

With and Without Beavers: What the Stream Surveys Show

Learning target: I can graph survey data from streams with and without beaver ponds, calculate averages and differences, and use the patterns to make a claim about how a change to a physical component affects populations.

Data and graphing

About 50 min

Pairs

MS-LS2-4 · practice

MS-LS2-1 · supports

data analysis

independent practice

Name _____

Date _____

Period _____

Directions

Both tables on this sheet are teaching datasets: the numbers were invented to look like a real stream survey, but no one measured them. Part A compares streams with and without beaver ponds. Part B follows one stream before and after beavers moved in. You may check calculations with a partner, but write your own answers. Show every calculation, keep units, and round to one decimal place. When a question asks what the data show, answer with numbers.

You will need: This worksheet, Pencil, Ruler, Calculator

The study

In July 2024, ecologists surveyed eight short sections of mountain stream, called reaches, in the same valley during the same week. Four reaches had an active beaver dam with a pond behind it. The other four were similar reaches nearby with no beavers. All eight were at about the same elevation, ran through the same kind of forest, and were sampled with the same nets in the same way. In each reach the team measured water depth and water speed, then counted three kinds of animals: **tadpoles** of the Pacific chorus frog, which develop in still or very slow water; **stonefly larvae**, insects that cling to rocks and need fast, cold water with plenty of oxygen; and **dragonfly larvae** of kinds that hunt small animals in still water.

Stream survey of eight reaches in one valley, July 2024 (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

Reach	Beaver pond?	Water depth (cm)	Water speed (cm/s)	Chorus frog tadpoles	Stonefly larvae	Dragonfly larvae
A	yes	120	5	64	2	18
B	yes	95	8	48	4	14
C	yes	140	3	71	1	22
D	yes	105	6	57	5	16
E	no	30	45	6	38	3
F	no	25	52	2	44	1
G	no	35	40	9	31	4
H	no	30	47	3	39	2

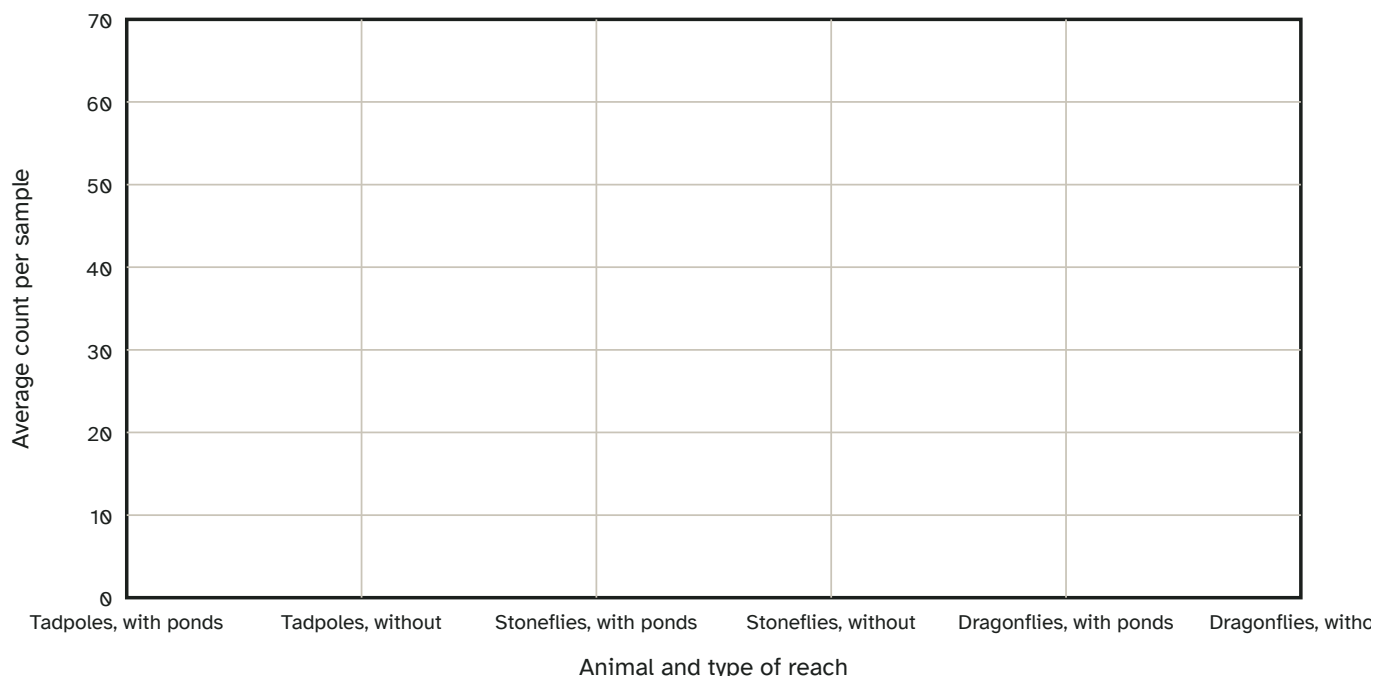
Simulated data for teaching. Tadpoles and dragonfly larvae are counts per 10 sweeps of a dip net; stonefly larvae are counts per kick-net sample. Reaches A to D have a beaver pond; reaches E to H do not.

