OVERVIEW

In this activity, students investigate randomness by using a sampler that models lights seen on in an office building at night. By adjusting the spinner to control the probability that lights are turned on, they can see how these probabilities affect the appearance of the building. Students compare their expectations of what randomly placed lights might look like to the results from a simulation model. They observe that random events tend to cluster together more often than they expect.

Activity Time: One class period

Objectives

- Model a simple probability experiment.
- Develop an understanding of how changing the probability of an event affects the outcome.
- Develop an understanding that randomness does not mean perfectly mixed up—that randomly determined events often appear to have patterns in them.

Common Core Standards Addressed

Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of discrepancy.

Grade 7, Statistics and Probability Standard 7

Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.

Grade 7, Statistics and Probability Standard 7b

Prerequisites

None

Materials

- Random Lights worksheet (one copy per student)
- **Random Lights.tp**

LESSON PLAN

Student Work at Computers (20 minutes)

Hand out the worksheet.

As students answer questions, encourage them to experiment with the sampler, observing how changing the percentages in the mixer affects the lights.

Discussion (25 minutes)

After students have worked through Step 6, bring them back together as a class and display **Random Lights.tp**.

You may wish to take time here to discuss the variability in the results. Students often expect that if the probability of lights being on is 0.5, then exactly 50% of lights should be turned on in every sample. You can clearly show the number of lights turned on by selecting the sampler and dragging a plot into the document. Separate the values and click the **Count (N)** button in the upper plot toolbar. Now run the sampler a few times to show the varying numbers of "On" lights. Discuss why students think these outcomes result.

Discuss with students what it means to be *random,* answering Step 12 together as a class. For this discussion it may be helpful to post some of the results students found surprising around the room so students can refer to them as they describe their observations.

Answers

3. The lights in the building are randomly placed. Students may point out that the lights that are on do not follow a specific pattern, and they change locations each time they run the sampler.

4. The probability that the lights in an office are on is 0.5, or 50%. Students can find this by clicking the **Device Options** menu in the spinner and choosing **Show Percent,** or by observing the count of how many buildings have their lights turned on (although the latter will take more work).

6. About $\frac{1}{3}$, or 33%

8. Students will tend to space the lights so there are few, if any, areas where there is a dense clustering of lights, or large areas with no lights. They often think that randomness means "mixed up as much as possible."

10. Students should notice that when the lights are randomly placed, they do in fact often form clumps (or clusters). They often struggle to recognize this, so you may need to call their attention to it.

11. Ideally, students will collect some interesting examples of randomly-placed lights that look quite unlikely to happen by chance. This is the same randomness that causes faces to appear in clouds or that produces a chance cluster of cancer cases in a town causing people to assume that something in the town is causing the cancer.

12. They are called *random* lights because there is not a pattern or process to determine whether the lights are on or off.