Randomness

Overview

Randomness is all around us - can you think of some examples?

You may be familiar with patterns, especially if you have done some of the previous activities such as *Sorting, Loops, Tessellation*, and *Binary Trees*. All of these examples are based on some kind of pattern or a process that is repeated in a predictable way.

For example, with the *Loops* activity, we created jewelry based on simple steps that were repeated, and in this they become a pattern. In *Tessellations* we explored shapes that fit together in order to repeat indefinitely. In these examples, the pattern creates a kind of predictable outcome. Because we know the pattern, we know what comes next.

But randomness is different. Randomness means that there is no pattern. This can be difficult to imagine sometimes because we naturally like to look for patterns as a way of understanding information.

While we know that patterns are incredibly useful and important, randomness is also quite useful. We need to randomly generate games, or lottery numbers, or in the case of medical trials, we use randomization to determine who receives which procedure. We generate random strings of characters for passwords and other encrypted information. We use randomization when we need to create a system with no predictable pattern, so that the outcome can closely reflect chance.

But how can we design a process that is random? In creating a process, we are essentially creating steps that can be repeated and followed. While randomness may seem simple enough, it is actually a challenging problem to solve!

For this activity, we will try to design randomness, and then create instances of randomness by flipping a coin. It may be surprising to learn that creating something that is random is actually not as easy as it appears!

learning
beautiful

Randomness

Can you create a random design?

Setting Up
- colored pencils, crayons, or markers

Steps

1. Print off the Randomness Template, or create your own grids (4x4, 8x8, 16x16 - use the template for reference).

2. Start with the 4x4 grid, and explain that we will be coloring in the grid. With colored pencils or crayons, allow the child to choose two different colors - higher contrast works best, such as a lighter color (yellow) and a darker color (like blue or dark green).

3. *What is a pattern? Can you make a pattern with these two colors on the grid?*
How do we know if this is a pattern?

A pattern is a sequence of elements that repeat in a predictable manner. This can be a string of numbers, or a design. It must repeat at least once to be considered a pattern.
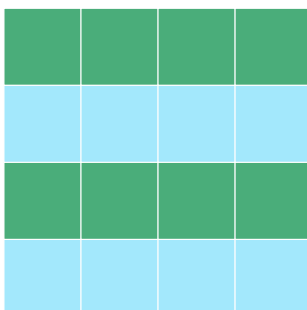
For example, maybe it follows a pattern like this:

A A B B
B B A A
A A B B
B B A A
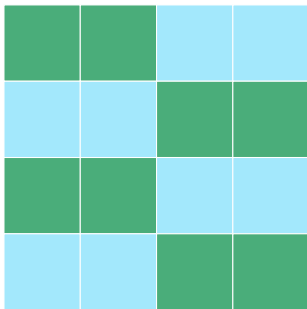
Or maybe each row is a different color, so it looks like this:

A A A A
B B B B
A A A A
B B B B

With both of these examples, if we were extend the grid to contain more rows, you could predict the pattern that would come next.

4. *Can you design other patterns, using these 2 colors on the 4x4 grid?* Have the child create a pattern or two on the 4x4 grid, using two color.

5. Now that we understand a pattern, can you create a design that is NOT a pattern. So that it is random - that is, it has no identifiable sequence that repeats.

Using the same two colors, try to create a design that has NO pattern.

6. After the child has done this, ask: *how did you go about making this random design? What was your process and what were you thinking about?*

7. Now introduce the coin, and demonstrate how to flip a coin. (If this is challenging for the child, you can flip the coin through the process, and allow the child to call out heads or tails, and color in the squares.)

8. We will be using a coin to introduce the idea of randomness. A coin has two sides; one side is HEADS, and the other side is TAILS. When we flip a coin, one of the sides will land face up, and there are two possible outcomes - heads or tails. *We cannot predict what side it will be! Why do you think that is?*

Assign one of the two colors for HEADS, and the other color for TAILS. (There is a page for this in the template, or you can simply write this down so that it is easy to remember.)

9. To start, flip the coin and then color in the square with the corresponding color, starting in the upper left corner, moving left to right, top to bottom. Move to the next square. Do this for the entire grid.

You will have a grid that is a random pattern; it was generated based on the coin flip.

