

Voronoi Sandbox – Version 1

Geometry Playground

Formative Evaluation

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2007

THIS IS **NOT** A DEFINITIVE FINAL REPORT

FORMATIVE evaluation studies like this one often:

- **are conducted quickly**, which may mean
 - small sample sizes
 - expedited analyses
 - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
 - a focus on problems and solutions, rather than successes
 - a change in form or title of the final exhibit/program

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Exhibit Prototype Fixed Panel

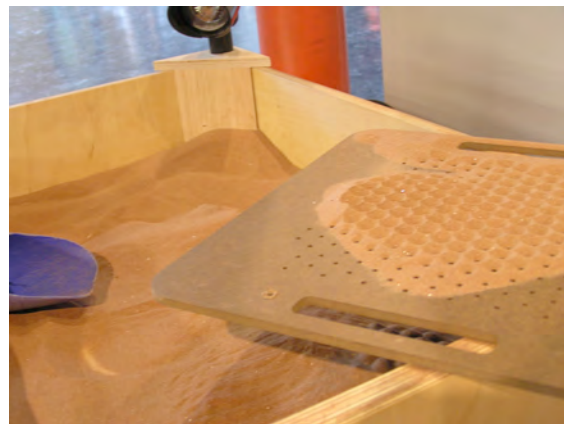


Exhibit Prototype Free Panel

Voronoi Sandbox

Try this:

Make a big pile of sand in the middle and watch the pattern form.

Now take a closer look:

Where does the wall or ridge form on any mountain?

What's going on?

There is a simple rule that is illustrated here - the ridges form at the exact midpoint between two neighboring holes.

Mathematicians call these patterns *Voronoi* ("voe-ruh-NOY") patterns.

Draft Exhibit Label

Background

Voronoi Sandbox is an exhibit prototype for the Geometry Playground exhibition. Visitors explore the patterns created in the sand. The exhibit explores the mathematical voronoi rule.

Goals

The goal of this evaluation is to:

- Observe how visitors use this initial exhibit prototype.
- Explore two different ways of setting up the exhibit – a fixed panel vs. a free panel.
- Look for promising next steps for the exhibit.

Methods

Informal conversation with visitors in the prototype area on the museum floor on Sunday, July 22, 2007 from 11-3pm.

Findings

Overview

On Sunday, July 22nd we took the exhibit out on the floor with visitors. The visitors seemed extremely excited by the sand and the beautiful patterns that resulted from the holes in the panel. We explored how the visitors used the exhibit and which of two ways (fixed panel or free panel) seemed to be easier to use and created a better pattern. We observed that it was very hard to get visitors to notice the illustration of the Voronoi rule, as it seemed to be secondary to the profound aesthetic experience.

General Observations

- The light gets very hot.
- The sand is very dusty.
- Kids, both boys and girls, are really drawn to the sand. They love it.
- On the fixed panel, the sand disappears underneath the box so you cannot scoop it easily.
- Lots of real world desert connections - "That looks like Egypt" and "It looks like sand dunes, but small."

Affect

Many visitors thought the experience was "cool". When we asked what about the exhibit seemed cool, the visitors said:

“To see a pattern forming in real time.”

“The light.”

“It wasn't what I expected. I expected all the sand to go through the holes.”

“It was beautiful.”

Exhibit Features

Pattern

- Visitors are very taken by the beauty of the overall patterning. When they switch to the other pattern they often said, "It is a different pattern!" with shock and delight. There seems to be a sense that the pattern is more by chance than it actually is.
- Visitors really notice the overall pattern...when they use the honeycomb patterned board, they often say, "It is like honeycomb!" If we use a pattern of holes that visitors don't recognize, would visitors focus more on voronoi's rule?
- When we had two examples from the real world out (honeycomb and pinecone) and visitors referred to the picture of the pattern that looked most similar, they immediately felt a connection to the images as if to say, "I did it right". This took the focus away from the intended observation - the experiential illustration of the equation/rule.

Sand

- The visitors are interested in the sand, what kind it is, what it is used for, the dust it makes, and the color it is.
- When visitors sprinkle the sand, the patterns don't emerge. When the sand is piled on the board, mostly the resulting patterns emerge very well. The exhibit requires at least a minimum amount of sand to work well.

Panels vs. Fixed Pattern Board

- The panels encouraged visitors to look at the pattern under the panel. Many visitors are used to a sieve and expecting that you notice what falls under, they expect all the sand to fall through at some point. They are surprised by the resulting mountains because they thought the sand might fall all the way through.
- The play with the fixed panel felt much more contained. It felt like visitors tried it less. The reaction was more like, "That is it?" The interaction was a lot more low-key.

- With the fixed panel, there was always a bit of sand left on the wood and so they made the pattern emerge further, but the blank free panel transforming to the final design was much more of a dramatic transition.

Voronoi Rule

- Explained the rule to many visitors, and yet it was hard to get a read on whether or not it was interesting to them. The rule seemed to be a minor player compared to the beauty of the overall pattern. As we continue to develop the label, might we push on why this rule might be relevant to them in their lives?

Visitor Questions

Visitors asked many questions about what they were seeing and doing. These questions are helpful to consider as we continue to build out the exhibit and draft the label text.

- "Why are there 4 (sides) here and 6 here?"
- "Where do you see this in the world?"
- More clarity on the firehouse example.
- "Does it build up depending on how far each hole is?"
- "What about the height of the mountain?"
- "Why does that happen?" (referring to the overall pattern)
- "Is it the height relative to how far away the holes are?"
- "I bet the (kind of) sand makes a difference?"
- "Is that it?"
- "What happens when the pile (of sand) is bigger?"
- "Why on these different panels was the resulting pattern different? I am trying to understand that."
- "Why is it making these designs?"

Recommendations

To Consider

- Per the exhibit developer, discuss the idea of area of influence.
- Discuss together whether visitors think the patterns are random and if this is important to clarify for them.
- It seems that as a possible next step, the exhibit developer, Sebastian, is going to think about approaching the exhibit in terms of the question, "When do we call something a pattern?" and see if we can direct visitors to

- observe that even though the resulting patterns are different, there is an underlying principle at play.
- The size of the exhibit - it feels like the exhibit could be very big, allowing many visitors the chance to make patterns all at once. At a point, many kids were trying to use it at once.
 - Consider introducing a challenge activity, something like, “Look at the holes then load up the panel with sand. What do you think the resulting pattern is going to be?”
 - Design the free panels such that there is a raised part where you could rest the panel... a mix between the open play and fixed panel.
 - A visitor described what he was seeing this way and this language could inform label text, "The grouping of holes is different, but the rule is the same. Walls form halfway in-between the holes."
 - One visitor used the word "walls" to refer to the ridges. This might be helpful for younger kids or make it confusing. We could test this language during the next round of evaluation.

Next Steps

Post-evaluation Decisions

(Based on discussions with Sebastian, Nina and Josh)

- Remove fixed panel board.
- Add platforms for saving and comparing platforms.
- Allow more space for saving and comparing platforms.
- Include geometric panels that are not nature-related.
- Include a “rule” panel.
- Address the nature question with the label. (*Note*: this ended up waiting until a later date)
- Use the title to tell visitors what the exhibit is about (i.e. “Split the Difference”).

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