation: The completion of the pixel art using micropipettes and colored water on a clear plastic sheet over the printed design represents a summative assessment of the student's ability to apply scientific principles (such as micropipetting and color mixing) and artistic creativity to produce a physical representation of their digital design.

- Final Discussion/Worksheet and Image Transfer: The concluding activity, when students discuss their strengths and challenges, serves as a summative reflection on their learning process. It assesses their ability to critically evaluate their work, understand the scientific principles at play, and articulate their learning journey.

Pixel Art Critique

Project Title: _____

Feedback from _____ Feedback for _____

Things I love	Things to consider

Pixel Art Reflection

Name: _____ Date: _____

1. Why did you choose the design that you used for this project?

2. What are some challenges that you faced? What could/would you change next time?

3. What are some skills that you learned through this project?

4. How would you describe the way waves are transferred through the materials in this project to someone else?