



Erasmus+



"STEAM for Sustainability"

PROBABILITY:

JUST A GAME OR SERIOUS SCIENCE?

"Chance favours the prepared mind" – Louis Pasteur

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Why this brochure?

This brochure is designed for teachers who want to introduce probability to students aged 14–18 through hands-on, low-cost activities.

Inside you will find two complete activities:

- The Pen Drop Experiment
- Buffon's Needle Problem

Each activity includes:

- Why / where / when to use it
- Learning objectives
- Materials needed
- Clear step-by-step instructions
- Discussion questions



The Pen Drop Experiment

How far will the pen go?

Why use it:

To introduce experimental probability using a simple, low-cost activity. Students discover that random events show predictable patterns when repeated many times.

Where:

Classroom with a tiled floor.

When:

Beginning of a probability unit.

Materials needed (per group of 6 students):

- 1 pen (or any small object)
- 1 tiled floor
- 1 recording sheet
- 1 pencil
- 1 calculator (optional)



Step by step - what to do

1 Form groups

Divide the class into groups of 6 students.

2 Choose a drop point

Each group chooses a fixed tile or marked point.

3 Drop the pen

Each student drops the pen from waist height 10 times.

4 Measure the distance

Count how many tiles away the pen lands.

5 Record

Write down the distance after each drop.

6 Combine data

All 6 students = 60 total drops per group.

7 Count frequencies

For each distance (0,1,2,3... tiles), count how manytimes it occurred.

8 Calculate probability

Use the formula: $\text{Probability} = \text{Occurrences} \div \text{Total drops}$

9 Discuss results

Compare results between groups.



Example and discussion questions

Distance (tiles)	Occurrences	Probability (%)
0	8	13.3%
1	15	25.0%
2	20	33.3%
3	12	20.0%
4	5	8.3%
Total	60	100%

Example

Questions for discussion:

- Did all groups get the same results?
- Why not?
- If you dropped the pen 600 times, what would happen?
- Can you predict the next drop?



Buffon's Needle Problem

When probability meets π

Historical background (1777):

French naturalist Buffon asked: «If you drop a needle on a floor with parallel lines, what is the probability that it crosses a line?» The answer involves π – a beautiful connection between randomness and pure mathematics.

Why use it:

