“Haunted by Math” Public Program Guide

Math on a Sphere

On Saturday, October 26, the Lawrence Hall of Science held a public program centered around the Math on a Sphere (MoS) development environment titled “Haunted by Math.” This guide documents how to set this up at the Hall, but it can be used to set up other public spaces.

Table of Contents

Overview
Communications and Marketing
Activity 1: Draw on the SOS
  Staff
  Materials
  Procedure
Activity 2: Draw on a balloon
  Staff
  Materials
  Procedure
Background Music and Information Kiosk
  Materials
  Procedure
Setup and Cleanup
Results and Observations
Appendix A: Instruction Cards
Appendix B: Signage
Appendix C: Balloon Tags
Appendix D: Computer setup
  Visitor Laptops
    Background Computer Setup
      Preparation:
      Setting up the SoS computer:
      Setting up the DJ laptop (client laptop):
      DJ Laptop (Client laptop)
      Returning SoS and SoS computer to original state:
      Additional Notes:
Pluses and Deltas
Overview

The event contained two main activities for the visitors and was held within the Science on a Sphere (SOS) room. The first activity featured the Math on a Sphere (MoS) software, which allows visitors to write code to draw on the science on a sphere. The second activity was a photobooth that allowed visitors to take home a souvenir balloon with their face drawn on it. Figure 1 shows a schematic of the room set up.

*Figure 1: The SOS room layout. 1a) Visitors created their drawings in the MoS software with laptops on two 6-foot long folding tables. 1b) The SOS Kiosk was converted to the DJ booth, which controlled the SOS. 1c) A computer projector showed the visitors the DJ’s computer screen on a wall behind and above the SOS. 2) Visitors traced their face on a balloon with the help of an iPad and projector in this photobooth. 3) Halloween themed music played in the background via the standard SOS equipment. 4) The information kiosk held general information about MoS and the event for visitors.*

The main concept explored through this public program is the relationship between 2D and 3D geometry. MoS is a piece of software that allows one to draw on the spherical surface by moving a “turtle” around the surface of the sphere. This is tricky because drawing on a 3D surface is different than drawing on a 2D surface. For example, 3D drawings that are projected onto 2D planes are distorted. Likewise, 2D drawings that are projected onto 3D
surfaces are also distorted, as seen by the draw the balloon activity. Other examples of this are maps of the earth.

Communications and Marketing
To promote the event, a blurb was created and sent to marketing with the following description for sharing on the Hall’s website and brochures.

Haunted by Math on Science On a Sphere
Saturday, 11:00 a.m.–2:30 p.m.
With simple computer programming tools, you can design and project jack-o’-lanterns, black cats, ghouls, and pumpkins onto Science On a Sphere. This activity is recommended for ages 9 and up. Younger kids are welcome, with an adult.

Signs were printed and posted on the museum floor to draw visitors to the public program (see Appendix A: Signage).

Activity 1: Draw on the SOS
The main activity was centered around the SOS. With the help of a facilitator, visitors drew on the SOS by writing code in the MoS software on the provided laptops and then submit their code to be plotted on the SOS.

Staff
1. Facilitator (1 person)

Materials
1. Instruction cards (2, one set per table; See Appendix B: Instruction Cards)
2. Laptops with chargers, wireless connectivity(4)
3. Extension cords
4. Desk lamps
5. Table (two 4-6 feet long)
6. DJ Laptop
7. Projector
8. Large projection area (in our case, one of the walls)
9. Microphone

Procedure
There were three parts to the set up of this activity. They are labeled 1a through 1c in Figure 1. As visitors wandered into the SOS room, they were greeted by one of the facilitators in the room. The facilitator at this activity encouraged visitors to sit and try their hand at programming a new drawing on the Sphere.
Four laptops were placed on two tables on one side of the SOS room (see Figure 1: 1a). The visitor laptops were set up as per Appendix D: Visitor Laptop Setup. Extension cords were needed to keep the laptops charged. Since the SOS room is dimly lit, desk lamps were also used to provide light to the visitors as they sat on the laptops. Visitors sat on stools while they coded. Instruction cards were placed on the tables to provide self-guided help to the visitors when they sat down. The facilitator was also available for a more guided experience. Facilitators were encouraged to engage and challenge the visitors. Most of the visitors were encouraged to begin with an already completed example, such as a jack o’lantern, and were shown how to change design parameters, such as size of nose or eyes. This was a quick way to get the visitor to experiment with the code and get feedback. Once the visitors were happy with their designs, they were shown how to submit their code to a google form so that that the DJ could display their designs on the large SOS.

