

OVERVIEW

In this activity, students study random sequences of 21 coin flips and use what they learn to detect which of two sequences of 21 coin flips came from actually flipping a coin and which was made up by a student to look like random coin-flips.

Activity Time: One class period

Objectives

- Work with a simulation that models a simple probability experiment.
- Collect data over multiple samples and analyze the sequence.
- Develop an understanding of what a random sequence looks like, and that sequences often clump together more often than we expect.

Common Core Standards Addressed

None.

Prerequisites

None

Materials

- Random Coin Flips worksheet (one copy per student)
- Coin Flip Results half-sheet (two copies per student)
- Coin (one per student)
- Cup (one per student, optional)
- **Random Coin Flips.tp**

LESSON PLAN

Can You Imitate a Coin? (5 minutes)

Students invent data for 21 coin flips. You might give instructions orally and wait until the next step to hand out the worksheet. Hand out the Coin Flip Results half-sheet and have students write *Fake* on the back (Blackline masters for the half-sheets are provided at the end of these notes) and tell students to record their made-up data.

Can You Spot Fake Data? (5 minutes)

If you haven't done so already, hand out the Random Coin Flips worksheet. In Step 2, students guess whether particular sequences of coin flips are made up or real. Don't discuss these now. Students will come back to these later to see whether they changed their mind about any of them.

Can Your Teacher Spot Fake Data? (10 minutes)

Hand out the Coin Flip Results half-sheet and have students write *Real* on the back. Students record the results of 21 actual flips. You might supply cups for students to use in flipping

coins to make it go faster, as some students will have difficulty flipping a coin. Tell students to place their real and fake half-sheets on their desks, flip results side up, and you will come around and try to guess which is the real data.

In truly random data, long runs of heads or tails are fairly likely. Fake data almost never include runs longer than three in a row (“H, H, H” or “T, T, T”), whereas one run of four or more in a row is relatively frequent in real data of 21 flips. Also, fake data will generally have about equal numbers of heads and tails, whereas real data is often not as evenly balanced.

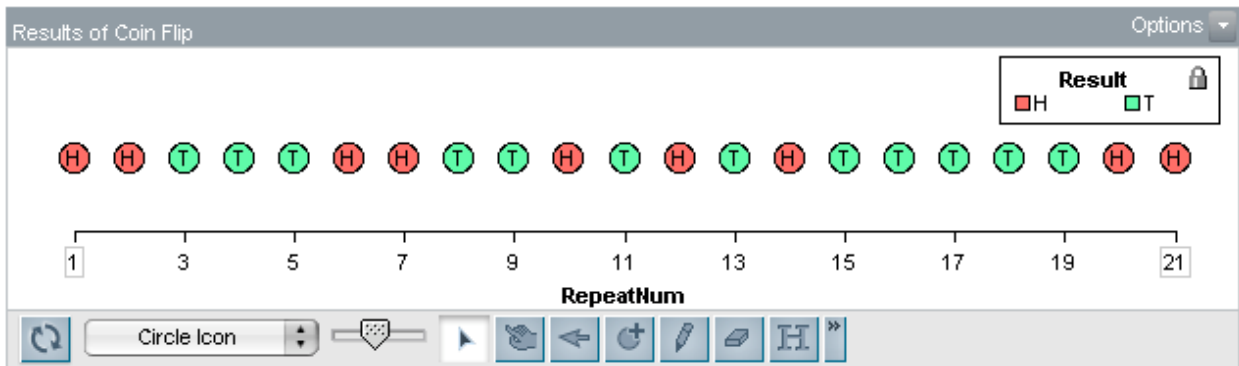
While these two principles will usually allow you to guess correctly, sometimes it will still be hard to tell which is which, so don’t expect to get all the predictions correct. About 20% of the time, real sequences will look fairly similar to fake ones. In addition, some students may think that long sequences shouldn’t happen. So they might reflip their coin when a long run occurs because they assume they did something wrong. This will make their real data look a little more like their fake data.