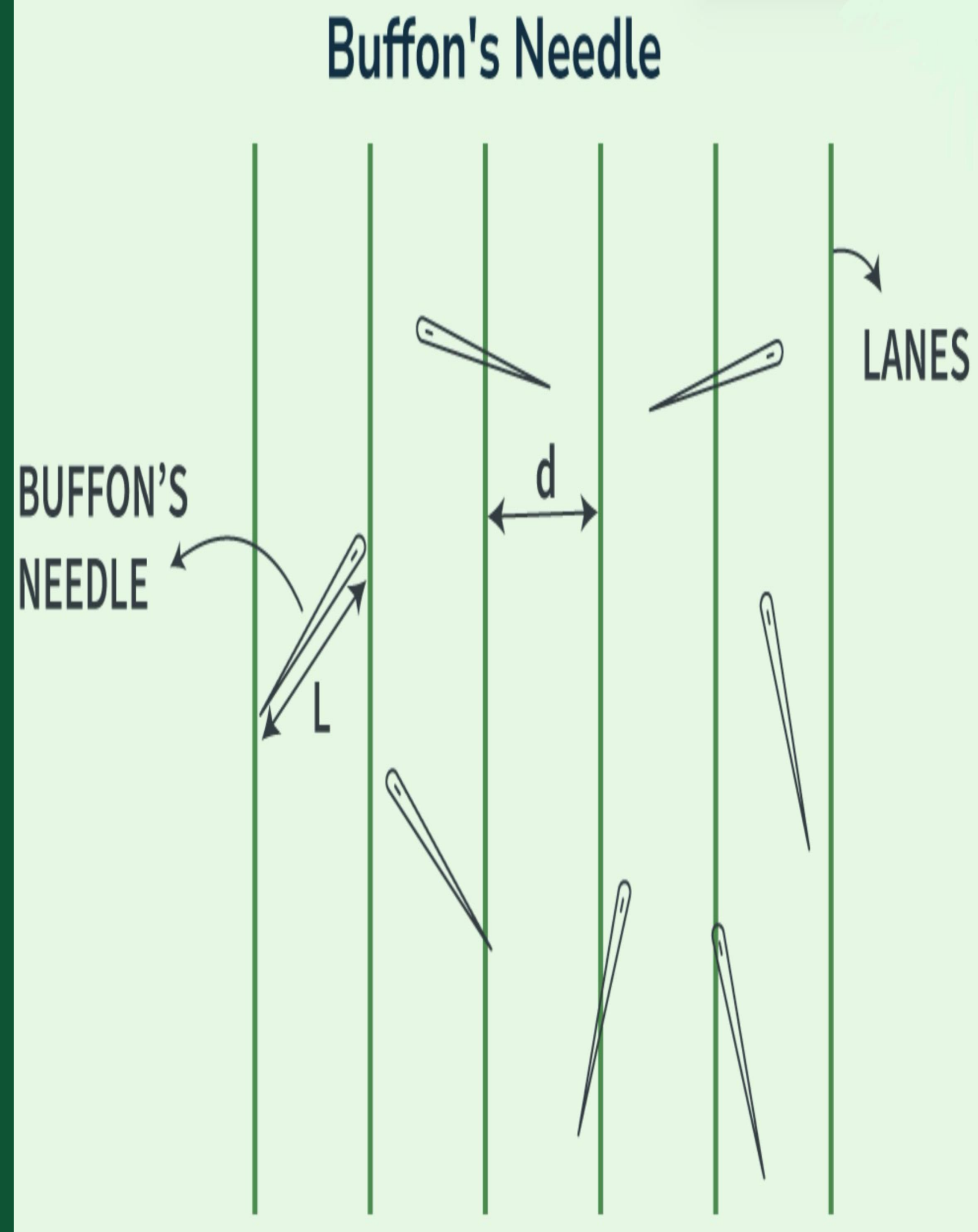
To show students that probability can reveal unexpected mathematical constants.

Where:

Classroom with a flat floor. Prepare a sheet with parallel lines (distance between lines = twice the needle length).

When:

After the pen drop experiment. For advanced or motivated students.



Materials and Step by step instructions

Materials (per group):

1 sheet with parallel lines (distance between lines = $2 \times$ needle length)

1 needle (or toothpick / matchstick)

1 ruler

1 recording sheet

1 pencil

Step by step:

Place the paper on a flat surface.

Drop the needle from a height of 10-15 cm. Do not aim.

Observe – Does the needle cross a line? (Yes / No)

Record the result (C = cross, N = no cross).

Repeat – Each student drops at least 20 times. Aim for 600+ total drops.

Count total crosses.

Calculate probability: $P(\text{cross}) = \text{Crosses} \div \text{Total drops}$

Calculate π (optional): $\pi \approx \text{Total drops} \div \text{Crosses}$ (if distance = $2 \times$ length)



Example and discussion

Example:

Total drops: 600

Total crosses: 190

$P(\text{cross}) = 190 \div 600 = 0.317$

$\pi \approx 600 \div 190 \approx 3.158$

Questions for discussion:

- Why does π appear in a random experiment?
- If you drop the needle more times, does your π estimate improve?
- Can you think of other random experiments that reveal mathematical constants?