![Figure 2: Facilitator Lizzie helping a young visitor write code on a laptop.](image)

The SOS kiosk was disabled from its regular SOS programming. The stand was converted into a DJ booth (Figure 1: 1b) by simply placing the DJ laptop on top of it (see Figure 3). From the DJ booth, assigned facilitators executed visitors’ and example code while explaining to the visitors what was going on through the microphone. The DJ was also encouraged to entertain the visitors with facts about the MoS and spherical geometry (see Figure 3).
Figure 3: The DJ explaining the purpose of Math on a Sphere and whose drawing was coming up next on the screen.

The DJ’s computer screen was projected onto the back wall of the SOS room so that visitors could see the code and MoS user interface, which largely mirrored the same as what the visitors did on the laptops. As the DJ executed the code on the server machine, the code was also drawn on the SOS. The MoS website displays a 2D representation of the drawing, so this allowed the visitors to see the drawings in 2D space, on a 3D simulated sphere, and on the actual SOS. The DJ was encouraged to help visitors connect the dots between all of these parts.

As an experiment, PI Mike Eisenberg skyped with one of the laptops so that visitors could virtually get help from him and he could also observe the activity.
Activity 2: Draw on a balloon

This activity was created to complement the Draw on the SOS activity. Visitors traced their faces that were projected onto a balloon with a permanent pen (sharpie). This activity required no coding for the visitors, but it offered the opportunity for the visitor to see how their face became distorted because of the curvature of the balloon. The visitors also got to take the balloon home as a free souvenir.

Staff
1. Facilitator (2 people)

Materials
1. Balloons (500; Medium-sized, orange*)
2. Sharpies (10)
3. Ribbon (Black*)
4. Scissors
5. Math on a Sphere Tag (n = 500, one per balloon; See Appendix C: Balloon Tags)
6. Balloon platform (see Figure 6 )
7. iPad
8. iPad to VGA adapter
9. C-stand or tripod
10. Computer short throw projector
11. Small Table
*colors chosen to fit with Halloween theme

Procedure
This activity was operated similarly to a photo booth (see Figure 4). Visitors took a seat to get their picture taken by an iPad. Their portrait was then projected onto a blown-up balloon so that the visitor could trace their face onto the Balloon. The facilitator was encouraged to talk about the relationship between this activity and the main activity. The facilitator was advised to offer assistance to the visitor while they traced their face, but only to assist if the visitor asked.
Figure 4: a) Visitor takes photo on iPad, which is held up by a c-stand b) visitor traces their face onto the balloon with a sharpie.

The balloons were held in place with a custom built balloon stand (see Figure 5a and Figure 6). After drawing on their balloons, visitors went to the small table to the side to attach ribbon and a tag to their balloon (see Appendix C: Balloon Tags).

Figure 5: a) A young visitor traces her face onto the balloon, which is held in place by the balloon stand. b) Two visitors showing off their souvenir balloon.

Figure 6: The balloon stand was made from a square piece of plywood which had a hole cut out in the middle. The legs were recycled legs from an old desk. The balloon was held in place with rubber bands and a binder clip. The rubber bands were tied to the legs.
Background Music and Information Kiosk

Materials
1. iPod or Laptop with music
2. Acrylic stands
3. Flyer

Procedure
An iPod was attached to the SOS system and set to a Halloween themed playlist on repeat (Figure 1: 3).

Informational flyers for visitors to take were placed next to a sign in an acrylic frame (Appendix A: Signs) on the information kiosk (Figure 1: 4).

Setup and Cleanup
Setup and cleanup of the SOS room and the SOS computers are detailed in Appendix D: Computer Setup.

