robot art

Technology is awesome, but it is easy for students and teachers alike to forget that *technology* is just another word for *tool*. As we began to play with robotic spheres, we quickly realized the potential for pure play was great, but we needed to take some time to think about how these tools can be used to teach skills in the visual arts and beyond. Technology can be a marvelous conduit to learning, but only if learning objectives come first.

What we present here is a result of our considerable contemplation on the topic. We have prepared a "menu" of different activities, with each activity idea accompanied by an image, a short description, teacher tips (highlighted in yellow), and art history connections (highlighted in blue). Each activity is also categorized by accompanying disciplines including computer science (the integration of hardware and software through programming), engineering (strategic application of science and math to problem-solving), mathematics, science, and additional technology.

This menu is incomplete – there will always be more ideas, and we will add more detail as we and our students identify additional points of success or frustration. Experience with new robotic spheres may also lead to the invention or re-imagination of activities.

In preparing this document, we have primarily explored the various iterations of the Sphero and Ozobot. The Sphero line can be directly controlled using a mobile device or programmed to follow a specific set of instructions. The not-quite-spherical Ozobot can also be programmed to follow a set of instructions, or it can follow lines and commands drawn on paper.

We hope to continue exploring the possibilities of different robotic spheres, but if you get hands-on before we do and have some ideas to share, we would welcome them! If you have questions about any of the projects, we would likewise be glad to answer any questions you might have! You can get in touch with us via e-mail at mchenrka@unit5.org and mthagam@ilstu.edu.

If you would like to find the latest version of this document (or receive notice of updates), we welcome you to visit http://mthagaman.com/?robotart.

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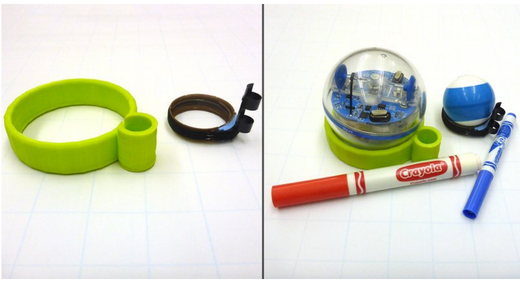
1. Design a Tool Holder

Art | Engineering



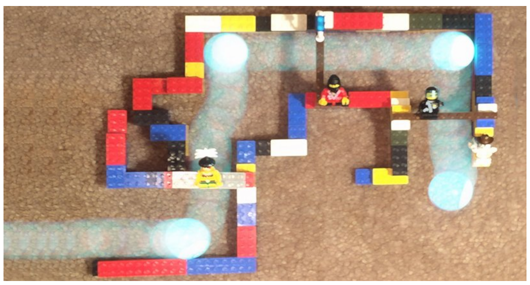
Use a variety of materials to design a tool holder for your robot. (Your robot's art-making possibilities are greatly enhanced when it can draw!)

Some constraints to consider while engineering:

- What tool should the robot carry? (eg. marker, paintbrush)
- How do you keep the tool in the best orientation? (eg. upright)
- What material properties would be beneficial? (eg. smooth, flexible)
- How close should the tool be held to the robot? (the closer it is, the higher the drawing accuracy)
- Can the holder be designed to hold a variety of tools?

2. Design a Maze / Containment

Art | Engineering



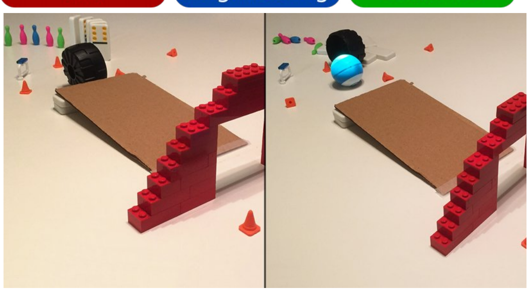
Use a variety of materials to design a maze through which the robot can run. There are several broad possibilities:

1) a maze where the user must control the robot's movement to succeed,
2) a maze/containment where corners must be designed to keep the robot moving toward the finish line without changing its direction of motion,
3) a confinement where the robot's random motion leaves a trail which is shaped by the confinement.

In the first possibility, tape alone might suffice. In the second and third, barriers might be built of cardboard, foam, or building blocks.

3. Design an Obstacle Course

Art | Engineering | Science

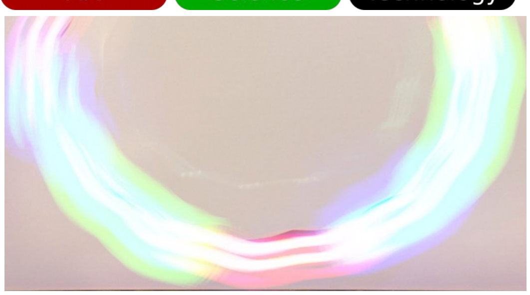


Use a variety of materials to develop an obstacle course for the robot. Plan on the robot being turned away by some obstacles and interacting with other obstacles. What happens when the robot bumps into a bucket of paint?