$$P = \frac{2L}{\pi D}$$



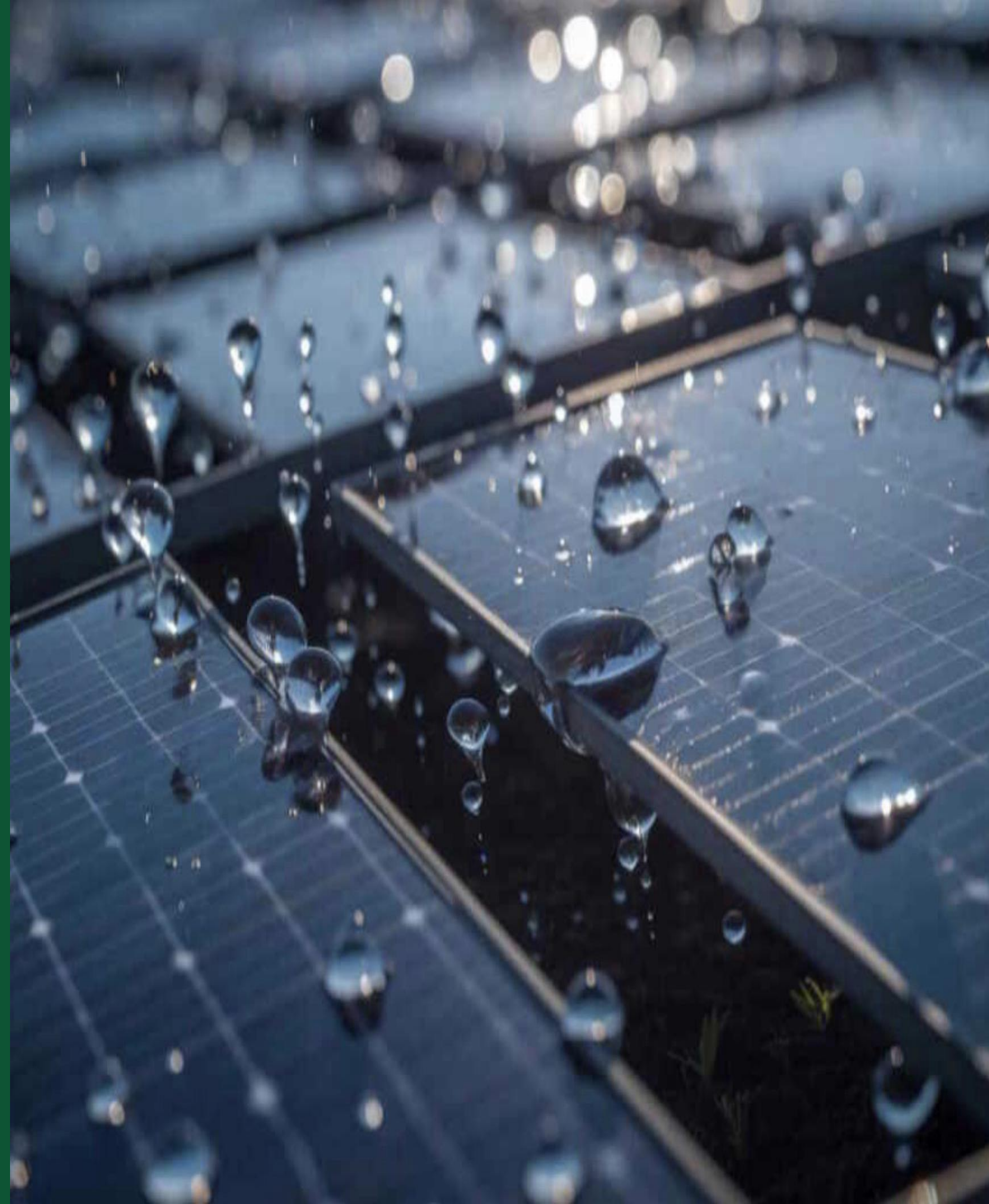
Why probability matters for sustainability

Roth activities show how probability turns random events into predictable data.