10. Compare the design you created to be random without a pattern, and the one generated by the coin flip. *How are they similar? How are they different? Do you see any patterns in either of them?*
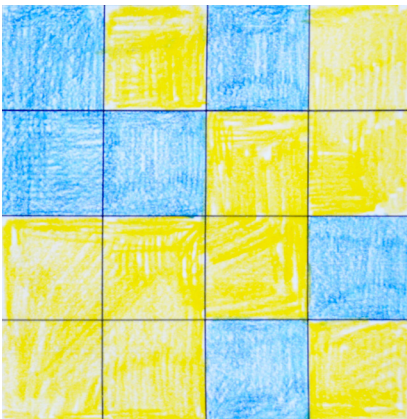
attempt to manually create a random design
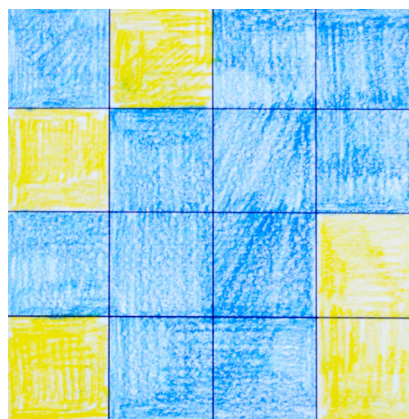
using the coin flip to generate a random design

8x8

Progress using the same instructions as before, only now with the larger grid.

16x16

This will take a bit more time! Best for older children.

Progress using the same instructions as before, only now with the larger grid. This grid is much larger! So it will take some time. When you finish all three, compare them all together.
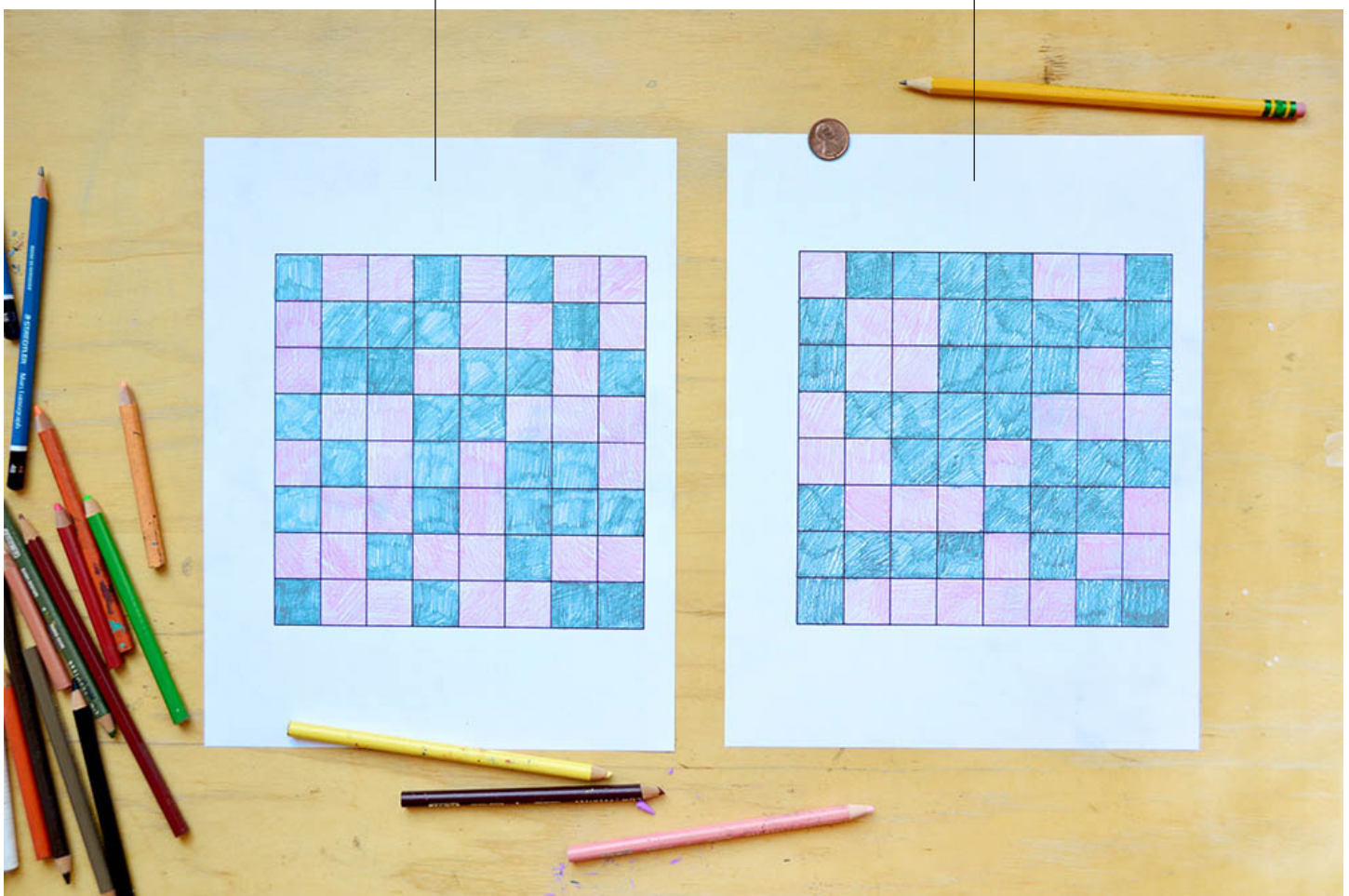
What do you observe?