This task provides a great opportunity for iterative design – after the robot runs the course once, how can the course be improved to better achieve the original goals? This same opportunity is available for any activity labeled Engineering.

4. Time-Lapse Photography

Art | Science | Technology

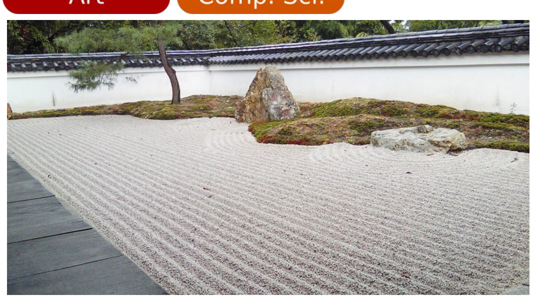


Use a camera or a mobile app on your phone or tablet to record the progress of your robot in its maze, as it is drawing, and more. Experiment with the visual impact of high-speed or slow-motion recording, then preserve this time-lapse as a record of the full experience!

◄ If exposure time can be controlled, the technique of motion blur might be combined with time-lapse photography techniques to create an even more dramatic rendering of the scene. A motion blur effect might be especially powerful if the robot is programmed to change colors as it moves!

5. Path on Sand / Dry Pigment

Art | Comp. Sci.



Place your robot into a bed of sand, spices, or other dry pigment to create a work of art in which the robot shapes its surroundings. Optional: can you program the robot to make the same impressions every time?

Try to use thin layers of course grit on a flat, rough surface.

◄ There are a number of modern earthwork artists as well as ancient cultures who shape sand as art. One form is Japanese *karesansui*, or dry landscape gardens, where sand is sculpted to resemble natural landscapes.

6. Marble Painting

Art | Comp. Sci.

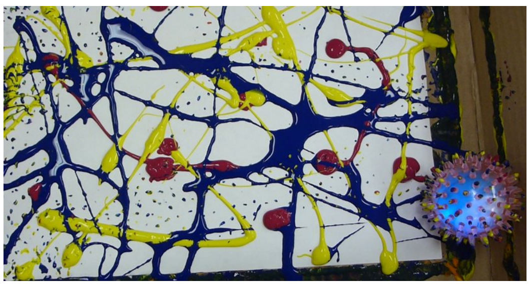
After ensuring it is sealed, dip or roll the robot in paint and set it on a paper surface. Drive the robot (or write a program to randomize its movement) and preserve the paper as your product.

This activity requires that paper be placed on a flat surface which can be easily cleaned or disposed of. Cardboard flats can minimize mess as long as they are truly flat. Sizing your paper to the flat is encouraged.

◄ Jackson Pollock's *Autumn Rhythm (Number 30)* resembles this style.

7. Paint Rolling

Art | Comp. Sci.



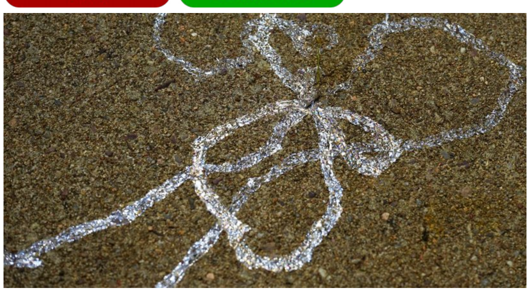
Place streams of paint across the paper. Then, after ensuring the robot is sealed, drive the robot (or write a program to randomize its movement) and preserve the paper as your product.

This activity requires that paper be placed on a flat surface which can be easily cleaned or disposed of. Cardboard flats can minimize mess as long as they are truly flat. Sizing your paper to the flat is encouraged.

Greater variety in this and similar projects can be accomplished by using a textured cover.

8. String Painting

Art | Science



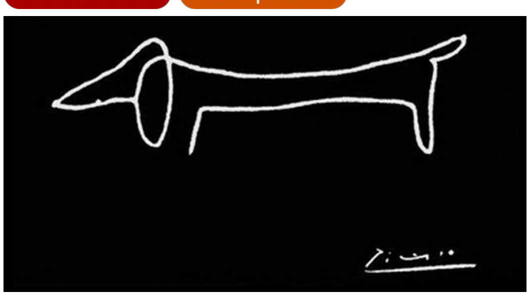
Attach a paint-soaked string to your robot and drive it around on a piece of paper. What can we learn about the movement of spheres through this activity?

Glue dots on the dry end of a piece of yarn might work well to hold the string to your sphere.

