STUDENT ACTIVITY · ABOUT 15 MINUTES

Did the sensor measure again, or did the network retry?

A fictional CO2 sensor measures every ten seconds. The network sometimes delivers one measurement more than once. Each row below is a delivery; reading_id identifies the original measurement.

reading_id	Measured (s)	CO2 (ppm)	Delivered (s)
r1	0	600	1
r2	10	650	11
r3	20	700	21
r4	30	750	31
r4	30	750	32
r4	30	750	33

Work through the data

1. Circle every delivery that repeats an earlier reading ID. How many deliveries are there? How many distinct measurements?

2. Find the mean CO2 value using all six delivered rows. Then find the mean using each reading ID once. Show your arithmetic.

3. Which mean answers “What was the average of the measurements?” Explain why the other mean differs.

4. Sketch the four distinct readings against measurement time. What else would you need before making a real indoor-air decision?

Think further

The delivery time changes on every retry. Why would removing only identical whole rows leave the repeated measurement in the table? Which field would you use as the key?

These values were invented for learning. They are not a classroom air-quality test or health assessment.

Count measurements, not deliveries

Goal: help students distinguish a sensor measurement from a network delivery. The activity works entirely on paper. The linked web lesson has the same fictional CSV and an optional retry control. This is a short warm-up, not a full sensor-data unit.

Answer key

1. Six deliveries, four distinct measurements. The fifth and sixth rows repeat reading ID r4.

2. Delivered-row mean: (600 + 650 + 700 + 750 + 750 + 750) ÷ 6 = 700 ppm. Distinct-measurement mean: (600 + 650 + 700 + 750) ÷ 4 = 675 ppm.

3. The distinct-measurement mean answers the question. Counting retries as new measurements gives extra weight to r4, the highest reading.

4. The distinct points are (0, 600), (10, 650), (20, 700), and (30, 750). Real interpretation needs calibration, placement, missing-reading and time-coverage checks, and ventilation context. Four points do not establish a room-wide or time-weighted average.

One-minute exit ticket

Ask: “If r4 arrives one more time, does the sensor now have five measurements?” A complete answer says no: there are still four measurements, although there are seven deliveries and the delivered-row mean changes.

Optional Telemetry connection

I built Telemetry. The web version at telemetry.sh/learn/sensor-retries has this same fictional CSV and a browser SQL query that needs no account. The paper activity needs neither. If a teacher chooses any cloud extension, check school policy first and use only synthetic data. Do not ask students to create accounts or upload real student or device data.

Prepared by JR with AI assistance. This activity has not been classroom-tested. Review and adapt it before teaching.