However, you’ll mostly be able to guess the correct one, and they’ll wonder how you were able to do this.

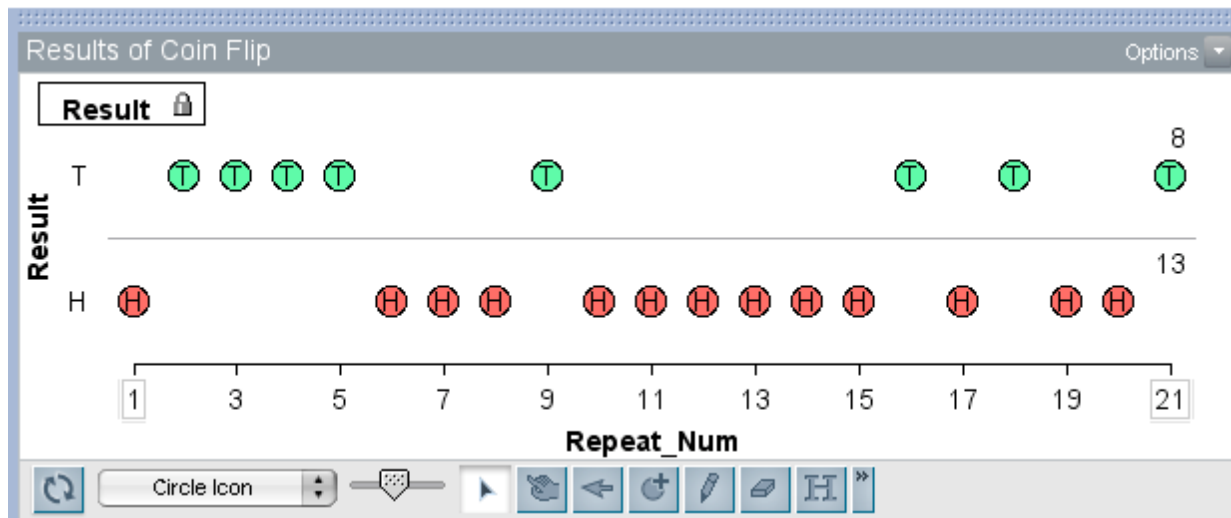
Look at Results from the Computer (15 minutes)

Display **Random Coin Flips.tp**. Run the model a couple of times on medium speed to make sure students understand how the data are being plotted. This is also the speed at which runs of heads and tails will likely attract a lot of attention. Either have students use computers to gather more data or continue to gather and discuss data as a whole class.

The document includes a plot in which cases are ordered along an axis by *RepeatNum*, like the one shown here.



Other plot options may appear more complex than is necessary, although you might also want to display a plot showing the total numbers of heads and tails. To do this, drag the attribute *Result* from the results table to the vertical axis. This separates the H's and T's as shown here.



As students draw more samples, they should come to accept that in truly random data, large runs of heads and tails are fairly likely. When people make up data, they almost never include long runs, which is how you spotted the fake data.

Can you Spot Fake Data Now? (10 minutes)

The first two sequences are fake, and the last two are real. Have students explain what it is about their fake sequences that make them not seem random.

ANSWERS

3. Answers will vary. Many students will think that, for example, sequence d is fake because of the long run of T's. They often think sequences that don't have long runs seem more random.
6. Answers will vary. Students might be surprised by long stretches of the same outcome ("I just got 7 T's in a row"). These long runs will often produce a sequence where one outcome occurs much more often than the other.
7. Most students will get a run of at least seven in fewer than 10 samples. Some students may not get a run of at least seven even after taking 30 samples.
9. Sequences a and b are fake, and sequences c and d are real. By the end of the activity, students will likely be convinced that in truly random coin flips, runs of 3, 4, or 5 heads (or tails) are fairly likely. When people make up data, they almost never include long runs, allowing them to be spotted as fake.

Coin-Flip Results

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21



Coin-Flip Results

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