◄ Many organisms leave trails, and trails like this slug trail on sand are an important part of understanding animal behavior.

9. Reverse Printmaking

Art | Comp. Sci.



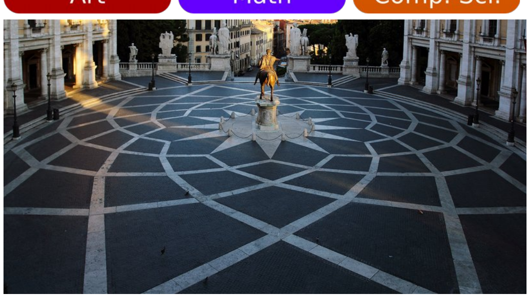
Use a brayer to lay down a thin layer of paint or block printing ink on a printing plate. Drive (or program the robot to drive) across the plate in order to remove some of the pigment, then use the printing plate to make a one-of-a-kind print.

As an alternative to paint or ink, glue could be used initially and the work could be finished by adding powdered pigment or sand.

◄ An inverted image of *The Dog*, Pablo Picasso's single-line screenprint.

10. Spirographic Art

Art | Math | Comp. Sci.



A Spirograph is a fun tool for making art, but you can replace a Spirograph with programming to produce a radially-symmetrical pattern.

This is another great opportunity for the use of motion blur photography.

◄ Michelangelo's design on the ground at the Piazza de Campidoglio in Rome, Italy is a great example of a repeated path forming a work of art.

While the core projects do not require the robot to make permanent lines and shapes, most of these expansion projects do. As a result, Activity 1 (building a tool holder) is an important prerequisite for Activities 11-24.

11. Linear Landscapes

Art

Use the robot to create the basis for a landscape. As you drive the robot, are you drawing a horizon line? Hills? Water? Clouds? When you have a few gesture lines, complete the work of art by continuing those line patterns.

◄ Vincent van Gogh's *The Starry Night* is a classic painting which could be inspired by gesture lines. The clouds, winds, and stars in this work could all have been shaped by a gestural drawing.

12. Cubist Cut-Out

Art

Use the robot to draw pencil lines on an existing image, then cut the image along those lines. Assemble the pieces into an abstraction of the original image.

Depending on your robot and tool holder, a soft pencil (2B or softer) might be needed. Glossy paper may also be more difficult to draw on.

◄ The color choices in Jean Metzinger's *Tea Time* suggest watercolor could be applied to individual pieces before assembling the final work.

13. Color Fields

Art Math

Start the robot off the edges of a paper, and drive it to draw a series of straight, intersecting lines. Color the piece using color families.

This is a great project for discussing the role of balance in a work of art. Students can consider how they use use color and size to achieve balance.

◄ Piet Mondrian's *Composition with Red, Blue, & Yellow* shows how fields of color might be composited into a work of art.

14. Abstract Line Art

Art

In this group project, drive the robot while a teammate randomly picks it up and sets it back down in another place. Through this teamwork, create a number of symbol-like lines, then use those lines to bound a monochromatic work of art.

This project is mimicked in several of the following activities, which makes them ideal for follow-up projects, even for early finishers.

◄ Paul Klee's *Blue Night* is a wonderful inspiration for this project.

15. Abstract Shape Art

Art

In this group project, drive the robot while a teammate randomly picks it up and sets it back down in another place. Through this teamwork, create a number of symbol-like lines, then close those shapes by hand and add other lines and shapes to complete the composition.

◄ While Joan Miró's *Dutch Interior II* was an abstracted reinterpretation of an earlier work, you can easily see how this style might instead be the result of turning random lines into imagined shapes and scenes.

16. Mobile

Art | Engineering | Science

Individually or with a group, drive the robot, picking it up and moving it after it has made a short line. Create a number of symbol-like lines, then close those shapes by hand cut them out, color them, and use wire to arrange them into a 3-dimensional mobile.

Mobiles require experimenting with centers of gravity (perhaps through a separate science activity) and applying engineering problem-solving.

◄ Alexander Calder's *Lobster Trap and Fish Tail* is an example of a work of art which could inspire this project.

17. Organic Tiles

Art

Individually or with a group, drive the robot, picking it up and moving it after it has made a short line. Create a number of symbol-like lines, then close those shapes by hand cut them out, color them, and arrange them into a colorful collage.

◄ *Les Betes de la Mer* is a painting by Henri Matisse which appears to be a collage. His process would be very different than the one described above, but the end product would be similar.

18. 3D Geometric Sculpture

Art | Comp. Sci. | Math

Program your robot to draw a series of geometric shapes on cardboard, foamboard, or another material. Cut these shapes out and assemble a sculpture. As with all sculpture, be sure to consider how the work will look from different angles as well as how to balance size and shape.

