

Poking fun at Science: Math with Pinholes

Multiplying a pinhole's effect

Recommended Grade Level: 3rd -12th grades

NGSS Science & Engineering Practices:

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and Interpreting data
- Using Mathematics and Computational Thinking

Time: 5 minutes prep, 30 minutes activity

Materials and Assembly:

- Please refer to the activity **Poking Fun at Science: The Basic Set-Up** for materials, assembly and basic operation of your device.
- Print the simple table on the next page to collect and your record data.

Background Information:

The pinhole viewer you created in **Poking Fun at Science: The Basic Set-Up** will cast an inverted image of a light source. Multiple holes will cast a multitude of these inverted images. Use your apparatus to conduct a simple scientific investigation. Collect real data and come up with a real mathematical formula to make predictions about the number of images produced by varying the number of pinholes you poke and the number of lights you use.

To Do and Notice:

1. You will be collecting data; use the table provided on the next page.
 - a. Write the number of holes poked in the foil in the first column,
 - b. The number of bulbs turned on in the second column
 - c. And the number of images you see on the wax paper in the third column.
2. Put a fresh sheet of foil (no holes) on your viewer.
3. Starting with one single light bulb.
 - a. Using your pushpin, poke one single hole in the foil.
 - b. Look at the number of image/s broadcast onto the wax paper.
 - c. Record your data.
4. Increase the numbers of lights turned on to 2 and then 3. Again, record this data.
5. Now, poke two holes and again, starting with one bulb, increase the number of light bulbs. Again, recording your data.
6. One by one, continue to poke holes in the foil and changing the number of lights, recoding your observations as you go.
7. Check out the data. Is there a relationship between holes, bulbs and images?
Can you or your students figure it out?
8. Can you make a prediction about the number of images formed if you know the number of holes poked and the number of bulbs used?



What's going on?

- It's a pinhole image multiplier!
- The multitude of inverted images is caused by the pinholes.
- Check out the sample data below:

Sample data:

Number of holes	Number of lights turned on	Number of images
1	1	1
1	2	2
1	3	3
2	1	2
2	2	4
2	3	6
3	1	3
3	2	6
3	3	9

It's a simple mathematical relationship!
Each separate pinhole inverts and projects each set of bulbs.

Or

$$\text{Holes} \times \text{Bulbs} = \text{Bulb images}$$

That's the formula!

Going Further:

Does this simple equation always work? Are there other mathematical variations you can try?
Can you engineer a pinhole camera to collect data other kinds of data?

What happens if you poke a huge number of holes right next to each other or just make a big hole?

Check out Poking fun at Science: Color Mixing to find the answer to that question.