Part A: Compare reaches with and without beaver ponds

1. Calculate the average (mean) of each measurement for the four reaches with beaver ponds (A to D) and the four without (E to H). Write each average to one decimal place. Show one full calculation below the table.

Average with beaver ponds (A to D)	Average without beavers (E to H)
Water depth (cm)	
Water speed (cm/s)	
Chorus frog tadpoles	
Stonefly larvae	
Dragonfly larvae	

Average animal counts in reaches with and without beaver ponds



2. On average, how many times as many chorus frog tadpoles were found in reaches with beaver ponds as in reaches without? How many times as many dragonfly larvae? Show each division.

3. By what percent were stonefly larvae lower in the reaches with beaver ponds? Use $(\text{average without} - \text{average with}) \div \text{average without} \times 100$, and show your work.

4. Describe the pattern in your graph in two sentences: which animals were more common where there were beaver ponds, and which were less common?

5. Use the depth and speed averages to explain the pattern. What did the beaver dams change about the stream, and why would that change help tadpoles and dragonfly larvae but hurt stonefly larvae?
- _____
- _____
- _____
- _____
6. Counts vary within each group. For example, tadpoles ranged from 48 to 71 in the beaver-pond reaches. For each animal, compare the **lowest** count in one group with the **highest** count in the other. What do you find, and why does surveying four reaches of each kind make the pattern more convincing than surveying one of each?
- _____
- _____
- _____
- _____

Part B: One reach, before and after

Reach J is in the same valley. Until the autumn of 2020 it was a fast, shallow stretch like reaches E to H. That autumn a beaver family built a dam there. The team had surveyed reach J every July since 2017, so they have four summers of data from before the dam. In 2021, the first summer after the dam, the pond was still filling and the stream bed was still changing.

Reach J surveys, 2017 to 2024 (teaching dataset)

Simulated teaching dataset: the numbers are invented to be realistic, not measured.

July survey	Chorus frog tadpoles (per 10 sweeps)	Stonefly larvae (per kick sample)
2017	4	41
2018	7	36
2019	3	44
2020	5	39
2021	31	18
2022	52	6
2023	58	4
2024	61	3

Simulated data for teaching. Same methods as the survey above. The beaver dam was built in autumn 2020, after the July 2020 survey.

7. Calculate the average tadpole count and the average stonefly count for the four years before the dam (2017 to 2020) and for the three most recent years (2022 to 2024). Leave out 2021, when the pond was still filling. Then give the change in each average.

8. Before the dam, tadpole counts at reach J went up and down from 3 to 7. Why do four years of 'before' data make the comparison more trustworthy than using only the 2020 survey?

9. Part A is a **with-and-without** comparison and Part B is a **before-and-after** record. Give one weakness of each kind of evidence, and explain how the other kind helps cover it. Then name one more set of measurements that would make the case stronger still.

10. Write one claim these data support about how a beaver dam affects populations in a stream, and back it with at least three numbers from this sheet. Then explain why the claim '**Beaver dams are good for streams**' is not supported by these data.

Three calculations, step by step

Average: add the four values, then divide by 4 (example with made-up numbers: $10 + 12 + 14 + 8 = 44$; $44 \div 4 = 11.0$). 'How many times as many': divide the bigger average by the smaller one ($30 \div 6 = 5$ times). Percent lower: subtract the smaller from the bigger, divide by the bigger, then multiply by 100 ($(20 - 5) \div 20 = 0.75$; $0.75 \times 100 = 75$ percent). Write each step on its own line so you can check it.

Design a before-after-control-impact study

Ecologists often combine both kinds of evidence in one design called before-after-control-impact: they survey places that will get a change and similar places that will not, both before and after the change. A restoration group plans to install beaver dam analogs (rows of wooden posts with willow branches woven between them, which slow water the way a beaver dam does) in two of reaches E to H next autumn. Design the study: which reaches get structures and which are left alone, what you would measure, in which years, and what pattern of results would convince you the structures caused any change. Sketch the line graph you would expect if they work.