Geometric shapes are great for teaching math through computer science. Understanding sides and angles is essential for geometric programming.

◄ David Smith's Cubi series suggests this concept (*Cubi XVIII* pictured).

19. Programmed Skyline

Art | Comp. Sci.

Program the robot to draw a skyline, either real or imagined. Be sure to think about how the program will return the robot to the horizon line when there are gaps between buildings (though the horizon line need not be straight!).

◄ Michael Tompsett is a modern artist who works with masks to make brilliantly-colored skylines. While his *St. Louis Missouri Skyline* is more complex than could be achieved with a spherical robot, it is inspiring!

20. Collaborative Shape Art

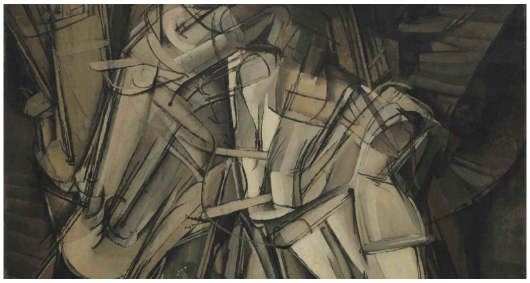
Art | Comp. Sci.

Program your robot to draw a single closed figure. Use your robot to draw the shape on yours and every other student's paper, choosing a different starting point on each. When everyone completes this task, all of the images will be different. To finish your piece, decide how to best color each of the new shapes. Will you choose to be more inspired by the shapes or their intersections?

◄ *The Gate* is a work by Hans Hofmann which might inspire this concept. In it, different combinations of shapes and intersections have been made into color blocks.

21. Linear Motion Art

Art | Comp. Sci.

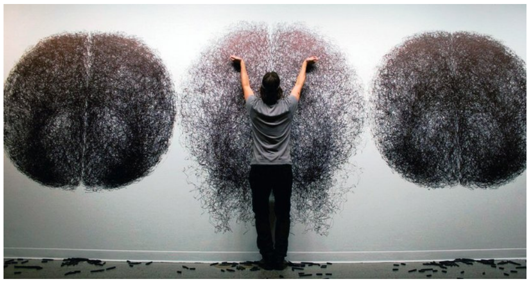


As exhibited by Duchamp's work (left), repetition of line can give the illusion of motion. To produce this effect, program your robot to make one complex line and draw your line many times in slightly different locations. To complete your work, consider how the use of color and value can accentuate this illusion of motion.

◄ Marcel Duchamp is known for a number of innovative works including *Nudes Descending a Staircase, No. 2*. The repetition of line and value choices give the viewer an illusion of motion.

22. Perfect Symmetry

Art | Comp. Sci.

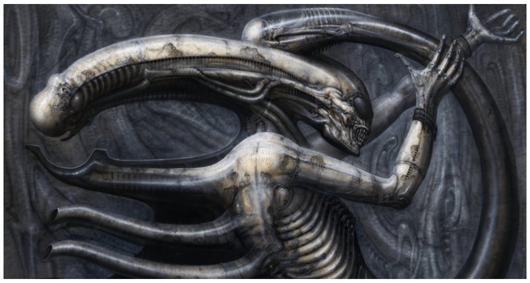


With two individuals / teams / robots working together, program mirror image drawings of a subject with bilateral symmetry (for example, a butterfly or a face). What changes to speed and direction are required to program a symmetrical artwork? (If you draw your plan first, you can use a 360-degree protractor to help identify angles.) Once you've gained experience with bilateral symmetry, can you draw with radial symmetry?

◄ Tony Orrico's *Unison Symmetry Standing* is a human connection to this robotic task: Orrico famously uses his body to make symmetrical drawings as a performance piece.

23. Paint Experiments

Art | Comp. Sci. | Science



How does paint behave at different speeds? Different viscosities? Use one of the methods described in Activities 6-9 to set up an experiment, then think about how your results could be made into a work of art.

Variables that might be changed include robot speed, viscosity of paint (adding/removing water), paint quantity, paint placement, and dry speed.

◄ The now-iconic Alien was inspired by airbrush artist H.R. Giger's *Necronom IV*. Airbrushing is very dependent on painting speed and viscosity.

24. Graphing Measurements

Art | Science | Technology

Most robots will record and report on their movement. Create a drawing using the robot, then capture (screen capture) graphs of velocity, acceleration, and/or direction. Superimpose these graphs over a photograph of the finished image. Use software like Photoshop, GIMP, or Pixlr to merge these components into an interesting final piece.

◄ Much of Andy Warhol's work features repetition, but his series of works featuring Marilyn Monroe (1967) are the perfect example of recolored repetition. How would this work be made more interesting of a graph of speed, direction, and/or acceleration were laid over top?