Are there similarities among them? How are they different? What can you see with the larger grid that is different than the small grid?

The idea here is that with the larger grid we have more information - it took a long time to flip the coin that many times! But when we have more information, it is easier to see patterns. *Why do you think that is?*
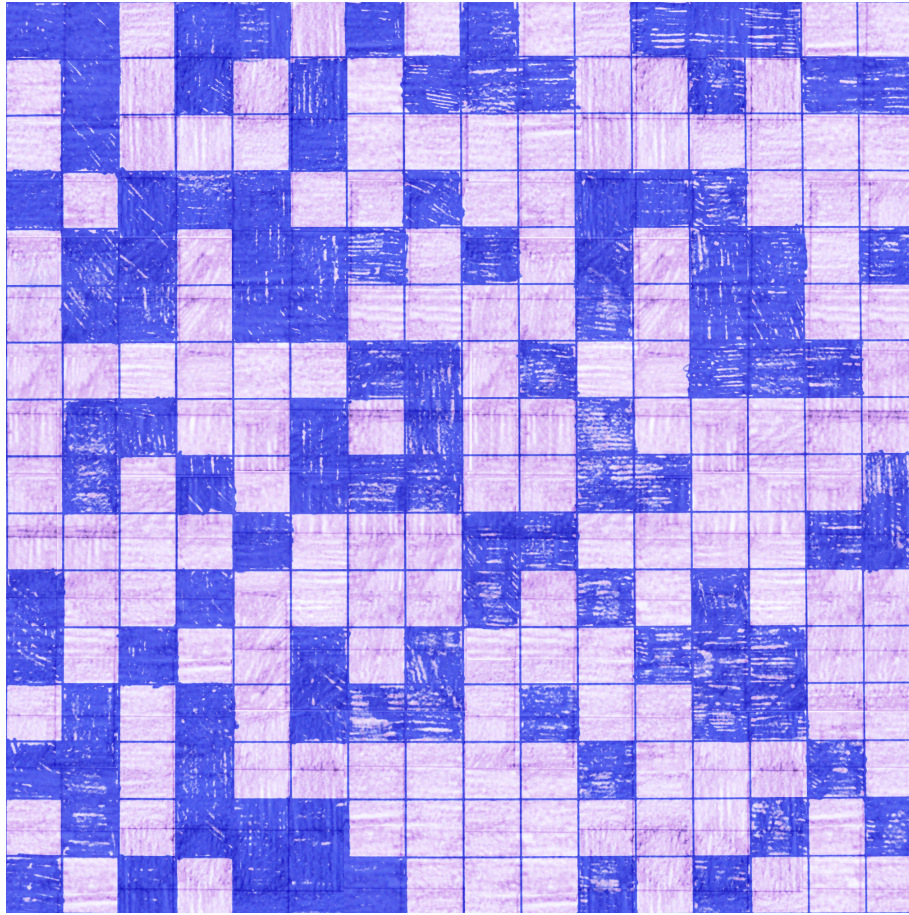
Show these to someone who hasn't seen the process, and ask if they can figure out which is truly random.

attempt to manually create a random design   using the coin flip to generate a random design

attempt to manually create a random design

using the coin flip to generate a random design