Results and Observations
Overall, this public program was considered a success. Visitors enjoyed their time in the program and the teen volunteers and staff who facilitated the program said that they enjoyed it too. The consensus was that the visitors enjoyed taking home a souvenir balloon the most.

We felt that the most important aspect that contributed to the success of the public program was the ambiance that was created within the SOS room. The room is usually left unfacilitated and visitors wander in, only to click on the kiosk a few times and then walk away shortly thereafter. During this public program, the visitors knew that an event was taking place because music could be heard from down the hall, clearly defined stations were well lit in this dark room, and the DJ entertained the audience while connecting the dots between the activities in the room.

If this public program were to run again, it would have to be optimized to use less facilitators. This time around, it used at least three facilitators (one per activity and the dj booth). The programming portion of the event should could be made easier to do without the help of a facilitator. The instruction cards were available, but since the facilitator was present and available, visitors referred to personal assistance rather than reading instructions. This would cut down on the need of facilitators.
Appendix

Appendix A: Instruction Cards
Appendix B: Signage

Welcome to Haunted by Math!

Make a pumpkin, cat, or ghoul

Learn math and programming

Display it on the giant sphere
Appendix C: Balloon Tags
Appendix D: Computer setup

Setup the SoS computer and the client laptop following the separate directions since we need to be able to access the Google form responses on the client laptop as kids upload their code, we can’t use the SoS network, so we need to use a different A-level network (and use the SoS’s external IP address).

Visitor Laptops

On each computer kids we need to open a WebGL-compatible web browser and then create two tabs:

1. In the 1st tab, the normal MoS website (http://ponder.org.uk/weblogo/client.html)
2. In the 2nd tab, the Google form (http://tinyurl.com/HauntedByMath)

The kids will create or modify code and then test it using the MoS website. When it’s working they can upload it to the Google form. Many kids won’t know how to copy and paste, and they should be reminded that it’s important to make sure they copy every single character in their code.

1. Go to Math on a Sphere Google Drive Folder
   https://drive.google.com/?authuser=0#folders/0B5k0rBDhpkpLWTZNTnFxWEVRWnc
   It’s probably best to use an incognito window to access your google drive.

2. Download LHS Logo from the Google Drive folder and make it the background for the computer. (Make sure you don’t download it to the desktop because you’re going to clean the desktop in the next step).

3. Unpin all menu items from the taskbar except google chrome, delete all icons on the desktop except google chrome and the recycling bin, and rename the chrome icon, “Run Math on a Sphere. Example of the desktop here:
4. Enable “Auto-hide the taskbar” in the taskbar properties menu.
5. In Chrome, open these two links in separate tabs:
   a. In the 1st tab, the normal MoS website (http://ponder.org.uk/weblogo/client.html)
   b. In the 2nd tab, the Google form (http://tinyurl.com/HauntedByMath)
6. Go to chrome settings, change the On Startup pages to the two tabs that were opened in the previous step.
   a. In settings, click “Set Pages”
b. Select “Use current pages.”

7. Make sure to log out of google drive.
Background Computer Setup

** Note: Many the specific instructions here are only relevant to the SoS at the Lawrence Hall of Science.

Preparation:

1. You need keys to the cabinet in the SOS room. These keys are available from Dan (CTI) or from the Visitor Services Desk on A-Level. (Dan keeps his key in the orange cabinet in D9.)
2. You need a second computer (here called “client laptop”) to load the Math on a Sphere designs.
3. Setting up the monitor can be confusing the first time, so give yourself extra time the first time you try this. Also, you may want to have a flashlight with you the first time, since it’s dark and hard to see things.
4. You will not need to unlock the big cabinet unless you want to get the iPad that is there.