This same logic is used in sustainability science to:

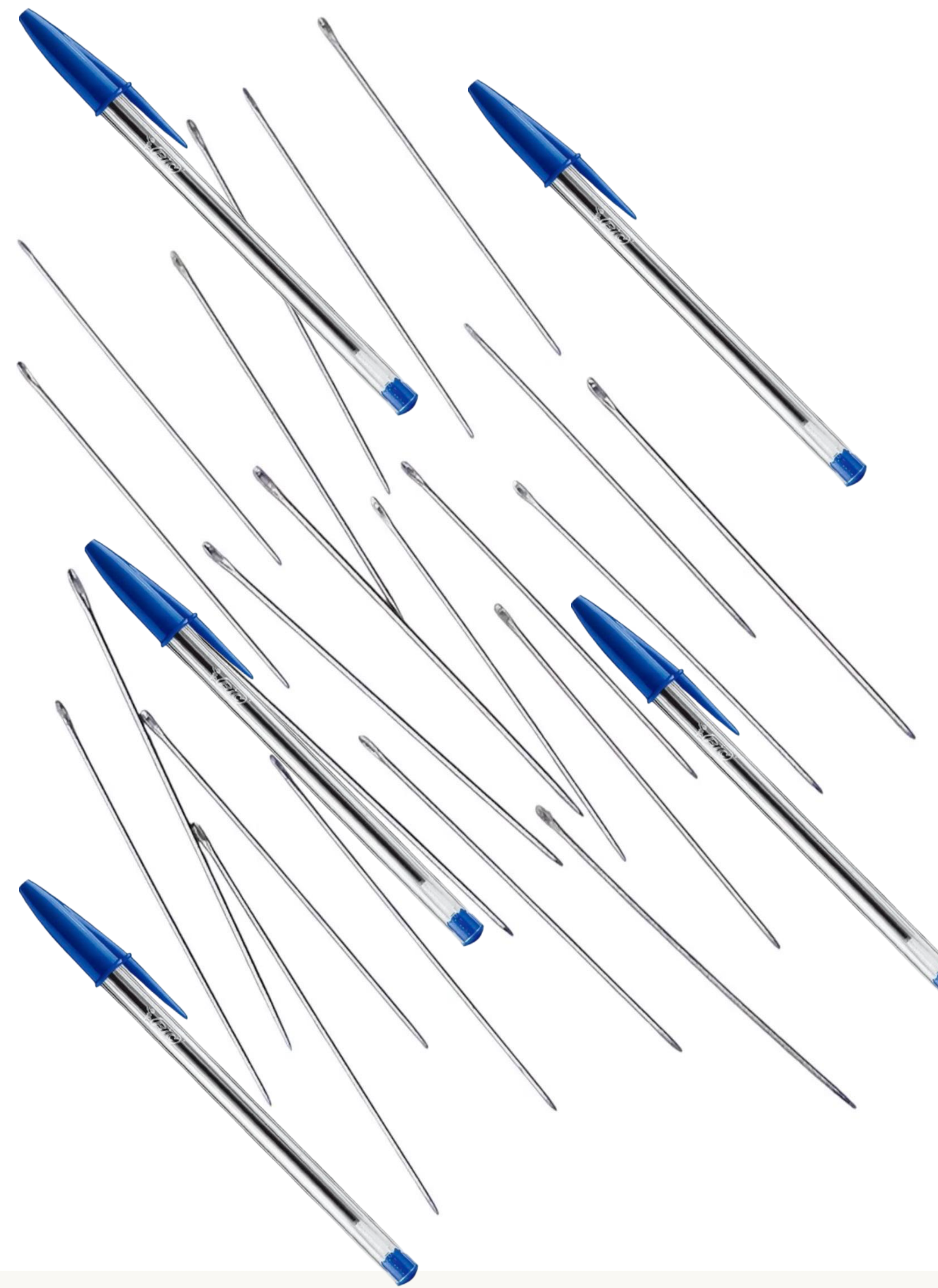
- Predict climate patterns (probability of extreme weather)
- . Estimate renewable energy output (probability of sunshine or wind)
- Assess environmental risks (probability of floods, droughts, or species extinction)

Understanding probability helps us make better decisions for the planet.



Activity summary

Aspect	Pen Drop	Buffon's Needle
Duration	30-40 min	30-45 min
Difficulty	Easy	Medium / Advanced
Main concept	Experimenta l probability	Probability + π
Materials	Pen, tiled floor	Needle, parallel lines
Best for	Introduction	Connecting probability to geometry



Credits

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