Setting up the SoS computer:

1. Stanchion off the SoS room, to keep visitors from coming in.
2. Lock the kiosk—this is the screen that is in front of the sphere, close to the room’s entrance. Lock it by pressing on the monitor with your finger in the top left hand corner and then the bottom left hand corner. Don’t pause for long between the two taps—do them quickly (within 1 second)
3. Take the wooden box off of the smaller cabinet. Open the metal lid, tilt it backward, and slide it to the back of the cabinet. (Photos on page 5 may help.)
4. Unlock the (small) cabinet. Ratchet up (tilt) the monitor. Careful with this step—you don’t want to smash your fingers!! It seems to work best at an angle of approximately 30 degrees. Higher angles do not seem stable.
5. If it’s very early in the morning and the projectors are turned off, you’ll need to turn them on. To do this you need to take the remote from inside the cabinet and aim it at each of the 4 projectors while pressing the power button. The projectors will turn on slowly.
6. Turn on the monitor by pressing on the small button on the back of the monitor. The button is located on the top, in the center.
7. Turn on the power for the gooseneck lamps—the button is on the bottom of the monitor, on the left.
8. Log out of the sosdemo account and into the sos account. (You can log out using the a drop-down menu on the top right of the desktop.) The password for the sos account is “sos!”.
9. Open a Terminal window. Activate the MoS server by typing “/start-mos.sh” into the terminal window. (If for some reason you need to switch accounts again or restart the computer you’ll have to redo this step.) Run the SoS GUI by clicking the “Start SOS” icon the desktop.
10. In the SoS GUI, go to menu item “File → Open Playlist → 02mos.sos → Open”.

1. If this doesn’t work, restart the computer by using the drop-down menu on the top, far-right area of the toolbar at the top of the screen.

Setting up the DJ laptop (client laptop):

1. Open the second computer you brought (the “client laptop”). Connect the client laptop wireless to the SOS wireless network using the password “lhsst@ff”.
   1. You can also connect to a different A-level wireless network. If you do this, make sure you read the note in 10(b).
2. Open a WebGL-capable browser (usually we use Google Chrome), since this is required to run the Math on a Sphere program.
3. In the browser’s address bar, type 10.1.1.31:48080/client/client.html. Do not use the web address we usually use (i.e., http://ponder.org.uk/weblogo/client.html), because this will not load the Math on a Sphere designs to SOS.
   1. Sometimes it takes a little while to connect.
   2. NOTE: If you connect your client laptop to an A-level wireless network, you are connecting to the MoS server software from outside the SOS system. As a result you must substitute the sphere’s internal IP address (10.1.1.31) with its external address: 128.32.86.242.
3. If you get an error, like website not available, make sure you started the Tomcat server (see page 1 step #9). Even if you already started the Tomcat server you’ll have to start it again if you had to log out of the user account or restart the system.
4. At the bottom of the browser window there is a line that says “Connect to server at:”. In the blank, type in “server/postreceive”.
5. Cut and paste code you want to use into the Editor Window at the top left of the browser window. Click “run commands” to start the animation.

DJ Laptop (Client laptop)

On the client laptop we need to open a WebGL-compatible web browser and then create two tabs:

1. In the 1st tab, connect to the SoS computer if we have to refresh the page we reconnect to the server using the button at the bottom.
2. In the 2nd tab, open Google response form
   (http://tinyurl.com/HauntedByMathResponses) will need to refresh it to get new entries.

The person on the client laptop will refresh the Google response form to find the new entries, and copies these into the MoS website that’s connected to the SoS computer. If a cell in the Google form is selected and you copy it entirely, the results will be enclosed by “ “, which will have to be removed. To prevent this, you can click inside a cell, select all, and then copy.
Returning SoS and SoS computer to original state:

1. Open a Terminal window. Type “./stop-mos.sh”. Close the terminal window.
2. Log out of the sos account and into the sosdemo account. (You can log out using drop-down menu on the top right of the desktop.) The password for the sosdemo account is “sosdemo!”.
3. Open the SOS GUI.
4. In the SOS GUI, go to menu item “File → Open Playlist → 00_normal-demo.sos → Open”.
5. Click on any playlist item to refresh the SOS with the new playlist.
6. Put away the monitor and its covers. Turn off the gooseneck lamps. Lock the cabinet. (The computer is left on.) Put the wooden box back on the small computer cabinet.
7. Unlock the kiosk—this is the screen that is in front of the sphere, close to the entrance to the room. (You unlock it the same way you locked it.) Unlock it by pressing on the monitor with your finger in the top left hand corner and then the bottom left hand corner. Don’t pause for long between the two taps—try to do them quickly (within 1 second).
8. Test the kiosk:
9. Select a (random) dataset. The selected dataset should appear on the SOS.
10. Select another (random) dataset just to verify that everything is working.
11. If the kiosk is not working
12. First, just try locking the kiosk and then unlocking it (see #6).
13. If this doesn’t work and you get a prompt to quit the kiosk, choose “Quit”. If there is no prompt, plug in the full keyboard into the USB port, and type “Alt+F4” to quit the kiosk.
   a. Then, startup the kiosk program from the Desktop of the kiosk.
   b. Hit “Ok” to use the pre-entered IP address.
   c. Test the kiosk by selecting a (random) dataset.
14. If it’s late in the day and the museum is closed, you need to turn off the projectors. To do this you need to take the remote from inside the cabinet and aim it at each of the 4 projectors while pressing the power button twice (each time).
15. Lock the small cabinet.
16. Remove the stanchions.
17. Return the key.
Additional Notes:
For the MoS system to work, the SOS system has to look in a particular directory and play the sequence of files found there. The MoS server software updates this sequence of files continuously while it is in operation, giving the impression of a continuous animation. Thus, there are three parts of the system that have to be set up correctly:

1. The SOS software must be pointed to the appropriate directory where the MoS server software will be writing files. This can be anywhere, but right now it is set up to be "/shared/sos/media/mos_images/". When the sphere is correctly directed to this location (using the GUI menus), you should see the last bit of the most recent animation looping on the sphere. This may be something to consider for presentation—what do you want students to see initially, if anything?

2. The MoS server must be running correctly in order to update the files once it receives a connection. The MoS is a Tomcat web app, so the Tomcat server must be running. The instance on the sphere computer has been set up to automatically start the MoS software when tomcat is started. You can confirm Tomcat is working on our system by going to the following URL: http://localhost:48080 and you can test if the MoS server software is running by connecting to this URL: http://localhost:48080/server/client.html

3. The laptop that will be running the client software—where you paste in and make changes to the scripts, as well as compile and reset the animation—must be connected to a network. It may be convenient to connect to the SOS Wi-Fi network (this network uses our well-known Wi-Fi password). If you connect in this way, you will not have access to the outside net, but you will have the most reliable connection to the MoS server. If you connect to the SOS network, the IP address of the sphere system is 10.1.1.31 while if you connect via an outside network (e.g. LHS-LOBBY or LHS-STORE) the sphere system's address is 128.32.86.242. Once you are connected, direct the client laptop’s (WebGL-enabled) browser to 10.1.1.31:48080/mosserver/client.html—this will provide you with an interface to the system once you've clicked 'connect' at the bottom of the screen. You will then be allowed to input and modify code and compile to see the results as animations.
(Left, above) Dan’s keys.
(Right, above) You won’t need to open the large cabinet on the left unless you need the iPad. You will need to open the small cabinet on the right. (In the picture the monitor is already visible. When you come into the SOS room there will be covers over the monitor and it won’t be visible.)

(Left, above) The cabinet will look like this initially. First you need to lift up the wood box on top.
(Right, above) Then you need to lift up the metal cover.
(Above) Next you can ratchet up the monitor—but be careful of your fingers!! It doesn’t work to raise the monitor much higher than this, because it isn’t stable and will start falling back.

(Left, above) The power button for the monitor is not visible in this picture, but the pink oval shows the general position of the button.
(Right, above) The pink circle on this picture shows the position of the power button for the monitor. The button is small and is in the circle visible on the photo.
(Left, above) The power button for the gooseneck lamps is visible in this photo—it is to the left of the gooseneck lamp.
(Right, above) This is what the SOS GUI looks like
Pluses and Deltas

photo consents?

Things we need
1. black sharpies
2. scissors to cut ribbon
3. more tags cut out
4. chairs
5. sign that says “Math on a Sphere Event 11 am to 2:30 pm.”

balloons - add ribbon with tag that has math on sphere url
project onto balloons

two projectors
“dj booth” - projected onto wall
microphone?

5 laptops for kids on a table w/ chairs and lamps.

skype with mike

copy pasting - ctrl + a, ctrl + c, ctrl + v

music? monster mash halloween playlist

group “sessions”: 1 pm 1:30 pm 2 pm